PHYSICAL CAPITAL PLAN

URBAN PLANNING SECTOR PLAN

DISCLAIMER/ TEAM MEMBERS

Urban Planning Team

Nadia Qureshi (Senior Specialist – Urban Planning and Architecture)

Sumaiyya Saleem (Senior Research Analyst – Urban Planning)

EXECUTIVE SUMMARY

Almost 25% of the total population lives in urban areas and 75% of the population lives in rural areas of the division. Total area of Bahawalpur division is 21,765 sq. km and the population density per sq. km. is 251. Moreover, population density of Rahim Yar Khan is highest i.e., 404 sq. km. followed by Bahawalnagar 329 sq. km. and Bahawalpur 326 sq. km.

Lack of updated plan for the management of urban growth in the cities is the major issue. Urban areas shown in the ODP for the cities are way less and the cities have grown drastically now. The rate of area change in the cities of Bahawalpur division is higher than Multan and Dera Ghazi khan. On average, 41% of housing units are overcrowded in Bahawalpur division and 3% of housing units are severely deprived i.e., need of new houses plus the need to replace dilapidated houses.

Districts of Bahawalpur division are experiencing haphazard urban growth and there is a need to identify areas for future development in the division. Potential areas have been identified in Rahim yar khan and Bahawalpur district to guide future development in Bahawalpur division

LIST OF ACRONYMS

ADP	Annual Development Programme
CDA	Cholistan Development Authority
GIS	Geographical Information System
MNA	Member of National Assembly
MPA	Member of Provincial Assembly
ODP	Outline Development Plan
P&D	Planning and Development
PTDC	Punjab Tourism Development Corporation

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OVERVIEW

According to the census, 2017, the population of Bahawalpur division is 11.5 million. Almost, 25% of the total population lives in urban areas and 75% of the population lives in rural areas of the division. Total population of Rahim Yar khan is highest i.e. 4.8 million among other districts of the division. However, urban population in Bahawalpur is high (32%) as compared to Bahawalnagar (21%) and Rahim Yar Khan (21%) as shown in figure 1.

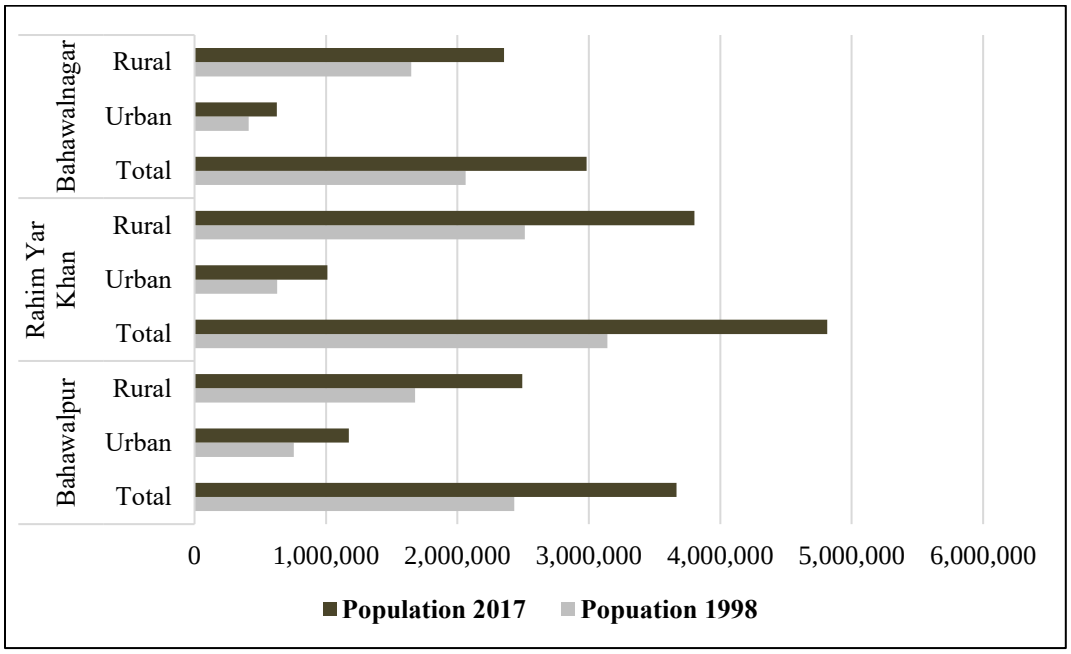


Figure 1: Population distribution in districts of Bahawalpur division.

Source: Population Census, 2017

1.1. City Classification based on Population

Bahawalpur and Rahim yar Khan are the two intermediate cities of population ranging from 0.25 million to 1 million. Moreover, Bahawalpur division has eight small cities of population ranging from 0.1 million to 0.25 million and six towns of population less than 0.1 million.

Table 1: City classification of Bahawalpur division

Sr. no.	Districts	District Population 2017	District Growth Rate (%) 2017	Cities/Urban Areas	Cities population 2017	Intermediate City	Small Cities	Towns
						0.25 million-1 million	0.1 million-0.25 million	<0.1 million
1	**Bahawalpur**	3,668,106	3.49	Bahawalpur City	681,696			
				Bahawalpur Saddar	107,653			
				Ahmadpur East	175,977			
				Hasilpur	115,536			
				Khairpur Tamewali	41,420			
				Yazman	48,976			
2	**Rahim Yar Khan**	4,814,006	3.16	Rahim Yar Khan City	484,124			
				Khanpur	233,347			
				Liaquatpur	51,989			
				Sadiqabad	263,176			
3	**Bahawalnagar**	2,981,919	1.96	Bahawalnagar City	161,033			
				Chishtian	149,339			
				Haroonabad	107,858			
				Fort Abbas	61,665			
				Minchinabad	56,526			
				Donga Bonga	33,009			

Source: Population census, 2017

1.2. Population Density

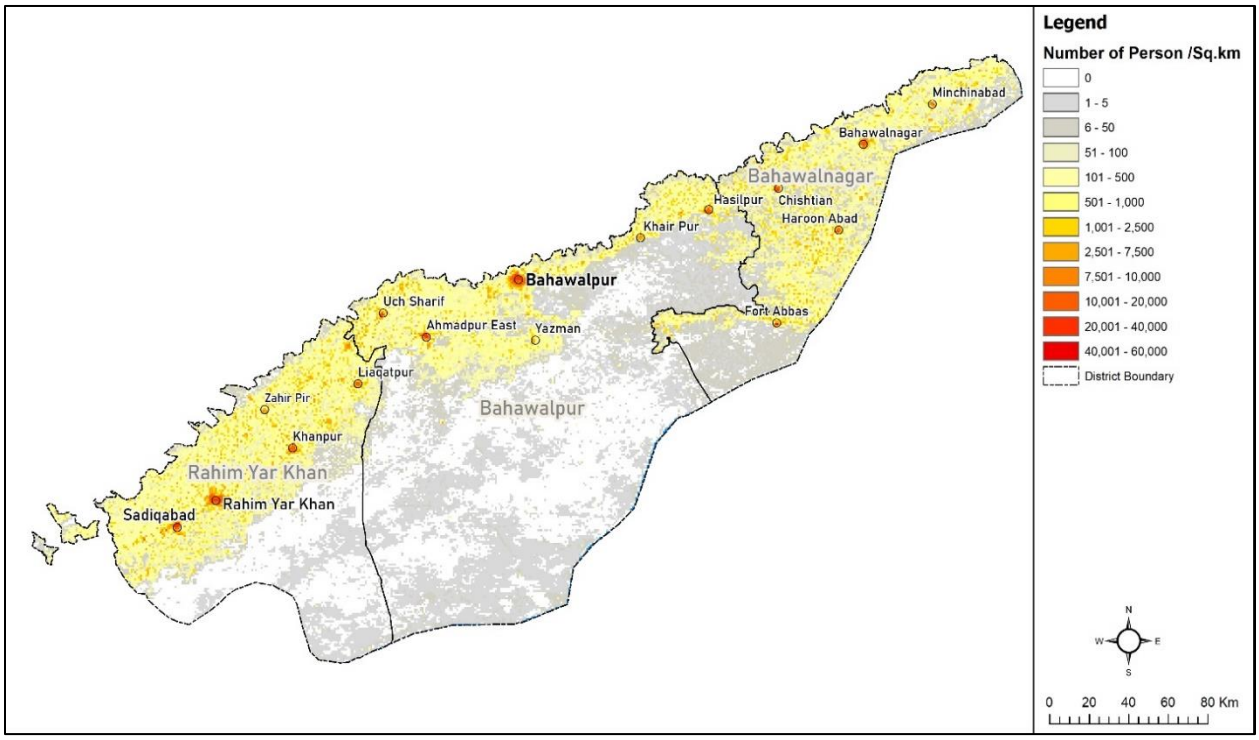
Total area of Bahawalpur division is 21,765 sq. km and the population density per sq. km. is 251. Moreover, population density of Rahim Yar Khan is highest i.e. 404 sq. km. followed by Bahawalnagar 329 sq. km. and

Bahawalpur 326 sq. km. The breakdown of population densities in urban and rural areas of districts in Bahawalpur division is given below:

Table 2: Population density in Bahawalpur division

Administrative Unit	Area (Sq. Km.) (Year 2017)	Population Density per Sq. Km. (Year 2017)
Bahawalpur Division	**45,588**	**251**
Bahawalnagar District	8,878	335
Rahim Yar Khan	11,880	404
Bahawalpur District	24,830	147

Source: Population census, 2017

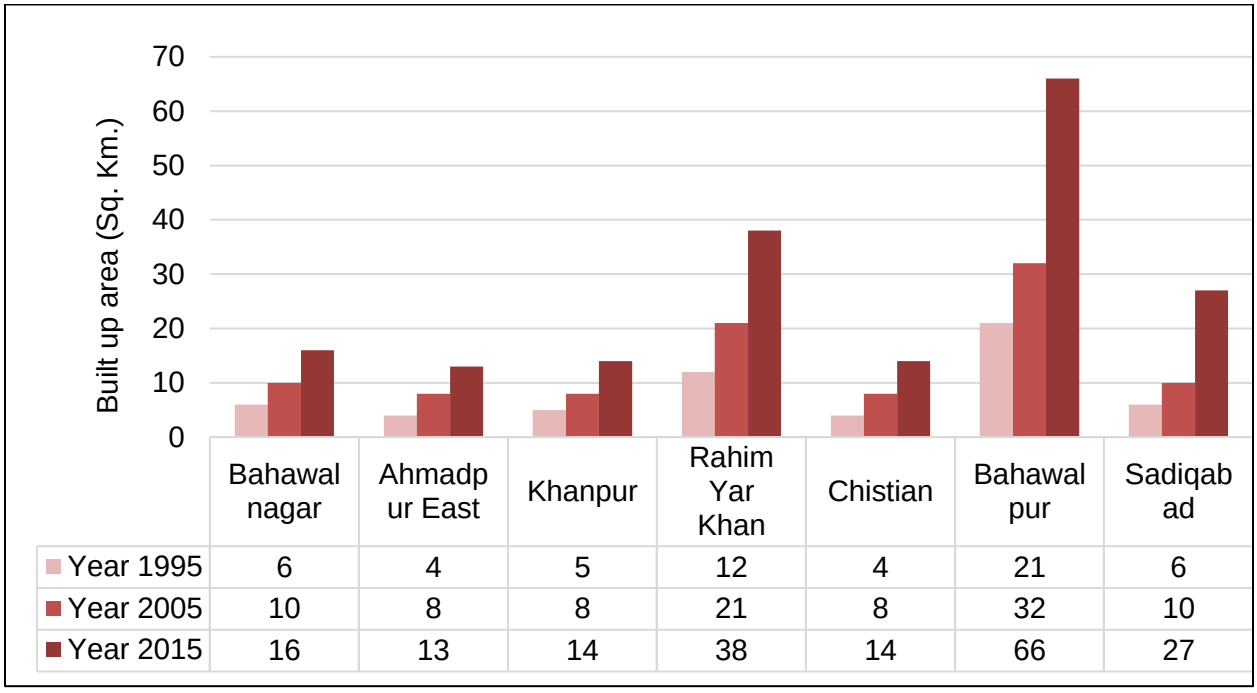


Map 1: Population density of all administrative units in Bahawalpur division

Source: The Urban Unit

1.3. Urbanization Trends

Based on the built-up area, seven cities in Bahawalpur division are highly urbanized namely: Bahawalpur, Bahawalnagar, Chistian, Sadiqabad, Rahim Yar Khan, Khanpur and Ahmadpur East.



	Bahawalnagar	Ahmadpur East	Khanpur	Rahim Yar Khan	Chistian	Bahawalpur	Sadiqabad
Year 1995	6	4	5	12	4	21	6
Year 2005	10	8	8	21	8	32	10
Year 2015	16	13	14	38	14	66	27

Figure 2: Built up areas of cities in Bahawalpur division

Source: Punjab Cities Growth Atlas, 1995-2015[1]

ISSUES AND CHALLENGES

2.1. Lack of updated planning documents for urban development

Lack of updated plan for the management of urban growth in the cities is the major issue. Land use surveys were performed in 70s, nothing has been updated so far. Outline development plans are outdated and are almost 25-30 years old. Urban areas shown in the ODP for the cities are way less and the cities have grown drastically now.

For instance, city area of Bahawalpur shown in ODP is 4000 acres but now it is 16000 i.e., 3 times the old size. Therefore, there is a need for regional planning and effective governance to manage the planning activities in the division.

[1] Punjab City Growth Atlas 1995-2015: https://urbanunit.gov.pk/UrbanAtlasCity/index.html#p=1

Table 3: Planning interventions in Bahawalpur division

Planning interventions	Bahawalpur	Bahawalnagar	Rahim Yar Khan
Land use survey performed	1974	1976	1975
Outline Development Plan	1974-1990	1976 - 1996	1975 - 1995
Years since ODP lapsed	31 years	25 years	26 years
Urban Area in Acres - ODP	4308	2176	7549 Acres
Urban Area in Acres (2015)	16309	4000	9400

2.2. Spatial Growth

The rate of area change in the cities of Bahawalpur division is higher than Multan and D.G khan. Sadiqabad has grown almost two times its size (183%) from 1995-2015 and it has the highest land consumption among other cities of South Punjab followed by Bahawalpur and Chistian.

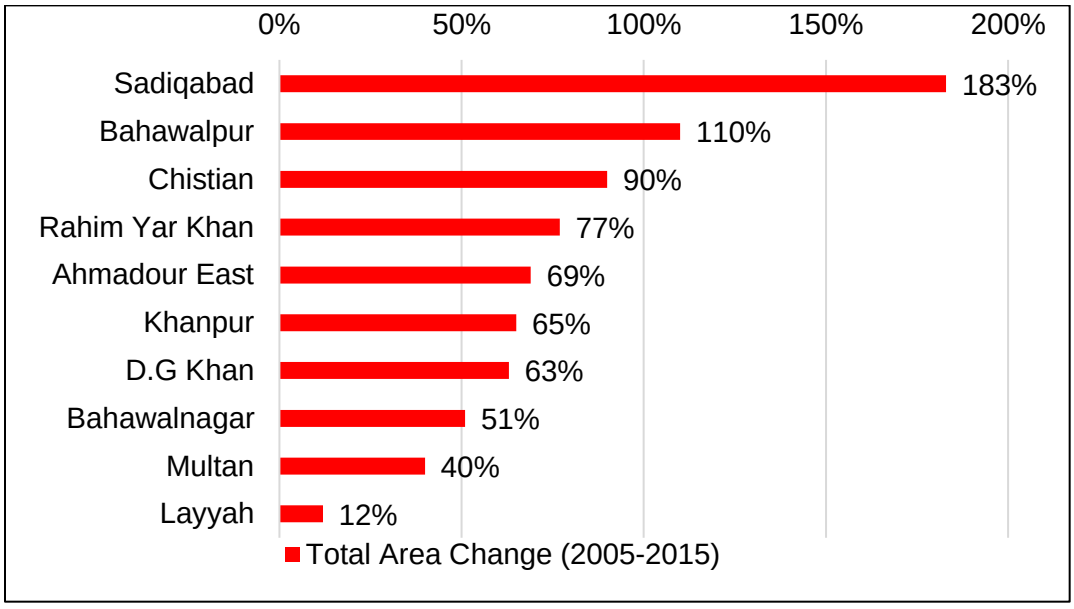


Figure 3: Urban land consumption rate in districts of South Punjab (2005-2015)

Source: Punjab Cities Growth Atlas, 1995-2015[2]

[2] Punjab City Growth Atlas 1995-2015: https://urbanunit.gov.pk/UrbanAtlasCity/index.html#p=1

The urban extent boundaries of districts in Bahawalpur division from 1995-2015 are shown below:

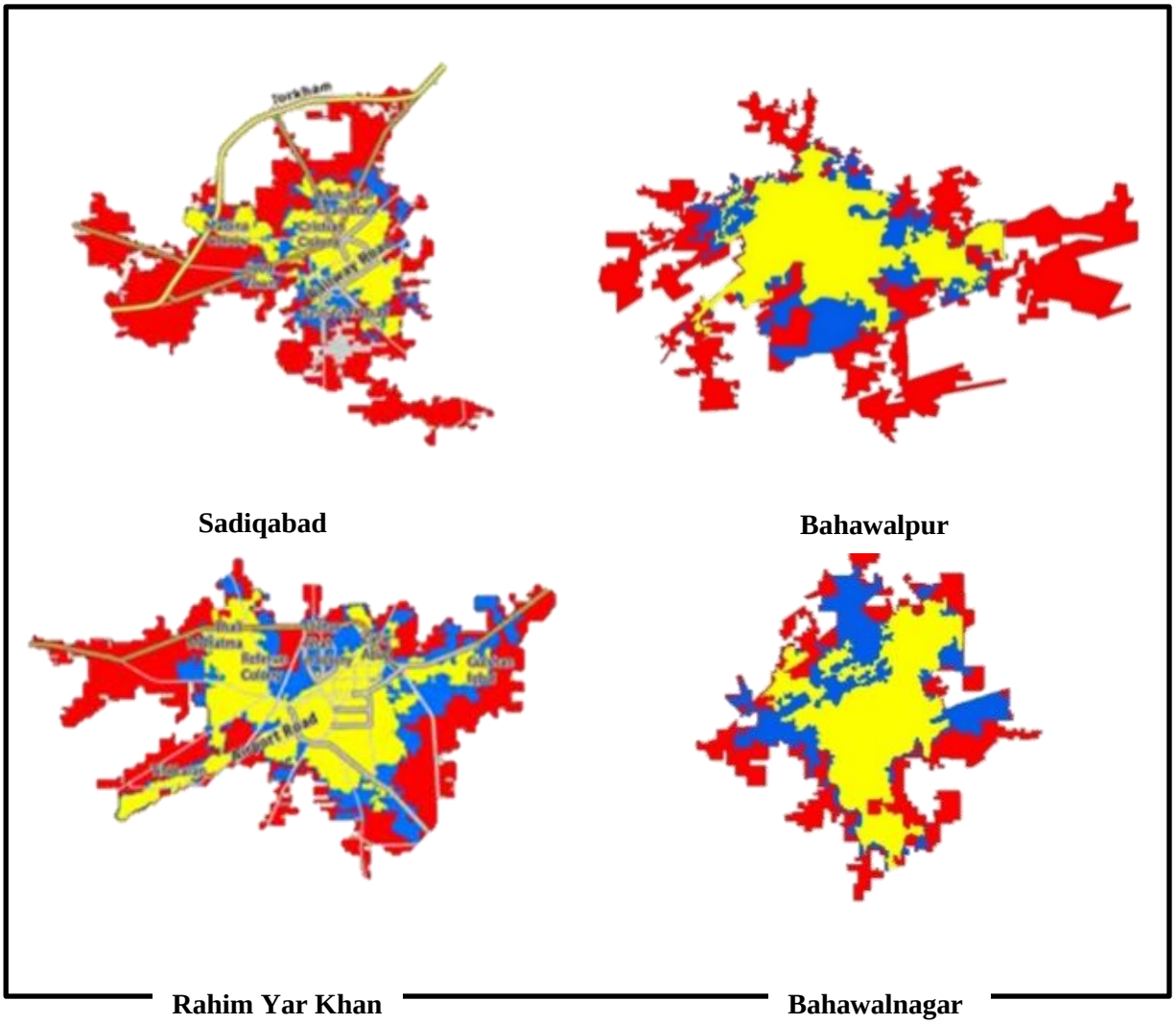


Figure 4: Urban extent boundaries of districts in Bahawalpur division (1995-2015)

Source: Punjab Cities Growth Atlas, 1995-2015[3]

[3] Punjab City Growth Atlas 1995-2015: https://urbanunit.gov.pk/UrbanAtlasCity/index.html#p=1

Projections are made to foresee the growth of cities in the next 20-25 years for informed planning. Chistian is only 38% of the total size of Rahim yar khan, however its rate of expansion is higher than RYK. Similarly, Sadiqabad is only 40% of the total size of Bahawalpur, however rate of urban growth in Sadiqabad is highest in the Bahawalpur division.

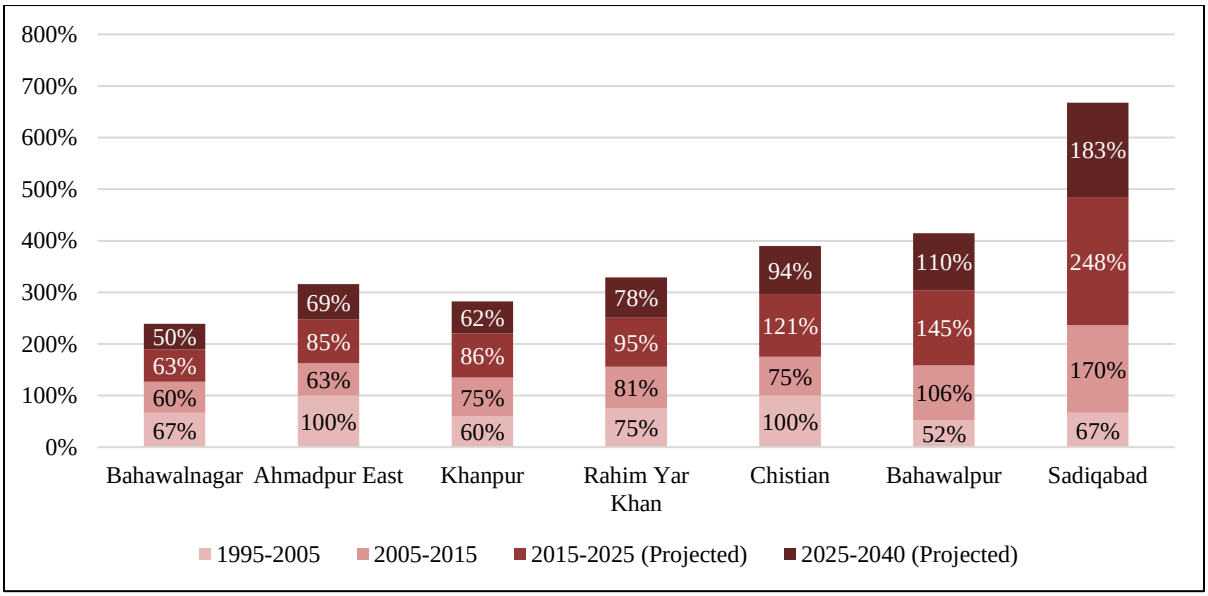


Figure 5: Projected rate of urban growth in districts of Bahawalpur division (2015-2040)

Source: The Urban Unit

2.3. Housing Demand

Total housing units in the division are almost 1.75 million. Out of which 0.7 million (40%) are the overcrowded units, 88,000 units (5%) are dilapidated and needs replacement and 11,000 new houses are required to meet the housing demand. Rahim Yar Khan has the highest overcrowded and dilapidated houses (Fig. 6).

However, need for new housing units is highest in Bahawalpur district. On average, 41% of housing units are deprived i.e. overcrowded in Bahawalpur division and 3% of housing units are severely deprived i.e. need of new houses plus the need to replace dilapidated houses.

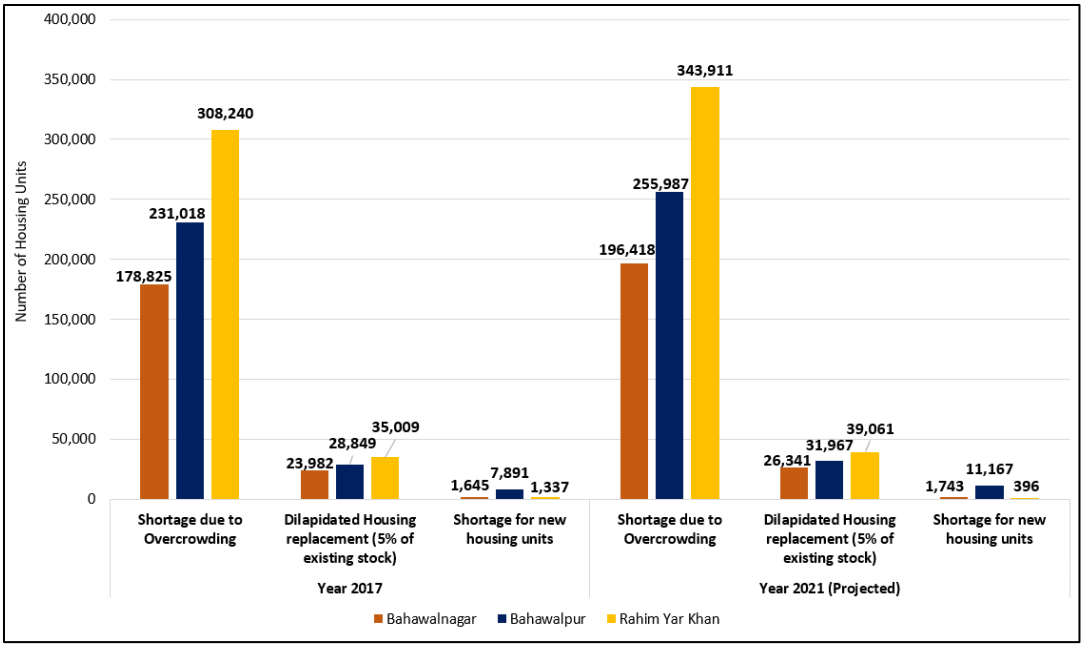


Figure 6: Housing shortage in the division (2017-2021)

Source: The Urban Unit

SCOPE OF WORK

Short term Goal: Preparing spatial outline plan for limiting haphazard urban sprawl.

Objectives:

1. Temporal growth analysis to identify potential land for future growth in Bahawalpur division.
2. Identify and analyze lal lakeers of Bahawalpur for future planning and development.

3. To prioritize locations in the divisions for future projects.

Long term Goal: Mainstream participatory planning approaches at the various levels, including through involvement of local groups, and building consensus in a gradual sort of way

Objectives:

1. Review existing planning and institutional structure, identify the loopholes and develop strategy/institutional framework for smooth functioning of developmental activities in the division.

METHODOLOGY

A rigorous and unbiased methodology is adopted for adequate analysis in the report. Geographic information system (GIS) is used to analyze spatial complexity of the division and for developing a set of feasible regional planning proposals for the future. Phasing of various activities that has been done in the project is given below:

FIRST PHASE: Stakeholder mobilization and data collection/ organization

Arranging an initial regional consultative workshop with representatives to discuss and agree on the objectives and the expected outcomes of the urban planning perspective of regional development of Bahawalpur division

Figure 7: Consultation sessions with stakeholders in Bahawalpur

SECOND PHASE: Preliminary spatial analysis and key consultative workshops

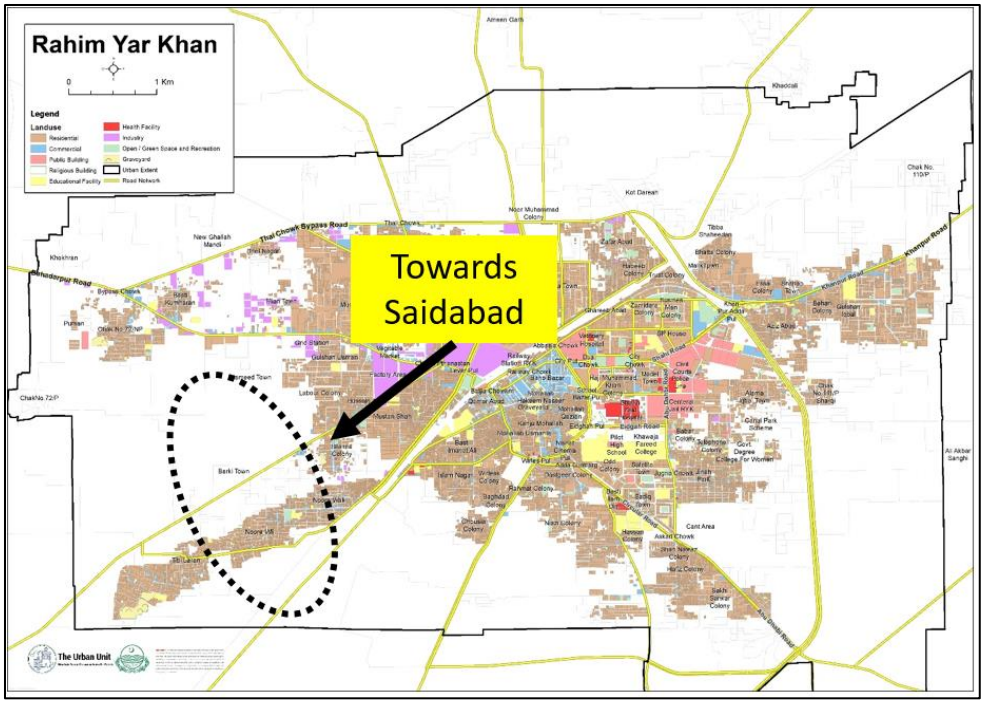
Producing preliminary regional planning results at regional level, together with an early definition of a spatial structure. Arranging consultative workshops with relevant department with the aim of further expounding the proposed analytical methods and presenting, further discussion and validation of preliminary results. These consultations also give an opportunity for group discussions with local representatives, which is particularly important in the identification of priority projects.

THIRD PHASE: Drafting, finalization of the spatial analysis and preliminary spatial planning

URBAN PLANNING PROPOSALS FOR FUTURE DEVELOPMENT IN THE DIVISION

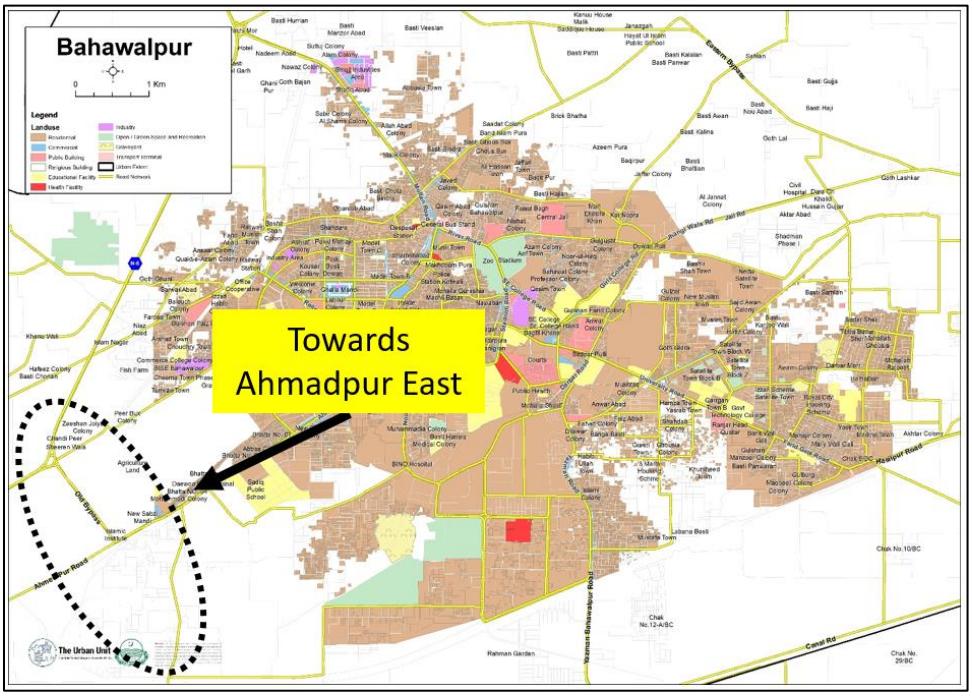
Districts of Bahawalpur division are experiencing haphazard urban growth and there is a need to identify areas for future development in the division. Potential areas have been identified in Rahim yar khan and Bahawalpur district to guide future development in Bahawalpur division (Map 2 and 3). Possible land for future planning activities is proposed towards Saidabad in Rahim yar khan district and towards Ahmadpur East in Bahawalpur district. Agriculture areas that need protection are also marked in Rahim yar khan and Bahawalpur district (Map 4 and 5) because Bahawalpur division is an agro-based area and most of the industry exists on agriculture produce[4].

[4] Retrieved from Urban Unit Publication https://www.urbanunit.gov.pk/Download/publications/Files/8/2021/PCIIP%20Cities%20Profile-Bahawalpur.pdf.



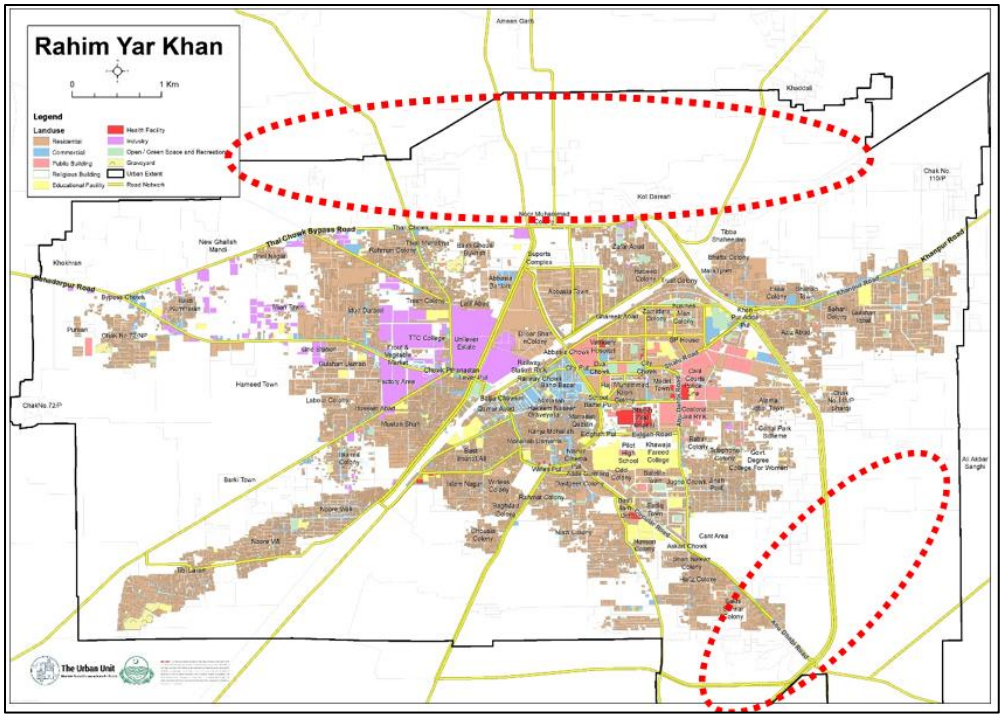
Map 2: Land for future development in Rahim Yar Khan district

Source: The Urban Unit



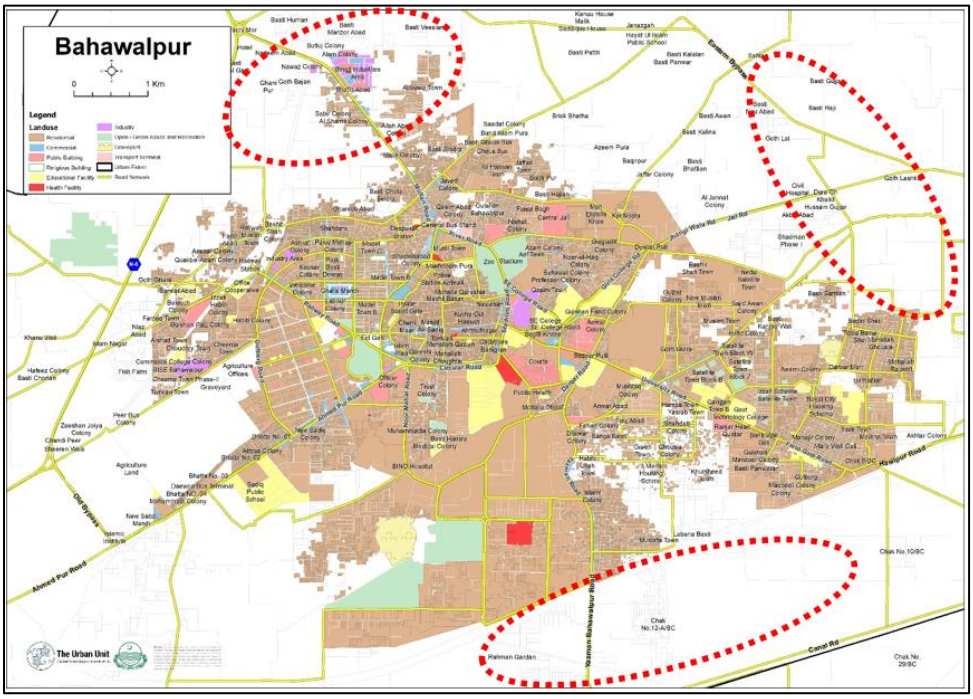
Map 3: Land for future development in Bahawalpur district

Source: The Urban Unit



Map 4: Location of agriculture areas for protection in Rahim Yar Khan district

Source: The Urban Unit



Map 5: Location of agriculture areas for protection in Bahawalpur district

Source: The Urban Unit

5.1. Bahawalpur Cultural District & Revitalization of Bahawalpur Old Town

The old city area of Bahawalpur is marked as central cultural district which needs façade uplift of the buildings, installation of signboards and development of walking infrastructure such as sidewalks. Moreover, revitalization of the area marked in red dotted line (Map 6) is proposed for creating small businesses such as handicrafts and jewelry centers because Bahawalpur is very famous for its pottery and Kurtas and Bahawalpuri style Jewelry[5]. The proposed cultural district should be part of wider cultural planning for the city at large to reflect the specific cultural, social and economic needs of its city.

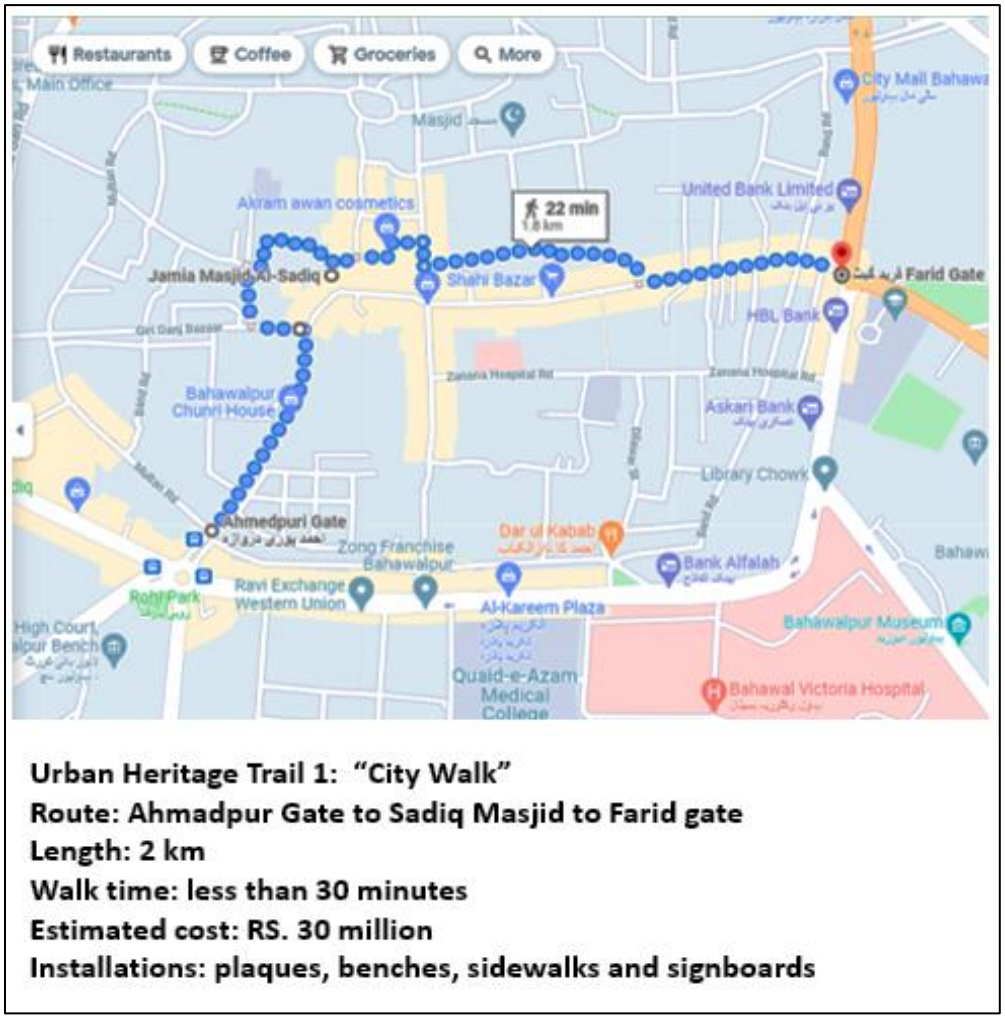
Map 6: Bahawalpur cultural district & revitalization of Bahawalpur old town

Source: The Urban Unit

[5]Retrieved from Urban Unit Publication https://www.urbanunit.gov.pk/Download/publications/Files/8/2021/PCIIP%20Cities%20Profile-Bahawalpur.pdf.

5.2. Urban Heritage Trails – Bahawalpur

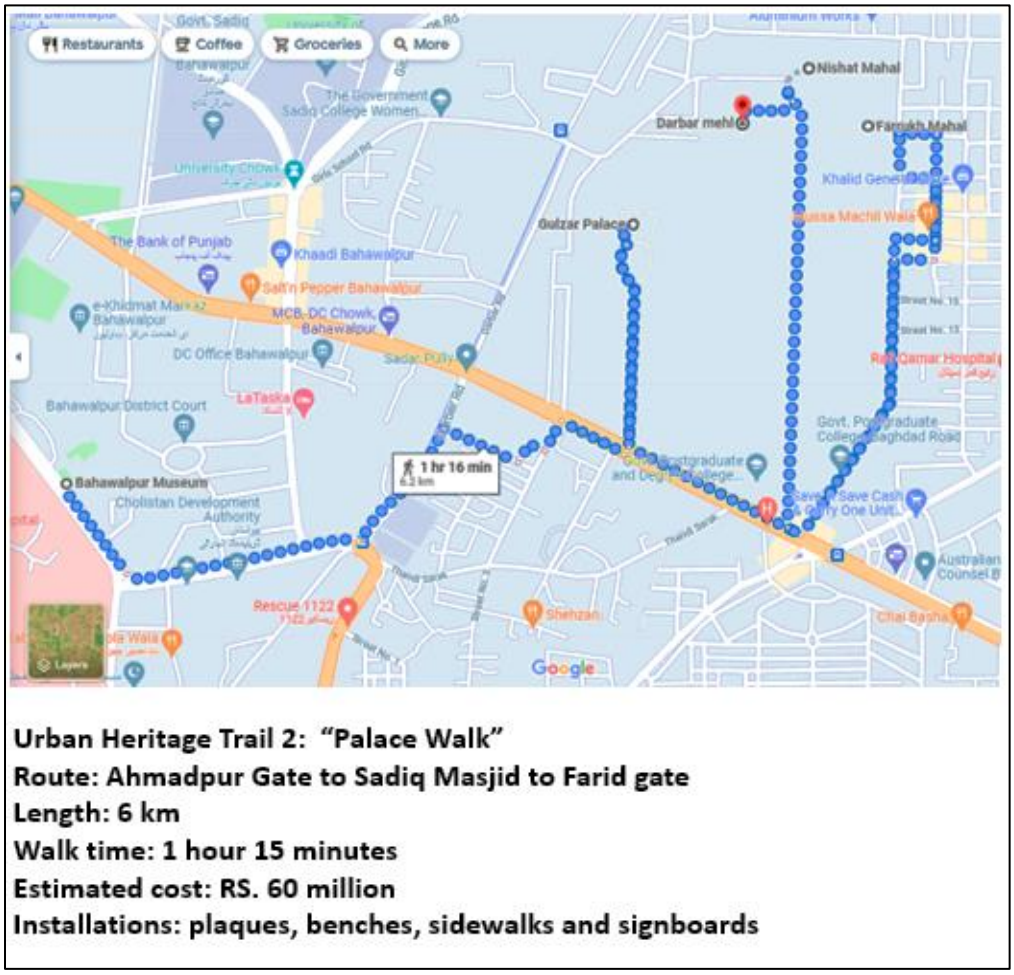
Walking trails in the proposed cultural district are proposed to facilitate the tourists coming to visit the landmarks in the area. Two urban heritage trails are proposed for the visitors in the old city area of Bahawalpur district. One walking trail of 2 km is proposed from Ahmad pur gate to farid gate via sadiq masjid (Map 7). Walking time is less than 30 minutes and along the route signboards, benches, footpaths are required to ease the pedestrian movement along the proposed route.



Map 7: Urban heritage trail 1 – Bahawalpur

Source: The Urban Unit

Similarly, heritage trail of 6 Km length with walking time of one hour and 15 minutes is also proposed from Ahmadpur gate to Farid gate including various places notably Gulzar palace and Darbar palace (Map 8). Signboards, plaques, benches and footpaths are required to ease the pedestrian movement along the proposed route.



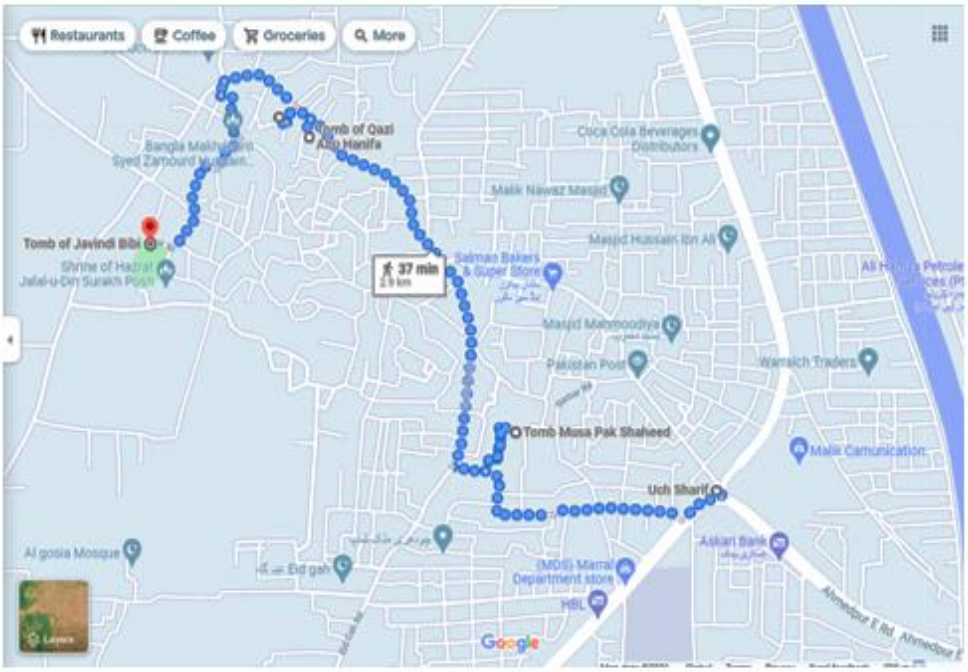
Map 8: Urban heritage trail 2 – Bahawalpur

Source: The Urban Unit

5.3. Urban Heritage Trails & Land Value Capture – Uch Sharif

Uch Sharif, 50 kilometers west of Bahawalpur, is one of Pakistan's oldest settlements. It is known for its stunning ruins and tombs, which are embellished with blue mosaic and other decorations. The octagonal tomb of Bibi Jawindi, built in the 15th century, is among the most well-known monuments. During the 13th

century, Uch sharif is considered important town for its cultural significance[6]. It is hub of tourist attraction due to many historic monuments in the town and therefore, there is a need to facilitate the visitors coming to this area from different cities. Northern trail of 2 km (from uch sharif bus stop to Makhdoom jahanian and Bibi Javindi via tomb of Qazi Abu Hanifa) and southern heritage trail of 2 km directly from Uch sharif bus stop to tomb of Bibi Javindi are proposed. Along the proposed route, tourist facilitation in the form of sign boards, benches, sidewalks are required to attract more visitors in the area. The proposed route details are shown in the figures below:



Urban Heritage Trail 1: "Northern Uch Sharif"
Route: Bus stop to Tombs of Makhdoom Jahanian & Bibi Javindi
Length: 3 km
Walk time: 40 minutes
Estimated cost: RS. 40 million
Installations: plaques, benches, sidewalks and signboards

Map 9: Urban heritage trail 1 – Uch Sharif

Source: The Urban Unit

[6] Retrieved from Punjab Tourism Portal https://tourism.punjab.gov.pk/uch-sharif.

Map 10: Urban heritage trail 2 – Uch Sharif

Source: The Urban Unit

PROPOSED PROJECTS

Based on the problems identified, spatial analysis performed and the meeting discussions with the stakeholders, various short-, medium- and long-term projects are proposed for the future regional planning and development in the division, detail of the projects are discussed below:

6.1. Short and Medium Term Projects

Table 4: Short and Medium Term Projects

S. No.	Project	Proposed budget (PKR)	Description	Relevant stakeholders
1	Integrated Master Plan of Cholistan Development Authority	50 million (Already in ADP (unapproved)	Land use zoning/ Site Development Zone in Cholistan	Cholistan Development Authority, District Government
2	Addition of Special Clause for land preservation in Land sub-division rules 2020 in Bahawalpur District	20 million	Agriculture land preservation	District government, local municipal department, Development Authorities
3	Regulations for land allotment in Desert areas of division	30 million (10 million for three districts)	District level rural land allotment plans	District government, local municipal department
4	Master Planning of Cities Project	500 million (3.35 million for each city) (Already added in ADP)	Bahawalpur, Uch Sharif, Ahmadpur East, Yazman, Hasilpur, Khairpur Tamiawali, Bahawalnagar, Chishtian, Haroonabad, Fort Abbas, Minchanabad, Rahim Yar Khan, Sadiqabad, Khanpur and Liaqatpur in Bahawalpur division.	District government, local municipal department

5	Capacity building of local government departments in entire division by hiring urban planning professionals on non-rotational contract.	30 million (10 million for three districts)	Hiring of urban planners for already vacant seats and new seats	Local government administrations
6	Infill development projects in low density and high value zones of Bahawalpur and RYK	30 million	Various sites and locations are available which could be used for increasing urban density and efficient land utilization in existing areas.	District government, local municipal department, PTDC
7	Rehabilitation of commissioner and deputy commissioner office for Bahawalpur district	20 million	Renovation of offices with latest equipment's for office use	District Administration
8	Construction of CDA office complex at the airport road (CDA land available)	20 million	New office complex in Bahawalpur district	Cholistan Development Authority
9	Development of housing colony and commercial plaza for Bahawalpur development authority	80 million	No housing colony and commercial plaza for BDA staff in Bahawalpur district	Bahawalpur Development Authority
10	Preparation of agricultural land preservation and urban land densification policies	40 million	No existing policy to preserve prime agricultural land	District government, local municipal department,

11	Identification of future site development zones for sustainable development	20 million	No existing plan or procedure for making site development zones	District government, local municipal department,

6.2. Long Term Projects

Table 5: Long Term Projects

S. No.	Project	Proposed budget (PKR)	Description	Relevant stakeholders
1	Designing an app for urban development information system	40 million	Mobile payment & status update for private development applications, fee & challans	District government, local municipal department
2	Construction of village hubs along the water supply line of CDA	100 million (Location: Derawar, Nawa Kot, Bijnot)	Construction of village hubs along the water supply line of CDA for providing electricity, public services to nearby local population clusters	Cholistan Development Authority
3	Formulation of katchi abadi policy and action area plan for katchi abadis in BWP division	50 million	Old Katchi Abadi rules, 1985 of Bahawalpur district only. No long-term policy and plan in Bahawalpur, Rahim Yar Khan and Bahawalnagar for relocating katchi abadis	District government, Katchi Abadi Authority, local municipal department
4	Formulation of affordable housing policy and standards for provision of affordable housing in division	30 million	Urban sprawl in the division due to housing schemes development under political influence.	District government, local municipal department, Development Authorities
5	Establishment of commercial and food	80 million	There is a lack of family friendly food streets and commercial centers in the old city, and the	District government, local municipal department

	street in Bahawalpur inner old city		existing places could be used for this	
6	Development of a new commercial corridor towards the north side in Bahawalpur	40 million	New commercial development towards Multan Road required due to overcrowding and high demand for business corridors in the city.	District government, local municipal department
7	Establishment of community hall in Uch Sharif old city area	50 million	Identification of suitable locations and provision of public building	District government, local municipal department
8	Development of chunri heritage and artisan village in Abbas Nagar	40 million	To market the local products, existing government buildings can be used to develop these faculties. CDA has already done base work for this.	MNAs, MPAs and P&D development directorate
9	Setting up 'Bahawalpur cultural district' in the old city of Bahawalpur	200 million	Installations: facade uplift, exhibition places, handicraft markets, walking infrastructure and storytelling points	District government, local municipal department; MNAs, MPAs and P&D development directorate;
10	Revitalization of Bahawalpur old town	80 million	Installations: faced uplift, plaques, sidewalks and signboards	District government, local municipal department; MNAs, MPAs and P&D development directorate;

11	Land value capture project for the revitalization and cultural districts of Bahawalpur old town	60 million	Design and construction of Multistory commercial and visitor center 'Handicrafts & Jewelry Center' in the revitalized old town area of Bahawalpur; Location: yet to be decided	District government, local municipal department; MNAs, MPAs and P&D development directorate;
12	Bahawalpur storytelling and urban heritage trail 1: "City Walk"	30 million	Urban Heritage Trail 1: "City Walk" Route: Ahmadpur Gate to Sadiq Masjid to Farid gate Length: 2 km Walk time: less than 30 minutes Installations: plaques, benches, sidewalks and signboards	District government, local municipal department; MNAs, MPAs and P&D development directorate;
13	Bahawalpur storytelling and urban heritage trail 2: "Palace Walk"	60 million	Urban Heritage Trail 2: "Palace Walk" Route: Ahmadpur Gate to Sadiq Masjid to Farid gate Length: 6 km Walk time: 1 hour 15 minutes Installations: plaques, benches, sidewalks and signboards	

14	Uch storytelling and urban heritage trail 1: "Northern Uch Sharif"	40 million	Urban Heritage Trail 1: "Northern Uch Sharif" Route: Bus stop to Tombs of Makhdoom Jahanian & Bibi Javindi Length: 3 km Walk time: 40 minutes Installations: plaques, benches, sidewalks and signboards	
15	Uch storytelling and urban heritage trail 2: "Northern Uch Sharif"	30 million	Urban Heritage Trail 2: "Southern Uch Sharif" Route: Bus stop to Tomb of Bibi Javindi Length: 2 km Walk time: 25 minutes Installations: plaques, benches, sidewalks and signboards	

Way Forward

The region will be able to address many of its pressing urban planning problems by focusing on the regional comprehensive plan and addressing the coordination gap at the local and regional levels, while ensuring equity in planning and development. Local jurisdictions and regional service providers can also plan for the expansion of their facilities and services in a more cost-effective and sustainable manner by pursuing the preferred planning concept outlined in this section, which calls for using funding as an incentive for local agencies and other service providers to make land use decisions and infrastructure investments that support smart growth.

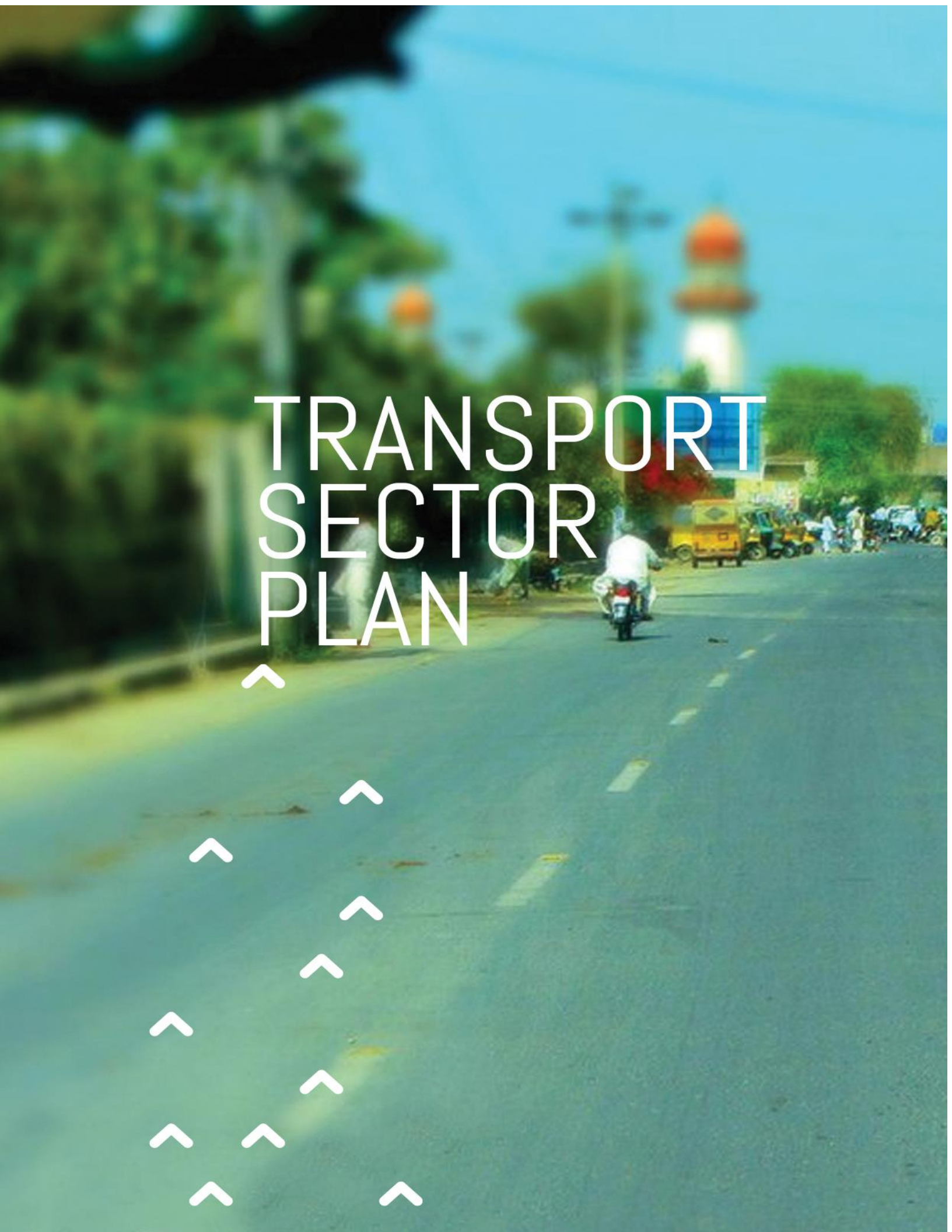
Bahawalpur division requires pro-poor inclusive strategies and standards that allow for new local solutions. If a city is suitable for its most vulnerable citizens- children, elderly persons, a new immigrant or a disabled person - it will be beneficial for everyone else. Integration and inclusion must be at the forefront of the regional planning agenda for urban sustainability in the division.

• In the division, sustainable development must be democratized at the local level.

• Existing citizen engagement approaches, such as participatory budgeting, should be applied in every community, with the most relevant tools and most pressing issues being selected locally.

• Cross-sector collaboration is required in both administration and political decision-making.

• Free public data access is a must for integrated planning, not just for data and access, but also for the ability to search for specific information and trends.



TRANSPORT SECTOR PLAN

DISCLAIMER/ TEAM MEMBERS

Urban Planning Team

Nadia Qureshi (Senior Specialist – Urban Planning and Architecture)

Mohsin Raza (Senior Research Analyst – Transport)

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Notations

BHV	Bahawalpur
BHV-	Bahawalpur without Cholistan
DEA	Dera Ghazi Khan
LYP	Faisalabad (Lyallpur)
GRW	Gujranwala
LHE	Lahore
MUX	Multan
RWP	Rawalpindi
SWN	Sahiwal
SGI	Sargodha

Bahawalpur Division Transport Connectivity Planning

1 Introduction

The primary modes of transportation in the Bahawalpur Division are roadways and railways. The total length of roads which run across the Division is 11,264 km (BoS, 2020). These roads include a Motorway, a National Highway, and a series of District Roads. District roads connect all the 14 Tehsils of the Division from Minchinabad in the east to Sadiqabad in the west (Figure 1). The Motorway (M-5) and the National Highway (N-5) connect the Division primarily with Muzaffargarh and Multan in the north and Sindh in the west. Thus, in general, the extant road network provides reasonable linkages for inter-district and regional movement of the local populace. However, the Cholistan Desert, which comprises the southern part of the Bahawalpur Division, lacks the transport infrastructure needed to connect its (roughly) 200,000 inhabitants with other parts of the Division.

Besides roads, Bahawalpur Division has a network of Main and Branch railway lines for passenger and freight transportation (Figure 2). Bahawalpur and Khanpur Railways Stations are two of the important stations on the Pakistan Railways Network. They are connected to the rest of the country by the Main broad-gauge double line of the Pakistan Railways. Thus, these railway stations can handle the bulk of passenger and freight traffic. It provides an excellent opportunity for trade, tourism, and leisure. In addition to the Main Line, Bahawalpur Division benefits from a branch line that originates from Samsata Junction Railways Station (in Bahawalpur District) and runs up to Amruka Railways Station (Tehsil Minchinabad) at the border of the Division. This combination of Main Line and Branch Line connects all the Tehsils of Division except Fort Abbas and Haroonabad (abandoned railway stations that were previously functional).

Concerning airways, there are two airports in Bahawalpur Division: Bahawalpur Airport (IATA Code: BHV) and Rahim Yar Khan Airport (IATA Code: RYK). As of now, these airports serve only domestic flight operations with no international commercial flights. Pakistan Civil Aviation Authority data shows that in 2018-2019, the BHV and RYK airports served 23,882 and 53790 (0.4% and 0.9% of the national) domestic air passengers, respectively (PCAA, 2020). There was no international passenger movement on these airports during this period, nor any cargo or mail movement (PCAA, 2020). The air transport capacity seems to have been under-utilized, and there is a potential to enhance air traffic significantly.

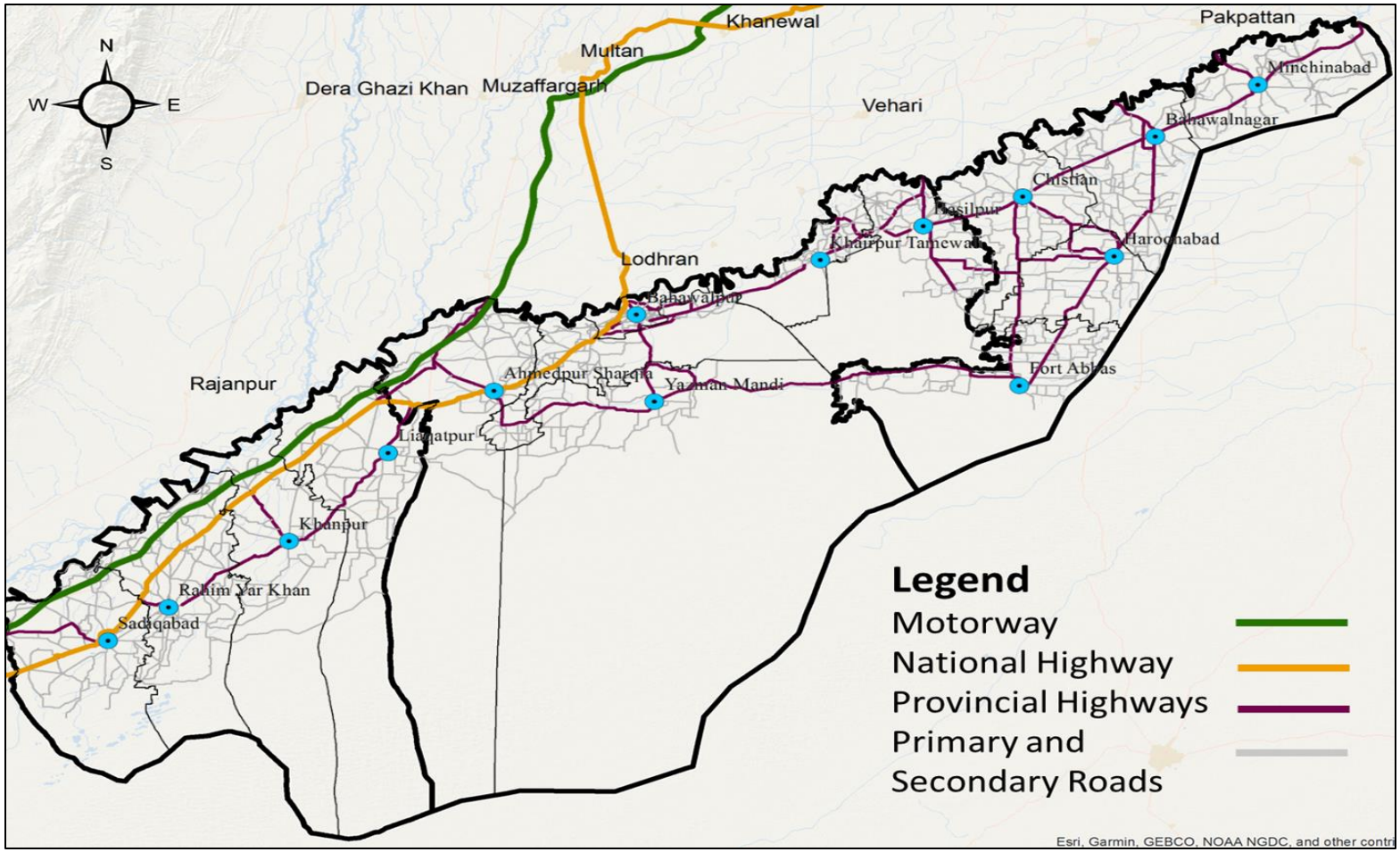


Figure 8: Road Network, Bahawalpur Division.

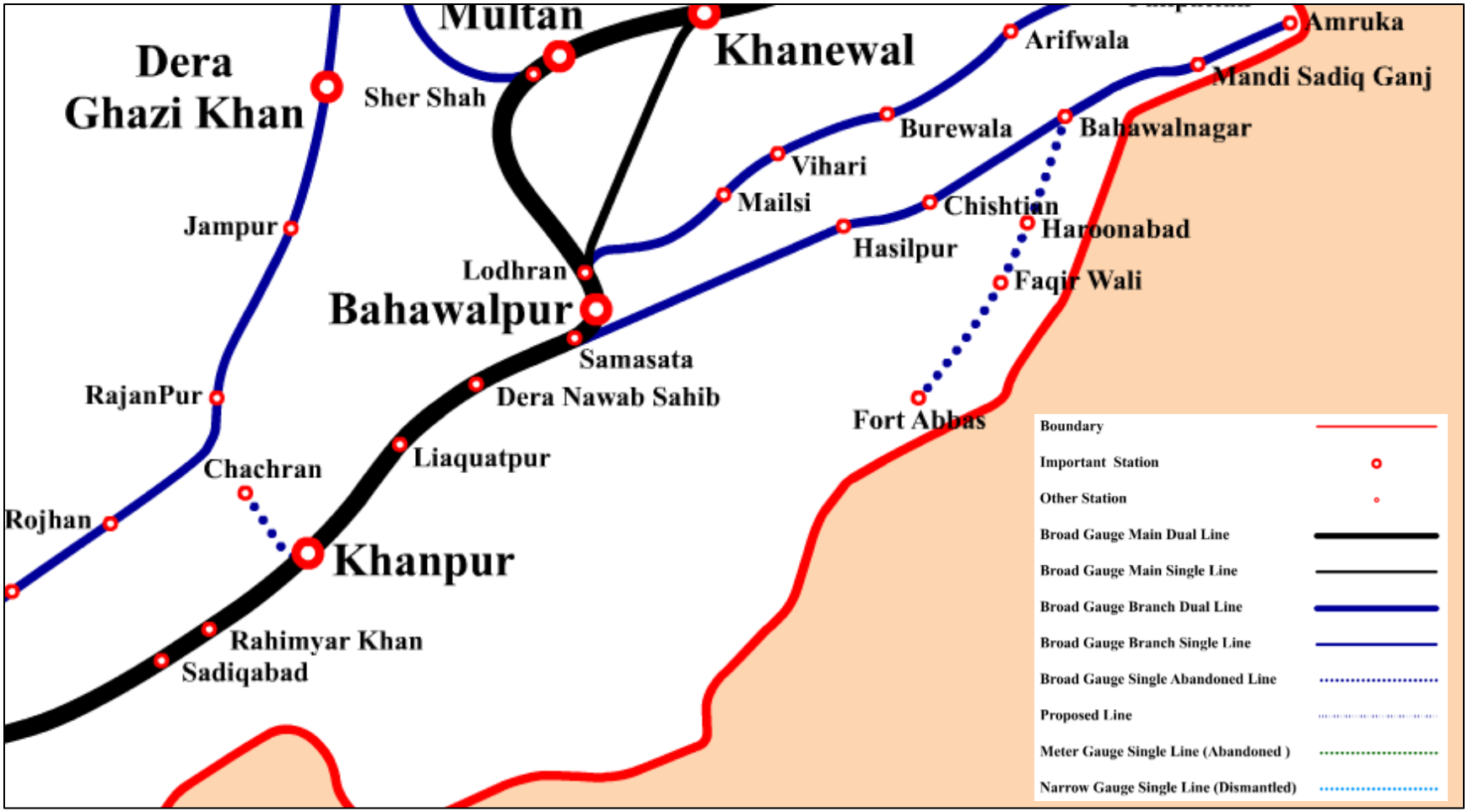


Figure 9 Rail Network in Bahawalpur Division

Since railways and airways are a subject of federal government development plans, the upcoming sections of this chapter will limit the analysis to road infrastructure and transport. Specifically, Section 2 of the chapter analyses the road density of the Bahawalpur Division and compares it with those of other Divisions in Punjab. In addition, this section includes an analysis of the operating speeds of District Roads in Bahawalpur. Section 3 reviews the state of freight transport infrastructure. Section 4 offers an overview of the public transport infrastructure.

2 Road Density

Road density indicates road length per unit area, expressed in km/km2. It is one of the measures of infrastructure quality (Duranton & Turner, 2011). More road density usually implies more access for the general public to markets, trade centers, educational institutes, offices, hospitals, and similar places that fulfill their wants. It is why an increased road density is usually considered a crucial measure of the sufficiency of road infrastructure for public needs.

The total paved roads length in the Bahawalpur division is 11,264 km, spread over 45,588 km2 (BoS, 2020). It gives an average road density of 0.25 km/km^2; the 2nd lowest road density by division in Punjab (Figure 3). It is not equitable given Bahawalpur is the 5th largest division by population in the province. The southern part of the Bahawalpur Division features the Cholistan Desert, where population density is very low, and its (roughly 200,000) inhabitants live a nomadic life.

For the sake of argument, if we exclude Cholistan land area (25,800 km^2), the road density ranking of Bahawalpur division improves to 0.57 km/km^2; the 3rd highest road density by divisions in Punjab (equal to that of Multan Division) as shown in Figure 3 as BHV-. However, this high road density (0.57) may not be considered for decision-making concerning the road sector because other divisions also include areas where population density is very low. For example, Rawalpindi and Dera Ghazi Khan Divisions have large areas covered with mountain ranges where the human population is scarce. Thus, we may conclude that the paved road density in the Bahawalpur division is 0.25 km/km2 that is very low.

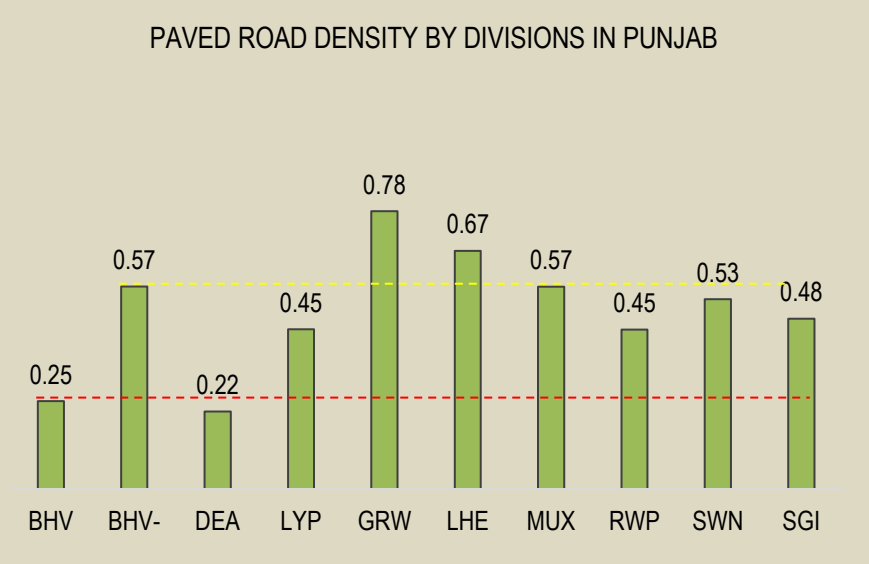


Figure 10 Paved Road Density by Division in Punjab.

Figure 4 presents an analysis of provincial roads (including farm to market roads) density and sugar cess road density. Note that the provincial (including farm to market) road density is a ratio of the roads network length in a given district to the cultivated land area of that district. Likewise, the sugar cess road density is the length of the sugar cess road divided by the sugar cane cultivation area. The provincial road density and sugar cess road density in Bahawalpur ranks 5th and 6th, respectively. On the other hand, the division has the 2nd largest cultivated land area and is the 3rd largest producer of sugarcane. Figure 4 summarizes these observations.

Globally, however, measurements of road lengths for calculating road density include both paved and unpaved roads. Therefore, reporting only the paved road lengths by the Bureau of Statistics (Punjab) needs to be changed. In a recent study for the National Transport Research Center, the Urban Unit measured the length of roads in the Bahawalpur Division using a geographic information system. The total length of paved and unpaved roads in Bahawalpur is 32,855 km, which gives a road density of 0.72 km/km^2.

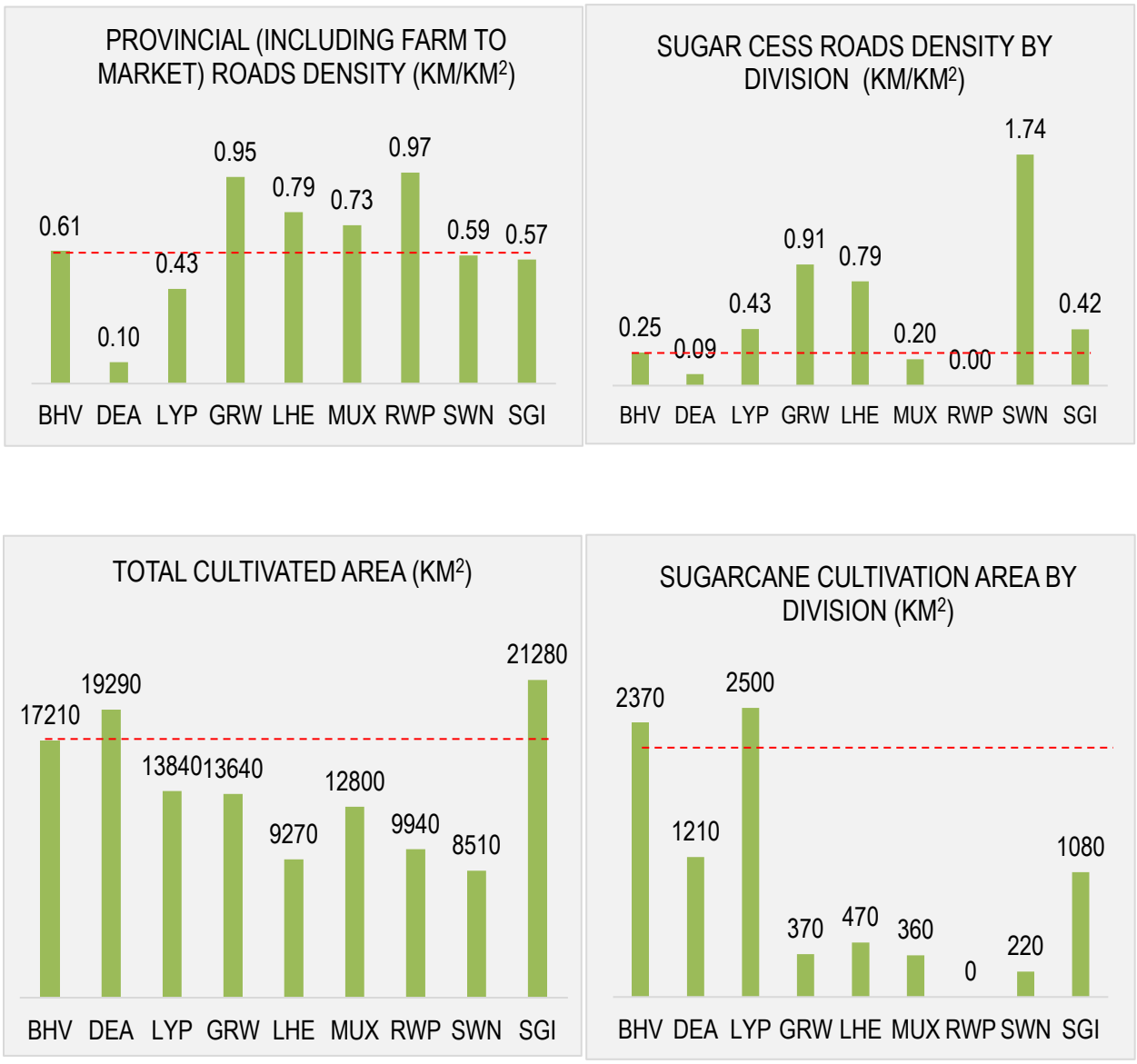


Figure 11 Cultivated Land and Corresponding Road Densities in by Division in Punjab

For perspective, the road density in India is 1.89 km/km^2 (MRTH, 2021) which is more than twice the road density of Bahawalpur (Pakistan's national average is even lower). However, the optimum value of the road density in a region is largely dictated by its development goals as well as its topography. To demonstrate this rule of thumb, Table 1 lists road densities across ten selected countries in the world. It can be seen that the road density in different countries, including highly developed countries such as the US, can be lower than 1.

Table 6 Road Density by Country

Country	*Road Density (km/km²)*	*Country*	*Road Density (km/km²)*
Austria	1.53	United States	0.73
Denmark	1.87	United Kingdom	1.74
France	2.00	Turkey	0.32
Japan	3.36	Switzerland	1.81
Norway	0.26	Italy	0.87

2.1 Analysis of Road Type and Operating Speeds

Table 2 shows length of roads in the three districts of Bahawalpur Division by road type. Bahawalnagar District is not directly connected to the N-5 or M-5. The shortest link between Bahawalnagar District and the N-5 passes through Arifwala, and is 89.4 km long with an average operating speed of 48 km/hour. This isolation from national road network obscures the trade and business development in Bahawalnagar. Bahawalpur and Rahim Yar Khan on the other hand are connected to N-5 and M-5. The length of provincial road network, on the other hand, is similar in all the three districts. The length of Sugar Cess roads is more in Rahim Yar Khan than the other two district. This is because sugar cess roads are funded by sugar cess funds that are linked to the number of sugar mills in a district (Rahim Yar Khan has the highest number of sugar mills in the division).

Table 7 Metaled Roads Length (Kms) by Districts in Bahawalpur Division (BoS, 2020)

District	*Total*	*National High-ways*	*Motor-way***	*District Roads*				
				*Provincial Highways**	*R&B Sector*	*Farm to Market Roads*	*Sugar Cess Roads*	*District Council Roads*
Bahawalpur	3225.98	83.00	48	3053.01	0	0	89.97	0
Bahawalnagar	3761.78	0	0	3647.52	0	0	114.26	0
R.Y. Khan	4276.61	157.00	150	3737.77	0	0	381.84	0

** Provincial highways lengths include farm to market, R&B (Roads and Bridges) Sector and District Council*
***Road lengths corrected based on Urban Unit Data.*

Analysis of satellite-based traffic data shows satisfactory average operating speeds (above 50 km/hr) on a weekday on most of the roads connecting the Tehsils of Bahawalpur Division. There are only four links where operating speeds are less than 50km/hr (Figure 5). These low speed links include Sadiqabad-Rahim Yar Khan road, Liaquatpur-Channi Goth (N-5) road, Fort Abbas-Hasilpur road, and Fort Abbas-Chishtian road. While the operating speeds on these roads are low as compared to the other district roads in the division, the decision to invest on these roads might not be a straight forward one.

The Sadiqabad-Rahim Yar Khan link road has a very low operating speed, around 46km/hour; however, there are three different roads that connect these two Tehsils: Sadiqabad-Rahim Yar Khan (link) Road, Kacha Sadiqabad Road, and N-5 (via Chak 72 NP). Therefore, further investment on this link, to connect these two Tehsils (Sadiqabad and Rahim Yar Khan) has to follow a careful consideration. The argument in support of further investment is that the Sadiqabad Tehsil is the entry gateway for all the traffic entering from Sindh to Punjab which increases the importance of its link to Rahim Yar Khan. Therefore, a more detailed analysis on the merits and demerits of improving the Sadiqabad-Rahim Yar Khan Link Road is warranted.

Similarly, the connection between Liaquatpur and Channi Goth (N-5) is supported by two different roads: Liaquatpur-Bahawalpur Road and Channi Goth Road. Therefore, investment to improve the operating speeds of the link road between Liaquatpur and Channi Goth would need stronger justification.

Fort Abbas-Chishtian-Hasilpur Road, however, seems a good candidate link for potential investment on improving the operating speeds. It is a 100-kilometer-long road segment that connects Fort Abbas not only to the two other Tehsils (Chishtian and Hasilpur) but also to the N-5 and M-3 via Vihari. Dualizing this road can help increase operating speeds of the traffic between Fort Abbas and National Highways and Motorways network. The current average operating speed on this road is around 46 km per hour which makes it one of the slowest district roads in the Bahawalpur division.

On the positive side, the overall average operating speed on Bahawalpur Division provincial roads is around 55 km/hr which is satisfactory. For a comparison with neighbouring countries, Figure 6 shows average operating speeds on ten randomly selected district roads in Indian Punjab. Note that the average operating speed on these roads is 53 km per hour which is closer to the operating speed observed in Bahawalpur.

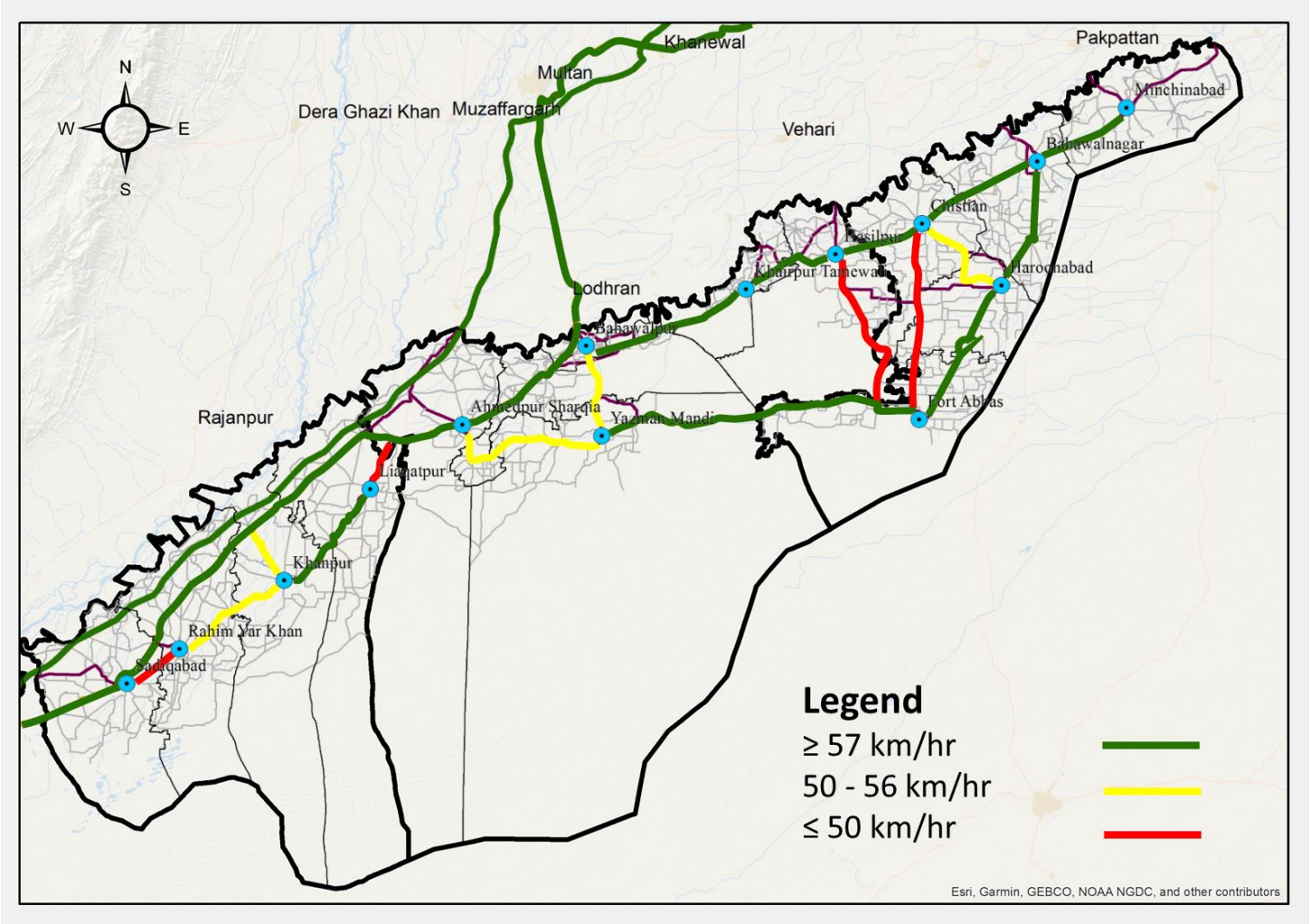


Figure 12 Average Operating Speeds on a Weekday by District Roads in Bahawalpur

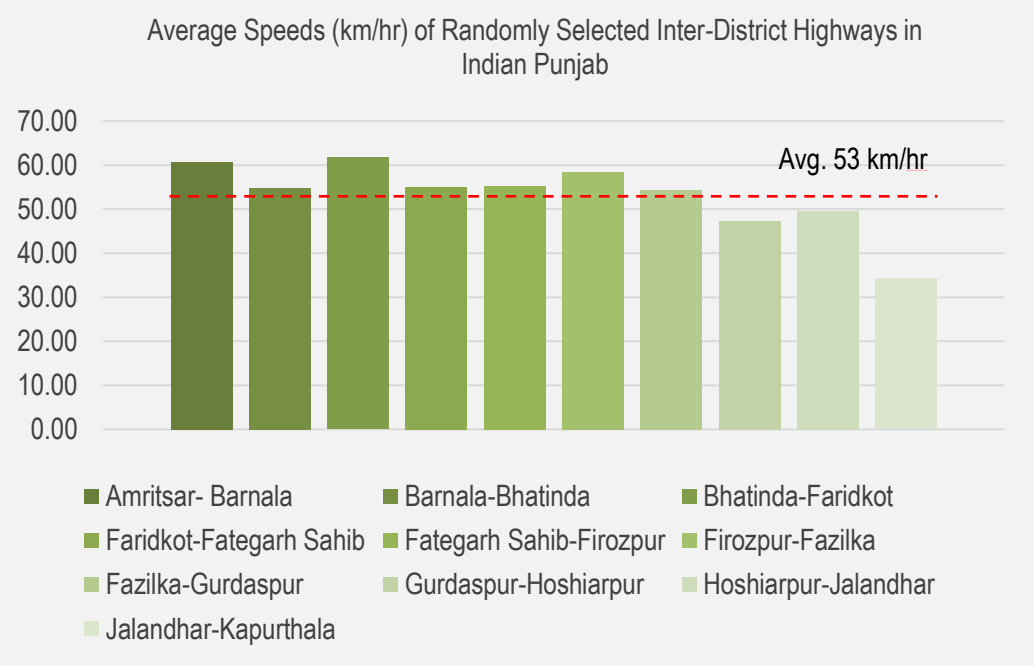


Figure 13 Operating Speeds on District Roads in Indian Punjab

2.2 Proposed Road Schemes

Bahawalnagar is a home to 2,982,000 people; Bahawalpur, 3,668,000; and Rahim Yar Khan 4,814,000 (BoS, 2021). This many people living in the division makes a strong case for the improvement of infrastructure in the division by increasing the road density. For identification of road projects at district level, we consulted the district administration in the Division to understand their priorities. In the light of inputs from key stakeholders in the district administration, and analysis of existing road network including operating speeds, following road projects are proposed for widening/improvement/dualization.

Table 8 Proposed Road Sector Projects

S. No.	*District*	*Proposed Scheme*	*Estimated Cost PKR (Millions)*
1	Bahawalnagar	Dualization of Road from Hasilpur to Bahawalnagar, length, 80km	9,000
2	Bahawalnagar	Widening improvement of road from Bahawalnagar to Minchinabad, length 36 km	4,400
3	Bahawalnagar	Widening improvement of road from Minchinabad to Head Sulemanki, length 43 km	3,000
4	Bahawalnagar	Widening improvement of road from Minchinabad to Dhak Pattan, length,17 km	2,000
5	Bahawalnagar	Widening improvement of road from Bunga Machi Chowk to Minchinabad Length 22.00 km	500

6	Bahawalnagar	Construction of By pass from Arifwala road via Minchinabad road to Haroonabad road, length 25 km	5,000
7	Bahawalnagar	Widening improvement of road from Chishtian to Haroonabad via Pull Murad length 26 km (reach taken up km 11 00 to 37 00 26 km)	1,300
8	Bahawalnagar	Improvement of road from Chishtian to Haroonabad via Dahranwala length 52 km	2,600
9	Bahawalnagar	Improvement of road from Pull Murad to Haroonabad via 23-24 Laleka length 23 km	1,150
10	Bahawalnagar	Widening improvement of road from Fortabbas to Mansoora via Maroot length 48 km	2,400
11	Bahawalnagar	Dualization of Fort Abbas-Chishtian-Hasilpur Road, 100 km.	5,000
Sub-Total Bahawalnagar			**27,350**
12	Bahawalpur	Ahmedpur Sharqia Farm to Market Roads with Provision for Sewerage System. Length, 50 Km	1,140
13	Bahawalpur	Dualization of Uch Sharif-Ahmedpur Sharqia Road (30 km, Links N-5 and M-5)	1,900
Sub-Total Bahawalpur			**3,040**
14	Rahim Yar Khan	Dual Carriageway from Rahim Yar Khan to Khan Pur District Rahim Yar Khan Length, 50 km	8,000
15	Rahim Yar Khan	Dual Carriageway from Rahim Yar Khan to Sadiq Abad via Pull Dagga Length 24 km	4,000
16	Rahim Yar Khan	Construction/widening and improvement of road from RYK Bypass to Yousaf Abad via Head Amin Garh, Tehsil Rahim Yar Khan, Length, 23 km	1,600
17	Rahim Yar Khan	Rehabilitation of Metalled Road from Khanpur to Chanjni via Nawan Kot Length 31 km	600
Sub-Total Rahim Yar Khan			14,200
GRAND TOTAL			44,590

3 Freight Transport

Globally, Pakistan ranks 122nd in terms of the logistics performance index (LPI) as measured by the World Bank (2021). Different variables that influence LPI include customs, infrastructure, international shipments, logistics competence, tracking and tracing and timeliness (Figure 7). Improving on these influencers can help a country enhance its capacity to do businesses, globally. For instance, moving from the median to the top 25th percentile in the distribution of infrastructure raises trade volumes for a country by 68 percent (Limao & Venables, 2001).

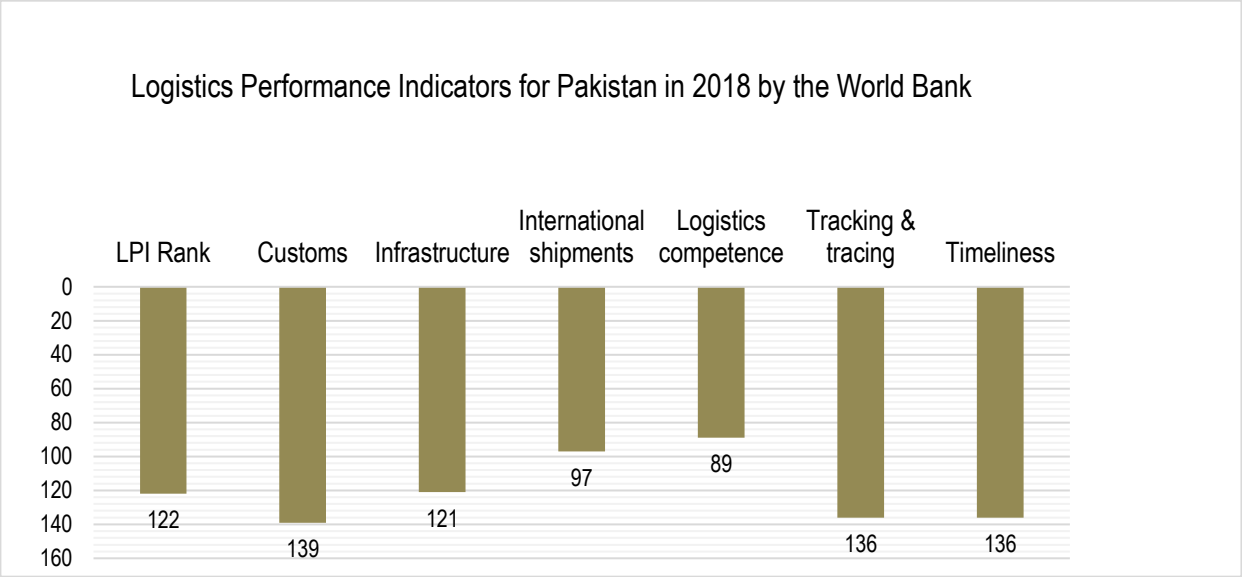


Figure 14 Pakistan's Logistic Performance Index

Table 4 lists number of goods forwarding agencies (GFAs) by districts in Punjab (The Urban Unit, 2020). Rawalpindi (102), Faisalabad (106) and Toba Tek Singh (56) are the top three districts in terms of the number of GFAs. On the other hand, Rahim Yar Khan (2) and Bahawalpur (8) districts are among the bottom ranking districts. Bahawalnagar, however, boasts a decent number of GFAs (27). This is a bit surprising given Sadiqabad in Rahim Yar Khan is the entry point of nearly all the container shipment entering from Sindh. Lack of facilities can be one of the reasons why Rahim Yar Khan could not capitalize on this opportunity. This hypothesis is supported by the fact that among the seven (07) dry ports in Punjab (Table 5), none is located Rahim Yar Khan.

Table 9 Goods Forwarding Agencies (GFA) by District

District	*GFA's*	*District*	*GFA's*	*District*	*GFA's*	*District*	*GFA's*
T. T Singh	56	Mianwali	9	Rawalpindi	102	Narowal	17
Sialkot	16	Sargodha	14	Faisalabad	106	Pakpattan	7
Jhang	10	Okara	17	Sheikhupura	0	R.Y khan	2
Gujrat	10	Khushab	30	Layyah	6	Attock	0
Chiniot	14	Lodhran	6	Nankana sahib	10		
Bahawalnagar	27	Sahiwal	6	M.B din	14		
Chakwal	11	Bhakar	19	Kasur	38		
Multan	21	Hafizabad	4	Muzaffargarh	36		
Vehari	23	Gujranwala	2	Bahawalpur	8		

The infrastructure facilities in Bahawalpur Division needs to be propped up because in the absence of a supporting infrastructure, business development is not possible. Not doing so will consequently have negative impacts on the per capita incomes and human development in the region. Apparently, there is a need for dry ports in Rahim Yar Khan, Bahawalpur and Bahawalnagar. Especially, in Rahim Yar Khan, where N-5, M-5 and Rail Networks merge, there is a potential to construct a multi-modal logistic hub that would allow transferring containers between roadways and railways. Such a multimodal logistics facility would not only decrease the cost of transportation but also help ease the number of overloaded trucks that ply on Bahawalpur Roads damaging them prematurely.

Table 10: Dry Ports in Punjab

S. No.	*Dry Port*	*Ownership*
1	Lahore Dry Port	Public sector
2	Multan Dry Port	Public sector
3	Rawalpindi Dry Port	Public sector
4	NLC dry Port	Private sector
5	Sialkot Dry Port	Private sector
6	Premnagar dry port	Private sector
7	Faisalabad Dry Port	Private sector

3.1 Recommended Studies

Since provision of dry ports and multimodal terminals is a costly venture, it is suggested to conduct feasibility studies for constructing dry ports in Bahawalnagar and Bahawalpur, and a multimodal logistics terminal in Sadiqabad (Rahim Yar Khan). These proposed feasibility studies would cost around PKR 40 million.

4 Public Transport

The urban public transport is becoming an increasingly critical issue in Punjab. With rising per capita incomes, more and more people are shifting to individual transport modes including cars and motorcycles. This shift, coupled with ban on public transport during the Covid-19, has led to the debacle of public transport in urban areas in nearly all the districts. Competing transport services such as ride-hailing applications (Uber, Careem, InDrive and Bykea), para-transits (mini vans) and rikshaws are also contributing to the downfall of public transport. Currently, the private transport service providers are reluctant to invest in the urban public transport. This is concerning, because individual transport contributes to environmental pollution and may not be sustained over a longer period. In particular, in the backdrop of recent smog issue in Lahore, the need for public transport cannot be over-emphasized.

Figure 8 shows the spatial distribution of public transport infrastructure (bus terminals) in Bahawalpur. There are 48 Bus Terminals in the division (including both inter-city and intra-city bus service terminals). This number includes 14 C Class bus terminals that are owned and operated by the Local Government and Community Development Department (LG&CD) and 34 D Class terminals owned and operated by private

entities. Note that the private entities mostly provide inter-city or sub-urban transport services. The problem however lies in the Urban Transport Operations as discussed earlier.

Further comparison of public transport infrastructure by division is shown in Figure 9. Gujranwala and Sahiwal top the chart with the highest number of bus terminals; 79 and 60, respectively. Bahawalpur (48) ranks third in terms of number of Bus Terminals. Apparat from the C and D Type bus terminals, there are B class terminals as well in three divisions of Punjab: Faisalabad, Gujranwala and Sargodha. These B Class Terminals are owned and operated by the respective Regional Transport Authorities and in total there are only four (04) B Class terminals in Punjab: two (02) in Faisalabad, one (01) in Gujranwala, and one (01) in Sargodha.

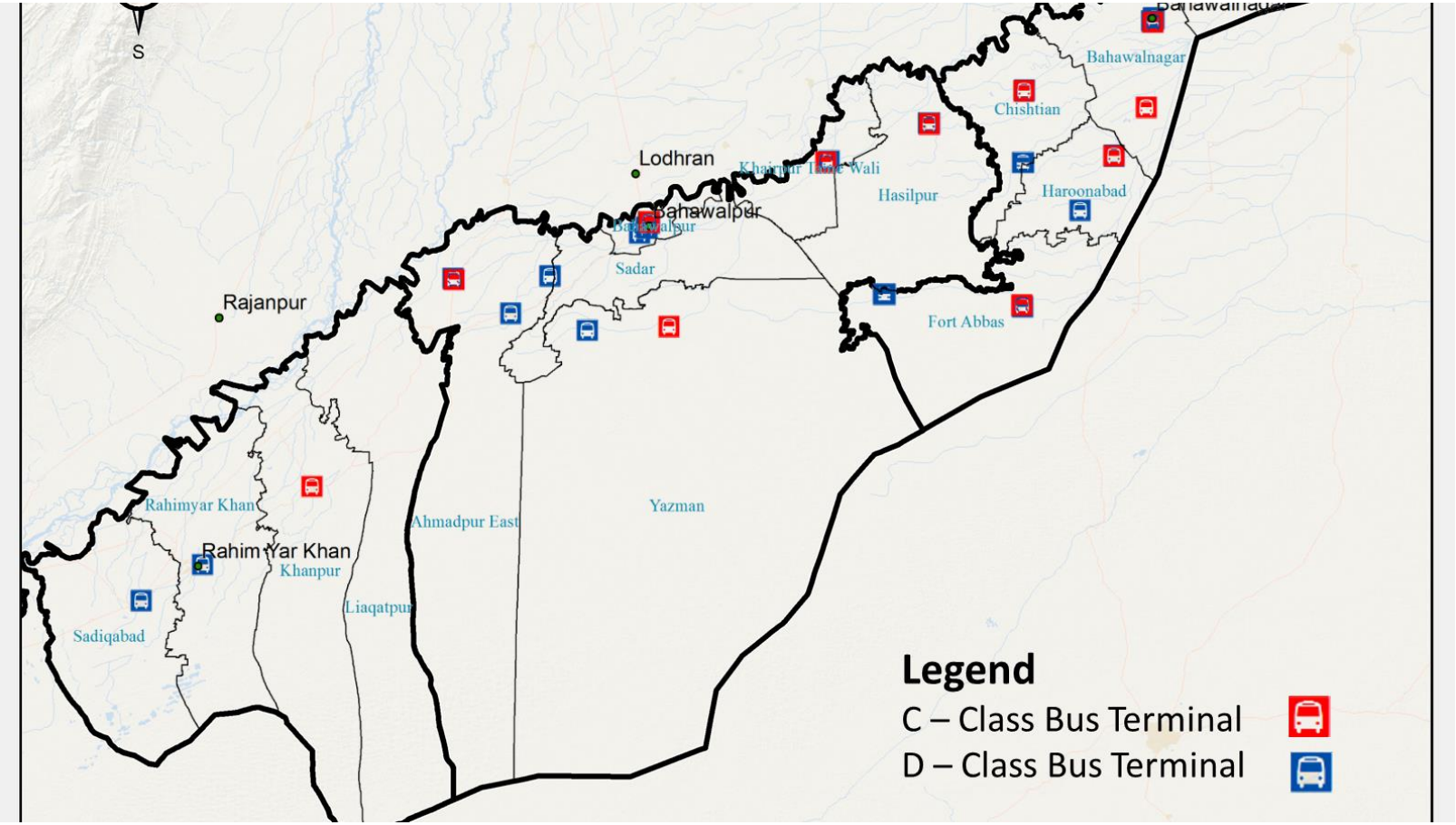
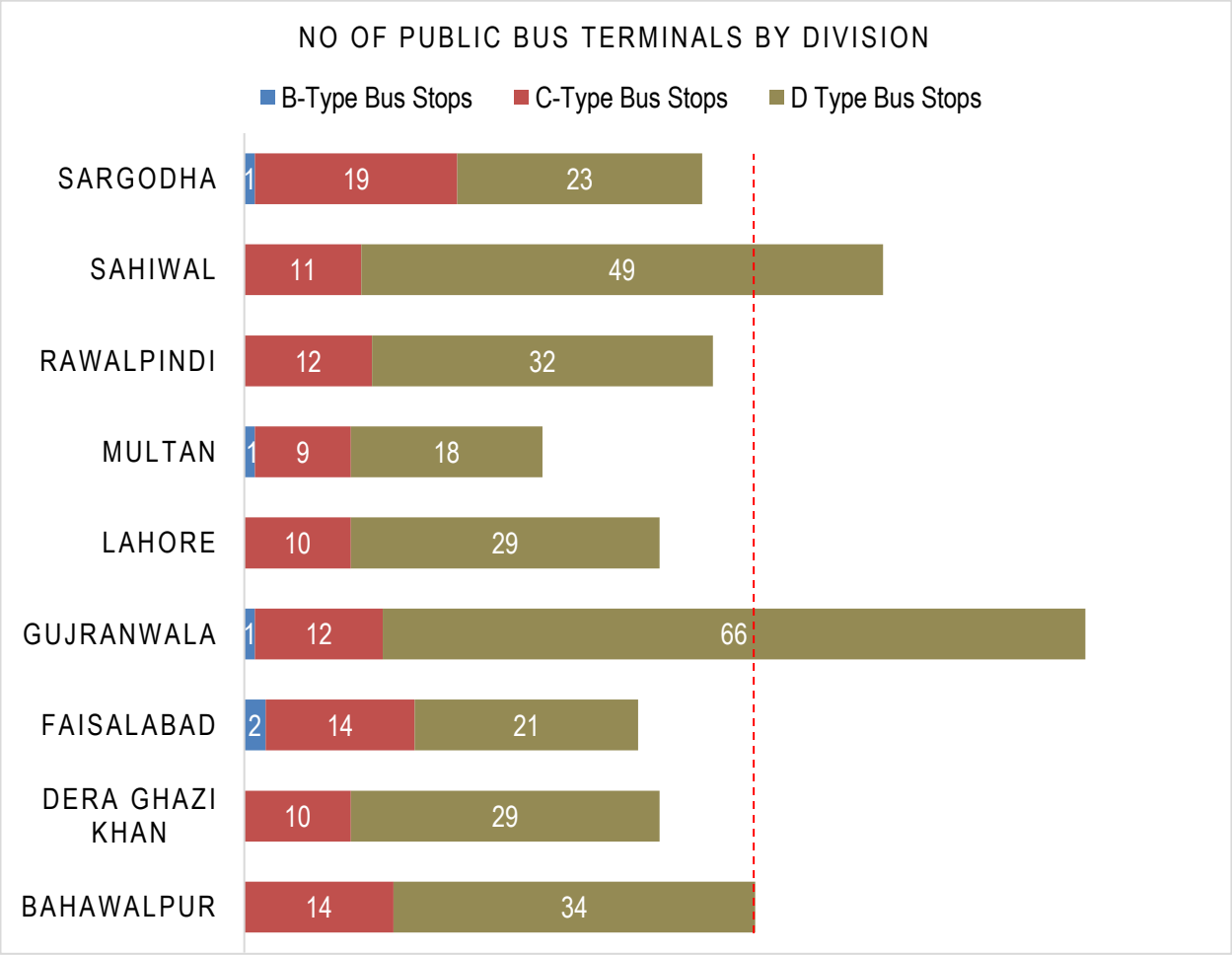


Figure 15 Spatial Distribution of Bus Stands in Bahawalpur

Even though the number of bus terminals is an indicator of the public transport infrastructure, it is not enough to comment on the sufficiency of public transport facilities in relation to public transport demand. A recent study (The Urban Unit, 2020) included a survey of the level of satisfaction of the public transport users with public transport bus terminal facilities in Punjab (Figure 10). Most of the respondents (34%) rated the terminal buildings as average; waiting areas, average (33%); booking areas, not available (37%); toilets, poor (29%); lighting, not available (31%), distilled water, not available (41%); shed, not available, (39%); CCTV, not available (85%), and mosque, not available (55%). These findings have implications for the public transport regulatory authorities.



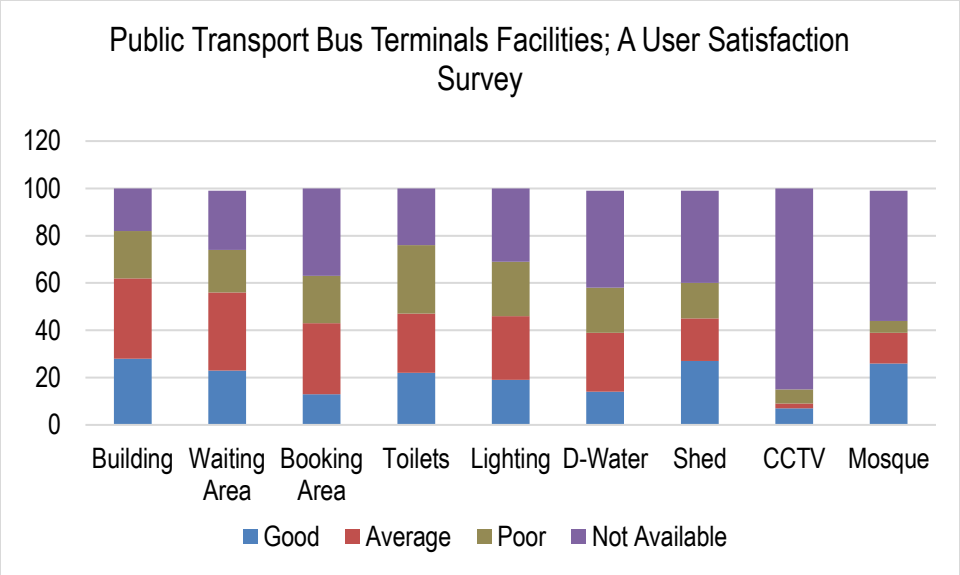


Figure 17 Public Transport Facilities Satisfaction Survey

The need for improving the public transport in Bahawalpur division was discussed with the relevant stakeholders. As an initial outcome of that discussion, following three urban transport routes are proposed, however, a much more detailed study of the need of the public transport in Bahawalpur Division is warranted to provide a comprehensive urban transport solution for the local population.

4.1 Recommended Bus Routes

Table 11 Recommended Bus Routes

Route No.	*Proposed Route Alignments*	*Expected Ridership (Per Trip)*	*Required No and Specification of Buses*	*Route Length (Kms)*
R-1	Islamia University, Baghdad Ul Jadid Campus to Lodhran	40	• Ten (10) Buses • Twelve (12) m Length (Seating Capacity 40 persons at a time)	28.7
R-2	Bahawalpur Railways Station to Jhangi Wala	30	• Four (04) Buses	13.0

			• Eight (08)) meter length (Seating Capacity 30 persons at a time)	
R-3	Civil Hospital to General Bus Stand	30	• Four (04) Buses • Eight (08)) meter length (Seating Capacity 30 persons at a time)	17.0

References

BoS. (2020). *Punjab Development Statistics, 2019*. Bureau of Statistics Planning & Development Board Government of the Punjab. http://www.bos.gop.pk/developmentstat

BoS. (2021). *Socio-Economic Profile By District Punjab 2019-20*. file:///E:/UU/The%20Bahawalpur/BHV_Presentation/Disticts%20socio%20economic%20profile%20-Updated.pdf

Duranton, G., & Turner, M. A. (2011). The Fundamental Law of Road Congestion: Evidence from US Cities. *American Economic Review*, *101*(6), 2616–2652. https://doi.org/10.1257/aer.101.6.2616

Limao, N., & Venables, A. J. (2001). Infrastructure, Geographical Disadvantage, Transport Costs, and Trade. *World Bank Economic Review*, *15*(3), 451–479. https://doi.org/10.1093/wber/15.3.451

MRTH. (2021). *Annual Report, 2021-2021*. Government of India. https://morth.nic.in/sites/default/files/Annual%20Report%20-%202021%20(English)_compressed.pdf

PCAA. (2020). *Pakistan Civil Aviation Authority- Major Traffic Flows by Airport During the Year 2018-2019*. Statistical Branch of the Pakistan Civil Aviation Authority. https://caapakistan.com.pk/upload/AT/stats/2018%20-%202019-APT.pdf

The Urban Unit. (2020). *Punjab Spatial Strategy, 2047.* https://pbit.punjab.gov.pk/system/files/Final%20PSS%20Report_compressed.pdf

World Bank. (2021). https://lpi.worldbank.org/

WASH SECTOR

https://biologydecoded.com.pk/index.php/2020/10/07/lal-suhanra-an-oasis-in-desert

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Executive Summary

The requirement of improved water and sanitation infrastructure for any region is essential for the welfare of its inhabitants as improved coverage of municipal services add to socio-economic development of the area. The Water Supply & Sanitation (WSS) specific Bahawalpur Regional Development Plan (RDP), covering Bahawalpur, Rahim Yar Khan and Bahawalnagar districts, has been prepared with the coordination of concerned Municipal Corporations (MCs) and Public Health Engineering Department (PHED) officials. The purpose of the exercise was to assess the WSS service delivery condition in the division and resultantly propose evidence based strategic interventions to offer improved quality of life to the citizens. Already published service delivery indicators; Water, Sanitation and Hygiene (WASH) data, have categorized the deliberated districts in lower ranks of Punjab with an indication for a need of higher level WSS Interventions in the region.

Development of WSS RDP is based on extensive on-ground survey for System and Infrastructure assessment, Departmental and Community Consultations as well as Spatial Data sets Assessment. Detailed Infrastructure Condition Assessment and Perception Survey formed the basis for concrete analysis and planning of future interventions for short (2023), medium (2026) and long-term (2031) phases. In the current scenario, major challenges observed were presence of brackish aquifer, poorly managed system with large number of outlived and abandoned WSS infrastructure, weak monitoring and governance, existence of unserved pockets, theft issues, high dependency on electricity and lack of proper human resource. Issues like these, and many others, call for immediate corrective actions to be taken in this regard.

The report entails brief sections on WSS Baseline Condition, Planning and Interventions for Water Supply and Sewerage in Urban and Rural areas of each district. On average, WSS coverage is approximately 20-50% in urban areas of districts as compare to 3-5% in rural areas. MC supplies water supply through extraction of seepage water along canals and then provide through OHRs, GSTs and pipelines to residents. However, most of the residents either rely on their own boreholes or water filtration plants managed by concerned MCs. On the other hand, sewage collected through sewerage lines and disposal stations are disposed-off to agricultural land after open ponds treatment at some places or without treatment in others. Overall, considering condition assessment of Urban WSS Infrastructure in the division, Machinery and Civil Structure were found to be Condition D (Poor) and Electrical Components were having Condition C (Fair) which establishes the need for rehabilitation and replacement interventions.

As compare to Urban areas, WSS sector especially sewerage component is poorly addressed in rural settlements which consists of 75% contribution of the Division. Community Based Organizations (CBOs) are hardly managing the rural water supply schemes (along the canals) and filtration plants. Lack of ownership, theft issues, poor revenue collection, absence of technical capacity are some of the hindrances, which results in a large number of non-functional infrastructures. People are forced to drink unfit (brackish) water leading to deterioration of their health. On the other hand, sewerage system in rural areas is almost non-existent except of open drains and lines in a few villages.

The evidence-based interventions are proposed to enable relevant stakeholders in making informed choices for respective sector-specific interventions to promote advocacy and investments in their

districts. Projects are prioritized in short (2023), medium (2026) and long-term (2031) phases with respect to their priority requirement to fill in the gaps and provide the efficient level of municipal services to citizens. Proposed Interventions intended to provide 80% sustainable coverage to the citizens by 2031 are articulated in project digest as well as in spatial mapping for three districts of division. Interventions revolving around rehabilitation and new installation of WSS Infrastructure, IT based Monitoring, Establishment of Distribution Network Improvement (DNI) zones, Renewable Energy usage, Establishment of treatment plants, and provision of machinery and equipment are needed to be well taken with clear implications for provision of sustainable and proficient service delivery and for achieving the WSS related Sustainable Development Goals (SDGs) target of 2030. WSS Project Portfolio of PKR 33 Billion for 10 years development of both urban (PKR 14 Billion) and rural (PKR 19 Billion) areas along with detailed costing is also reflected in this report.

1. Introduction

Historical Background

Bahawalpur Division was the State of Bahawalpur, which had a history of 228 years of rule by the Abbasi Nawabs. The State, which was formed in 1727, ended in 1955 and the whole area of the State was made a division of Punjab Province. Bahawalpur was converted into one unit to run the Management Affairs smoothly and it became a Division of Punjab province in twentieth Century. The former Bahawalpur State, which consisted of only two districts of Bahawalpur and Rahimyar Khan, was later on categorized into three districts with the addition of Bahawalnagar District.

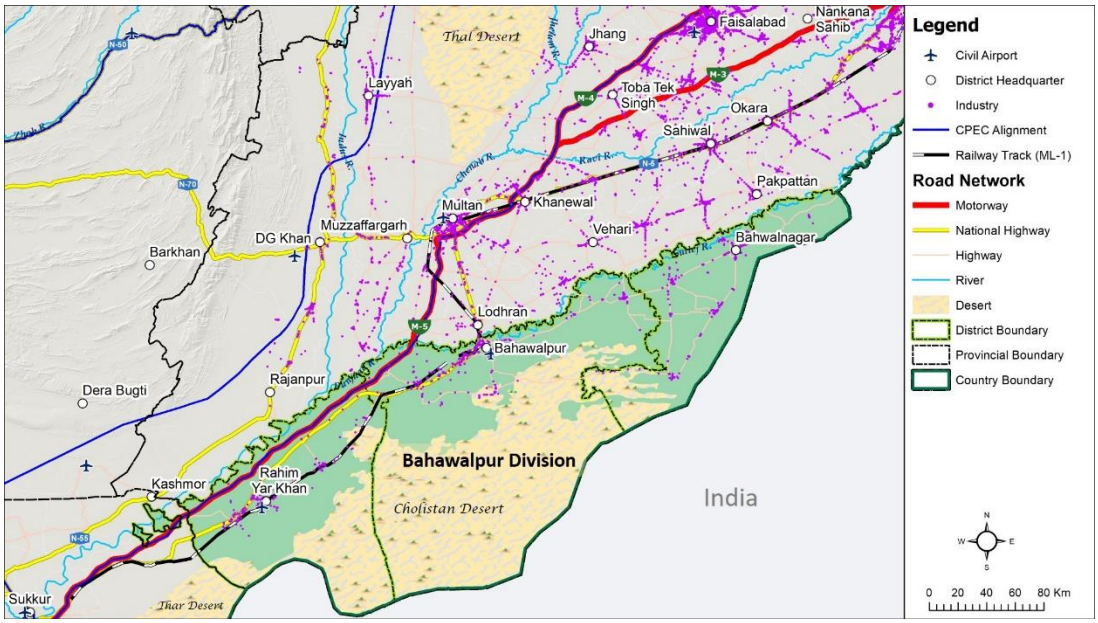


Figure 18: Bahawalpur Division Punjab

Topography

Bahawalpur is of 170 km from East to West and 175 km from South to North. River Sutluj is the boundary of Bahawalpur, which runs from the start, and goes side by side of the district. It also meets the boundary of District Lodhran, Muzafargarh and District Vehari. From North, it shares Border with India, where the Bikaner starts. The eastern side of District Bahawalpur meets District Bahawal Nagar, Chishtian, Haroon Abad Bahawalpur, by its side. The Western side of Bahawalpur joins District Rahim Yar Khan, Liaquatpur and Khanpur on equal Surface level.

The Bahawalpur topologically can be divided into three parts i.e. the riverian area, the plain area and the desert area. The riverian area lies close to the river Satluj which flows from the north along its boundary with Vehari, Lodhran, Multan and Muzzafar Garh districts. The desert area is known as “Cholistan”. It lies to the south and east of the irrigated track and north of the desert of Bikanir and Jaisalmir of India. It extends along the entire eastern boundary of Bahawalnagar district in the North and Rahimyar Khan district in the south.

Geography

The Geographical situation of this area is very diverse as compared with most common areas. Bahawalpur is divided into three parts on the basis of surface level of Earth.

- It is like a ship, which sails from river Sutluj by the side of Head-Islam and ends at Head-Punjnand.
- Second part is the hard ground of the area; it starts twenty km away from River strip towards south. It starts from the eastern boundary to the western boundary of the Bahawalpur.

The third part is the desert of Cholistan. This part is famous for its sand dunes and is a very dry area as it is away from River Satluj and still there is no canal system there.

Districts Profile & Demography

Currently, Bahawalpur Region is comprised of three districts namely **Bahawalpur, Rahim Yar Khan and Bahawalnag**ar. Population of these districts as per census 2017, area and tehsil names are tabulated in table 1. Headquarter (HQ) cities in these three districts, which are of prime importance, are city Bahawalpur, Rahim Yar Khan and Bahawalnagar with 2017 census population of Approximately 7 lakh, 5 lakh and 2 lakh respectively.

Table 12: Salient Features of Bahawalpur Division

Districts	Population (2017)	Area (Km2)	Tehsils
Bahawalpur	3,668,106	21,765	Bahawalpur Ahmedpur Sharqia Hasilpur Khairpur Tamewali Yazman
Bahawalnagar	2,981,919	8,878	Bahawalnagar Chishtian Minchinabad Haroonabad
RYK	**4,800,000**	11,880	**RYK** **Sadiqabad** **Liaqatpur** **Khanpur**

Within Bahawalpur Region, male to female (51:49) proportion in the Bahawalpur division is almost equal. It is pertinent to mention that Rural population (75%) in all of the three districts of Region is far higher than urban areas (25%), demanding the equal opportunities and interventions in regard to services and standard of living to remove the gender and regional disparities.

Climate

The climate of Bahawalpur division is sub-tropical warm desert, with a mild and no rainfall, followed by a very hot period from mid-April through June, when the temperature can reach 46/47 °C (115/117 °F).

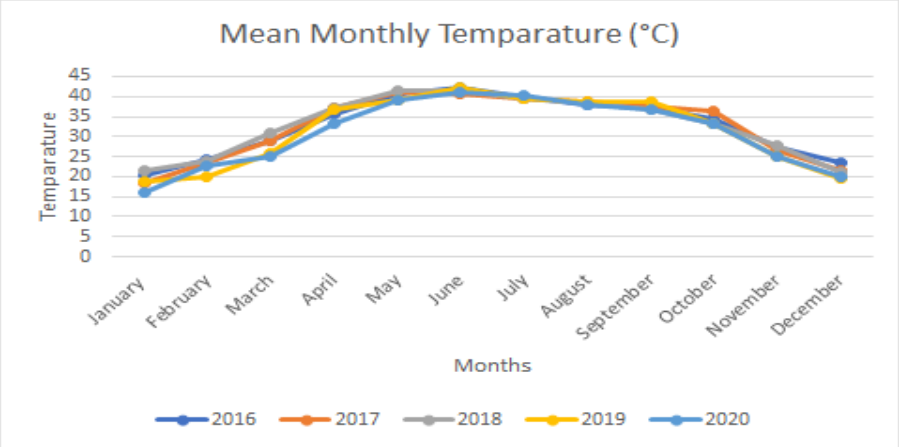


Figure 19: Temperature Variation in Bahawalpur Division

The mean annual rainfall varies from less than 150 mm in east to 200 mm in west. Mostly summer months of April – June are observed in which maximum rainfall occurs for more days. However, maximum rainfall recorded in the year 2021 is 72.3 mm in district Bahawalnagar which has resulted in avg of 31 mm in July – September. Avg Maximum and Minimum rainfall of 58 mm and 0.77 mm was recorded in 2021 in Bahawalpur Division stated that there is much less or no potential available for reliance on rainwater for collection or usage. Average Rainfall data for the current year of 2021 in Bahawalpur Division is articulated in figure 3 with max of 22 days in April-June.

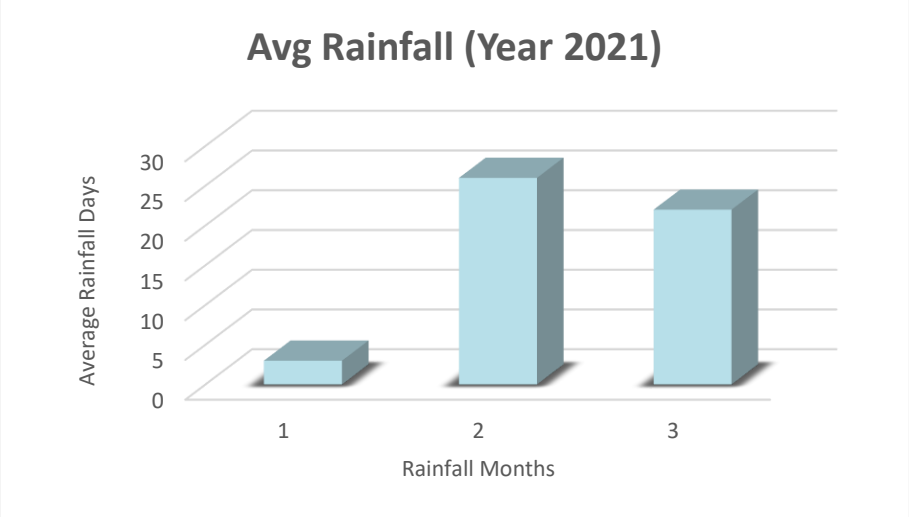


Figure 20: Rainfall Variation in Bahawalpur Division

Surface Water Resources

Rivers

Panjnad River is at the extreme end of Bahawalpur district in Punjab. Panjnad River is formed by successive confluence or merger of the five rivers of the Punjab namely Jhelum, Chenab, Ravi, Indus and Sutlej. Bahawalpur city lies just south of the Sutlej River. *Sutlej River*, longest of the five tributaries of the *Indus River*, flows about 220 miles (350 km) to join the Chenab *River* west of *Bahawalpur*.

Canals or Streams

Bahawal Canal" is one of the biggest canals of Bahawalpur State. After the water distribution of Punjab was connected with it, it irrigates the three Tehsils of Bahawalpur. Canal Dera Nawab was taken out of Bahawal Canal and it irrigates the North of Cholistan as well as the lands and ends at Dera Nawab. Ahmadpur Canal, which is also bigger than the Bahawal Canal, irrigates the Tehsil Bahawalpur Ahmadpur. This way Hasilpur gets water from Head Sulemanki and irrigates its land. In Bahawalpur there are three famous bridges: Head Islam,Head Punjnad and Head Satluj.

Bahawalpur Canal Circle

- Bahawalpur Canal Circle consists of 4 Nos. Divisions namely Bahawalpur Canal Division, Ahmadpur Canal Division, Panjnad Headworks Division and Mailsi Syphon Division. It operates and maintains Sutlej Valley Canal System in Bahawalpur Canal Circle. In Bahawalpur Canal Circle 4 Nos. Main Canals viz Bahawal Canal Upper, Qaim Canal, Bahawal Canal Lower, Abbasia Canal and Abbasia Link Canal. Sidhnai – Mailsi – Bahawal (SMB Link) and Pakpattan – Islam (P.I. Link) are the Links which too fall under jurisdiction of Bahawalpur Circle. Bahawalpur Canal Circle covers gross area of 0.945 million Hectors with Cultureable Commanded Area of 0.690 million Hectors
- Bahawalnagar Canal Circle consists of 3 Nos. Divisions namely Sadiqia Canal Division, Hakra Canal Division and Fordwah Canal Division. It operates and maintains Sutlej Valley Canal System in Bahawalnagar and part of Bahawalpur District. In Bahawalnagar Canal Circle there are 2 Nos. Main Canals viz Sadiqia Canal and Fordwah Canal. Bahawalnagar Circle is at the Tail Command of Mangla Dam.Bahawalnagar Canal Circle covers gross area of 1.055 million Hectors with Culture-able Commanded Area of 0.892 million Hectors.
- Rahimyarkhan Canal Circles consists of four No. Divisions namely Rahimyarkhan, Khanpur, Dallas Canal Divisions and Tubewell Operation Division Khanpur. It operates and maintains Sutlej Valley Canal System falling in Rahimyarkhan District. Rahimyarkhan Circle is at the tail Command of Tarbela Dam. Rahimyarkhan Canal Circle covers gross area of 1.122 million Hectors with Culture-able Commanded Area of 1.006 million Hectors.

Lakes

A place in Bahawalpur called Lal-Sohanra National Park, is home to a beautiful lake which is around five thousand acres in area

Socio-Economic Profile of Bahawalpur

Cities all over the world, particularly in developing countries like Pakistan, are experiencing rapid urban growth and changing socio-economic profile. Bahawalpur district spreads over 451 Km in length (Northeast to

Southwest) and 120 Kms in width (North to South), with an area of 45,589 square Kms. Total population of Bahawalpur district is estimated as 3,668,106 out of which 2,496,848 population lives in rural areas and 1,171258 population lives in urban areas *(Bureau of Statistics, Punjab, 2017).* However, the population of current metro area of Bahawalpur is 870,000 in 2021 which indicates 2.96% increase in urban population from 2020 *(District Economic Profile and Investment Opportunities, Bahawalpur, SMEDA, 2020)*. Cholistan desert also falls under the southern part of Bahawalpur division which enhances the worth of this district as it is one of the largest deserts in the Punjab.

Bahawalpur division is playing a vital role in the economy of the Pakistan through hosting a variety of CPEC projects like Quaid-e-Azam Solar Park and M-5 Motorway covering a length of almost 200 Kms in the districts of Bahawalpur and Rahim Yar Khan. Bahawalpur is also known for its distinctly embroidered slippers, shoes and the filigree pottery therefore, contributing significantly in the economic growth of the country.

Health is an important concept that emphasises on physical as well as on social resources and capacities. One of the overarching goals of the Sustainable Development Goals (SDGs) is the reduction of infant and under-five mortality rate. The infant mortality rate is the probability of dying before the first birthday, while the under-five mortality rate is the probability of dying before the fifth birthday. As per the data, Bahawalpur witnessed infant mortality rate at 91 per 1000 lives and under five mortality rate is 116 per 1000 lives which is quite high and far away from SDG target 2030 (*MICS, 2015*). Moreover, hospital facilities and health care centres in Bahawalpur also do not contribute much in the economic growth as they lack in basic facilities and machinery. Government hospitals and health care centres in Bahawalpur do not have adequate machinery and equipment to provide best medical care to the patients.

Figure 21: Typical Health Facilities in Bahawalpur

Due to high population density and industrial activities, an enormous amount of 325 tons of solid waste is being produced per day; which is currently dumped under conventional disposal system. However, this disposal site accommodates only 200 tons/day of solid waste, which is only about 55% of the total waste generated from the city. The remaining 125 tons/day solid waste is being dumped in depressions, open plots and along the roads which results in serious adverse health and environmental impacts *(Solid Waste Landfill Site at Bhinda Dakhli, Bahawalpur, ECSP)*.

The social amenities are virtually obscure in division and do not fulfil the basic needs of local inhabitants. Therefore, it is stated that solid waste is causing a negative impact on the health and lifestyle of the general public. Though, all the environmental issues are directly or indirectly affecting human health, but water quality, sanitation, air pollution and waste disposal have imposed immediate effects which cannot be neglected in any case.

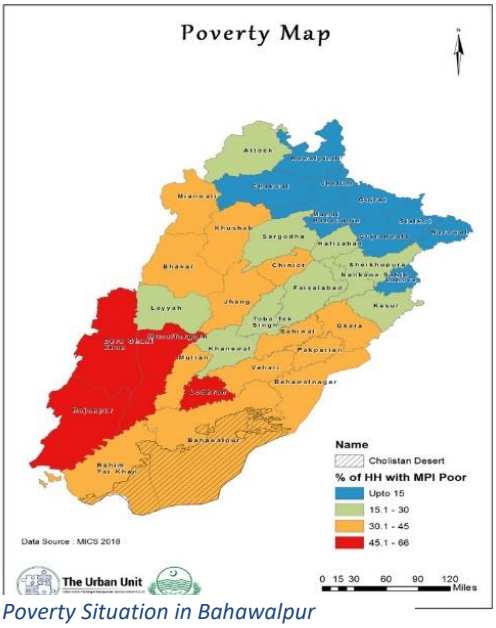


Figure 22: Poverty Situation in Bahawalpur

Poor sanitation and hygiene are responsible for a variety of infectious diseases, such as schistosomiasis, diarrhea, cholera, meningitis, and gastritis in the Bahawalpur division. However, poverty and poor health facilities are thought to be the prime causes of imbalanced social economic development.

South Punjab is generally underdeveloped and a destitute portion of the province, suffering from the adverse impacts of poverty, poor health and quality education. As per available statistics on poverty, 43.1% of the population in Bahawalpur lives below the poverty line compared to 27.7% of Punjab *(District Economic Profile and Investment Opportunities, Bahawalpur, SMEDA, 2020)*. They do not have enough access to clean water for drinking and suffer from poor environmental degradation. Thus, water scarcity and unfavorable sanitation has imposed adverse impact on the livelihood of the population in the Bahawalpur district.

Education is also an important component that portrays about the economic profile of the district more significantly. The literacy rate of the Bahawalpur district is 48% *(Bureau of Statistics, Punjab, 2017).* There are more than 21 technical / commercial / vocational institutions imparting training in various trades e.g., Mechanical, Electrical, Auto - Engineering, welding, Wood Working, Commerce and Freelancing. Vocational institutions for women impart training in Hand and Machine embroidery, Stitching and Knitting, Cooking, Art and craft and Fashion designing etc. However, only 37 % of the total population of the division completed the primary education. As the total population of the district that has ever attended school is 48%. So, remaining 52 % population has not attended school ever *(Bureau of Statistics, Punjab, 2017).* Therefore, the ratio of unskilled labour is more than skilled and semi-skilled labour in the division. The estimated unskilled labour in the district is round about 480,000. Most of the unskilled labour is associated with agriculture activities. Moreover, it has been seen that most of the government schools in Bahawalpur do not have adequate facilities and trained staff. This is the main reason that people remain

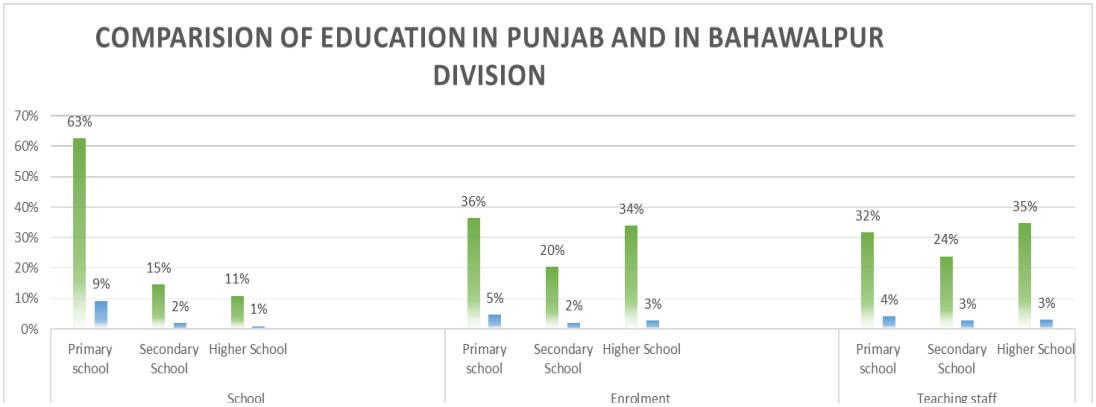


Figure 23: Education Situation in Bahawalpur

illiterate due to the lack of necessities. Poor maintenance of the school buildings and due to unqualified teachers, students do not even bother to attend school on regular basis. Thus, educational system of the division Bahawalpur is portraying adverse impact on the livelihood of the economy.

Data retrieved from Punjab Development Statistics, 2017. The above graph is clearly indicating about the educational level in the division of Bahawalpur. According to the Punjab Development Statistics, 2017 Number of schools, enrolment rate and teaching staff in overall Punjab is far more than the Bahawalpur division. No proper attention has been given to this division specifically in the field of education. Bahawalpur is lacking in having number of schools at primary, secondary as well as at higher level. Similarly, enrolment rate is also very low at different level of schools in this division. In the same context, teaching staff relies on only 4%, 3% and 3% at primary level, secondary level and at higher level respectively. Hence, the economic profile for Bahawalpur reflects the fact that it falls into the priority category for issues on health, education and poverty that needs to be put on the agenda in a more challenging manner.

2. WSS at a Glance

Drinking Water and Sanitation are the most essential elements for human life and its dignity. The Government of Pakistan recognizes access to drinking water and sanitation services as a fundamental human right implied into the Constitution of Pakistan under Article 9 that "no person shall be deprived of life or liberty save in accordance with law". Access to safe drinking water and improved sanitation facilities is vital to improve inclusive socio-economic development of the region.

Provision of **safely managed drinking water** (use of an improved drinking water source located on premises that is accessible to all and is free from contamination on sustainable basis) and sanitation services to urban and rural

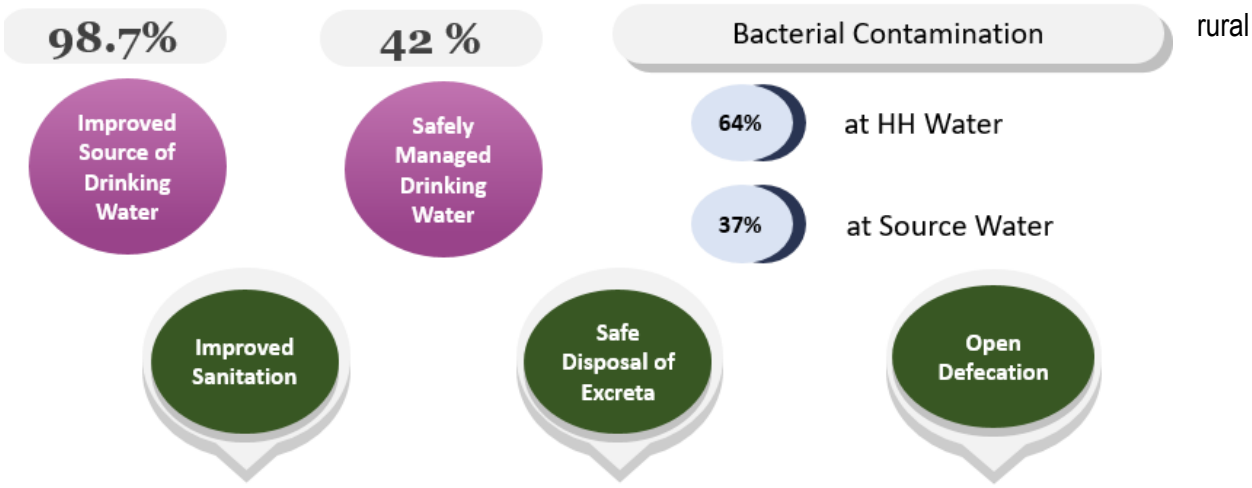
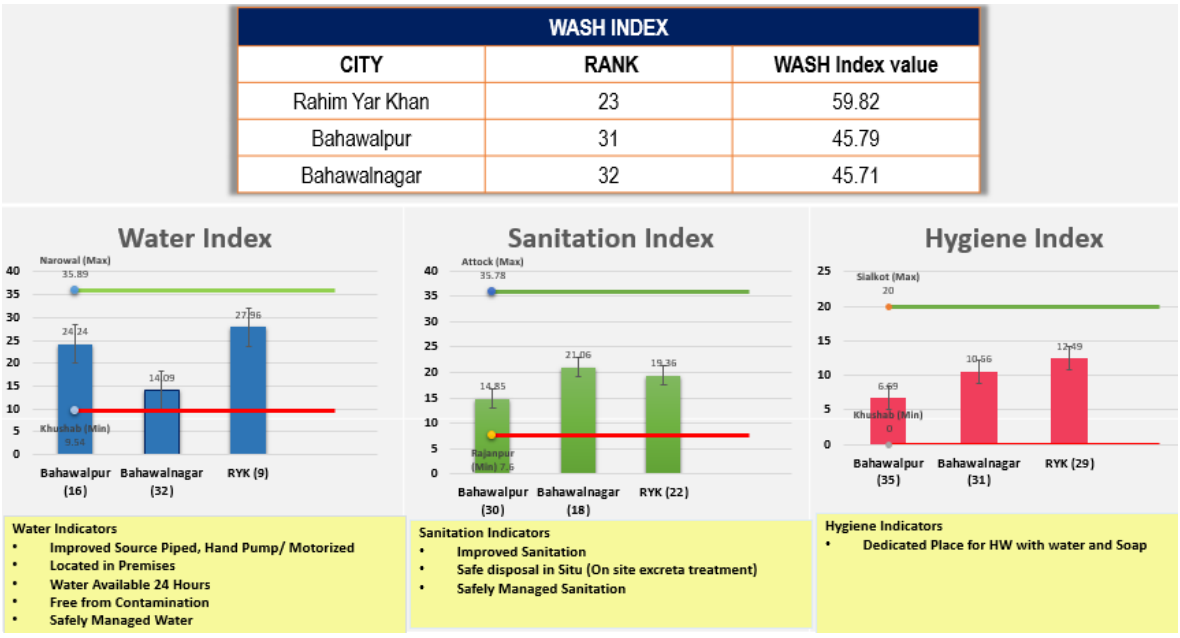


Figure 24: WSS Indicators in Bahawalpur Division

population is the responsibility of the Government in achieving the ***Sustainable Development Goals (SDGs) Target*** (Goal 6.1 & 6.2) by 2030. Pakistan Bureau of Statistics conduct Multiple Indicator Cluster Survey (MICS) after every five years in the province to collect data at Household level and publishes its report. Along with numerous other aspects, MICS also collects and presents WSS situation in the province. Latest MICS 2018 facts pertaining to WSS as indicated in figure 7 represents the lagging towards efficient service delivery in Bahawalpur Division. It is important to highlight that these facts and figures of WSS indicators reflects the need of attention towards progressive developments interventions to achieve the WSS related targets and goals.

WASH Index in Bahawalpur Division

The elements of disparities and inequities with respect to WSS are always found among districts/divisions as

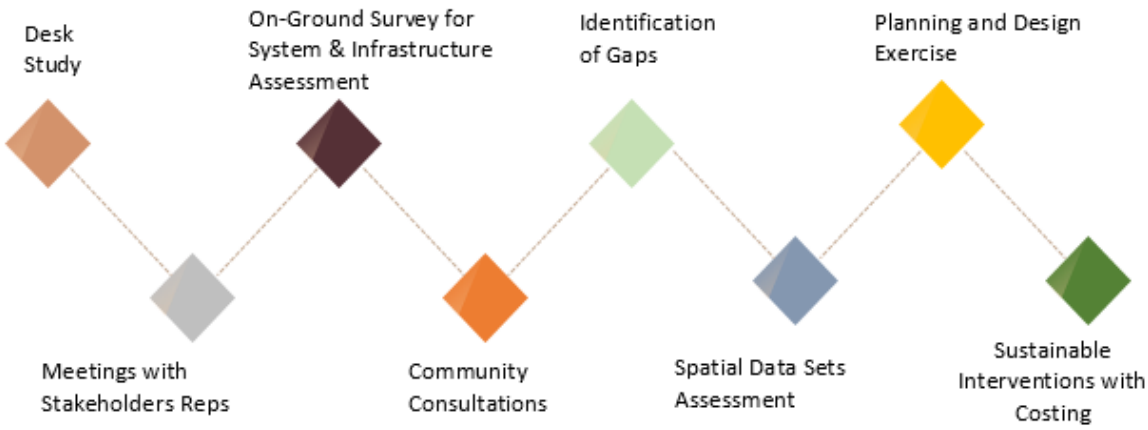


well as urban and rural settlements. A draft report of tehsil-based equity mapping of Punjab in September 2015, funded by United Nations Children's Fund (UNICEF), indicates that there are inequity issues in Bahawalpur division as well especially in relation to piped water supply and improved sanitation between rural and urban areas as well as income groups. The figures of indicators echoes the availability of services are double in urban areas as compare to rural regime. Later on, UNICEF also developed detailed district wise WASH scorecard and published its report in 2019 to enable relevant stakeholders in making informed choices for respective sectoral specific interventions to promote advocacy and evidence based investments. In general, Bahawalpur division as part of the southern Punjab is categorized as priority area needing WASH Interventions.

The Water, Sanitation and Hygiene (WASH) is a composite index of three pillars: water, sanitation and hygiene, which are further based on multiple sub-indicators as depicted in figure. Bahawalnagar is one of the districts in division which is categorized in to lowest rank of 32 among 36 districts of Punjab with respect to WASH situation. Data Analysis shows that Bahawalpur and RYK needs more attention in sanitation sector as compare to water while Bahawalnagar calls for more interventions in water sector as recently major interventions has been taken place over there. Punjab Cities Program also covers Bahawalnagar district for WSS Interventions. Hygiene is one of the most essential components, which has not fully addressed before along with WSS as can be seen from falling in lowest rankings. Overall, none of the three districts falling in Bahawalpur Division have gained an excellent WASH based ranking among all 36 districts of Punjab which makes the basis for vital need

Figure 25: WASH Index in Bahawalpur Division

of planning and implementing WASH interventions in the region.



3. Methodology

The methodology for the entire work of the development of water supply & sanitation (WSS) regional development plan has been divided into different steps, which are summarized and enumerated below in figure 6:

Desk Study

A comprehensive desk research was conducted in order to understand the situation of water supply and sanitation (WSS) in the Bahawalpur Region during the past decade. Existing legal landscape, latest WSS ADP Schemes, development plans, relevant published reports, publications and journals were deliberated in the desk study. Number of projects and programs executed in the previous years for the improvement of WSS infrastructure were also assessed. Team also consulted with relevant departments to share any available secondary as well as primary sectoral data/report, which was also analyzed and utilized.

Meeting with Stakeholders

Team carried out a detailed 10 days visit (August 29-September 07, 2021) to Bahawalpur Division where meetings with multiple relevant stakeholders were carried out:

Figure 26: Methodology Steps

- *Deputy Director Development Bahawalpur*
- *XEN PHED Bahawalpur, RYK and Bahawalnagar*
- *Chief Officer MC Bahawalpur, RYK and Bahawalnagar*
- *Sub-Divisional Officer (SDO) MC Bahawalpur, RYK and Bahawalnagar*
- *Community Development Officers (CDO) Bahawalpur, RYK and Bahawalnagar*
- *Junior Research Officers (JRO) Bahawalpur, RYK and Bahawalnagar*

- *Technical Director, Pakistan Council of Research in Water Resources (PCRWR)*

During the consultations, relevant department officials were inquired about the current situation, challenges and future required WSS interventions in the districts. Major Challenges expressed by concerned officers included Outlived WSS Infrastructure; Absence of groundwater quality testing; High electricity tariffs; Non-existent metering system; Sewerage network leakages polluting water supply infrastructure; Political & feudal influence in Urban & Rural area schemes; Presence of brackish groundwater; Existence of Unserved WSS Pockets; Absence of legal cover to CBOs; Theft issues and Lack of Proper Human Resource and Capacity Building Mechanism.

Figure 27: Glimpse of Meetings with Stakeholders

On-ground Survey

Team conducted filed visit to Urban as well as Rural WSS Infrastructure to assess its condition. Team used various tools and developed survey forms based on the international best practices to assess the condition of all assets for Water Supply and Sewerage System. For Water Supply, primary data collection targeted Tube Wells, Overhead Reservoirs (OHRs), Ground Storage Tanks (GSTs), Water Filtration Plants (WFPs), Disposal Stations, and Wastewater Treatment Plants (WWTPs). Condition assessment of Machinery, Civil Structure and Electrical Components of WSS Infrastructure were carried out broadly and categorized in to following ratings as per condition. Team also conducted random water quality testing through mobile testing kits and equipment.

Table 13: Asset Condition Assessment Criteria

Rating	Asset Condition	Description
A	Excellent	No noticeable defects. Some aging or wear may be visible.
B	Good	Only minor deterioration or defects are evident.
C	Fair	Some deterioration or defects are evident, but function is not significantly affected.
D	Poor	Serious deterioration in at least some portion of the structure. Function is inadequate.
F	Failing	No longer functional. General failure or complete failure of a major structural component.

Some glimpses of WSS machinery and structure as captured during visit is illustrated in figure.

Figure 28: Glimpse of WSS Infrastructure Condition

Community Consultations

Perception survey of three cities (Bahawalpur, Rahim Yar Khan and Bahawalnagar) has been conducted by the Water and Engineering team. Each city was divided into 6 to 7 densely populated areas to conduct the survey. Citizens of different age groups (21 years to 65 years) participated in this survey. Survey forms were developed and utilized to gather the feedback from the citizens. On average, the team gathered feedback from than 100 citizens from each city.

Factors like **Willingness to Pay** (For Improved WSS & Environment Services), **Development Priority of the citizens** (WSS, Roads, Parks, SWM) and **Satisfaction level with the Existing Service Structure** were focused in this survey to gather support in **Regional Development Plan** narratives.

Figure 29: Shots of Community Consultations

General feedback consultation session with community were also carried out in rural areas to capture their needs, expectations and outlook for provision of improved water services and auspicious livelihood. Majorly, following areas in cities were covered during the perception survey

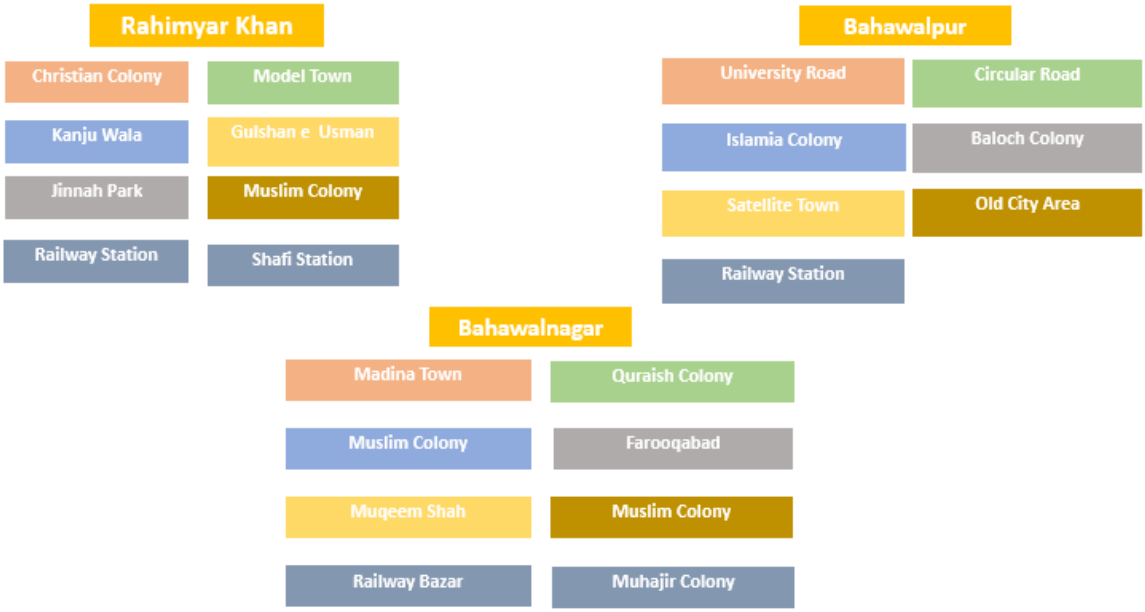


Figure 30: Consultation areas of Cities

Identification of Gaps

Based on consultation conducted with stakeholders and community and as well as the field visit assessment, the gaps and challenges were identified and jotted down that intended to be addressed in planning of WSS services in the region.

Spatial Data Sets Assessments

All geo-tagged data collected in field was shifted to ArcGIS, GIS-based Asset Inventory system was developed and the entire assets were mapped based on identified condition rating. Base maps were developed with all above ground and underground assets along with their condition for the three districts of Bahawalpur Division. Other spatial data sets such as settlements, river tributaries, secondary water quality layers, groundwater table, along with other essential relevant data layers were overlaid on existing WSS infrastructure to assess and plan the interventions.

Planning & Design Exercise

Based on primary data collection and existing secondary available data, engineering team strategized the plan for provision of drinking water and sanitation services to meet the demand of people. Future population and respective water demand was calculated for targeted short, medium and long-term phases. Team also considered the existing installed infrastructure and potential to identify the gaps to propose solutions to meet the demand for future sustainable planning. All aspects of the water supply system including design criteria, infrastructure requirement, equipment, machinery & facilities requirement, monitoring requirements were evaluated and planned in detail in sectoral plan.

Sustainable Interventions with Costing

On basis of gap analysis and need assessment, team jotted down the priority neglected/problematic areas, most severe problems and identified the list of interventions in water supply and sanitation sector needed to meet the requirements in a sustainable manner. Projects/actions were prioritized with respect to their urgency requirement. Based on urgency of requirement and severity of challenge, the interventions were identified and placed in short (2023), medium (2026) and long-term (2031) phases to provide the efficient level of municipal services.

Majorly, rehabilitation of existing infrastructure, establishment of new infrastructure, proposed extension of water supply and sewerage lines along with its associated machinery and infrastructure, water quality testing, required equipment & machinery and provision of possible water treatment options were deliberated along with other development aspects. Conceptual design of WSS infrastructure and detailed costing of the identified short, medium and long-term plans were developed.

Consultation is an essential step to engage the multi-stakeholders and get their feedback and ownership in finalizing the project digest for the Bahawalpur Region. Therefore, a feedback visit will be conducted for final consent from the relevant departments before submitting it to the Planning and Development Board, Government of Punjab.

4. Perception Survey

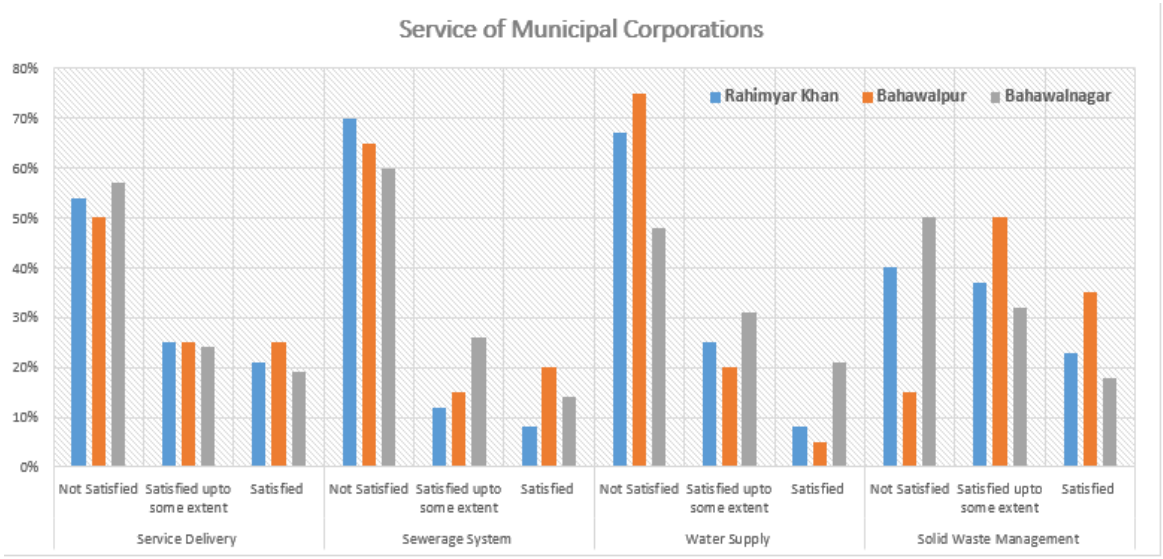
Municipal Services including Water Supply & Sanitation play a significant role in improving the health and quality of life of citizens. Effective involvement of communities to take their perception about current situation of services at their end and desire for improvement requirements is essential for right assessment and planning.

By considering the scope of work to be carried out in sectoral WSS regional development plan, the team intended to conduct a perception survey in each district and developed survey form for collection of information regarding water supply and sanitation services provided by concerned MCs. Each city was divided into 6 to 7 densely populated areas to conduct the survey and on average, the team gathered feedback from than 100 citizens of different age groups (21 years to 65 years) from each city. Following main aspects were inquired to gather support in developing RDP narrative.

1. Satisfaction level with the Existing Service Structure
2. Source of Drinking Water
3. Willingness to pay
4. Development Interventions Priority of the citizens

Service Delivery Satisfaction

The survey results analysis gave the picture that majority of the citizens were not satisfied with Municipal services provided to them. It is found that 75% of Citizens of Bahawalpur were not satisfied with Water Supply and 70% of Rahim Yar Khan were having complaints of Sewerage System. Satisfaction level pertaining to WSS



Service Delivery: Public Complaint Redressal Mechanism and Public Dealings

Satisfied: Satisfied with the existing system
Satisfied up to some extent: Minor improvements required within existing system
Not satisfied: Major Improvements required in the system

Figure 31: Community Feedback on Service Delivery Satisfaction

did not exceeded 20% which is of quite concern and depicts the need for taking the steps to improve the services.

Source of Drinking Water

Source of drinking water is very important to inquire in Bahawalpur because of presence of brackish aquifer. Survey results indicated that on average 45% of the citizens collect water from hand pumps along canal, 25% citizens rely on MC's water filtration plants, 18% buy from mineral water companies & local drinking water suppliers and 12% are employing rapid filtration systems installed on home-based bores. The results represent the need of provision of safe drinking water to reduce people' time to fetch water from canals.

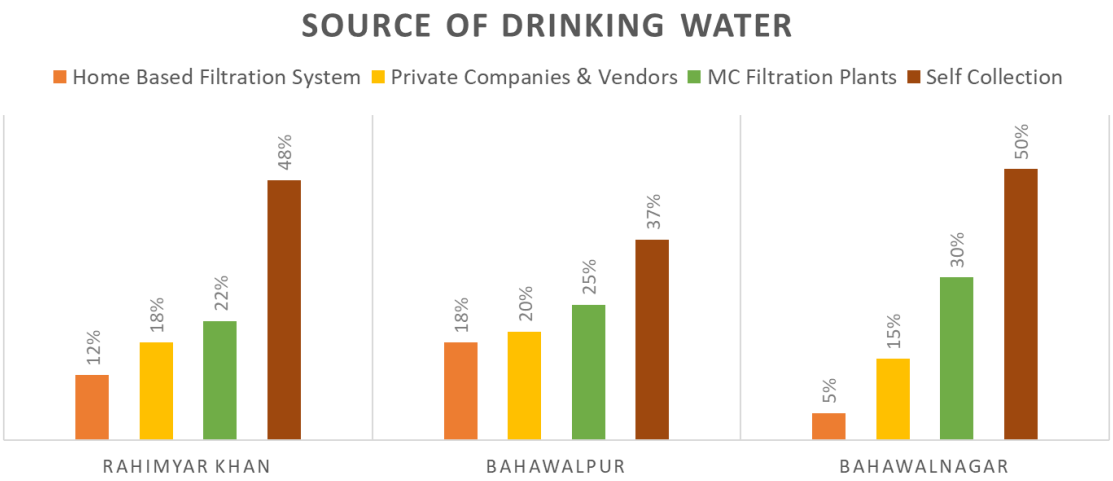


Figure 32: Source of Drinking Water in Bahawalpur

Willingness to Pay:

Overall data analysis trend shows that people are willing to pay for improved services by their respective municipal corporations. It was noted that most of participants opted for monthly charges between Rs. 100 and Rs. 300.

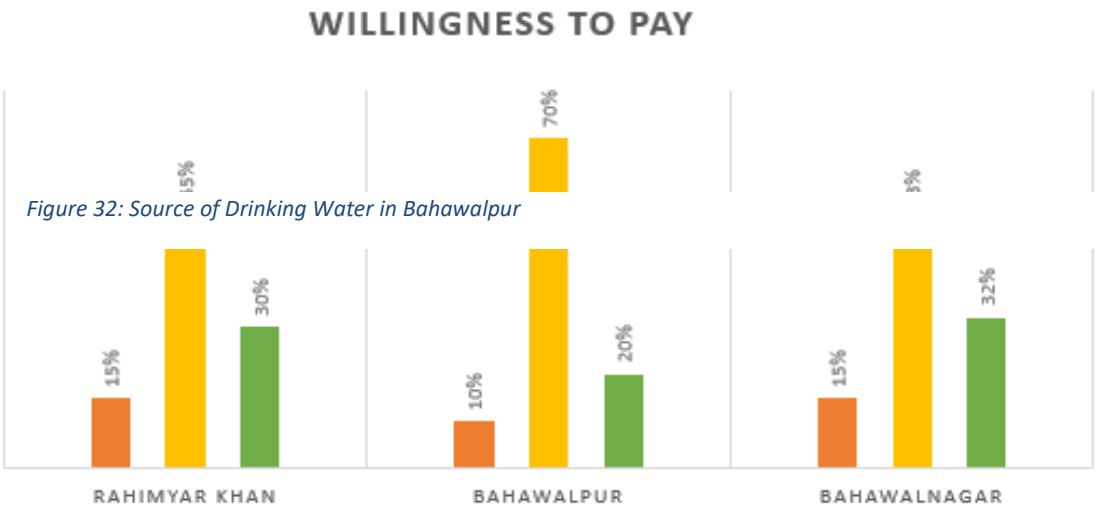


Figure 33: Community Feedback on Willingness to Pay

Priority for Development Interventions

Citizens' priority was investigated regarding their utmost need of interventions among WSS, Roads, Solid Waste Management (SWM), Public Parks and Industries sectors. Highest level of priority was given to WSS in all districts of division, which make the basis for special attention for stakeholders and Government to dedicate investment in desired sector for customer satisfaction.

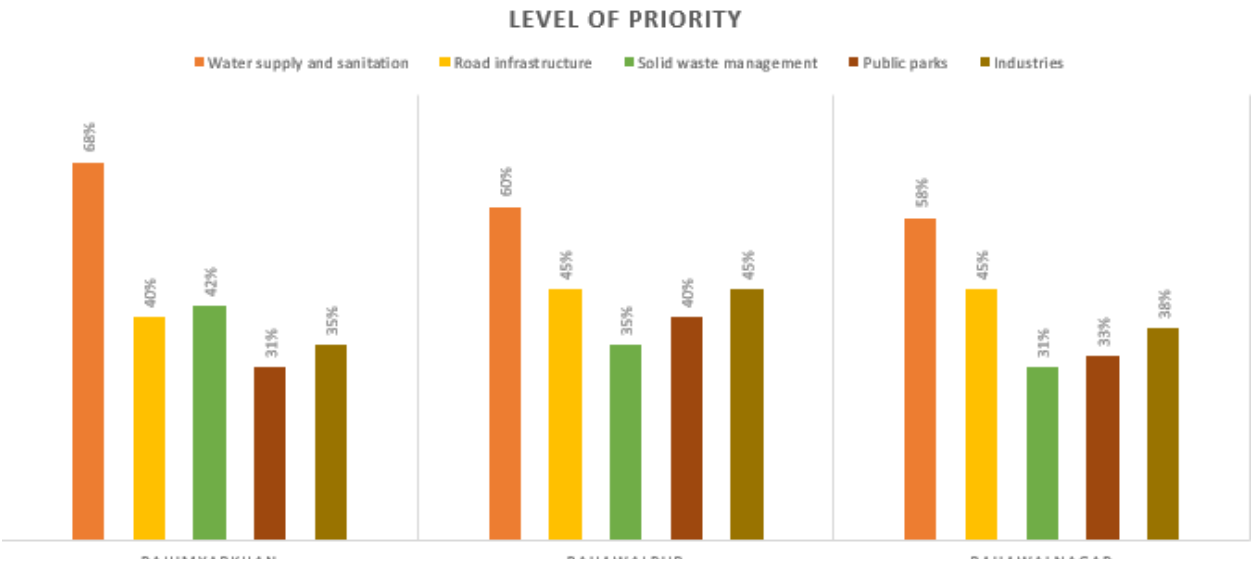


Figure 34: Community Feedback on Priority of Interventions Required

5. Legal Landscape

The Existing Legal Landscape

Bahawalpur once a princely state was later merged into the Punjab Province. Bahawalpur is now a region/Division of the Punjab Province. It spans over three districts namely Bahawalpur, Bahawalnagar and Rahim Yar Khan. Bahawalpur being the regional headquarter is divided into urban and rural areas according to the Local Government Act 2019. Urban area is called the Metropolitan Corporation whereas rural areas of the district are divided into tehsil councils, municipal committees and town committees. Likewise other two districts Rahim Yar Khan and Bahawalnagar are divided into tehsil councils, municipal committees and town committees. Water and Sanitation is an integral part in the standard of living of the humanity. Punjab Local Government act of 2019 under various schedules describes the role and functions of the corporation, councils and committees with respect to the water and sanitation components. Authorities such as Water and sanitation authority (WASA) are nonexistent in the region.

5.1.1 National and local strategies / policies / frameworks

The right to water and stable living conditions are a few of the fundamental and constitutional guarantees that are to be provided to every national of Pakistan. **Article 9** of the constitution clearly talks about the security of a

person stating that *no person shall be deprived of life* or liberty in accordance with law. It may be noted that no life is possible without water and absence of a functional sanitation mechanism means a sub-standard quality of life only. Similarly, **Article 24 (3) (e) (ii)** of the constitution clearly stipulates the provision of housing and public facilities and services such as roads, water supply, sewerage, gas and electric power to all. Therefore, it is the duty of the state to provide such rights to the people without any discrimination. This brings us to the often discriminated rural areas and their under-development. **Article 25** promises equality of rights to all citizens regardless of their races and class. In the same realm, provision of clean water or basic services such as sewerage and sanitation should be provided to the urban and rural areas equally.

Superior Courts have also reinforced the same in the various judgments such as:

- General Secretary Salt Miners Labour Union (CBA) Khewra, Jhelum v The Director, Industries and Mineral Development, Punjab, Lahore 1994 SCMR 2061: "The right to have unpolluted water is the right of every person wherever he lives".
- SUIT vs. Nestle Milkpak, 2005 CLC 424 (Sindh High Court) "No civilized society shall permit the unfe_ered exploita5on of its natural resources, par5cularly in respect of water."

The constitutional guarantees have been re-instated in the preamble of **The Punjab Housing and Town Planning Agency Ordinance, 2002 (PHATA)**. PHATA aims at establishing a comprehensive system of Town Planning at provincial, regional, district, tehsil and union council level in order to ensure systematic, integrated growth of *urban* and *rural areas* in the Province of the Punjab.[7] This means that regional planning for both, urban and rural areas is the responsibility of the provincial governments and PHATA allots this under *section 4* of the Ordinance whereby sub-section 2 (xv) the relevant agencies are to formulate provincial land use policy, plan and prepare *regional development plans* (Inter district spatial planning – Master plans) for an integrated, coordinated and systematic planning.[8] However, the same Ordinance lacks the course that may be employed for implementation of these development plans and extensive studies that have been conducted by various government agencies such as Urban Unit at the instance.

Punjab Development of Cities Act, 1976 ("PDCA")

The main aim of **PDCA** is to provide development of cities in the Punjab and to establish ''a comprehensive system of planning and development in order to improve the quality of life in the cities of the Punjab.'' [9] Clearly, cities are not inclusive of the rural area/region and this practice of overlooking of underdeveloped rural areas has resulted in their poor and worsening condition. The co-called integrated approach does not integrate the development of the rural and urban areas collectively and thereby results in the lack of any course for enforcing this or any other Regional Development Plan.

Despite this obvious gap within the law, interpretation of law purposively can be the key in solving this issue. Although there is no express initiative taken for rural areas or the Act misses the course of implementation of development plans (if any) we can use **section 7** to help our case. The BDA is already under the duty of maintaining comprehensive development planning of the region[10] and to also co-ordinate its implementation by

[7] PHATA Ordinance 2002, Preamble

[8] PHATA Ordinance 2002, sec. 4(2)(xv)

[9] PDCA, preamble

[10] PDCA, Sec. 7(2)(I)

the Authority or Government Agencies within the area[11]. For more efficiency, BDA may formulate Agency/Agencies and entrust to it such powers and functions as it may deem fit with the approval of the Government.[12]

The Punjab Water Act 2019

''An Act to comprehensively manage and regulate water resources in the Punjab in the interest of conservation and sustainability''

The main aim of The Punjab Water Act 2019 was to ensure comprehensive management of all water resources in the Punjab by regulating their use in the interest of conservation and sustainability. This agenda was to be facilitated by regulating water and sewerage services with the help of water undertakers and sewerage undertakers.[13] This Act prioritizes conservation and redistribution of waters in the Punjab equitably[14] and if abided by then this may lead to resolution of many interprovincial water disputes.

The Punjab Water Resources Commission built under the Punjab Water Act 2019 has several functions and objectives. One such duty is of ensuring that the acts of an undertaker do not negatively impact those residing in the rural areas.[15] Once again, the bare mention of those residing in the rural areas does not do enough for these people and Punjab Water Resources Commission should have been guided for ensuring that the appointed undertakers deal with the rural areas as well.

Sustainable Development Goals (SDGs)

- 6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all
- 6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations
- 6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally
- 6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
- 6.5 By 2030, implement integrated water resources management at all levels
- 6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
- 6.7 By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies
- 6.8Support and strengthen the participation of local communities in improving water and sanitation management

[11] PDCA, Sec. 7(2)(II)

[12] PDCA, Sec. 7(2)(XVI)

[13] The Punjab Water Act 2019, Chapter IV and V

[14] The Punjab Water Act 2019, Sec. 4(a)

[15] The Punjab Water Act 2019, Sec. 8 (3)(c)

Punjab Spatial Strategy 2047

It may be noted that the **Punjab Spatial Strategy 2047** envisaged integration of regional and local development frameworks. The focus of this strategy has primarily been the planning hierarchy which duly deals with regional development frameworks. This shows the intent of the government which wants to progress with development as per the regional plans, however, lacks the effective course of doing so.

Similarly, the **Punjab Growth Strategy, 2023** states the same mission and targets for "*sustainable economic growth and attaining regional equalization*."[16] This strategy sees regional equalization as a precondition to attain sustainable growth and without a doubt this also aligns with Pakistan's **Sustainable Development Goals** (SDGs) commitment.[17] Regardless of these, the absence of an implementation program of Regional Development Plans is a glaring example of non-effective policy making by the relevant authorities.

Water and Sanitation Policies (Draft)

The laws for equitable water utilization and sanitation range from National undertakings to Provincial policies. The national **Water and Sanitation Policies (Draft)**, **2005** projected water and sanitation as issues related to larger environment, housing, city and regional planning. This called for a national process of coordination at the federal, provincial and district and town/tehsil municipal administration (TMAs) level.

Pakistan vision 2025

The Vision 2025 of Pakistan also tackled the issue of water and sanitation in Pakistan and recognizes the importance of providing water equitably for the economic growth and development of a country. The pillar IV of the National Vision 2025 clearly deals with the energy, water and food security issues and accepts that there is a need to fill the enormous gaps in these areas, while simultaneously making efforts to respond to the looming threat of climate change. There is a renewed national consensus, as articulated in the manifestoes of all leading political parties, to commit major new resources through public and private sector collaboration in these areas and ensure required production and storage capacities. At the same time, efforts will be made towards conservation, efficient distribution and usage of resources, and preventing contamination and environmental degradation.

The Punjab Local Government Act 2019

There appears to be no legal framework to ensure true implementation of such a Regional Plan other than mere instructions given to the local governments to take into consideration regional planning considerations (if any) while drafting their Local development and land-use plans in **section 260** of **The Punjab Local Government Act 2019.**

Water, Sanitation and Hygiene (WASH) Sector Development Plan 2014-2024

The Government of Punjab took a clean water initiative in 2014-2015, with a focus on establishing filtration plants in rural areas for the provision of safe drinking water. A key achievement was the development of the

[16] Punjab Growth Strategy 2023, preamble

[17] Sustainable Development Goals, SDGs No. 6, 10, 11, 12

Water, Sanitation and Hygiene (WASH) Sector Development Plan 2014-2024 that proposed short, medium and long-term strategic objectives, and overall investments required to achieve these objectives.

Suggestions

On thorough evaluation of the relevant laws and legislations, one finds a glaring vacuum for the implementation or enforcement of Regional Development Plans. Despite the scant mentions of Regional plans or Regional development within different legislations, there is a glaring need for a relevant Authority or any other provincial body that may duly set the parameters for the approval or implementation of these Strategic Development Plans.

Following are a few suggestions that can be made to ensure effective implementation of this Regional Development Plan:

The term Regional Development Plans or an appropriate course for its implementation has not been added to the PLGA 2019. In order to provide legal enforcement of these Regional Plans, an amendment by way of addition to the powers and functions of local governments will be required. It is proposed that the words 'Regional Development Plans' other than the spatial plans be added in Municipal Corporations under Third schedule of the PLGA ACT 2019.

As per the PLGA 2019, the implementing agencies at the level of local government include *Metropolitan Corporation, Municipal Committee, Municipal Corporation and Town Committees and Tehsil Councils*.[18] In case, the Government does not approve the making of more *Agencies* then the most appropriate solution seems like empowering the already existing institutions. It is important that the Municipal Committee or the Municipal Corporations are made accountable for fulfilling their duty of enforcing and executing these Regional Development Plans and others to their letter and spirit.

In order to ensure true implementation and effective mechanisms, the Water Act 2019 has **section 53** which created the *power of investigation.* Powers like these were made to ensure that the undertakers delivered to their fullest and in case of non-cooperation they would face a penalty. The same mechanism can be employed for ensuring that the Regional Development Plans are being implemented.

In case the government Authorities believe that their agencies will not be able to deliver the goods, it is advisable that they form public-private partnerships as directed under the **Punjab Public Private Partnership Act 2019.** It may be noted that one of the aims of this Act is to *foster an enabling environment for private sector participation in development in the Punjab.* Other than generating revenue, this partnership can also help in effective development of the region. For instance, the appointment of undertakers or using their services under contractual obligations can ensure the implementation of the Regional Development Plans as well. The penalty of not abiding by their contractual obligations will result in the private partners or the undertakers to fulfill their duties and this might help in actualizing this Development Plan. It is proposed that the local government department may formulate and notify an execution of regional development plan rules under powers to make

[18] PLGA 2019, sec. 21

rules conferred by section 310 of PLGA act 2019.These rules will set out the process by which local government may prepare, notify and implement regional plans and their execution in local areas.

Furthermore, it is proposed that water and sanitation authority be made on lines of other regional areas of the province. Bahawalpur being the regional hub and considering the future growth of population and other allied factors WASA should come into being for the benefit of the public at large.

Present institutional arrangement/mechanism to manage water resources are deficient, therefore keeping in view the emerging challenges, the mandate, scope and functions of the regulatory bodies need to be revisited and reformed.

Investment in highly professional trained water managers can have a high pay off in improving the present water situation in the country. Such training must include diverse disciplines. Such human capital investment should be taken keeping in mind short, medium and long term requirements.

The environmental protection authorities may be strengthened and their roles and jurisdictions be expanded to the district and union councils.

Drinking water policy, Strategy and Action Plan reflecting the principles of sustainable management setting goals for water use, protection & conservation, groundwater regulation, licensing, allocation and institutions needs to be implemented.

Improvement in Water Management Laws, Rules and Writ of the system

The State Bank of Pakistan (2017) argues that the water sector in Pakistan is characterized by multiple authorities with overlapping responsibilities and duplication of work and as such in terms of domestic and industrial water supply, the problem is not so much water availability but the system of water management and governance. Both the TMAs and the WASAs suffer from a lack of capacity in terms of both human resources and management systems (Lerebours, 2017). Wastewater and waste management are serious challenges; the WASAs lack capacity, infrastructure and systems, including functioning water treatment plants (Lerebours, 2017).

Recommendations for improving formal water management and governance include improving monitoring and evaluation, capacity building, installing water meters, proper waste and wastewater management and regulation including building treatment plants, and raising awareness of water conservation (SBP, 2017; IUCN, 2014, p. 33). To reduce the number of dysfunctional water schemes, the World Bank has worked with the Government of Punjab to create a back-up support mechanism for CBOs to allow them to access funding for repairs before the system becomes dysfunctional (World Bank, 2016).

Governance and Management challenges include institutional capacity, a lack of coordination between stakeholders and adequate funding levels. The Sector Plan outlines a number of actions to tackle these challenges, including:

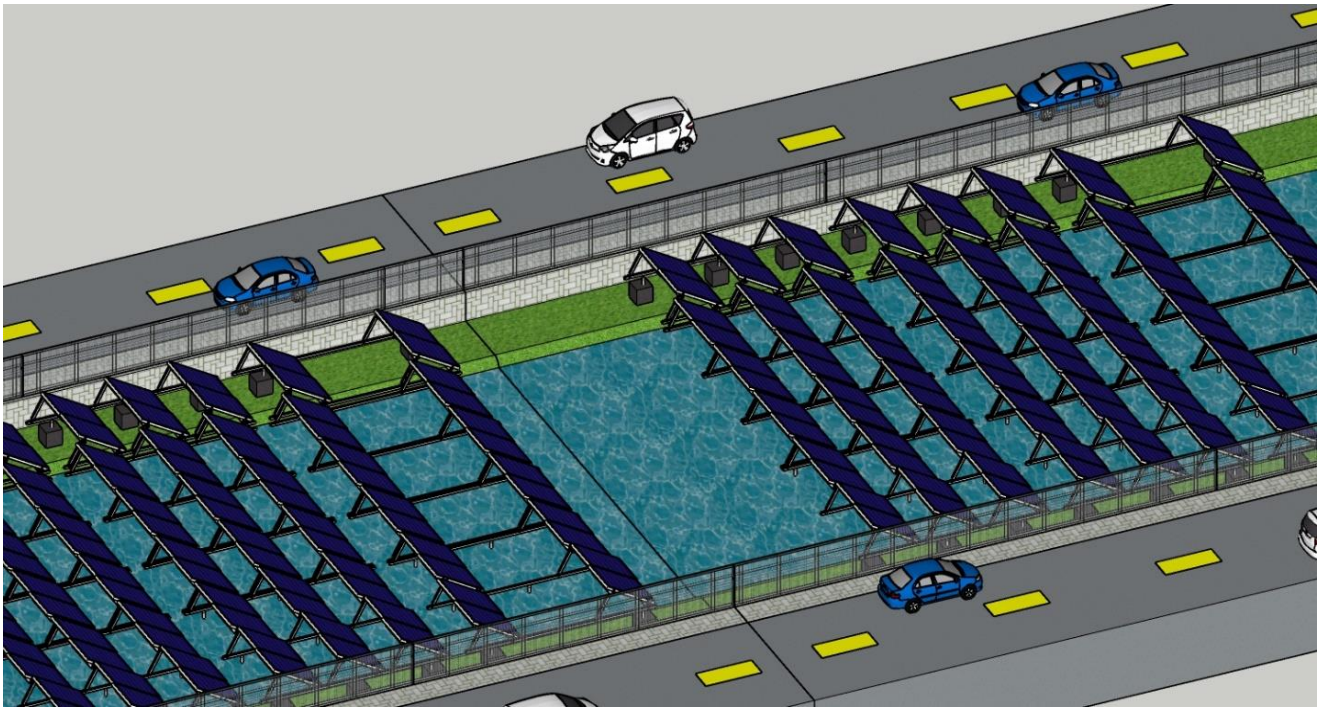
- formulating a legal framework and operationalizing the Punjab Water Commission to govern municipal water in addition to implementing the Local Government Act;
- Introduce compulsory training in community development for all staff engaged in WASH programmes;
- Increasing funding for WASH: costs for 2014-2024 are estimated at Pakistani Rupees (Rs.) 42 billion annually, but, in 2013-13, the government invested Rs. 12 billion (Government of Punjab, 2015). (These

estimated costs are not based on universal water supply coverage but on estimates of 80% urban and 65% rural piped water coverage and 82% urban and 70% rural coverage with underground drains) (Government of Punjab, 2015);

- Establish a steering committee and program management unit as part of the Punjab Water Commission to strengthen coordination and monitoring and evaluation: currently there is no mechanism for coordinating WASH stakeholders and for setting and delivering the WASH agenda (Government of Punjab, 2015).
- Improve monitoring and evaluation in the sector: currently M&E is fragmented and complexities exist due to the different stakeholders involved in the sector. The Government wants to compile an annual sector status report and district dashboard or WASH scorecard with clear indicators (Government of Punjab, 2015).

The Punjab also faces water quality and nonrevenue water issues (Government of Punjab, 2015).
Consequently, the Government will:

- rationalise per capita production for water supply, reduce system leakage losses and ensure water metering in all new schemes and high income areas;
- strengthen periodic water quality testing at source and distribution network with regular chlorination of overhead reservoirs and storage tanks (Government of Punjab, 2015).



BAHAWALPUR (BWP) DISTRICT

WATER SUPPLY & SANITATION

The Urban Unit

Urban Sector Planning & Management Services Unit (Pvt.) Ltd.

6. Water Supply BWP

Bahawalpur city water supply is mainly managed by Municipal Corporation (MC) after Public Health Engineering Department (PHED) design and executes the water supply schemes in the city. The groundwater in Bahawalpur district is not suitable for drinking purposes in most of the areas due to high TDS and Arsenic as well in some of the regions. Majority of the inhabitants have complaints about the poor quality of water which is often found colored, turbid and bacterial contaminated. The ground water available in the mostly brackish and is unfit for drinking purpose due to impurities dissolved in the form of salts and metals termed as total dissolved solids (TDS) and as well as Arsenic. In the absence of proper water supply system public is left with no option other than to drink contaminated water due to which many suffers with water borne diseases like dysentery, cholera and typhoid fever. The data referred of water quality is outdated and there is need to investigate the existing water quality of the city to identify more sweet water pocket zones available and provide water through groundwater aquifer sweet zones.

Existing Water Supply Infrastructure

Bahawalpur's water supply is not fulfilling the required water demand. There are about 20,667 households at present in current water supply network; of which only 5217 households have active water supply connections. Approximately 18% of the area in the city receives water from the MC administered water supplying systems. According to the officials of MC Bahawalpur, the water supply coverage was increased in 2008-09 through Southern Punjab Basic Urban Services Project (SPBUSP), an ADB funded project but due to poor management and improper measures of handing over/taking over, these schemes are still idle and installed equipment & accessories are non-functional. Hence, there is a need to rectify these service delivery gap in order to provide a sustainable plan for the water supply system.

In Rural areas schemes designed by PHED are handed over to Community Based Organizations (CBOs), here situation is even worse, existence of high blackish zones in majority of the district and vast distances between settlements are major hindrance in addressing the water scarcity related issues. A total of 242 villages are reported with non-existent water supply schemes yet the total unserved number of villages remains unknown.

A rating criterion for the assessment of water supply have been developed in order to categorize the current infrastructure system. To measure the condition, physical inspection and the performance parameters are evaluated. Following table is used to rate the assets based on their condition:

Table 14: Condition Rating of Assets

Rating	Asset Condition	Description
A	Excellent	No noticeable defects. Some aging or wear may be visible.
B	Good	Only minor deterioration or defects are evident.
C	Fair	Some deterioration or defects are evident, but function is not significantly affected
D	Poor	Serious deterioration in at least some portion of the structure. Function is inadequate
F	Failing	No longer functional. General failure or complete failure of a major structural component.

The piped water system in Bahawalpur is supplied by tube wells constructed at various locations in the city which pumps water into ground storage tanks (GSTs), overhead reservoirs (OHRs) or directly into the system. Valves have been installed on the network but MC's staff has not been using valves given the interconnectivity of the network and the production capacity of the system. Moreover, the valves installed have mostly been buried under the ground due to road construction and other construction activities, limiting the knowledge about their location. If one or two tube wells are dysfunctional, other tube wells in the vicinity feed the system thus catering for emergency needs.

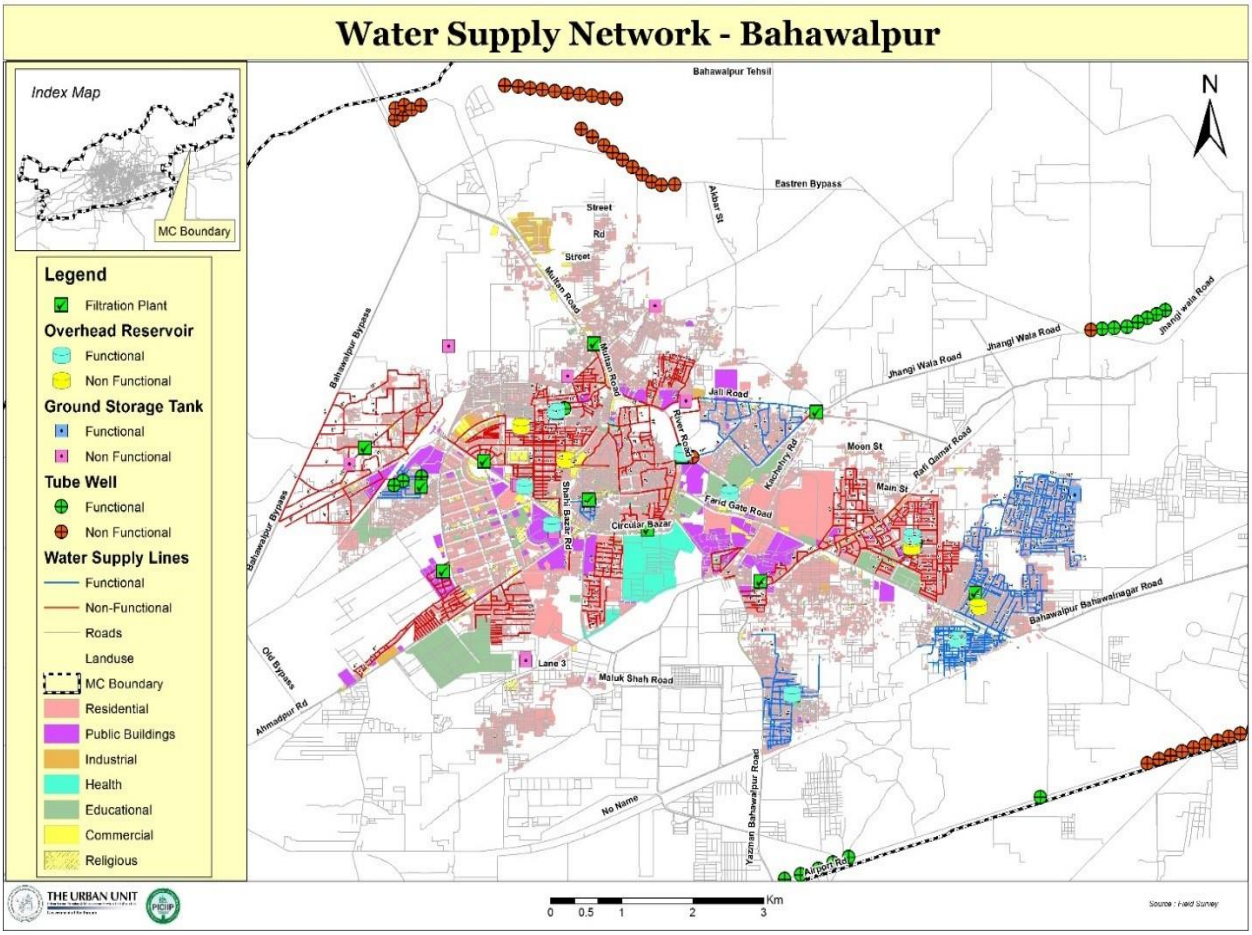


Figure 35: Baseline Water Supply System in Bahawalpur City

Approximately 18% of the area in the city receives water from the MC system and this limited coverage is due to idle schemes in city like SPBUSP and PHED projects.

Table 15: Urban Water Supply Infrastructure in Bahawalpur City

Urban (BWP City)	**Tube well**	**74**
	Operational	22
	Non-Operational	52
	Overhead Reservoir	**12**
	Operational	8
	Non-Operational	4

	Ground Storage Tanks	**18**
	Operational	2
	Non-Operational	16
	Pipeline (Inches)	**Length (KM)**
	3 to 28 inch dia	264

6.1.1 Condition Assessment of Assets

With regard to condition assessment of the water supply system, overall machinery present in the city has been evaluated as **"D"** which indicate the evidence of some deterioration or defects present, but function is not significantly affected. However, existing civil structure and electrical components can be evaluated as **"C"** meaning that some deterioration or defects are evident, but function is not significantly affected. Both evaluated aspects need attention to be addressed by upgrading electrical components, civil structure and machinery as per current requirement.

Table 16: Asset Rating in Bahawalpur City

Assets	Rating
Machinery	**D**
Civil Structures	**C**
Electrical Components	**C**

6.1.2 Tube Wells

The MC owns a total of 74 Tubewells, 52 of which are non-operational. Tubewells are installed in different schemes, detail of individual component of each Tube-wells along with discharge capacity is presented in **Annexure A**. According to MC staff, water is supplied on average for 6 hrs during daylight, allowing consumers to store water in their overhead tank during night hours. Within the Municipal limits, few households have installed their own tube wells to cater for gardening or excessive water use needs. Chlorination plants have been installed at almost all tube wells. Pumps have been maintained and where required necessary maintenance is done. Since the whole network is open and sufficient water is being produced, operational issues at one or two tube wells does not affect the overall water supply of a particular area. However extra pumps are not available with TMA to cater for emergencies.

6.1.3 Overhead Reservoir (OHR)

There are twelve (12) elevated overhead reservoirs (OHR) distributed throughout the piped network with a total storage capacity of 645,000 gallons. Only 8 out of 12 OHRs are currently in service with a total of 425,000 gallons' capacity.

The pictures below show the different overhead reservoirs installed at different locations in Bahawalpur.

Figure 36: Fareed Ladies Park (Functional OHR)

Figure 37: Satellite Town Extension (Non-Functional O…,

6.1.4 Ground Storage Tank (GST)

The main storage source of water in Bahawalpur city is Ground Storage Tank (GST) built under SPBUSP and PHED projects shown in figure 3 below. A total of 18 GSTs constructed with total capacity of 6.3 Million Gallons. Only 2 out of 18 GSTs are functional with storage capacity of 1.05 million gallons.

Figure 38: Ground Storage Tank in Bahawalpur City

6.1.5 Filtration Plants

Filtration Plants: 21 filter plants are installed by KSB and MC Bahawalpur. Most of the plants are ultrafiltration plants (UF), some RO plants are also installed. Plants are well maintained and citizens rush to get quality drinking water. All filtration plants are functional with detail attached in annex.

6.1.6 Water Supply Pipelines:

The water supply is supplied through mix of AC and PVC pipes laid into 264 km long network consisting of 3" to 28" dia pipes. The age of these pipelines also varies and almost 50 % of the piping is more than 30 years old and has outlived its usable life. The following **Table** shows distribution network in Bahawalpur.

Diameter (inch)	3	4	5	6	8	10	12	14	16	18	20	24	28	N/A	Total
Length (km)	84.6	39.4	0.2	23.1	10.6	9.4	10.8	2.9	2.2	14.2	20.2	3.7	2.6	39.7	263.7

Figure 39: Piping Network Dia and Length.in Bahawalpur City

Planning & Design criteria

This section refers to the design of main components of water supply network. The main components are discussed in the subsequent sections. Based on the current and projected populations for the Municipal Corporation and the proposed water demand of 22 gallons per capita per day i/c 20% as unaccounted for water (NRW) & 5% of commercial water demand and 10% of Industrial water demand have also been added in the design, the current (2021) water demand and future (2023, 2026 and 2031) water demands are shown in **Table 3** below.

Table 17: Estimated Water Demands for Bahawalpur City

	Water Demand (Gallons per Day)			
	2021	2023	2026	2031
	Existing Urban Boundary	Existing Urban Boundary	Existing Urban Boundary	Existing Urban Boundary
Population	*755,576*	*795,222*	*858,625*	*975,728*
Domestic Demand 22 gpcd (including 20% NRW)	16,6222,672	17,494,884	18,889,750	21,466,016
Industrial (Educational, Institutions and Hospitals) 10% of Domestic Demand	1,662,267	1,749,488	1,888,975	2,146,602

Commercial (Shops & Restaurants etcetera.) 5% of Domestic Demand	831,134	874,744	944,488	1,073,301
Average Day Demand (G/D)	**19,116,073**	**20,119,116**	**21,723,213**	**24,685,919**
Max Day Demand (G/D)	**28,674,110**	**30,178,674**	**32,584,820**	**37,028,879**

Design Criteria

The design main objective is to evolve a water supply network, which can be operated with minimum maintenance for design life of the project. There is a need to develop a sustainable system for water supply that takes into account the impact of population growth and efficient aquifer recharge mechanism.

PLANNING HORIZONS

Planning horizon for this plan is ten years i.e 2021-2031. Short, medium and long term phases are identified for 2, 3 & 5 years i.e 2023, 2026 and 2031 respectively.

POPULATION PROJECTION

The population projections are determined by using following formula:

$P_n = P_o (1+r)^n$

Where,

P_n = Projected population for required year

P_o = Population of base year

r = Population annual growth rate (taken from last Census Report 2017)

n = Number of years, counted from base year

Growth rate in case of Bahawalpur city is taken as 2.59% as per 2017 Census report of Pakistan.

MAXIMUM DAY DEMAND

Maximum day demand is taken as 1.5 times the average day demand.

TUBE WELL WORKING HOURS

Tube Well Working Hours are taken as 16 Hours/day in city as proposed in Design Criteria for WASAs by Urban Unit

OVERHEAD RESERVOIR

Overhead reservoirs are designed for the continuous supply of water. Capacity of overhead reservoirs in case of communities having population of more than 10,000 people should be based on around 1/6th of average day demand.

GROUND STORAGE TANKS

When the length of the rising main is such that the loss of head is very high, intermediate pumping stations comprising a storage tank and pumping machinery installed in a pump house will be used. Capacity of ground water storage tanks is taken as 1/4th of average daily demand.

DRINKING WATER REQUIREMENT

World Health Organization (WHO) recommends a value of 22 Gallons per capita per day (GPCD) to meet domestic water requirements while maintaining self-hygiene.

Proposed Interventions

Based on the existing infrastructure analysis including condition survey and service delivery gap analysis, the recommendations are divided into three phases: i.e. Short (Year 2023), Medium (2026) and Long (2031) term plans in order to reduce the financial stress.

6.1.7 Short Term Plan

In the first phase, the existing Water Supply network will be made functional and Fifty Seven (57) new tube wells will be constructed near River Sutlej to cater the water demand up to 2023. This will include the condition improvement of existing Tube wells, Overhead Reservoirs & GSTs along with installation of new tube wells shown in table below. Four (04) non-functional OHRs and sixteen (16) GSTs are also proposed to be rehabilitated in Short term Intervention. Addressed areas in Short term plan are marked in the map below.

Table 18: WS Short Term Interventions in Bahawalpur City

❑ INFRASTRUCTURE
TUBEWELL:
▪ New 57 No. of Tubewells each of 1-Cusec
OVERHEAD RESERVOIR (OHR):
▪ Rehabilitation of 4 no. of OHRs (55,000 Gallons each)
▪ Construction of 28 no. of OHRs (50,000 Gallons)
GROUND STORAGE TANKS (GSTs):
▪ Rehabilitation of 16 No. of GSTs
▪ New 2 No. GSTs, capacity 200,000 Gallons each
WATER SUPPLY PIPE LINE:
▪ REPLACEMENT OF TOTAL LENGTH = 176 KM (varying dia)
❑ MACHINERY
▪ Chlorinators

- Bulk Meters/Flow Meters

According to the conditional assessment of the distribution lines, more than 50% of the pipe lines are outlived and require immediate interventions. Most of the pipes are cast iron pipes and are corroded or damaged. All these pipes need to be replaced on immediate basis for increased water supply and to cater the future demands. Therefore, a total f 176km line of varying dia. (HDPE pipe) have been proposed in the short-term intervention. Construction of Two (02) new GSTs and Twenty Eight (28) new OHRs have also been proposed. Location of these new proposed OHRs and GSTs have been shown in the proposed intervention map however these locations are tentative and can be changed as per the requirement of the stakeholders involved. Land-use and MC ownership are also one of few factors involved in the process of allocation of infrastructure involved. Location of Tubewells is also subject to detailed Hydrological and Geotechnical surveys in order to make full use of assumed yield from the Tubewells however suggested Tubewells should preferably be placed along River Sutlej.

6.1.8 Medium Term Plan

In the medium phase interventions, new infrastructural will be installed in order to carter for the future aforementioned population and water demand. This intervention will include construction of 7 new Tubewells along the Irrigation canal. Provision of two (02) new GSTs (300,000 Gallons each) and five (05) new GSTs of (350,000 gallons) and provision of 2 new OHRs of (65,000 Gallons each). In this phase installation of solar panels is planned on Ahmadpur Canal. Solar installation on RO plants in school will also be done in this phase. Water supply pipeline (HDPE) for unserved areas and house water metering on existing served areas will also be done. Addressed areas in Medium term plan are marked in the map below.

Table 19: WS MEDIUM TERM INTERVENTIONS IN BAHAWALPUR CITY

- ❑ INFRASTRUCTURE

TUBEWELLS:

- New 7 Number of Tubewells each of 1-Cusec.

OVERHEAD RESERVOIRS (OHRs):

- New 2 No. OHRs (65,000 Gallons each)

GROUND STORAGE TANKS (GSTs):

- New 2 no. of GSTs (300,000 Gallons each) & New 5 no. of GSTs (350,000 Gallons each)

- ❑ Solarization
  - Tubewells
  - Water Treatment Plants

❑ MACHINERY ▪ Chlorinators ▪ Bulk Meter & House water metering ❑ WATER TREATMENT PLANTS ▪ Outsourcing of existing 21 RO plants and provision of 79 in various schools in MC (PPP) – Solarization & space to be provided by Gov.

6.1.9 Long Term Plan

In the long term plan, construction of Twelve (12) new Tubewells along the irrigation canal and provision of four (04) new GSTs (300,000 gallons) and provision of four (04) new OHRs (50,000 Gallons). Since MC lacks the capacity of quick recovery in case of any failure of the scheme a backup machinery for inventory is also proposed. SCADA system and DNI zones in Trust Colony and Model Town B will also be established. Addressed areas in Long term plan are marked in the map below.

Table 20: WS LONG TERM INTERVENTIONS IN BAHAWALPUR CITY

❑ INFRASTRUCTURE TUBEWELLS: ▪ New 12 No. of Tubewells each of 1-Cusec OVERHEAD RESERVOIRS (OHRs): ▪ New 4 No. of OHR (50,000 Gallons each) GROUND STORAGE TANKS (GSTs): ▪ New 4 no. GSTs, capacity 300,000 Gallons ❑ Backup depository for quick fix ❑ Establishment of SCADA & One Window operations for Bahawalpur City ❑ Establishment of Distribution Network Improvement (DNI) Zones

Comprehensive list of interventions projects and spatial overview for the city water supply system under this regional development plan are shown in table and figure.

Table 21: Proposed WS Projects Interventions for Bahawalpur City

SR.	PLANN-ING PERIOD	URBAN WATER SUPPLY SCHEME DESCRIPTION	Mode
1	SHORT	Construction of new 57 no. of Tubewells (source seepage water from River Sutlej)	ADP
2		Rehabilitation of 4 no. nonfunctional OHR (55,000 Gallons) & Rehabilitation of 16 no. of GSTs	ADP
3		Construction of 2 no. of new GSTs (200,000 Gallons each) & 28 new OHR (50,000 Gallons)	ADP
4		Water supply line replacement of 176 KMs of varying dia. (HDPE pipe)	ADP
1	MEDIUM	Construction of new 7 new Tubewells along the Irrigation Canal	ADP
2		Provision of 2 no. of new GSTs (300,000 Gallons each) & 5 no. of new GSTs (350,000 Gallons) & Provision of 2 new OHRs (65,000 each)	ADP
3		Solarization of Tube wells on Ahmadpur Canal (Solar Panels on canal top) and Construction & Solarization of 100 RO Plants in Schools	ADP & PPP
4		Water supply line for unserved areas (HDPE pipe) & House water metering on existing served areas	ADP
1	Long	Construction of 12 no. of new Tubewells along the Irrigation Canal	ADP
2		Provision of 4 no. of new GSTs (300,000 Gallons) & Provision of 4 no. of new OHRs (50,000 Gallons)	ADP
3		Backup Machinery for Inventory (10 Pumps – 1 Cusec, 100 Valves, 20 Chlorinators, Electric wire coils (10 - varying gauge)	ADP
4		Establishment of DNI Zone in Trust Colony & Madel Town B & Metering of newly served areas with establishment of SCADA system for Bahawalpur city area	PPP

Proposed Interventions Water Supply System - Bahawalpur

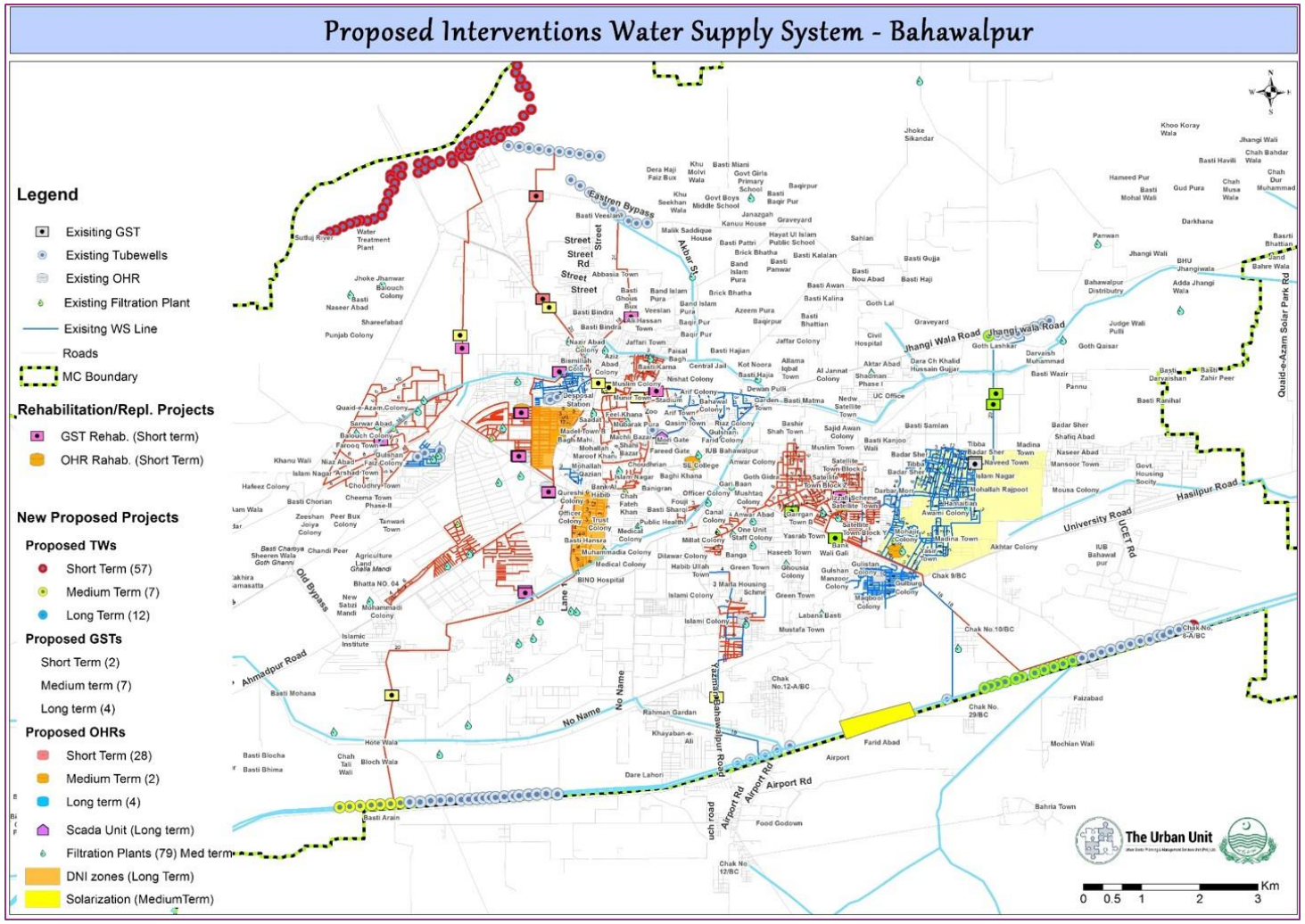


Figure 40: Proposed Spatial WS Interventions for Bahawalpur City

7. Sewerage System BWP

Along with water supply services, MC Rahim Yar Khan is also responsible for provision of sewerage services to the citizens in the city. Likewise water supply, sewerage schemes are also constructed or executed by the concerned PHED and handover to MC for its O&M.

Existing Sewerage Infrastructure

History of disposing off waste water of Bahawalpur City is substandard. Sewerage system is seemed under capacity especially in rainy and peak flow seasons. Some portion of sewerage system of city was installed 30 to 35 years before and remaining in South Punjab Basic Urban Services Project (SPBUSP) (2008-2009) & PHED projects in different phases. Some other rectifications and time to time replacements of lines are also found in record. Large part of commercial and residential areas is connected with single 54 inch dia line, which is connected to Laal Bagh disposal station. Mainly AC pipe is used in overall the network which is settled and damaged at different locations. SPBUSP installed sewerage lines are working but some uncovered manholes were found full of garbage and road materials which creates hurdles in free flow of waste water. As a result waste water schemes installed in SPBUSP project are not performing as planned. As per MC officials many major sewer lines have improper slope and improper monitoring during execution phase. Mechanism of cleaning of lines is traditional, unavailability of modern cleaning equipment makes more challenging and difficult for sewer staff to clean sewer lines as per standard. As a result inundation can be observed in low income and congested areas. It must be mentioned here that leakage of these sewerage pipes also pollutes water supply lines when penetrated into it. The Condition rating chart, used to rate the Sewerage Assets listed above, is tabulated below

Table 22: Asset Condition Assessment Criteria

Rating	Asset Condition	Description
A	Excellent	No noticeable defects. Some aging or wear may be visible.
B	Good	Only minor deterioration or defects are evident.
C	Fair	Some deterioration or defects are evident, but function is not significantly affected
D	Poor	Serious deterioration in at least some portion of the structure. Function is inadequate
F	Failing	No longer functional. General failure or complete failure of a major structural component.

Overall, the existing Sewerage disposal system is not sufficient to meet current and future waste disposal demand of the city & condition of the existing structure especially sewerage lines needs attention so that it is also properly disposed-off. It is of pertinent to mention that most the city area is either deprived of proper sewerage lines or the existing lines are outdated (as indicated through color yellow & red) and result in to the ponding in the areas. City' Existing Sewerage Infrastructure and along with its condition has been geo-tagged illustrated in below map figure. Current sewerage in water is disposed the fields which penetrates to the nearby water GST supplying infrastructure i.e. and water supply lines.

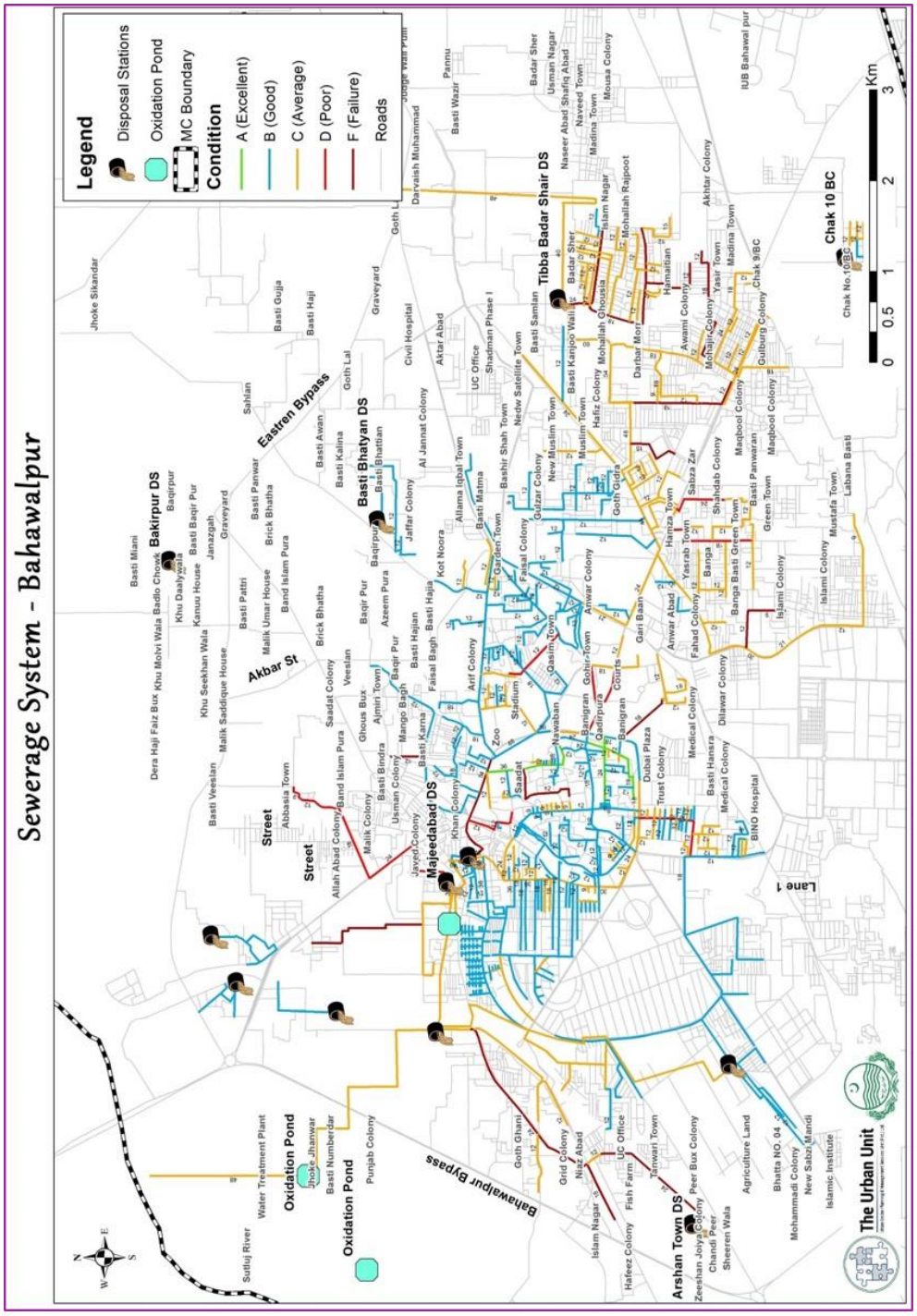


Figure 41: Baseline Sewerage System in Bahawalpur City

The infrastructure present in the city was visited and then geo-tagged and evaluated with respect to above-mentioned condition assessment criteria. The summary of functionality of the infrastructure is presented in table. It can be noted that major city sewerage infrastructure is functional however is insufficient when compared to the volume it have to address. Disposal Stations are dumping in field without being treated which is also a major issues addressed in the interventions made

Table 23: Sewerage Infrastructure in Bahawalpur City

Disposal Station	No.
Operational	11
Non Operational	1
Total	**12**
Oxidation Ponds	**No.**
Operational	1
Non Operational	1
Total	**2**
Sewerage Pipeline	**Length (km)**
Dia (9" to 60")	186

7.1.1 Sewerage Network

There is a network of pipeline extended to approximately 186 Km in city. The condition of the lines is already illustrated in above figure which also represents the area it is placed in. Graph below quantifies the length of pipe condition-wise out of which "D" and "F" is to be replaced.

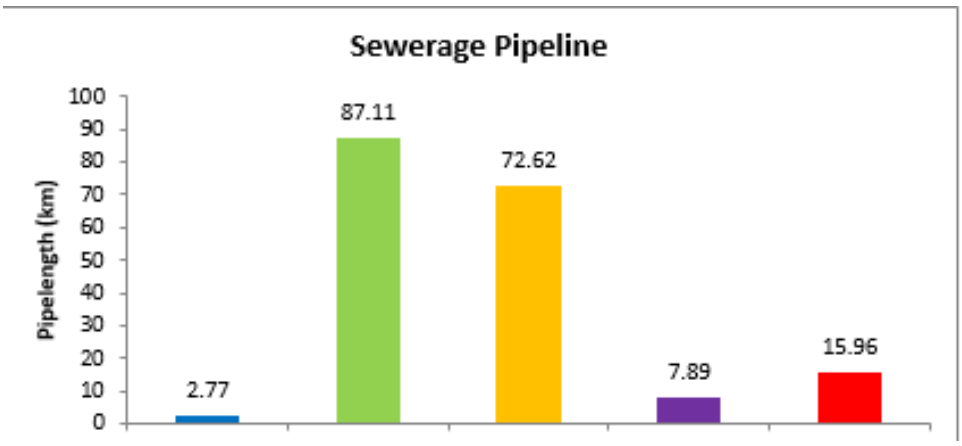


Figure 42: Sewerage Lines Condition

7.1.2 Disposal Stations

There are 12 Disposal stations in Bahawalpur City. The total discharge capacity is 92,306 gallons per minute. The total capacity of wet wells installed is 1.30 million gallons. Only 1 of the disposal station is not functional due to payment issues of Municipal Corporation. Detail of these Disposal Station is also annexed. Disposal Stations of Chak 10 BC, Basti Bhatyan, Manzoorabad, Bakirpur, Basti Horyan and Qadirabad are not connected with any sludge carrier or oxidation pond.

7.1.3 Wastewater Treatment Plants (Oxidation Pond)

Oxidation ponds, also called stabilization ponds, these are large, shallow ponds designed to treat wastewater through the interaction of sunlight, bacteria, and algae. There are two oxidation ponds in Bahawalpur City to treat and dispose waste water to River Sutlej. The oxidation ponds are not working properly as the sludge carriers from disposal stations to oxidation ponds are still under construction. Sludge carriers are constructed to take waste water from attached disposal stations to oxidation ponds and then to River Sutlej. These sludge carriers are damaged, partially unlined and unable to work as required. Therefore, wastewater flows out of the carriers and one of them even passes near drinking water Ground Storage Tank which is a serious threat to human health. The waste water of these disposal stations is directly used for cultivation of surrounded agricultural lands which is alarming and calls for corrective measures.

There are two oxidation ponds are here to treat and disposing off waste water to River Satlaj. Sludge carriers are constructed to take waste water from attached disposal stations to oxidation ponds then dispose off to River Satlaj. Wastewater of Tibba Badar Sher DS is attached with Oxidation Pond (built in SPBUSP Project). And delivery line of laal Bagh DS, Bhatajaat DS, Majeedabad DS and Quaid e Azam colony DS are attached with Sludge carrier connect with second oxidation pond, an additional forceman of Arshad town disposal station is laid and connected with this sludge carrier. Both sludge carriers are incomplete or damaged as waste water inundate in passage and creates environmental hazards.

One of which sludge carrier passes near drinking water GST creating horrible situation of environmental hazards. Chak 10 BC DS, Basti Bhatyan DS, Manzoorabad DS, Bakirpur DS, Basti Horyan and Qadirabad DS are not connected with any sludge carrier nor oxidation pond, their waste water delivery pipes directly used for cultivation of surrounded agricultural lands which is environmentally uneven situation.

Figure 43: Gharib Abad Oxidation Pond

Planning & Design Criteria

The purpose of this planning exercise was to assess the current gaps and future wastewater disposal demand for the citizens of the city. The current population of the city is Approximately 5,00,000 with total wastewater flow of 38 MGD while current functional disposal stations are operating more than this capacity. Therefore, no new disposal station is proposed for future, however, upgradation of existing outdated and poor condition disposal stations are proposed to be upgraded. The foremost and essential need is the replacement and installation of new sewerage lines in poorly served and underserved areas of the city.

Based on the current and projected populations for the Municipal Committee and the proposed water demand of 35 gallons per capita per day, the current (2021) and future (2023, 2026 and 2031) wastewater production are shown in **Table** below, for the existing and potential future service areas.

Table 24: Estimated Sewage Flow

Year	Population	Average Flow	Peak Flow	Storm Water	Non-Domestic Flow	Infiltration	Total Flow (Peak + storm + non-domestic + infiltration)
		MGD	MGD	MGD	MGD	MGD	MGD
2021	755,576	13.3	29.3	13.3	1.3	2.0	**45**
2023	795,222	14.0	30.8	14.0	1.4	2.1	**47**
2026	858,625	15.1	33.2	15.1	1.5	2.3	**51**
2031	975,728	17.2	37.8	17.2	1.7	2.6	**58**

Average wastewater is taken as 80% of water demand. Peak flow is calculated by multiplying average flow with factor of 2 as per population of the city (>100,000). Storm water is taken as 100% of avg. sewerage flow, Non-domestic flow is taken as 10% of Avg. sewerage flow and Infiltration as 15% of average sewerage flow.

Proposed Interventions

It is evident from aforementioned analysis that Bahawalpur city area lacks sewerage system as per requirement of the city therefore, interventions are made such that it address all infrastructure upgradation. Interventions for sewerage system are divided into three phases: i.e. Short, Medium and Long term.

7.1.4 Short Term Plan (2021-23)

In the initial short-term period, major focus is put on rehabilitation of poorly condition sewerage lines and disposal station machinery as waste water is planned to reach Oxidation ponds instead of agricultural fields. Replacement of 24.9 KM of sewerage pipeline (varying dia) is planned to be done in the areas shown in the map. New Pipeline for 6 replaced Disposal Station (varying dia) 23.3 KM will also be done so waste water reached Oxidation pond.

7.1.5 Medium Term Plan (2023-26)

In medium term, replacement of six (6) Disposal Stations is planned so that they can be connected to waste water treatment plants. Rehabilitation of one (01) existing Oxidation ponds is also planned in this term to efficiently process the sewerage which will be added through newly attached disposal stations.

7.1.6 Long Term Plan (2026-31)

Extension of sewerage network for the unserved (30% of the city) 80 KM is planned in this term detail of which is annexed and also represented in the map below. Provision of 1 new Oxidation pond is also planned in this phase.

In Nut Shell, proposed interventions for short, medium and long term sewerage plans are articulated in table and map.

Table 25: Sewerage Interventions for BWP City

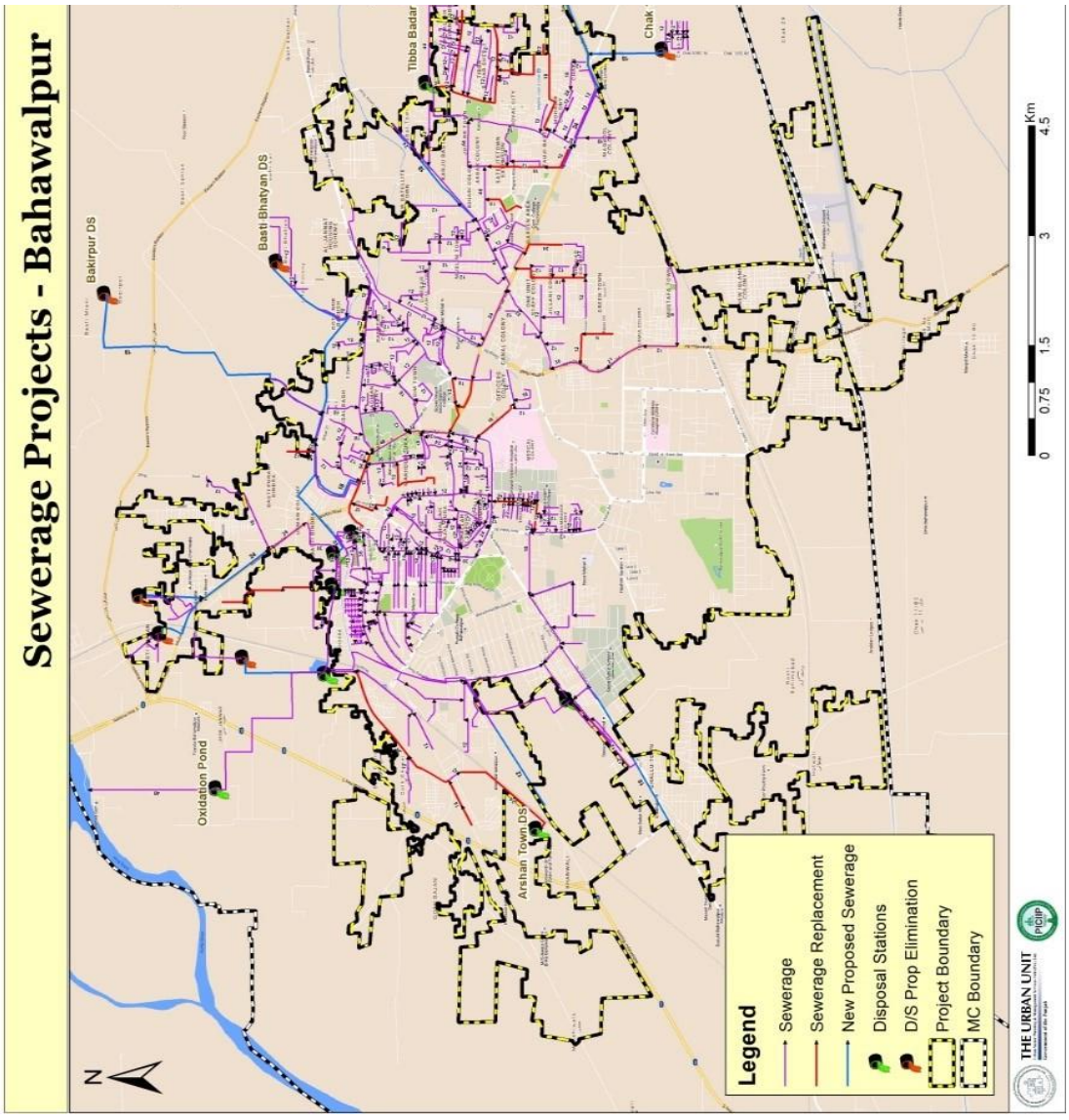
SHORT TERM PLAN (TILL YEAR 2023)	MEDIUM TERM PLAN (TILL YEAR 2026)	LONG TERM PLAN (TILL YEAR 2031)
❑ INFRASTRUCTURE MACHINERY: ▪ Replacement of 15 Pumps at Disposal Station SEWERAGE PIPELINE: ▪ Replacement of 24.9 KM of sewerage pipeline (varying dias) ▪ New Pipeline for 6 replaced Disposal Station (varying dias) 23.3 KM	❑ INFRASTRUCTURE DISPOSAL STATION: ▪ Replacement of 6 Disposal Stations ❑ OXIDATION POND ▪ Rehabilitation of 1 existing Oxidation ponds	❑ INFRASTRUCTURE New Sewerage Network: ▪ Extension of sewerage network for the unserved (30% of the city) 80 KM ❑ OXIDATION POND ▪ Provision of 1 new Oxidation Pond

Table 26: Proposed Sewerage Projects for BWP City

SR.	PLANNING PERIOD	URBAN SEWERAGE SCHEME DESCRIPTION
1	SHORT	Replacement of 15 Pumps at 6 Disposal Stations
2		Replacement of 24.9 KM of exiting sewerage network
3		Cleansing of 161.4 KM of Existing sewerage network

SR.	PLANNING PERIOD	URBAN SEWERAGE SCHEME DESCRIPTION
4		New pipeline network for 6 Disposal Stations (23.3 KM – Dias 12-24”)
5	MEDIUM	Rebuilt of 6 Disposal Stations (Eliminated)
6		Rehabilitation of 1 existing Oxidation ponds
7	LONG	Extension of sewerage network for rest of the city (30%)
8		Provision of 1 new Oxidation pond near River Sutlej (Bahawalpur Bypass)

Figure 44: Proposed Spatial Sewerage Interventions for BWP City-



8. Rural WSS BWP

According to CBO officials, Bahawalpur District encompasses Three Hundred and Sixty Three (363) Rural areas with known status of WSS condition. A total of 242 rural areas (villages) are reported to have no Water Supplying Schemes. More than half of these areas have high TDS issues. A total of 155 rural schemes have been identified out of which 102 are operational and 53 are non-operational.

Table 27: Rural WSS Infrastructure in Bahawalpur

Rural Areas (363 reported Villages)	**Water Supply Schemes**	**155**
	Operational	102
	Non-Operational	53
	Filtration Plant	**33**
	Operational	19
	Non-Operational	14
	Non-existent Sewerage System in reported no. of villages	**318**
	Non-existent Water supply system in reported no. of villages	**238**

Rural Water Quality

Bahawalpur district encloses a massive region of rural area which are far distanced and settlements are very scattered, as such, very few schemes are planned in the region in the past. Around 155 schemes exists in the rural areas out of which 53 are dysfunctional. A total of 33 Filtration plants also exists out of which only 19 were reported to be functional and 14 were non-functional. Following map shows presence of high TDS and Arsenic zones in rural areas of Bahawalpur district.

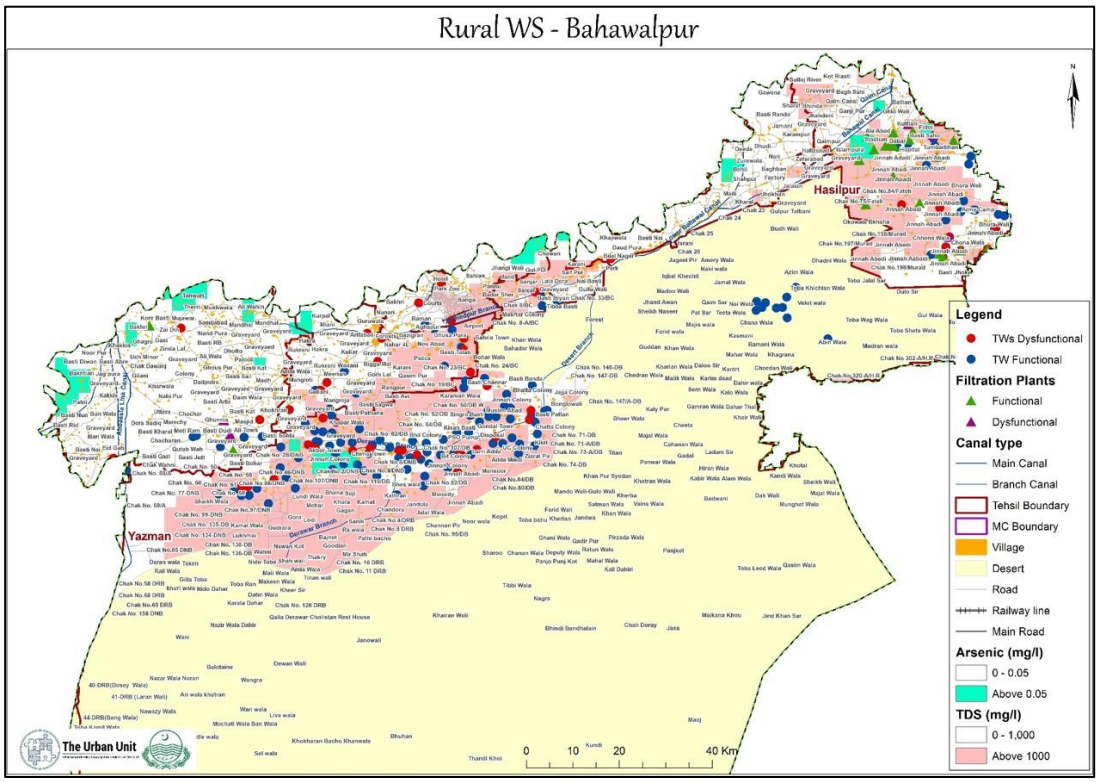


Figure 45: Baseline Rural WSS Infrastructure in Bahawalpur

Rural WS Interventions

For the Rural areas, following Interventions have been proposed:

8.1.1 Short Term Plan

In the short-term, rehabilitation of fifty three (53) schemes have been proposed of worth 499.98. In order to address the WASH issues, 5 Million rupee have been allocated in the scheme. Provision of sewerage network and disposal station for 100 rural areas is also allocated in this plan.

8.1.2 Medium Term Plan

In the medium-term, construction of 445 RO plants have been proposed under PPP mode, location of RO plants have been marked keeping in view the High TDS and arsenic regions (Cost: 1673 millions). Solarization and RO plant space is suggested to be provided from Government in educational institutes such as schools, whereas RO plant can then be privatized which can also be made bound to manage its Operation and Maintenance cost.

8.1.3 Long Term Plan

In the Long-term plan, construction of 500 RO plants have been proposed location of which are marked keeping in view the High TDS and Arsenic regions. ADP and PPP mode are suggested with operation is suggested same as mentioned afore in the Medium-term plan. For sanitation, provision for 120 rural areas sanitary works i.e. sewerage network and disposal station is suggested.

Table 28: Proposed Rural WSS Interventions for Bahawalpur

SHORT TERM PLAN (TILL YEAR 2023)	MEDIUM TERM PLAN (TILL YEAR 2026)	LONG TERM PLAN (TILL YEAR 2031)
❑ **INFRASTRUCTURE** **Water Supply Schemes:** ▪ Rehabilitation of 53 existing Schemes ❑ **INFRASTRUCTURE** **SEWERAGE NETWROK:** ▪ Provision of sewerage network for 100 Rural areas ▪ Provision of 100 Disposal Stations	❑ **INFRASTRUCTURE** **Water Kiosks (RO):** ▪ 445 new RO plants **(PPP)** in Schools by private investors (Solar powering to be done by Gov.) ❑ **INFRASTRUCTURE** **SEWERAGE NETWROK:** ▪ Provision of sewerage network for 100 Rural areas ▪ Provision of 100 Disposal Stations	❑ **INFRASTRUCTURE** **Water Kiosks (RO):** ▪ 500 new RO plants **(PPP)** in Schools by private investors (Solar powering to be done by Gov.) ❑ **INFRASTRUCTURE** **SEWERAGE NETWROK:** ▪ Provision of sewerage network for 120 Rural areas ▪ Provision of 120 Disposal Stations

Table 29: Proposed Rural WSS Projects for Bahawalpur

SR.	PLANNING PERIOD	RURAL WASH DESCRIPTION	MODE
1	SHORT	Rehabilitation of 53 Number of Rural water supply schemes	ADP
2		Hygiene Awareness program	ADP
3		Provision of open sewerage drains for 100 rural areas	ADP
4	MEDIUM	Solarization of 478 RO Plants in Rural Areas in Bahawalpur division	ADP
5		Construction of 478 RO plants through PPP Mode	PPP
6		Provision of open sewerage drains for 100 rural areas	ADP
7	LONG	Solarization of 500 RO Plants in Rural Areas in Bahawalpur division	ADP
8		Construction of 500 RO plants through PPP Mode	PPP
9		Provision of open sewerage drains for 120 rural areas	ADP

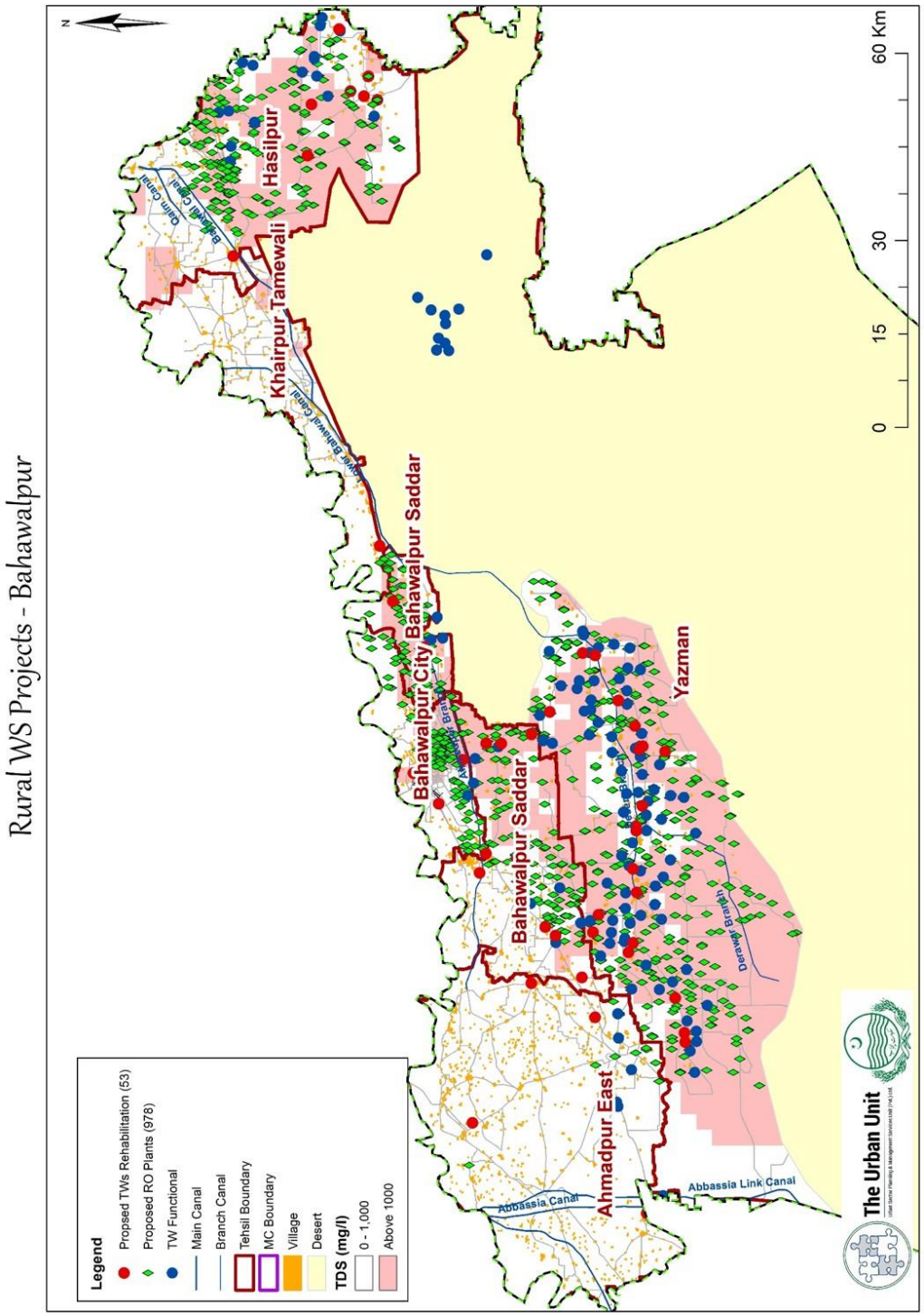


Figure 46: Proposed Spatial Rural WSS Interventions for Bahawalpur

RAHIM YAR KHAN (RYK) DISTRICT

WATER SUPPLY & SANITATION

The Urban Unit

Urban Sector Planning & Management Services Unit (Pvt.) Ltd.

9. Water Supply RYK

Currently Municipal Corporation (MC) Rahim Yar Khan (RYK) is providing basic water supply services within its own limited resources to approximately four lacs inhabitants in Rahim Yar Khan City. Public Health Engineering Department (PHED) mainly design and execute the water supply scheme and handover to MC and Community Based Organizations (CBOs) in Urban and Rural areas respectively. MC majorly relies on seepage water source from canals which is pumped in to the system whereas few tube wells are installed in available sweet water zone pockets. Existing water supply system covers only 20% of the city population as per data and statistics provided by MC RYK.

Existing Water Supply Infrastructure

The Water Supply system in Rahim Yar Khan is composed of Tube Well Stations, Overhead Reservoirs (OHRs), Ground Storage Tank (GSTs), Water Supply Pipelines and Filtration Plants. The piped water system in Rahim Yar Khan is supplied by tube wells constructed at various locations in the city which pump water into ground storage tanks (GSTs), overhead reservoirs (OHRs) or directly into the system. If one or two tube wells are dysfunctional, other tube wells in the vicinity feed the system thus catering for emergency needs.

The present water demand is 36 MGD. The functional capacity of the existing water supply system is **6.1 MGD** which is 17% of the water demand at present. This is why most residential and commercial units do not rely on the Municipal Committee for water supplies rather they have water bores installed in their own property and extract water directly from ground.

It is however, important to check the efficiency and condition of existing water supply network to figure out the scope of improvement and further extension of the network and system. For this purpose, a detail survey was carried out in which each asset condition was determined. Asset condition was determined keeping in view the physical parameters as well as the Performance parameters. The Condition rating chart, used to rate the Water Supply Assets listed above, is tabulated below

Table 30: Asset Condition Assessment Criteria

Rating	Asset Condition	Description
A	Excellent	No noticeable defects. Some aging or wear may be visible.
B	Good	Only minor deterioration or defects are evident.
C	Fair	Some deterioration or defects are evident, but function is not significantly affected
D	Poor	Serious deterioration in at least some portion of the structure. Function is inadequate
F	Failing	No longer functional. General failure or complete failure of a major structural component.

Overall, the existing Water Supply System is not only in sufficient to meet current and future demand but condition of the existing structure also needs attention so that clean water is delivered to the consumers. City' Existing Water Supply Infrastructure along with its condition has been geo-tagged and illustrated in below map figure.

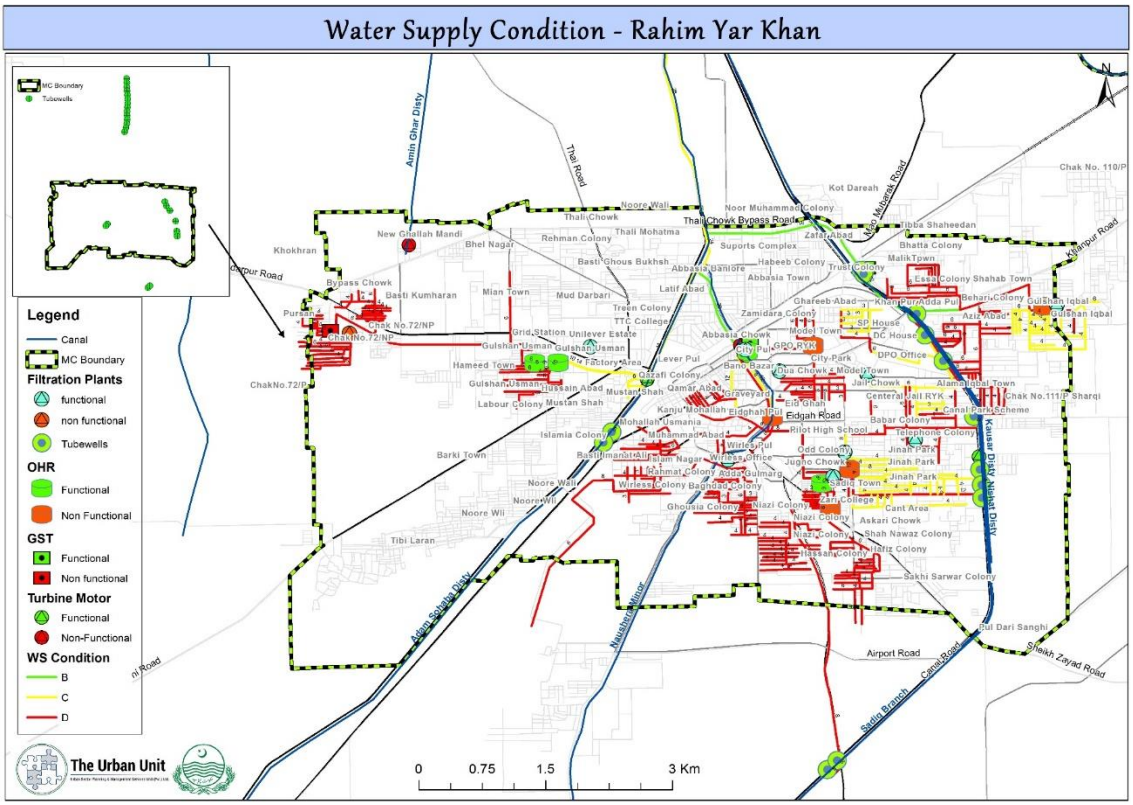


Figure 47: Baseline Water Supply System in RYK City

9.1.1 Condition Assessment of WSS Assets

Team conducted in-field survey of water supply infrastructure and all components of water supply system including tube wells, overhead reservoirs, ground storage tanks, filtration plants present in the city were geo-tagged and evaluated with respect to above-mentioned condition assessment criteria. The summary of functionality of the infrastructure is presented in table while detail of each infrastructure is presented ahead. It can be noted that major city water supply infrastructure is functional except overhead reservoirs. The non-functional infrastructure need to be rehabilitated immediately to include the demand in to the system. With regard to condition assessment of the water supply system, overall machinery and electrical components present at infrastructure has been evaluated and found to be lied in condition D category which indicate the evidence of some deterioration or defects present, but function is not significantly affected.

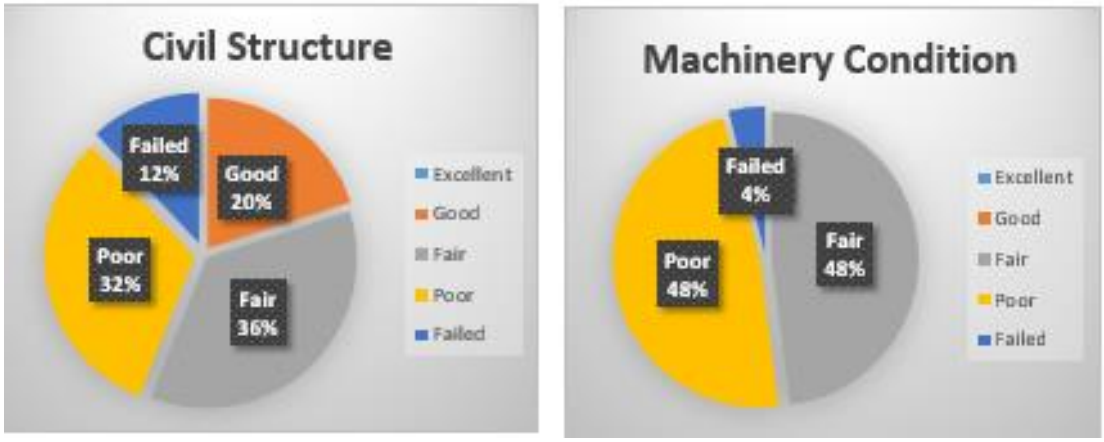
Table 31: WS Infrastructure in RYK City

Tube Well	No.
Operational	35
Non-operational	0
Total	**35**
Over Head Reservoir	**No.**
Operational	3
Non-operational	6
Total	**9**
Ground Storage Tanks	**No.**
Operational	6
Non-operational	1
Total	**7**
Water Filtration Plants	**No.**
Operational	16
Non-operational	2
Total	**18**
Pipelines (inch)	**Length (km)**
3 to 28 inch dia	130

However, existing civil structure was observed having condition D indicating serious deterioration in at least some portion of the structure affecting its function. Both evaluated aspects need attention to be addressed through provision of investment in upgradation of electrical components, civil structure and machinery.

Table 32: Asset Rating in RYK City

Assets	Rating
Machinery	C
Civil Structures	D
Electrical Components	C



More than 50% of pumping stations have less than 60% efficiency, the reason being poor maintenance mechanism. There is no pr ly.

Figure 48: Condition of Asset Components

9.1.2 Tube Wells

Under ground water of the city is not fit for human use. Main source of water supply is at Head Amin Garh 08KM away from city Rahim Yar Khan. Where 14 Nos. Turbines have been installed, which supply water to Water Supply Scheme Adda Khan Pur, Garden Area & Gulshan Usman ground storage tanks. Water is further pumped to Gulshan-e-Iqbal, Satellite Town, Sadiq Town, City area, Officer Colony, Basti Amanat Ali, Gulshan-e- Usman, Chak No.72/NP. However, 21 Nos. Turbines are installed at different location of city mostly along the bank of Sadiq & Adam Shaba Canal and water is directly pumped to Jinnah Park, Officer Colony, Chak NO.111/P. 20% of the total population is being served by this system. These 35 tube wells are of 0.5, 0.75 and 1 cusecs with total capacity of 19.75 cusecs operating with average duration of 14 hr/day and supplying water through approximately 5,000 connections to citizens in city. It was noted that 17 tube wells have currently chlorinators installed for disinfection of water. Detail of installed tube wells is given in tabular form present at Annex. It is pertinent to mention that all tube wells of the city are functional while civil structure and machinery need attention to be replaced or rehabilitated.

Figure 49: Tube Wells Shots in RYK City

9.1.3 Overhead Reservoirs

There are total of 9 Overhead reservoirs (OHRs) in Rahim Yar Khan City with a total capacity of approximately 340,000 Gallons. It is of concern that only 3 out of the 9 OHRs are currently functional. Non-functional infrastructure are proposed to be rehabilitated to utilize existing storage capacity. Detailed information of existing OHRs is attached at Annexure.

Figure 50: OHRs Shots in RYK City

9.1.4 Ground Storage Tanks

There are a total of 7 Underground water tanks (UGWTs) in Rahim Yar Khan City with a total capacity of approximately 550,000 Gallons. Only Chak 72 GST is currently non-functional state. Most of the existing GSTs are in Good and Fair condition. Detailed information of existing GSTs is attached at Annexure.

Figure 51: GSTs Shots in RYK City

9.1.5

There a se Osmosis Rahim Yar Khan C tion. It is ob ntly non-functio

Figure 52: Filtration Plants Shots in RYK City

9.1.6 Water Supply Pipelines

There i[illegible] Most of these lines are of Galvanized Iron (GI) but some of them are of HDPE & PVC material. It is noted that 90 Km of lines are in good condition while remaining lines need to be rehabilitated or upgraded. The condition of the pipeline is shown in map already illustrated above and Diameter wise length can be seen in the following table.

Table 33: Diameter wise pipeline length in RYK City

Pipe Dia (in)	3	4	6	8	10	12	14	16	20	24	28	**Total**
Length (m)	9	53	34	11	3	6	2	2	1	1	7	**129**

Planning & Design Criteria

The purpose of this planning exercise was to assess the current gaps and future water demand for the citizens of the city as well as rural areas of Rahim Yar Khan. The current population of the city is Approximately 5,00,000 with maximum water demand of 36 MGD while current functional tube wells have the capacity of 6 MGD. Similarly, current population is projected for next 10 years which comes out to be 650,000 in 2031 with max water requirement of 48 MGD. Balance Water Discharge Required in 2031 will be of Approximately 98 Cusecs.

Based on the current and projected populations for the Municipal Committee and the proposed water demand of 35 gallons per capita per day, the current (2021) water demand and future (2023, 2026 and 2031) water demands are shown in **Table** below, for the existing and potential future service areas.

Industrial water demand is assumed only 10% of the total water consumption, as there exist less industrial units in city. Commercial and institutional demands have been assumed as 15% and 10% of the total water consumption respectively. The water losses are assumed as 0% as 35 GPCD includes water losses as well. The interventions are proposed for short, medium and long-term phases keeping in view the respective years water demand.

Table 34: Estimated Water Demands for RYK City

	Water Demand (Gallons per Day)

	2017	2021	2023	2026	2031
Population	441,126	492,646	520,621	565,589	649,331
Domestic (MGD)	15,439,410	17,242,616	18,221,721	19,795,603	22,726,591
Commercial (MGD) (15%)	2,315,912	2,586,392	2,733,258	2,969,340	3,408,989
Institutional (MGD) (10%)	1,543,941	1,724,262	1,822,172	1,979,560	2,272,659
Industrial (MGD) (10%)	2,315,912	1,724,262	1,822,172	1,979,560	2,272,659
Total Avg Demand (G/d)	21,615,174	23,277,532	24,599,323	26,724,064	30,680,899
Total Max Demand (G/D)	32,422,761	34,916,298	36,898,985	40,086,096	46,021,348
Total (MGD)	**32**	**35**	**37**	**40**	**46**

Similarly, drinking water demand is calculated for rural areas of Rahim Yar Khan as well by considering 3 liter per capita per day as drinking water needed as per WHO guidelines.

Table 35: Estimated Rural Drinking Water Demand for RYK

Tehsils	future Drinking water demand (l/hr) 2021	future Drinking water demand (l/hr) 2023	future Drinking water demand (l/hr) 2026	future Drinking water demand (l/hr) 2031
Khan Pur tehsil	418,835	442,618	480,849	552,045
Liaqat Pur tehsil	549,194	580,379	630,509	723,864
RYK Tehsil	584,197	617,371	670,695	770,000
Sadiqabad tehsil	559,276	591,034	642,084	737,153

Design Criteria

Following design criteria for water supply system has been based on "Technical and Service Delivery Standards for Water Supply and Sanitation Sectors" 2008 by Punjab Devolved Social Services Program (PDSSP) with some proposed practical modifications is used in demand calculations and proposed to be used for detailed designing of interventions.

Planning Horizon:

Planning horizon for this plan is ten years i.e 2021-2031. Short, medium and long term phases are identified for 2, 3 & 5 years i.e 2023, 2026 and 2031 respectively.

Population Projection:

The population is estimated for the year 2023, 2026 & 2031. The growth rate was taken from District Census Report and population projection has been worked out as per the following formula:

$$P_n = P_o (1+r)^n$$

Where,

P_n = Projected population for required year

P_o = Population of base year

r = Annual population growth rate

n = Number of years, counted from base year

Growth rate, in this case, is taken as 2.8% in case of Rahim Yar Khan.

Maximum Day Demand:

Maximum day demand is taken as 1.5 times the average day demand.

Tube Well Working Hours:

Tube Well Working Hours are taken as 16 Hours/day in city as proposed in Design Criteria for WASAs by Urban Unit

Storage Capacity:

The water storage capacity is taken as 1/10th of average day demand as stated “Capacity of overhead reservoirs in case of communities having population more than 10,000 persons should be based on around 1/10th of average day demand”.

Drinking water Requirement:

The treated drinking water requirement is taken as 3 Liter per capita per day (lpcd) as per World Health Organization (WHO) guidelines.

Proposed Interventions in RYK City

Considering the fact, that only 20% water supply coverage is present in Rahim Yar Khan city, it is important that actions and steps are taken in a way that can provide safe drinking water to citizens also contributing in meeting SDG water 6.1 Target of 2030.

Based on the existing infrastructure analysis including condition survey, service delivery gap analysis, and future water demand, the recommendations for sustainable water supply are divided into three phases: i.e. Short (0-2 Years), Medium (2-5 years) and Long term (5-10 years) phases.

9.1.7 Short Term Plan (2021-23)

In the initial short-term period, major focus is given on rehabilitation of non-functional or deteriorated water supply infrastructure. Recommendations for immediate implementation majorly include the rehabilitation and replacement of identified poor water supply pipelines which needs instant replacement. Lengths and diameters of pipelines to be replaced in short term phase are tabulated below

Table 36: WS Pipelines Replacement for RYK City

Sr. No.	Areas	Length (km)
1	Chak 72 NP	**8.5**
2	Bahadurpur Road & Hassan Abad near Gulshan e usma*	**8.2**
3	Baghdad Colony,Kanjo muhalla,Muhalla Qadria	**15.2**
4	Rehmat Colony,Dastgir Colony	**11.2**
5	Shahnawaz colony, Sakhi sarwar & Hafiz Colony	**10.7**
6	Sadiq Colony& Khwaja Farid college Road	**7.8**
7	Haji Muhammad Colony & Fazeelat town	**11.8**
8	Khanpur, Chak 111P East, Sardar Colony	**15.1**
Total		**88.6**

Dia (inch)	Sr. No.								Total Length (km)
	1	2	3	4	5	6	7	8	
3	-	-	1.8	1.8	-	1.7	0.7	-	**6.0**
4	5.6	0.4	5.8	8.3	6.0	1.3	7.0	5.0	**39.5**
6	2.9	7.3	2.7	0.8	1.6	1.2	3.5	8.4	**28.3**
8	-	-	4.0	0.3	3.2	1.9	0.6	-	**9.9**
10	-	0.4	-	-	-	-	-	1.7	**2.1**
12	-	0.0	0.8	-	-	1.8	-	-	**2.6**
Total Length (km)	**8.5**	**8.2**	**15.2**	**11.2**	**10.7**	**7.8**	**11.8**	**15.1**	**88.5**

Along with water supply lines, other water supply infrastructure such as Tube well, Over Head Reservoirs and Ground Storage Tanks are also considered for rehabilitation and upgradation purpose. Based on assessment, three Nos of Turbine Motors at Garden Area and Chak No 72/NP (inc Cholrinator) are proposed to be rehabilitated. Similarly, Civil works of six tube wells present in areas of Jinnah Park, Garden Area and Sadiq Town will be upgraded for improved infrastructure.

Table 37: WS Short Term Interventions in RYK City

SHORT TERM PLAN (TILL YEAR 2023)
❑ **INFRASTRUCTURE**
TUBEWELL:
▪ Rehabilitation of 3 Turbine Motors
▪ Upgradation of Civil Works of 6 Tube Wells
▪ 2 Nos New Tube Well (Each 01 Cusecs capacity)
OVERHEAD RESERVOIR (OHR):
▪ Rehabilitation of 6 Non-Functional OHRs
GROUND STORAGE TANKS (GSTs):
▪ Rehabilitation of 1 GST of 25000 Gallons
▪ New 02 Nos GSTs each having capacity of 100,000 Gallons
WATER SUPPLY PIPE LINE:
▪ Rehabilitation of 89 Km water supply lines
❑ **MACHINERY**
▪ Establishment of Store for MC RYK with Provision of WS equipment & stand-by machinery
❑ **Others**
▪ Mobile Water Quality Lab for identification of sweet pockets

Furthermore,, rehabilitation of 6 Non-Functional OHRs in areas of Sadiq Town, Near Zarai College, Eid Gah Tank, Jugnoo Chowk, Gulshan e Iqbal, Islam Nagar and Office Public Health; 1 Non-Functional GST at Chak NP/72; and 2 Non-Functional RO Water Filtration Plants in Chak 72 Np and Garden Area will be carried out to utilize the potential of already established water supply infrastructure.

New Distribution Network Improvement (DNI) Zones are planned to be established to provide state of the art 24/7 water supply in Rahim Yar Khan City in medium term plan. In this regard, two numbers of new tube wells (Each 01 Cusecs capacity) and 02 Nos of GSTs (each having capacity of 100,000 Gallons) are proposed to be installed in Babar and Christian Colony. Summarized water supply interventions for Rahim Yar Khan for first two years are articulated here in figure over here.

Equipment and Machinery play a key role in provision of water supply & sanitation services. The availability of essential daily basis operation and maintenance machinery and equipment enable the service provider to furnish efficient operations. Therefore, establishment of a store with standby machinery and equipment is proposed for MC Rahim Yar Khan in short-term phase to enhance the operational efficiency.

One of the biggest issue of water supply in the city is the presence of brackish water zone. Currently, there is no mechanism exist for screening of water quality of aquifer. Pakistan Council of Research in Water Resources (PCRWR) being federal entity only analyze the paid water samples on demand. Therefore, a Mobile Water Quality Laboratory equipped with all testing apparatus & equipment is identified as an immediate need and proposed in short term projects for identification of sweet pockets in the city.it will gauge the city' water quality and enable the service providers for requisite actions of interventions.

9.1.8 Medium Term Plan (2023-26)

The three years medium term development plan includes installation of Water Supply Infrastructure such as Tube Wells, OHRs and GSTs to cater the gap between water supply and water demand. Shifting to renewable energy is considered in the plan to avoid high burden on electricity cost through installation of solar panels on existing Water Treatment Plants present in the city. It is well known that city Rahim Yar Khan in Bahawalpur Division lie in brackish water zone overall. Although secondary data predict the presence of high TDS in groundwater, however, proper water quality screening is not carried out to identify the hotspots in city area. Therefore, installation of Solar based Reverse Osmosis plants are proposed in medium term phase based on actual identified hotspot through mobile water quality testing in short term plan. The two areas having approximately 2000-3000 households are identified for establishment of DNI zones where currently situation of water supply is very poor as can be visualized through red lines of water supply network in city water supply map. In today's modern age, IT Technology is playing a key role in effective management and monitoring of municipal services for evidence based planning and right decision making for policy makers, therefore, MIS based digital monitoring and outsourcing of WSS services is made part of the plan. Summarized water supply interventions for Rahim Yar Khan for medium term plan are articulated here in table here while details are present in project digest.

Table 38: WS Medium Term Interventions in RYK City

MEDIUM TERM PLAN (TILL YEAR 2026)	LONG TERM PLAN (TILL YEAR 2031)
❑ IN TUBEV ▪ Ne OVER ▪ Ne GROU ▪ Ne ❑ SC ▪ Sc Pk ❑ MI ▪ Asse ❑ W ▪ Inst Filt ❑ Otl ▪ Est ▪ Ou of Urban WS System	❑ **INFRASTRUCTURE** **TUBEWELLS:** ▪ New 9 No. of Tube wells each of 1-Cusec **OVERHEAD RESERVOIRS (OHRs):** ▪ New 2 No. OHR (50,000 Gallons each) **GROUND STORAGE TANKS (GSTs):** ▪ New 6 no. GSTs, (each capacity 100,000 Gallons) **WATER SUPPLY LINES:** ▪ New HDPE lines in 7 areas ❑ Establishment of SCADA & One Window operations for City ❑ Feasibility Study for Establishment of 20 MGD WTP on Surface Water through Public Private Partnership and associated water bottling plant

9.1.9 Long Term Plan (2026-31)

Big scale interventions have been made part of the long-term plan for making the water supply system more efficient. Along with installation of new water supply infrastructure, including Tube wells, OHRs, and GSTs, new HDPE water supply lines in identified unserved or poorly served areas of the city are proposed to be laid down. SCADA system is proposed to be installed in the city for effective supervision of water supply system by MC RYK.

Table 39: WS Long Term Interventions in RYK City

One of the key intervention is the need of the conducting feasibility study for establishment of surface water treatment plant because of presence of brackish water and high reliance of seepage water of canals. It is

envisaged that surface water treatment plan along with its associated water bottling plants should be established by engaging some private investor through Public Private Partnership (PPP) mode. Summarized water supply interventions for Rahim Yar Khan for long-term plan are articulated here in figure here while details are present in project digest.

Comprehensive list of interventions with cost and spatial overview for the city water supply system under this regional development plan are shown in table and figure

Table 40: Proposed WS Projects Interventions for RYK City

SR.	PLANN-ING PERIOD	URBAN WATER SUPPLY SCHEME DESCRIPTION	Mode
1	SHORT	Rehabilitation of 89 Km water supply lines, 4 Non-Functional Turbine Motors, 6 Non-Functional Over Head Reservoirs, 1 Ground Storage Tank & 2 RO Water Filtration Plants	ADP
2		Installation of 2 Tube Well of Each 01 Cusecs capacity and 02 GSTs each having capacity of 100,000 Gallons	ADP
3		Establishment of Store for MC RYK with Provision of equipment & stand-by machinery for city Water supply system Tube Wells	ADP
4		Mobile Water Quality Lab for identification of sweet pockets	PPP
1	MEDIUM	Solarization of 18 RO & UF City Water Filtration Plants	PPP
2		Installation of 18 Tube wells, 10 GSTs and 4 OHRs and new water supply lines	ADP
3		Outsourcing of Repair & Maintenance (R&M) of Urban Water Supply System	PPP
4		Establishment of 2 DNI Zones	PPP
5		MIS based Digital Monitoring - Asset Management & Monitoring	ADP
6		Installation of 20 Atm and solar based RO Water Filtration Plants (4000 l/hr) in city	PPP

1	Long	Installation of 9 Tube wells of each 1 cusecs capacity, 6 GSTs each having 1 Lakh Gallons Capacity & 2 OHRs having 50, 000 Gallons Capacity	ADP
2		Installation of new HDPE water supply lines	ADP
3		Establishment of SCADA & One Window operations for Urban WSS	ADP
4		Feasibility Study and Establishment of 15 MGD WTP on River/Canal Water through Public Private Partnership	PPP

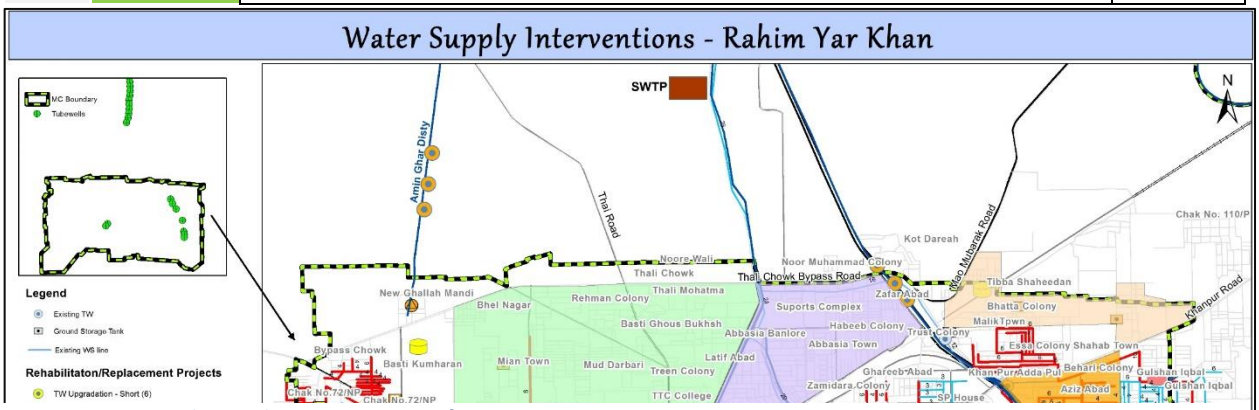
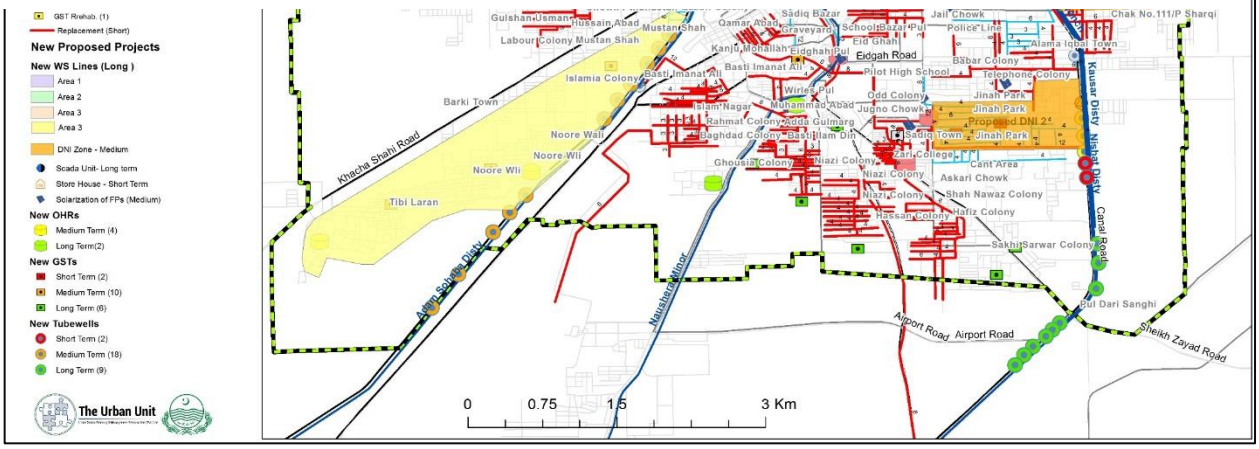


Figure 53: Proposed Spatial WS Interventions for RYK City



10. Sewerage System RYK

Along with water supply services, MC Rahim Yar Khan is also responsible for provision of sewerage services to the citizens in the city. Likewise water supply, sewerage schemes are also constructed or executed by the concerned PHED and handover to MC for its O&M.

Existing Sewerage Infrastructure

The existing sewerage system of Rahimyar khan city is composed of Sewerage Pipe Network, Disposal Stations and Wastewater Treatment Plants. Ultimate disposal of raw sewerage is a major concern of the city as currently it is being disposed-off into the agricultural land. Moreover, about 15% of developed areas of City are without Sewerage System[19]. At some locations, sewers have become undersized with frequent chocking of sewers being generally observed. The crown failure was observed as a major issue in the city. Most of the sewerage lines are also outdated or in poor condition.

According to information provided by MC RYK, city is divided in to two zones A & B with respect to sewerage system. The Sewerage Water of 6 Nos. Union Councils of the City area is finally collected at Disposal Station Niazi Colony, which is further pumped to Patan Minara Treatment Plant. After treatment, the sewerage water is disposed-off in the Agricultural fields and seepage drain. While, the sewerage water of 3 Nos. Union Councils is collected at Abbasia Town Disposal which is further pumped to Moe-Mubarak Treatment Plant. After treatment with natural light and air, the treated water is supplied to Agriculture fields.

The present sewerage generated is approximately 70 MGD or 106 cusecs according to current population of the city while the installed capacity of the disposal stations is 330 cusecs. It is however, important to check the efficiency and condition of existing sewerage system network to figure out the scope of improvement and further extension of the network and system. For this purpose, a detail survey was carried out in which each asset condition was determined. Asset condition was determined keeping in view the physical parameters as well as the Performance parameters. The Condition rating chart, used to rate the Sewerage Assets listed above, is tabulated below

Table 41: Asset Condition Assessment Criteria

Rating	Asset Condition	Description
A	Excellent	No noticeable defects. Some aging or wear may be visible.
B	Good	Only minor deterioration or defects are evident.
C	Fair	Some deterioration or defects are evident, but function is not significantly affected
D	Poor	Serious deterioration in at least some portion of the structure. Function is inadequate
F	Failing	No longer functional. General failure or complete failure of a major structural component.

Overall, the existing Sewerage disposal system is sufficient to meet current and future waste disposal demand of the city but condition of the existing structure especially sewerage lines needs attention so that sewage is properly disposed-off. It is also pertinent to mention that most of the city area is either deprived of proper sewerage lines or the existing lines are outdated (as indicated through color yellow & red) and result in to the ponding in the areas. City' Existing Sewerage Infrastructure along with its condition has been geo-tagged and illustrated in below map figure.

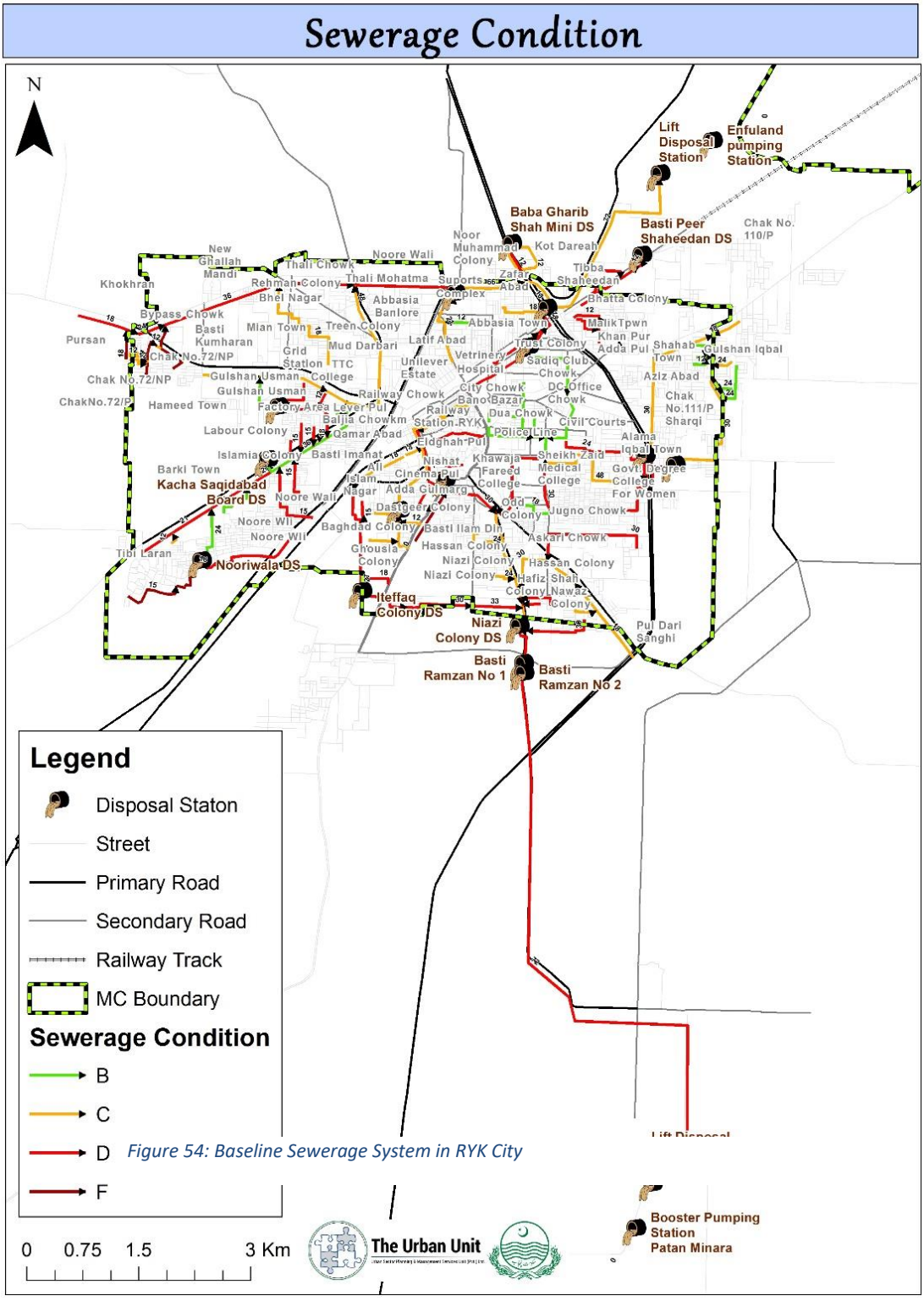


Figure 54: Baseline Sewerage System in RYK City

Team conducted in-field survey of sewerage system infrastructure including disposal stations and wastewater treatment plants. The infrastructure

present in the city was geo-tagged and evaluated with respect to above-mentioned condition assessment criteria. The summary of functionality of the infrastructure is presented in table. It can be noted that major city sewerage infrastructure is functional.

Table 42: Sewerage Infrastructure in RYK City

Disposal Station	No.
Operational	18
Non Operational	02
Total	**20**
Oxidation Ponds	**No.**
Operational	68
Non Operational	0
Total	**68**
Sewerage Pipeline	**Length (km)**
Dia (9" to 72")	370

10.1.1 Sewerage Network

There is a network of pipeline extended to approximately 108 Km in city. The condition of the lines is already illustrated in above figure… while detail of length of pipelines with dia is tabulated below.

Table 43: Diameter wise sewerage pipeline length in RYK City

Pipe Dia (m)	12	15	18	21	24	27	30	33	36	48	54	60	66	72	N/A	Total
Length (m)	10	9	18	7	7	5	11	1	5	5	1	1	2	13	11	**108**

10.1.2 Disposal Stations:

The city is being served with total of 18 Disposal Stations with total pumping capacity of Approximately 340 Cusecs. Furthermore, the details of condition of pumps, functionality and working hours are tabulated in table placed at Annexure which indicate the presence of sufficient infrastructure while some of the components need rehabilitation and upgradation for effective performance.

10.1.3 Wastewater Treatment Plants (WWTP)

Public Health Engineering Department Punjab constructed two wastewater treatment plants in Rahim Yar Khan under project "Sewerage Scheme Rahim Yar Khan with Treatment Plant" in 2008-2009. These two plants are treating city municipal wastewater via waste stabilization pond, consist of 68 ponds with total treatment capacity

of Approximately 95 Cusecs. Detailed facts and condition regarding Pumps, Motors and ponds of WWTP is present in Annexure.

1. Patan Minara WWTP

- First treatment plant was constructed near Patan Minara in Southern Zone (Zone 1).
- Force main of 111P/East, Basti Nayan, Ittefaq Colony, Abbasia Colony, Niazi Colony are attached with Patan Minara wwtp.
- Total No. of Ponds are 36; 9 nos. of Anaerobic Ponds, 18 nos. of facultative Ponds and 9 nos. of Maturation Ponds (all are functional).
- Operational since October 2011.
- Effluent Pumping station is part of this treatment plant.
- Treated water is used for agriculture.

Figure 55: WSP WWTP at Patan Minara in RYK City

2. Moi Mubarak WWTP

- Second treatment plant was constructed at Moi Mubarak Road in Northern Zone (Zone 2).
- Force main of Basti Nooriwale, Kacha Sadiqabad road, trust colony, habib colony, gulshan e usman Disposal stations are attached with Moi Mubarak wwtp.
- Total No. of Ponds are 32; 8 nos. of Anaerobic Ponds, 16 nos. of facultative Ponds and 8 nos. of Maturation Ponds (all are functional).
- Operational since October 2011.
- Effluent Pumping station is part of this wwtp.
- Produced water is used for agriculture.

Figure 56: WSP WWTP at Moh Mubarak in RYK City

Planning & Design Criteria

The purpose of this planning exercise was to assess the current gaps and future wastewater disposal demand for the citizens of the city. The current population of the city is Approximately 5,00,000 with total wastewater flow of 38 MGD while current functional disposal stations are operating more than this capacity. Therefore, no new disposal station is proposed for future, however, upgradation of existing outdated and poor condition disposal stations are proposed to be upgraded. The foremost and essential need is the replacement and installation of new sewerage lines in poorly served and underserved areas of the city.

Based on the current and projected populations for the Municipal Committee and the proposed water demand of 35 gallons per capita per day, the current (2021) and future (2023, 2026 and 2031) wastewater production are shown in **Table** below, for the existing and potential future service areas.

Table 44: Estimated Sewage Flow

Year	Population	Per Capita WW	Average Flow		Peak Flow	Storm Water		Non-Domestic Flow		Infiltration		Total Flow (Peak + storm + non-domestic + infiltration)	
		gpcd	MGD	Cusec	MGD	MGD	Cusec	MGD	Cusec	MGD	Cusec	MGD	Cusec
2021	492,646	28	13.79	21.34	27.59	9.10	14.08	0.69	1.07	0.69	1.07	38.07	58.90
2023	520,621	28	14.58	22.55	29.15	9.62	14.88	0.73	1.13	0.73	1.13	40.23	62.24
2026	565,589	28	15.84	24.50	31.67	10.45	16.17	0.79	1.22	0.79	1.22	43.71	67.62
2031	649,331	28	18.18	28.13	36.36	12.00	18.56	0.91	1.41	0.91	1.41	50.18	77.63

Wastewater is taken as 80% of water demand. Peak flow is calculated by multiplying average flow with factor of 2 as per population of the city. Storm water is taken as 33% of peak flow, Non-domestic flow and Infiltration as 5% of average flow.

Proposed Interventions

Considering the fact, that few of the areas have proper sewerage lines coverage in Rahim Yar Khan City, it is important that actions and steps are taken in a way that can provide safe transmission of wastewater.

Based on the existing infrastructure analysis including condition survey and service delivery gap analysis the recommendations for sewerage system are divided into three phases: i.e. Short (0-2 Years), Medium (2-5 years) and Long term (5-10 years) phases.

10.1.4 Short Term Plan (2021-23)

In the initial short-term period, major focus is given on rehabilitation of poorly condition sewerage lines and large trunk infrastructure.

Recommendations for immediate implementation majorly include the rehabilitation and replacement of identified poor pipelines, which needs instant replacement. Detail of areas where lines need to be replaced include 7 Km in Basti peer Shaheedan, Bhatta & Habib Colony, 6 Km in Chak 111 West Chiristian Colony, 6.6 Km in Ittefaq & Niazi Colony, 10 Km in Katcha Sadiqabad Road Gulshan Usman, and 6.5 Km in Baghdad Colony Jugno Chowk.

Trunk sewer (72”) and major sewerage line along Thali Chowk Bypass Road across north and south of the city need immediate attention as the wastewater coming from the city areas are heading through these large lines towards treatment plants.

Currently MC RYK possess only 3 Nos of Tanker Sludge Carrier and, 01 Sucker and 01 Jetting machine for carrying out the sewerage drainage work of the city. Considering the sewerage situation of the city, more machinery including dewatering sets are proposed to be provided in short term plan so that issues in highly ponding areas can be efficiently and quickly resolved to relief the citizens.

10.1.5 Medium Term Plan (2023-26)

Medium term interventions include the replacement of B & C Condition sewer lines. Installation of New Sewerage lines in Islamia Colony, Qazafi Colony Wali Muhammad, Norre Wali & Chak 72 NP, Shafi town & basti kumharan, Abbasi town & dilbar colony , Gulshan e Usman and hameed town are proposed where voices were raised for the need of sewerage lines from residents and as well as the department. Overall, the efficiency of the whole municipal services in city can be improved through considering the outsourcing to private contractor option for efficient O&M which can be properly regulated by concerned Local Government.

10.1.6 Long Term Plan (2026-31)

Unserved and expanded areas of the city are intended to be covered through Installation of Sewerage System in Hanfia Colony, Gulshan Iqbal & Azizabad. Furthermore, advanced technology of IT system Monitoring are proposed to be installed for efficiently managing the extensive sewerage system

In Nut Shell, proposed interventions for short, medium and long term sewerage plans are articulated in table and map.

Table 45: Sewerage Interventions for RYK City

SHORT TERM PLAN (TILL YEAR 2023)	MEDIUM TERM PLAN (TILL YEAR 2026)	LONG TERM PLAN (TILL YEAR 2031)
❑ INFRASTRUCTURE Sewerage Lines: ▪ Replacement of 36.1 Km sewerage pipelines ▪ Replacement of 10 Km Trunk sewer (72") Disposal Stations : ▪ Rehabilitation and Upgradation of 5 Disposal Stations ❑ MACHINERY ▪ Provision of Machinery for Cleaning & Desilting (Sucker & Jetting Machine (2), Dewatering Units (30) to MC RYK	❑ INFRASTRUCTURE Sewerage Lines: ▪ Installation of New Sewerage lines in 11 areas ▪ Installation of new Sewerage line of 4 Km of 36 inch dia ▪ Replacement of 34 Km of sewerage lines ❑ Others ▪ Outsourcing of R&M of Urban Sewerage System (Sewerage Lines + Disposal Stations + WWTP)	❑ INFRASTRUCTURE Sewerage Lines: ▪ Installation of New Sewerage lines in 4 areas ❑ Centralized MIS based Digital monitoring ▪ Complaint Management System (App & Call) ▪ Online Disposal Stations & WWTP Monitoring

Table 46: Proposed Sewerage Projects for RYK City

SR.	PLANNING PERIOD	URBAN SEWERAGE SCHEME DESCRIPTION	MODE
1	SHORT	Rehabilitation of Sewerage Lines	ADP
2		Rehabilitation & Upgradation of Disposal Stations	ADP
3		Provision of Machinery for Cleaning & Desilting (Sucker & Jetting Machine, Dewatering Units to MC RYK	ADP
5	MEDIUM	Installation of New Sewerage lines	ADP
6		Replacement of 34 Km of sewerage lines	ADP
		Outsourcing of R&M of Urban Sewerage System	PPP

SR.	PLANNING PERIOD	URBAN SEWERAGE SCHEME DESCRIPTION	MODE
7	LONG	Installation of Sewerage Lines	ADP
8		Centralized MIS based Digital monitoring Complaint Management System (App & Call) Online Disposal Stations & WWTP Monitoring	ADP

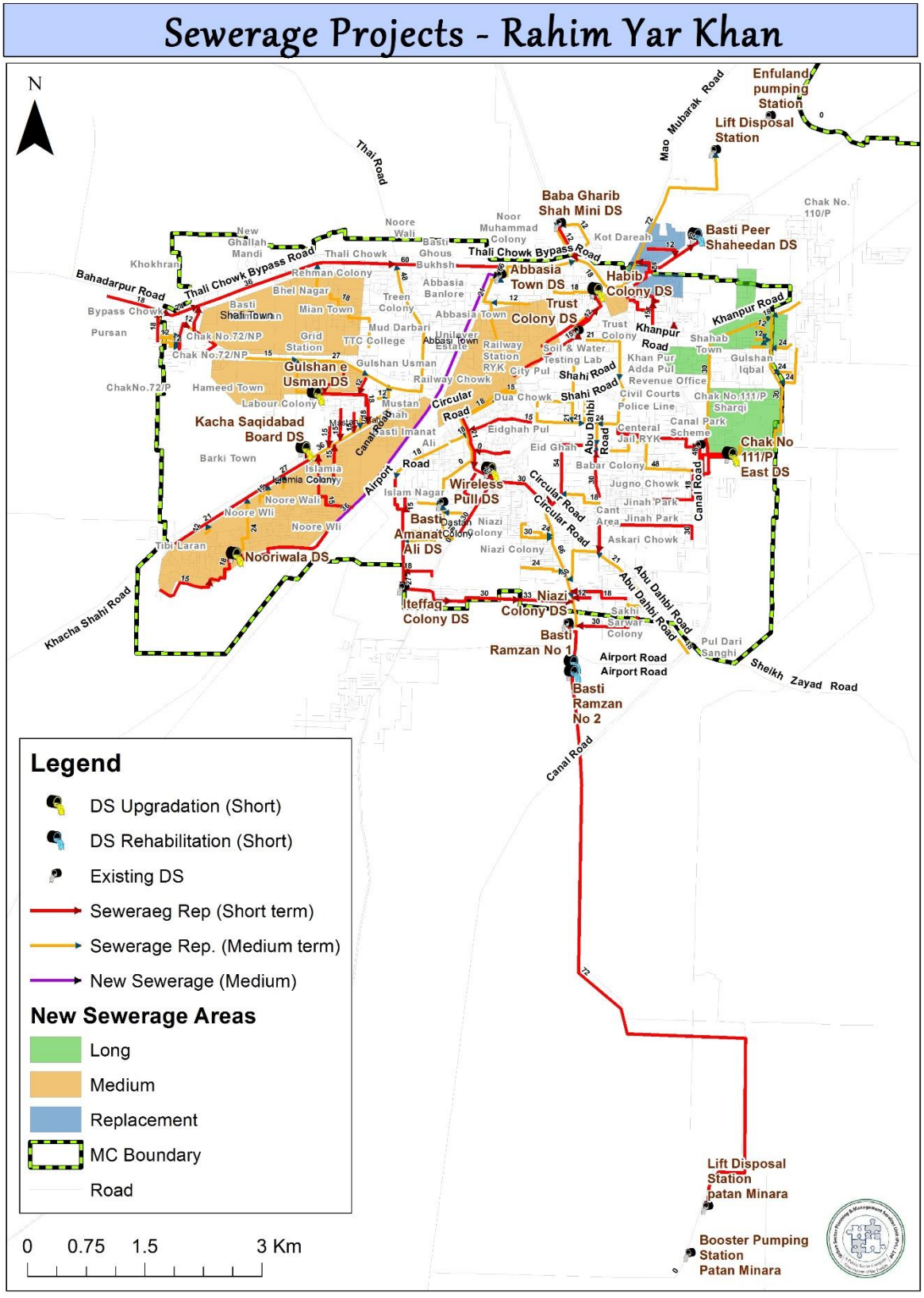


Figure 57: Proposed Spatial Sewerage Interventions for RYK City-

11. Rural WSS RYK

Rural area of district Rahim Yar Khan covers huge population of four million where people are deprived of proper water supply & sanitation facilities. Public Health Engineering Department (PHED) mainly install water

supply and sewerage schemes and handover to Community Based Organizations (CBOs) for its operation and maintenance.

Existing Rural WSS Infrastructure

According to UNICEF 2019 study, rural area of district RYK is given 23rd rank among all 36 districts of Punjab based on WASH Index, which depicts the worst situation of WASH facilities over there. Similarly, latest available MICS indicators also show the presence of 31% safely managed sanitation in contrast to 55% safely managed water in rural area, which indicate the need of sanitation intervention. According to Junior Research Officer (JRO) PHED, only 224 villages are having sewerage system in form of Underground lines and somewhere drains. While residents in more than 1000 villages are compelled to living life without proper sewerage system.

Table 47: Baseline Rural WSS Infrastructure

Water Supply Schemes	No.
Operational	152
Non Operational	88
Total	**240**
Filtration Plant	**No.**
Operational	31
Non Operational	06
Total	**37**
Sewerage System	**No.**
No. of villages with sewerage system	224
No. of villages with no sewerage system	1226
Total	**1450**

11.1.1 Rural Water Supply Schemes

There are 240 total rural water supply schemes installed by Public Health Engineering Department (PHED) in rural areas of RYK which are currently operated and maintained by Community based Organizations (CBOs). According to data provided by PHED, currently there are total 152 schemes are in functional condition out of 240 which are supplying water through 129 tube wells and 23 canal sources with average operating hours of 4 hr/day. It is to be noted that these functional water schemes are providing water to 50,000 households through 32,000 connections. It is pertinent to mention that 88 rural water schemes, which are currently non-functional due to couple of reasons including source failure, damaged raising main & machinery and expiry of design life

need to be rehabilitated to provide water to community. Detailed features and information of rural water supply schemes is attached at Annexure.

It is noted that total 240 rural water supply schemes were installed by PHED in rural RYK as per data obtained from concerned CBO. Detail facts and status is presented in table indicated the presence of huge number of non-functional infrastructure. All schemes are based on 0.5 cusecs tube wells installed along canal and supplying water at an average of 4 hr/day after chlorination. Data provided by CBOs revealed that current functional rural water supply schemes are only serving the approximately four Lac population from 4 million present in all rural tehsils of district RYK. It is observed that 75% schemes are non-functional due to outlived structure, 14% due to rising main machinery damage and 11% are due to source failure as per data provided by CBO and PHED. Detailed information of existing rural water supply schemes is attached at Annexure. The spatial picture of Rural Water Supply Infrastructure is shown in figure.

11.1.2 Rural Water Filtration Plants

According to data provided by PHED and CBOs, there are total 37 water filtration plants are present in rural areas (63 RO & 11 UF). These all are of 2000 liter per hour each capacity and provide clean drinking water to communities for average 5 h/day. Among these installed 37 plants, total of 3 UF and 3 RO plants are currently non-functional condition. Detailed information of existing rural water filtration plants is attached at Annexure.

It is also to mention that under Community Development Program (CDP), the Government of Punjab (GoPb) has recently installed total 91 Water Filtration Plants (RO & UF) in schools of RY Khan, Laiaqat Pur and Khan Pur tehsils of Rahim Yar Khan. Both students as well as community is benefited from clean and safe drinking water. There are total 90 filtration plants, which are in functional condition and good source of provision of safe drinking water in brackish area zone. During the visit to RYK in September 2021, team visited 5 Urban and rural said Water Filtration Plants. It was highlighted and brought to information that there are currently ownership issues as currently only 73 plants has been handed Over to relevant TC & MC**.** Overall, community was Satisfied with the water from these filtration Plants which are operating for 3-5 h/day. However, some challenges of Power Breakdown, Poor attention towards effective Repair & Maintenance and Electricity Bills Burden on Schools were emphasized to be addressed to ensure successful O&M of these expensive plants. Detailed information of these CDP School water filtration plants is attached at Annexure

Figure 58: Shoots of Rural Water Filtration Plants

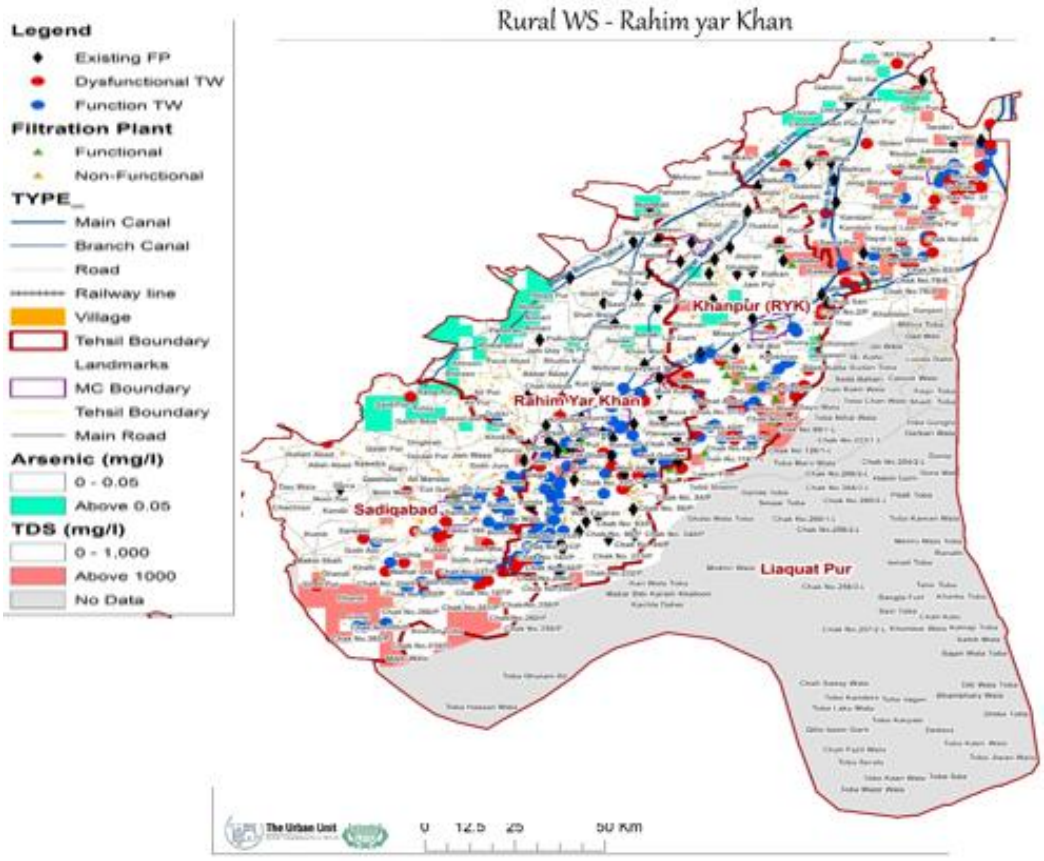


Figure 59: Baseline Rural WSS in RYK

11.1.3 Rural Water Quality

The ground water in Rahimyar Khan is not suitable for drinking purposes due to marginal and substandard quality apart from areas, which lie close to canals and river Sutlej. Majority of the inhabitants have complaints about the poor quality of water, which is often found colored, turbid and bacterial contaminated.

Ground water occurs in abundance in the district at variable depths from the natural surface level. It can be divided into fresh/sweet water zone and brackish water zone. For sweet water zones, ground water is the source of choice and can be obtained through the installation of tube wells. As numbers of canals like Dallas Branch Canal, Sadiq Branch, Rahimyar Khan Branch, Sadiq Feeder and many distributaries originating from these canals having sufficient discharge are flowing in tehsil, plenty of fresh/sweet water is available at shallow depths and can be used as ground water source for the water supply schemes for the localities located near the canal bank. The ground water available in the brackish zone is not fit for drinking purpose due to impurities dissolved in the form of salts and metals termed as total dissolved solids (TDS) and as well as Arsenic. It is observed that 16% TDS and 5% Arsenic contamination is present as per secondary UNICEF water quality data of RYK villages. In the absence of proper water supply system people are forced to drink this contaminated water due to which they are suffering with water borne diseases like dysentery, cholera and typhoid fever. The data referred of water quality is quite old and there is need to investigate the existing water quality of the city to

identify the sweet pocket zones available and provide water through groundwater aquifer sweet zones. The Water Quality Contamination spots in RYK is shown in map below.

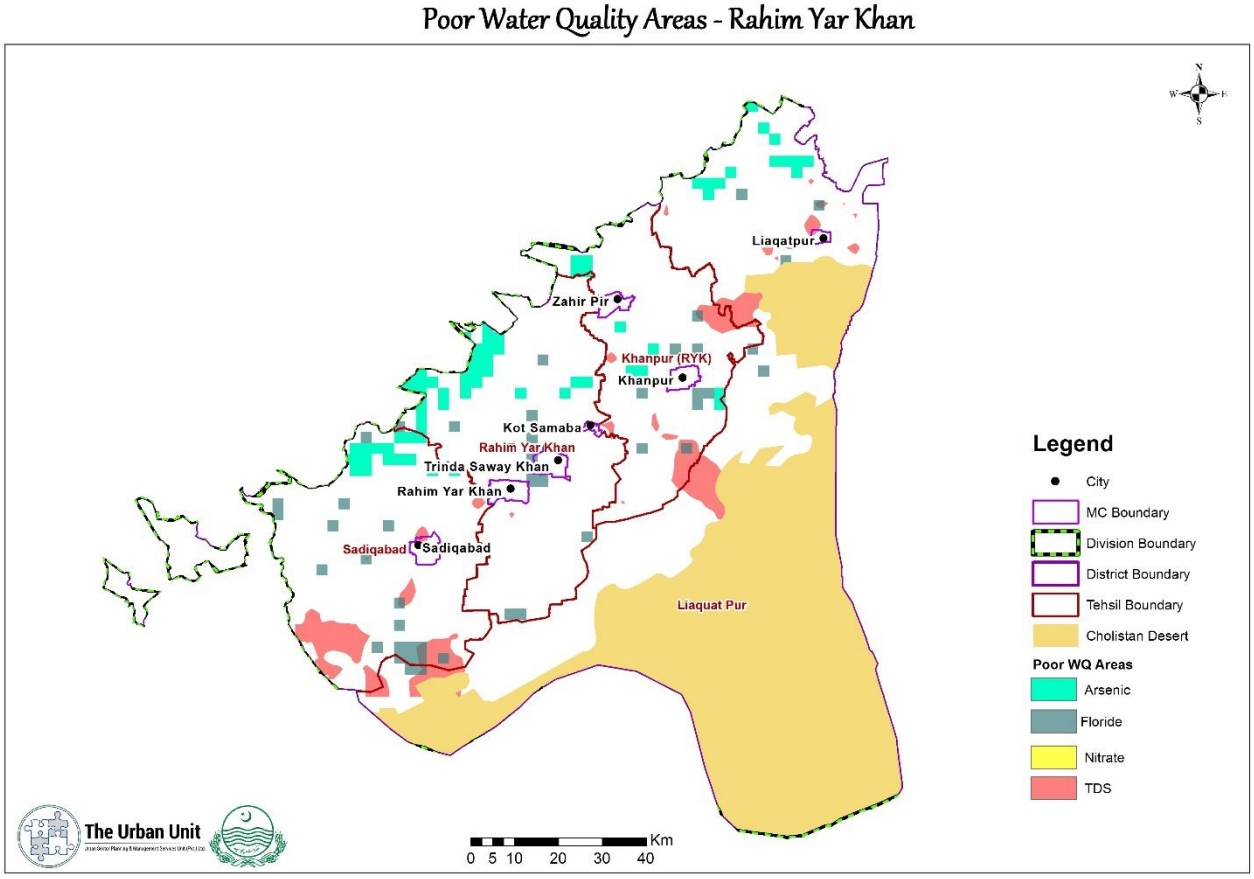


Figure 60: Rural Water Quality in RYK

Proposed Interventions

For the Rural areas, following Interventions have been proposed:

11.1.4 Short Term Plan (2021-23)

Rehabilitation of existing Rural WSS infrastructure including water supply scshems and filtration plants are proposed. While provision of simple sewerage system having scope of drains and small disposal station in villages are proposed.

11.1.5 Medium Term Plan (2023-26)

Installation of unit with motor pumps each of 0.5 cusecs along the Canals are envisaged and outsourcing and Engagement of contractors for maintenance of unit and supply bottled water to people of villages is made part of the short-term plan. Shifting of solar energy from electricity is proposed for existing water filtration plants. Solar-based large scale RO plants units with mobile ATM machines and Ultra Filtration Arsenic Removal plants are spatially proposed to be outsourced in identified hotspot contaminated areas to provide safe drinking water to people. Provision of simple sewerage system having scope of drains and small disposal station in villages are proposed

11.1.6 Long Term Plan (2026-31)

Existing rural water supply schemes are proposed to be shifted on Solar Energy. The issue of operation & maintenance (O&M) of rural water infrastructure is addressed through proposal of outsourcing for effective management. For clean drinking water, installation and outsourcing of Ultra Filtration Plants are proposed. Furthermore, option of surface water treatment plants such as slow sand filter on canal water is also anticipated in long term for provision of safe drinking water. Provision of simple sewerage system having scope of drains and small disposal station in villages are proposed. Outlook of brief interventions and projects proposed for rural water supply & sanitation (wss) plan is expressed in tables.

Table 48: Rural WSS Interventions for RYK

SHORT TERM PLAN (TILL YEAR 2023)	MEDIUM TERM PLAN (TILL YEAR 2026)	LONG TERM PLAN (TILL YEAR 2031)
❑ WATER INFRASTRUCTURE TUBEWELL/WATER SCHEMES: ▪ Rehabilitation of 44 Non-Functional Rural Water Schemes (0.25 Cusecs each) WATER FILTRATION PLANTS (WFPs): ▪ Rehabilitation of 6 Non-Functional (3 RO & 3 UF) Rural Water Filtration Plants each of 2000 l/hr ❑ Sewerage Infrastructure ▪ Provision of sewerage system (15 villages) in rural areas of RYK	❑ INFRASTRUCTURE TUBEWELL/WATER SCHEMES: ▪ Rehabilitation of half 44 Non-Functional Rural Water Supply Schemes (0.25 Cusecs each) ▪ Installation of 25 motor pumps each of 0.5 cusecs along the Canals. ❑ SOLARIZATION ▪ Solarization of 37 Rural RO/UF Water filtration Plants (WFPs) ❑ WATER TREATMENT PLANTS ▪ Establishment & outsourcing of 05 large scale 6000 l/hr solar based RO Plant units ▪ Installation & Outsourcing of Solar based 20 UF + Arsenic Plants (each of 2000 l/hr) in identified hotspot arsenic area ❑ Sewerage Infrastructure ▪ Provision of sewerage system (100 villages) in rural areas of RYK ❑ Outsourcing of O&M and De-silting of Drains, and Treatment Ponds in Rural Areas	❑ INFRASTRUCTURE TUBEWELL/WATER SCHEMES: ▪ Installation of 105 motor pumps each of 0.5 cusecs along the Canals. ❑ SOLARIZATION ▪ Conversion of existing 88 rural water supply scheme on Solar ❑ WATER TREATMENT PLANTS ▪ Installation & Outsourcing of Solar based 60 UF Plants (each of 2000 l/hr) ❑ Sewerage Infrastructure ▪ Provision of sewerage system (200 villages) in rural areas of RYK ❑ Outsourcing of O&M of 200 Rural WSS Scheme ❑ Installation of 3 Nos (5 MGD each) Canal water treatment plant through slow sand filter

Table 49: Proposed Rural WSS Projects for RYK

SR.	PLANNING PERIOD	RURAL WATER SUPPLY SCHEME DESCRIPTION	Mode
1	SHORT	Rehabilitation of 6 Non-Functional RO & UF Rural Water Filtration Plants RWFPs	ADP
		Rehabilitation of 44 NF Rural Water Supply Schemes	ADP
		Hygiene Awareness Package for Rural Areas	PPP
2	MEDIUM	Rehabilitation of 44 Non-Functional Rural Water Supply Schemes RWSS, and Solarization of Existing 37 Rural RO/UF Water filtration Plants	ADP
		Installation of 5 large scale 6000 l/hr solar based RO Plant Unit and 20 UF+Arsenic Plants (each of 2000 l/hr)	ADP
		Installation of 25 motor pumps each of 0.5 cusecs	ADP
3	LONG	Conversion of existing 88 rural water supply schemes on Solar – PPP	PPP
		Outsourcing of O&M of 200 Rural WSS Schemes	ADP
		Installation of 105 motor pumps each of 0.5 cusecs	ADP
		Installation & outsourcing of Solar based 60 UF Plants (each of 2000 l/hr)	ADP
		Installation of 3 canal water treatment plant (5 MGD) through slow sand filter	PPP
SR.	PLANNING PERIOD	RURAL SEWERAGE SCHEME DESCRIPTION	
1	SHORT	Provision of Open Sewerage Drains in rural areas of RYK 15 Villages	ADP
2	MEDIUM	Provision of Open Sewerage Drains in rural areas of RYK 15 Villages 100 Villages	ADP
		Engagement of Contractor for proper O&M and De-silting of Drains, and Treatment Ponds in Rural Areas (Outsourcing)	PPP
3	LONG	Provision of Open Sewerage Drains in rural areas of RYK 15 Villages- 200 Villages	ADP

Spatially proposed interventions for rural areas of RYK are presented in map figure

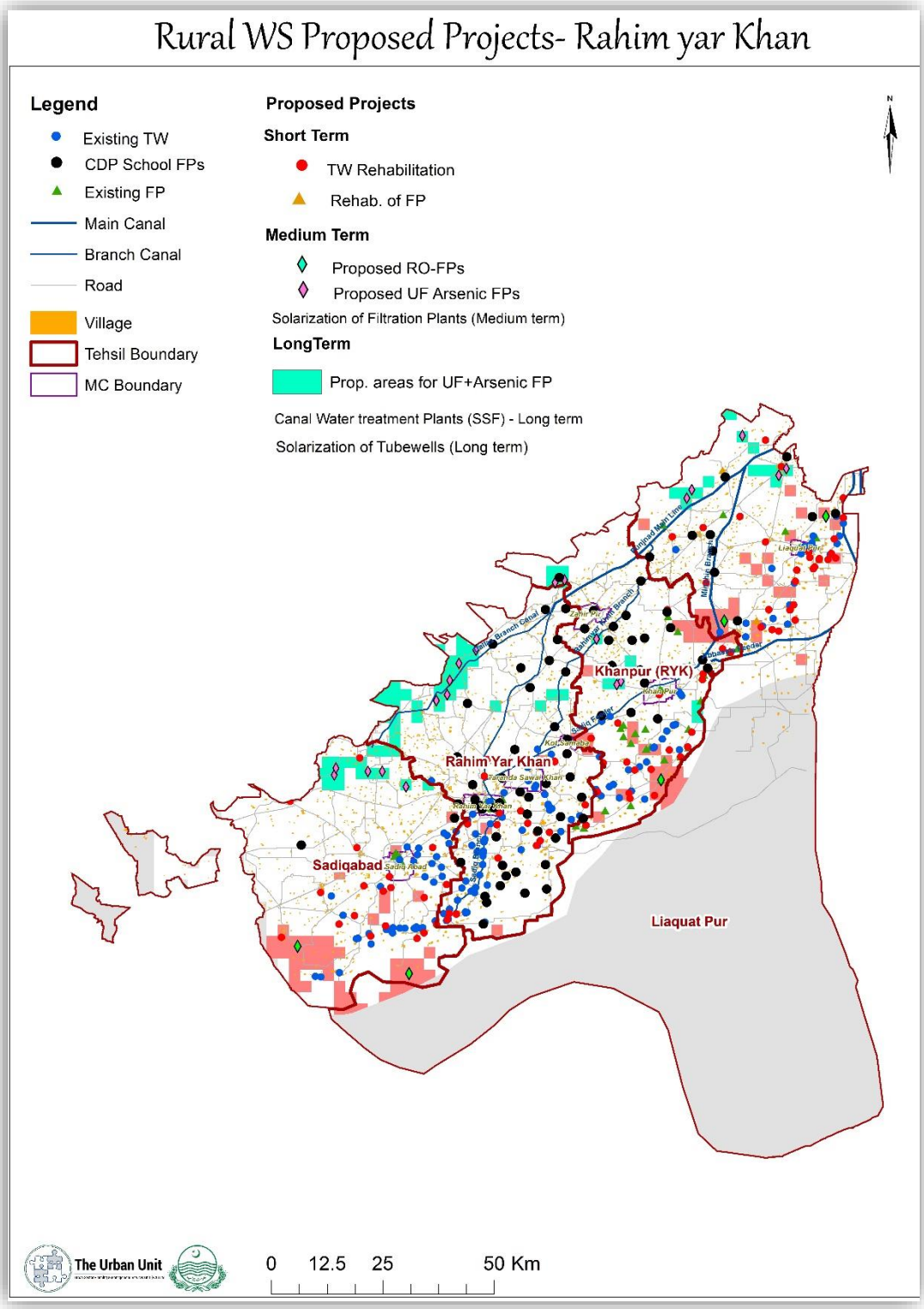


Figure 61: Proposed Spatial Rural WSS Interventions for RYK

BAHAWALNAGAR (BWN) DISTRICT

WATER SUPPLY & SANITATION

The Urban Unit

Urban Sector Planning & Management Services Unit (Pvt.) Ltd.

12. Water Supply BWN

There are two major sources developed by Municipal Committee for water supply system to Bahawalnagar city on Fordwah Canal and Sadiqia Canal. The Fordwah Canal and the Eastern Sadiqia Canal obtain their water supply through the Suleimanki Headworks located along the Sutlej River. A sub soil investigation was carried out along these canals by WAPDA Hydrology Department which declared the underground water fit for drinking purposes. Municipal Corporation (MC) Bahawalnagar is responsible to provide basic water supply services within its own limited resources to the inhabitants of Bahawalnagar city. MC Bahawalnagar has to rely on seepage water wells along canals as the sub soil water of the town is brackish and unfit for human consumption. Water from seepage wells is pumped to the reservoirs (Ground Storage Tanks & Overhead Tanks) located in different areas of the city through long distribution network. According to MC staff, water is supplied on average for 6 hrs during daylight, allowing consumers to store water in their overhead tank during night hours. Existing water supply system covers 65% of the city population as per data and statistics mentioned in Annual Report of MC Bahawalnagar.

Existing Water Supply Infrastructure

The water supply system in Bahawalnagar is composed of Tube Well stations, Overhead Reservoirs (OHRs), Ground Storage Tank (GSTs), Distribution Network and Filtration Plants. The piped water system in Bahawalnagar is supplied by tube wells constructed along Fordwah & Sadiqia canal which pump water into ground storage tanks (GSTs), overhead reservoirs (OHRs) or directly to the consumers. Domestic water needs of the people hardly met with the existing water supply system. It needs improvements i.e. rehabilitation of dysfunctional assets, addition of new water sources to meet water shortage and provision of water distribution network in the un-served area of the city. A brief overview of the existing water supply system of Bahawalnagar city is given in this section.

Overall, the existing Water Supply System is not only in sufficient to meet current and future demand but condition of the existing structure also needs attention so that clean water is delivered to the consumers. City' Existing Water Supply Infrastructure along with its condition has been geo-tagged and illustrated in below map figure.

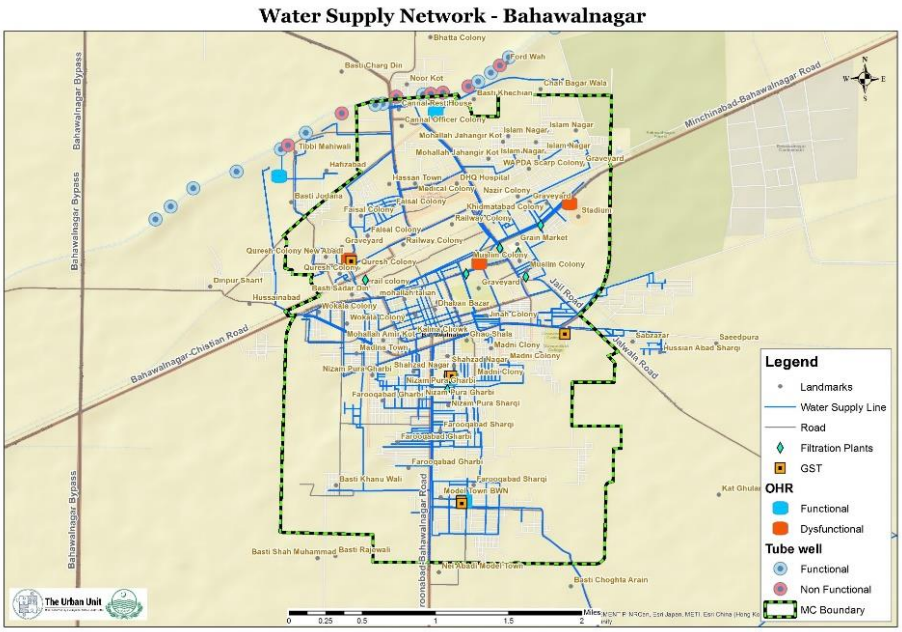


Figure 62: Baseline WS System in Bahawalnagar

12.1.1 Condition Assessment of WS Assets

Overall, the existing Water Supply System is not only insufficient to meet current and future demand but condition of the existing structure also needs attention so that clean water is delivered to the consumers. It is however, important to check the efficiency and condition of existing water supply network to figure out the scope of improvement and further extension of the network and system. For this purpose, a detailed survey was carried out in which each asset condition was determined. Asset condition was determined keeping in view the physical parameters as well as the Performance parameters. The Condition rating chart, used to rate the water supply assets is tabulated in table.

Table 50: Asset Condition Assessment Criteria

Rating	Asset Condition	Description
A	Excellent	No noticeable defects. Some aging or wear may be visible.
B	Good	Only minor deterioration or defects are evident.
C	Fair	Some deterioration or defects are evident, but function is not significantly affected
D	Poor	Serious deterioration in at least some portion of the structure. Function is inadequate
F	Failing	No longer functional. General failure or complete failure of a major structural component.

With regards to condition assessment of the water supply system, overall machinery and electrical components present at infrastructure has been evaluated and found to be lied in condition **D** which indicates the evidence of serious deterioration and function is inadequate. However, existing civil structure was observed having condition **C** indicating some deterioration or defects are evident but function is not significantly affected. Both evaluated aspects need attention to be addressed through provision of investment in up gradation of electrical components, civil structure and machinery. More than 50% of pumping stations have less than 60% efficiency, the reason being poor maintenance mechanism. There is no proper maintenance framework in place for the assets. This is why the asset condition is deteriorating rapidly. Figure 4 shows the condition of water supply assets and figure 5 presents detailed asset map.

Figure 63: Condition assessment of water supply assets

12.1.2 Tube Wells

Bahawalnagar city comes under brackish zone. No reliable water source exists inside the city. To meet the water demands of the inhabitants, tube wells are installed on seepage zones along Bahawalnagar irrigation network. There are 51 (0.5 cusecs each) tube wells installed on Fordwah canal (termed as Fordwah Old and Fordwah New) whereas 10 (0.5 cusecs each) tube wells are installed on Sadiqia canal. The installed capacity of the existing water supply system is **10.3 MGD**. However, due to dysfunctional tube wells and outdated distribution network, functional capacity reduces to **7.3 MGD.** A typical tube well at Fordwah & Siddiqia canal respectively are presented in figure 1 below.

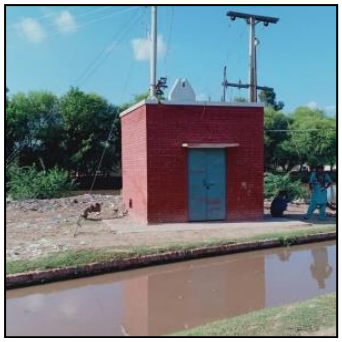



Figure 64: Tube Wells along Fort Wah and Sadiqia Canals

12.1.3 Water Storage Tanks

Storage has been constructed in the form of ground storage tanks (GST) and overhead reservoirs (OHR) as it is not possible to feed the OHRs directly from tube-wells because of long lengths of transmission mains and high pumping head involved. There are nine (9) elevated overhead reservoirs (OHR) and seven (7) ground storage tanks (GST) distributed throughout the piped network with a total storage capacity of 450,000 gallons and 650,000 gallons respectively. During survey, it was noted that four (4) OHRs are currently not in service. The status of the storage tanks is given in table and shown in figure over here.

Table 51: Operational Status of Storage Tanks

Scheme Name	No. of GSTs	Capacity (gallons)	Status	No. of OHRs	Capacity (gallons)	Status
Sadiqia Water Works	1	100,000	Working	1	50,000	Working
Old Model Town	1	200,000	Working	1	50,000	Working
Shehzad Nagar	1	100,000	Working	-	-	
	2	50,000	Working	1	50,000	Working
Quraish Colony	1	100,000	Working	2	50,000	Not working
Boys Degree College	1	100,000	Working	-	-	
Khadimabad	-	-		1	50,000	Not working
Main Water Works	-	-		1	100,000	Working
City Water Works	-	-		1	50,000	Not working
Hafizabad	-	-		1	50,000	Working
Total	**7**	**650,000**		**9**	**450,000**	

Figure 65: Overhead Reservoir and Ground Storage tank in Bahawalnagar

12.1.4 Water Filtration Plants

Total 14 filtration plants are being maintained by MC in the city to supply potable water to the inhabitants. These filtration plants use Ultrafiltration (UF) technology where water intake is provided through overhead reservoirs. All the filtration plants are in working condition, however the condition of filters and piping system was found outdated during the survey.

12.1.5 Water Supply Pipelines

The abstracted water is conveyed to storage tanks and households through combination of AC, GI and PVC pipes having diameter varying from 3" to 28". The age of these pipelines also varies but majority of the network is more than 30 years old and has outlived its usable life. Furthermore, valves and joints are also in deteriorating condition. Leakages are evident where pipes are exposed and condition of pipes is shown in figure over here.

Figure 66: Condition of water distribution network in Bahawalnagar

Planning & Design Criteria

The purpose of this planning exercise was to assess the current gaps and future water demand for the inhabitants of the city as well as rural areas of Bahawalnagar. The current population of the city is approximately 213,351 people with maximum water demand of 15.6 MGD while current functional tube wells have the capacity

of 7.3 MGD. Similarly, current population is projected for next 10 years which comes out to be 273,325 in 2031 with maximum daily water requirement of 20 MGD.

Based on the current and projected populations for the Municipal Committee and the proposed water demand of 35 gallons per capita per day, the current (2021) water demand and future (2023, 2026 and 2031) water demands are shown in Table below, for the existing and potential future service areas.

Industrial water demand is assumed only 10% of the total water consumption, as there exist less industrial units in city. Commercial and institutional demands have been assumed as 15% and 10% of the total water consumption respectively. The water losses are assumed as 0% as 35 GPCD includes water losses as well. The interventions are proposed for short, medium and long-term phases keeping in view the respective year's water demand.

Table 52: Water Demand Projections Bahawalnagar

Description	Water Demand (Gallons per Day)				
	2017	2021	2023	2026	2031
Population	194,042	213,351	223,803	243,133	273,325
Domestic (MGD)	6,791,470	7,467,300	7,833,091	8,509,666	9,566,367
Commercial (MGD) (15%)	1,018,721	1,120,095	1,174,964	1,276,450	1,434,955
Institutional (MGD) (10%)	679,147	746,730	783,309	850,967	956,637
Industrial (MGD) (10%)	1,018,721	1,120,095	1,174,964	1,276,450	1,434,955
Total Avg. Demand (G/D)	9,508,058	10,454,220	10,966,327	11,913,532	13,392,913
Total Max Demand (G/D)	14,262,087	15,681,330	16,449,491	17,870,298	20,089,370
Total (MGD)	**14**	**15.6**	**16.4**	**17.8**	**20**

Similarly, drinking water demand is calculated for all the tehsils of district Bahawalanagar as well by considering 3 liter per capita per day as drinking water needed as per WHO guidelines.

Table 53: Drinking Water Demands of District Bahawalnagar

Tehsils	Population	Current Drinking Water Demand (liters)	Future Drinking Water Demand (Liters)

	2017	2021	2023	2026	2031
Bahawalnagar	813,390	2,682,995	2,813,324	3,020,784	3,401,101
Chishtian	689,766	2,275,217	2,385,738	2,561,667	2,884,180
Fort Abbas	422,768	1,394,515	1,462,255	1,570,084	1,767,758
Haroonabad	524,715	1,730,791	1,814,866	1,948,697	2,194,038
Minchinabad	525,017	1,731,787	1,815,910	1,949,819	2,195,301

Design Criteria

Following design criteria for water supply system has been based on "Technical and Service Delivery Standards for Water Supply and Sanitation Sectors" 2008 by Punjab Devolved Social Services Program (PDSSP) with some proposed practical modifications is used in demand calculations and proposed to be used for detailed designing of interventions.

Planning Horizon:

Planning horizon for this development plan is ten years i.e. 2021-2031. Short, medium and long term phases are identified for 2, 3 & 5 years i.e. 2023, 2026 and 2031 respectively.

Population Projection:

The population is estimated for the year 2023, 2026 & 2031. The growth rate was taken from District Census Report and population projection has been worked out as per the following formula:

$$P_n = P_o (1+r)^n$$

Where,

P_n = Projected population for required year

P_o = Population of base year

r = Annual population growth rate

n = Number of years, counted from base year

Growth rate, in the case of Bahawalnagar, is taken as 2.42%.

Maximum Day Demand:

Maximum day demand is taken as 1.5 times the average day demand.

Tube Well Working Hours:

Tube Well Working Hours are taken as 16 Hours/day in city as proposed in Design Criteria for WASAs by Urban Unit.

Storage Capacity:

The water storage capacity is taken as 1/10th of average day demand as stated "Capacity of overhead reservoirs in case of communities having population more than 10,000 persons should be based on around 1/10th of average day demand".

Drinking water Requirement:

The treated drinking water requirement is taken as 3 Liter per capita per day (lpcd) as per World Health Organization (WHO) guidelines.

Proposed Interventions in BWN City

According to the conditional assessment of the water supply assets, dysfunctional and outlived assets need to be replaced on immediate basis for improved water supply coverage. However, to cater the future demands, extension of services is also made part of this development plan. Furthermore, in order to reduce energy expenditures, multiple solar based projects are also included in interventions. Location of these new proposed interventions have been shown in the proposed development map however these locations are tentative and can be changed as per the requirement of the stakeholders involved. Land-use and MC ownership are also one of few factors involved in the process of allocation of infrastructure involved. Location of tube wells is also subject to detailed Hydrological and Geotechnical surveys in order to make full use of assumed yield from the tube wells however suggested tube wells should preferably be placed along Fordwah and Sadiqia canal. The recommendations for sustainable water supply are divided into three phases: i.e. Short (0-2 Years), Medium (2-5 years) and Long term (5-10 years) phases.

12.1.6 Short Term Plan (2021-23)

In the initial short-term period, primary focus is given on rehabilitation of non-functional or deteriorated water supply infrastructure. In today's modern age, IT Technology is playing a key role in effective management and monitoring of municipal services for evidence based planning and right decision making for policy makers, therefore, MIS based digital monitoring is made part of the plan. Recommendations for immediate implementation majorly include the rehabilitation and replacement of identified poor water supply pipelines which needs instant replacement.

Table 54: WS Short term interventions in BWN City

Sr. No	Interventions (2 Years)	Mode
1	Rehabilitation of 16 tube wells (0.50 cusec each) on Fordwah Canal and 06 tube wells (0.5 cusec each) on Sadqia Canal	ADP
2	Replacement of WS distribution network in the following areas: i. Faisal Colony, New Quraish Colony **(UC-1)** ii. Wuqla Colony, Moh. Sheikhanwala, Moh. Titlianwala **(UC-2)** iii. Madni Colony, Nizampura west, Farooqabad **(UC-4)** iv. Moh. Islam Nagar **(UC-5)** v. Muslim Colony **(UC-6)** vi. Katchehry Road 15" (1.76 km)	ADP

3	Rehabilitation of 4 OHRs in Quraish Colony, Khadimabad and City Water Works	ADP
4	Energy audit of WS schemes to reduce power costs and to find out energy management opportunities	ADP
5	Provision of Roof top solar system (4 kW) for 14 filtration plants through public private partnership	PPP
6	Establishment of IT Data Center and GIS Cell (Procurement of Computers, Scanners, Printers, Software) in Municipal Corporation Bahawalnagar	ADP
7	Establishment of one window facilitation center at MC Bahawalnagar	ADP

12.1.7 Medium Term Plan (2023-26)

The three years medium term development plan includes installation of Water Supply Infrastructure such as Tube Wells, OHRs and GSTs to cater the gap between water supply and water demand. Shifting to renewable energy is considered in the plan to avoid high burden on electricity cost through development of canal top solar based plants for tube wells. One of the key interventions is the need of the conducting feasibility study for identification of suitable water recharge methods in consultation with Irrigation Department because of presence of brackish water and high reliance of seepage water of canals. Summarized water supply interventions for Bahawalnagar for medium term plan are articulated here in the table below.

Table 55: WS Medium Term Interventions in BWN City

Sr. No	Interventions (5 Years)	Mode
1	Provision of mobile workshop units (3 vehicles) with trained staff	ADP
2	Development of canal top solar plant (500 kW) on Sadiqia canal for conversion of electricity source of tube wells	PPP
3	Construction of 02 GSTs (150k gal each) with 02 OHRs (150k gal each) in Madina Town and Hussainabad	ADP
4	Construction of 05 tube wells (0.5 cusec each) on Sadqia Canal (Connected to Solar Plant)	ADP
5	Construction of 02 UF filtration plants with newly constructed OHRs in madina town and Hussainabad (2000 lph)	ADP
6	Extension of WS distribution network to the unserved areas of Madina Town and Hussainabad	ADP
7	Feasibility study on suitable artificial recharge methods with Irrigation Department	PPP
8	Development of Operation and Maintenance store in MC Bahawalnagar with adequate spares	ADP

12.1.8 Long Term Plan (2026-31)

Large scale interventions have been made part of the long-term plan for making the water supply system more efficient. Along with installation of new water supply infrastructure, including Tube wells, OHRs, and GSTs, new HDPE water supply lines in identified unserved or poorly served areas of the city are proposed to be laid down. SCADA system is proposed to be installed in the city for effective supervision of water supply system by MC

Bahawalnagar. Summarized water supply interventions for Bahawalnagar for long-term plan are articulated here in the table below.

Table 56: WS Long term Interventions for BWN City

Sr. No	Interventions (10 Years)	Mode
1	Establishment of DNI zones in the areas: Nizampura East and Nizampura West	PPP
2	Construction of 05 tube wells (0.5 cusec each) on Sadqia Canal (Connected to Solar Plant) and 05 tube wells on Fordwah Canal	ADP
3	Construction of 03 GSTs with 03 OHRs Qaimabad, Hassan Town and Liberty Bazar	ADP
4	Extension of WS distribution network Basti Rajaywali, Islampura Sharqi and Ahmad Town	ADP

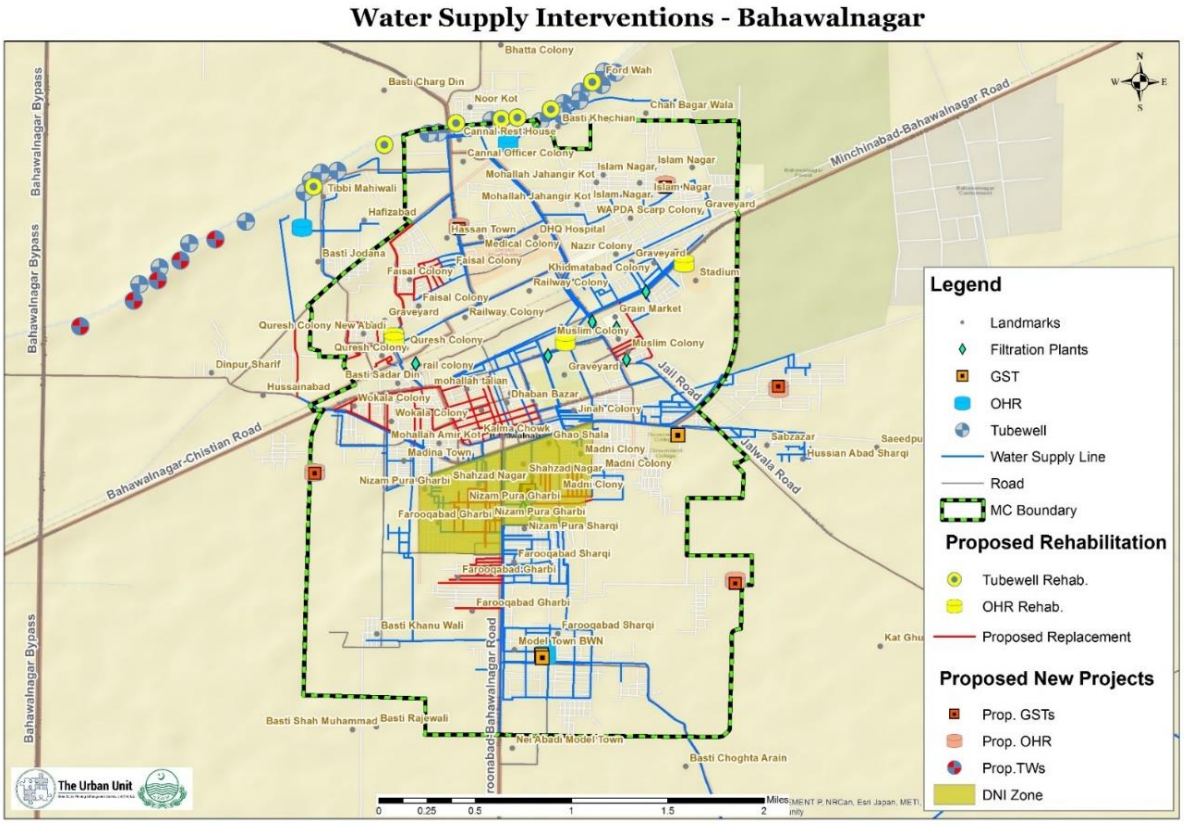


Figure 67: Proposed Spatial WS Interventions for BWN City

13. Sewerage System BWN

The responsibility of safe disposal of sewage and drainage lies on Municipal Corporation (MC) Bahawalnagar. The city has been divided in to four zones with respect to drainage. This zoning of sewerage network has been in place to avoid laying of sewer lines under sub soil water at maximum. All zones are being served by pumping/disposal stations. RCC sewer pipes of varying diameters from 9" to 42" are laid in each zone for the conveyance of waste water. Overall 60% coverage area with sewerage system is reported by MC Bahawalnagar.

Existing Sewerage Infrastructure

Zone A can be considered as the center of the city. Madina town, Railway colony, Quraish colony, Bukhari colony and Amir kot are some densely populated areas which fall under zone A. A newly constructed disposal works of this zone is located in Madina town and the waste water from this disposal works is being pumped through a force main which is being used for broad irrigation. However, the outfall capacity of the channel being used for conveyance is limited which restricts the overall operational capacity of the pumping station. Furthermore, the efficacy of tertiary sewerage system is insufficient in more than 50% of the area which causes water flooding in streets.

Zone A-2 is relatively a small area as compared to other zones. Some of the major areas are Khadimabad, Muslim colony and Sadaat colony. There are two small scale disposal stations in this zone called Hassanabad and Karmanwala disposal station. Both the disposal stations are interconnected where Karmanwala disposal station disposes the waste water to seepage drain carried by Hassanabad disposal station.

Zone B is the largest zone by area. Model town, Nizampura east & west, Shehzadnagar, Madni colony and Bihari colony are some major areas of the zone. There are two disposal stations located in Madni colony and Model town. The disposal station in model town has outlived its useful life which makes it difficult to manage the waste water generated by the area. On the other hand, Madni colony disposal station is relatively in better condition but facing crown failure problems.

Zone C lies in the northern part of the city which contains areas of Faisal colony, Officer colony, Nazar colony and Qaimabad. The disposal works of this zone is located in Islam nagar and the waste water from this disposal works is being pumped into seepage drain. Most of the machinery in this disposal station is not operational which makes it incapable to manage the waste water efficiently.

Overall, the existing Sewerage disposal system is sufficient to meet current and future waste disposal demand of the city but condition of the existing structure especially sewerage lines needs attention so that sewage is properly disposed-off. It is also pertinent to mention that most of the city area is either deprived of proper sewerage lines or the existing lines are outdated (as indicated through color yellow & red) and result in to the

ponding in the areas. City' Existing Sewerage Infrastructure along with its condition has been geo-tagged and illustrated in below map figure.

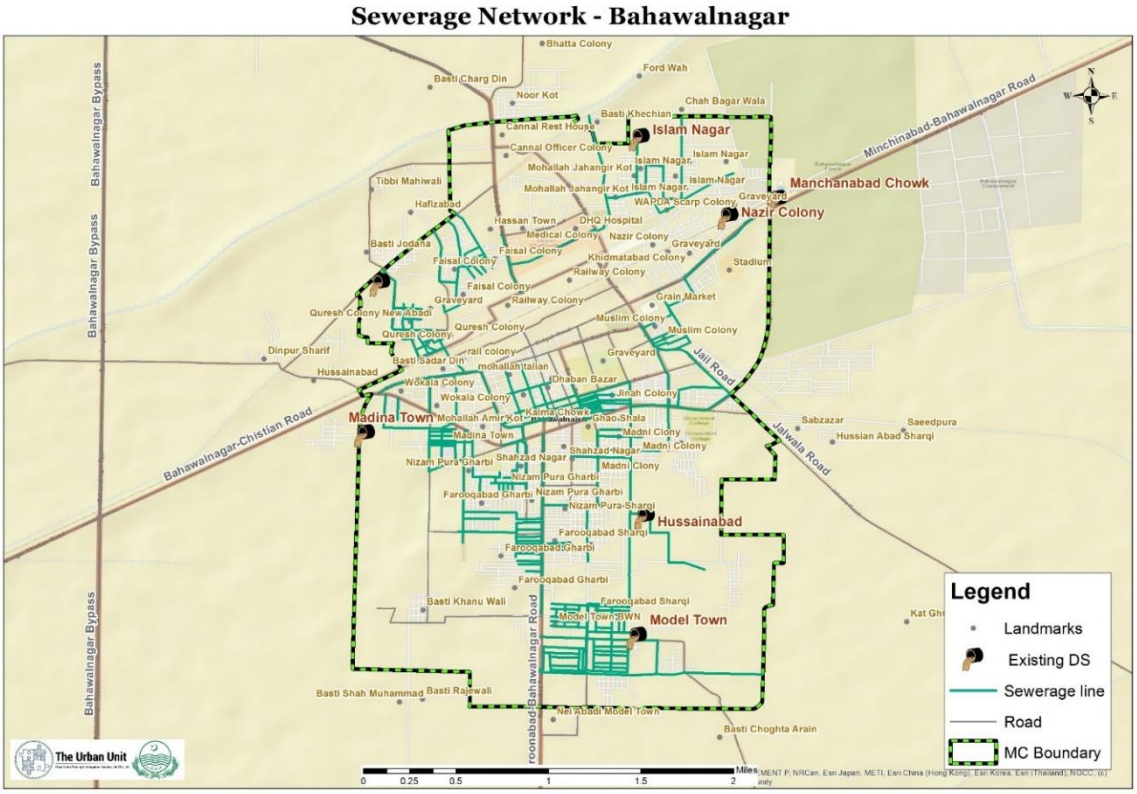


Figure 68: Baseline Sewerage System in BWN City

Team conducted in-field survey of sewerage system infrastructure including disposal stations and wastewater treatment plants. The infrastructure present in the city was geo-tagged and evaluated with respect to above-mentioned condition assessment criteria.

13.1.1 Disposal Stations:

The detailed condition assessment exercise conducted on the disposal stations in Bahawalnagar city during survey is articulated in table 5 supported by some photographs in figure 8. This assessment activity was based on the same condition rating chart used for water supply assets. (See table 2)

Table 57: Condition Assessment of Disposal Stations

Location	Pumps	Disposal	Condition Assessment		
			Civil	Electrical	Mechanical
Madina Town	7	Irrigation	B	B	B
Hussanabad	4	DS	C	D	C
Karmanwala	4	Seepage Drain	C	D	D
Madni colony	4	Seepage Drain	B	C	C
Model Town	1	Seepage Drain	D	D	D

Islam Nagar	5	Seepage Drain	C	D	D

Figure 69: Condition of Disposal Station in BWN City

13.1.1.1 Supporting Machinery

Number of sewers are being silted up and chocked because of negligence in de-silting of the sewers. Manual de-silting of manholes is being done by MC but it is not so effective unless the silt from the barrel of the pipes is removed. Furthermore, there are only 01 sucker and 01 jetting machines being used by MC to remove blockades and cleaning of sewers. The sucker and jetting machines are quite old and require repairs along with supply of required pressure pipe for jetting machine.

Planning & Design Criteria

The purpose of this planning exercise was to assess the current gaps and future wastewater disposal demand for the citizens of the city. The current population of the city is 213,351 with total wastewater flow of 16.27 MGD while current functional disposal stations are sufficient to withstand this flow. However, to cater the demands in future, up gradation of existing outdated and poor condition disposal stations are proposed and additional new disposal station is recommended as discussed as highlighted by MC Bahawalnagar. The foremost and essential need is the replacement and installation of new sewerage lines in poorly served and underserved areas of the city.

Based on the current and projected populations for the Municipal Committee and the proposed water demand of 35 gallons per capita per day, the current (2021) and future (2023, 2026 and 2031) wastewater production are shown in Table below, for the existing and potential future service areas.

Table 58: Estimated Sewage Generation

Year	Population	Per Capita WW	Average Flow		Peak Flow	Storm Water		Non-Domestic Flow		Infiltration		Total Flow (Peak + storm + non-domestic + infiltration)	
		gpcd	MGD	Cusec	MGD	MGD	Cusec	MGD	Cusec	MGD	Cusec	MGD	Cusec
2021	213,351	28	5.9	9.12	11.8	3.89	6	0.29	0.48	0.29	0.48	16.27	25.17
2023	223,803	28	6.2	9.59	12.4	4.1	6.34	0.31	0.49	0.31	0.49	17.12	26.4
2026	243,133	28	6.8	10.5	13.6	4.5	6.96	0.34	0.52	0.34	0.52	18.78	29
2031	273,325	28	7.6	11.7	15.2	5	7.7	0.38	0.58	0.38	0.58	20.96	32.4

Wastewater is taken as 80% of water demand. Peak flow is calculated by multiplying average flow with factor of 2 as per population of the city. Storm water is taken as 33% of peak flow, Non-domestic flow and Infiltration as 5% of average flow.

Proposed Interventions

Considering the fact, that few of the areas have proper sewerage lines coverage Bahawalnagar City, it is important that actions and steps are taken in a way that can provide safe transmission of wastewater.

Based on the existing infrastructure analysis including condition survey and service delivery gap analysis the recommendations for sewerage system are divided into three phases: i.e. Short (0-2 Years), Medium (2-5 years) and Long term (5-10 years) phases.

13.1.2 Short Term Plan (2021-23)

In the initial short-term period, major focus is given on rehabilitation of poorly condition sewerage lines and large trunk infrastructure. Recommendations for immediate implementation majorly include the rehabilitation and replacement of identified poor pipelines, which needs instant replacement.

Table 59: Proposed Short Term Sewerage Projects for BWN City

Sr. No	Interventions	Mode
1	Rehabilitation of Electrical and Mechanical Machinery and discharge lines in Islam Nagar Disposal Station (4 NF Pumps)	ADP
2	Capacity enhancement of force main on Madina Town Disposal Station	ADP
3	Replacement & capacity enahncement of Sewerage & drainage network in water flooded areas: 1. Old Model Town (9" with 12", 12" with 15", 15" with 18") 2. New Quraish Colony (15" with 18") 3. Moh. Farooqabad (15" with 18")	ADP

	4. Replacement of 18" RCC sewer line with 24" RCC sewer line on 22 ft Road (650m)	
4	Energy audit of disposal stations to reduce power costs and to find out energy management opportunities	
5	Capacity enhancement of Karmanwala Disposal Station through provision of 3 sets of pumping machinery (50 HP each)	ADP
6	Provision of Electrical and Mechanical spares (Valves, Joints, Circuit Breaker, Cables etc)	ADP
7	On-job-training to sewer men and disposal station operators in collaboration with TEVTA	PPP

. Medium Term Plan (2023-26)

Medium term interventions include the upgradation of disposal station. Installation of New Sewerage lines in Khadimabad Colony, Muslim Colony, Muhajir colony, Quraish Colony and adjacent areas are proposed where voices were raised for the need of sewerage lines from residents and as well as the department. Overall, the efficiency of the whole municipal services in city can be improved through considering the outsourcing to private contractor option for efficient O&M mechanism. Considering the sewerage situation of the city, more machinery is proposed to be provided.

Table 60: Proposed Medium Term Sewerage Projects for BWN City

Sr. No	Interventions	Mode
1	Establishment of new disposal station (4 pump sets and two collection tanks) in Moh. Hafizabad	ADP
2	Upgradation of existing mini disposal station in Nazir Colony by providing (3 sets of pumping machinery 30 hp each)	ADP
3	Extension of lateral sewerage network in the following: 1. Khadimabad colony, Muslim Colony, Muhajir Colony 2. Moh. Sheikhanwala, Moh. Titliyanwala, Lawyers Colony 3. Quraish Colony (Old), Nazir Colony	ADP
4	Provision of 2 Nos. Sucker and 2 Nos. Jetting Machines to MC Bahawalnagar	ADP

13.1.3 Long Term Plan (2026-31)

Unserved and expanded areas of the city are intended to be covered through Installation of Sewerage System. In addition to it, for safe and environment friendly disposal to waste water, a waste water treatment plant is recommended for the city.

Table 61: Proposed Long Term Sewerage Projects for BWN City

Sr. No	Interventions
1	Extension of Sewerage network to the following areas: 1. Basti Muneerabad 2. Basti Rajay wali 3. Farooqabad Colony 4. Islampura Sharqi 5. Nazarwali Basti

Sr. No	Interventions
2	Construction of Waste water treatment plant (WWTP) on Madina Colony Disposal Station

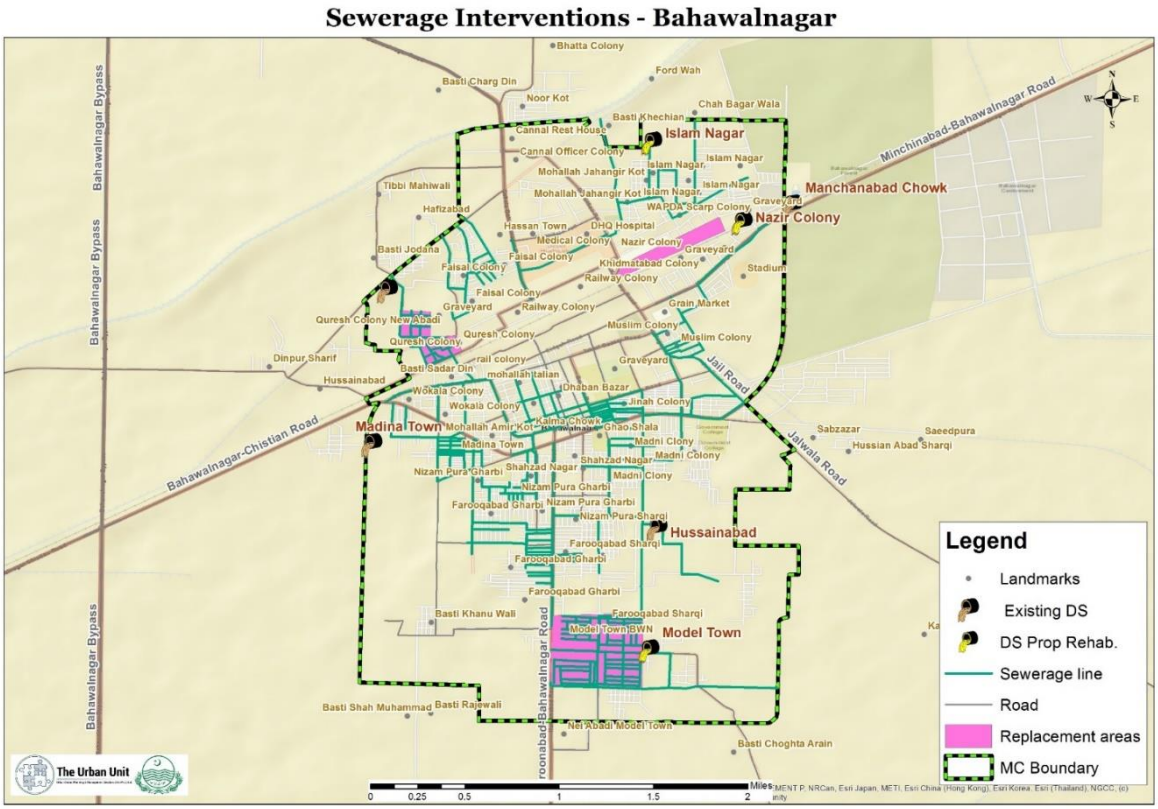


Figure 70: Proposed Spatial Sewerage Interventions for BWN City

14. Rural WSS BWN

Rural area of district Bahawalnagar covers huge population of 2.3 million (according to population census 2017) where people are deprived of proper water supply & sanitation facilities. Public Health Engineering Department (PHED) has the prerogative to designs and executes water supply and sewerage schemes and handover to Community Based Organizations (CBOs) for its operation and maintenance.

Existing Scenario

According to UNICEF 2019 study, rural area of district Bahawalnagar is given 32nd rank among all 36 districts of Punjab based on WASH Index, which depicts the worst situation of WASH facilities over there. Similarly, latest available MICS indicators also show the presence of 31% safely managed sanitation in contrast to 55% safely managed water in rural area, which indicate the need of sanitation intervention.

14.1.1 Rural Water Supply Schemes & Filtration Plants

According to official statistics, total 554 rural water supply schemes have been installed by PHED in Bahawalnagar district. Detail facts and status is presented in table 5, which indicates the presence of considerable number of non-functional infrastructure. All schemes are based on 0.5 cusecs tube wells installed along canal and supplying water at an average of 4 hours per day after chlorination. Data provided by CBOs revealed that current functional rural water supply schemes are insufficient to cater the population of Bahawalnagar.

According to data provided by PHED and CBOs, there are total 71 water filtration plants are present in Bahawalnagar district. These filtration plants work on the capacity of 2000 liter per hour and provide clean drinking water to communities for average 5 h/day. Among these installed 71 filtration plants, there are 46 Ultra Filtration plants whereas 25 of them are Reverse Osmosis filtration plants. Detailed information of existing rural water supply schemes & filtration plants are attached in **Annexure**.

14.1.2 Rural Water Quality

The ground water in Bahawalnagar is not suitable for drinking purposes due to marginal and substandard quality apart from areas, which lie close to canals and river Sutlej. Majority of the inhabitants have complaints about the poor quality of water, which is often found colored, turbid and bacterial contaminated. Ground water occurs in abundance in the district at variable depths from the natural surface level. It can be divided into fresh/sweet water zone and brackish water zone. For sweet water zones, ground water is the source of choice and can be obtained through the installation of tube wells. The ground water available in the brackish zone is not fit for drinking purpose due to impurities dissolved in the form of salts and metals termed as total dissolved solids (TDS) and as well as Arsenic. It is observed that 16% TDS and 5% Arsenic contamination is present as per secondary UNICEF water quality data of Bahawalpur villages. In the absence of proper water supply system people are forced to drink this contaminated water due to which they are suffering with water borne diseases like dysentery, cholera and typhoid fever. The data referred of water quality is quite old and there is need to investigate the existing water quality of the city to identify the sweet pocket zones available and provide water

through groundwater aquifer sweet zones. The Water Quality Contamination spots in Bahawalnagar is shown over here from map.

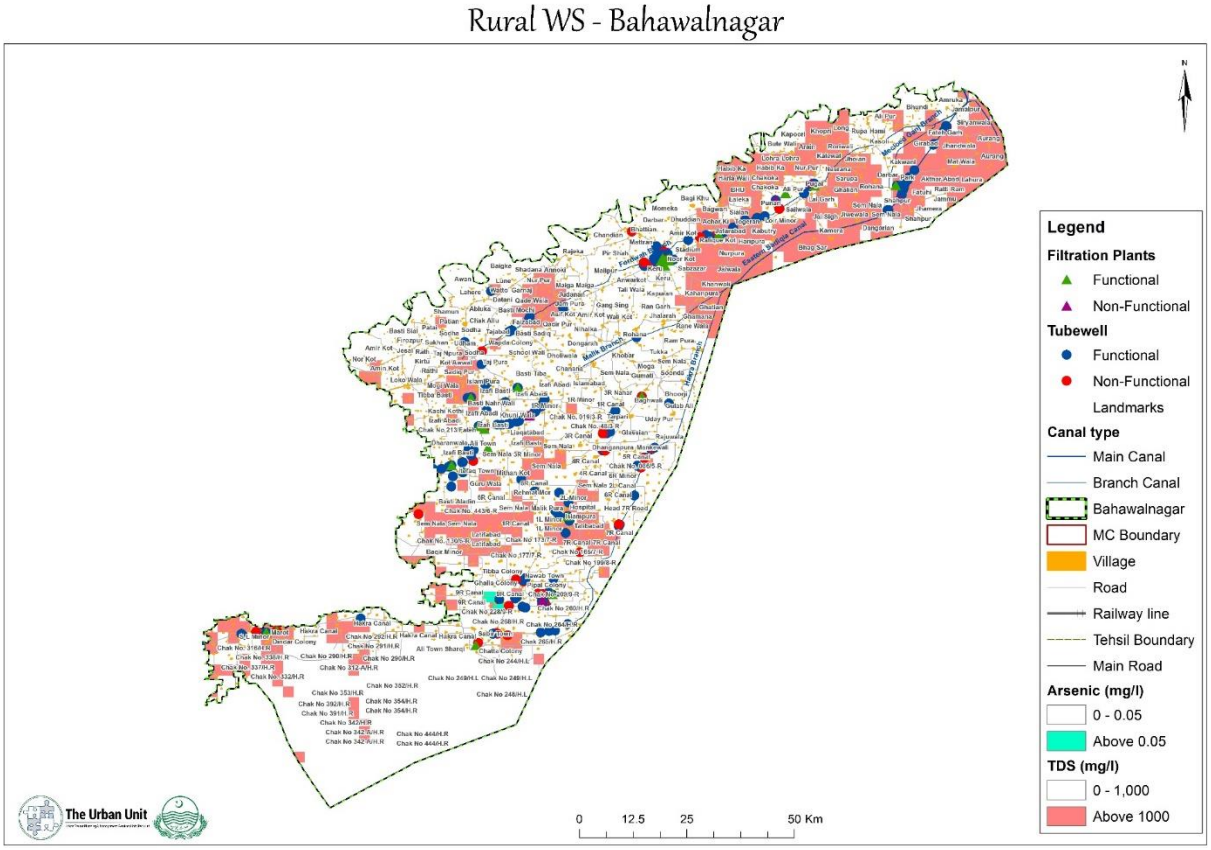


*Figure 71: Baseline Rural WSS in B**WN***

Proposed Interventions

For the Rural areas, following Interventions have been proposed:

14.1.3 Short Term Plan (2021-23)

Rehabilitation of existing Rural WSS infrastructure including water supply schemes and filtration plants are proposed. While provision of simple sewerage system having scope of drains and small disposal station in villages are proposed.

14.1.4 Medium Term Plan (2023-26)

Installation of unit with motor pumps each of 0.5 cusecs along the Canals are envisaged and outsourcing and Engagement of contractors for maintenance of unit and supply bottled water to people of villages is made part of the short-term plan. Shifting of solar energy from electricity is proposed for existing water filtration plants. Solar-based large scale RO plants units with mobile ATM machines and Ultra Filtration Arsenic Removal plants are spatially proposed to be outsourced in identified hotspot contaminated areas to provide safe drinking water to people. Provision of simple sewerage system having scope of drains and small disposal station in villages are proposed.

14.1.5 Long Term Plan (2026-31)

Existing rural water supply schemes are proposed to be shifted on Solar Energy. The issue of operation & maintenance (O&M) of rural water infrastructure is addressed through proposal of outsourcing for effective management. For clean drinking water, installation and outsourcing of Ultra Filtration Plants are proposed. Furthermore, option of surface water treatment plants such as slow sand filter on canal water is also anticipated in long term for provision of safe drinking water. Provision of simple sewerage system having scope of drains and small disposal station in villages are proposed. Outlook of brief interventions and projects proposed for rural water supply & sanitation (wss) plan is expressed in tables.

Spatially proposed interventions for rural areas of Bahawalnagar district are presented in map

Table 62: Rural WSS Interventions for BWN

SR. No.	PLANNING PERIOD	RURAL WASH DESCRIPTION	MODE
1	SHORT	Rehabilitation of 90 dysfunctional rural water supply schemes	ADP
2		Hygiene Awareness program	ADP
3		Provision of sewerage drains with mini disposal station for 71 villages having population more than 5000 people	ADP
4	MEDIUM	Solar system for existing (RO & UF) 71 filtration plants	ADP
5		Construction of solar based 265 RO plants through PPP Mode in public schools	PPP
6	LONG	Construction of solar based remaining 265 RO plants through PPP Mode in public schools	ADP
7		Provision of oxidation ponds to 71 villages for safe disposal to agriculture fields	ADP

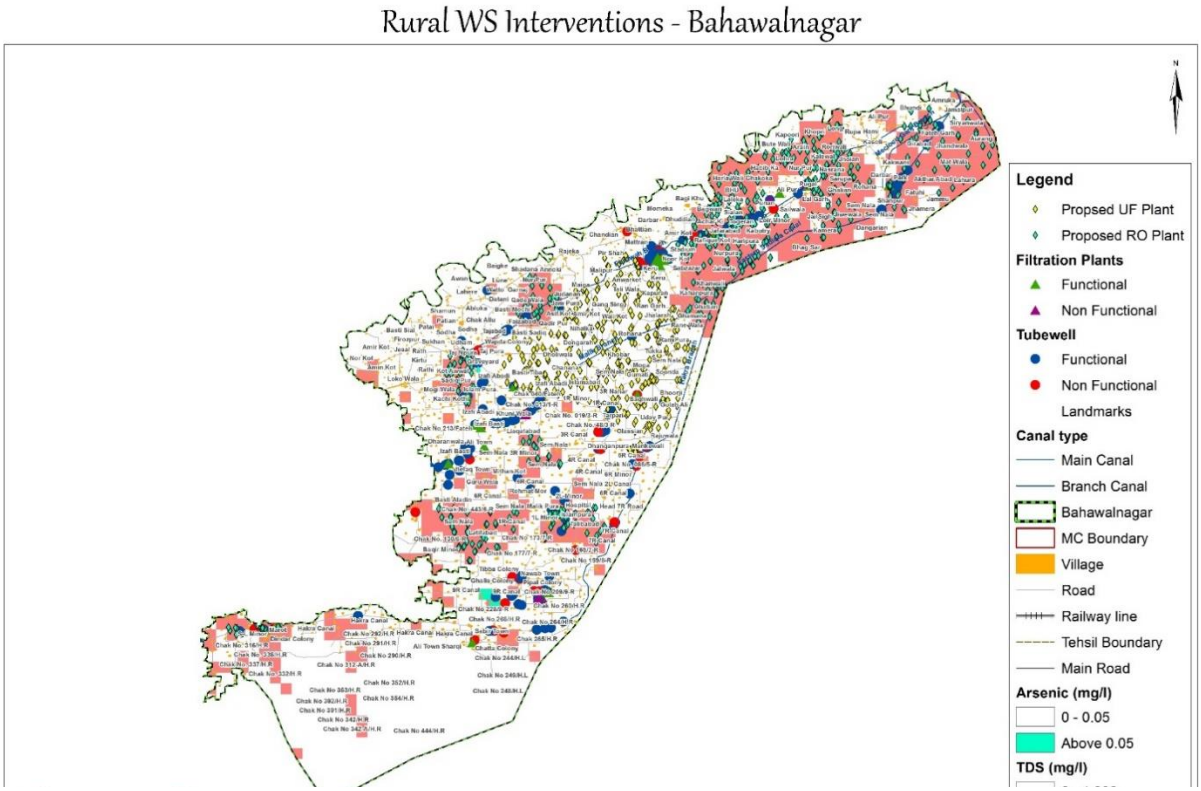


Figure 72: Proposed Spatial WSS Interventions in Rural BWN

15. Divisional Interventions

Other than hard-core city specific interventions, there are some other soft components, which were neglected in the past and in dire need to be addressed to bring Institutional and Governance reforms in the division.

Institutional Reforms

As per laws and regulations, Local Government & Community Development Department (LG&CDD) is responsible for provision of water and sanitation services in the cities. MCs are currently managing the Operation & Maintenance (O&M) of Water Supply and Sanitation (WSS) along with many other delegated functions in Bahawalpur, Rahim Yar Khan and Bahawalnagar districts.

MC consists of the Administrator, Chief Officer (CO), 5 Municipal Officers (MO) and other officials of the Local Council Service and officials of the offices delegated to the Municipal Committee. Administrator is the head of Municipal Committee and exercises all functions and powers as have been assigned to him. The Chief Officer is acting as coordinating and administrative officer in-charge of the Municipal Officers. Furthermore, Municipal Officers (MO), Deputy MOs and Assistant MOs support the above staff. These officers are looking into Infrastructure and Services (I&S), Finance, Regulation, Information Technology (IT), Planning & Architecture

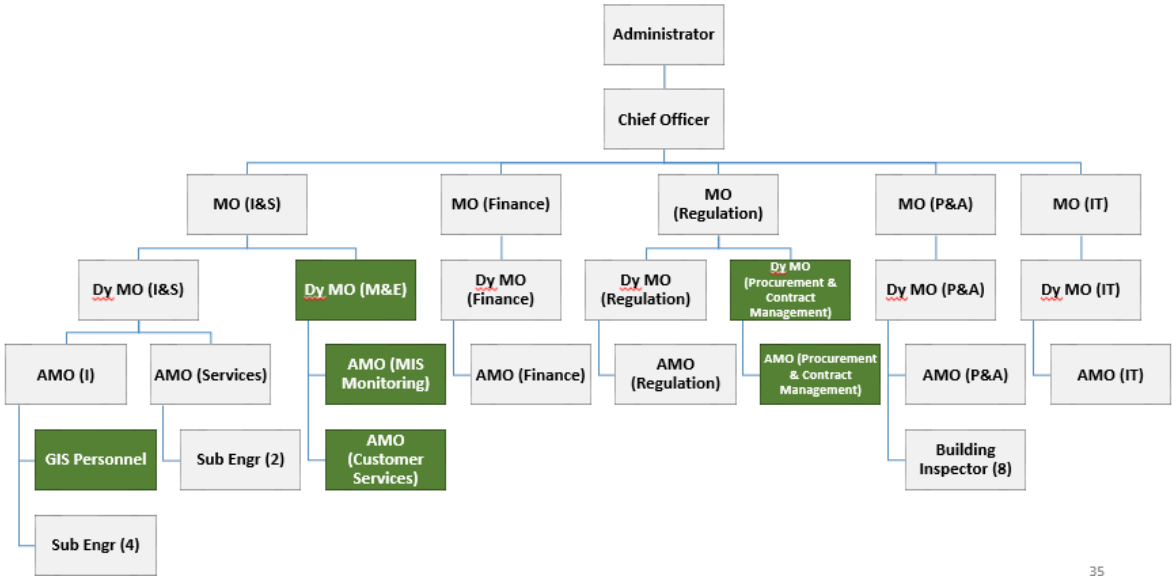


Figure 73: Proposed Institutional Structure for MCs

(P&A) head functions.

It is observed that some of the essential components of municipal services are neglected by the existing staff due to lack of proper relevant Human Resource (HR). The embedding of aspects of Asset Management, geo-tagging, mapping and monitoring along with Complaint Management in service delivery results in to efficient management, accountability and customer satisfaction.

Geographical information System (GIS), Monitoring & Evaluation (M&E), Customer Services, MIS based Monitoring and Procurement & Contract Management are identified and proposed in green color to be added in the existing structure.

Adaptation of Renewable Energy (Solar)

Huge potential of Solar Energy using Canal Top Solar & Roof Top Solar Systems is evaluated and proposed to capture to cater electricity needs in an economical and environment friendly way

Table 63: Estimated Bahawalpur Solar Potential

Sr. No	Facility	District	Potential	Cost	Capacity
1	Central Library (Rooftop)	Bahawalpur	72 kW	7.2 Million	Complete Load
2	Museum (Rooftop)	Bahawalpur	140 kW	14 Million	Complete Load
3	Quaid e Azam Medical College (Rooftop)	Bahawalpur	250 kW	25 Million	Major Load
4	Canal Top Solar (Ahmedpur Canal)	Bahawalpur	500 kW	51 Million	Major Load (Tube wells)
5	Allama Iqbal Library (Rooftop)	Rahimyar Khan	31 kW	3.1 Million	Major Load
6	DHQ Hospital (Rooftop)	Bahawalnagar	270 kW	27 Million	Major Load
7	Commerce College	Bahawalnagar	145 kW	15 Million	Major Load
8	Canal Top Solar (Sadqia Canal)	Bahawalnagar	500 kW	51 Million	Major Load (Tube wells)
			Total 1,908 kW	**Total 193 M**	

Canal top solar plant of 500 KW is proposed along Ahmedpur Branch Canal for 18 Tube Wells in Bahawalpur. On average, 400,000 electricity units (kwh) are consumed annually by 18 tube wells along the AP branch canal

Figure 74: Shots of Roof Top Solar Panels in BWP

BWP. This canal top solar plant will be capable of handling the load and PKR 17.3 Million will be saved annually (electricity cost)

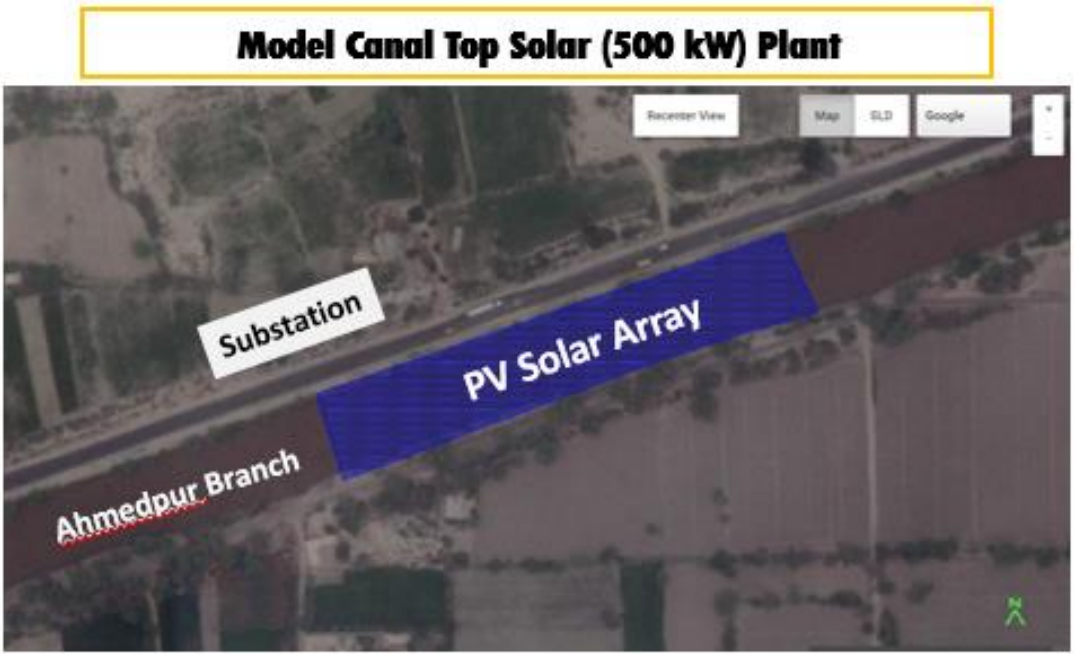
Total typical Load Requirement for these tube wells are estimated as:

- Total Load = 270 kW (15 kW each)
- Annual units @ 5 hrs (0.80 PF) = 400,000 kWh
- Annual Electricity Cost = PKR 17.3 Million
- *Average PKR 80,000 electricity cost per Tube well

To cater the need, following technical specifications along cost are evaluated for Solar Panels to be installed

Technical Specifications

- Average Solar Irradiance = 5.86 W/m²
- Total Area = 94,806 ft² (2.1 Acres)
- Total DC Potential = 650 kW
- Total AC Potential = 520 kW



- Annual AC units = 1,328,600 kWh (at Avg. 7 hours)
- Tentative Cost = PKR 90 Million (PKR 100/Watt)

Figure 75: Shot of Canal Top Solar in BWP

MIS based Monitoring

MIS based Monitoring System and Mobile App is proposed to be developed for Monitoring of Water Supply and Sewerage Infrastructure. Concerned official will upload the all attributes of relevant WSS infrastructure. Functional or Non-Functional Status will help in identification of Repair & Maintenance Investments. All relevant attributes related to Water Supply and sewerage System Components with Pictures will be present on Portal. Moreover, Served Population, No of Connections, Revenue Collection and Finance related data will also be derived from the system. The system will result in to GIS based Asset Mapping and monitoring and help in evidence based planning and investment.

Monthly Survey can be carried out of these Ge-Tagged WSS Units and Indicators data will be uploaded through Mobile application by engagement of Youth. Continuous Monitoring of these units will result in Accountability and Respective required Actions for any Dis-Functionality or issue

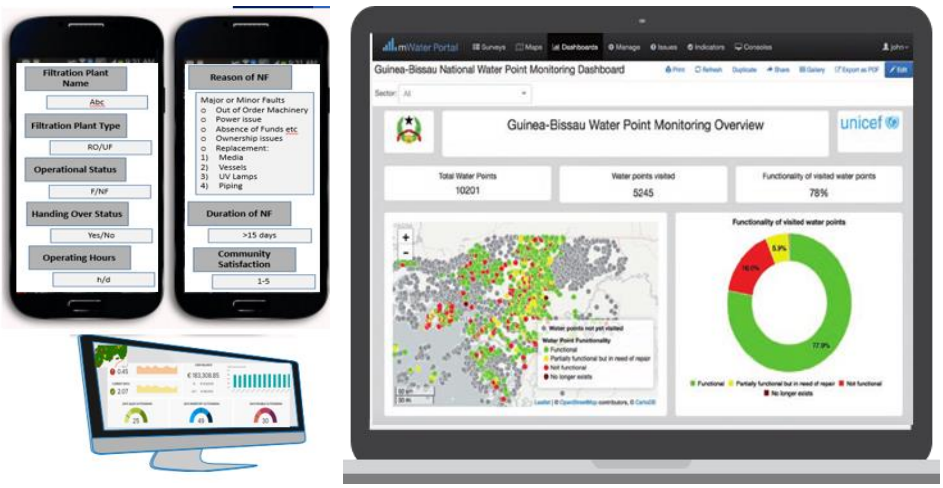


Figure 76: Proposed Prototype of MIS based Monitoring System and App

Mobile Water Quality Laboratory

In general, the groundwater aquifer of Bahawalpur Division lies in brackish water zone. Water Quality testing in villages in rural areas of RYK carried out back in 2012. While no water quality data of city aquifer is present to identify the sweet & brackish water zone. Therefore, it is proposed that a mobile Water Quality Testing Laboratory will be procured and mobilized for free of cost tap water sampling throughout in city as well as in rural areas of RYK. A number of parameters can be carried out on-site. Significant parameters e.g. Bacteriological, pH, Turbidity, electrical conductivity (TDS), arsenic, nitrate & iron will be analyzed on site in mobile Lab. It will contain all necessary required glassware's, testing kits and equipment's recharged through Battery. Some private party like PCRWR may manage the proposed lab. Water sample will be collected and tested and its relevant data along with coordinates will be entered in to android mobile application linked with Water Quality Dashboard. Water Quality Results will direct towards installation of right technology at right location.

Figure 77: Glimpse of Proposed Mobile Water Quality Lab

Store Room for Standby Equipment

A store is proposed to be established for concerned MCs where Spare Machinery, Necessary Equipment and Spares will be present as standby use in case of any repair or need to keep City' Water Supply System Functional. The essential equipment can be as following:

- Pumping Machinery (Motors, Pumps, Impellers)
- Sluice/Gate Valves (10",8",6",4",3")
- Air release Valve
- Pipe Joints (Elbow joints, Reducer joints, Flange Joints)
- Hypo Chlorinator (Dozing Pump & Chlorine Drums)
- Electrical Spares (Magnetic Contactor, Fuses, Relays, Breaker)
- Gland Dory
- Pressure Gauges
- Bulk Meters
- Leakage Detection Equipment

Figure 78: Shot of Proposed Store Room with Tools

SOLID WASTE MANAGEMEN PLAN

DISCLAIMER

Urban Sector Planning and Management Sector Unit (Pvt.) Ltd. has prepared this report for Regional Solid Waste Management Plan in Bahawalpur Division. Maximum care and caution have been observed while developing this document.

The opinions expressed in the document are solely those of the authors and publishing them does not in any way constitute endorsement of the opinion by the Urban Unit.

TECHNICAL TEAM

Mr. Azhar Ali, Sr. Specialist SWM, The Urban Unit

Mr. Syed Osama Faheem Rizvee, Research Associate, The Urban Unit

Haris Bin Khawar Cheema, Research Associate, The Urban Unit

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List of Acronyms

BWMC	Bahawalpur Waste Management Company
CDGB	City District Government Bahawalpur
HR	Human Resource
LF	Landfill
MC	Municipal Corporation
MSW	Municipal Solid Waste
MS	Mechanical Sweepers
MD	Mini dumpers
SWM	Solid Waste Management
SW	Solid waste
TS	Transfer Station
TPD	Ton per Day
WMC	Waste Management Company
KPI	Key Performance Indicators
SPE	Special Purpose Entity
TOR	Terms of Reference
ITB	Invitation to Bid
RFP	Request for Proposal
EOI	Expression of Interest

Executive Summary

Waste production is an eminent result of all human activities and it requires a handling system to save environmental and public health. In Punjab province an estimated 40,000 Ton of solid waste is generated each day which needs collection, transport and safe disposal. Along with efficient and safe waste collection and transport waste disposal must also be done in accordance with standards placeto protect nature and human health.

This plan which covers 2022 – 2032 era proposes the pathway towards increasing waste collection efficiency, its transport and much safer disposal as compared to the present situation covering all settlements with population of 10,000 or above (total 31 settlements) in Bahawalpur Division. Population of these settlements is expected to rise from 3.073 Million (2017 Census Report) to 4.30 Million by 2032. Average amount of solid waste production is may increase from 1,296 Ton/day to 1,944 Ton/day in 2032. The plan suggests increased waste collection efficiency and proposes wet and dry waste streams to be collected separately in 3-year time. It also suggests that green waste should be shredded using mobile shredder and then used as mulch within proximity of its source. This would decrease need for transport and disposal space in addition to provision of key nutrients back to the soil. A pilot composting plant to covert separately collected organic and restaurant waste is also recommended at the existing waste dump site of Bahawalpur city.

Bahawalpur Waste Management Company (BWMC) which is currently operating mainly within Bahawalpur city is one of the most successful interventions in this field in the country. It has successfully expanded its operations in Ahmadpur East (District Bahawalpur) recently. The company has thoroughly been assessed and this plan has been prepared in consultation with the company. It was found that in order to have a successful waste management system at the Divisional level, BWMC must lead the way and manage the new system. It is proposed that in first phase (additional HR 590 persons), it should take over all waste management operations in Rahim Yar Khan city (additional capital cost for first 5 years PKR 330 million; additional operational cost PKR 150 million /year); Sadiqabad city (additional capital cost for first 5 years PKR 210 million; additional operational cost PKR 62 million /year); and Bahawalnagar (additional capital cost for first 5 years PKR 185 million; additional operational cost PKR 132 million/year).

In the next phase (770 new HR) it should take over the operations in 9 remaining Tehsils of the Division (additional capital cost for first 5 years PKR 850 million; additional operational cost PKR 400 million /year). In third phase BWMC may expand operations to 17 settlements (730 new HR hiring) with more than 10,000 population (additional capital cost for first 5 years PKR 382 million; additional operational cost PKR 370 million /year). Operational costs include all machinery, equipment and HR related costs. In next stage it may expand its operations in to remaining areas if feasible.

For the successful expansion of the system, it is suggested that BWMC should be restructured. It must have a senior cadre with decision making powers led by the CEO known as BWMC Divisional Office and each District to have team to perform functions well.

Chapter 1. INTRODUCTION

1.1 Background

The management of Municipal Solid Waste (MSW) is a global concern and becoming a great challenge in rapidly growing towns and cities of developing countries. Pakistan, being the fifth largest country in the world in terms of population[20], is facing the problem of poor MSW management and problem is growing with every passing day. The situation is even more challenging due to rapid urbanization, overexploitation of non-renewable resources and increase in diversity of waste composition which is no longer mainly food waste rather includes growing amounts of plastic, paper, leather, rubber, textile, and glass etc.

The matter is of grave concern particularly in Punjab Province as it is the most progressive province in terms of population density, urbanization, industrialization, and economic growth. According to population census report 2017, Punjab is home to about 53% of whole population of the country and the number is increasing with growth rate of 2.13% annually[21]. Correspondingly, the waste generation has reached to a level where it is imperative to undertake substantial steps in solid waste management (SWM) management for an improved civic life in the province.

There is a dire need to device and implement an integrated SWM system that can manage waste collection, storage, its transportation, and safe disposal to avoid over exploitation of existing resources and to save environment.

Keeping in view the rapidly increasing problem of poorly managed Municipal Solid Waste (MSW), The Urban unit has been given a task to devise a comprehensive SWM plan for Bahawalpur Division which covers every aspect of integrated SWM including generation, collection, storage, transportation and disposal.

1.2 Objectives

Following are the objectives of the plan:

- To analyse and document the gaps in existing SWM services in Bahawalpur Division in terms of institutional structure, human resource (HR), machinery and equipment, operational planning, and financing.

[20] World Population Data Sheet 2017, Population Reference Bureau.
[21] Population Profile Punjab 2017, Population Welfare Department GoP.

- To design an integrated Solid Waste Management (SWM) system for Bahawalpur division, which is economically viable and sustainable in longer term.
- To undertake basic field studies to address the gaps and to provide the future roadmap for efficient SWM in Bahawalpur division.

1.3 Methodology

To achieve the above-mentioned objectives, following SWM model is proposed. In this proposed model, SW generated from settlements will be collected through Handcarts, Rickshaws and Mini-Dumpers. It is then stored in containers having capacities of 0.8m^3 and 5m^3. SW will then be transferred into suitable vehicles (Arm rolls, Compactors, Tractor Trollies and Container Carrier) and transported to transfer station or controlled dumpsite/Landfill. The details of this model are discussed further in this report.

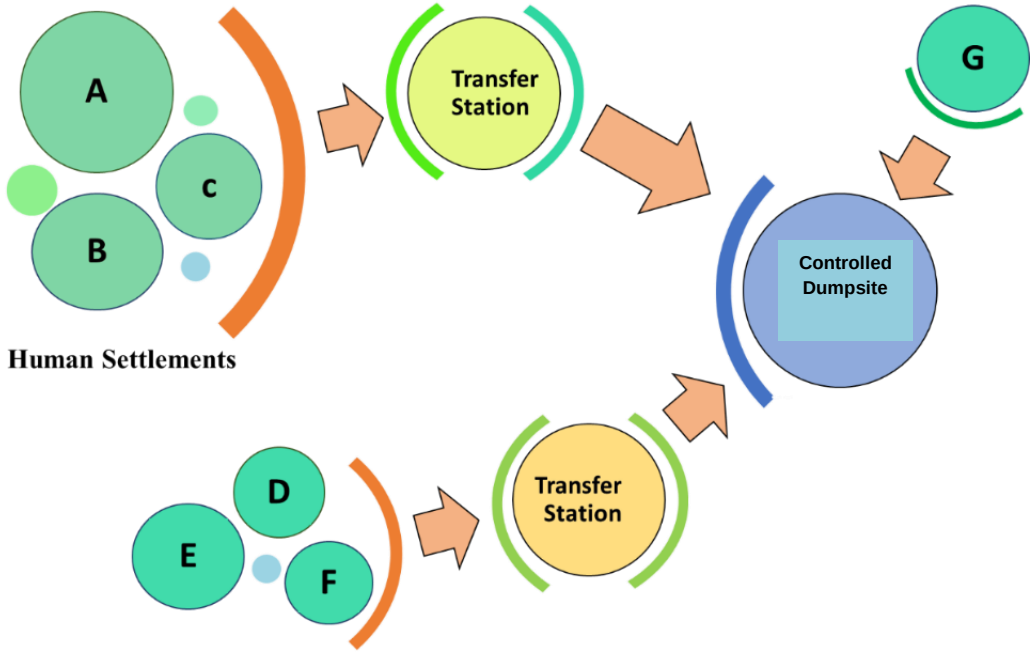
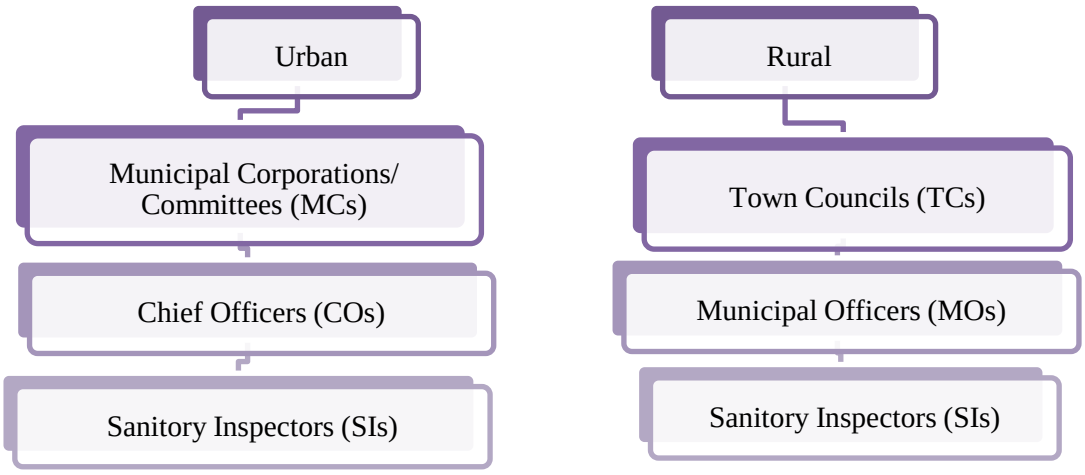


Figure 1.1: SWM Model

In the existing SWM system of the Bahawalpur division, Municipal Corporations (MCs) and Town/Tehsil Councils (TCs) are responsible to manage MSW in urban and rural areas respectively. Each MC is headed by Chief Officer (CO) and Town Council is headed by Municipal Officer (MO). The following chart shows the existing solid waste management structure followed in the Bahawalpur division.



Moreover, in Bahawalpur City, a government-owned company exists which executes the operations related to SWM. The company is named Bahawalpur Waste Management Company (BWMC), which provides services within the jurisdiction of MC Bahawalpur. The company is responsible for the collection, transportation, and safe disposal of waste generated on daily basis.

BWMC is currently performing very well in the cities of Bahawalpur and Ahmedpur East and is also planning to take over Yazman followed by the rest of the Division in upcoming years.

To take over the whole Bahawalpur division, it is recommended that BWMC should follow its own working model and replicate it on the Bahawalpur Division in the following three phases.

Phase I: Takeover of Integrated SWM including collection, storage, transportation, and safe disposal of solid waste in the cities of Rahim yar khan, Sadiqabad and Bahawalnagar in Bahawalpur Division.

Phase	Areas
Phase-1	Rahim Yar Khan City
	Sadiqabad City
	Bahawalnagar City

Phase II: After the successful takeover of Phase-I it is recommended that BWMC should extend their services of Integrated SWM (collection, storage, transportation, and safe disposal of SW) in remaining 09 Municipal Committees of Bahawalpur Division.

Phase	District	Areas
Phase-II	Bahawalpur	Yazman

		Khairpur Tamewali
		Hasilpur
	Rahim Yar Khan	Khanpur
		Liaquatpur
		Chishtian
	Bahawalnagar	Minchinabad
		Haroonabad
		Fort Abbas

Phase III: After successful takeover of MCs, it is recommended that BWMC should further extend its services in Tehsil Councils and Town Committees (Total 17) with the areas where population is greater than 10,000 persons.

Phase	District	Area
Phase III	Bahawalpur	Uch Sharif
		Qaimpur
		Jamalpur
		Mubarakpur
	Rahim Yar Khan	Ahmadpur Lamba
		Tranda Sway Khan
		Kot Samba
		Zahir pir
		Khanbela
		Ferozay
	Bahawalnagar	Donga bunga
		Mandi Sadiq Ganj
		Mcleod Ganj
		Faqeerwali
		Maroot
		Kichiwala
		Dharanwala

It may be noted that rural areas having a population of less than 10,000 persons are not included in this plan because of the following reasons.

1. Population in those areas is very scattered and sparsely distributed, hence a SWM system for these areas would not be economically viable.
2. Amount of waste generation is very low to have a separate collection and transportation system.
3. 70 to 80% of generated solid waste is organic in nature and is reused as fertilizer.

In the light of the above-mentioned considerations, the district wise SWM plans for Bahawalpur division is discussed further in the report.

Chapter 2. BAHAWALPUR DISTRICT

2.1 Description:

Bahawalpur District is one of the districts of Southern Punjab which covers an area of 24,830 km^2 approximately. Two-thirds of the Bahawalpur District (approximately 16,000 km^2) is covered by the Cholistan Desert, which extends into the Thar Desert of India. Bahawalpur district is bordered by India to its south and southeast. Bahawalnagar to its northeast, Vehari, Lodhran and Multan to its north, Rahim yar Khan to its west, and Muzaffargarh to its northwest. The map of Bahawalpur District is shown in the figure below.

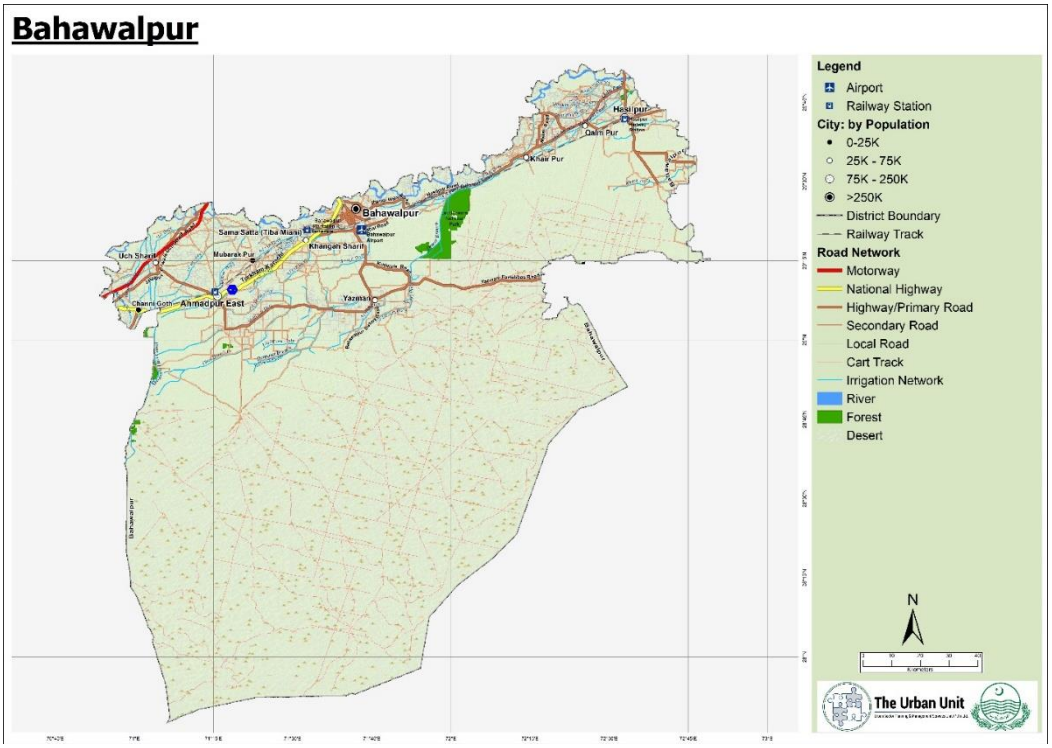


Figure 2.1: Bahawalpur District Map

2.2 Population:

The population is one of the most important factors for determining the waste amount produced in a region. For the current study, population data has been taken from the population census of Pakistan, as it is a prime source of relevant information. The population census of 2017, which is the latest in the sources of the population censuses was used for the current analysis of the district's population. The current population data is projected till 2032 by taking a suitable growth rate. The following table summarizes the population of the Bahawalpur district.

Table 2.1: Area-wise Population of Bahawalpur District

Division	District	Area	Population	Projected Population
			2021	2032

Bahawalpur	Bahawalpur	Bahawalpur City	869,548	1,117,399
		Ahmadpur East	180,000	231,306
		Yazman	48,613	62,469
		Khairpur Tamewali	45,000	57,827
		Hasilpur	130,000	167,054
		Uch Sharif	50,000	64,252
		Qaimpur	26,760	34,388
		Jamalpur	11,000	14,135
		Mubarakpur	25,000	32,126

Source: Pakistan Bureau of Statistics (PBS) Census Report 2017.

2.3 Waste Generation:

Waste generation of Bahawalpur District has been calculated from the above-mentioned population. By conducting field visits and analyzing the quantity of waste generated on a real-time basis, the waste generation rate (WGR) of 0.4 kg/cap-day is taken for Bahawalpur City while 0.37 kg/cap-day for the rest of the areas in Bahawalpur district. By using these WGR, the total waste generation for the Bahawalpur district is projected till 2032 and is shown in the table below.

Table 2.2: Waste Generation of Bahawalpur District

Division	District	Area	Waste Generation 2021	Waste Generation 2032
			Ton/day	Ton/day
Bahawalpur	Bahawalpur	Bahawalpur City	348	526
		Ahmadpur East	67	101
		Yazman	18	27
		Khairpur Tamewali	17	25
		Hasilpur	48	73
		Uch Sharif	19	28
		Qaimpur	10	15
		Jamalpur	4	6
		Mubarakpur	9	14
TOTAL			**540**	**815**

Considering the above table, MSW generation in the Bahawalpur district is calculated at around 540 tons per day which is approximately 196,690 tons per year and is expected to reach 297,731 tons per year (or 815 tons per day) by the end of 2032, taking maximum of 1.5% annual increase[22] in waste generation rate.

[22] What a Waste: A Global Review of Solid Waste Management, The World Bank report, March 2012.

2.4 Current SWM Practices in Bahawalpur District:

The Bahawalpur and Ahmedpur east cities are managed well by BWMC. In the areas other than mentioned above, the services of SWM are currently managed by the respective MCs of that area. MCs of Bahawalpur districts are still using old methods of waste collection and transportation. The system currently has poor collection efficiency, as it consumes more time and more manpower to collect and transport the solid waste to dumpsites. This system deploys sanitary workers and handcarts to collect waste from households and sweep related waste. The waste is then stored in containers of different capacities. Transportation of waste is done through Arm-roll Trucks, Tractor trolly, and Container Carriers. As far as disposal is concerned, the waste is being dumped indiscriminately in open spaces and open plots of Bahawalpur District. However, there are some controlled dumpsites constructed under Southern Punjab Basic Urban Services Project (SPBUSP) in areas like Ahmedpur East and Hasilpur. The pictorial view of these dumpsites is given below.

Figure 2.2: BWMC Transfer Station

Figure 2.3: Ahmedpur East Dumpsite

Figure 2.4: Hasilpur Dumpsite

The details of existing equipment available in the Bahawalpur District are given in the table below.

Table 2.3: Existing Resources for SWM in Bahawalpur District

Sr No	Place	Sanitary Workers		Collection		Transportation					
			HC	Rickshaws	Containers 5 m3	Tractor Trolley	Loader/scraper	Arm Roll	Compactor	Container Carrier	M.S
1	Yazman	52	0	0	02	02	0	0	0	0	0
2	Khairpur Tamewali	30	05	0	02	02	01	0	0	01	0
3	Hasilpur	132	25	03	12	03	01+01	0	0	02	0
4	Uch Sharif	0	0	0	0	0	0	0	0	0	0
5	Qaimpur	15	0	0	0	0	0	0	0	0	0
6	Jamalpur	0	0	0	0	0	0	0	0	0	0
7	Mubarakpur	0	0	0	0	0	0	0	0	0	0

The table mentioned above shows that MCs still have some resources while small settlements having populations ranging from 10,000 to 50,000 persons in Bahawalpur District do not have any machinery for the collection of solid waste. In case of emergency or any official visit, the machinery from nearby MC is used. Therefore, a comprehensive plan is needed that covers these areas as well.

2.5 Proposed SWM Plan for Bahawalpur District

A comprehensive SWM System is required in the Bahawalpur district to cater the existing problems to manage solid waste. The proposed SWM system in Bahawalpur District will be a 10-year plan (2022 to 2032), which intends to uplift the existing practices and bring a more efficient and cost-effective waste management system to the district.

This system will provide a complete waste collection mechanism identifying resources that are needed to manage solid waste till 2032. Starting with waste collection from households, commercials, institutions, offices, and public places, and parks and transferring it into containers. The collected waste will then be transported in vehicles of suitable size and disposed of in a controlled dumpsite in an environmentally safe manner unlike the existing practice of wild dumping.

The proposed system of SWM will transform the functions and operations of existing SWM sectors and will be comprised of three (03) major components.

- Primary collection system
- Secondary collection system
- Final disposal

2.6 Primary waste collection system:

Primary Collection is the collection of SW at the primary level i.e. consumer/generator level. In the proposed SWM plan, Primary collection will be done through handcarts (HC) and Mini dumpers (MD). In case of Bahawalpur MCs, 45% of the generated waste will be collected by Mini-dumpers, 35% will be collected by handcarts and the remaining waste will come directly to containers/collection points. Workers for primary collection will collect the waste from households, markets, open vacant plots and bring it to the nearest collection points or community containers.

In areas with a population ranging from 10,000 to 50,000 persons, 50% of waste will be collected by loader rickshaws, and the remaining will be collected by handcarts, as the streets are not suitable for the mini dumper.

The day-to-day duty of sanitary workers will include street sweeping, waste collection from households, de-silting, and scrapping works needed for streets and roads. In addition to a regular team of sanitary workers, there would be a special group of workers consisting of 10-15 sanitary workers in the district headquarters of Bahawalpur district, who will work in a team and clean public places like grounds, parks, and graveyards twice a week.

2.7 Secondary waste collection system

Secondary collection system is the collection of solid waste from the secondary level. In this type of collection system, the waste collected from the community would be taken to the designated Transfer Station (TS)/

temporary collection point or directly to the dumpsite (if feasible). In MCs, solid waste will be collected through compactors (having capacities of 8/13m^3) and arm roll vehicles, while remaining areas of the Bahawalpur district will be served through Arm roll vehicles and tractor-trollies. Community Containers of 5 m^3 capacity are proposed along major streets and places of littering/bulk generators/un-serviced areas. While containers of 0.8 m^3 will serve secondary streets, roads, and localities. Mechanical Sweepers (MS) will be used to clean main roads while dumpers and excavators/loaders are proposed to clean plots and transport waste from TS.

2.8 Final disposal

Final transport & disposal includes transportation of waste from locality/Transfer Station / temporary collection point to the controlled dumpsite. In the proposed model, Controlled Dumpsite is situated within 20km periphery of any served area. In this way, POL costs will be lessened and effective utilization of machinery can be done in terms of trips.

Figure 2.5: Dumping sites and Transfer stations in Bahawalpur District

The following combination of Transfer Stations and Dumping sites would cater to all the waste coming in a day from human settlements lying within the vicinity of the Dumpsite/Transfer Station.

The details of Proposed Dumpsites in Bahawalpur District including their area and locations are given below

Table 2.4: Dumpsites Bahawalpur District

Bahawalpur Control Dumpsites (Proposed)					
Sr no	**Area Served**	**Location of Dumping Site**	**Area (Acres)**	**Coordinates**	**Tonnage (tons/day)**
1	Bahawalpur City	Bahawalpur City	87	29.308, 71.584	526
2	Ahmadpur East	Ahmadpur East	12	29.156, 71.215	101
3	Yazman	Yazman	4	29.112, 71.749	27
4	Khairpur Tamewali	Khairpur Tamewali	25	29.566, 72.238	25
5	Hasilpur	Hasilpur	20	29.690, 72.537	73
6	Uch Sharif	Uch Sharif	7	29.222, 71.073	28

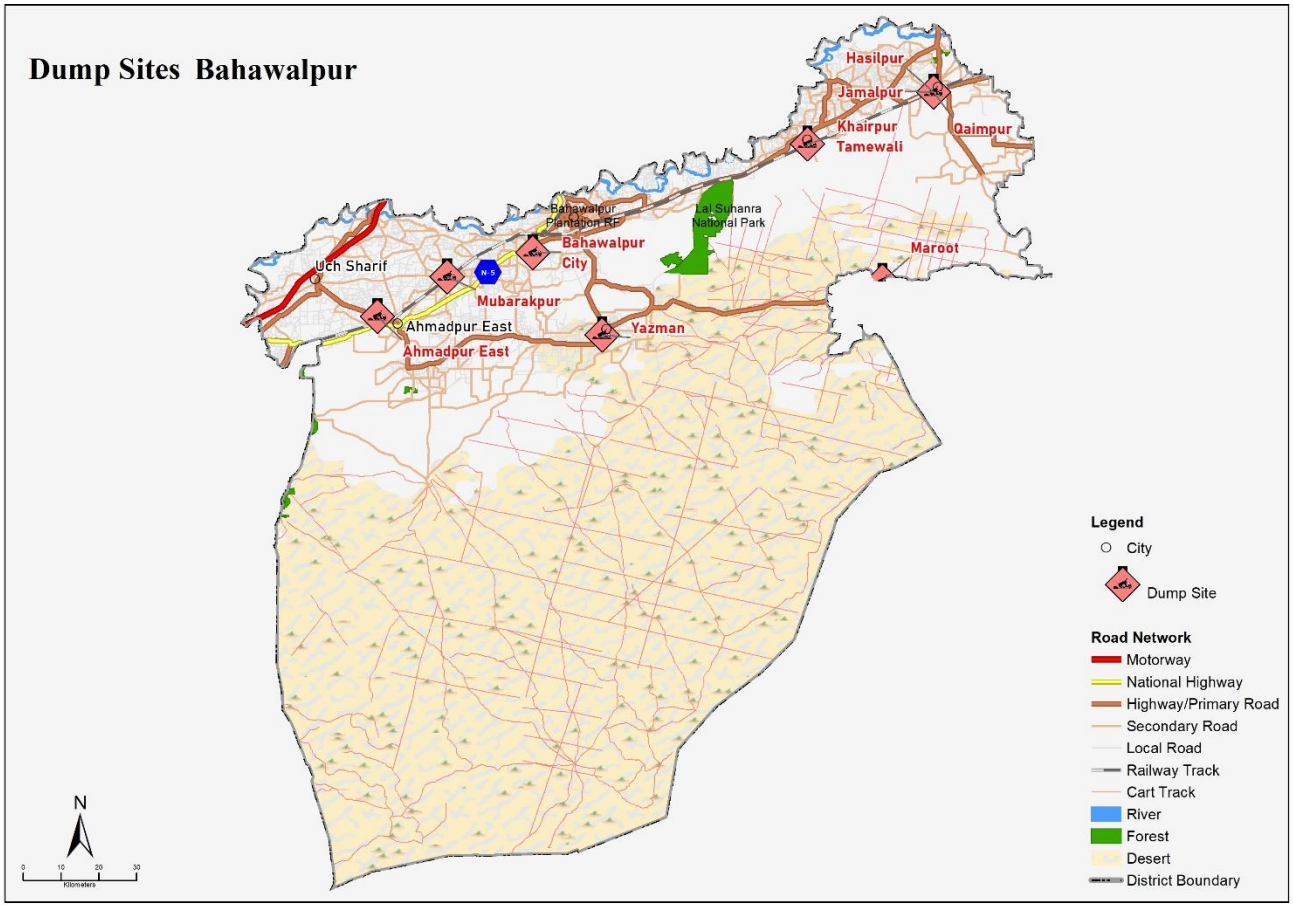


Figure 2.6: Map showing Bahawalpur Districts Dumpsites

2.9 Required resources

Based on waste load, and area requirements, the number of compactors, arm rolls, container carrier, collection containers (having capacities of 0.8 / 5 m^3), mechanical sweeper, and required human resources are calculated for Bahawalpur district. The resources required are shown in the table below.

Table 2.5: Required additional Resources for Efficient SWM in Bahawalpur District

Name of area	Bahawalpur City	Ahmadpur East	Yazman	Khairpur Tamewali	Hasilpur	Uch Sharif	Qaimpur	Jamalpur	Mubarakpur
Population (2022)	895,287	185,000	50,052	46,332	133,848	51,480	27,552	11,326	25,740
Waste Generation. Tons/day.(avg of ten years)	444.46	85.10	22.98	21.28	61.46	23.64	12.65	5.20	11.82
Distance to Dumpsite (km)	13	5	2	3	10	7	14	24	24
Loader Rickshaw (0.6 cu.m)						5	3	1	3
Minidumper(1 cu.m)	48	9	2	2	7				
Containers (0.8 cu.m) @150% capacity	1,042	200	54	50	145	-	-	-	-
Containers for carrier (5 cu.m)					12				
Containers (5cu.m) (66% will be filled in a day.else are extra	167	32	9	8	11	18	9	4	9
Arm Rolls	19	4	1	1	2	2	2	1	1
Compactors (8 cu.m)	11	3	1	1	2	-	-	-	-
Compactors (13 cu.m)	2								
Container Carrier					2				
Tractor Trolly (2 ton)	15	3	1	1	3	1	1	1	1
Front End Loader	5	1	-	-	1	-	-	-	-
Scraper (Blade)	2	1	1	1	1	1	1	1	1
Dumper (8 ton)	4	2	2	2					
Front End Loader	1	1	1	1	-	-	-	-	-
Mechanical Sweeper	2	1	1	1	-	-	-	-	-
Water Bowser	2	2	2	2	1	1	1	1	1
Excavator 120	1								
Monitoring Vehicles (Alto 660cc)	0	3	0	0	3	0	0	0	0
District/ Sr.Mgr	0								
Manager (OPs+HR/admin+Accnt/Fin+MIS)		1			1				

Name of area	Bahawalpur City	Ahmadpur East	Yazman	Khairpur Tamewali	Hasilpur	Uch Sharif	Qaimpur	Jamalpur	Mubarakpur
Deputy.Mgr (Op+Admin/HR+MIS)	0	1			1				
Assistant Managers (Ops)	0	1	0	0	1				
Field officer	0	2	1	1	2	1	1	1	1
AM(Admin+HR+Workshop+Comms+Accnt/Finance+MIS)	1								
HR/Admin/Proc									
DM (Workshop)	1						1		
Sanitary Workers	195	15	-	16	2	21	13	11	18
Assistant		1			1				
Assistant Managers	-				3				
Workshop/Vehicle officer	2	1	1	1	1	1	1	1	1
POL Incharge	1	1	1	1	1	1	1	1	1
Drivers	133	36	15	15	26	12	10	6	8
Helpers	139	28	8	8	21	12	8	3	7
Guards	6	4	4	4	4	4	2	2	4
Tiremen	2	1			1				
Mechanics	2	1	1	1	1	1	1	1	1
Electricians	2	1	1	1	1	1	1	1	1
Painters	2								
Supervisors	7	1	-	1	1	1	1	1	1

2.10 Financial Costing:

The total cost for Primary, Secondary, and Tertiary waste collection & transport for the whole district has been calculated using above mentioned resources. Taking the whole project life of 10 years, the following parameters were considered in costing

- Cost of handcarts, loader rickshaws, containers, compactors, arm roll vehicles, container carrier, Containers), Front End Loaders, and Monitoring vehicles.
- Capital and depreciation cost
- Operational and Maintenance Cost.
- Cost of HR for primary, Secondary, and Tertiary waste collection system (managers, sanitary workers, drivers, helper and office staff)
- Office establishment and management costs including furniture, utilities, IT equipment, MIS systems and management staff etc.

The detail of each cost has been shown in tables below:

2.10.1 Capital Cost

Table 2.6: Capital Cost for SWM in Bahawalpur District (2022-2032)

Cost Component	Bahawalpur City	Ahmadpur East	Yazman	Khairpur Tamewali	Hasilpur	Uch Sharif	Qaimpur	Jamalpur	Mubarakpur
Capital Cost (Millions)	906.92	205.52	84.49	72.61	135.67	46.72	27.35	20.38	26.69
Cost per ton	508	601	916	850	550	492	538	976	562
Grand total for Bahawalpur District (Million)	1526.34								
Average per ton cost for Bahawalpur district (Rs/ton)	552								

**This cost includes depreciation cost as well.*

2.10.2 Operational and Maintenance Cost

Table 2.7: O&M cost for SWM in Bahawalpur District

Cost Component	Bahawalpur City	Ahmadpur East	Yazman	Khairpur Tamewali	Hasilpur	Uch Sharif	Qaimpur	Jamalpur	Mubarakpur
POL Cost (Millions Rs./Year)	79.67	12.67	5.21	5.30	12.54	4.86	6.32	5.97	6.34
Maintenance cost (Million Rs. /year)	11.95	1.90	0.78	0.80	1.88	0.73	0.95	0.90	0.95
O&M cost/Year (Million Rs.)	91.63	14.57	5.99	6.10	14.42	5.59	7.27	6.87	7.29
Per ton Cost (Rs/ton)	513	426	649	714	584	589	1,431	3,289	1,536
Grand total for whole BWP District (Million Rs./year)	**159.73**								
Average per ton O&M cost for Bahawalpur District (Rs./ton)	**578**								

2.10.3 HR cost

Table 2.8: HR cost for SWM in Bahawalpur District

Cost Component	Bahawalpur City	Ahmadpur East	Yazman	Khairpur Tamewali	Hasilpur	Uch Sharif	Qaimpur	Jamalpur	Mubarakpur
HR Cost (Millions Rs./Year)	184.67	39.14	12.55	18.21	27.57	20.51	15.33	10.38	15.85
Per ton Cost (Rs/ton)	1,035	1,146	1,360	2,132	1,117	2,161	3,018	4,970	3,341
Grand total for whole BWP district (Million Rs./year)	344.22								
Average per ton HR cost for Bahawalpur District (Rs./ton)	1,245								

Operational and HR cost for the span of 10 years is attached at Annex - A

Chapter 3. RAHIM YAR KHAN DISTRICT

3.1 Description:

District Rahim Yar Khan (RYK) is the largest district in the Bahawalpur Division in terms of population, and the city of RYK is its Capital. The district consists of 4 tehsils, namely Rahim yar Khan, Sadiqabad, Khanpur, and Liaquatpur. It has a total area of 11,880 km^2. The district is ideally situated in the convergence point of 03 provinces of Pakistan i.e. Punjab, Sindh, and Baluchistan, making it an industry and business center. The following map illustrates the location of RYK district

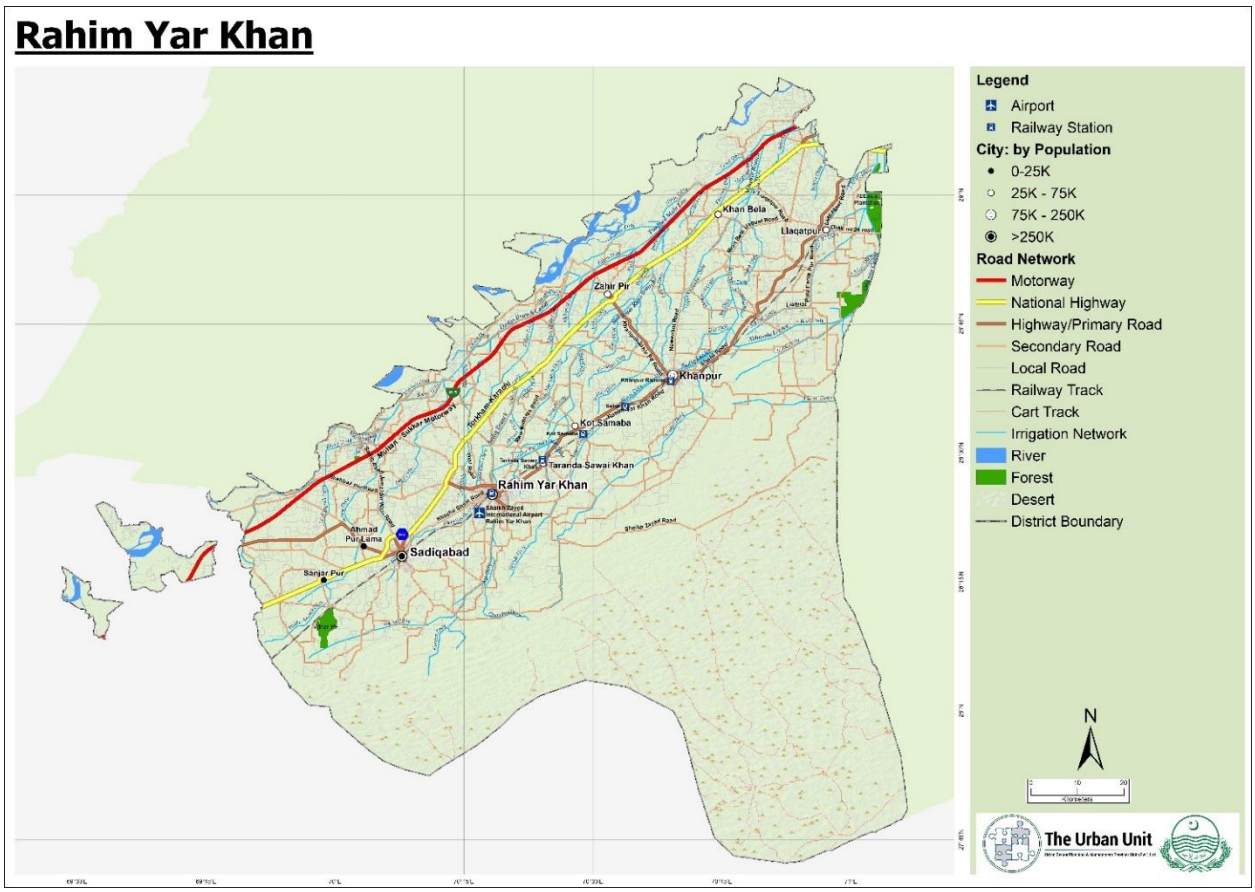


Figure 3.1: Rahim yar khan District Map

3.2 Population:

The current population of Rahim yar khan district is taken from the 2017 Census report and is projected till 2032 by taking a suitable growth rate. The table below shows the population of the RYK district.

Table 3.1: Area wise Population of Rahim Yar Khan District

Division	District	Area	Population	Projected Population
			2021	2032
Bahawalpur	Rahim yar khan	Rahim Yar Khan City	420,419	539,204
		Sadiqabad	253,000	324,482
		Khanpur	225,000	288,571
		Liaquatpur	53,000	67,975
		Ahmadpur Lamba	24,500	31,422
		Tranda Sway Khan	32,600	41,811
		Kot Samba	31,900	40,913
		Zahir Pir	50,000	64,127
		Khanbela	35,000	44,889
		Ferozay	12,000	15,390

Source: Pakistan Bureau of Statistics (PBS) Census Report 2017.

3.3 Waste Generation:

Waste generation of RYK district has been calculated from the population by taking the waste generation rate per capita as 0.4kg/cap-day for Rahim yar khan city while WGR of 0.37 kg/cap-day is adopted for remaining areas of the district[23]. Details of waste generation in the RYK district are given in the table below and are projected till 2032.

Table 3.2: Waste Generation of Rahim yar khan District

Division	District	Area	Waste Generation 2021	Waste Generation 2032
			Ton/day	Ton/day
Bahawalpur	Rahim Yar Khan	Rahim Yar Khan City	168	254
		Sadiqabad	94	141
		Khanpur	83	126
		Liaquatpur	20	30
		Ahmadpur Lamba	9	14
		Tranda Sway Khan	12	18
		Kot Samba	12	18
		Zahir Pir	19	28
		Khanbela	13	20
		Ferozay	4	7
TOTAL			**434**	**656**

[23] The values of waste generation rate is taken after carefully considering local conditions and after consulting relevant stakeholders of Rahim yar khan district

Considering the above table, MSW generation of RYK District is around 434 Tons per day which is approximately 158,045 Tons per year, and is expected to reach 239,075 Tons per year (or 656 Ton per day) by the end of 2032, taking a 1.5% annual increase in waste generation rate.

3.4 Current SWM Practices in Rahim yar khan District:

Currently, no Waste Management company (WMC) exists in the RYK district. SWM services in urban areas of the district are provided by their MCs, while Tehsil councils and Town councils are providing the services of SWM in the rural areas. MCs of the RYK district are using outdated machinery and old methods for waste transportation and disposal except for RYK and Liaquatpur cities, as these two cities have recently brought new machinery under the project of the Punjab Intermediate Cities Improvement Investment Programme (PICIIP).

Figure 3.2: Wild MSW dumping near canal at Kot Samba-RYK

In Tehsil councils and Town Committees, sanitary workers and a few containers for waste collection are present with manual loading and unloading mechanism whereas, the disposal of solid waste is done wildly along roadsides and nearby canals.

However, there are some properly constructed controlled dumpsites under the Southern Punjab Basic Urban Services Project (SPBUSP) in the city of Liaquatpur. The pictorial view of Liaquatpur Dumpsite is given below.

Figure 3.3: RYK Dumpsite near Railway Line

Figure 3.4: Liaquatpur Dumpsite

The details of existing equipment available in the RYK District are given in the table below.

Table 3.3: Existing Resources for SWM in RYK District

Sr No	place	Sanitary Workers	Collection			Transportation					
			HC Rickshaws	Rickshaws	Containers 5 m^3	Tractor Trolley	Loader/scraper	Arm Roll	Compactor	Container Carrier	M.S
1	**Rahim Yar Khan City**	408	100	0	0	02 Manual 09 hydraulic	04 Loader 02 Scrapers	0	0	01	01
2	**Sadiqabad**	254	38	02	00	06	02	0	0	0	01 (not working)
3	**Khanpur**	240	0	0	06	03	02 Front Blade 01 Loader	01	0	0	01 (out of order)
4	**Liaquatpur**	107	05	10	25	03 hydraulic 01 Non hydraulic	01 Loader 01 Scrapper	03	0	1	0
5	**Ahmadpur Lamba**	0	0	0	0	0	0	0	0	0	0
6	**Tranda Sway Khan**	04	04	0	0	02	01	0	0	0	0
7	**Kot Samba**	16	08	0	08	01	01 Loader 01 Scrapper	0	0	01	0
8	**Zahir Pir**	39	15	04	05	02	01	0	0	0	01
9	**Khanbela**	0	0	0	0	0	0	0	0	0	0

Sr No	place	Sanitary Workers	Collection			Transportation					
			HC Rickshaws	Rickshaws	Containers 5 m^3	Tractor Trolley	Loader/scraper	Arm Roll	Compactor	Container Carrier	M.S
10	**Ferozay**	0	0	0	0	0	0	0	0	0	0

3.5 Proposed SWM Plan for Rahim yar khan District

Similar to Bahawalpur, RYK District also needs to have a separate plan for SWM. This plan will uplift the existing practices and propose a cost-effective and sustainable SWM system for the RYK district. This system will provide a complete waste collection and transportation mechanism and identify resources that are needed to manage solid waste till 2032. The duration of the plan is 10 years (2022-2032).

The primary collection will be done through handcarts and Mini-dumpers. In MCs of the RYK district, 45% of the generated waste will be collected through Mini-dumpers while 35% will be collected through handcarts and the remaining waste will come directly to containers/collection points. In the case of tehsil councils/town committees, 50% of the generated waste will be collected through loader rickshaws, and the remaining will be collected through Handcarts. The workers and machinery for primary collection will collect the waste from households, markets, open vacant plots and transfer the collected waste to the nearest collection point or community container.

In RYK MCs, Secondary Collection of solid waste will be done through compactors of 8 / 13m^3 capacities along with arm roll vehicles. Areas of Town / Tehsil councils will be served through arm roll vehicles and tractor trollies. Community containers of 5 m^3 capacity are proposed along with major roads/streets or points having relatively higher waste generation, while containers of 0.8 m^3 will serve secondary streets, roads, and localities. Dumpers with excavator/loaders are proposed for plot cleaning activities and to transport waste from the Transfer Station to the Dumpsite.

For final disposal, it is recommended that existing dumpsites must be converted into controlled dumpsites with ample area to cater waste in future years, till the establishment of scientific sanitary engineered landfills. In this SWM Plan, the following combination of Transfer Station and controlled dumpsites will be used which will cater to the waste coming from the nearby human settlements and is given in the figure below.

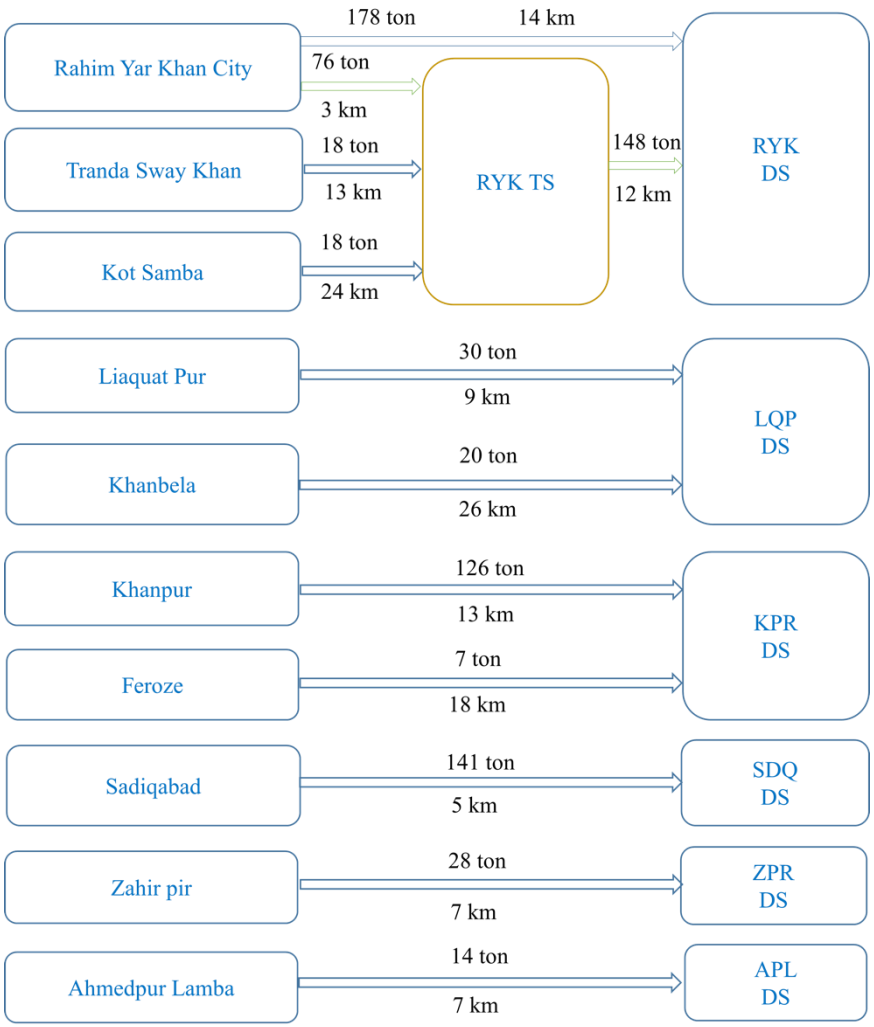


Figure 3.5: Transfer Stations and Dumping Sites in the RYK district

The details of these proposed dumpsites including their area and locations are given in below.

Table 3.4: RYK District Dumpsites

RYK District Controlled DS (Proposed)					
Sr no	**Area Served**	**Location of Dumping Site**	**Area (Acres)**	**Coordinates**	**Tonnage (tons/day)**
1	RYK City	RYK City	50	28.324, 70.335	254
2	Sadiqabad	Sadiqabad	20	28.335, 70.114	141
3	Khanpur	Khanpur	25	28.671 70.744	126
4	Liaquatpur	Liaquatpur	12	28.928, 70.972	30
5	Zahir Pir	Zahir Pir	10	28.862, 70.449	28
6	Ahmadpur Lamba	Ahmadpur Lamba	12	28.268, 70.144	14

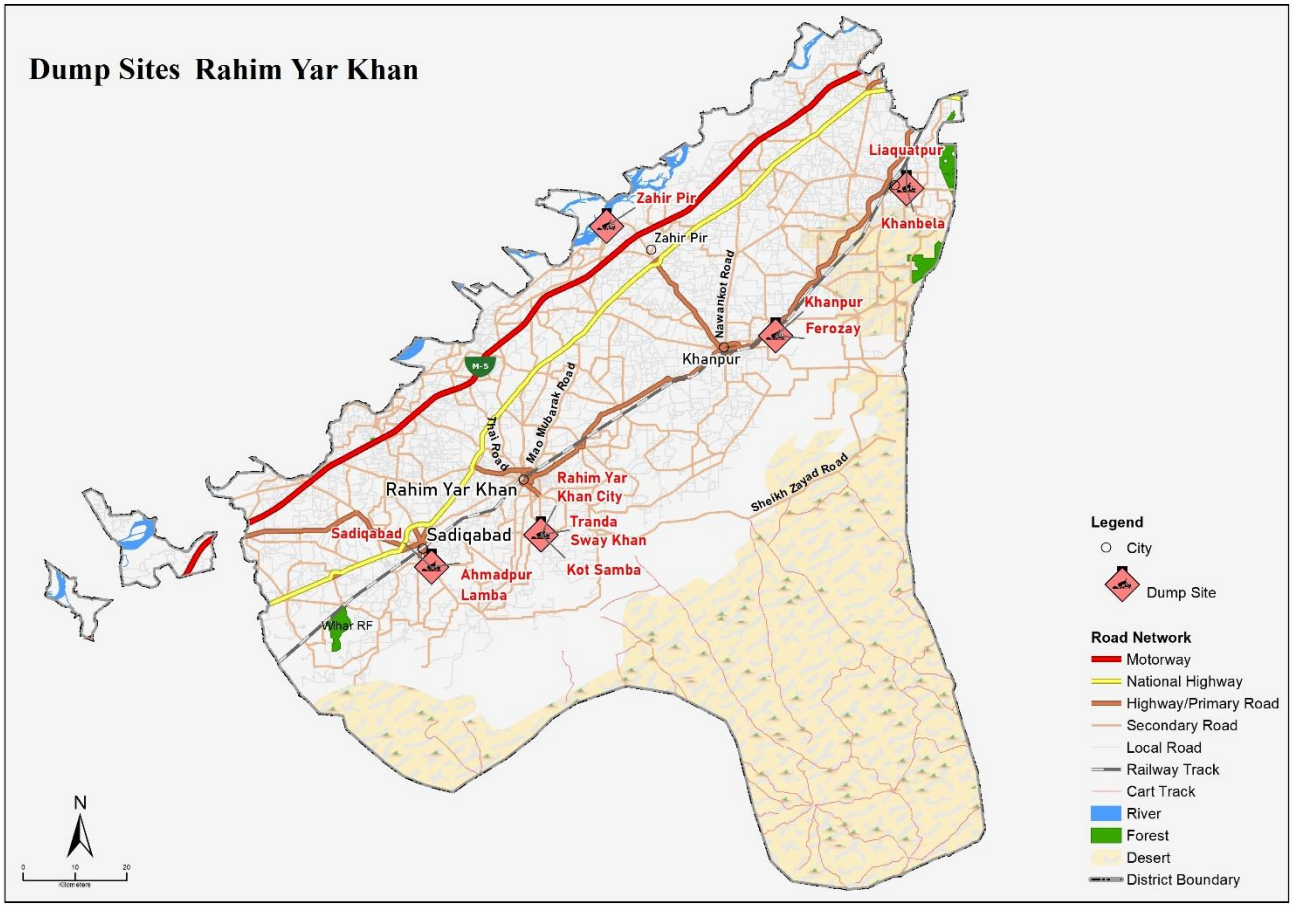


Figure 3.6: Dumpsites in RYK District

3.6 Required Resources

Based on waste load, and area requirements, the number of compactors, arm rolls, container carriers, collection containers (0.8 / 5 m^3), mechanical sweepers, and required human resources (HR) are calculated for the RYK district. The resources required are shown in the table below.

Table 3.5: Required additional Resources for efficient SWM in RYK district

Name of area	Rahim Yar Khan City	Sadiqabad	Khanpur	Liaquatpur	Ahmadpur Lamba	Tranda Sway Khan	Kot Samba	Zahir Pir	Khanbela	Ferozay
Population (2022)	431,826	259,865	231,105	54,438	25,165	33,485	32,766	51,357	35,950	12,326
Waste Generation. Tons/day.(avg of ten years)	213.83	119.03	105.86	24.93	11.53	15.34	15.01	23.52	16.47	5.65
Distance to Dumpsite (km)	14	5	13	9	7	13	24	7	26	18
Loader Rickshaw (0.6 cu.m)					3	3	3	5	4	2
Minidumper(1 cu.m)	23	13	11	3						
Containers (0.8 cu.m) @150% capacity	502	279	249	-	-	-	-	-	-	-
Containers for carrier (5 cu.m)				25			9			
Containers (5cu.m) (66% will be filled in a day.else are extra	80	45	40	-	9	12	-	18	12	4
Arm Rolls	9	5	5	-	1	2	-	2	2	1
Compactors (8 cu.m)	5	4	4	-	-	-	-	-	-	-
Compactors (13 cu.m)	1									
Container Carrier				4			2			
Tractor Trolly (2 ton)	8	4	4	1	1	1	1	1	1	1
Front End Loader	3	2	2	-	-	-	-	-	-	-
Scraper (Blade)	1	1	1	1	1	1	1	1	1	1
Dumper (8 ton)	2	2	2	2						
Front End Loader	1	1	1	1	-	-	-	-	-	-
Mechanical Sweeper	2	1	1	1	-	-	-	-	-	-
Water Bowser	2	2	2	2	1	1	1	1	1	1
Excavator 120	1	1	1							
Monitoring Vehicles (Alto 660cc)	8	1	1	1	0	0	0	0	0	0
District/ Sr.Mgr	1									
Manager (op+HR/admin+Accnt/Fin+MIS)	4									

Name of area	Rahim Yar Khan City	Sadiqabad	Khanpur	Liaquatpur	Ahmadpur Lamba	Tranda Sway Khan	Kot Samba	Zahir Pir	Khanbela	Ferozay
Deputy.Mgr (Op+Admin/HR+MIS)	0	1	1	1						
Assistant Managers (Ops)	3	0	0	0						
Field officer	0	2	2	2	1	1	1	1	1	1
AM(Admin+HR+Workshop+Comms+Accnt/Finance+MIS)	6									
HR/Admin/Proc	2	1	1	1						
DM (Workshop)	1							1		
Sanitary Workers	24	6	-	-	25	29	17	12	14	12
Assistant	5									
Assistant Managers	2					3				
Workshop/Vehicle officer	2	1	1	1	1	1	1	1	1	1
POL Incharge	1	1	1	1	1	1	1	1	1	1
Drivers	80	44	42	19	8	10	10	12	11	7
Helpers	68	39	36	9	7	8	8	12	10	5
Guards	6	4	4	4	4	2	2	4	2	2
Tiremen	1	1	1							
Mechanics	2	1	1	1	1	1	1	1	1	1
Electricians	2	1	1	1	1	1	1	1	1	1
Painters	2									
Supervisors	1	1	-	-	1	1	1	1	1	1

3.7 Financial Costing:

The total cost for an efficient SWM system in the RYK district is calculated similarly to the Bahawalpur district. The Capital Cost, O&M cost, and HR cost are summarized in the tables below;

3.7.1 Capital Cost

Table 3.6: Capital cost for SWM in RYK District (2022-2032)

Cost Component	Rahim Yar Khan City	Sadiqabad	Khanpur	Liaquatpur	Ahmadpur Lamba	Tranda Sway Khan	Kot Samba	Zahir Pir	Khanbela	Ferozay
Capital Cost (Million Rs.)	458.24	287.18	264.80	96.39	26.49	36.88	28.02	41.02	39.93	20.78
Cost per ton (Rs./ton)	534	601	623	963	572	599	465	434	604	917
Grand total for RYK District (Million Rs.)	1,299.75									
Average per ton cost for RYK district (Rs/ton)	587									

*This Capital cost includes Depreciation cost as well

3.7.2 Operational and Maintenance Cost

Table 3.7: O&M costs for SWM in RYK District

Cost Component	Rahim Yar Khan City	Sadiqabad	Khanpur	Liaquatpur	Ahmadpur Lamba	Tranda Sway Khan	Kot Samba	Zahir Pir	Khanbela	Ferozay
POL Cost (Millions Rs./Year)	49.56	18.35	26.54	9.43	3.74	6.06	8.07	4.86	9.64	5.24
Maintenance cost (Million Rs. /year)	7.43	2.75	3.98	1.41	0.56	0.91	1.21	0.73	1.45	0.79
O&M cost/Year (Million Rs.)	57.00	21.10	30.52	10.84	4.30	6.97	9.28	5.59	11.08	6.02
Per ton Cost (Rs/ton)	664	442	718	1,083	929	1,132	1,540	592	1,677	2,657
Grand total (Million Rs./year)	**162.75**									
Average per ton cost for RYK District Rs./ton	**735**									

3.7.3 HR cost

Table 3.8: HR cost for SWM in RYK District

Cost Component	Rahim Yar Khan City	Sadiqabad	Khanpur	Liaquatpur	Ahmadpur Lamba	Tranda Sway Khan	Kot Samba	Zahir Pir	Khanbela	Ferozay
HR Cost (Millions/Year)	92.89	40.44	36.60	16.84	18.53	20.23	15.65	18.43	15.86	11.96
Per ton Cost (Rs/ton)	1,082	846	861	1,682	4,003	3,285	2,597	1,951	2,399	5,277
Grand total (Million/year)	**287.42**									
Average per ton cost for RYK District	**1,298**									

Operational and HR cost for Rahim yar Khan District for the span of 10 years is attached at Annex- B

Chapter 4. BAHAWALNAGAR DISTRICT

4.1 Description:

Bahawalnagar district is one of the districts of Bahawalpur Division and is located in southern Punjab, It has five tehsils namely Bahawalnagar, Chishtian, Haroonabad, Minchinabad, and Fort Abbas.
The total area of district is 8,878 sq.km. Bahawalpur district lies on its western side while river Sutlej flows on its northern side. The map of District Bahawalnagar is shown below.

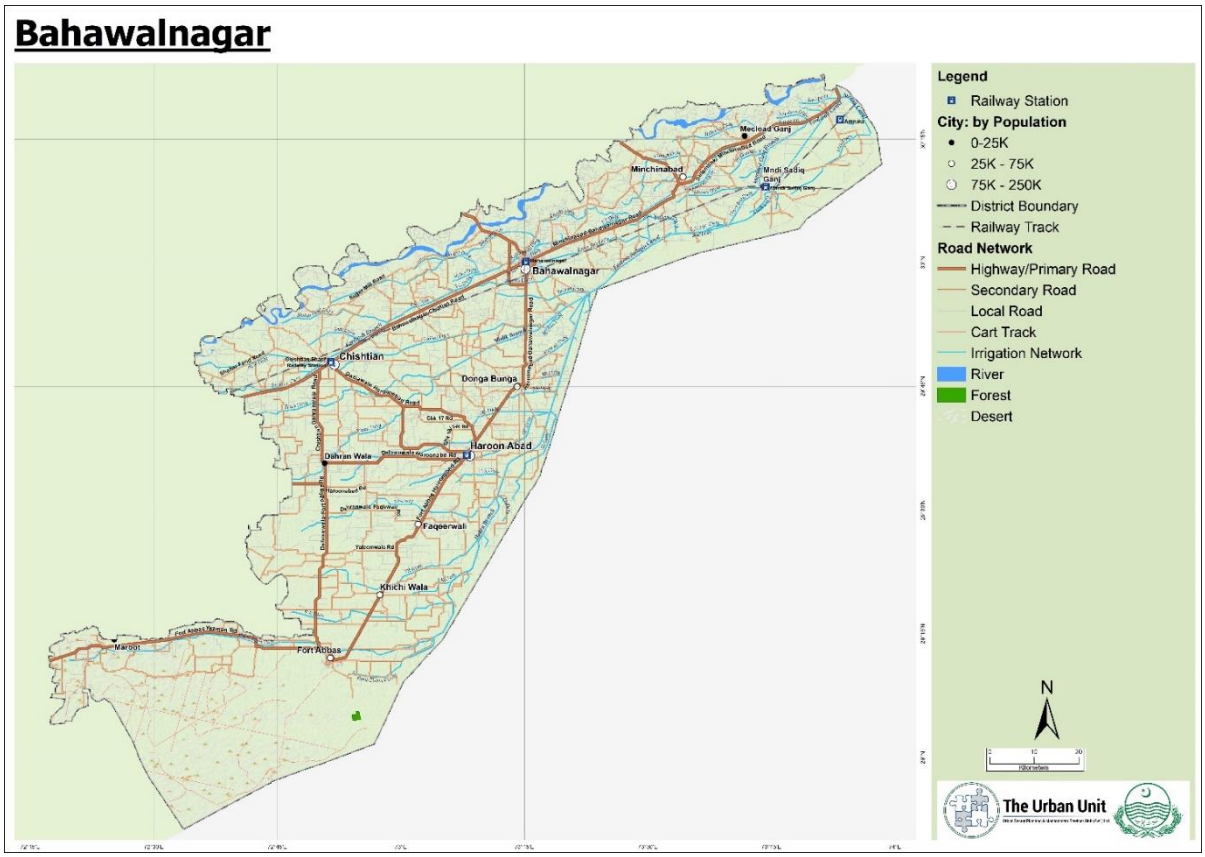


Figure 4.1: Bahawalnagar District Map

4.2 Population:

The population of Bahawalnagar district is taken from Census report 2017 and is projected till 2032 by taking suitable growth rate. Area wise population of Bahawalnagar district is given in the table below.

Table 4.1: Area Wise Population of Bahawalnagar District

Division	District	Area	Population	Projected Population
			2021	2032
Bahawalpur	Bahawalnagar	Bahawalnagar City	217,000	269,280
		Chishtian	200,000	248,184
		Minchin Abad	72,000	89,346
		Haroonabad	145,000	179,934
		Fort Abbas	65,600	81,404
		Donga Bunga	33,000	40,950
		Mandi Sadiq Ganj	16,000	19,855
		McLeod Ganj	20,000	24,818
		Faqeerwali	35,000	43,432
		Maroot	10,000	12,409
		Kichiwali	14,400	17,869
		Dhranwala	30,000	37,228

Source: Pakistan Bureau of Statistics (PBS) Census Report 2017.

4.3 Waste Generation:

Waste generation from the population of Bahawalnagar is calculated and projected till 2032. A waste generation rate of 0.40 kg/cap-day is adopted for Bahawalnagar city while it is taken as 0.37 kg/cap-day for areas other than Bahawalnagar City[24]. Details of waste generation in the Bahawalnagar district are given in the table below.

[24] The values of waste generation rate is taken after carefully considering local conditions and after consulting relevant stakeholders of Bahawalnagar district

Table 4.2: Waste Generation of Bahawalnagar District

Division	District	Area	Waste Generation 2021 Ton/day	Waste Generation 2032 Ton/day
Bahawalpur	Bahawalnagar	Bahawalnagar City	87	127
		Chishtian	74	108
		Minchin Abad	27	39
		Haroonabad	54	78
		Fort Abbas	24	35
		Donga Bunga	12	18
		Mandi Sadiq Ganj	6	9
		McLeod Ganj	7	11
		Faqeerwali	13	19
		Maroot	4	5
		Kichiwali	5	8
		Dhranwala	11	16
TOTAL			**324**	**473**

Considering the above table, the MSW generation of Bahawalnagar district is around 324 Tons per day which is approximately 118,260 Tons per year and is expected to reach 173,010 Ton per year (or 473 Tons per day) by the end of 2032.

4.4 Current SWM Practices in Bahawalnagar District:

As compared to District Bahawalpur and Rahim Yar Khan, Bahawalnagar district is comparatively lacks in terms of infrastructure and services. The same can be said for SWM services in the district. In Bahawalnagar, there is no specific company operating for SWM. Old tractor trollies with environmentally unsafe emissions are operating in almost all urban and rural areas of the district. The system is less efficient as it requires more time and more manpower to transport the MSW to dumpsites. Some areas of the district do not have SWM system at all while a few MCs deploy sanitary workers and handcarts to collect waste from households and sweep related waste. As far as disposal is concerned, the waste is being dumped wildly in open spaces and open plots in Bahawalnagar District. However, the disposal situation of Bahawalnagar city among the rest of the areas of the district is somewhat better as they have a controlled dumpsite constructed under Southern Punjab Basic Urban Services Project (SPBUSP) in Bahawalnagar City.

Figure 4.2: A worker collecting waste from household in Bahawalnagar city

Figure 4.3: A view of Bahawalnagar Dumpsite

Figure 4.4: SW dumping in natural depressions of Fort Abbas

The details of existing equipment available in the Bahawalnagar District are given in the table below.

Table 4.3: Existing resources for efficient SWM in Bahawalnagar District

Sr No	Place	Sanitary Workers	Collection			Transportation					
			HC	Rickshaws	Containers 5 m^3 / Bins	Tractor Trolley	Loader/scraper	Arm Roll	Compactor	Container carrier	M.S
1	Bahawalnagar City	117	15	02	65 Container 30 Bins	04 Hydraulic	01 Loader 01 Scrapper	04	0	0	02
2	Chishtian	52	0	06	12 Bins	04 Hydraulic	03 Front Blade	0	0	0	01
3	Minchin Abad	59	02	06	0	02 Hydraulic	02 Front Blade	0	0	0	0
4	Haroonabad	84	0	03	0	04 Hydraulic 01 Manual	01 Loader	0	0	0	0
5	Fort Abbas	60	0	03	0	04 Hydraulic	01 Loader	0	0	0	0
6	Donga Bunga	0	0	0	0	0	0	0	0	0	0
7	Mandi Sadiq Ganj	0	0	0	0	0	0	0	0	0	0
8	McLeod Ganj	0	0	0	0	0	0	0	0	0	0
9	Faqeerwali	22	0	0	0	01 Hydraulic	0	0	0	0	0
10	Maroot	0	0	0	0	0	0	0	0	0	0
11	Kichiwali	0	0	0	0	0	0	0	0	0	0
12	Dhranwala	07	06	0	0	01 Hydraulic	01 Loader	0	0	0	0

4.5 Proposed SWM Plan for Bahawalnagar District

The proposed SWM system in Bahawalnagar District would consist of 10 years plan (2022 to 2032). The system will comprise of 3 major components i.e., Primary Collection, Secondary Collection, and Final Disposal.

In case of the urban areas in the Bahawalnagar district, Primary collection is done with Mini dumpers, which will collect 45% of waste generated by MCs, while 35% of the generated waste will be collected by handcarts and the remaining waste will come directly to containers/collection points. In case of areas having a population ranging from 10,000 to 50,000; 50% of the waste will be collected by loader rickshaws, and the remaining will be collected by Handcarts.

In urban areas of the Bahawalnagar district, solid waste is to be collected through compactors (8 / 13m^3 capacity) and arm roll vehicles while areas that fall in tehsil councils will be served through arm roll vehicles and tractor trollies with front end loaders. Community containers of 5m^3 capacity are proposed along with major streets and places of the Bahawalnagar district. Dumpers and excavators/loaders are proposed for C&D waste and plot clearing activities.

The waste collected from settlements would require a suitable place to dump. Hence, in the Bahawalnagar District, the following combination of controlled dumpsites is proposed.

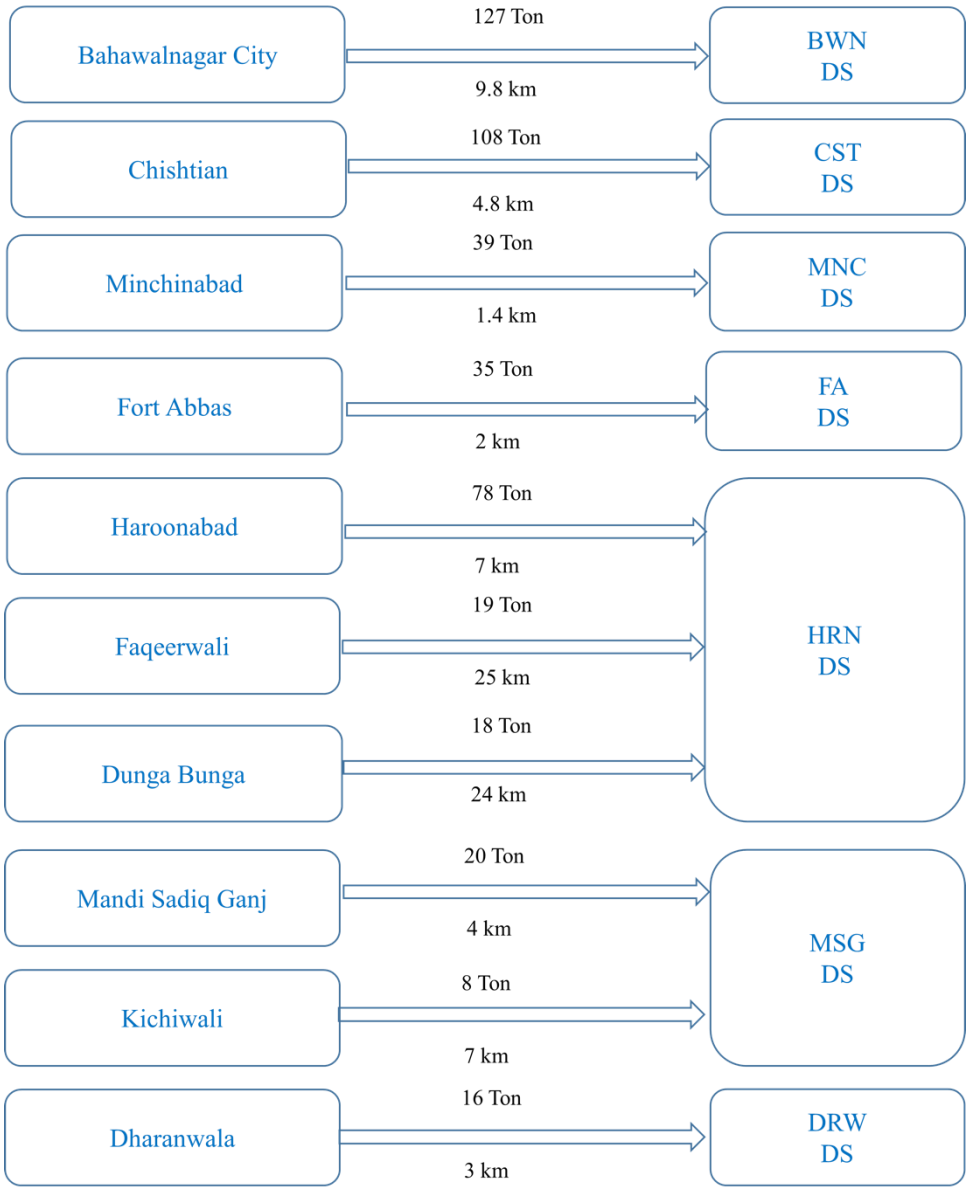


Figure 4.5: Dumpsites in Bahawalnagar District

The details of these proposed dumpsites including their area and locations are given below

Table 4.4: Dumpsites in Bahawalnagar District

Bahawalnagar Controlled DS (Proposed)					
Sr no	**Area Served**	**Location of Dumping Site**	**Area (Acres)**	**Coordinates**	**Tonnage (tons/day)**
1	Bahawalnagar City	Bahawalnagar City	20	30.049, 73.221	127
2	Chishtian	Chishtian	12	29.796, 72.845	108
3	Minchin Abad	Minchin Abad	10	30.154, 73.558	39

4	Haroonabad	Haroonabad	25	29.648, 73.160	78
5	Donga Bunga				18
6	Faqeerwali				19
7	Mandi Sadiq Ganj	Mandi Sadiq Ganj	12	30.186, 73.722	16
8	Kichiwali				8
9	Fort Abbas	Fort Abbas	25	29.183, 72.845	35
10	Dhranwala	Dhranwala	22	29.596, 72.876	16

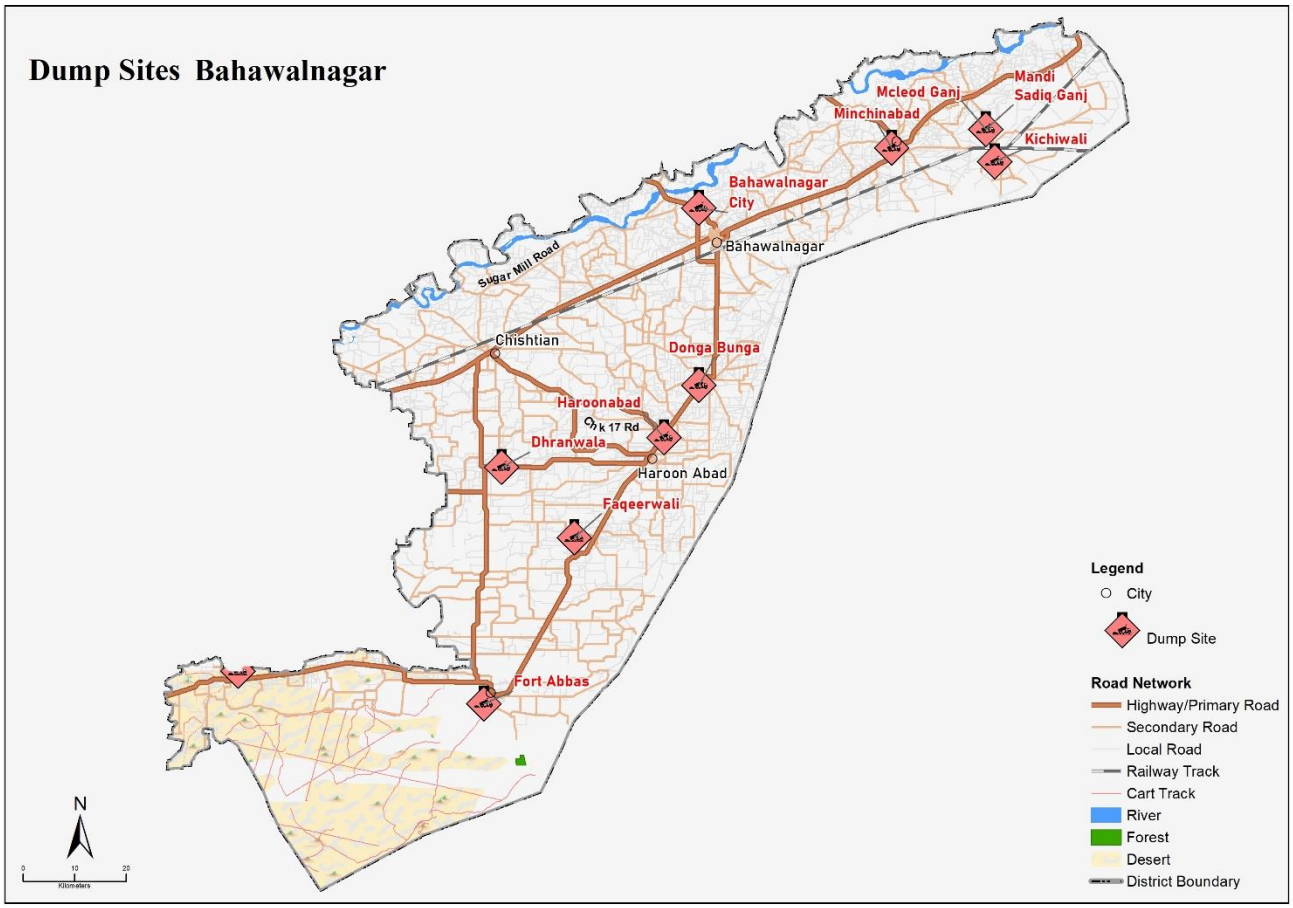


Figure 4.6: Map showing Bahawalnagar Dumping points

4.6 Required resources

Based on waste load, and area requirements, the number of compactors, arm rolls, container carrier, collection containers (0.8 / 5 m^3), mechanical sweeper, and required human resources are calculated for the Bahawalnagar district. The resources required are shown in the table below.

Table 4.5: Required additional resources for efficient SWM in Bahawalnagar district

Name of Area	Bahawalnagar City	Chishtian	Minchinabad	Haroonabad	Fort Abbas	Donga Bunga	Mandi Sadiq Ganj	Mcleod Ganj	Faqeerwali	Maroot	Kichiwali	Dhranwala
Population (2022)	221,800	204,424	73,592	148,207	67,051	33,730	16,354	20,442	35,774	10,221	14,718	30,664
Waste Generation. Tons/day.(avg of ten years)	107.88	91.97	33.11	66.68	30.17	15.18	7.36	9.20	16.10	4.60	6.62	13.80
Distance to Dumpsite (km)	10	5	1	7	2	24	4	4	25	5	7	3
Loader Rickshaw (0.6 cu.m)						3	2	2	4	1	2	3
Minidumper(1 cu.m)	12	10	4	7	3							
Containers (0.8 cu.m) @150% capacity	253	216	78	157	71	-	-	-	-	-	-	-
Containers for carrier (5 cu.m)												
Containers (5cu.m) (66% will be filled in a day.else are extra	40	34	12	25	11	11	6	7	12	3	5	10
Arm Rolls	5	4	2	3	2	2	1	1	2	1	1	2
Compactors (8 cu.m)	4	3	1	3	1	-	-	-	-	-	-	-
Compactors (13 cu.m)												
Container Carrier												
Tractor Trolly (2 ton)	4	4	2	3	2	1	1	1	1	1	1	1
Front End Loader	2	1	-	1	-	-	-	-	-	-	-	-
Scraper (Blade)	1	1	1	1	1	1	1	1	1	1	1	1
Dumper (8 ton)	2	2	2	2	-							
Front End Loader	1	1	1	1	1	-	-	-	-	-	-	-
Mechanical Sweeper	2	-	1	1	-	-	-	-	-	-	-	-
Water Bowser	2	2	2	2	2	1	1	1	1	1	1	1
Excavator 120	1											
Monitoring Vehicles (Alto 660cc)	7	2	2	2	1	0	0	0	0	0	0	0

District/ Sr.Mgr	1											
Manager (op+HR/admin+Accnt/Fin+MIS)	4											
Deputy.Mgr (Op+Admin/HR+MIS)	0	1	1	1								
Assistant Managers (Ops)	2	1	1	1	1							
Field officer	0	2	2	2	1	1	1	1	1	1	1	1
AM(Admin+HR+Workshop+Comms+Accnt/Finance+MIS)	6											
HR/Admin/Proc	2	1	1	1								
DM (Workshop)	1											
Sanitary Workers	105	152	15	64	7	9	16	8	14	7	8	24
Assistant	5											
Assistant Managers	2						3					
Workshop/Vehicle officer	2	1	1	1	1	1	1	1	1	1	1	1
POL Incharge	1	1	1	1	1	1	1	1	1	1	1	1
Drivers	51	36	21	31	16	10	7	7	11	6	7	10
Helpers	36	30	11	23	10	8	5	5	10	3	5	8
Guards	4	4	4	4	4	4	4	4	4	4	4	4
Tiremen	1	1		1								
Mechanics	2	1	1	1	1	1	1	1	1	1	1	1
Electricians	2	1	1	1	1	1	1	1	1	1	1	1
Painters	2											
Supervisors	4	6	1	3	1	1	1	1	1	1	1	1

4.7 Financial Costing:

The total cost for an efficient SWM system in the Bahawalnagar district is calculated similarly to the previously calculated costs of the Bahawalpur and RYK districts. The Capital Cost, O&M cost, and HR cost are summarized in the tables below:

4.7.1 Capital Cost

Table 4.6: Capital cost for SWM in Bahawalnagar district (2022-2032)

	Bahawalnagar City	Chishtian	Minchin Abad	Haroonabad	Fort Abbas	Donga Bunga	Mandi Sadiq Gani	McLeod Ganj	Faqeerwali	Maroot	Kichiwali	Dhranwala
Capital Cost (Million Rs.)	252.71	203.16	108.84	163.77	75.1	38.9	22.6	24.1	37.9	19.96	22.1	35.5
Cost per ton (Rs./ton)	583	550	819	612	620	639	768	653	586	1,081	831	641
Grand total for Bahawalnagar District (Million Rs.)	**1004.72**											
Average per ton cost for Bahawalnagar district (Rs/ton)	**621**											

**This Capital cost includes Depreciation cost as well*

4.7.2 Operational and Maintenance cost

Table 4.7: O&M cost for SWM in Bahawalnagar district

	Bahawalnagar City	Chishtian	Minchin Abad	Haroonabad	Fort Abbas	Donga Bunga	Mandi Sadiq Ganj	McLeod Ganj	Faqeerwali	Maroot	Kichiwali	Dhranwala
POL Cost (Million Rs./Year)	29.10	11.50	6.23	12.68	4.77	8.93	3.10	3.10	9.38	3.06	3.55	3.45
Maintenance cost (Million Rs. /year)	4.37	1.72	0.93	1.90	0.72	1.34	0.46	0.46	1.41	0.46	0.53	0.52

O&M cost/Year (Million Rs.)	33.47	13.22	7.16	14.58	5.48	10.27	3.56	3.56	10.78	3.52	4.09	3.97
Per ton Cost (Rs/ton)	773	358	539	544	453	1,686	1,205	964	1,669	1,909	1,537	716
Grand total (Million Rs./year)	**113.66**											
Average per ton cost for Bahawalnagar District (Rs./ton)	**703**											

4.7.3 HR cost

Table 4.8: HR cost for SWM in Bahawalnagar district

	Bahawalnagar City	**Chishtian**	**Minchin Abad**	**Haroonabad**	**Fort Abbas**	**Donga Bunga**	**Mandi Sadiq Ganj**	**McLeod Ganj**	**Faqeerwali**	**Maroot**	**Kichiwali**	**Dhranwala**
HR Cost (Million Rs./Year)	97.26	87.27	24.39	51.34	17.11	13.47	14.13	11.28	16.51	9.62	11.02	18.85
Per ton Cost (Rs/ton)	2,245	2,363	1,835	1,917	1,413	2,211	4,783	3,056	2,556	5,210	4,146	3,403
Grand total (Million Rs./year)	**372.27**											
Average per ton cost for Bahawalnagar District (Rs./ton)	**2,303**											

Operational and HR cost for Bahawalnagar District for the span of 10 years is attached at Annex-C

Chapter 5. RECOmMENDATIONS & WAY FORWARD

5.1 Recommendations

It is recommended that Citizens' Committees be formed in each community that monitors the waste management services. An app should be launched where these committees can upload daily issues to be dealt by the concerned authority/company. In addition to that, segregated collection of wet and dry waste should be ensured in a 3 years span and a pilot scale compost facility at BWMC existing dumpsite should be established. Sector-wise recommendations for efficient SWM are given below

5.1.1 Street Sweeping and Drains Cleaning

Following recommendations are for noticeable improvements in services delivery for street sweeping and drain cleaning.

- Drain cleaning of lesser than 2ft. width and sweeping should be included in job descriptions of sanitary workers with a proper monitoring mechanism.
- All workers should be provided with necessary tools, and PPE's including gloves, face masks, and gumboot (for drain cleaner).
- If street sweeping is not possible during daytime in some areas due to congestion and traffic load, then the activity should be done in the nighttime.
- Zonal offices/MCs should be strengthened. The majority of activities related to SWM should be attempted to be solved at zonal offices/MCs.

5.1.2 Waste Collection System

Following recommendations are proposed for efficient waste collection system

- A model area in each of the district headquarters should be identified in which source segregation can be implemented immediately in par with international best practices.
- The focus should be on a 100% communal collection system with the immediate introduction of door-to-door collection in planned areas and posh societies of the Bahawalpur Division.
- Open collection points should be replaced by a covered bin of a suitable size.
- The door-to-door collection must be done using smaller vehicles, preferably MD's of $1m^3$ capacity. It would be better if the proposed MD is equipped with compartments for biodegradable, non-biodegradable, and recyclable waste.
- In long term however the waste producers must be sensitized to bring waste to communal container.

- It is recommended that green waste should be shredded with mobile shredder and used as a soil conditioner for parks and green belts.

5.1.3 Waste Transport System

The following recommendations are proposed for improvements in the transport system.

- A proper supervision mechanism should be in place, showing a number of containers cleared, the total quantity of fuel required vs total fuel used in a day, and detail about damaged containers and vehicles.
- Key Performance Indicators (KPIs) may be developed and monitoring teams be given targets of effective monitoring and reporting the non-compliance through the internet of things (IoT) based system for maintaining proper record of:
    1. Attendance of Field and Managerial staff,
    2. Operation and maintenance of existing vehicles,
    3. Procuring the additional vehicles required as per the specification and design duly approved by the relevant authorities,
    4. Lifting of the containers/bins/heaps as per the time communicated, and
    5. Preventive maintenance of the vehicles and containers.

5.1.4 Disposal System:

The following recommendations are for noticeable improvements in the disposal system.

- The construction of a separate landfill site in every city is not possible as it would involve huge investment and operational costs beyond our economic capability. Therefore, the inclusion of controlled dumpsites[25] must be done immediately into the current SWM system.
- Wild dumping should not be allowed in any case and controlled dumping as per technical guidelines to be practiced till the establishment of scientific Landfills (local or regional) into the system.

5.2 Way forward:

The following steps are recommended as a way forward:

1. Approval of proposed model from the competent Forum and allocation of additional funds required for the implementation of the proposed model in Bahawalpur Division.
2. The regular staff salaries of MC/ TMA (who will later be transferred to BWMC after signing the SAAMA agreement) are not included in the given cost estimations. However the budget for BWMC and MC /

[25] Per ton cost for controlled dumping varies from Rs. 400 to Rs.700/ton depending upon the area

TMA staff salaries should be released/transferred separately to BWMC from Finance department, in lieu of PFC share/grant in aid/loan.

3. Nomination of Special Purpose Entity (SPE) for the signing of Agreement with defined TORs.
4. Development of execution Plan including the capacity development of MC for primary collection, procurement planning, action planning, and planning for the introduction of monitoring regimes.
5. Finalization of the detailed operational and financial plan for taking over SWM in Bahawalpur Division
6. Allocation of required funds on basis of the financial plan through special grant or allocation in ADP (Annual Development Plan).
7. Development of tender documents including ITBs, RFPs, EOI, and PQ documents.
8. Completion of the procurement process for integrated SWM system in Bahawalpur Division and award of contract.

Operational and HR Costs (Bahawalpur District) (Mil. Rs.)									
Year	**Bahawalpur City**	**Ahmadpur East**	**Yazman**	**Khairpur Tamewali**	**Hasilpur**	**Uch Sharif**	**Qaimpur**	**Jamalpur**	**Mubarakpur**
2022	276.30	53.72	18.54	24.31	41.99	26.11	22.60	17.24	23.15
2023	290.11	56.40	19.47	25.52	44.09	27.41	23.73	18.11	24.30
2024	304.62	59.22	20.44	26.80	46.29	28.78	24.92	19.01	25.52
2025	319.85	62.19	21.46	28.14	48.61	30.22	26.16	19.96	26.79
2026	335.84	65.29	22.54	29.55	51.04	31.73	27.47	20.96	28.13
2027	352.63	68.56	23.66	31.02	53.59	33.32	28.85	22.01	29.54
2028	370.27	71.99	24.85	32.57	56.27	34.98	30.29	23.11	31.02
2029	388.78	75.59	26.09	34.20	59.08	36.73	31.80	24.26	32.57
2030	408.22	79.37	27.39	35.91	62.04	38.57	33.39	25.48	34.20
2031	428.63	83.33	28.76	37.71	65.14	40.50	35.06	26.75	35.91
2032	450.06	87.50	30.20	39.59	68.40	42.52	36.81	28.09	37.70
Grand total	**3,925.31**	**763.16**	**263.41**	**345.33**	**596.53**	**370.88**	**321.09**	**244.99**	**328.82**
Total Tonnage	**1,784,492**	**341,692**	**92,282**	**85,423**	**246,778**	**94,915**	**50,798**	**20,881**	**47,457**

Rs./Ton	**2,200**	**2,233**	**2,854**	**4,043**	**2,417**	**3,908**	**6,321**	**11,732**	**6,929**

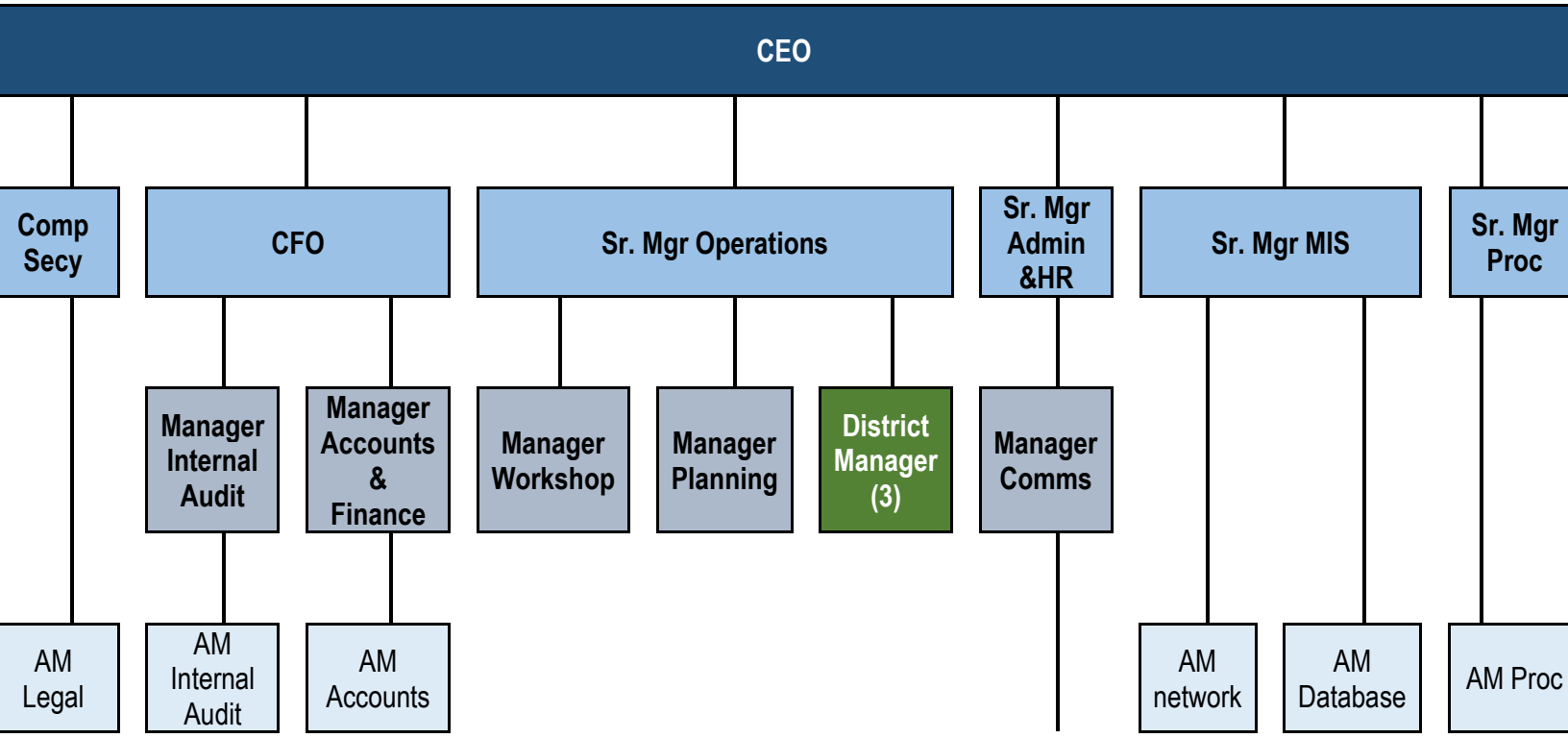
Operational and HR Costs (Rahim Yar Khan District) (Mil. Rs.)										
Year	**Rahim Yar Khan City**	**Sadiqabad**	**Khanpur**	**Liaquatpur**	**Ahmadpur Lamba**	**Tranda Sway Khan**	**Kot Samba**	**Zahir Pir**	**Khanbela**	**Ferozay**
2022	149.89	61.54	67.12	27.69	22.83	27.20	24.93	24.02	26.94	17.98
2023	157.38	64.62	70.47	29.07	23.97	28.56	26.17	25.22	28.29	18.88
2024	165.25	67.85	73.99	30.52	25.17	29.98	27.48	26.48	29.70	19.83
2025	173.52	71.24	77.69	32.05	26.43	31.48	28.85	27.81	31.19	20.82
2026	182.19	74.80	81.58	33.65	27.75	33.06	30.30	29.20	32.75	21.86
2027	191.30	78.54	85.66	35.34	29.13	34.71	31.81	30.66	34.39	22.95
2028	200.87	82.47	89.94	37.10	30.59	36.45	33.40	32.19	36.10	24.10
2029	210.91	86.60	94.44	38.96	32.12	38.27	35.07	33.80	37.91	25.31
2030	221.45	90.93	99.16	40.91	33.73	40.18	36.83	35.49	39.81	26.57
2031	232.53	95.47	104.12	42.95	35.41	42.19	38.67	37.27	41.80	27.90
2032	244.15	100.25	109.32	45.10	37.18	44.30	40.60	39.13	43.89	29.29

Grand total	**2,129.44**	**874.31**	**953.50**	**393.34**	**324.30**	**386.38**	**354.11**	**341.27**	**382.76**	**255.50**
Total Tonnage (Tons)	**858,535**	**477,901**	**425,011**	**100,114**	**46,279**	**61,579**	**60,257**	**94,447**	**66,113**	**22,667**
Rs./Ton	**2,480**	**1,829**	**2,243**	**3,929**	**7,008**	**6,274**	**5,877**	**3,613**	**5,789**	**11,272**

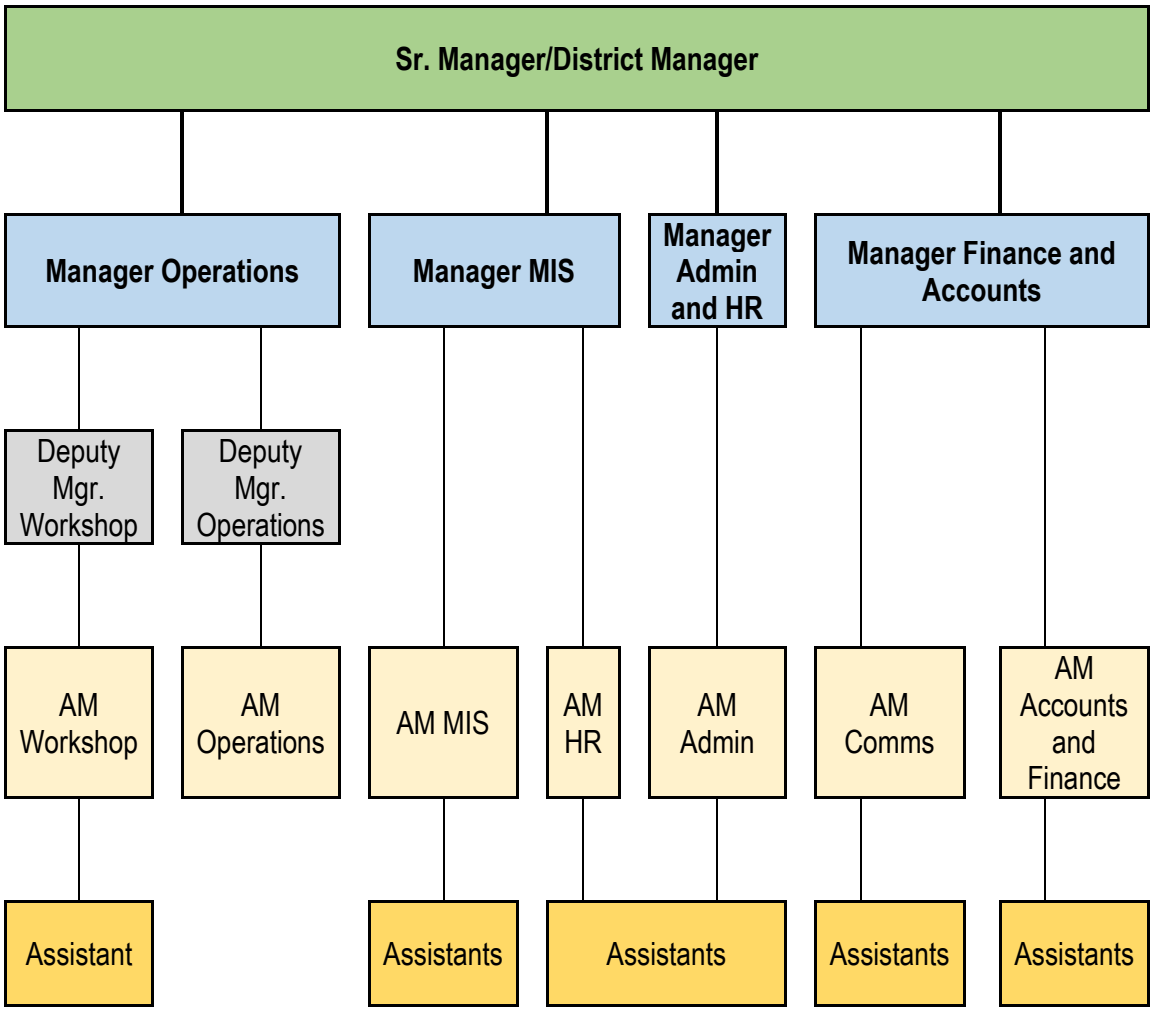
Operational and HR Costs (Bahawalnagar District) (Mil. Rs.)												
Year	**Bahawalnagar City**	**Chishtian**	**Minchinabad**	**Haroonabad**	**Fort Abbas**	**Donga Bunga**	**Mandi Sadiq Ganj**	**Mcleod Ganj**	**Faqeerwali**	**Maroot**	**Kichiwali**	**Dhranwala**
2022	130.73	100.49	31.56	65.91	22.60	23.75	17.69	14.84	27.30	13.14	15.11	22.82
2023	137.26	105.52	33.13	69.21	23.73	24.93	18.58	15.59	28.66	13.80	15.87	23.96
2024	144.13	110.79	34.79	72.67	24.91	26.18	19.50	16.36	30.10	14.49	16.66	25.16
2025	151.33	116.33	36.53	76.30	26.16	27.49	20.48	17.18	31.60	15.22	17.49	26.42
2026	158.90	122.15	38.36	80.12	27.47	28.86	21.50	18.04	33.18	15.98	18.37	27.74
2027	166.84	128.26	40.27	84.12	28.84	30.31	22.58	18.94	34.84	16.77	19.29	29.12
2028	175.19	134.67	42.29	88.33	30.28	31.82	23.71	19.89	36.58	17.61	20.25	30.58

2029	183.95	141.40	44.40	92.75	31.80	33.41	24.89	20.89	38.41	18.49	21.26	32.11
2030	193.14	148.48	46.62	97.38	33.39	35.08	26.14	21.93	40.33	19.42	22.33	33.71
2031	202.80	155.90	48.95	102.25	35.06	36.84	27.45	23.03	42.35	20.39	23.44	35.40
2032	212.94	163.69	51.40	107.36	36.81	38.68	28.82	24.18	44.47	21.41	24.61	37.17
Grand total	**1,857.21**	**1,427.70**	**448.30**	**936.41**	**321.03**	**337.36**	**251.34**	**210.87**	**387.82**	**186.73**	**214.67**	**324.19**
Total Tonnage (Tons)	**433,151**	**369,276**	**132,939**	**267,725**	**121,123**	**60,931**	**29,542**	**36,928**	**64,623**	**18,464**	**26,588**	**55,391**
Rs./ Ton	**4,288**	**3,866**	**3,372**	**3,498**	**2,650**	**5,537**	**8,508**	**5,710**	**6,001**	**10,113**	**8,074**	**5,853**

Proposed Organogram for BWMC Head Office Staff



Proposed District Offices Staff



Appendix-I: Capital Cost for Bahawalpur Division

Capital Cost						
District	**Cost**	**Capital Cost (2022-2028)**	**Capital Cost (2022-2028)**	**Total (2022-2032)**	**Cost per Ton (Rs.)**	**Division Head office Cost (Rs.)**
Bahawalpur	**Total (Rs.)**	1,057,207,780	469,131,360	1,526,339,140	**552**	**28,500,000**
Rahim yar Khan		926,729,058	373,019,574	1,299,748,632	**587**	
Bahawalnagar		725,413,877	279,303,859	1,004,717,736	**621**	

Appendix-II: Operational and HR Cost for Bahawalpur Division

Per Year Cost (Additional)						
District	**Cost**	**Operational Cost**	**HR Cost**	**Controlled Dumping Cost**	**Total**	**Division Head office cost (Rs./Year)**
Bahawalpur	*Total (Rs.)*	159,728,199	344,222,086	138,235,938	642,186,223	**60,508,800**
	Per ton Cost (Rs./ton)	**578**	**1,245**	**500**	**2,323**	
Rahim yar Khan	*Total (Rs.)*	162,711,613	287,419,024	110,645,144	560,775,781	

	Per ton Cost (Rs./ton)	**735**	**1,299**	**500**	**2,534**	
Bahawalnagar	*Total (Rs.)*	113,665,933	372,272,899	80,834,012	566,772,844	
	Per ton Cost (Rs./ton)	**703**	**2,303**	**500**	**3,506**	

5 Years Costing

Project 1 (Phase -1): Provision of efficient SWM services to cities of RYK, Sadiqabad and Bahalnagar

	PKR Million
Capital Cost	725
Operational Cost	1,720
Total	**2,445**

Project 2 (Phase -2): Provision of efficient SWM services in 9 remaining Tehsils of the Division

	PKR Million
Capital Cost	850
Operational Cost	2,000
Total	**2,850**

Project 3 (Phase -3): Provision of efficient SWM services to 17 remaining settlements with population above 10,000 in the Divisi

	PKR Million
Capital Cost	382
Operational Cost	1,850
Total	**2,232**