The Urban Unit

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

REGIONAL DEVELOPMENT PLAN

WATER SUPPLY AND SANITATION

DERA GHAZI KHAN

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Executive Summary

The Dera Ghazi Khan Division covers the extreme southwestern area of Punjab, encompassing roughly 20% of the province's total area. It comprises of four districts, namely, Dera Ghazi Khan, Rajanpur, Layyah, and Muzaffargarh. The total population of the division is estimated at around 13 million in year 2024.

DG Khan District

DG Khan City: The Metropolitan Corporation (MC) Dera Ghazi Khan is responsible for providing potable water, sewerage, and drainage services to the inhabitants of the city. The water supply and sewage systems have been under strain for years due to aging water supply infrastructure, outdated and inefficient sewer systems, and profligate water consumption on the part of consumers. The groundwater in the city is brackish. High TDS values (>1500 ppm) were found during rapid water quality testing. The city faces acute issues related to WSS i.e. Low coverage ratio, Poor water quality delivered due to contamination, Illegal connections, and not enough trained and qualified staff.

Similarly, the sewerage infrastructure coverage (spatially) is around 60%-70% but due to the insufficient capacity of the sewerage system, the city faces ponding issues during and after rainfall events. The branch sewerage network of the city has expired its designed life (40-50 years old) causing wastewater flooding in the city center frequently. The ultimate disposal of collected wastewater is in the Old Manka Drain passing through the city center.

In response to the current challenges, a Water Supply and Sanitation plan has been proposed for the next decade, aiming at addressing the needs of an estimated projected population of approximately 766,465 by the year 2034.

DG Khan District Rural: Dera Ghazi Khan District houses a staggering population of around 2,326,410 (2024) in its rural areas which is estimated to reach 3,629,013 in 2034. Despite such a large rural populace, merely 38% of the population is served by public water supply schemes. It is noted that around 26% of Rural Water Supply Schemes are abandoned due to outlived infrastructure and well-bore failures. It is important to discuss that according to the UNICEF Wash Index (2019), Dera Ghazi Khan has 19th rank in access to water and 32nd in access to sanitation facilities out of 36 districts.

As per the data collected from PHED, a total of 392 rural water supply schemes exist in the district out of which 247 (63%) are functional, 42 (11%) are dysfunctional and 103 (26%) are abandoned. Most of these schemes are dysfunctional and/or abandoned due to outlived infrastructure and well-bore failures. The groundwater of this region has high Total Dissolved Solids (TDS) values that make it unfit for drinking purposes.

Based on the data provided by the PHED, a thorough analysis of the water supply scheme has been carried out that depicts that around 47% of the schemes are more than 40 years old expiring their designed life. Whereas the remaining schemes are 10-25 years old.

Muzaffargarh District

Muzaffargarh City: Muzaffargarh is the capital city of Muzaffargarh District & is located on bank of river Chenab. It is 39th largest city of Pakistan by population as per Census 2017 with current population (2024) being 255,185 and forecasted (2034) population being 337,329. Residents of Muzaffargarh City rely on seven filtration plants owned by the Municipal

Corporation (MC) for their drinking water. However, a long-term solution is underway in the form of a piped water supply scheme. This new water supply scheme (termed here as on-going or under-construction scheme) aims to deliver water directly to homes. Unlike the current system, it will draw water from the Tailari Canal, a source deemed suitable for consumption based on tests by the Public Health Engineering Department (PHED) of Punjab. This canal-based scheme aims to cover over 70% of the municipal area. Unfortunately, although partially completed, the project has been inactive for about ten years. The reason for this delay is reportedly a lack of funds allocated by the P&D Board, particularly for the operation and maintenance (O&M) of the scheme. Therefore, to address this issue and revive the project, the timely allocation of O&M funds is crucial. This would allow for the completion and operation of the new water supply scheme, as proposed in PHED's scheme (G.S. No. 1335 ADP 2022-2023).

Muzaffargarh city sewerage system constitute of sewers (191.4 km) and open drains (222 km) and eight sewage pumping stations for wastewater disposal. While this network spread cover over 60% of the municipal area, the overall sewerage infrastructure is in a critical state as eight disposal/pump stations which assist in disposing sewage are all in poor and failing condition. The city also currently lacks a proper wastewater treatment facility. Consequently, sewage ends up being discharged directly into the Ganesh Wah distributary canal, an irrigation canal passing from the city, which further carry it to agricultural fields. This practice is highly problematic and poses environmental and health risks.

Muzaffargarh District Rural: Muzaffargarh District is further comprised of four tehsils, Muzaffargarh, Alipur, Jatoi and Kot Addu. As of the year 2024, district houses population of around 4,297,443 which is estimated to further augment to 5,338,709.

As per the data collected by PHED, a total of 23 water supply schemes exist with district jurisdictional boundary. In addition to these, a rural water supply scheme is also ongoing or under-construction in Fateh Pur Janubi village. It is unfortunate that as much as 65% schemes are dysfunctional, due to multiple reasons however even though the communities reported PHED of essence of schemes and its operationalization, they are unable to pay their shares.

Rajanpur District

Rajanpur City: Rajanpur City is the administrative headquarters of Rajanpur District, and lies in the south-western parts of Punjab. River Indus flows towards the east of the city and the Suleman Mountains rise towards west of the city. The current estimated population (year 2024) for the city is 133,957 which is further projected to increase to 206,048 in 2034, which is planning year for this regional development plan. The current water supply system of Municipal Committee (MC) Rajanpur is reported to be abandoned. The water supply system was based on groundwater-based tube wells spread across the city, with an estimated spatial coverage of distribution network being mere 20% of the city. Major reason for abandoning of the system is over-lived infrastructure. The city has good quality groundwater in most areas of the city, with only few areas along Aqilpur Road exhibiting borderline brackish groundwater. Overall, the water supply system of the city can be termed as in Failed condition, with need of major interventions for rehabilitation of the system.

The sewerage system of Rajanpur city is gravity-based owing to its relatively plain terrain. Existing sewerage infrastructure of Rajanpur city includes the main trunk lines (and adjoining

sewers) along the Muhammadpur and Aqilpur Roads. The sewage is then carried to three existing disposal stations which further dispose it to agricultural fields on the outskirts of the city without any treatment. Currently the sewerage system has a spatial coverage of mere 50% of the city. However, a development scheme for sewerage system is currently under execution by the Public Health Engineering Department. Once completed, the spatial coverage of sewerage system of the city will be increased to approximately 80% of the city. Poor condition of existing sewerage system and the lack of treatment mechanism remains key hurdle in smooth operation of sanitation mechanism of the city.

Rajanpur District Rural: The Rajanpur district currently houses a staggering population of around 2,041,432 in its rural areas. Despite such a large rural populace, mere 10% is served with public water supply schemes in 36 rural villages across the district. It should be noted that Rajanpur ranks 29th out of the 36 districts of Punjab with respect to 'Access to Water' for rural areas of the district (UNICEF, 2019). Similarly, the district ranks 34th with respect to 'Access to Sanitation' for rural areas of the district (UNICEF, 2019). The extremely low ranking of the region is a clear indication of the gap towards fulfilling the basic needs of water and sanitation for the rural communities of the district. Public Health Engineering Department (PHED) is the major stakeholder tasked with installation and operation of rural water-sanitation infrastructure in the district. As per the data collected by PHED, a total of 73 rural water supply schemes exists in the district out of which 36 (49%) are functional, 30 (41%) are dysfunctional and 7 (10%) are abandoned. Most of these schemes are dysfunctional and/or abandoned due to damaged machinery (49%). Other reasons contributing towards dysfunctional schemes include source failure (27%), outlived schemes (19%) and pending WAPDA dues (5%). Total water supply in rural areas of Rajanpur can be gauged at 3 MGD through these schemes, however, this may be augmented to 7 MGD if the dysfunctional infrastructure is rehabilitated.

Layyah

Layyah City: Layyah City is the 72nd largest city of Pakistan by population as per Census 2017. The current estimated population (year 2024) for the city is 154,611 which is further projected to increase to 206,978 in 2034, which is the planning year for this regional development plan. The existing water supply infrastructure for Layyah City comprises groundwater-based schemes with seven tubewells, which cover only about 30% of the city. Six of these tubewells have a capacity of 0.75 cusecs each, while one has a capacity of 0.5 cusec. Currently, three out of the seven tubewells are functional, while the remaining four are non-functional due to the absence of electrical panels and damaged distribution system. Rapid water quality testing indicated an acceptable pH level (6.5-8.5). The average value of Total Dissolved Solids (TDS) was also within the permissible range (< 1000 ppm), indicating that the water is sweet and suitable for drinking purposes. There is a lack of public interest in the city's water supply system, as the majority of residents have opted to install boreholes on their premises.

The sewerage system of Layyah City is a gravity-based system, with an existing network covering approximately 60% of the city. The city's wastewater is disposed of in agricultural fields and Indus River Creek through disposal stations without any treatment. The sewerage network comprises sewers with 15% of them in poor condition. Moreover, a significant length of sewers has passed their design life.

Layyah District: Layyah District currently has a rural population of around 1,706,920 which is expected to reach 2,208,367 in 2034. The population is spread over three tehsils with a total of 674 villages. According to the UNICEF Wash Index (2019), Layyah has 1st Rank in access to water and 15th in access to sanitation.As per the data collected by PHED, a total of 11 rural water supply schemes exist in the district, out of which 5 are functional and 6 are non-functional. The majority of the non-functional schemes are in Layyah. A total of 12 Water Filtration plants are installed in the region by the Public Health Engineering Department and all of them are reported to be functional. Layyah district has around 22 sewerage and drainage schemes operational in different villages and being operated and maintained by community-based organizations (CBOs).

Scope of Study & Methodology

The following sections discuss the area of concern for the project, the agreed scope of the study, planning years as well as the adopted methodology for the project.

1.1. Area of Concern

The DG Khan Regional Development Plan will be focused on urban centers of all four districts of the division; DG Khan, Muzaffargarh, Rajanpur and Layyah districts. Moreover, the rural areas in the aforementioned districts will also be the area of concern for this planning exercise.

1.2. Scope of the Study

The scope of the planning exercise includes but is not limited to the following.

- Rehabilitation plan of WSS Infrastructure
- Extension to the unserved areas for WSS Services
- Planning for WSS in Rural areas
- Proposals for machinery
- Drawing of wet utilities
- Rough Cost Estimates

1.3. Planning Year

The following planning horizon has been adopted for this planning exercise with phasing opted for short, medium and long term. Details of the phasing is as follows.

Table 1: Planning terms

Term	Years	Planning Year
Short Term	2	2026
Medium Term	5	2029
Long Term	10	2034

1.4. Methodology

Following methodology discusses the steps involved in the planning exercise of the DG Khan Regional Development Plan.

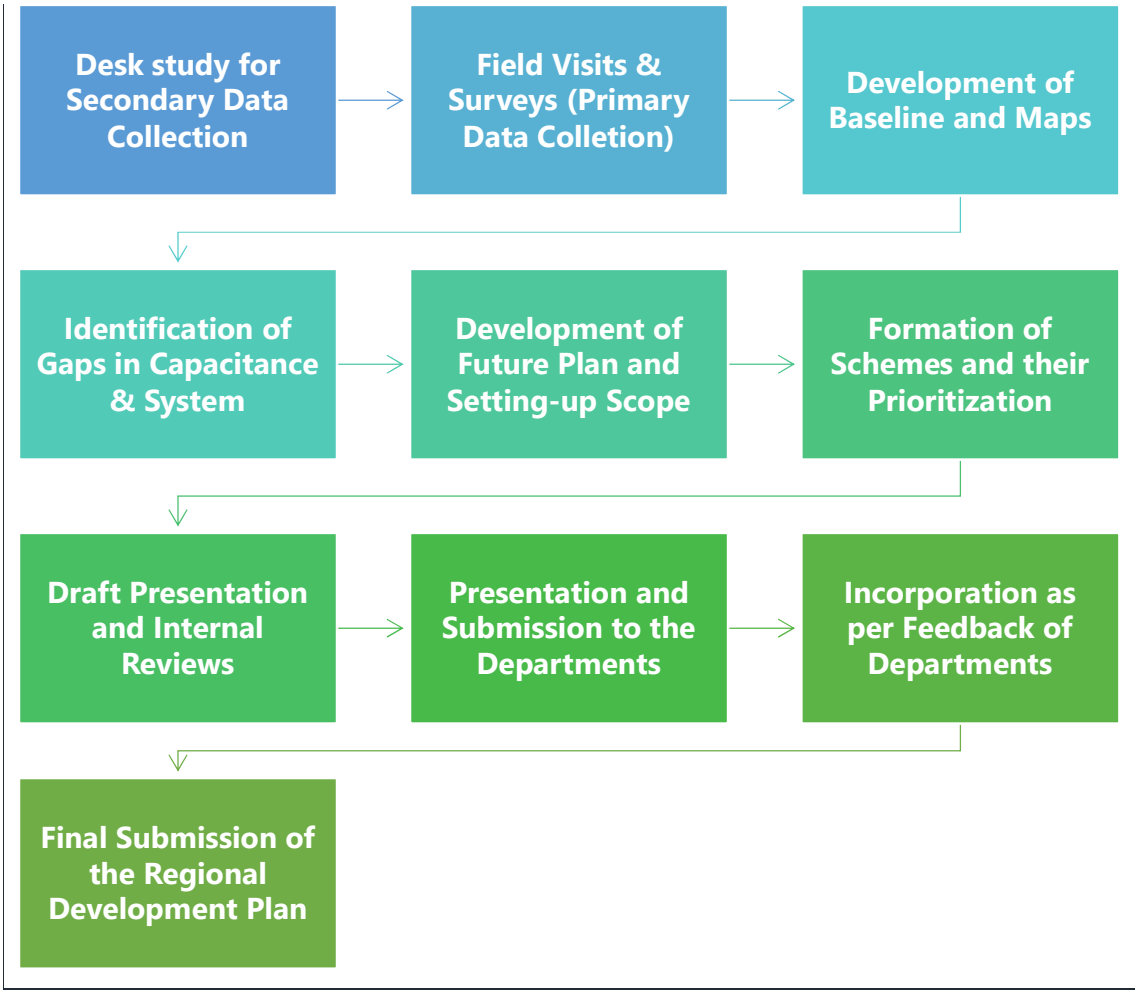


Figure 1: Planning Methodology

1.5. Field Visits

A detailed field visit for assessment of water and sanitation infrastructure of DG Khan division was conducted in May of 2024. The assessment included but was not limited to assessing the condition of WATSAN assets, GIS tagging of WSS assets and service lines with attributes, rapid water quality testing, concrete strength testing using Schmidt hammer, need assessment for rehabilitation and stakeholder meeting for their insights on the related issues etc.

1.6. Framework for Asset Mapping

Following framework was adopted for the purpose of asset mapping of the existing WSS infrastructure (Civil, Electrical, & Mechanical). All of the existing WSS utilities and assets were rated using the internationally accepted framework for condition assessment as follows.

Table 2: Condition Assessment Framework

Rating	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

1.7. Design Parameters & Considerations

The design criteria of Public Health & Engineering Department (PHED) have been broadly opted for this exercise. However, any different factors, wherever used, are rationalized, and referred to in relevant sections of the report.

1.7.1. Population Projection

Population projection is based on assumption that the past trends (growth rate of census) will continue to operate in the future. The reliability and usefulness of projections depend on the assumptions and their closeness to reality. In general, population projections are treated as predictions and should never be termed as final and fully accurate population. Following equation of Arithmetic Increase Method has been used in order to project population.

$P_n = P_0 (1+R)^n$

Where,

P_n = Population in the required year
P_0 = Population in the base year (known year)
R = Annual rate of growth in percentage
N = No. of years counted from base year (Census 2017 Population)

1.7.2. Water Demand

Keeping in view the water resources and ground water conditions, various water demands has been used for different cities. These are mentioned in relevant city water demand calculation section.

1.7.3. Variations in Water Demand

The following have been used for computation of variations in water demands.

A. Maximum Day Demand is to be taken as 1.5 times the Average Day Demand
B. Peak Hour Demand to be taken as 1.5 times the Maximum Day Demand

1.7.4. Operational Hours

Working or operational hours for water supply sources is proposed to be 16 hours. However, in case of high or low demand, working hours can be adjusted accordingly.

1.7.5. Velocity Flow in Pipes

The following standards shall be adopted for the maintaining velocity of water in pipes in the detail design phase, prior to installation of any water supply scheme.

A. Distribution mains 0.5 to 2 m/sec
B. Rising mains 0.3 to 1.5 m/sec

1.7.6. Sewage Generation

Design Flow will be the summation of Peak Sewerage Flow, Industrial / Non-domestic flow, Infiltration, and Storm Water allowances.

A. The sewage contribution of the water consumed will be as follows: 80%-85%
B. Infiltration Rate: 5% is assumed
C. Peak Factor: 2.00 as projected population is greater 100 thousand
D. Allowance for industrial waste as per actual assessment on treated industrial waste as per National Environmental Quality Standards (NEQS) is also to be allowed. 5% is taken as industrial / non-domestic sewerage flow
E. Storm water allowance: 33% of Peak Sewage Flow (Southern Punjab)

1.7.7. Sewage Conveying Medium

Sewers of Reinforced Concrete (RC) are proposed as sewage conveying medium as they are cost effective and have following benefits:

A. Cement pipes are corrosion resistant
B. They can provide working pressures up to 1.25 MPa (12.5 kgf/cm2)
C. Conduits i.e., open drains and sullage carriers are also have been opted for sewage conveying purpose where it is not possible to lay sewers

1.7.8. Sullage Carrier Sizing

For sizing and opting the right size of sewers and of sullage carriers, Manning's equation is used to calculate the Maximum carrying discharge and flow velocity against a slope which is assumed. This has been done for main sewers and where possible. Detail Hydraulic Statement must be made part of detail design for proper sizing of the sewers of the schemes prior to their execution.

$$\mathbf{Q = A\,V = \left(\frac{1.00}{n}\right) A R^{\frac{2}{3}} \sqrt{S}\ \ (SI\ Units)}$$

Where:
R= Hydraulic Radius in meters
P= Wetted Perimeter in meters
S= Slope in m/m
n= Manning's coefficient of roughness of flow carrying material (here it is assumed as 0.013 for brickwork with rough plaster)
Q= Maximum Flow Carrying capacity in m^3/sec
V= Velocity of flow in m/s against assumed slope

DERA GHAZI KHAN CITY

Dera Ghazi Khan is situated at a distance of 15 Kilometers on the right bank of the river Indus, 96 Kilometers west of Multan. It is the headquarters of Dera Ghazi Khan District and Dera Ghazi Khan Division. It is the 19th largest city in Pakistan by population. In 2024, the city holds a population of 520,793 people according to the 2017 Pakistan Census, which is expected to reach 766,465 in the year 2034. The study area of the Regional Development Plan (RDP) comprises Metropolitan Corporation (MC) Dera Ghazi Khan. Due to a vast migration activity from rural to urban areas, the rapid growth of the city has overburdened the natural resources and made it difficult for the service providers to provide an adequate quantity of necessities to the residents of the city.

The Asian Development Bank (ADB) has collaborated with the Government of Punjab Province (GoPb) to undertake the Punjab Intermediate Cities Improvement Program (PICIIP). The program aims to turn selected urban areas into smart cities that are green, inclusive, and competitive, enhancing livability and economic growth through improved governance, urban planning, service delivery, mobility, climate resilience, and IT integration. The identified projects are under approval process (As of May 2024).

The Metropolitan Corporation (MC) Dera Ghazi Khan is responsible for providing potable water, sewerage, and drainage services to the inhabitants of the city. The water supply and sewage systems have been under strain for years due to aging water supply infrastructure, outdated and inefficient sewer systems, and profligate water consumption on the part of consumers. The groundwater in the city is brackish. High TDS values (>1500 ppm) were found during rapid water quality testing. The city faces acute issues related to WSS i.e. Low coverage ratio, Poor water quality delivered due to contamination, Illegal connections, and not enough trained and qualified staff.

Similarly, the sewerage infrastructure coverage (spatially) is around 60%-70% but due to the insufficient capacity of the sewerage system, the city faces ponding issues during and after rainfall events. The branch sewerage network of the city has expired its designed life (40-50 years old) causing wastewater flooding in the city center frequently. The ultimate disposal of collected wastewater is in the Old Manka Drain passing through the city center.

In response to the current challenges, a Water Supply and Sanitation plan has been proposed for the next decade, aiming at addressing the needs of an estimated projected population of approximately 766,465 by the year 2034.

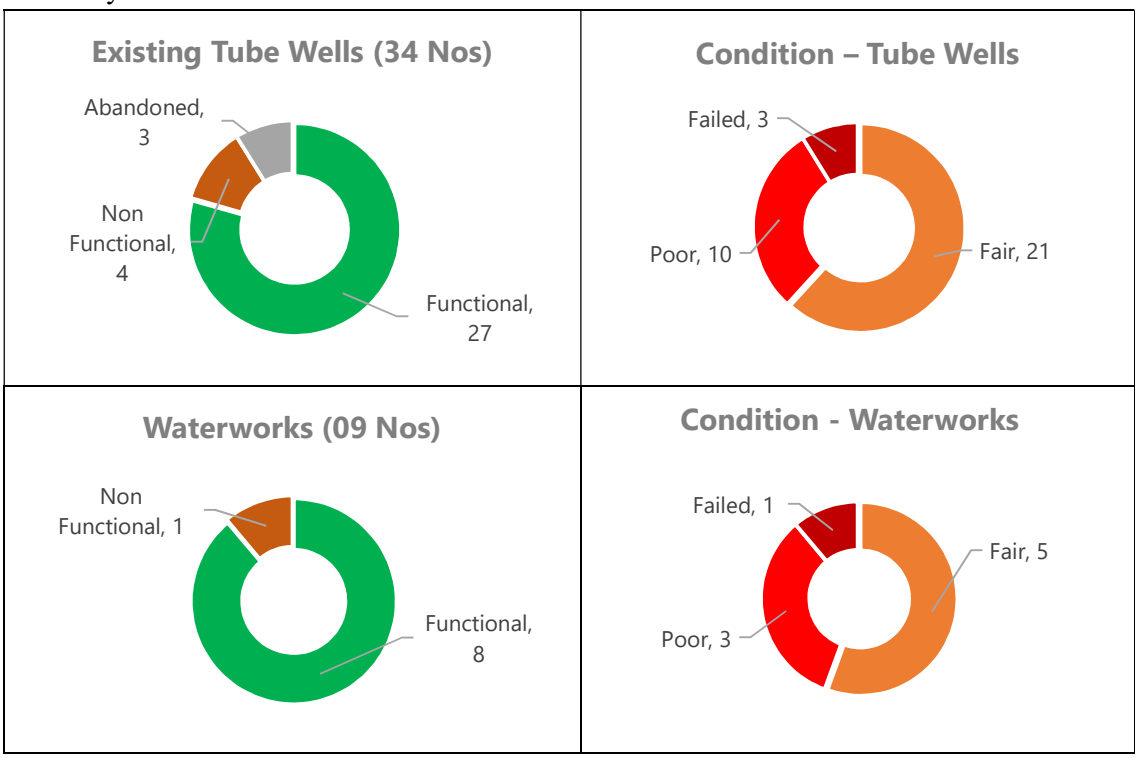
2.1. Existing Water Supply Infrastructure

The current water supply infrastructure in Dera Ghazi Khan City relies on seepage wells along Shoriya distributory, supported by 31 tube wells distributed along the canal whereas 03 tube wells are installed on DG Khan Canal. These tube wells have the capacity of 1 cusec and the water is collected in 09 waterworks (1 Abandoned) that are connected to the distribution network of the city. The water distribution system mostly adopts a direct supply method, where water is pumped directly from the waterworks to the consumers; however, there are 11 overhead reservoirs in the city out of which six (6) are functional for the service. The

operational hours of these tube wells vary, ranging from 08 to 10 hours per day, depending on the availability of electricity.

A comprehensive assessment was conducted to evaluate the condition of the tube wells in Dera Ghazi Khan City. The findings indicated that 32% of the tube wells are in fair to condition, primarily due to their better management and availability of appropriate electromechanical components. These wells are efficiently functioning and contributing significantly to the city's water supply. Furthermore, 29% of the tube wells were assessed to be in poor condition whereas the remaining tube wells are completely failed. Similarly, the waterworks consisting of ground storage tanks and pumping units are also assessed based on their civil, electrical, and mechanical components. Out of nine (9) waterworks, five (5) are rated as fair, three (3) as poor, and the remaining one (1) in failed condition. As far as overhead reservoirs are concerned, six (06) of them are rated as fair whereas the remaining five (05) are in poor condition.

The water supply distribution infrastructure has an estimated spatial coverage of approximately 80% in the city. The water distribution network of the city comprises 192 Km distribution and around 41 Km rising mains. The assessment of the water supply infrastructure of Dera Ghazi Khan city is illustrated in the charts below.



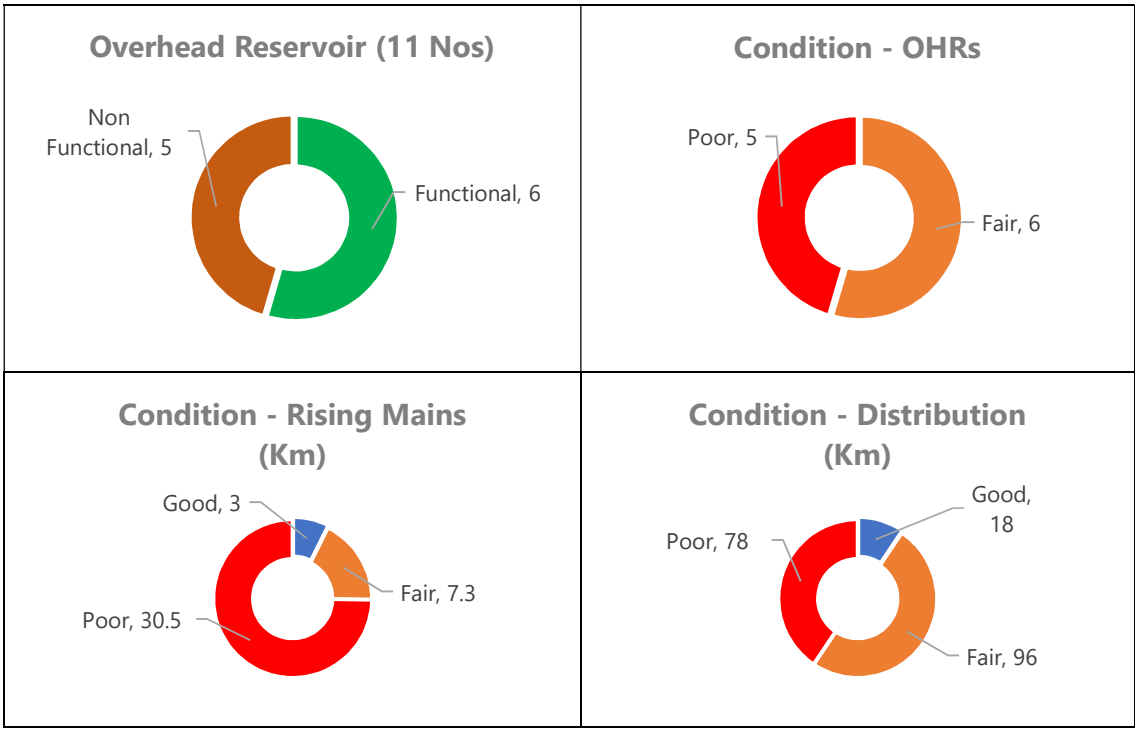


Figure 2: Condition Assessment of Water Supply Infrastructure

Detail of Water Supply infrastructure is tabulated below:

Table 3: List of Tube wells

FID	Name	Status	Zone	Inst_Year	Capacity	Condition
0	Zone-C TW-2	Non Functional	C	2008	1 Cusec	C
1	Zone-B TW-01	Functional	B	2008	1 Cusec	C
2	Zone-B TW-03	Functional	B	2008	1 Cusec	C
3	Zone-B TW-06	Non Functional	B	2008	1 Cusec	NF
4	Zone-A TW-11	Functional	A	2008	1 Cusec	D
5	Zone-A TW-09	Functional	A	2008	1 Cusec	C
6	Zone-A TW-07	Functional	A	2008	1 Cusec	C
7	Zone-A TW-08	Functional	A	2008	1 Cusec	C
8	Zone-A TW-06	Functional	A	2008	1 Cusec	C
9	Zone-A TW-05	Functional	A	2008	1 Cusec	D NF
10	Zone-A TW-04	Functional	A	2008	1 Cusec	C
11	Zone-A TW-02	Functional	A	2008	1 Cusec	C
12	Zone-A TW-01	Functional	A	2008	1 Cusec	C
13	Houbara TW-01	Abandoned		2008	1 Cusec	F
14	Houbara TW-02	Abandoned		2008	1 Cusec	F
15	Houbara TW-03	Abandoned		2008	1 Cusec	F
16	Zone-C TW-1	Non Functional	C	2008	1 Cusec	C
17	Zone-C TW-6	Functional	C	2008	1 Cusec	C
18	Zone-C TW-5	Functional	C	2008	1 Cusec	D NF
19	Zone-C TW-4	Functional	C	2008	1 Cusec	D
20	Zone-C TW-3	Functional	C	2008	1 Cusec	C
21	Zone-B TW-02	Functional	B	2008	1 Cusec	C
22	Zone-B TW-07	Functional	B	2008	1 Cusec	D

23	Zone-B TW-05	Non Functional	B	2008	1 Cusec	NF
24	Zone-B TW-04	Functional	B	2008	1 Cusec	D
25	Zone-A TW-03	Functional	A	2008	1 Cusec	C
26	Zone-A TW-10	Functional	A	2008	1 Cusec	C
27	Allahabad TW1	Functional	C	2008	0.5 Cusec	C
28	Allahabad TW2	Functional	C	2008	0.5 Cusec	C
29	Zone-C TW-10	Functional	C	2008	1 Cusec	D NF
30	Zone-C TW-9	Functional	C	2008	1 Cusec	C
31	Zone-C TW-7	Functional	C	2008	1 Cusec	C
32	Zone-C TW-8	Functional	C	2008	1 Cusec	D NF
33	Sadiqabad TW	Functional	C	2008	0.5 Cusec	C

Table 4: List of Ground Storage Tanks

FID	Name	Total	Capacity	Year	Zones	Condition	Status
0	Main WW	7	14 Lac Gallon	2006	A	C	Functional
1	Chowk Chorhatta	1	3 Lac Gallon	2006	A	C	Functional
2	Gharbi	1	7 Lac Gallon	2006	B	D	Functional
3	Azmat Park	2	7 Lac Gallon	2006	B	D	Functional
4	Waqar Canteen	1	3 Lac Gallon	2006	B	C	Functional
5	Model Town	1	7 Lac Gallon	2006	C	C	Functional
6	Shahzad Colony	1	2 Lac Gallon	2006	A	D	Functional
7	Khayaban e Sarwar	2	5 Lac Gallon	2006	C	C	Functional
8	Hobara Foundation	1	1 Lac Gallon		C	F	Abandoned

Table 5: List of Overhead Reservoirs

FID	Name	Status	Zone	Capacity
0	Chowk Chorhatta	Functional	A	50000
1	Buzdar OHR/Main WW 2	Functional	A	50000
2	Hospital Chowk	Functional	C	50000
3	Waqar Canteen	Functional	B	50000
4	Main WW 1	Non Functional	A	50000
5	Gharbi	Non Functional	B	50000
6	New Tanki	Non Functional	B	50000
7	Model Town	Non Functional	C	50000
8	Hobara Foundation	Non Functional	C	50000
9	Khayaban e Sarwar	Non Functional	C	50000
10	Shahzad Colony Water Works	Functional	A	50000

The overall condition of water quality was also assessed through Rapid Water Quality Testing across MC Dera Ghazi Khan. Handheld water quality testing equipment was utilized for this exercise and different water quality parameters like Total Dissolved Solids (TDS), PH, and Electrical Conductivity were measured. It was noted that the TDS values are higher (greater than 1500 ppm) than the prescribed limits under national and international standards. The groundwater of the city is saline and it is not fit for drinking purposes. However, the residents of the city are using the ground for their domestic needs other than drinking which is due to frequent interruptions and wastewater contamination in public water supply. The residents

fulfill their drinking water requirements from filtration plants installed by different private entities since MC Dera Ghazi Khan does not operate any filtration plant in the city.
The condition of the water supply infrastructure as encountered during the field visit performed by the Urban Unit team is indicated in the pictures below.

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Pumping Machinery
(Tube well along Shoria Disty)</td><td>Pump House
(Tube well along Shoria Disty)</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Pump House
Main Waterworks (MC DGK)</td><td>Overhead Reservoir
Constructed in 1964 (PHED)</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Water Quality Testing (@ WW)
TDS: 1588 ppm</td><td>Water Contamination
Old GI Rising Main passing through Nullah</td></tr>
</table>

Figure 3: Water Supply Infrastructure

Existing Water Supply Infrastructure Map of MC DG Khan

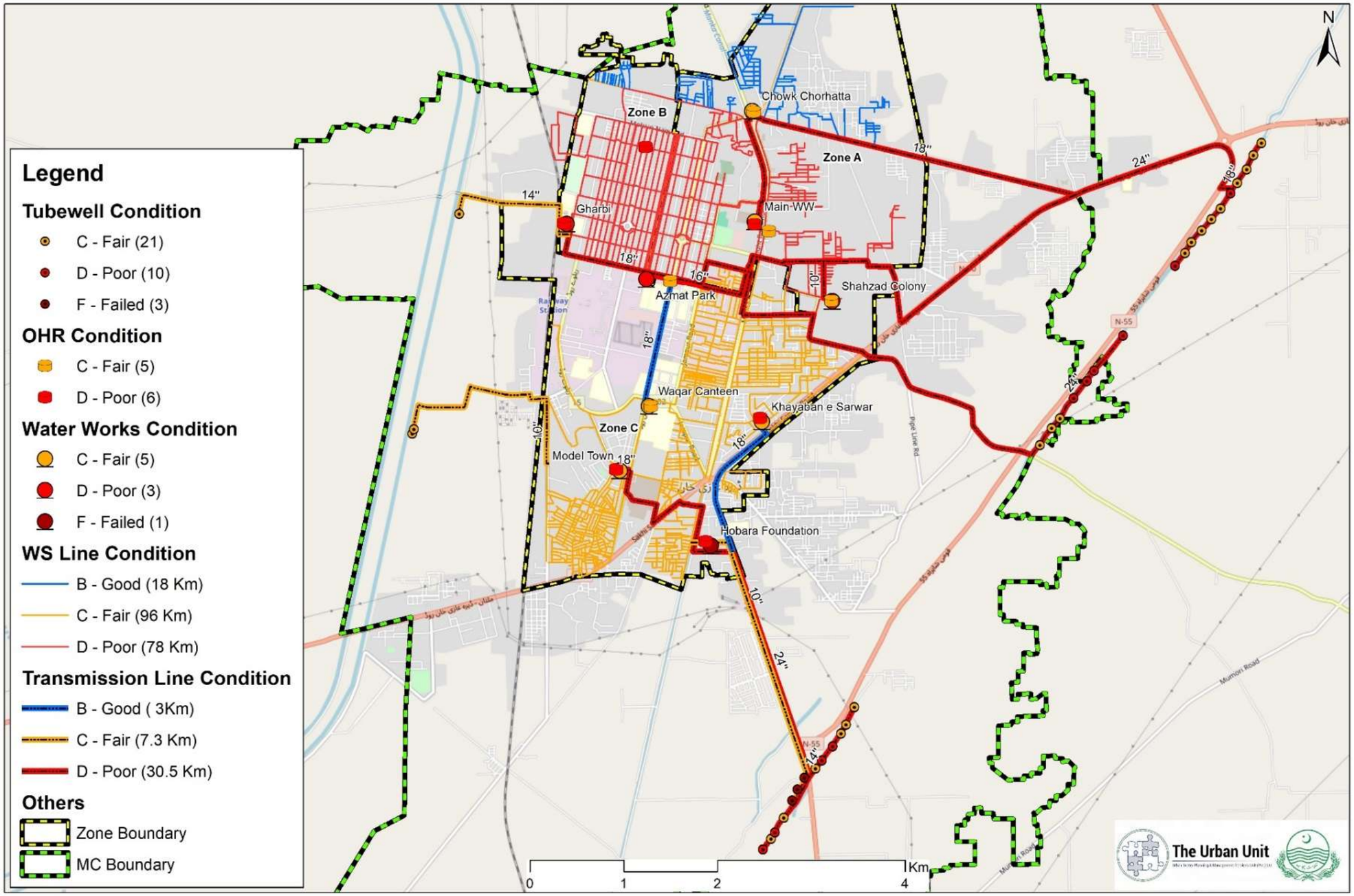


Figure 4: Condition Map of Water Supply Infrastructure

2.2. Water Supply Demand and Supply Analysis

The water supply demand comparisons have been made corresponding to a water demand of 30 GPCD keeping in consideration the water conservation strategies and global best practices. Additionally, demand augmentation for commercial, industrial, and institutional have been included as 15% each in the total water demand. It must be noted that 30 GPCD water demand is considered adequate and is aligned with the United Nations 'Human Right to Water and Sanitation Guidelines' which recommends a minimum of 11 – 22 GPCD of water to ensure full realization of the individual right to water. Moreover, this figure is also aligned with the 'National Drinking Water Policy of Pakistan (2009)' which ensures a minimum amount of 26 GPCD (120 LPCD) for equitable access to water in urban areas.

The current (2024) and future (2026, 2029, 2034) water demand are tabulated below. A comparison of estimated water demands, water supply (After PICIIP Projects), and water supply (BAU) graph are represented in the figure below.

Table 6: Water Supply Demand Estimations

Year	2024	2026	2029	2034
Population	520,793	562,640	631,799	766,465
Average Day Demand (MGD)	14.97	16.18	18.16	22.04
Max Day Demand (MGD)	22.46	24.26	27.25	33.05
Peak Hour Demand (MGD)	33.69	36.40	40.87	49.58

Supply and demand analysis is illustrated below:

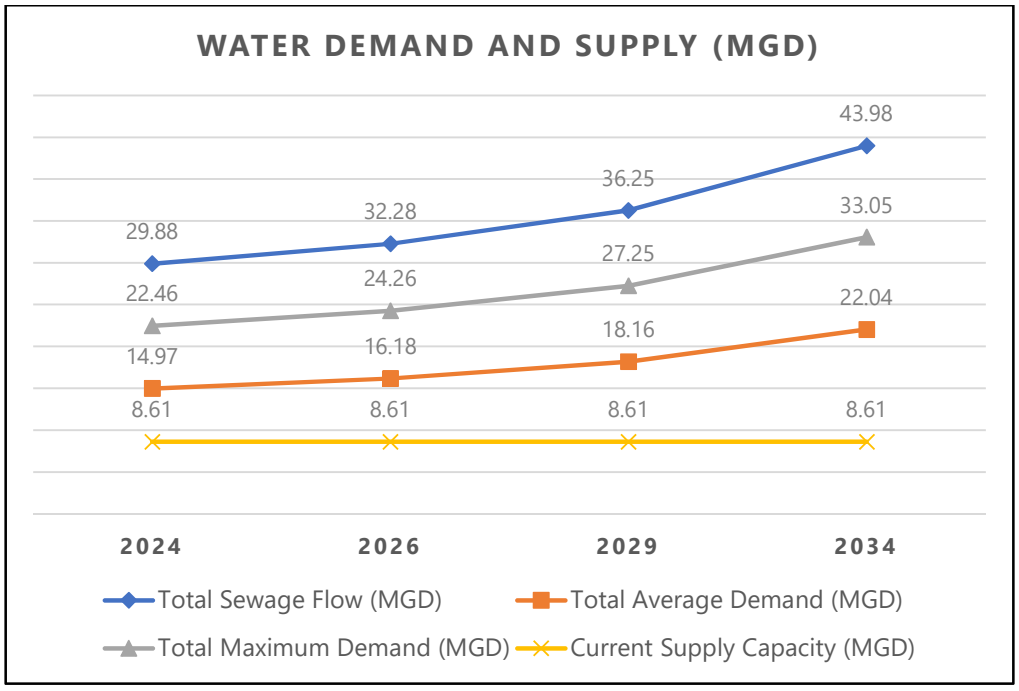


Figure 5: Water Supply Demand and Supply Analysis

2.3. Interventions for Water Supply System

The conditional assessment of existing water supply infrastructure and its comparison with present and future projected demand and needs has resulted in the identification of service delivery gaps that exists within the system. The planning exercise aims to fulfill the afore-described gaps to water supply. Prioritization of these gaps is also done and schemes are proposed based on various factors such as the essence of intervention, the duration required to execute them, cost required, and their impact on public. The total cost required to uplift the current water supply situation is 6,018 Million. For Rough Cost Estimation, MRS 1st Bi-Annual-2024 (01.01.2024 to 30.06.2024) District Dera Ghazi Khan has been applied. This is further subject to the detailed design of the proposed schemes upon PC-1 formation.

2.3.1. Short Term Plan

The short-term plan of Dera Ghazi Khan is focused on fulfilling the existing service delivery gaps. It focuses on the rehabilitation of existing tube wells, rehabilitation and upgradation of waterworks, replacement of outlived distribution infrastructure (108.6 Km), and new infrastructure (10 tube wells and 3 overhead reservoirs) to immediately fill the gaps of demand and supply. The short-term plan of Dera Ghazi Khan is expected to cost 1,045 Million.

2.3.2. Medium Term Plan

The medium-term plan involves the installation of fifteen (15) new tube wells of 1 cusec each on 1-Link Canal, the addition of two (02) new ground storage reservoirs on existing waterworks, the construction of seven (07) new overhead reservoirs, and the laying of the distribution network of approximately 130 Km to cater to the unserved areas in the city. Furthermore, due to the huge gap between water demand and existing supply, the construction of a surface water treatment plant (6 MGD) based on slow sand filtration technology on Katchi Canal is proposed in this plan to augment the water supply service. In addition, the establishment of asset management and GIS cell is proposed for better management of the assets. The medium-term plan for Dera Ghazi Khan is estimated to cost around 2,412 Million.

2.3.3. Long Term Plan

The long-term plan discusses the further extension of water supply services in the city with the proposed installation of twenty (20) new tube wells of 1 cusec each, along overhead and ground storage reservoirs and extension of the distribution network of approximately 276 Km for the future population of the city. Similarly, extension of the surface water treatment plant up to 10 MGD is also proposed in this term. The long-term plan for Dera Ghazi Khan is estimated to cost 2,561 Million.

The following schemes are proposed for uplifting the water supply system of MC Dera Ghazi Khan as per the performed assessments and analysis.

Table 7: Proposed Interventions for Water Supply

Sr.	Phase	Proposed Schemes, Estimated Costs & Scope

1	Short Term (2026)	**Water Supply Uplift Program for Dera Ghazi Khan City – Phase I (1,045 M)** **Scope of Project:** ▶ Repair/rehabilitation of 10 Tube Wells (1 cusec each) including civil works (pump house repairs as per requirement), electro-mechanical (machinery and panel as per requirement), rehabilitation (Civil & Electromechanical) of 06 Ground Storage Tanks (GSTs), Reconstruction of 6 existing Outlived Overhead Tanks (50,000 gallons) ▶ Replacement of outlived/damaged transmission mains (30.6 Km) and distribution network (78 Km) with HDPE pipes ▶ Addition of 10 New tube wells (1 Cusec each) on Dera Ghazi Khan Canal and construction of 03 Overhead tanks (100,000 gallons each)
2	Medium Term (2029)	**Water Supply Uplift Program for Dera Ghazi Khan City – Phase II (2,412 M)** **Scope of Project:** ▶ Construction of 15 Nos Tube wells (1 cusecs) on 1-Link Canal, addition of 02 ground storage tanks with pumping machinery on existing water works (300,000 gallons at Gharbi and 150,000 gallons at Hobara) and 07 No Overhead Reservoirs (OHRs) (100,000 gallons each) ▶ Laying of the water distribution (Transmission and distribution) network (3", 4", 6" & 8") of approx. 130 Km in the unserved areas ▶ Construction of Surface Water Treatment Plant (Slow Sand Filtration) of 6 MGD on Katchi Canal to improve the water availability ▶ Establishment of Asset Management and GIS cell in MC Dera Ghazi Khan: Provision of computers, workstations, dedicated server system and related IT equipment & and resources.
3	Long Term (2034)	**Water Supply Uplift Program for Dera Ghazi Khan City – Phase III (2,561 M)** **Scope of Project:** ▶ Construction of 20 Nos Tube wells (1 cusecs) on DG Khan and Shoriya Canal, 02 New Water Works including 02 ground storage tanks with pumping machinery on existing water works (200,000 & 300,000 gallons each) with 02 No Overhead Reservoirs (OHRs) (100,000 gallons each). ▶ Extension of the water distribution network (3", 4", 6", 8") of approximately 276 Km to cater the future population ▶ Extension of Surface Water Treatment Plant (Slow Sand Filtration) to 10 MGD on Katchi Canal to improve the water availability

Total Cost for Water Supply System = 6,018 Million PKR

Proposed Water Supply Infrastructure Map of MC DG Khan

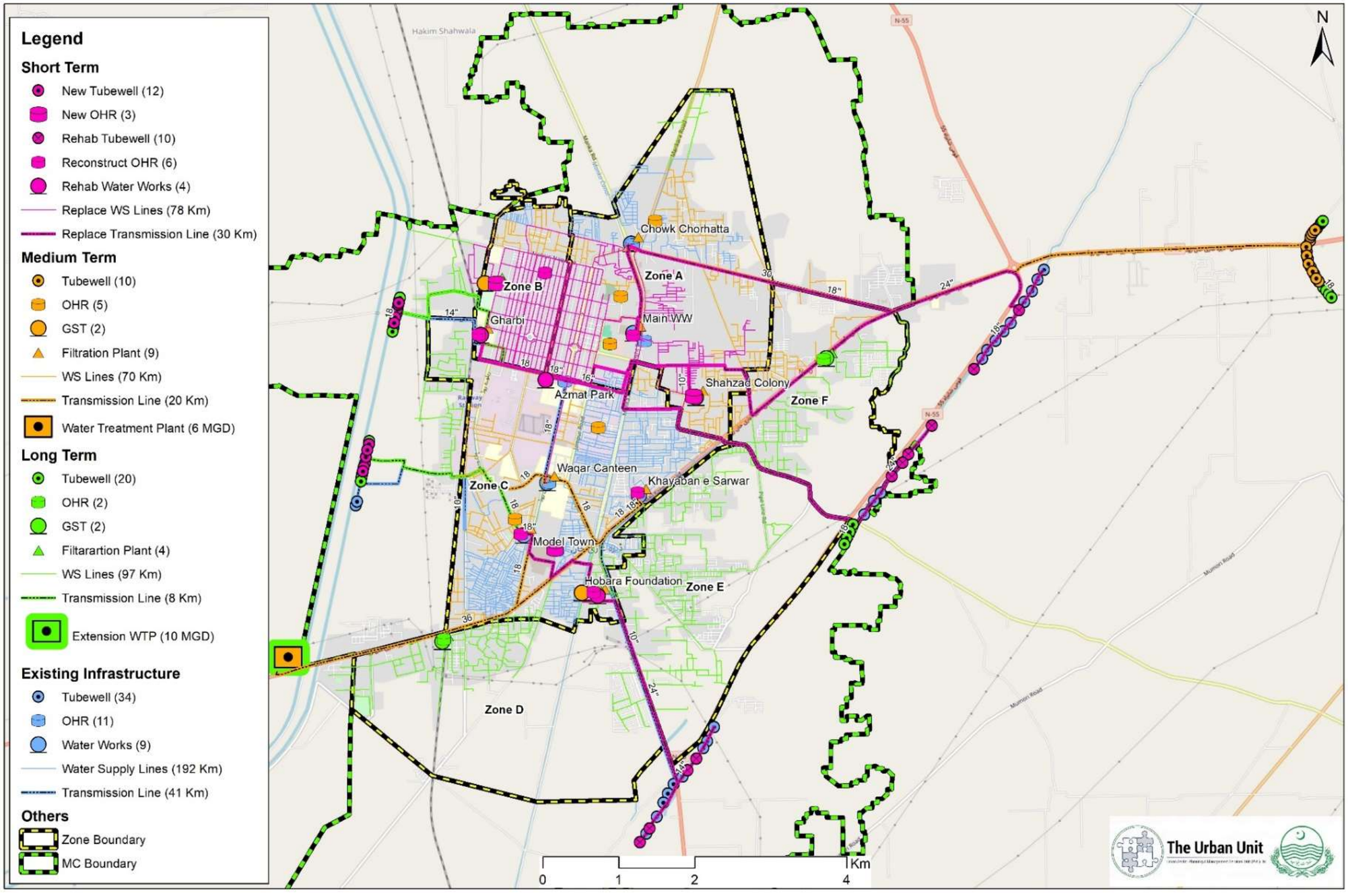


Figure 6: Proposed Water Supply Infrastructure

2.4. Existing Sewerage Infrastructure

The current sewerage infrastructure of Dera Ghazi Khan City includes trunk and lateral sewers (147 Km) that transport wastewater to disposal stations. The collected sewage is then transferred to thirteen (13) disposal stations, which discharge it into irrigation canals and agricultural fields without any treatment. The existing disposal stations are overburdened and machinery is not sufficient to manage the wastewater generated by the city. Similarly, the sewerage network is outdated and under capacity causing frequent overflowing and ponding. The proposed plan aims to address the major sanitation issues of outdated lateral sewerage infrastructure and plan for a new sewerage network in the unserved areas.

The condition of disposal stations in the city was assessed and it was noted that 70% of the disposals were in fair condition whereas the remaining 30% of disposals were assessed to be in poor condition. All of these disposals have an average operational time of 18 hours per day. Whereas, the lateral sewerage infrastructure (240 Km) has an estimated spatial coverage of over 85% in the city. All of the lateral sewerage network is 40 to 50 years old and rated in poor condition.

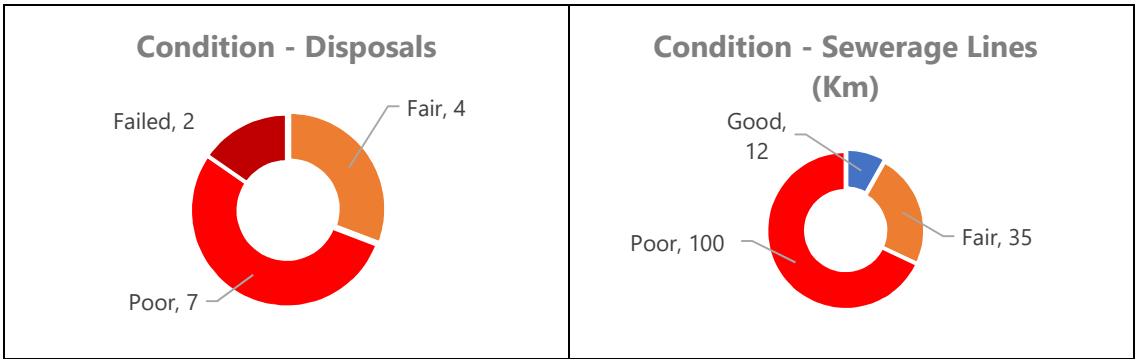
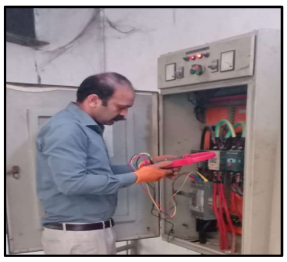


Figure 7: Condition Assessment of Sewerage Infrastructure





Portable Pumping Machinery	Outlived Jetting Machine	Electromechanical Assessments

Figure 8: Existing Sewerage Infrastructure

List of Disposal Stations in MC DG Khan are tabulated below:

Table 8: List of Disposal Stations

FID	Name	Condition	Status	year
0	Naurang Abad Disposal Station	C	Functional	2016
1	Masoom Abad Disposal Station	D	Functional	2010

2	Sabzi Mandi Disposal Station	D	Functional	1980
3	Bhutta Colony Disposal Station	C	Functional	2006
4	Model Town Disposal Station	D	Functional	1980
5	Rasheed Abad Disposal Station	D	Functional	1985
6	Khayaban e Sarwar Disposal Station	D	Functional	1985
7	Main Disposal Station	D	Functional	1980
8	Shamas Abad Disposal Station	C	Functional	2011
9	Waqar Canteen Disposal Station	C	Functional	2012
10	Gadhai Qabaristan Disposal Station	D	Functional	1995
11	Sadiqabad Disposal Station	F	Abandoned	

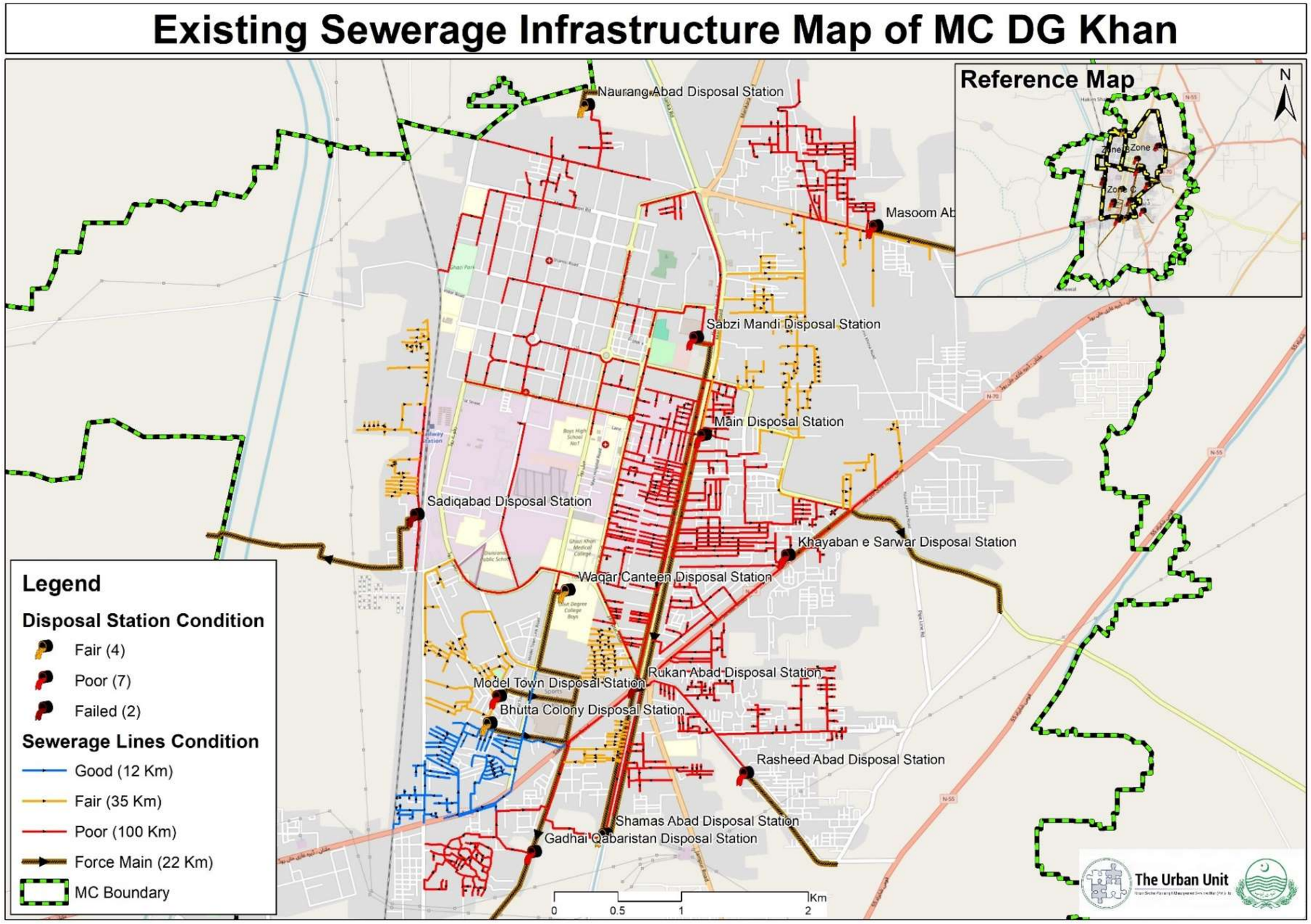


Figure 9: Condition Map of Existing Sewerage Infrastructure

2.5. Sewage Flow Estimations

The sewage generation has been made corresponding to the 30 gallons per capita per day water demand. A contribution of 50% for storm-water flow, 5% infiltration & 5% non-domestic flows have been included during the calculation of the total sewerage flow. The current (2024) and future (2026, 2029, 2034) sewage flows are tabulated below.

Table 9: Sewage Flow Estimation

Year	2024	2026	2029	2034
Population	520,793	562,640	631,799	766,465
Avg. Sewage Generated (MGD-I)	11.07	11.96	13.43	16.29
Peak Sewage Flow (MGD-I)	22.13	23.91	26.85	32.57
Storm Water Flow (MGD-I)	6.64	7.17	8.06	9.77
Infiltration Flow (MGD-I)	0.55	0.60	0.67	0.81
Non-Domestic Flow (MGD-I)	0.55	0.60	0.67	0.81
Total Sewage Flow (MGD-I)	**29.88**	**32.28**	**36.25**	**43.98**

The current estimated wastewater generation of DG Khan City is approximately 29.88 MGD-I. It should be noted that this flow is expected to increase up to 43.98 MGD by the end of 2034. The estimated wastewater flows for Dera Ghazi Khan are graphically represented below.

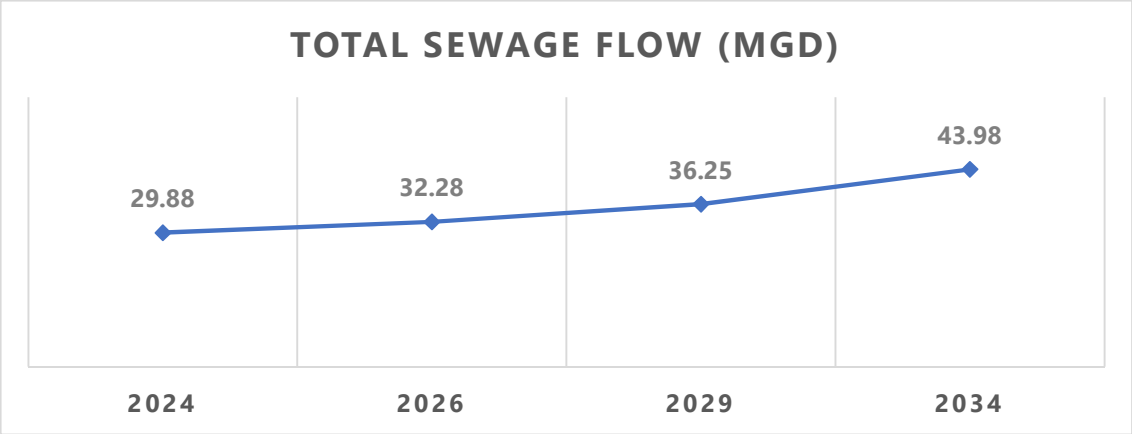


Figure 10: Estimated Total Sewage Flow (MGD-I)

2.6. Interventions for Sewerage System

The conditional assessment of existing sanitation infrastructure and its comparison with present and future projected demand and needs has resulted in the identification of service delivery gaps that exist within the system. The planning exercise aims to fulfill the afore-described gaps in sewerage. Prioritization of these gaps is also done and schemes are proposed based on various factors such as the essence of intervention, the duration required to execute them, the cost required, and their impact on the public. The total cost required to uplift the current sewerage situation is around 8,271 Million.

For Rough Cost Estimation, MRS 1st Bi-Annual-2024 (01.01.2024 to 30.06.2024) District Dera Ghazi Khan has been applied. This is further subject to the detailed design of the proposed schemes upon PC-1 formation.

2.6.1. Short Term Plan

The short-term plan for sewerage focuses on the rehabilitation/upgradation of priority disposal stations along with the replacement of force mains (7 Km) and procurement of mobile machinery i.e. Sucker, Jetting, and Desilting Machines. The total expected cost for the Short Term is around 359 Million.

2.6.2. Medium Term Plan

In the medium-term plan, in continuation of the previous project replacement of existing outdated trunk and sewer mains (18 Km) along with lateral network (83 Km) are proposed. Additionally, the laying of new sewerage infrastructure of trunk and sewer mains (42 Km) along with the lateral network of 66 Km for the unserved areas is also added in the term. Like the short-term plan, capacity enhancement and rehabilitation of six (06) disposal stations are part of the medium-term plan as well. The total expected cost for the medium term is around 3,805 Million.

2.6.3. Long Term Plan

The long-term plan deals with expanding the coverage of the sewerage network of 62 Km to the unserved areas of the city along with a new disposal station. For the treatment of wastewater in the city, it is suggested to construct the waste treatment plant based on trickling filter technology (45 MGD) owing to less land requirement, unlike stabilization ponds. The total expected cost of the Long term is around 4,107 Million.
The following schemes are proposed for uplifting the sewerage system of MC DG Khan as per the performed assessments and analysis.

Table 10: Proposed Interventions for Sewerage Infrastructure

Sr.	Phase	Proposed Schemes, Estimated Costs & Scope
1	Short Term (2026)	**Sewerage Uplift Program in Dera Ghazi Khan City – Phase I (359 M)** **Scope of Project:** ▶ Rehabilitation and capacity upgradation of Disposal Stations (Main Disposal Station, Masoomabad and Khayaban-e-Sarwar) along with replacement of force mains (7 Km) ▶ Procurement of allied machinery (02 Sucker Machines, 02 Jetting Machines, 02 Desilting Machines & 02 Wench Machines)
2	Medium Term (2029)	**Sewerage Uplift Program in Dera Ghazi Khan City – Phase II (3,805 M)** **Scope of Project:** ▶ Replacement of existing outdated trunk and main sewer network (21” to 42”) of total length 18 Km

		▶ Laying of new trunk and main sewer network of total length 42 Km ▶ Replacement of existing outdated lateral sewer network (9" to 18") of total length 83 KM ▶ Laying of new lateral sewer infrastructure (9" to 18") of total length 66 Km ▶ Rehabilitation and Capacity upgradation of Disposal Stations (Model Town, Gadhai Qabaristan, Naurangabad, Shamsabad, Rashidabad and Sadiqabad)
3	Long Term (2034)	**Sewerage Uplift Program in Dera Ghazi Khan City – Phase III (4,107 M)** **Scope of Project:** ▶ Extension of sewage conveyance network to the unserved areas of the city (62 Length), Sullage Carriers of 6 Km, and Construction of new disposal station (6 Cusecs Capacity). ▶ Construction of WWTP Trickling Filter Technology with auxiliary facilities and an estimated area of 50 Acres [Total Capacity: 45 MGD (09 MGD x 5)]
Total Cost for Sewerage System = 8,271 Million PKR		

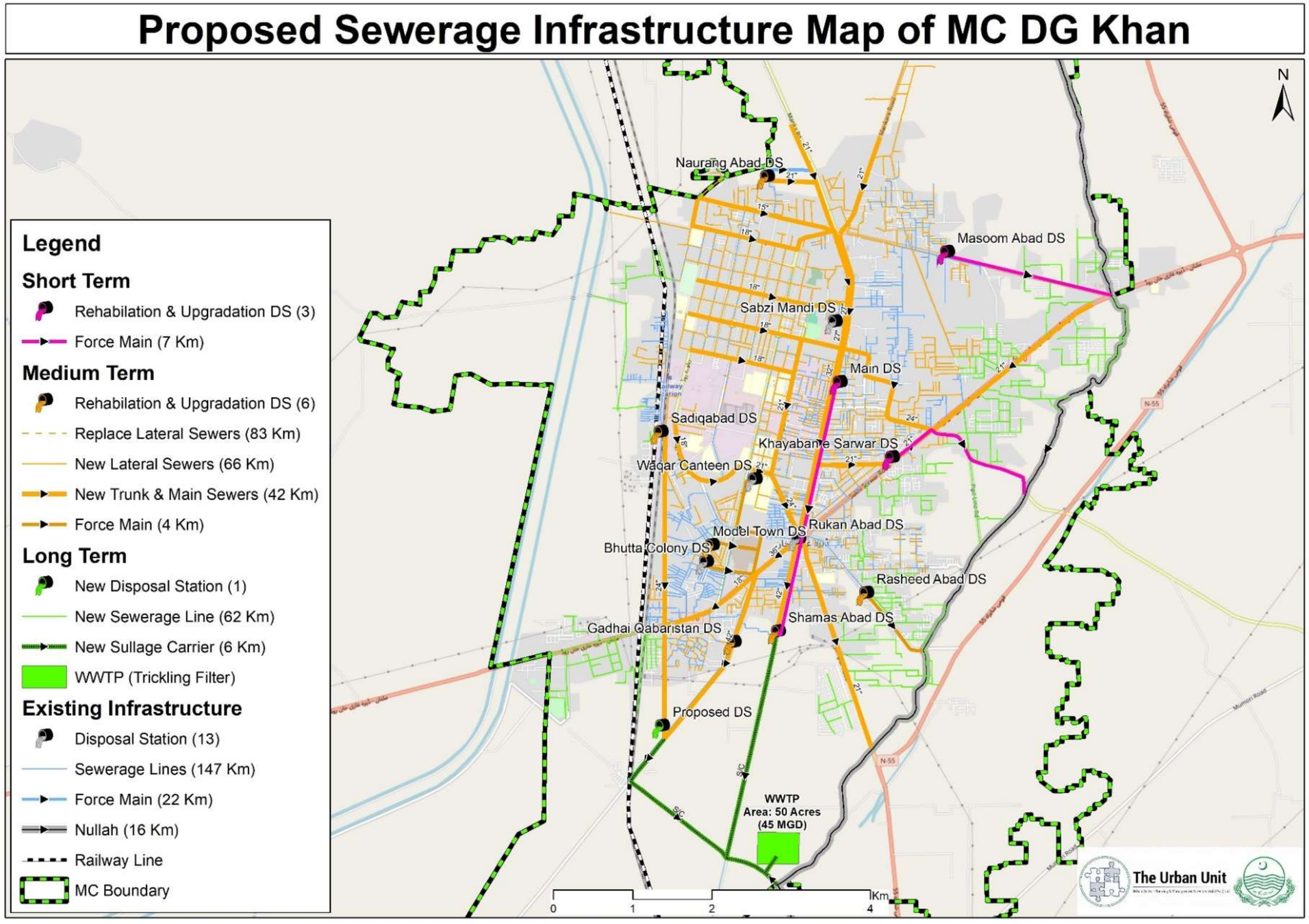


Figure 11: Proposed Sewerage Infrastructure

2.7. Rural Water Supply and Sanitation Infrastructure

Dera Ghazi Khan District houses a staggering population of around 2,326,410 (2024) in its rural areas which is estimated to reach 3,629,013 in 2034. Despite such a large rural populace, merely 38% of the population is served by public water supply schemes. It is noted that around 26% of Rural Water Supply Schemes are abandoned due to outlived infrastructure and well-bore failures. It is important to discuss that according to the UNICEF Wash Index (2019), Dera Ghazi Khan has 19th rank in access to water and 32nd in access to sanitation facilities out of 36 districts.

As per the data collected from PHED, a total of 392 rural water supply schemes exist in the district out of which 247 (63%) are functional, 42 (11%) are dysfunctional and 103 (26%) are abandoned. Most of these schemes are dysfunctional and/or abandoned due to outlived infrastructure and well-bore failures. The groundwater of this region has high Total Dissolved Solids (TDS) values that make it unfit for drinking purposes.

Based on the data provided by the PHED, a thorough analysis of the water supply scheme has been carried out that depicts that around 47% of the schemes are more than 40 years old expiring their designed life. Whereas the remaining schemes are 10-25 years old.

For drinking water, PHED has reported that no public filtration plants are operational in the district however, a few plants have been installed by the NGOs and some are installed by the Punjab Aab-e-Pak Authority which are operated and maintained by community-based organizations (CBOs).

Regarding sanitation infrastructure, there is no proper sewerage scheme reported in the district. The collected wastewater is generally consumed for agriculture purposes where required otherwise it is dumped into irrigation channels without any treatment.

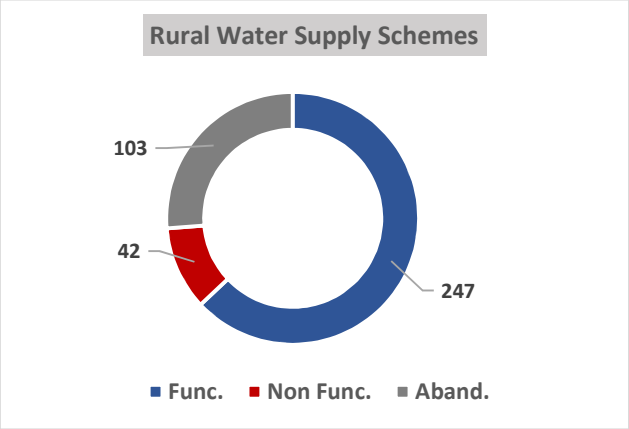


Figure 12: Status of Rural Water Supply Infrastructure

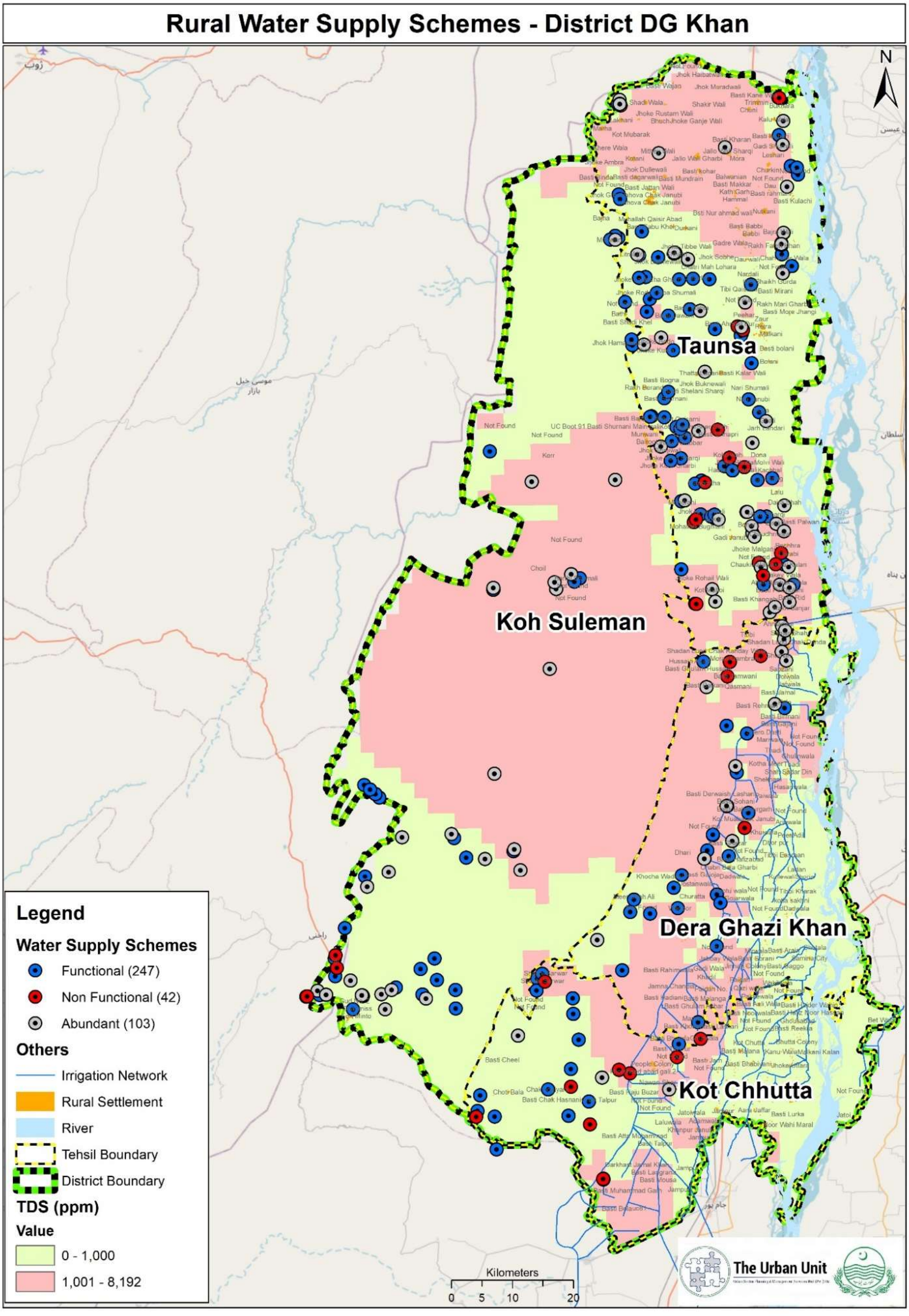


Figure 13: Baseline Map of Rural Water Supply and Sanitation Infrastructure

2.8. Interventions for Rural Water Supply and Sanitation

Following evidence-backed interventions have been proposed to address the issues in the operationalization and maintenance of water supply infrastructure in the Dera Ghazi Khan district.

- Provision of Solar-based Interventions for financial sustainability of schemes
- Technical Capacity Building of the community for effective operation and maintenance of rural schemes
- Operationalization of dysfunctional schemes for immediate relief to communities in need-based areas

The following schemes are proposed for uplifting the rural water supply of Dera Ghazi Khan district as per the performed assessments and analysis.

Table 11: Proposed Water Supply projects

Sr.	Phase	Proposed Schemes, Estimated Costs & Scope
1	Short Term (2026)	**Rural Water Supply Uplift Program – Phase I (1,638 M)** **Scope of Project:** ▶ Rehabilitation of 42 Nos Rural Water Supply Schemes in Dera Ghazi Khan District
2	Medium Term (2029)	**Rural Water Supply Uplift Program – Phase II (774 M)** **Scope of Project:** ▶ 18 Nos New Rural Water Supply Schemes with distribution infrastructure in Dera Ghazi Khan District (Pop>15,000) **Rural Sewerage and Drainage Scheme – Phase I (860 M)** **Scope of Project:** ▶ 20 Nos New Rural Sewerage and Drainage Schemes along with disposal mechanism in DG Khan District for villages having a population more than 15,000. (5 for each Tehsil)
3	Long Term (2034)	**Rural Water Supply Uplift Program - Phase III (1,419 M)** **Scope of Project** ▶ Solarization of 33 Nos RWSS in Dera Ghazi Khan District (Population > 10,000) **Rural Sewerage and Drainage Scheme – Phase II (860 M)** **Scope of Project** ▶ 20 Nos New Rural Sewerage and Drainage Schemes along with disposal mechanism in DG Khan District for villages having a population of more than 15,000. (5 for each Tehsil) **Model Village Program in District DG Khan – Pilot Project (300 M)**

		Scope of Project ▶ Establishment of a Model Village in each tehsil of DG Khan - Provision of 100% coverage of water, sewerage and drainage services, wastewater treatment plant, and paved streets network.
Total Cost for Rural Areas = 3,568 M		

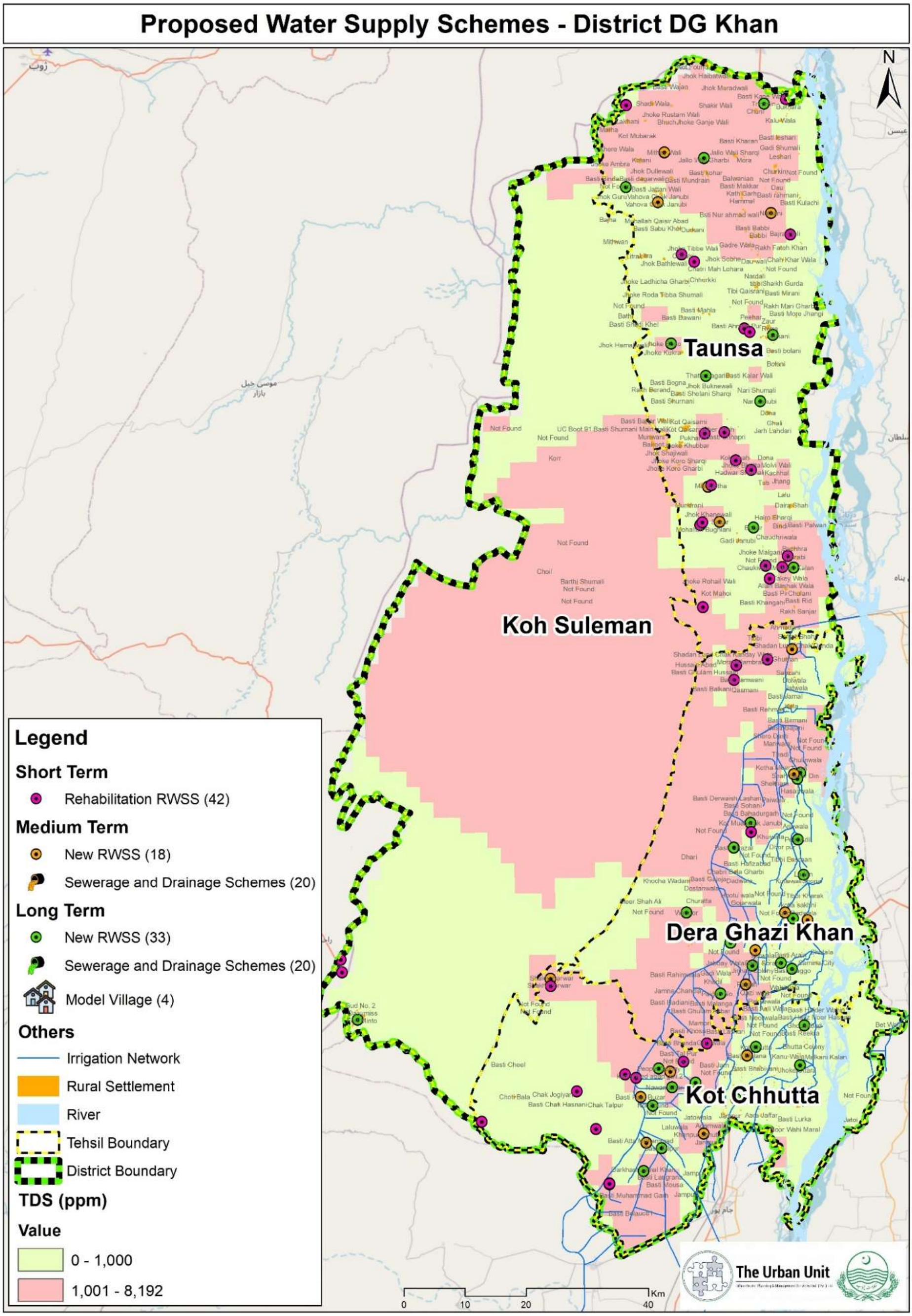


Figure 14: Proposed WSS Infrastructure

Muzaffargarh City

Muzaffargarh is the capital city of Muzaffargarh District & is located on bank of river Chenab. It is 39th largest city of Pakistan by population as per Census 2017 with current population (2024) being 255,185 and forecasted (2034) population being 337,329.

Water Supply:

Residents of Muzaffargarh City rely on seven filtration plants owned by the Municipal Corporation (MC) for their drinking water. However, a long-term solution is underway in the form of a piped water supply scheme. This new water supply scheme (termed here as on-going or under-construction scheme) aims to deliver water directly to homes. Unlike the current system, it will draw water from the Tailari Canal, a source deemed suitable for consumption based on tests by the Public Health Engineering Department (PHED) of Punjab. This canal-based scheme aims to cover over 70% of the municipal area. Unfortunately, although partially completed, the project has been inactive for about ten years. The reason for this delay is reportedly a lack of funds allocated by the P&D Board, particularly for the operation and maintenance (O&M) of the scheme. Therefore, to address this issue and revive the project, the timely allocation of O&M funds is crucial. This would allow for the completion and operation of the new water supply scheme, as proposed in PHED's scheme (G.S. No. 1335 ADP 2022-2023).

Sewerage System:

Muzaffargarh city sewerage system constitute of sewers (191.4 km) and open drains (222 km) and eight sewage pumping stations for wastewater disposal. While this network spread cover over 60% of the municipal area, the overall sewerage infrastructure is in a critical state as eight disposal/pump stations which assist in disposing sewage are all in poor and failing condition. The city also currently lacks a proper wastewater treatment facility. Consequently, sewage ends up being discharged directly into the Ganesh Wah distributary canal, an irrigation canal passing from the city, which further carry it to agricultural fields. This practice is highly problematic and poses environmental and health risks.

3.1. Existing Water Supply Infrastructure

Residents of Muzaffargarh City rely on seven filtration plants owned by the Municipal Corporation (MC) for their drinking water. However, a long-term solution is underway in the form of a piped water supply scheme. This new water supply scheme (termed here as on-going or under-construction scheme) aims to deliver water directly to homes. Unlike the current system, it will draw water from the Tailari Canal, a source deemed suitable for consumption based on tests by the Public Health Engineering Department (PHED) of Punjab. This canal-based scheme aims to cover over 70% of the municipal area. Unfortunately, although partially completed, the project has been inactive for about ten years. The reason for this delay is reportedly a lack of funds allocated by the P&D Board, particularly for the operation and maintenance (O&M) of the scheme. Therefore, to address this issue and revive the project, the timely allocation of O&M funds is crucial. This would allow for the completion and operation of the new water supply scheme, as proposed in PHED's scheme (G.S. No. 1335 ADP 2022-2023).

The Detail of water supply infrastructure, both under-construction (inoperative) and operative, is as under.

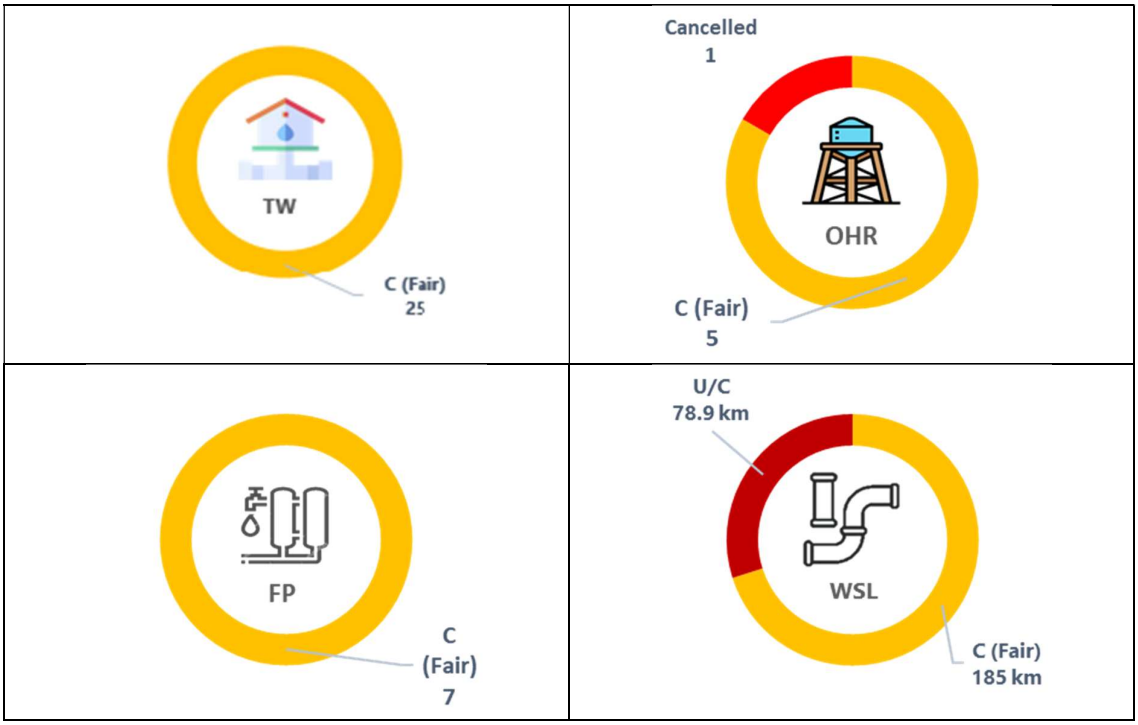


Figure 15: Water Supply Infrastructure detail

3.2. Water Supply versus Water Demand

Water Supply in terms of maximum day demand is calculated and compared with water demand. The existing water supply capacity is analyzed and it stands out at around 6.8 MGD-I maximum for all water supply appurtenances, when made operational, whereas Water Demands standing at various planning years are as follow:

Table 12: Water Demands

Water Demands				
Year	2024	2026	2029	2034
Population	255,185	269,833	293,396	337,329
Average Day Demand (MGD)	5.6	5.9	6.5	7.4
Max Day Demand (MGD)	8.4	8.9	9.7	11.1
Peak Demand (MGD)	12.6	13.4	14.5	16.7
NOTE: Due to unavailability of Water in subject region, Water demands are reduced to 22 GPCD including all provision for allowances and losses. This figure is aligned with the United Nations media brief report "Human Right to Water and Sanitation" which quote				

"According to the World Health Organization (WHO), between 50 and 100 litres of water per person per day are needed to ensure that most basic needs are met and few health concerns arise."
This value of 50-100 lpcd or 11-22 Gpcd have been practiced in other water scare areas of Punjab such as Chakwal city.

In current year (2024), even if the on-going WS scheme is made functional, there still will be deficit of around 1.6 MGD-I which is expected to reach 4.7 MGD-I in the year 2034 (Planning Year of RDP). These gaps indicate severe shortage of water. Following graph depict the water demand and best possible yield from under-construction scheme.

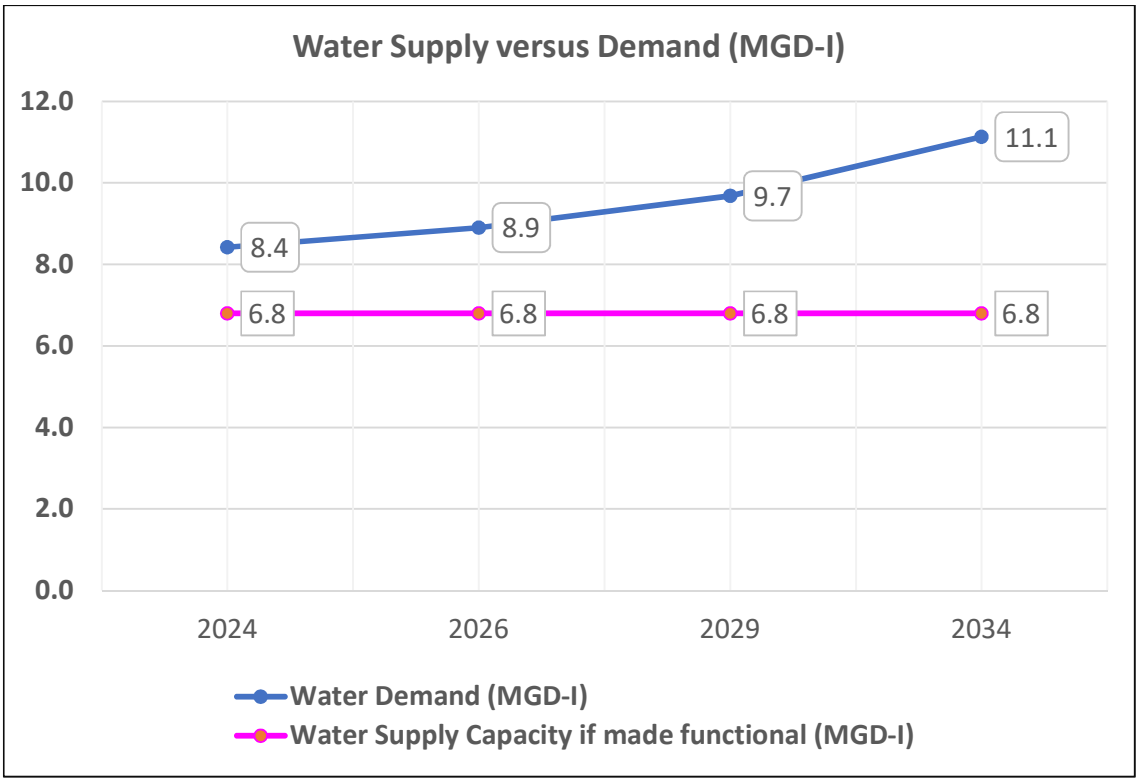


Figure 16: Water Supply versus Demand

3.3. Condition Assessment of Water Supply Infrastructure

After a detailed condition assessment, the following rating was attributed for the overall condition of Water Supplying infrastructure.

Table 13: Condition Assessments Outcome

Asset Attribute	Rating
Civil Structures	**C (Fair)**
Distribution Network	**C (Fair)**

Electro-Mechanical	**C (Fair)**

As per the detailed condition assessment of the water supply infrastructure in Muzaffargarh City, the overall civil structures condition of Pump Houses of Tube-wells, Structure of Overhead Reservoirs and GSTs have been rated as "C (Fair)" which indicates that only small non-structure cracks may be present on some of the structures however no major structural failure was evident at the time of assessment.

Since on-going/under-construction scheme was inoperative, it was not possible to test machinery performance, electrical panels, or water supply pipes, as such, based upon their looks (where possible), they are also assumed of fair condition meaning no requirement of rehabilitation.

<table>
<tr><td> 
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<tr><td>Discussion with MC Muzaffargarh</td><td>PHED office Intermediate Pumping Station (inoperative)</td></tr>
<tr><td> 
</td><td>  </td></tr>
<tr><td>Pump house of canal-based WS scheme Tube-well (inoperative)</td><td>Electrical Panel of canal-based WS scheme Tube-well (inoperative)</td></tr>
</table>

Figure 17: In Pictures: Field Survey and Assessment

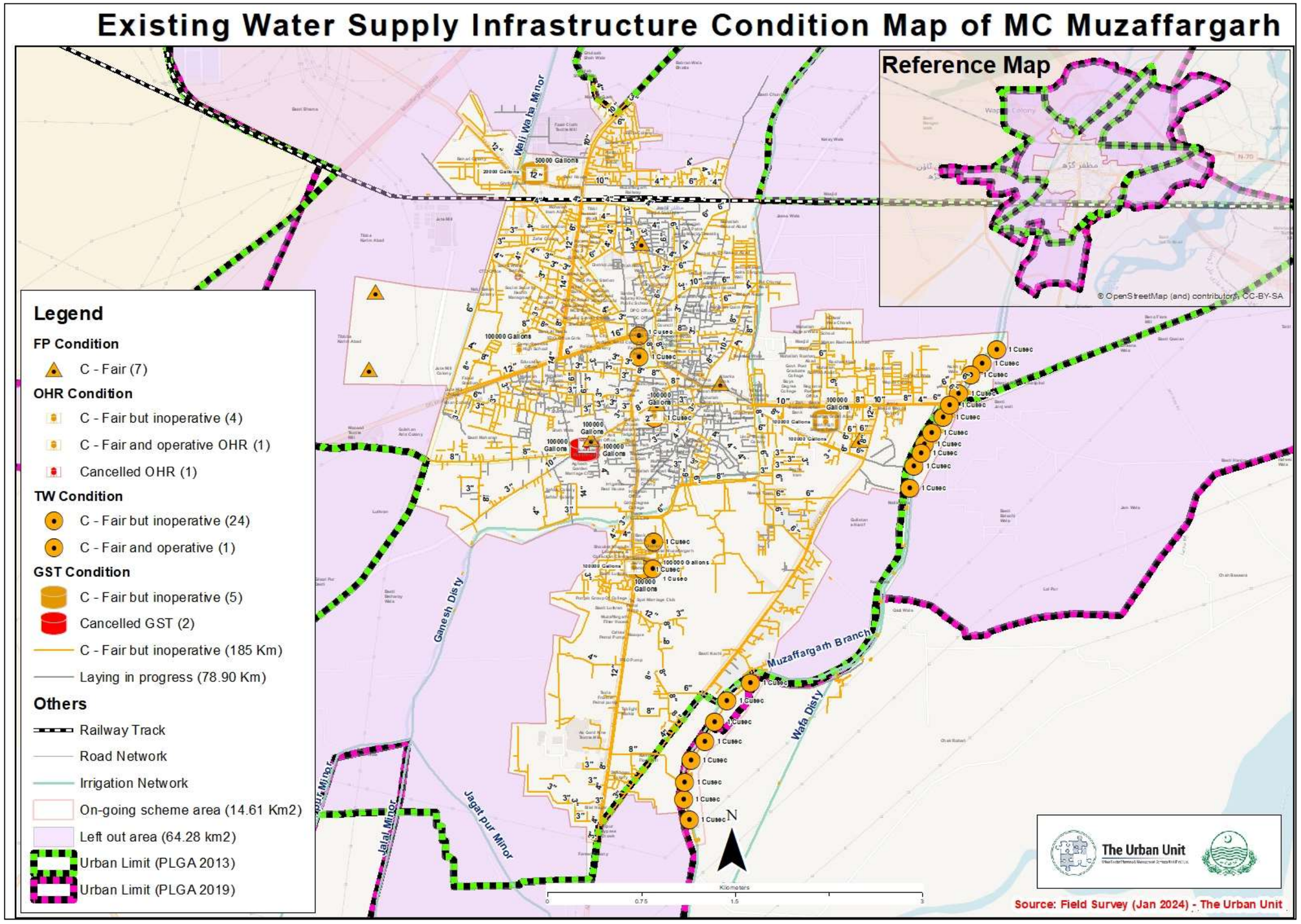


Figure 18: Water Supply Baseline

3.4. Water Supply Interventions

The conditional assessment of existing water supply infrastructure and its comparison with present and future projected demand and needs has resulted in the identification of service delivery gaps that exists within the system. Afore-described gaps relating to the Water Supply are filled in the planning exercise in detail. Prioritization of these gaps is also done and hence schemes are proposed based on various factors such as essence of intervention, duration required to execute them, cost required, and their impact on general public. Total cost required to uplift the current water supply situation is 1,319 Million.

3.4.1. Short Term Plan

It is of utmost essence to fully complete the on-going/under-construction scheme. As such, for functioning of this dormant urban water supply scheme, Muzaffargarh city, it is proposed to immediately release of O&M amount for functioning and completion of newly-made dormant water supply scheme (also proposed in PHED scheme (G.S. No. 1335 ADP 2022-23). It is also proposed that solarization of existing 25 tube-wells and three Pumping Stations is done to save energy consumption cost.
Short-term plan is estimated to cost around 125 million (for solarization cost).

3.4.2. Medium Term Plan

The Medium-term plan involves the extension of water supply services to the unserved areas of the MC. For this, two sites of unserved areas are identified.
Site 1 (Northern side):
Water Supply Improvement Project - Muzaffargarh City (Phase 1-North) is estimated to cost around 683 M. Scope of this proposed project includes, provision of 05 new TWs on Tailari Canal with capacity of 1 cusecs (each) with HDPE 18" Rising Main (134 km) to meet water future water demands (11 MGD in 2034), construction of one Pumping Station with one GST (275,000 Gallons) and one OHR (125,000 Gallons), extension of Water Supply network to unserved areas and solarization of proposed 5 tube-wells and one Pumping Station.
Site 2 (Southern side):
Water Supply Improvement Project - Muzaffargarh City (Phase 2-South) is estimated to cost around 511 M. Scope of this proposed project also includes the same, which is, provision of 05 new TWs on Tailari Canal with capacity of 1 cusecs (each) with HDPE 18" Rising Main (76) to meet water future water demands (11 MGD in 2034), construction of one Pumping Station with one GST (275,000 Gallons) and one OHR (125,000 Gallons), extension of Water Supply network to unserved areas and solarization of proposed 5 tube-wells and one Pumping Station.

3.4.3. Long Term Plan

Since interventions are of high essence so they are planned for Short and Medium terms. As such, no interventions are required in the Long-term plan.
The following are proposed schemes for the Muzaffargarh (MC):

Table 14: Proposed Water Supply projects

Sr. #	Planning Term	Sector	Proposed Schemes	Scope	Cost (Million)
1	Short (2026)	Water Supply	Functioning of Existing Dormant Urban Water Supply Scheme - Muzaffargarh City (125 M)	▸ Immediate release of O&M amount for functioning and completion of newly-made dormant water supply scheme (also proposed in PHED scheme (G.S. No. 1335 ADP 2022-23) ▸ Solarization of existing 25 tube-wells and three Pumping Stations	125
2	Medium (2029)		Water Supply Improvement Project - Muzaffargarh City (Phase 1-North) (683 M)	▸ Provision of 05 new TWs on Tailari Canal with capacity of 1 cusecs (each) with HDPE 18" Rising Main each to meet water future water demands (11 MGD in 2034) ▸ Construction of one Pumping Station with one GST (275,000 Gallons) and one OHR (125,000 Gallons) ▸ Extension of Water Supply network to unserved areas ▸ Solarization of proposed 5 tube-wells and one Pumping Station	683
3			Water Supply Improvement Project - Muzaffargarh City	▸ Provision of 05 new TWs on Tailari Canal with capacity of 1 cusecs (each) with HDPE 18" Rising Main	511

			(Phase 2-South) (511 M)	each to meet water future water demands (11 MGD in 2034) ▸ Construction of one Pumping Station with one GST (275,000 Gallons) and one OHR (125,000 Gallons) ▸ Extension of Water Supply network to unserved areas ▸ Solarization of proposed 5 tube-wells and one Pumping Station	
Total Water Supply – Muzaffargarh MC					**1,319 M**

For Rough Cost Estimation, MRS 1st BI-ANNUAL-2024 (01.01.2024 to 30.06.2024) District Muzaffargarh has been applied. This is further subject to the Detail Design of the proposed schemes upon PC-1 formation.

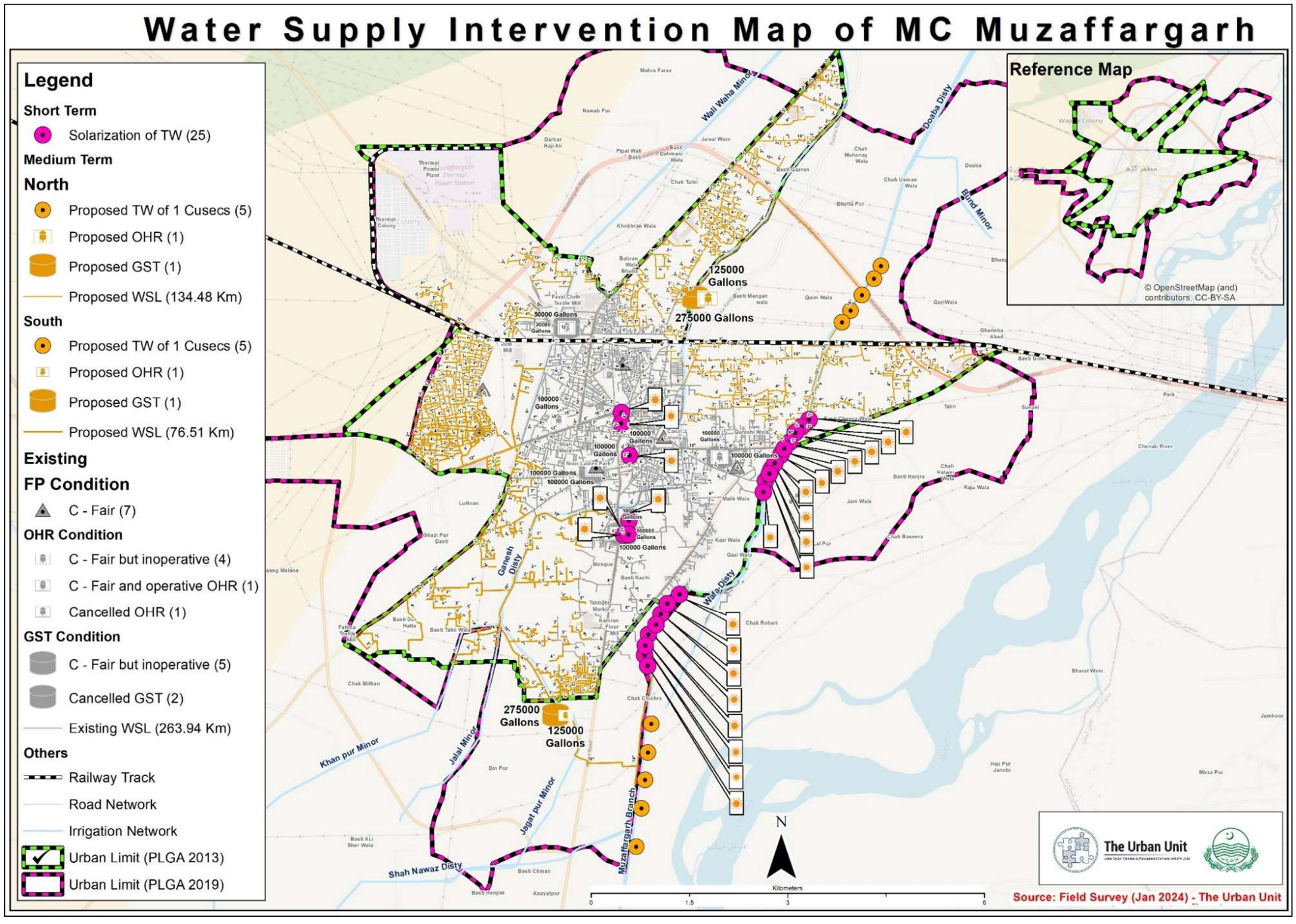


Figure 19: Water Supply Intervention

3.5. Existing Sewerage Infrastructure

Muzaffargarh City constitute of constitute of sewers (191.4 km) and open drains (222 km) and eight sewage pumping stations for wastewater disposal. While this network spread cover over 60% of the municipal area, the overall sewerage infrastructure is in a critical state as eight disposal/pump stations which assist in disposing sewage are all in poor and failing condition. The city also currently lacks a proper wastewater treatment facility. Consequently, sewage ends up being discharged directly into the Ganesh Wah distributary canal, an irrigation canal passing from the city, which further carry it to agricultural fields. This practice is highly problematic and poses environmental and health risks.
The detail of the MC-owned sewerage infrastructure is tabulated below.

Table 15: Sewerage Infrastructure Detail

Sr. No.	Infrastructure	Condition	Sizes	Overall Condition
1	Sewers (Trunk/Main)	▸ B (Good) @ 0.39 km ▸ C (Fair) @ 1.17 km ▸ D (Poor) @ 4.12 km ▸ F (Failing) @ 13.70 km	12” to 42”	D (Poor)
2	Sewers (Laterals)	▸ D (Poor) @ 172.75 km	9”	
3	Force Main	▸ D (Poor/Undersize) @ 1.10 km	10”	
4	Open Drains / Sullage Carriers	▸ D (Good) @ 221.85 km	0.75’ x 0.75’ / > 2’ x > 2’	
5	Disposal Stations	▸ C (Fair) @ 3 (No’s) ▸ D (Poor) @ 5 (No’s)	NA	

3.6. Condition Assessment of Sewerage Infrastructure

The overall condition of sewerage infrastructure was assessed based on developed rating criteria. During the field visit sewerage infrastructure was visited (wherever possible) and evaluated accordingly through consultation.
The detail of sewerage infrastructure is as under.

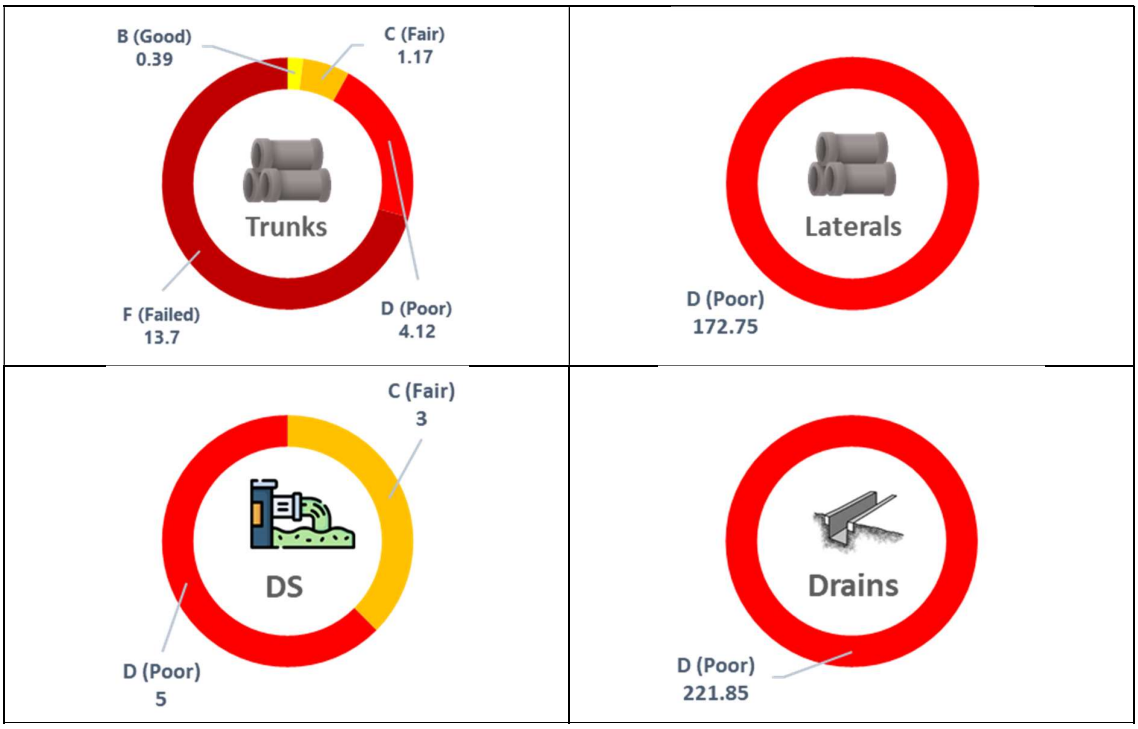


Figure 20: Sewerage Infrastructure Condition

Following are few of pictorial evidences of field survey which was aimed at identifying poorly/unserved served areas, disposal station condition, and ultimate disposal points, etc.

Discussion with MC officials (XEN MC)

Temporary hack by MC staff to maintain sanitation services in city

	
Problematic areas visit with MC staff	Problematic areas visit with MC staff

Figure 21: In Pictures: Field Survey and Assessment

After a detailed condition assessment, the following rating was attributed for the overall condition of sewerage infrastructure.

Table 16: Condition Assessment Outcome

Overall Condition	Rating
Civil Structures	**D** (**Poor** Condition)
Sewers	**D-F** (**Poor** to **Failing** Condition)
Electro-Mechanical	**D-F** (**Poor** to **Failing** Condition)

3.7. Sewage Generation

The sewage generation has been made corresponding to the 22 gallons per capita per day water demand. A contribution of 33% for storm-water flow, 5% infiltration & 5% non-domestic flows have been included during the calculation of the total sewerage flow. The current (2024) sewage generation and the future (2026, 2029 and 2034) sewage generation are shown in the table below.

Table 17: Sewage Generation

Sewage Generation				
Year	**2024**	**2026**	**2029**	**2034**
Population	255,185	269,833	293,396	337,329
Avg. Waste Water Generation (MGD-I)	4.8	5.0	5.5	6.3
Peak Sewage Flow (MGD-I)	9.5	10.1	11.0	12.6
Storm Water Flow (MGD-I)	3.1	3.3	3.6	4.2

Infiltration Flows (MGD-I)	0.2	0.3	0.3	0.3
Non-Domestic Flows (MGD-I)	0.5	0.5	0.5	0.6
Total Sewage Flow (MGD-I)	**13**	**14**	**15**	**18**

Following is projected sewage generation of the City.

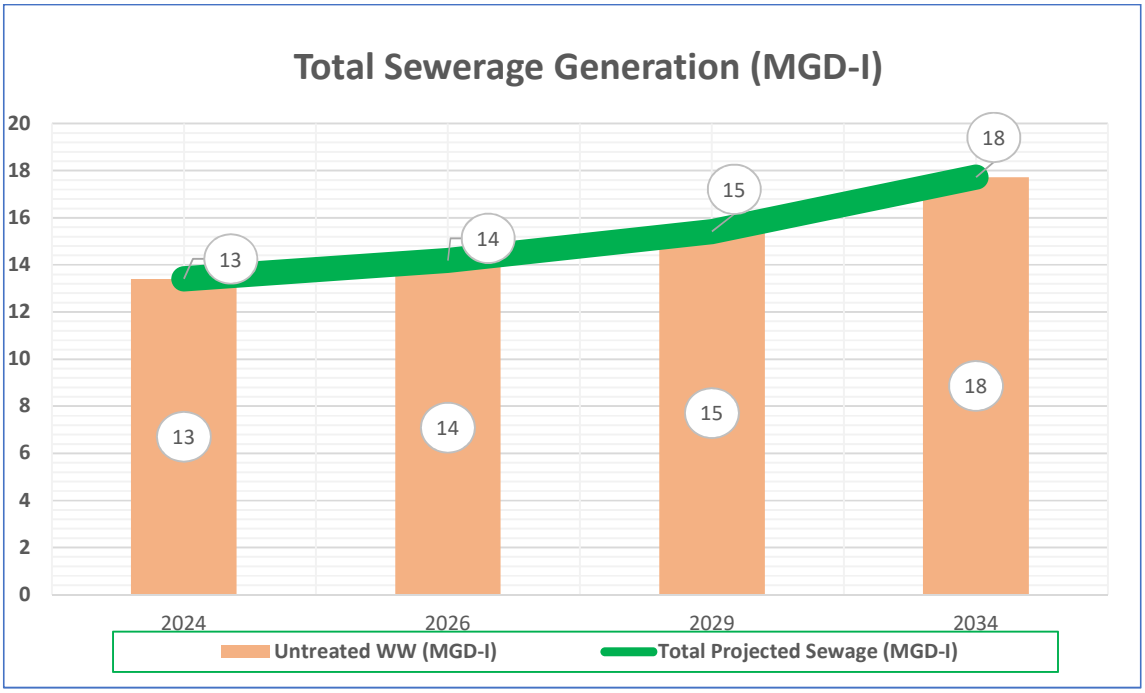


Figure 22: Projected Sewage

An elevation Map has been developed for planning purposes which indicates the elevation level of the terrain and appropriate natural flow for the drainage system and sewage pipelines however due to shallow ground water table (as low as 20' in some parts of the city). This factor has been considered in planning of future sewerage infrastructure.

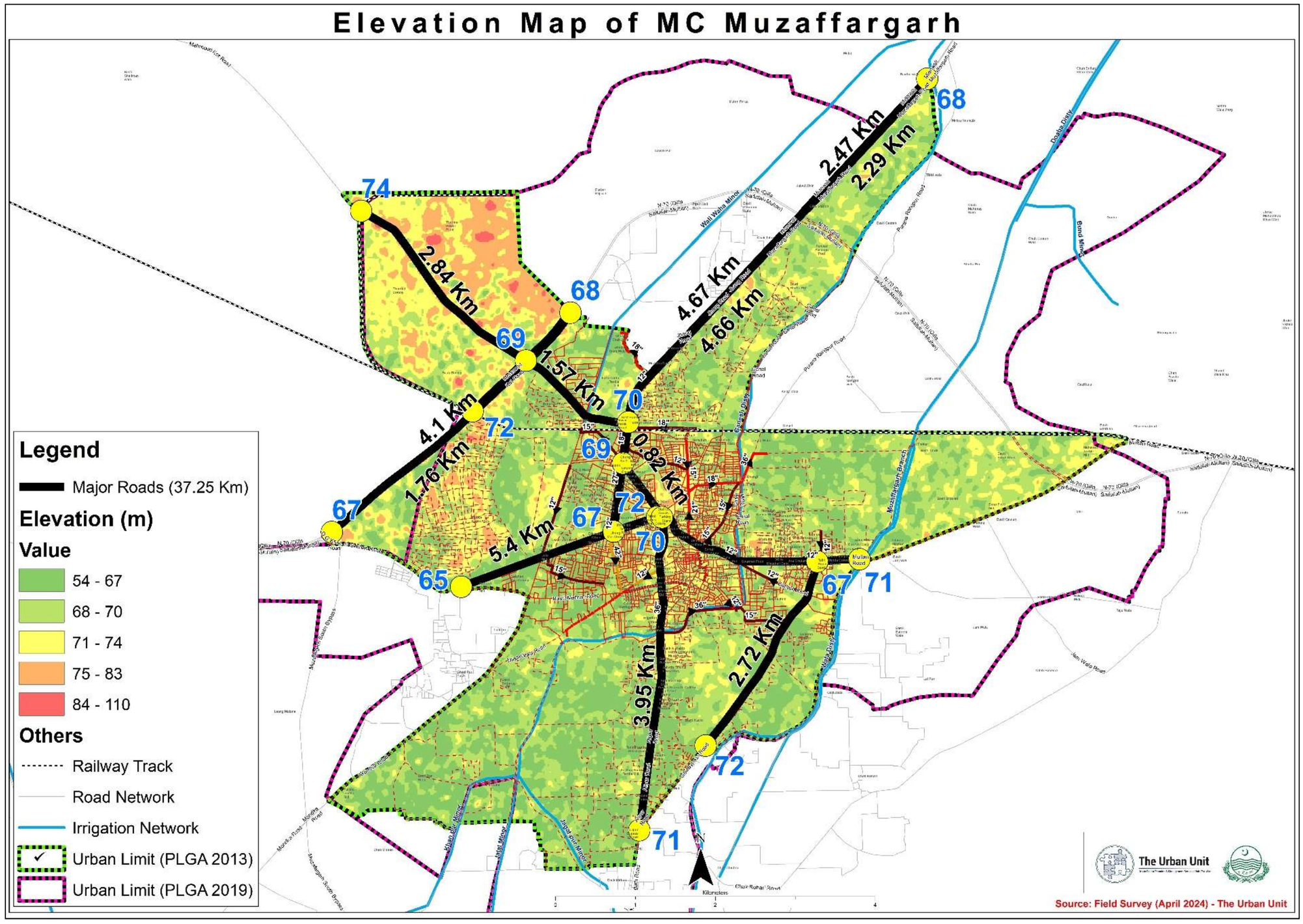


Figure 23: Elevation Map

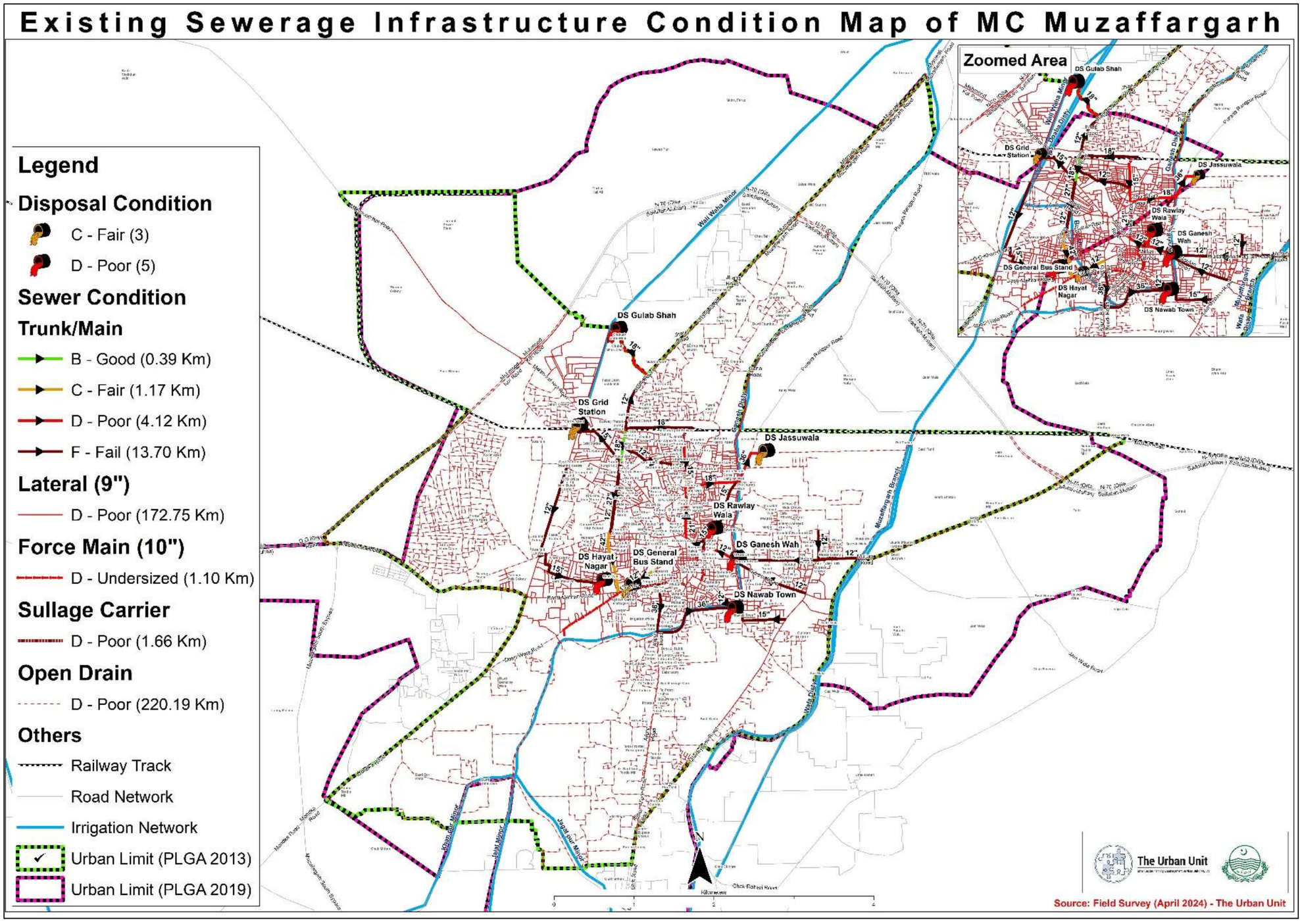


Figure 24: Sewerage Baseline

3.8. Sewerage Interventions

Afore-described gaps relating to the Sewerage issues are filled in the planning exercise in detail. Prioritization of these gaps is also done and hence schemes are proposed based on various factors such as essence of intervention, duration required to execute them, cost required, and their impact on public. Total cost required to uplift the current sewerage situation is around 7,160 Million.

3.8.1. Short Term Plan

In the Short term, in order to improve the existing sewerage condition of the city rehabilitation of the existing sewerage disposal/lift stations is proposed. To reduce the operational cost, solarization component is also added for all eight disposal/lift stations.
This plan may cause around 444 Million.

3.8.2. Medium Term Plan

The Medium-term plan for the sewerage system involves comprehensive sewerage system - Muzaffargarh City (Phase 1). This is aimed at changing the dynamics of existing sewerage system of the city though using sullage carriers for sewage disposal to future WWTPs (Northern and Southern sides), of varying sizes i.e., 3'x4', 4'x6' and 5'x7'. It is also planned to re-routing of all existing pumping stations to constructed sullage carriers for safe disposal and treatment. Sewer replacement and placement for central areas of the city is also being proposed in this phase. It is felt that two mega disposal stations will be need on both ends of Northern and Southern tail points of sullage carriers hence construction is proposed for two mega disposal stations (D/S North = 7 Cusecs & D/S South = 26 Cusecs) with solarization and including all auxiliary facilities, near two afore-mentioned proposed sites of future WWTPs. For smooth operation of the proposed scheme, procurement of sewerage system machinery [1 @ sucker, 1 @ jetting, 5 @ portable de-watering sets (5 @ Peter & 5 @ Electric)] is also proposed.
This plan may require around 1,421 Million.

3.8.3. Long-Term Plan

In the Long-term plan for the sewerage system involves comprehensive sewerage system - Muzaffargarh City (Phase 2). This will include extension of piped sewerage services to left-over areas in outskirts of city through construction of three new pump stations including solarization (2, 4 & 2 cusecs with HDPE Force Mains (varying Dias: 10", 12" and 10"). Laying and replacement of sewers is also integrated component of this proposed scheme. For sewerage treatment, construction of two WWTPs (i) North = 4 MDG with 14 Acres area (ii) South = 14 MGD with 50 Acres area (Anaerobic and Facultative Ponds).
This is estimated to cost around 4,441 Million.

Table 18: Proposed Projects

Sr. #	Planning Term	Sector	Proposed Schemes	Scope	Cost (Million)

1	Short (2026)	Sewerage	Existing Sewerage Disposal Stations Rehabilitation and Solarization Scheme - Muzaffargarh City (444 M)	▸ Major rehabilitation of all eight existing sewerage pumping stations (Disposal & Lift) with solarization	444
2	Medium (2029)		Comprehensive Sewerage System - Muzaffargarh City (Phase 1) (2,274 M)	▸ Construction of three R.C. sullage carriers for sewage disposal to future WWTPs (Northern and Southern sides), varying sizes i.e., 3'x4', 4'x6' and 5'x7' ▸ Re-routing of all existing pumping stations to constructed sullage carriers for safe disposal and treatment ▸ Installation of HDPE Force Mains at all eight existing pumping stations (varying Dias: 10", 12" and 14") ▸ Sewer replacement and placement for central areas of the city ▸ Construction of two mega disposal stations (D/S North = 7 Cusecs & D/S South = 26 Cusecs) with solarization and including all auxiliary facilities, near two afore-mentioned proposed sites of future WWTPs ▸ Procurement of sewerage system machinery [1 @ sucker, 1 @ jetting, 5 @ portable de-watering sets (5 @ Peter & 5 @ Electric)]	1,421
3	Long (2034)		Comprehensive Sewerage System - Muzaffargarh City (Phase 2) (4,441 M)	▸ Extension of piped sewerage services to left-over areas in outskirts of city through construction of three new pump stations including solarization (2, 4 & 2 cusecs with HDPE Force	4,441

				Mains (varying Dias: 10", 12" and 10") ▸ Laying/replacing sewers ▸ Construction of two WWTPs (i) North = 4 MDG with 14 Acres area (ii) South = 14 MGD with 50 Acres area (Anaerobic and Facultative Ponds)	
				Total Sewerage – Muzaffargarh MC	**7,160 M**

For Rough Cost Estimation, MRS 1st BI-ANNUAL-2024 (01.01.2024 to 30.06.2024) District Muzaffargarh has been applied. This is further subject to the Detail Design of the proposed schemes upon PC-1 formation.

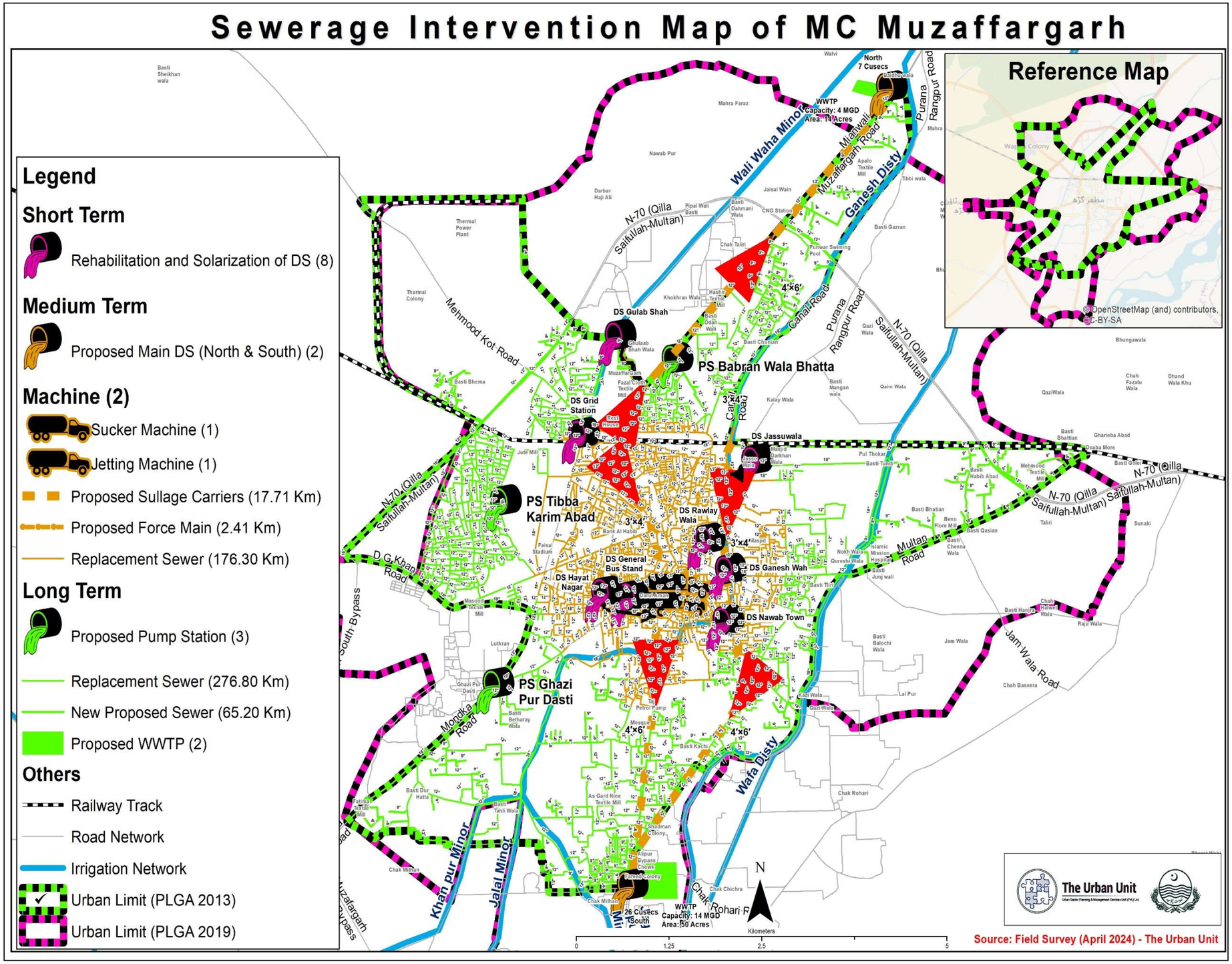


Figure 25: Sewerage Interventions

3.9. Rural Areas – Muzaffargarh District

Muzaffargarh District is further comprised of four tehsils, Muzaffargarh, Alipur, Jatoi and Kot Addu. As of the year 2024, district houses population of around 4,297,443 which is estimated to further augment to 5,338,709.

3.9.1. Rural Water Supply Schemes

As per the data collected by PHED, a total of 23 water supply schemes exist with district jurisdictional boundary. In addition to these, a rural water supply scheme is also ongoing or under-construction in Fateh Pur Janubi village. It is unfortunate that as much as 65% schemes are dysfunctional, due to multiple reasons however even though the communities reported PHED of essence of schemes and its operationalization, they are unable to pay their shares.
Aging analysis of above-mentioned schemes is as follow:

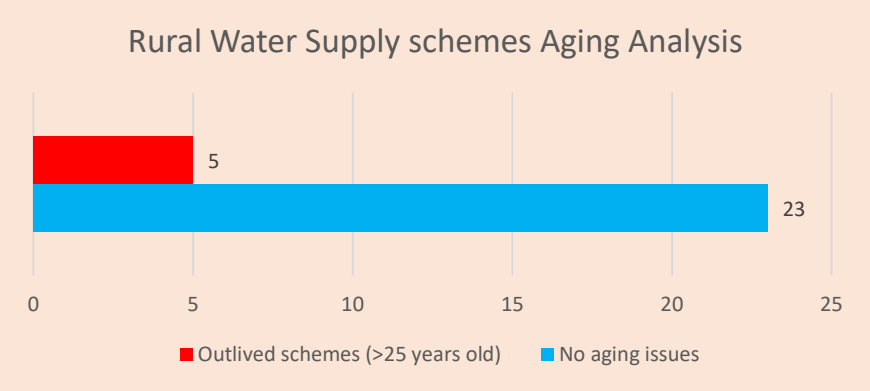


Figure 26: Rural Water Supply schemes aging analysis

Functionality status of above-mentioned schemes is as follow:

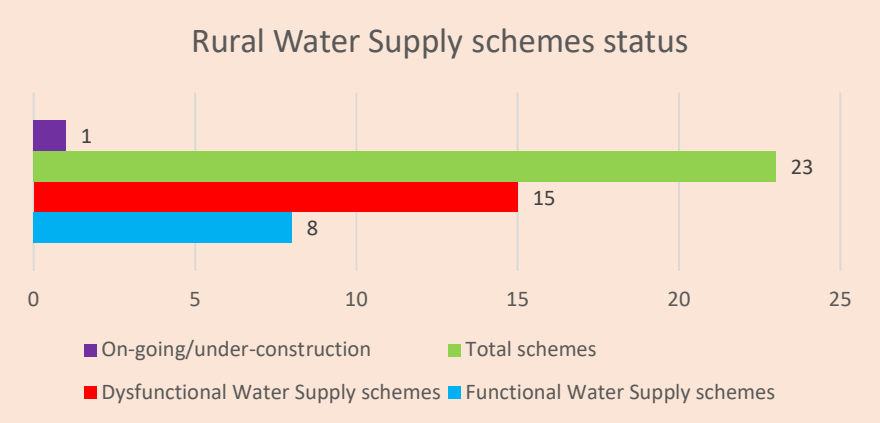


Figure 27: Rural Water Supply schemes status

3.9.2. Rural Filtration Plant Schemes

As per the data collected by PHED, a total of 55 rural water filtration plants (WFPs) exist with district jurisdictional boundary. Most of these WFPs are new i.e., < 25 years old. However, four of 55 WFPs are dysfunctional and needs rehabilitation or new bore.
Aging analysis of above-mentioned WFPs schemes is as follow:

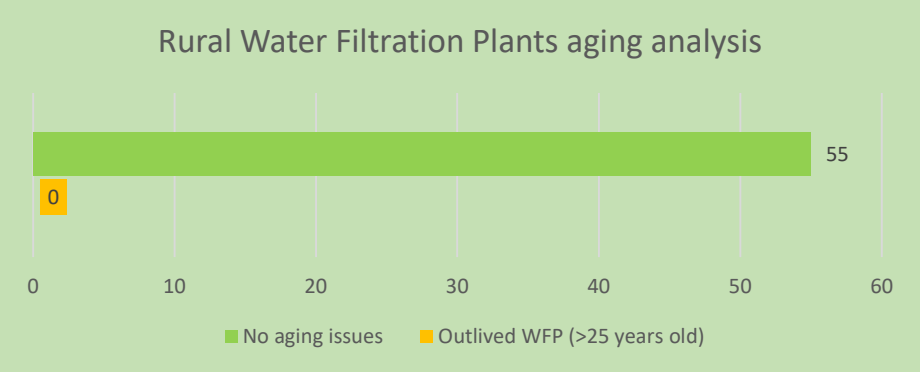


Figure 28: Rural Water Filtration Plants aging analysis

Functionality status of above-mentioned WFPs schemes is as follow:

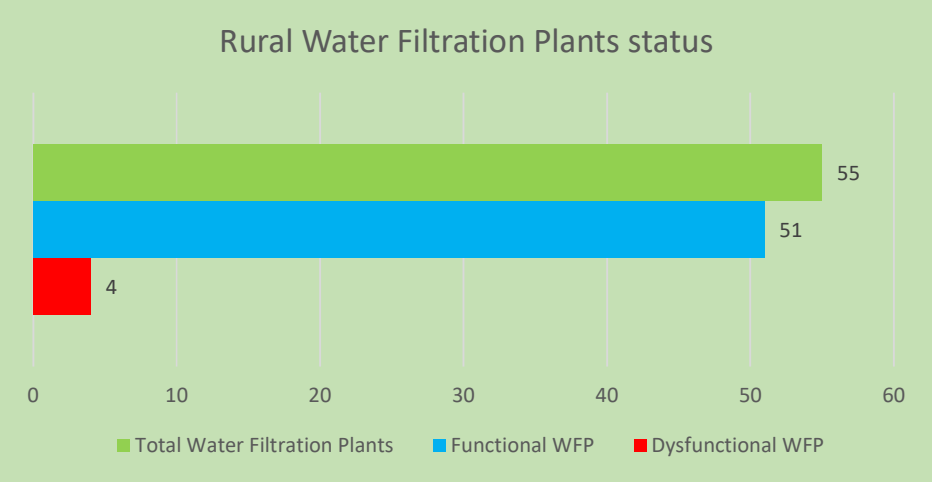


Figure 29: Rural Water Filtration Plants status

3.9.3. Rural Sewerage/Drainage Schemes

Currently only three rural sewerage or drainage schemes exists, these are located at, Mahra city (village), Karam Dad Qureshi (village) and Murad Abad (village). These are all functional.

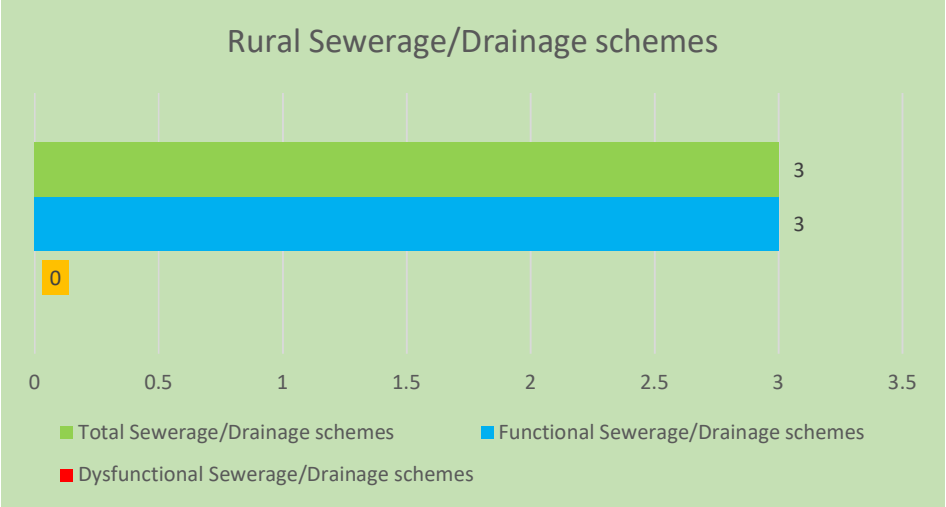


Figure 30: Rural Sewerage/Drainage schemes

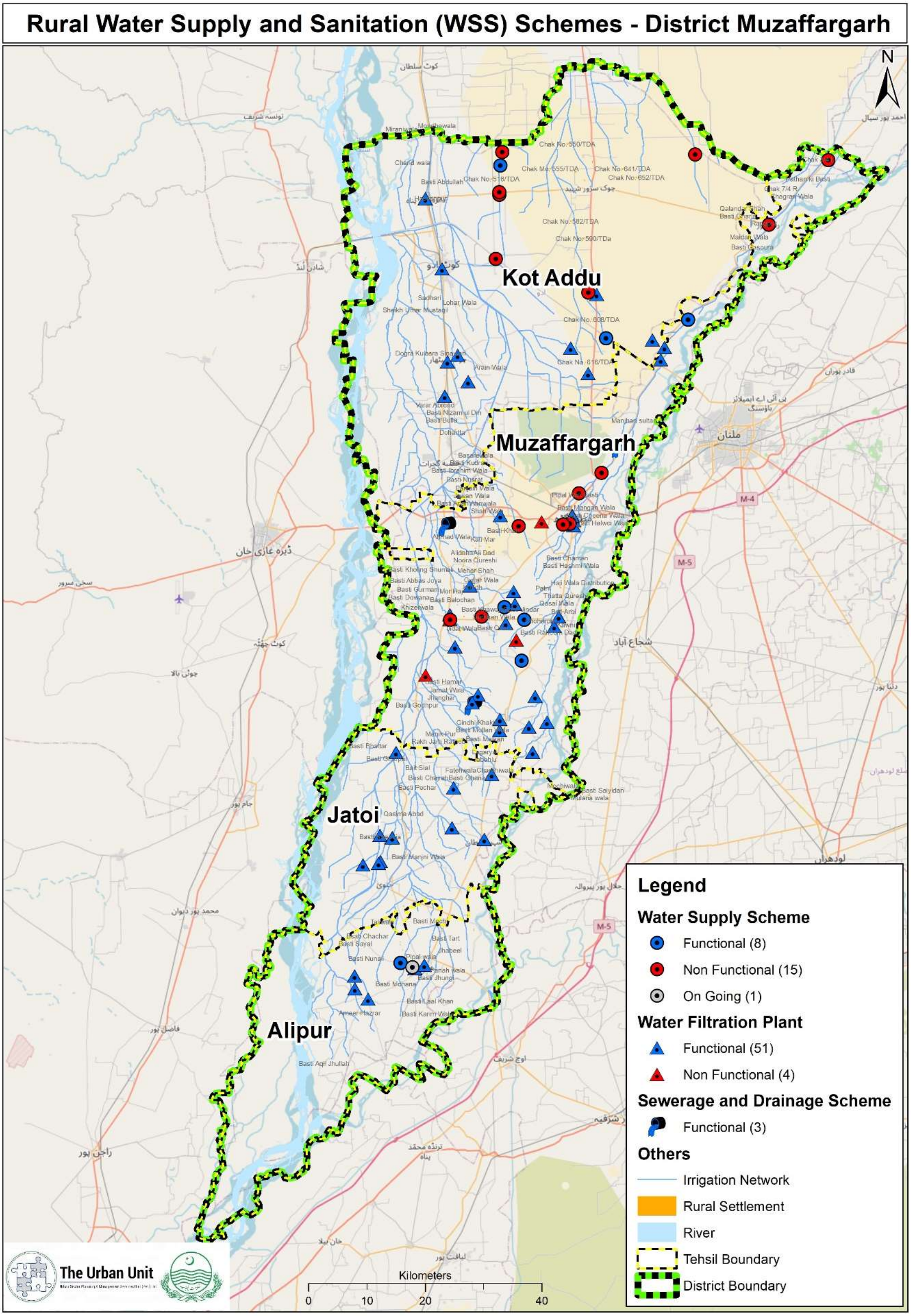


Figure 31: Baseline Map of Rural Water Supply & Sanitation infrastructure

3.9.4. Interventions for Rural Water Supply Infrastructure

As per the PHED data, following need-based schemes should be rehabilitated which includes 12 rural water schemes and five WFPs. Solarization of 21 rural water supply schemes is also proposed. The following schemes are proposed for uplifting the rural water supply of Muzaffargarh district as per the performed assessments and analysis.

Table 19: Proposed Rural Projects

Sr. #	Planning Term	Sector	Proposed Schemes	Scope	Cost (Million)
1	Short (2026)	Rural Water Supply	Rehabilitation of Malfunction Rural Water Supply Schemes and Water Filtration Plants - District Muzaffargarh (700 M)	▸ Rehabilitation of 12 need-based rural water supply schemes: (Villages: Wahander No. 17, Noor Shah Talai, Chak No. 132-133, Bhemay Wala, Khan Pur Shumali, Shah Jamal, Tibba Karim Abad, Chak No. 5-4/L, Shadab Colony, Chak No.116/ML, Chak No. 518/TDA, and Meher Pur) ▸ Rehabilitation of 5 rural water filtration plants (Areas: Recep Rajib Tayyip Erdogan Model Village, Veterinary Hospital in Shah Jamal, Pakka Ghalwan, Basti Lundda in Basti Balouch Gharbi, and Basti Ghareeb Abad)	700
2	Medium (2029)		Solarization of existing Rural Water Supply Schemes - District Muzaffargarh (1,097 M)	▸ Solarization of 21 rural water supply schemes (Villages: Wahander No. 17, Noor Shah Talai, Chak No. 132-133, Bhemay Wala, Khan Pur Shumali, Shah Jamal, Tibba Karim Abad, Chak No. 5-4/L, Shadab Colony, Chak No.116/ML, Chak No. 518/TDA, Meher Pur, Chak No. 138/ML, Chak No. 142/ML, Pakka Ghalwan, Tibba Bhattian, Wandher Sharqi, Basti Poli Wala, Shah Garh, Judicial Complex Ali Pur and Jal Wala)	1,097
Total Sewerage – Muzaffargarh District Rural					**1,797 M**

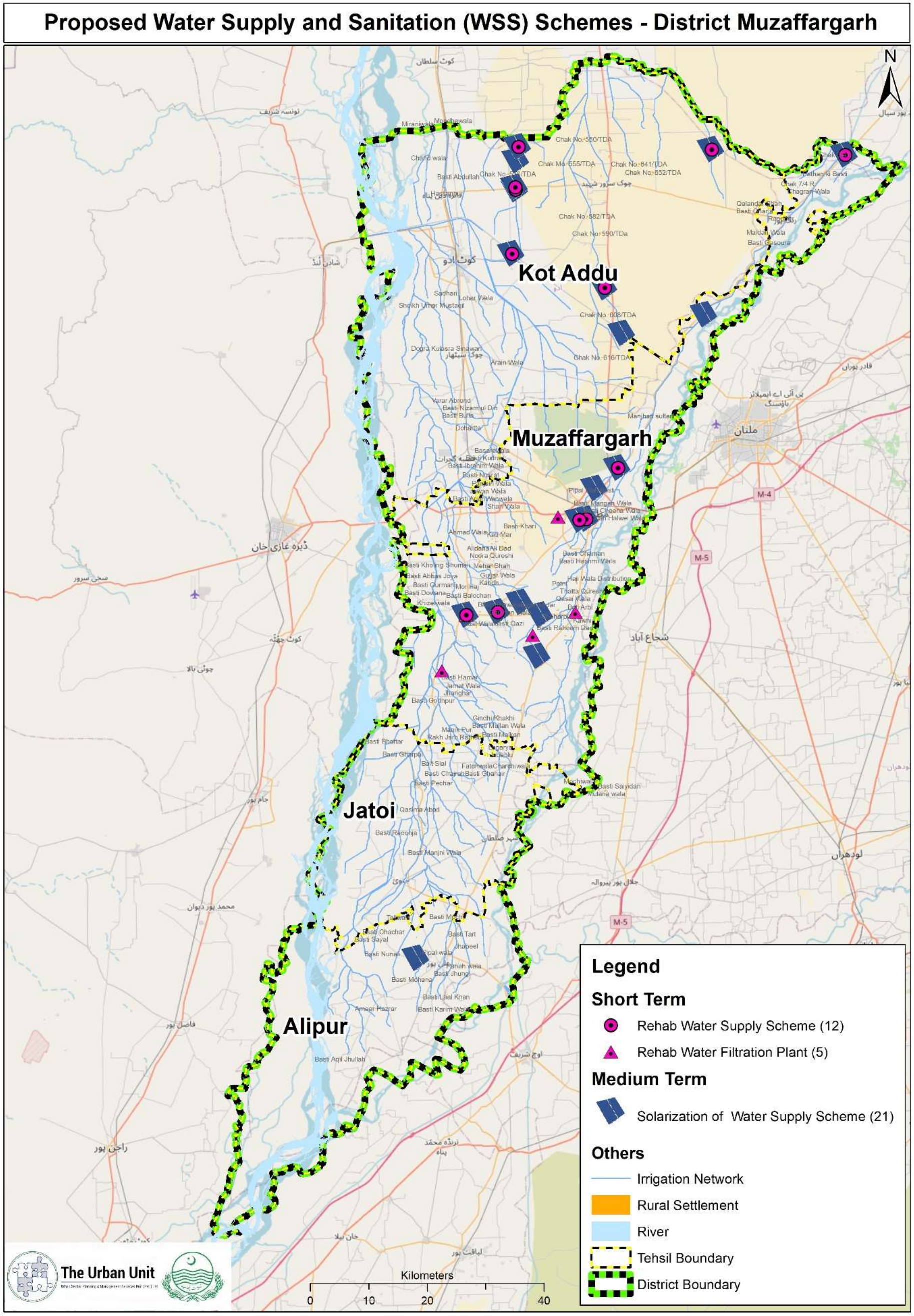


Figure 32: Rural Water Supply Schemes Interventions Map

RAJANPUR CITY

Rajanpur City is the administrative headquarters of Rajanpur District, and lies in the south-western parts of Punjab. River Indus flows towards the east of the city and the Suleman Mountains rise towards west of the city. The current estimated population (year 2024) for the city is 133,957 which is further projected to increase to 206,048 in 2034, which is planning year for this regional development plan.

The current water supply system of Municipal Committee (MC) Rajanpur is reported to be abandoned. The water supply system was based on groundwater-based tube wells spread across the city, with an estimated spatial coverage of distribution network being mere 20% of the city. Major reason for abandoning of the system is over-lived infrastructure. The city has good quality groundwater in most areas of the city, with only few areas along Aqilpur Road exhibiting borderline brackish groundwater. Overall, the water supply system of the city can be termed as in Failed condition, with need of major interventions for rehabilitation of the system.

The sewerage system of Rajanpur city is gravity-based owing to its relatively plain terrain. Existing sewerage infrastructure of Rajanpur city includes the main trunk lines (and adjoining sewers) along the Muhammadpur and Aqilpur Roads. The sewage is then carried to three existing disposal stations which further dispose it to agricultural fields on the outskirts of the city without any treatment. Currently the sewerage system has a spatial coverage of mere 50% of the city. However, a development scheme for sewerage system is currently under execution by the Public Health Engineering Department. Once completed, the spatial coverage of sewerage system of the city will be increased to approximately 80% of the city. Poor condition of existing sewerage system and the lack of treatment mechanism remains key hurdle in smooth operation of sanitation mechanism of the city.

4.1. Existing Water Supply Infrastructure

The existing water supply infrastructure for Rajanpur city consists of groundwater-based schemes with 6 tube wells spread across the city having capacity of 0.5-cusec each. The tube-wells in the city are accompanied by an Overhead Reservoir having capacity of 30,000 gallons. However, the existing water supply system of Rajanpur city was found to be abandoned with all tube-wells and storage infrastructure in the city currently being dysfunctional. The details of water supply assets in MC Rajanpur is tabulated as follow.

Table 20: Water Supply Infrastructure

Sr.	Location	Capacity	Year of Inst.	Status	Condition
Tube Wells					
1	Qutab Canal	0.5 cusec	2007	Dysfunctional	Failed
2	Qutab Canal	0.5 cusec	1990	Dysfunctional	Failed
3	Qutab Canal	0.5 cusec	1990	Dysfunctional	Failed
4	Warraich Colony	0.5 cusec	2006	Dysfunctional	Failed
5	Warraich Colony	0.5 cusec	2006	Dysfunctional	Failed
6	Faridabad Colony	0.5 cusec	2006	Dysfunctional	Failed

Overhead Reservoirs					
1	Jail Road	30,000 G	1982	Dysfunctional	Failed

The water supply lines (10 KM) have an estimated spatial coverage of over 20% of the city. The diameter of the lines varies from 3" to 10" in the city. The lines in the city were also assessed to be in Poor condition. The major reason for abandonment of the water supply system of the city is reported to be over-lived infrastructure as well as a lack of public interest. The details of water supply lines in MC Rajanpur is tabulated as follows.

Table 21: Water Supply lines

Asset Type	Diameter	Material	Status	Condition
Water Supply Lines (10 KM)	Varies 3" – 10"	Varies (CI, PVC, AC)	Dysfunctional	Poor

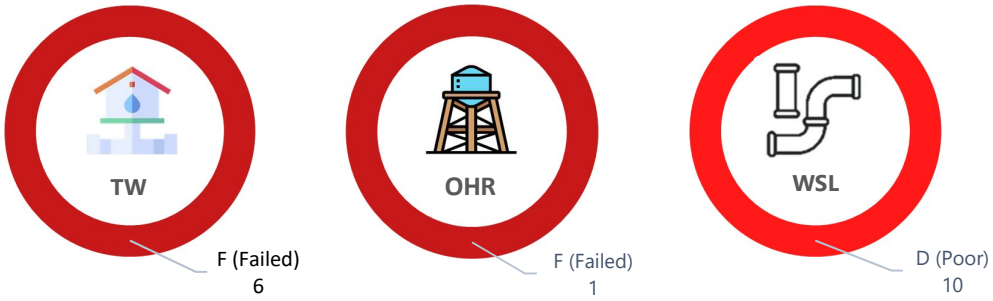


Figure 33: Condition Assessment of Water Supply infrastructure

The figure below indicates the condition assessment of water supply infrastructure in the city. The overall conditional of water supply infrastructure has been evaluated in order to gauge the condition of the system as a whole, based on the most recurring conditions for the individual components of the system. The overall assessment is provided in the table below.

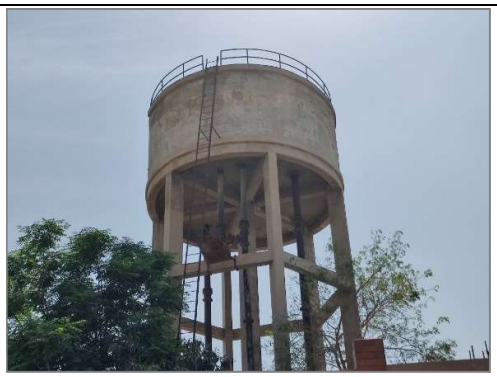
Table 22: Overall Asset Condition for Water Supply Infrastructure

Overall Asset Condition	Rating
Civil Structures	D (Poor Condition)
Distribution Network	D (Poor Condition)
Electro-Mechanical	F (Failed Condition)

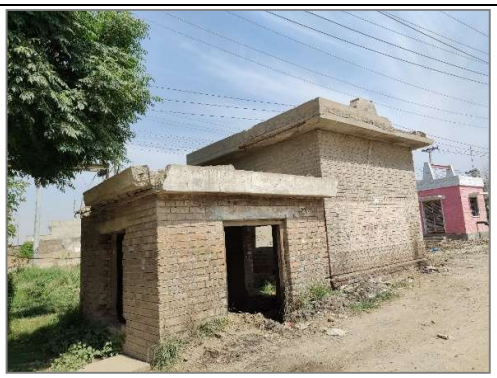
The condition of water supply infrastructure as encountered during the field visit performed by Urban Unit is indicated in the pictures below.

An abandoned tube-well on the Qutab Canal installed in 2007. Lack of public interest is one of the reason for abandonment.

Team Urban Unit performing Rapid Water Quality Testing at a shallow tube well on the outskirts of Rajanpur city.



Abandoned OHR of 30,000 Gallons capacity. The poor structural health is clearly evident from the picture above.



Abandoned tube-well on the Qutab Canal. The structure is severely deteriorated and classified as Failed condition.

Figure 34: Condition of Water Supply Infrastructure

Existing Water Supply Infrstructure Map of Rajanpur MC

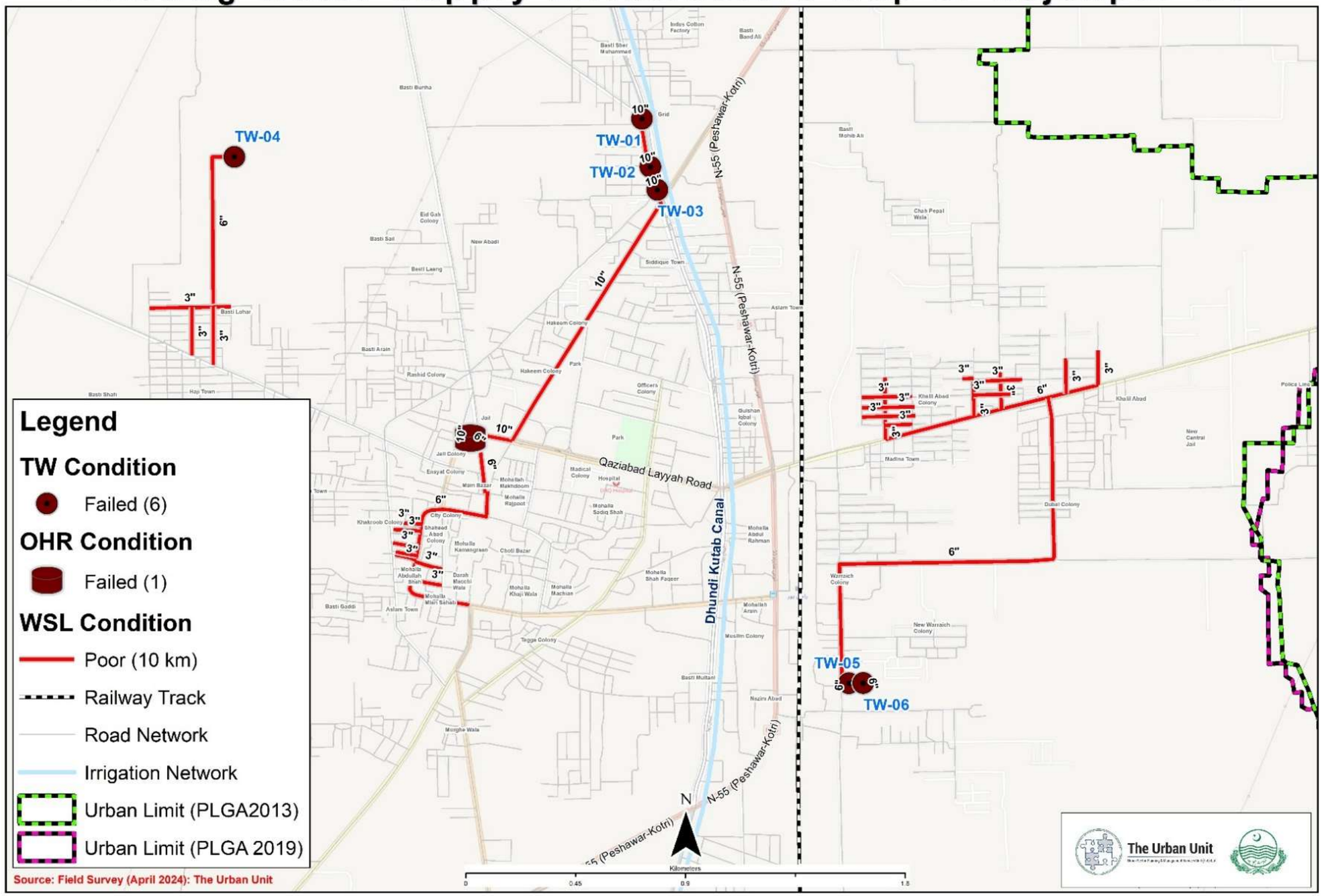


Figure 35: Existing Water Supply Infrastructure Map

4.2. Water Supply versus Demand Analysis

The water supply demand calculations have been made corresponding to a water demand of 30 GPCD inclusive of the non-domestic water demands. It must be noted that this figure for water demand is considered adequate and is aligned with the United Nations 'Human Right to Water and Sanitation Guidelines' which recommends a minimum of 11 – 22 GPCD of water to ensure full realization of the individual right to water. Moreover, this figure is also aligned with 'National Drinking Water Policy of Pakistan (2009)' that ensures a minimum amount of 26 GPCD (120 LPCD) for equitable access to water in urban areas.
The current (2024) and future (2026, 2029, 2034) water demand are tabulated as below.

Table 23: Water Supply versus Demand Calculations

Year	2024	2026	2029	2034
Population	133,957	146,004	166,137	206,048
Average Day Demand (MGD)	4.02	4.38	4.98	6.18
Max Day Demand (MGD)	6.03	6.57	7.48	9.27
Peak Hour Demand (MGD)	9.04	9.86	11.21	13.91

It can be observed from the table above that a water supply gap of 4.02 MGD against the Average Day Demand currently exists in the city. This gap is expected to increase up to 6.18 MGD by the end of 2034, indicating the need of additional water supply infrastructure to cater for this demand-supply nexus. The average and max water demands versus the water supply capacity is graphically represented below.

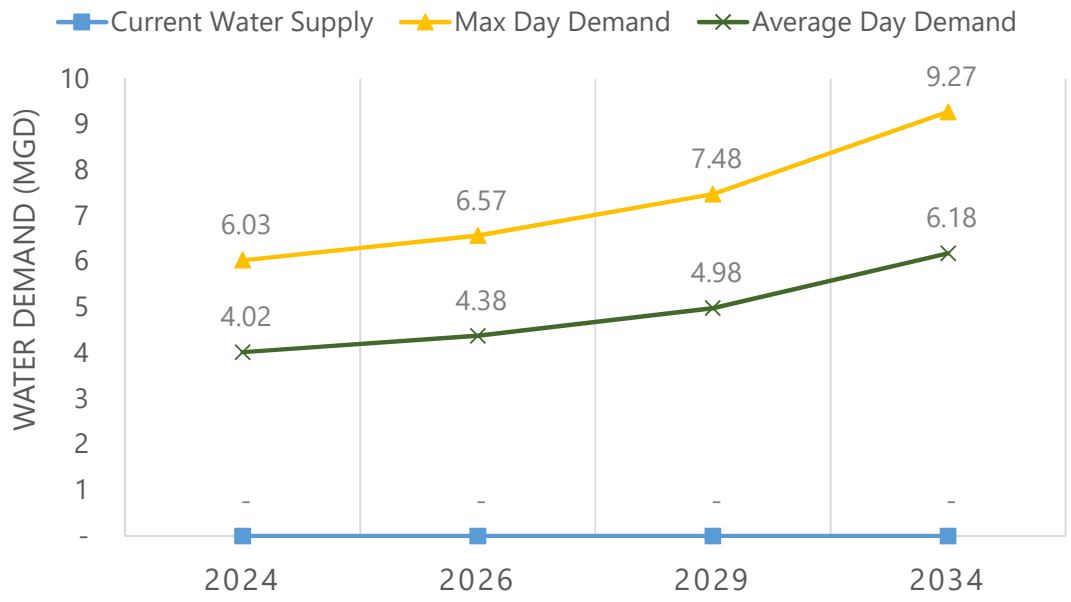


Figure 36: Water Supply versus Water Demand (MGD-I)

4.3. Interventions for Water Supply System

The conditional assessment of existing water supply infrastructure and its comparison with present and future projected demand and needs has resulted in the identification of service delivery gaps that exists within the system. The planning exercise aims to fulfill the afore-described gaps to water supply. Prioritization of these gaps is also done and schemes are proposed based on various factors such as essence of intervention, duration required to execute them, cost required, and their impact on general public. Total cost required to uplift the current water supply situation is 1,131 Million.

4.3.1. Short Term Plan

The short term plan of Rajanpur is focused on installation of water supply infrastructure to cater for the existing service delivery gaps. Three (03) tube-wells of 2-cusec each along with three (03) overhead reservoirs of 100,000 gallons each are proposed to be installed during first phase of the project. This will be accompanied by laying of water supply distribution network in the city. The short term plan of Rajanpur is expected to cost 432 Million.

4.3.2. Medium Term Plan

The medium term plan of Rajanpur is focused on extension of infrastructure in the city. Three (03) tube-wells of 2-cusec each along with three (03) overhead reservoirs of 100,000 gallons each are proposed to be installed during this phase of the project. This will be accompanied by laying of water supply distribution network in the city. The medium term plan of Rajanpur is expected to cost 506 Million.

4.3.3. Long Term Plan

The long term plan discusses the further extension of water supply services in the city with proposed installation of six (06) new tube-wells of 2 cusecs each. This will be accompanied by laying of water supply distribution network in the city. The long term plan for Rajanpur is estimated to cost 193 Million.
The following schemes are proposed for uplifting the water supply system of MC Rajanpur as per the performed assessments and analysis.

Table 24: Water Supply proposed projects

Sr.	Phase	Proposed Schemes, Estimated Costs & Scope
1	Short Term (2026)	**Water Supply Extension & Improvement Project for MC Rajanpur - Phase I (432 M)** Scope of Project: ▶ Construction of 03 TWs having capacity of 2 cusecs each ▶ Construction of 03 OHRs having capacity of 100,000 Gallons each ▶ Laying of Rising Mains & Distribution Network (73 km)

2	Medium Term (2029)	**Water Supply Extension & Improvement Project for MC Rajanpur - Phase II (506 M)** Scope of Project: ▶ Construction of 03 TWs having capacity of 2 cusecs each ▶ Construction of 03 OHRs having capacity of 100,000 Gallons each ▶ Laying of Rising Mains & Distribution Network (84 km)
3	Long Term (2034)	**Water Supply Extension & Improvement Project for MC Rajanpur - Phase III (193 M)** Scope of Project: ▶ Construction of 06 TWs having capacity of 2 cusecs each ▶ Laying of Rising Mains & Distribution Network (23 km)
Total Cost for Water Supply System = 1,131 M		

For Rough Cost Estimation, MRS 1st Bi-Annual-2024 (01.01.2024 to 30.06.2024) District Rajanpur has been applied. This is further subject to the Detail Design of the proposed schemes upon PC-1 formation.

Water Supply Intervention Map of Rajanpur MC

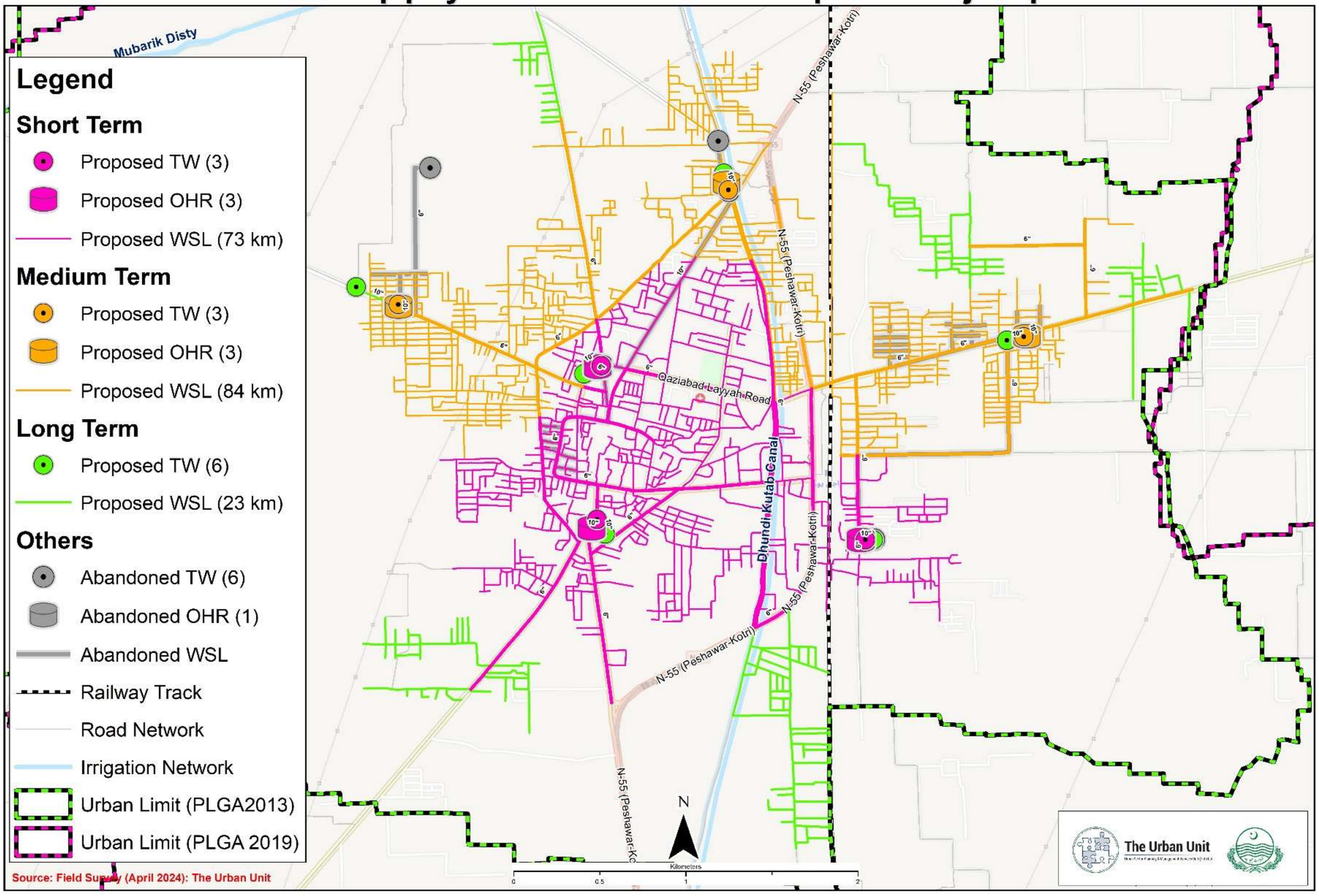


Figure 37: Water Supply Interventions Map

4.4. Existing Sewerage Infrastructure

The sewerage system of Rajanpur city is gravity-based owing to its relatively plain terrain. Existing sewerage infrastructure of Rajanpur city includes the main trunk lines (and adjoining sewers) along the Muhammadpur and Aqilpur Roads. The sewage is then carried to three existing disposal stations which further dispose it to agricultural fields on the outskirts of the city. Currently, no sewerage treatment facility currently exists in Rajanpur city, and contaminated wastewater from the city is directly being used for broad irrigation. The existing sewerage system in Rajanpur city has a spatial coverage of 50% of the city and can be classified as in Poor condition. The details of existing disposal stations in MC Rajanpur is tabulated as follows.

Table 25: Sewerage Infrastructure of MC Rajanpur – Disposal Stations

Sr.	Name/Area	Disposal	Operation	Status	Condition
1	Disposal Works – Muhammadpur Road	Agricultural Fields	18	Functional	Poor
2	Disposal Works – Aqilpur Road	Agricultural Fields	18	Functional	Poor
3	Disposal Works – Aslam Town	Agricultural Fields	18	Functional	Poor

A development scheme for sewerage system is currently under execution in the city by the Public Health Engineering Department. The scheme involves laying of sewerage network (trunks and adjoining sewers) along the Fatehpur and Asni Roads. Two new disposal stations are also being constructed in this scheme, however, no treatment mechanism is planned to be constructed in this scheme. Once completed, the spatial coverage of sewerage system of the city will be increased to approximately 80% of the city.

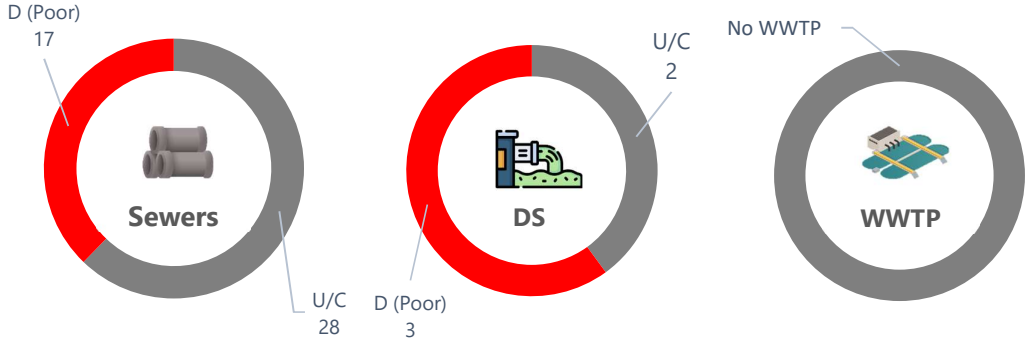


Figure 38: Conditional Assessment of Sewerage Infrastructure

The figure below indicates the condition assessment of sewerage infrastructure in the city. The details of the sewerage infrastructure in the city has been attached as annexure to this report. The overall conditional of sewerage infrastructure has been evaluated in order to gauge the condition of the system as a whole, based on the most recurring conditions for the individual components of the system. The overall assessment is provided in the table below.

Table 26: Overall Asset Condition for Sewerage Infrastructure in Rajanpur City

Overall Asset Condition	Rating
Civil Structures	D (Poor Condition)
Distribution Network	D (Poor Condition)
Electro-Mechanical	D (Poor Condition)

The condition of sewerage infrastructure as encountered during the field visit performed by Urban Unit is indicated in the pictures below.

Under Construction DS Fatehpur Road. Solar system is proposed to be installed at the two Under Construction Disposals.

Sullage Carrier carrying wastewater for broad irrigation from the Under Construction Disposal Station Fatehpur Road.

Wet Well of a newly constructed disposal station in Rajanpur city.

Poor condition of Disposal Station Aqilpur Road is evident from picture above.

Figure 39: Condition of Sewerage Infrastructure)

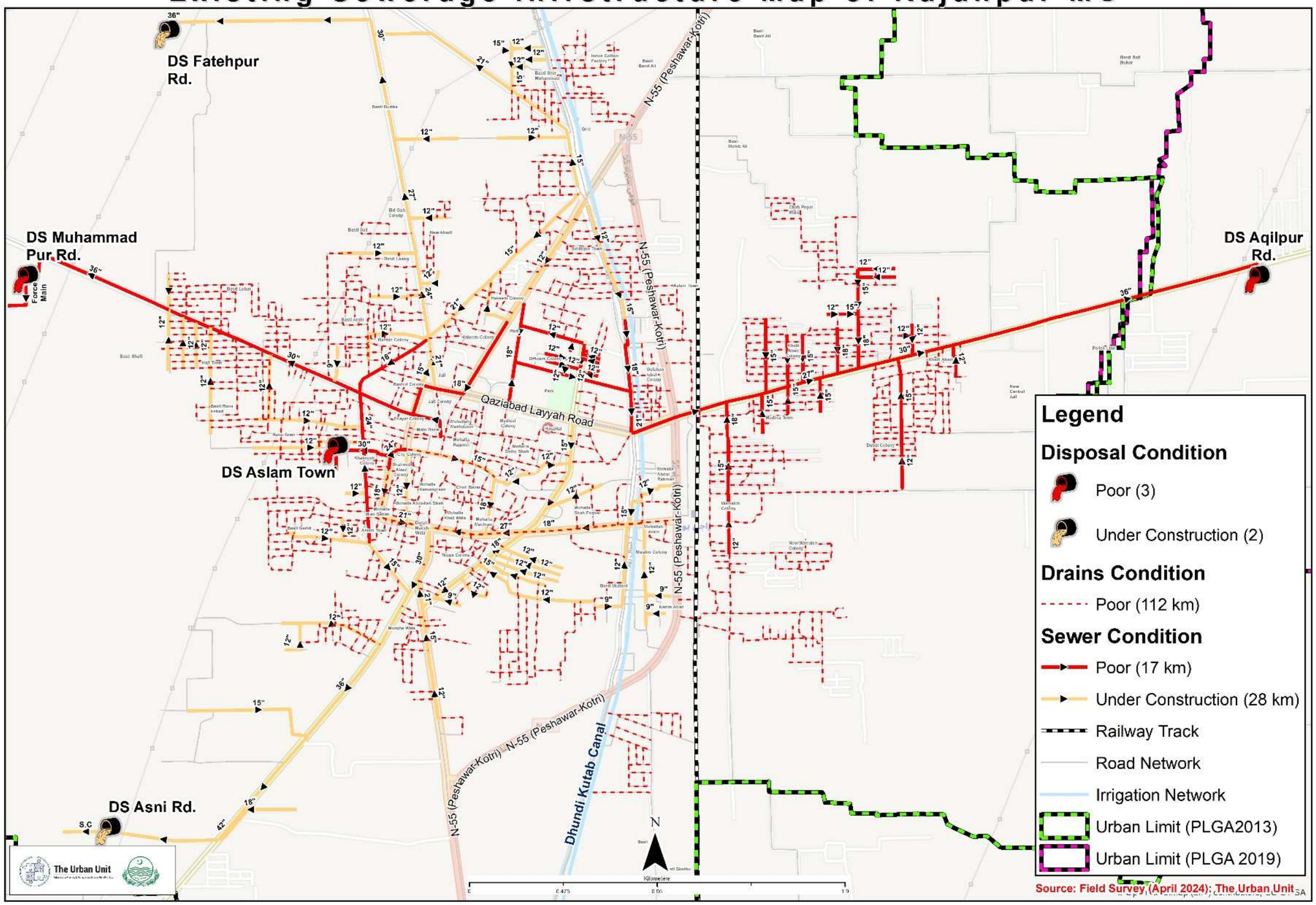


Figure 40: Existing Sewerage Infrastructure Map

4.5. Sewage Flow Estimation

The sewage flow estimation has been made corresponding to the 30 gallons per capita per day water demand. A contribution of 33% for storm-water flow, 5% infiltration & 5% non-domestic flows have been included during the calculation of the total sewerage flow. The current (2024) and future (2026, 2029, 2034) sewage flows are tabulated as below.

Table 27: Sewage Flow Estimation

Year	2024	2026	2029	2034
Population	133,957	146,004	166,137	206,048
Avg. Sewage Generated (MGD-I)	3.42	3.72	4.24	5.25
Peak Sewage Flow (MGD-I)	6.83	7.45	8.47	10.51
Storm Water Flow (MGD-I)	2.25	2.46	2.80	3.47
Infiltration Flow (MGD-I)	0.17	0.19	0.21	0.26
Non-Domestic Flow (MGD-I)	0.17	0.19	0.21	0.26
Total Sewage Flow (MGD-I)	9.43	10.28	11.69	14.50

The current estimated wastewater generation of Rajanpur city is approximately 9.43 MGD-I. It should be noted that this flow is expected to increase up to 14.50 MGD by the end of 2034. The estimated wastewater flows for Rajanpur is graphically represented below.

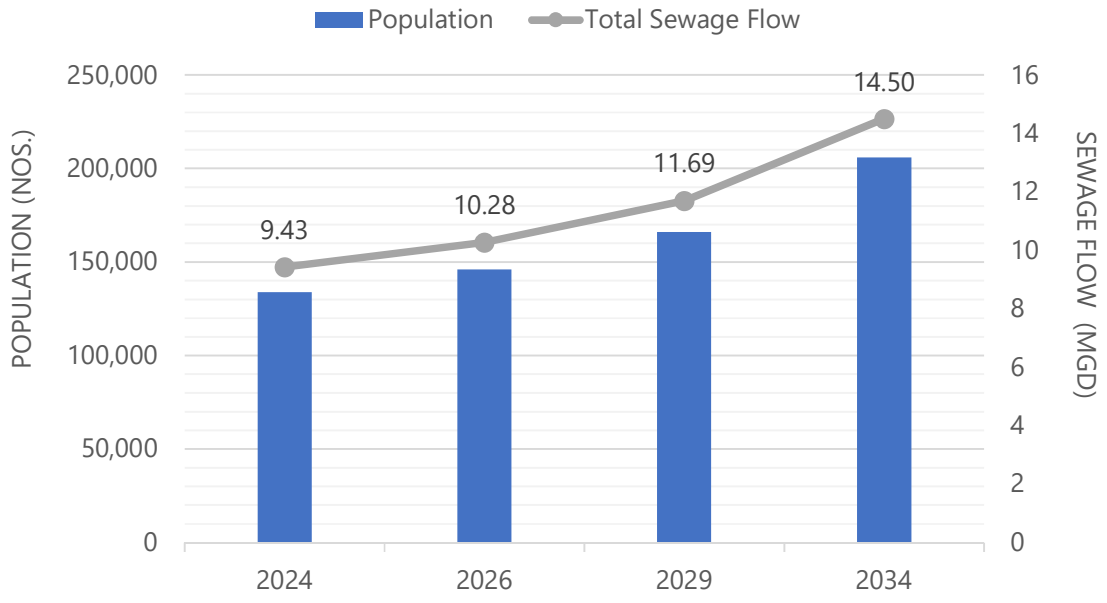


Figure 41: Estimated Total Sewage Flow (MGD-I)

4.6. Interventions for Sewerage System

The conditional assessment of existing sanitation infrastructure and its comparison with present and future projected demand and needs has resulted in the identification of service delivery

gaps that exists within the system. The planning exercise aims to fulfill the afore-described gaps to sewerage. Prioritization of these gaps is also done and schemes are proposed based on various factors such as essence of intervention, duration required to execute them, cost required, and their impact on general public. Total cost required to uplift the current sewerage situation is around 2,980 Million.

4.6.1. Short Term Plan

The Short term plan for sewerage discusses the immediate uplifting of drainage infrastructure in the city. Rehabilitation and repairs is proposed for the existing roadside and street-level drainage system in Rajanpur. Moreover, procurement of one Sucker and Jetting machine is also proposed during this phase. The total expected cost for Short Term is around 335 Million.

4.6.2. Medium Term Plan

The Medium term plan for the sewerage system is focused on rehabilitation of the existing sewerage infrastructure in the city. This includes replacement of sewers (trunks, mains and sub-mains) in the city and rehabilitation of the Disposal Works at Aqilpur Road and Muhammadpur Road. The total expected cost for Medium term is around 623 Million.

4.6.3. Long Term Plan

The Long term project for sewerage system involves extension of sewerage infrastructure towards the outskirts of the city. Moreover, wastewater treatment plants are proposed to be constructed in the city for effective treatment of wastewater prior to its disposal in agricultural fields. The total expected cost for Long term is around 2,022 Million.
The following schemes are proposed for uplifting the sewerage system of MC Rajanpur as per the performed assessments and analysis.

Table 28: Proposed Sewerage projects

Sr.	Phase	Proposed Schemes, Estimated Costs & Scope
1	Short Term (2026)	**Sewerage System Uplift Project for MC Rajanpur - Phase I (335 M)** Scope of Project: ▶ Procurement of 01 Sucker & 01 Jetting Machine ▶ Rehabilitation/Repair of Drainage Network (112 km)
2	Medium Term (2029)	**Sewerage System Uplift Project for MC Rajanpur - Phase II (623 M)** Scope of Project: ▶ Replacement of Trunk Sewers ▶ Laying/Replacement of Mains and Sub-Mains (17 km) ▶ Rehabilitation of Disposal Stations; DS Aqilpur Road & DS Muhammadpur Road

3	Long Term (2034)	**Sewerage System Uplift Project for MC Rajanpur Phase III (2022 M)** Scope of Project: ▶ Extension of Sewerage System & Laying of Lateral Sewers (16 km) ▶ Construction of WWTP (WSP-Type) for Zone A @ 15 Acres ▶ Construction of WWTP (WSP-Type) for Zone B @ 15 Acres ▶ Construction of WWTP (WSP-Type) for Zone C @ 25 Acres ▶ Construction of WWTP (WSP-Type) for Zone D @ 15 Acres
Total Cost for Sewerage System = 2,980 M		

For Rough Cost Estimation, MRS 1st Bi-Annual-2024 (01.01.2024 to 30.06.2024) District Rajanpur has been applied. This is further subject to the Detail Design of the proposed schemes upon PC-1 formation.

Sewerage Intervention Map of MC Muzaffargarh

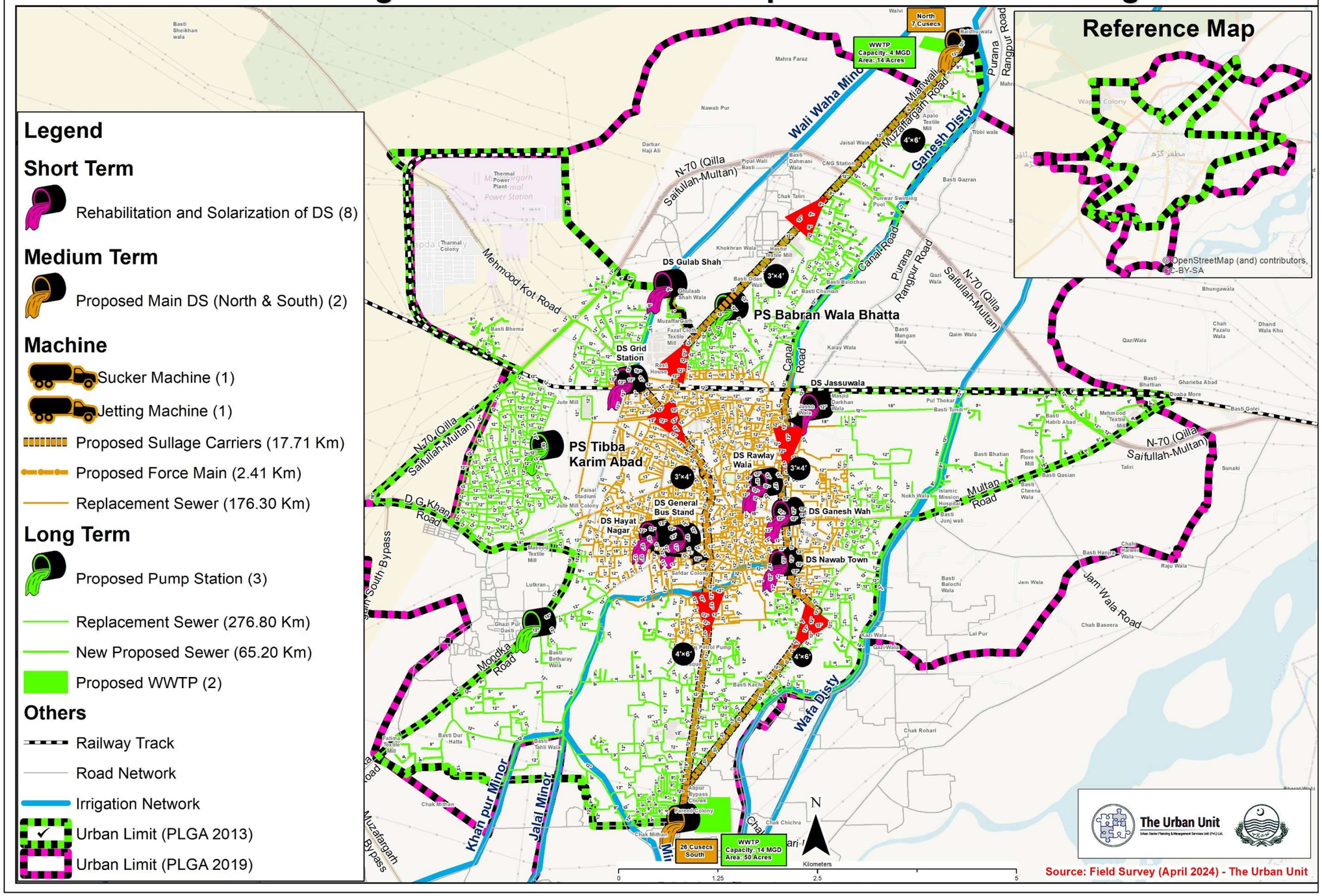


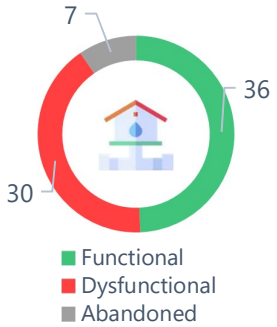
Figure 42: Sewerage Interventions Map

4.7. Rural Areas - Rajanpur District

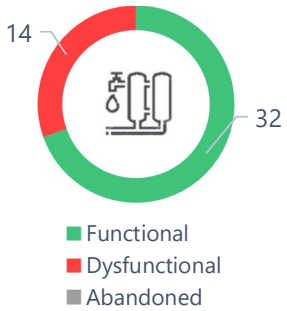
The Rajanpur district currently houses a staggering population of around 2,041,432 in its rural areas. Despite such a large rural populace, mere 10% is served with public water supply schemes in 36 rural villages across the district. It should be noted that Rajanpur ranks 29th out of the 36 districts of Punjab with respect to 'Access to Water' for rural areas of the district (UNICEF, 2019). Similarly, the district ranks 34th with respect to 'Access to Sanitation' for rural areas of the district (UNICEF, 2019). The extremely low ranking of the region is a clear indication of the gap towards fulfilling the basic needs of water and sanitation for the rural communities of the district.

Public Health Engineering Department (PHED) is the major stakeholder tasked with installation and operation of rural water-sanitation infrastructure in the district. As per the data collected by PHED, a total of 73 rural water supply schemes exists in the district out of which 36 (49%) are functional, 30 (41%) are dysfunctional and 7 (10%) are abandoned.

Most of these schemes are dysfunctional and/or abandoned due to damaged machinery (49%). Other reasons contributing towards dysfunctional schemes include source failure (27%), outlived schemes (19%) and pending WAPDA dues (5%). Total water supply in rural areas of Rajanpur can be gauged at 3 MGD through these schemes, however, this may be augmented to 7 MGD if the dysfunctional infrastructure is rehabilitated.



A total of 46 number of Rural Water Filtration plants are installed in the district by the Public Health Engineering Department. These filtration plants collectively serve an estimated population of 149,677 individuals. 32 (70%) of these filtrations units are currently reported to be functional, whereas 14 (30%) are reported to be dysfunctional.



It should also be noted that 56% area of Rajanpur district has been classified as Brackish zone, 13% as Contaminated zone whereas 29% has been classified as Sweet Water zone. The map below represents the existing rural water supply infrastructure in Rajanpur district. The water quality variation across the district has also been indicated in the map.

Rural Water Supply Infrastructure District Rajanpur

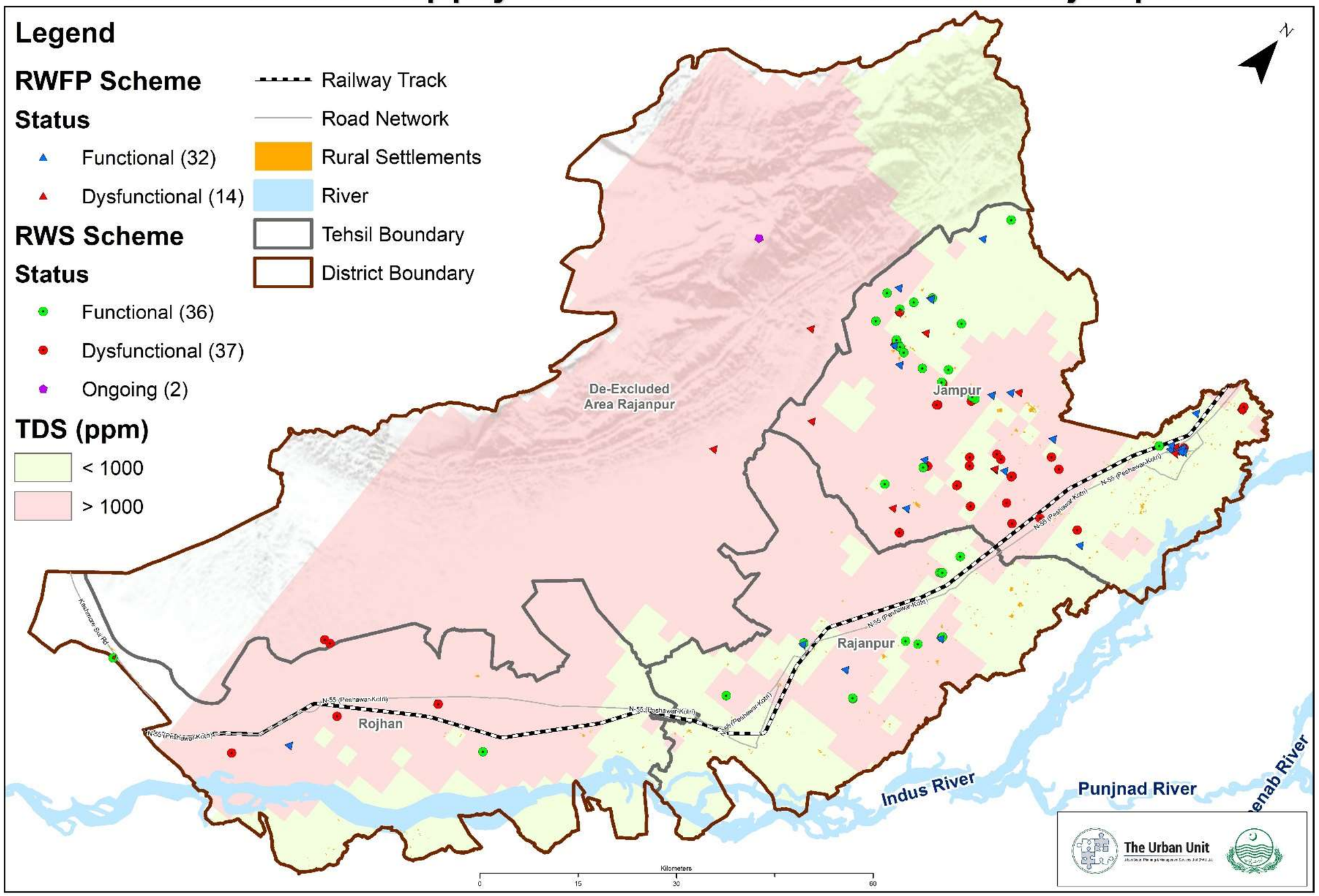


Figure 43: Rural Water Supply Infrastructure Map

4.8. Interventions for Rural Water Supply Infrastructure

Following evidence-backed interventions have been proposed in order to address the above-mentioned issues in operationalization and maintenance of water supply infrastructure in Rajanpur district.

- Provision of Solar-based Interventions for financial sustainability of schemes
- Technical Capacity Building of community for effective operation and maintenance of rural water and sanitation schemes
- Rehabilitation of dysfunctional schemes & Provision of new schemes for immediate relief to communities in need-based areas of the district

The following schemes are proposed for uplifting the rural water supply of Rajanpur district as per the performed assessments and analysis.

Table 29: Rural Water Supply interventions

Sr.	Phase	Proposed Schemes, Estimated Costs & Scope
1	Short Term (2026)	**Rajanpur Rural Water Supply Uplift Project - Phase I (150 M)** Scope of Project: ▶ Technical Capacity Building of Community for effective Operation & Maintenance of Schemes ▶ Rehabilitation of 14 Nos Rural Filtration Plants in Rajanpur District
2	Medium Term (2029)	**Rajanpur Rural Water Supply Uplift Project - Phase II (302 M)** Scope of Project: ▶ Rehabilitation of 9 Nos Rural Water Supply Schemes in Rajanpur District ▶ Provision of 7 New Rural Water Supply Schemes in Rajanpur District
3	Long Term (2034)	**Rajanpur Water Supply Uplift Project - Phase III (20 M)** Scope of Project: ▶ Solarization of 46 Nos Rural Filtration Plants in Rajanpur District **Establishment of 3 Nos Model Villages – District Rajanpur (300 M)** Scope of Project: ▶ Scopes including but not limited to 100% coverage of water supply, sewerage/drainage services, tuff tiles and wastewater treatment facilities in 3 villages (@1 each Tehsil of District Rajanpur)
Total Cost for Rural Areas = 772 M		

Rural Water Supply Intervention District Rajanpur

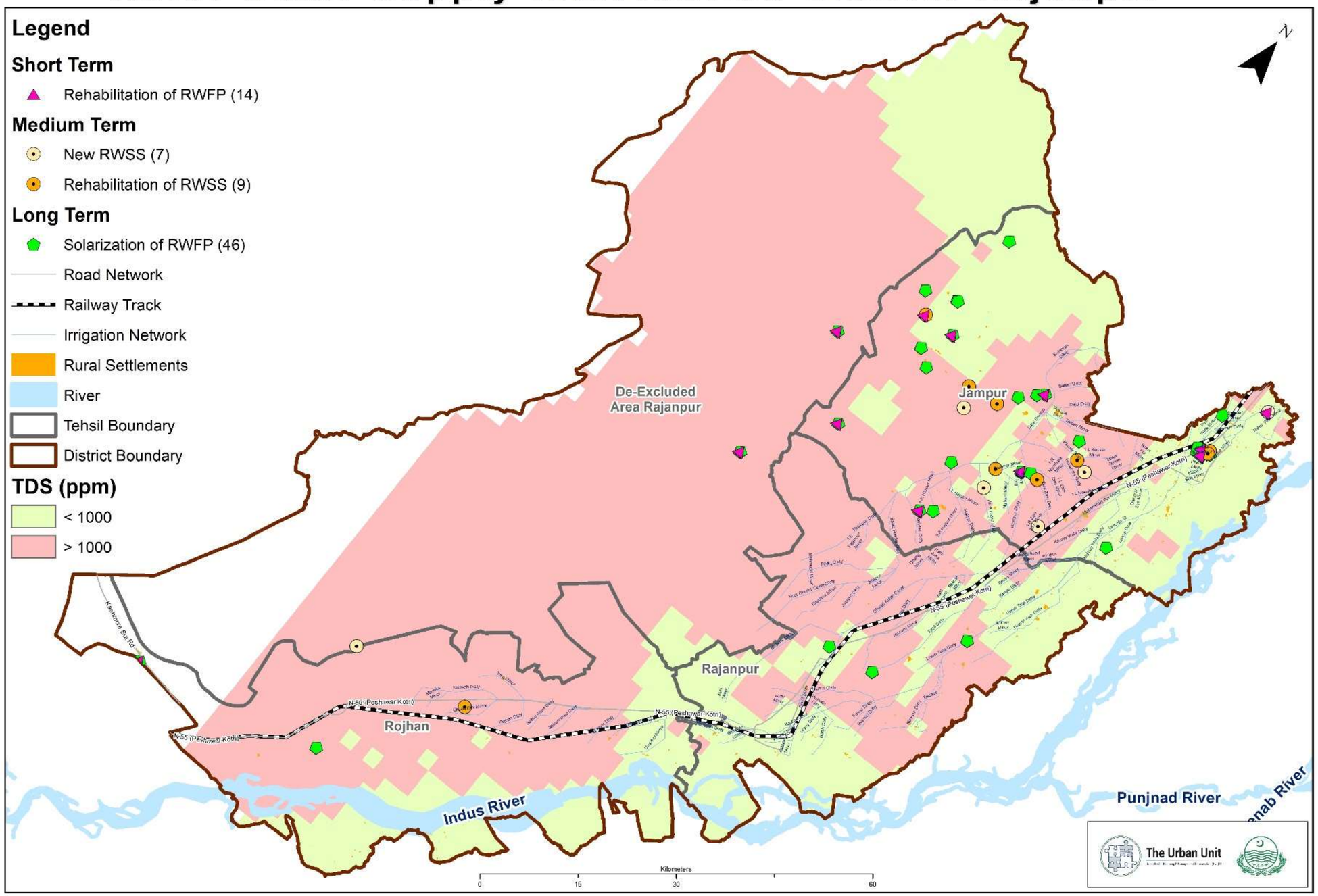


Figure 44: Rural Water Supply Interventions Map

LAYYAH CITY

Layyah City is the 72nd largest city of Pakistan by population as per Census 2017. The current estimated population (year 2024) for the city is 154,611 which is further projected to increase to 206,978 in 2034, which is the planning year for this regional development plan.

The existing water supply infrastructure for Layyah City comprises groundwater-based schemes with seven tubewells, which cover only about 30% of the city. Six of these tubewells have a capacity of 0.75 cusecs each, while one has a capacity of 0.5 cusec. Currently, three out of the seven tubewells are functional, while the remaining four are non-functional due to the absence of electrical panels and damaged distribution system. Rapid water quality testing indicated an acceptable pH level (6.5-8.5). The average value of Total Dissolved Solids (TDS) was also within the permissible range (< 1000 ppm), indicating that the water is sweet and suitable for drinking purposes. There is a lack of public interest in the city's water supply system, as the majority of residents have opted to install boreholes on their premises.

The sewerage system of Layyah City is a gravity-based system, with an existing network covering approximately 60% of the city. The city’s wastewater is disposed of in agricultural fields and Indus River Creek through disposal stations without any treatment. The sewerage network comprises sewers with 15% of them in poor condition. Moreover, a significant length of sewers has passed their design life.

5.1. Existing Water Supply Infrastructure

The existing water supply infrastructure for Layyah City comprises groundwater-based schemes with seven tubewells, which cover only about 30% of the city. Six of these tubewells have a capacity of 0.75 cusecs each, and one has a capacity of 0.5 cusec. Currently, three out of the seven tubewells are functional, while the remaining four are non-functional due to the absence of electrical panels and damaged distribution system. The functional tubewells operate for 4 to 9 hours daily. There are only 80 domestic and 2 commercial connections. The water quality in Layyah is sweet and drinkable, leading to a lack of public interest in the city's water supply system. The majority of residents have installed boreholes on their premises.

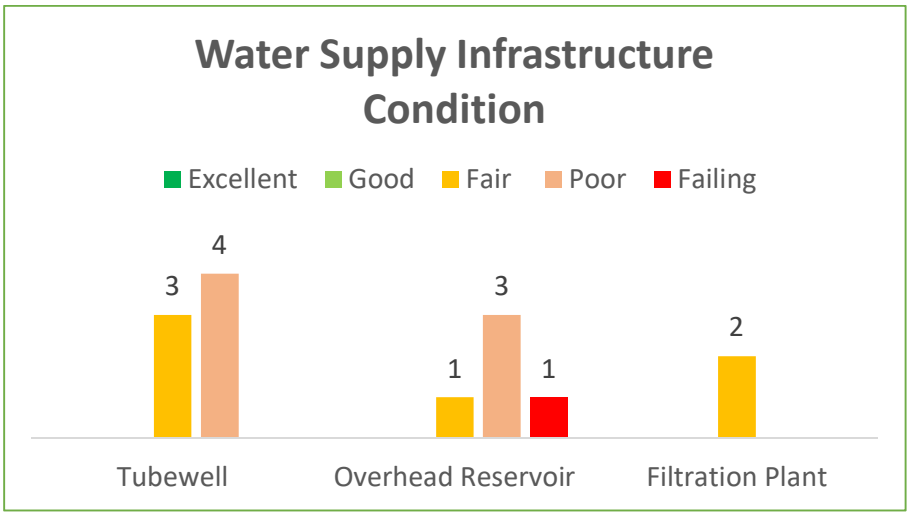


Figure 45: Water Supply Infrastructure condition

The condition of tube wells in the city was assessed and it was noted that the majority of the tube wells in the city were in poor condition. Four tube wells were assessed to be in poor, while three were in fair condition. The city's water supply lines, having a total length of 23 Km, cover 30% of the area. The diameter of the lines varies from 4" to 8". Upon assessment, it was found that 65% of the WS pipeline was in fair condition, while 30% was in failing condition.

Similarly, the overhead reservoirs were mostly assessed to be in unsatisfactory condition, with three in poor, one in failing condition and only one in fair condition. The city also has two UF filtration plants being maintained by the MC Layyah. Both of them were assessed to be in fair condition.

The details of tube wells and overhead reservoirs in the city have been provided in the table below.

Table 30: Details of Water Supply Infrastructure

Asset Type	Asset Name	Functional Status	Capacity	Installed Motor Rating	Overall Condition
Tube Well	Municipal Park Muhalla Gujranwala TW # 01	Functional	0.75-cusec	30 HP	D
	Municipal Park Muhalla Gujranwala TW # 02	Non-Functional	0.75-cusec	30 HP	C
	Municipal Park Muhalla Gujranwala TW # 03	Non-Functional	0.75-cusec	30 HP	C
	TDA Waterworks	Functional	0.75-cusec	30 HP	D
	Housing Colony Waterworks	Functional	0.5-cusec	20 HP	C

Asset Type	Asset Name	Functional Status	Capacity	Installed Motor Rating	Overall Condition
	Jinnah Parks Water Works TW#01	Non-Functional	0.75-cusec	25 HP	D
	Jinnah Parks Water Works TW#02	Non-Functional	0.75-cusec	25 HP	D
Overhead Reservoirs	Municipal Park Muhalla Gujranwala OHR#01	Non-Functional	50,000 G	N/A	D
	Municipal Park Muhalla Gujranwala OHR#02	Non-Functional	50,000 G	N/A	C
	Jinnah Park Waterworks OHR	Non-Functional	30,000 G	N/A	F
	TDA Colony Waterworks OHR	Non-Functional	30,000 G	N/A	D
	Housing Colony OHR	Functional	30,000 G	N/A	D
Filtration Plants	DHQ Layyah	Functional	Type - UF	N/A	C
	Municipal Park	Functional	Type - UF	N/A	C

The overall conditional assessment of water supply infrastructure has been evaluated to gauge the condition of the system as a whole, based on the most recurring conditions for the individual components of the system. The overall assessment is provided in the table below.

Table 31: Overall Asset Condition for Water Supply Infrastructure

Overall Asset Condition	Rating
Civil Structures	D – Poor
Distribution Network	C – Fair
Electro-Mechanical	D – Poor

The condition of water quality was assessed through Rapid Water Quality Testing across MC Layyah. Handheld water quality testing equipment was utilized for this exercise, measuring different parameters such as Total Dissolved Solids (TDS), pH and Electrical Conductivity. It was found that all the samples had pH levels within the acceptable range (6.5-8.5), as per Pakistan Standards & Quality Control Authority (PSQCA) and World Health Organization

(WHO) (1996, 2004) guidelines. The average value of Total Dissolved Solids was also within the permissible range (< 1000 ppm) stated in these standards, indicating that the water is sweet and suitable for drinking purposes.

The condition of the water supply infrastructure as encountered during the field visit performed by the Urban Unit is indicated in the pictures below.

Muncipal Park Mohalla Gujranwala TW#01 Constructed in 1974

Non Provision of Electrical Panels at Muncipal Park Mohalla Gujranwala TW#02

Muncipal Park Mohalla Gujranwala OHR (Capacity: 50,000 Gallons)

Muncipal Park UF Filtration Plant

Constructed in 2007

Figure 46: In Pictures: Field assessment

Existing Water Supply Infrastructure - MC Layyah

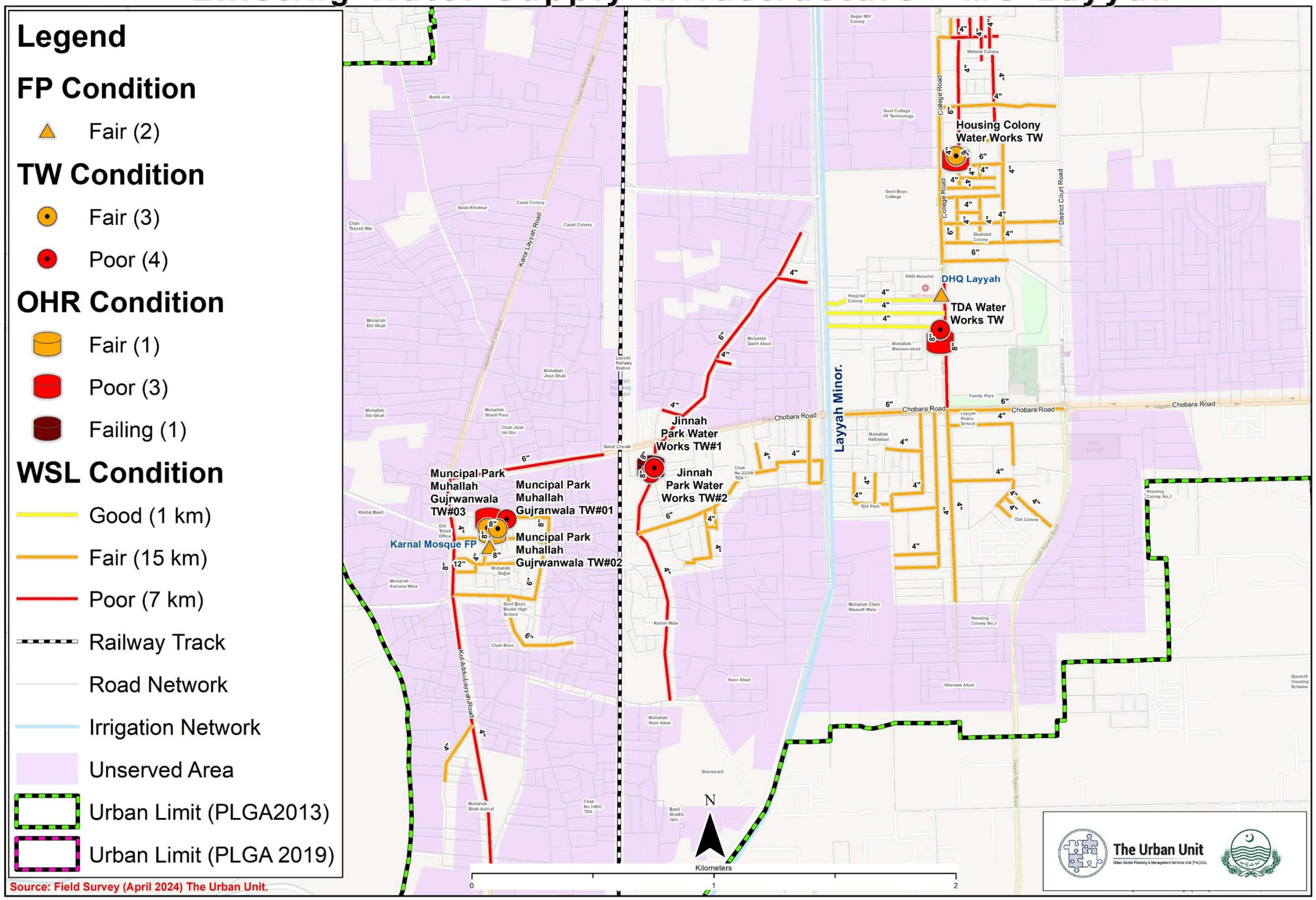


Figure 47: Water Supply Baseline map

5.2. Water Supply versus Demand Analysis

The water supply demand calculations have been made corresponding to a water demand of 30 GPCD inclusive of unaccounted-for water (NRW). It must be noted that this figure for water demand is considered adequate and is aligned with the United Nations 'Human Right to Water and Sanitation Guidelines' which recommends a minimum of 11 – 22 GPCD of water to ensure full realization of the individual right to water.
The current (2024) and future (2026, 2029, 2034) water demand are tabulated below.

Table 32: Water Supply versus Demand calculations

Year	2024	2026	2029	2034
Population	154,611	163,899	178,889	206,978
Average Day Demand (MGD)	4.64	4.92	5.37	6.21
Max Day Demand (MGD)	6.96	7.38	8.05	9.31
Peak Hour Demand (MGD)	10.44	11.06	12.07	13.97

Capacitance analysis for existing infrastructure has yielded a current supply capacity of 0.29 MGD against 3 operational tube wells in the city. This indicates a current water supply deficit of 6.67 MGD against Maximum Day Demand. It is important to note this demand is projected to increase up to 9.02 MGD by the end of 2034. Therefore, additional water supply infrastructure is imperative to address this water supply disparity. The water demand versus the water supply capacity is graphically represented below.

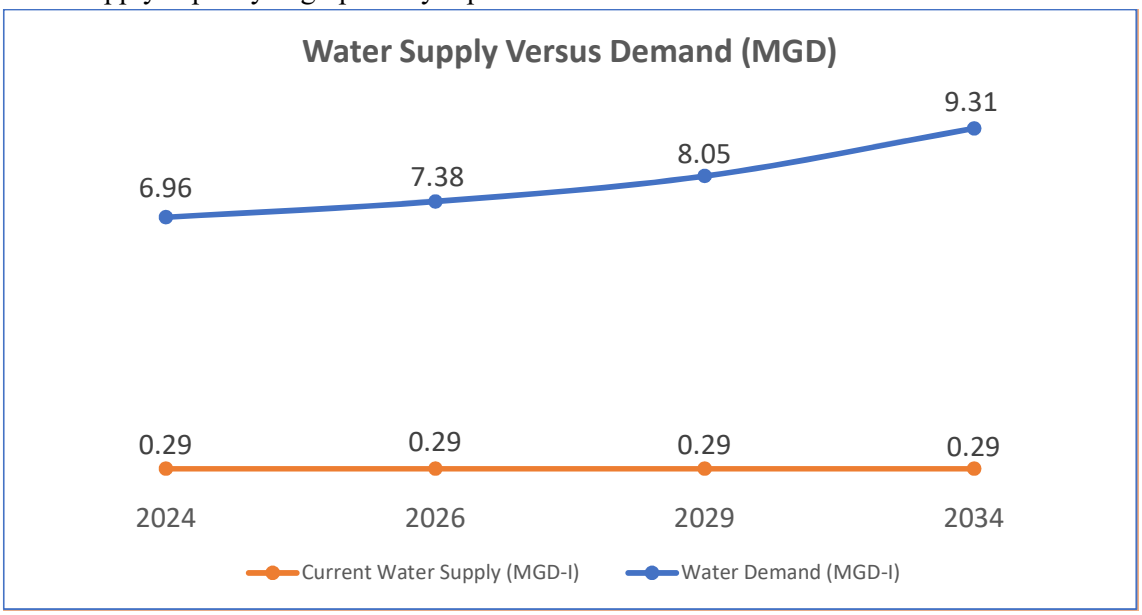


Figure 48: Water Supply versus Demand (MGD-I)

5.3. Interventions for Water Supply System

The conditional assessment of existing water supply infrastructure and its comparison with present and future projected demand and needs has resulted in the identification of service

delivery gaps that exist within the system. The planning exercise aims to fulfil the aforementioned gaps in water supply. Prioritization of these gaps is also done and schemes are proposed based on various factors such as the essence of intervention, the duration required to execute them, the cost required, and their impact on the general public. The total cost required to uplift the current water supply situation is 1,512 Million.

5.3.1. Short Term Plan

The Short-Term plan for Layyah prioritizes the rehabilitation of both above and below-ground water supply assets to restore the system to its full capacity. This involves improving the existing water supply scheme maintained by the Municipal Committee Layyah. The plan includes rehabilitating six tubewells, three overhead reservoirs and problematic water supply pipelines to operationalize the currently non-functional tube wells in the city. The short-term plan of Layyah is expected to cost 192 Million.

5.3.2. Medium Term Plan

In this term, the proposal includes the provision of water supply systems in unserved areas by installation of 08 new tube wells, each with a capacity of 1.5 cusecs, along with construction of overhead reservoirs to enhance service delivery efficiency. Additionally, the proposal includes dismantling one outlived overhead reservoir and reconstructing it. The medium-term plan for Layyah is estimated to cost around 700 Million.

5.3.3. Long Term Plan

The long-term plan discusses the further extension of water supply services in the city with proposed installation of 07 new tube wells of 1.5 cusecs each, along with the construction of overhead reservoirs. The long-term plan for Layyah is estimated to cost 620 Million.
The following schemes are proposed for uplifting the water supply system of MC Layyah as per the performed assessments and analysis.

Table 33: Water Supply projects

Sr.	Phase	Proposed Schemes, Estimated Costs & Scope
1	Short Term (2026)	**Rehabilitation of Existing Water Supply System in Layyah City (@192 M)** Scope of Project: ▶ Rehabilitation of existing tube wells in Layyah City which includes: ○ Rehabilitation of 02 Non-Functional Tube Wells (Municipal Park Mohalla Gujranwala TW#02 and Municipal Park Mohalla Gujranwala TW#03) through the provision of electrical panels ○ Rehabilitation of Municipal Park Mohalla Gujranwala TW#01 Tube Well, involving civil structure rehabilitation by application of plaster and paint on outer walls, as well as replacement of electromechanical equipment.

Sr.	Phase	Proposed Schemes, Estimated Costs & Scope
		○ Rehabilitation of TDA water works tube well through major rehabilitation of civil structure and replacement of electromechanical equipment ○ Major civil structure rehabilitation of the outlived pump house of Jinnah Park Water Works TW # 01 and Jinnah Park Water Works TW # 02 ▶ Major Rehabilitation of Problematic overhead reservoirs (OHRs) at Municipal Park Mohalla Gujranwala OHR#01 (50,000 Gallons), TDA Colony Water Works OHR (30,000 Gallons), Housing Colony OHR (30,000 Gallons) ▶ Replacement of 8 Km poor condition of WS Rising and Distribution Mains having Diameter of 8", 6", 4", 3".
2	Medium Term (2029)	**Extension of Water Supply System in Layyah – Phase I (@663 M)** Scope of Project: ▶ Construction of 08 Tube Wells (1.5 Cusec each) including well bores, pump houses, machinery and allied components ▶ Construction of 06 OHRs having a capacity of 50,000 Gallons each with laying of rising main and distribution network of a total length of 105 Km having varying diameters (4", 6", 8") in unserved areas of Panch Marla Scheme, Basti Jota, Rehmanabad, Mohallah Eidghah, Noorabad & Housing Colony #2. **Rehabilitation of Existing Water Supply System in Layyah City (@37 M)** Scope of Project: ▶ Dismantling of existing outlived Overhead Reservoir at Jinnah Park Water Works OHR and its reconstruction with a capacity of 50,000 Gallons
3	Long Term (2034)	**Extension of Water Supply System in Layyah – Phase II (@620 M)** Scope of Project: ▶ Construction of 07 Tube Wells (1.5 Cusec each) including well bores, pump houses, machinery and allied components ▶ Construction of 03 OHRs having a capacity of 50,000 Gallons each with laying of rising main and distribution network of a total length of 68 Km having varying diameters (4", 6", 8") in unserved areas of Yousafabad, Near Thana Sadar Road and Near Jinnah Park,
Total Cost for Water Supply System = 1,512 M		

For Rough Cost Estimation, MRS 1st BI-ANNUAL-2024 (01.01.2024 to 30.06.2024) District Layyah has been applied. This is further subject to the detailed design of the proposed schemes upon PC-1 formation.

Water Supply Intervention - MC Layyah

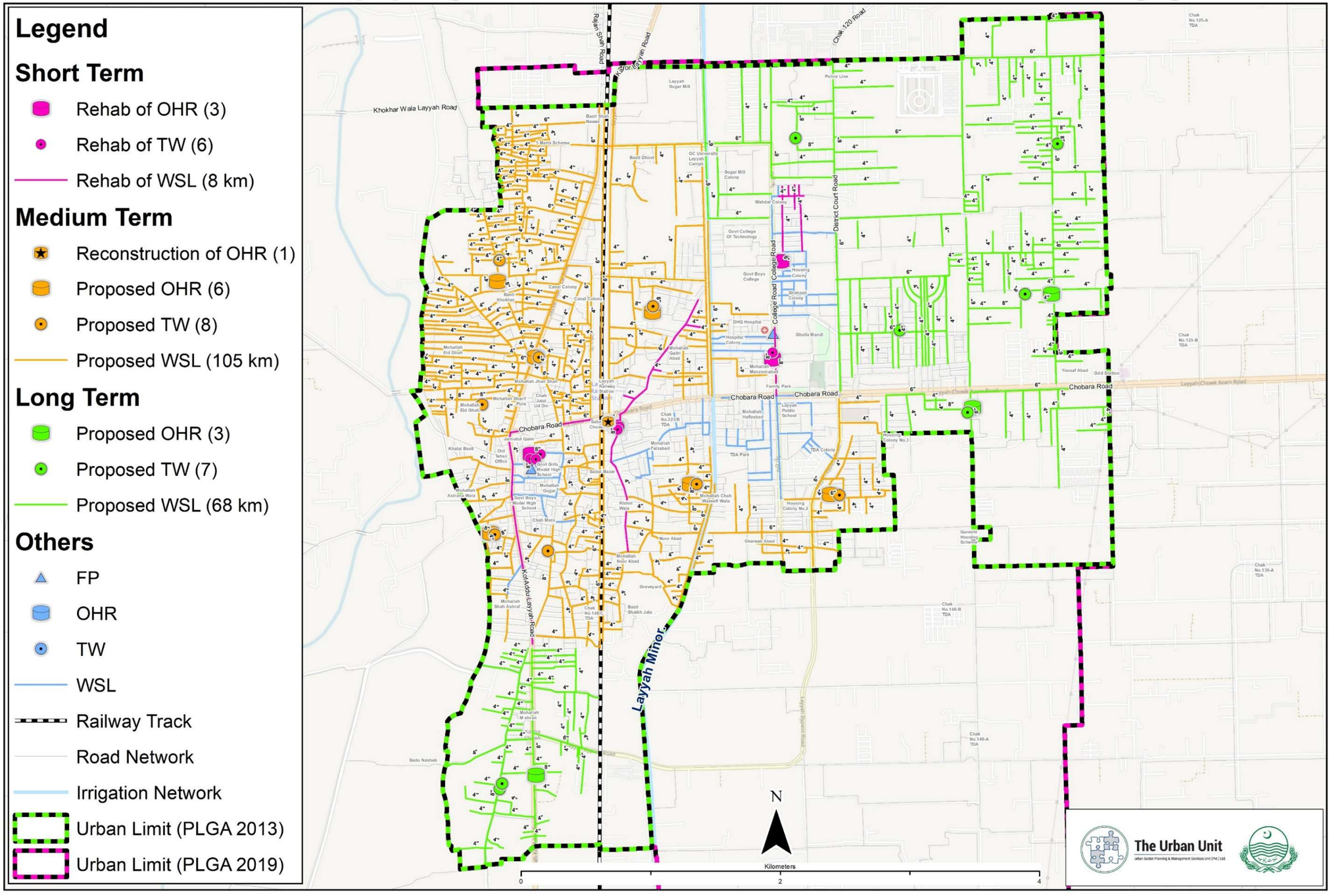


Figure 49: Water Supply Intervention map

5.4. Existing Sewerage Infrastructure

The sewerage system of Layyah City is a gravity-based system, with an existing network covering approximately 60% of the city. The city's wastewater is disposed of in agricultural fields and Indus River Creek through disposal stations without any treatment. The sewerage network comprises sewers with 15% of them in poor condition. Moreover, a significant length of sewers has passed their design life. There is also one PHED scheme for unserved areas in the western part of the city. The scheme consists of RCC sewers, force mains, tough tiles and a disposal station. The wastewater from the areas covered by this scheme is collected through the sewage network, then collected at the disposal station and ultimately disposed of in the Indus River Creek.

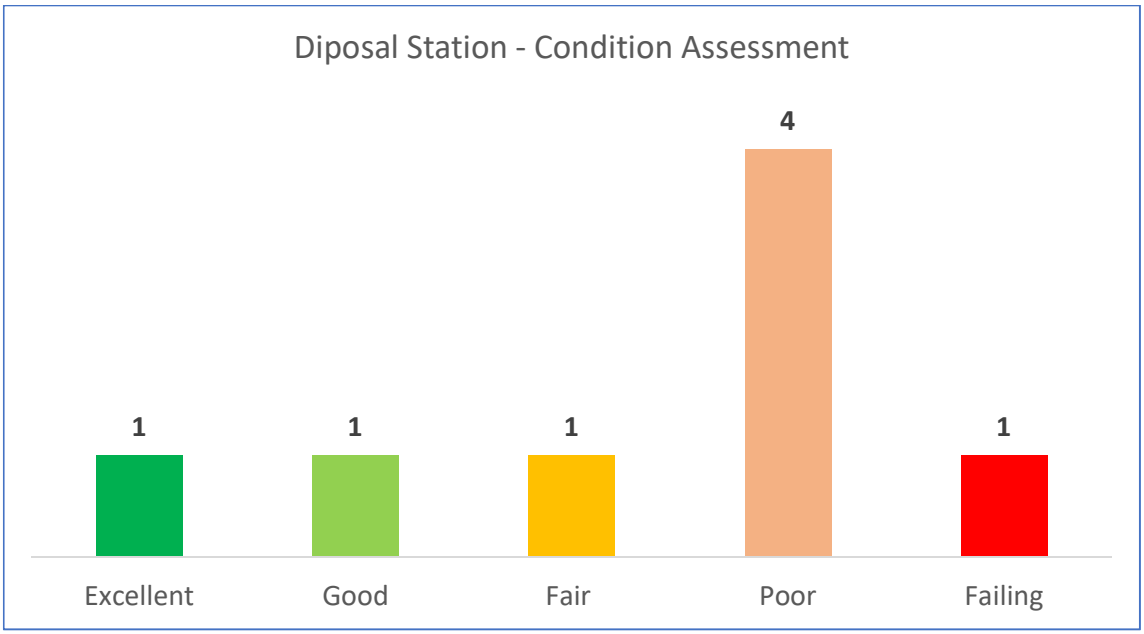


Figure 50: Disposal Stations condition assessment

The condition of disposal stations in the city was assessed and it was noted that the majority of the disposal stations are in unsatisfactory condition with four in poor and one in failing condition. Only one disposal station is non-functional and the rest of them are functional and have operational time of 20 hours per day. The poor disposal stations have corroded and rusted screens in the screening chamber.

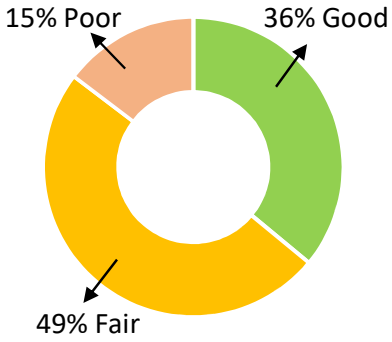
The details of the disposal stations in the city have been provided in the table below.

Table 34: Details of Disposal stations

Disposal Name/Area	Functional Status	Motors Capacity (Hp)	Overall Condition
Old Budh Mandi Road	Functional	50 + 60	D

Disposal Name/Area	Functional Status	Motors Capacity (Hp)	Overall Condition
Pull Angra DS Housing 2	Functional	50 + 60	D
Disposal Works Zilla Council	Functional	25	B
Jinnah Park Disposal	Functional	50	D
Gharay Bhan	Functional	60	C
Housing Colony No.1	Functional	25	D
New Disposal Eidghah	Functional	50+50+50+30	A
5 Marla Disposal	Non- Functional	25	F

The sewers (76 KM), cover an estimated spatial area of 60% of the city. The diameter of the sewers ranges from 9" to 33" and 49% were found to be in Fair condition, whereas 15% of sewers were in Poor condition and almost 36% were assessed in good condition.



The overall conditional assessment of sewerage infrastructure has been evaluated to gauge the condition of the system as a whole, based on the most recurring conditions for the individual components of the system. The overall assessment is provided in the table below.

Table 35: Overall Asset Condition for Sewerage Infrastructure

Overall Asset Condition	Rating
Civil Structures	D - Poor
Distribution Network	C - Fair
Electro-Mechanical	C - Fair

The condition of the sewerage infrastructure as encountered during the field visit performed by the Urban Unit is indicated in the pictures below.

Dry Wall Condition of Old Budh Mandi Disposal Station (Constructed in 1993)

Wet Well Condition of Disposal Station

Sewer Jetting Machine at MC Layyah Office

Pumping Machinery Assessment of Pull Angra DS (Constructed in 2003)

Figure 51: Sewerage System Assets condition

Existing Sewerage Infrastructure - MC Layyah

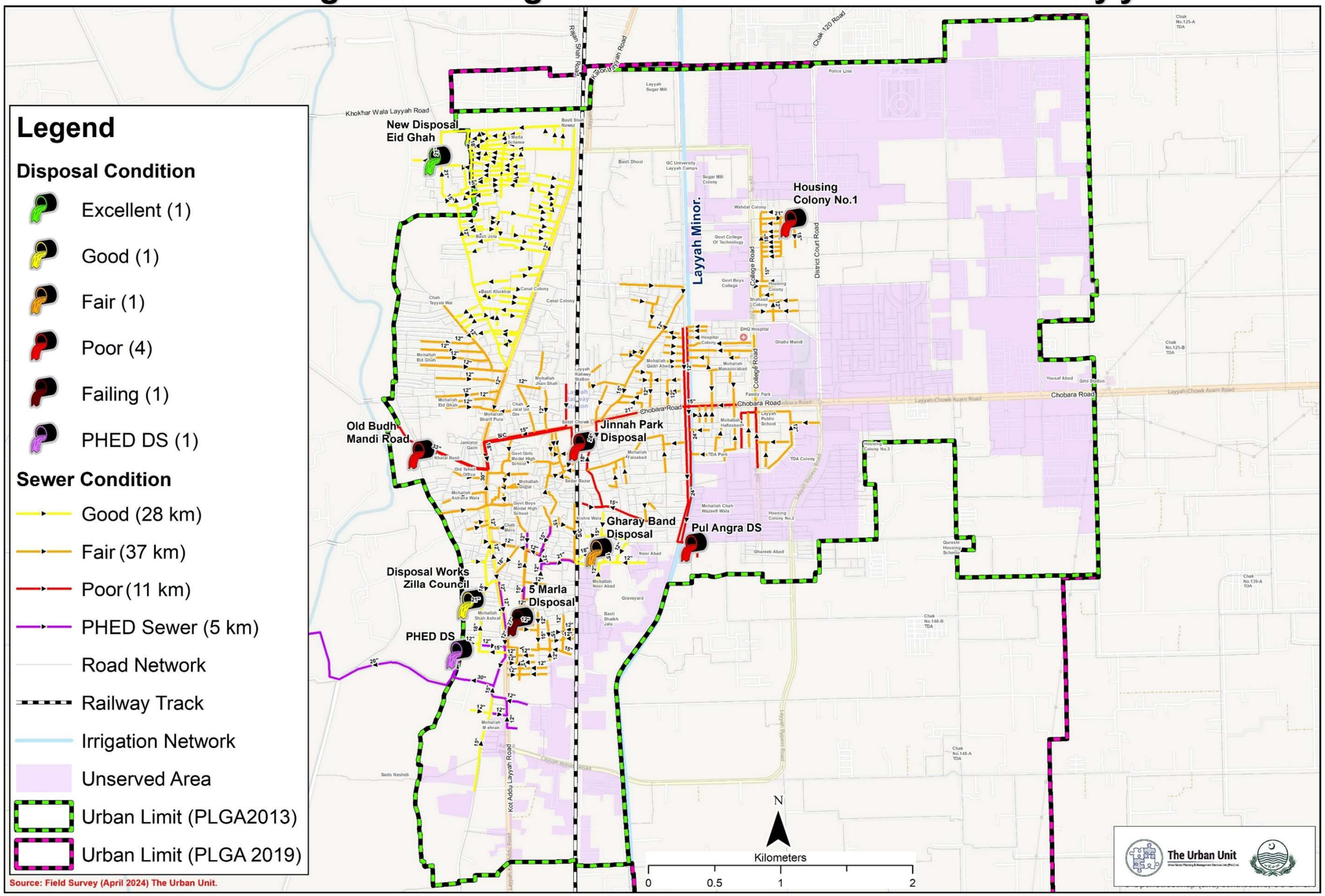


Figure 52: Sewerage Baseline map

5.5. Sewage Flow Estimation

The sewage generation has been made corresponding to the 30 gallons per capita per day water demand. A contribution of 33% for storm-water flow, 5% infiltration & 5% non-domestic flows have been included during the calculation of the total sewerage flow. The current (2024) and future (2026, 2029, 2034) sewage flows are tabulated below.

Table 36: Sewage flow estimation

Year	2024	2026	2029	2034
Population	154,611	163,899	178,889	206,978
Avg. Sewage Generated (MGD-I)	3.94	4.18	4.56	5.28
Peak Sewage Flow (MGD-I)	7.89	8.36	9.12	10.56
Storm Water Flow (MGD-I)	2.60	2.76	3.01	3.48
Infiltration Flow (MGD-I)	0.20	0.21	0.23	0.26
Non-Domestic Flow (MGD-I)	0.20	0.21	0.23	0.26
Total Sewage Flow (MGD-I)	10.9	11.5	12.6	14.6

The current estimated wastewater generation of Layyah City is approximately 10.9 MGD-I. It should be noted that this flow is expected to increase up to 14.6 MGD by the end of 2034. The estimated wastewater flows for Layyah are graphically represented below.

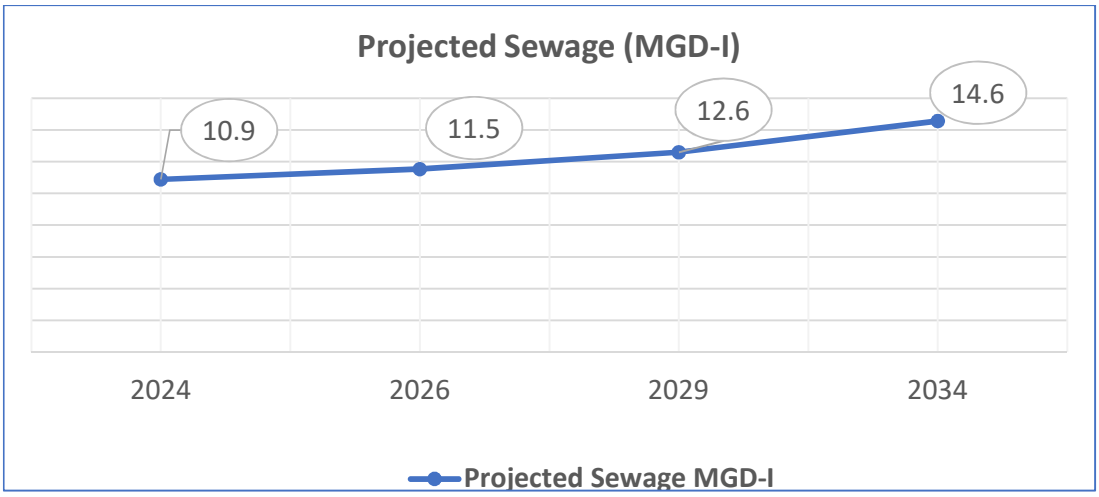


Figure 53: Estimated Total Sewage Flow (MGD-I)

An elevation Map has been developed for planning purposes which indicates the elevation level of the terrain and appropriate natural flow for sewage pipelines. The lowest and highest levels of Layyah City are approximately 91 meters and 107 meters respectively from Mean Sea Level (MSL). The maximum difference in city elevation is around 16 meters.

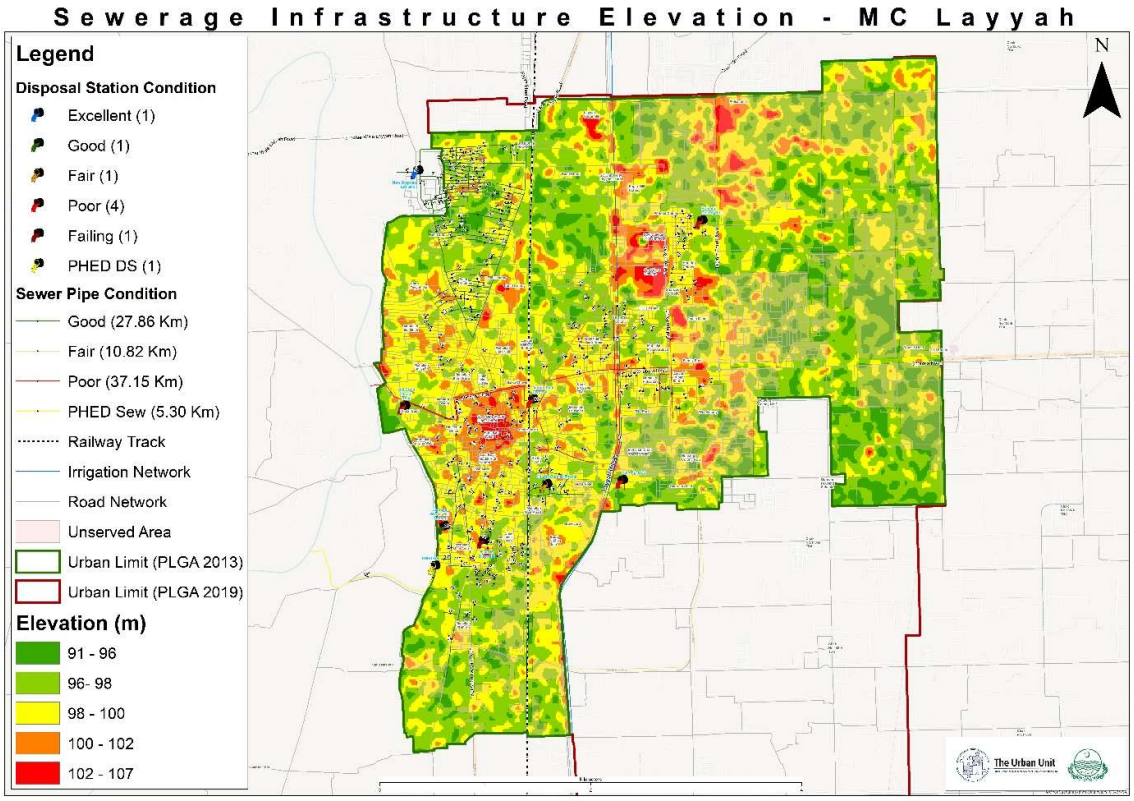


Figure 54: Sewerage Infrastructure elevation map

5.6. Interventions for Sewerage System

The conditional assessment of existing sewerage infrastructure and its comparison with present and future projected demand and needs has resulted in the identification of service delivery gaps that exist within the system. The planning exercise aims to fill the afore-described gaps in sewerage. Prioritization of these gaps is also done and schemes are proposed based on various factors such as the essence of intervention, the duration required to execute them, the cost required, and their impact on the general public. For planning purposes, the city is divided into two zones: the western and eastern zones, divided by Layyah Minor passing through the city. The total cost required to uplift the current sewerage situation is around 3,539 Million.

5.6.1. Short Term Plan

The Short-term plan for sewerage involves the rehabilitation of existing poor-conditioned disposal stations and the replacement of poor-conditioned sewerage lines in MC Layyah. The total expected cost for the Short Term is around 354 Million.

5.6.2. Medium Term Plan

The Medium-term plan for the sewerage system involves the improvement of the existing sewerage system and the provision of wastewater treatment plants of WSP technology for the western zone. Procurement of sucker and jetting machine is also proposed in this term.
The total expected cost for the medium term is around 1,284 Million.

5.6.3. Long Term Plan

The Long-term project for the sewerage system involves an extension of sewerage lines in unserved areas of the eastern zone of Layyah. Also, the construction of a wastewater treatment plant for the eastern zone is proposed for safe disposal of wastewater.
The total expected cost of the Long term is around 1,901 Million.

Table 37: Sewerage proposed projects

Sr.	Phase	Proposed Schemes, Estimated Costs & Scope
1	Short Term (2026)	**Sewerage System Rehabilitation Scheme for Layyah City (@354 M)** Scope of Project: ▶ Rehabilitation of Old Budh Mandi Disposal Station by repairing the civil structures of the dry and wet wells as required ▶ Rehabilitation of Pull Angra Housing 2 Disposal Station by providing screens in the screening chamber ▶ Rehabilitation of Jinnah Park Disposal by repairing the wet well and replacing the screen in the screening chamber ▶ Major Rehabilitation of Housing Colony No.1 Disposal Station, involving civil structure rehabilitation, major rehabilitation of wet wells, replacement of pumps, and rehabilitation of electrical panels

Sr.	Phase	Proposed Schemes, Estimated Costs & Scope
		▶ Replacement of 9 Km Poor & outlived sewerage Lines in Zone 3 & 4 having varying dias (12''-54'') in Western and Eastern Zones
2	Medium Term (2029)	**Improvement of Sewerage system and Provision of Waste Stabilization Pond WSP for Western Zone-A (20 Acres) & Western Zone-B (7 Acres)(@1,231 M)** Scope of Project: ▶ Construction of an RCC Sullage carrier (2'x2.5' size) for sewage disposal for the future WWTP (Western Zone) and laying of HDPE Force Mains at Old Budh Mandi Road and Disposal Works Zila Council with a diameter of 15 and 27 inches. ▶ Construction of WSP of 6 MGD with 20 Acres of Land for primary and secondary treatment of Waste Water for Western Zone - A ▶ Construction of WSP of 2 MGD with 7 Acres of Land for primary and secondary treatment of Waste Water for Western Zone – B **Sewerage System Machinery Procurement of Layyah City (@53 M)** Scope of Project: ▶ Procurement of one Sucker and One Jetting Machine for maintenance of the sewerage system in MC Layyah
3	Long Term (2034)	**Extension of Sewerage System in Layyah City (@1,901)** Scope of Project: ▶ Extension of Sewerage Lines to unserved Areas of the Eastern Zone including Police Line, Yousaf Abad and Housing Colony 3 having varying diameters of 12" to 36". ▶ Installation of Lift Station with 1 km Force Main having Dia of 36" up to newly constructed WWTP ▶ Construction of Sewage Treatment Plant for Eastern Zone of 7.5 MGD capacity and 25 Acres complete in all aspects including auxiliary works
Total Cost for Sewerage System = 3,539 M		

For Rough Cost Estimation, MRS 1st BI-ANNUAL-2024 (01.01.2024 to 30.06.2024) District Layyah has been applied. This is further subject to the detailed design of the proposed schemes upon PC-1 formation.

Sewerage Intervention - MC Layyah

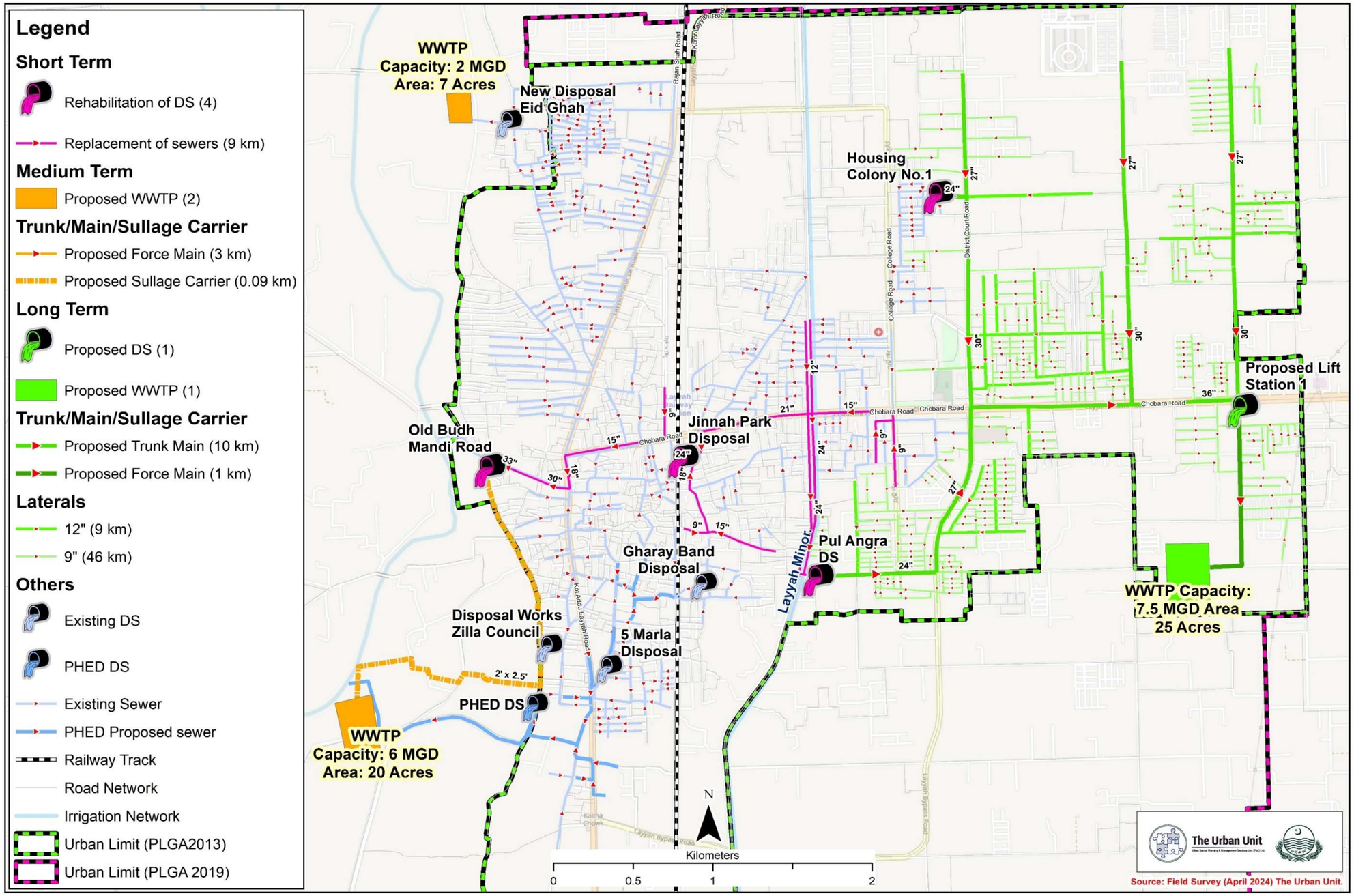


Figure 55: Sewerage Infrastructure baseline map

5.7. Rural Water Supply and Sanitation Infrastructure

Layyah District currently has a rural population of around 1,706,920 which is expected to reach 2,208,367 in 2034. The population is spread over three tehsils with a total of 674 villages. According to the UNICEF Wash Index (2019), Layyah has 1st Rank in access to water and 15th in access to sanitation.

As per the data collected by PHED, a total of 11 rural water supply schemes exist in the district, out of which 5 are functional and 6 are non-functional. The majority of the non-functional schemes are in Layyah. A total of 12 Water Filtration plants are installed in the region by the Public Health Engineering Department and all of them are reported to be functional.

Layyah district has around 22 sewerage and drainage schemes operational in different villages and being operated and maintained by community-based organizations (CBOs).

The rural water supply schemes have been installed in various phases from 1985 to 2024. Ageing analysis reveals that 45% of the assets are 1 to 10 years old whereas 27% are 10 to 20 years old, and 27% are more than 20 years old and have completed their design life. Similarly, 92% of the Filtration Plants are 0 to 10 years old whereas 8% of the assets are 10 to 20 years old.

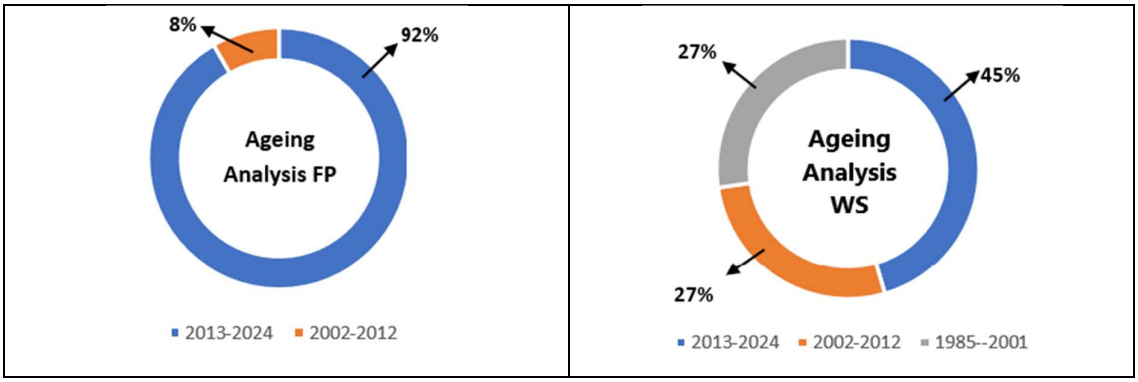


Figure 56: Condition Ageing Analysis of Rural Water Supply Schemes

The map below represents the existing rural water supply infrastructure in the Layyah district. The water quality variation across the Layyah district has also been indicated in the map.

Baseline Map of Rural Sewerage & Water Supply Infrastructure - Layyah

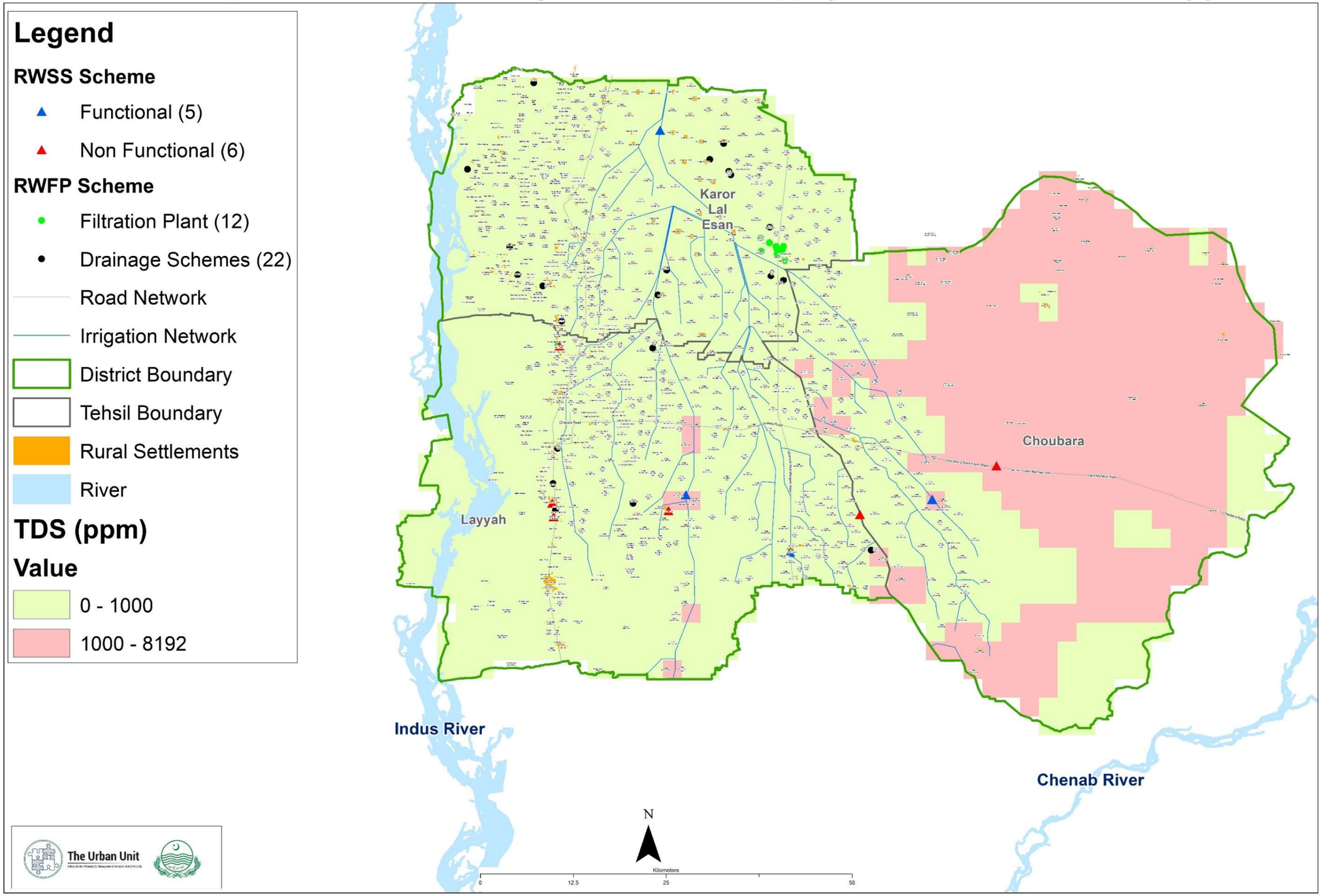


Figure 57: Rural Water Supply & Sewerage Baseline

5.7.1. Interventions for Rural Water Supply and Sanitation Infrastructure

Following evidence-backed interventions have been proposed to address the issues in the operationalization and maintenance of water supply infrastructure in the Layyah district.

- Rehabilitation of existing water supply schemes and filtration plants
- Provision of Solar-based Interventions for financial sustainability of schemes
- Development of Model Village

The following schemes are proposed for uplifting the rural water supply and sewerage system of Layyah district as per the performed analysis.

Table 38: Rural proposed projects

Sr.	Phase	Proposed Schemes, Estimated Costs & Scope
1	Short Term (2026)	**Layyah Rural Water Supply Improvement Program – Phase I (@313 M)** Scope of Project: ▶ Rehabilitation of 06 Nos Rural Water Supply Schemes in Layyah District (05 in Layyah and 01 in Choubara) ▶ Provision of Public Toilets (10 total: 04 in Layyah, 03 in Choubara and 03 in Karor Lal Esan)
2	Medium Term (2029)	**Layyah Rural Water Supply Improvement Program – Phase II (@100 M)** Scope of Project: ▶ 12 Nos new Rural Water Filtration Plants in Layyah District (4 for each Tehsil) ▶ Solarization of 12 Rural Water Filtration Plants (01 in Layyah and 11 in Karor Lal Esan)
3	Long Term (2034)	**Layyah Rural Water Supply Improvement Program – Phase III (@331 M)** Scope of Project: ▶ Solarization of Water Supply Schemes (05 total: 02 in Layyah, 02 in Choubara and 01 in Karor Lal Esan) ▶ Proposal of 1 Model Village (1 Village in Layyah District with 300 Households) covered sewerage system, paved streets, and decentralized wastewater treatment plant
Total Cost for Rural Areas = 744 M		

Intervention Map of Rural - Layyah

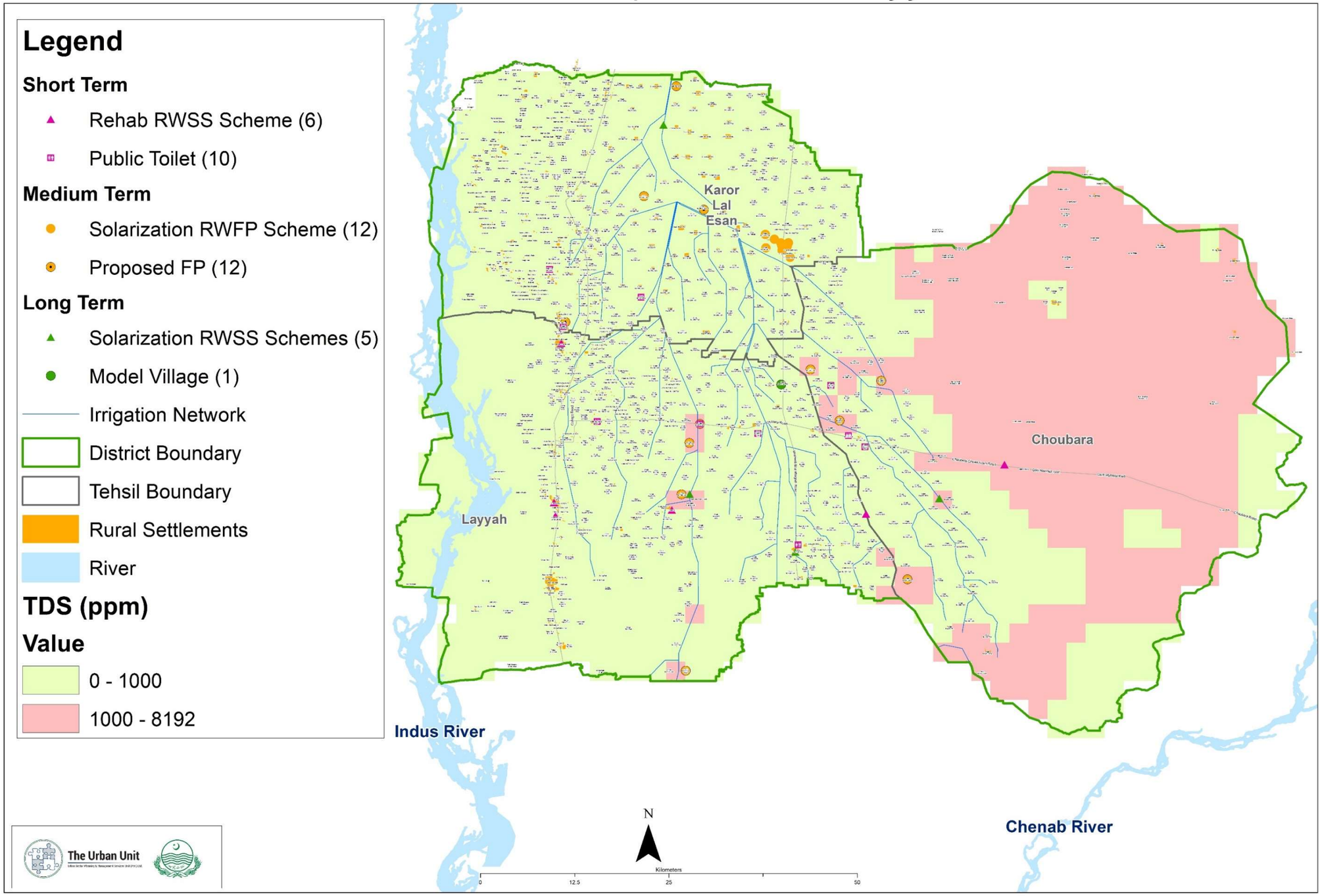
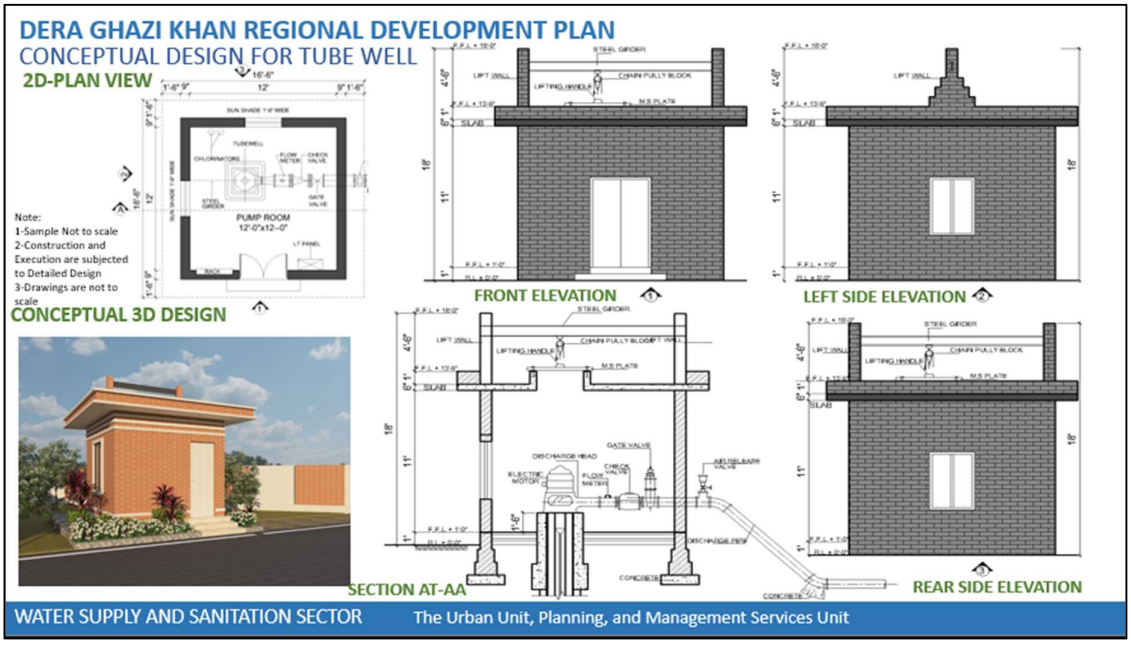
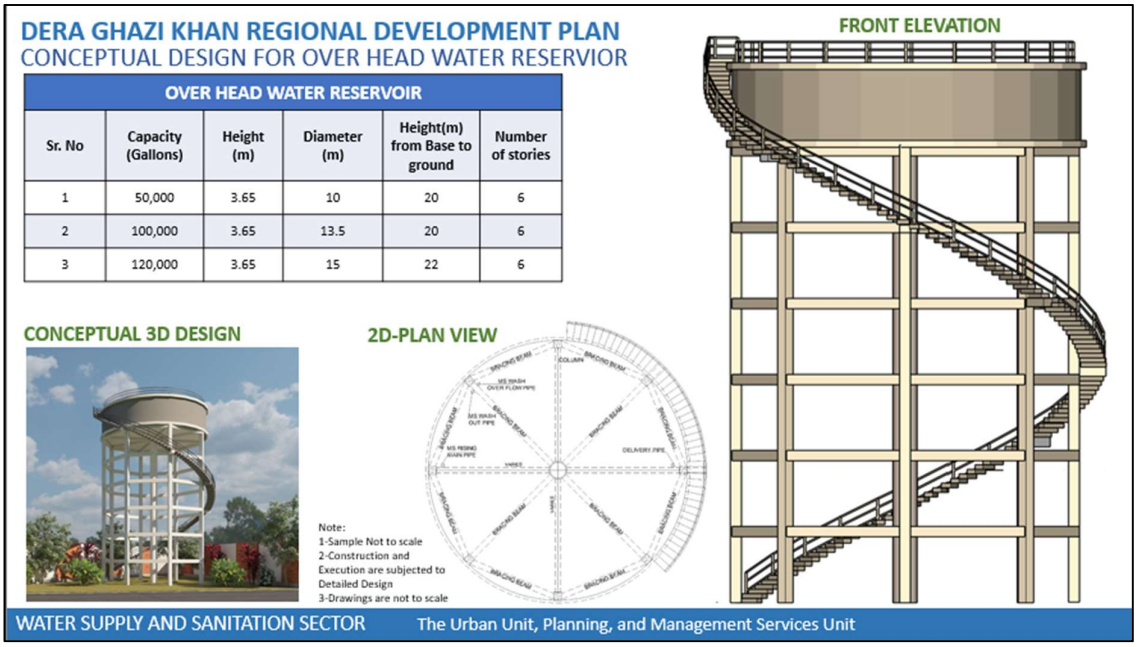


Figure 58: Rural Water Supply & Sewerage Intervention map

Concept Designs & Drawings

Conceptual designs are developed to explore and communicate design ideas and concepts to help stakeholders in visualization of proposed interventions. It is pertinent to mention here that actual designs vary in the physical sense as there are several considerations such as availability of land, on-ground technical challenges and financial constraints. The conceptual designs of water and sanitation infrastructure can be seen in the sections below.

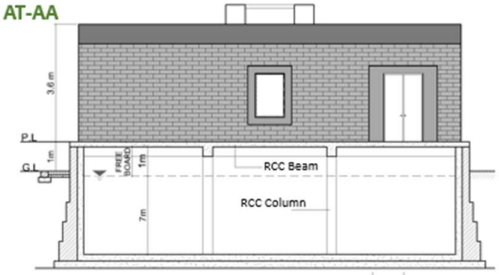




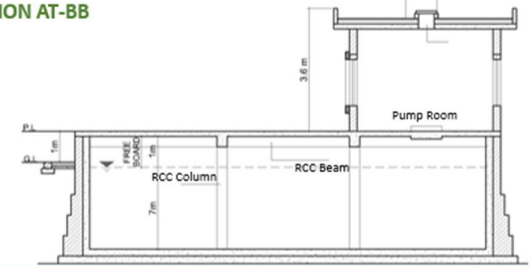
DERA GHAZI KHAN REGIONAL DEVELOPMENT PLAN

CONCEPTUAL DESIGN FOR GROUND STORAGE TANK

SECTION AT-AA

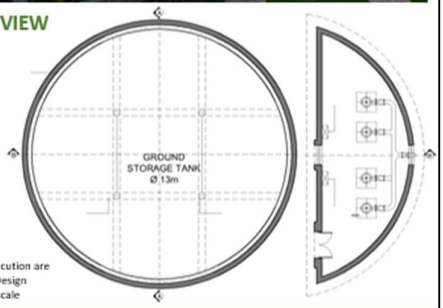


SECTION AT-BB



CONCEPTUAL 3D PERSPECTIVE VIEW

2D-PLAN VIEW



Note:
1-Sample Not to scale
2-Construction and Execution are subjected to Detailed Design
3-Drawings are not to scale

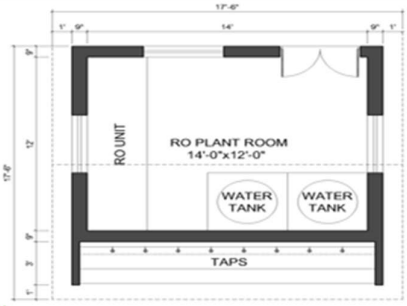
WATER SUPPLY AND SANITATION SECTOR — The Urban Unit, Planning, and Management Services Unit

DERA GHAZI KHAN REGIONAL DEVELOPMENT PLAN

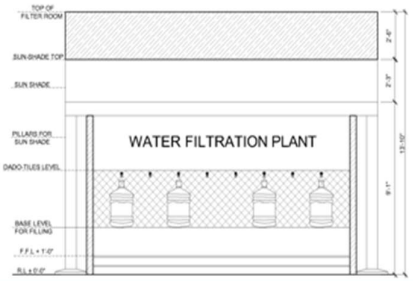
CONCEPTUAL DESIGN FOR FILTER PLANT

CONCEPTUAL 3D PERSPECTIVE VIEW

2D-PLAN VIEW



FRONT ELEVATION

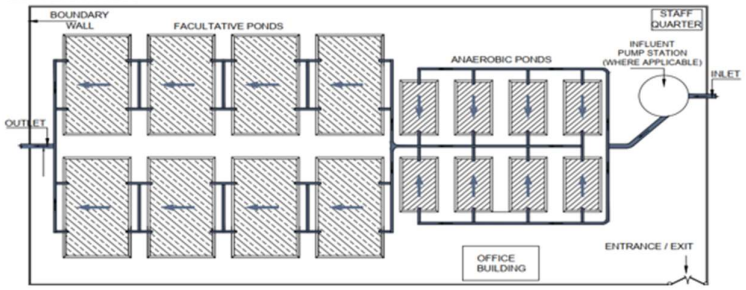


WATER SUPPLY AND SANITATION SECTOR — The Urban Unit, Planning, and Management Services Unit

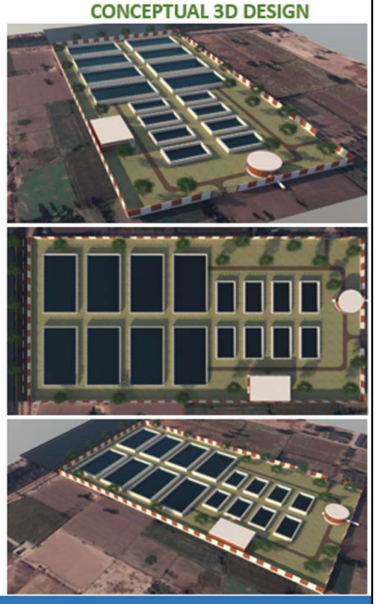
DERA GHAZI KHAN REGIONAL DEVELOPMENT PLAN

CONCEPTUAL DESIGN FOR WASTE WATER TREATMENT PLANT

2D-PLAN VIEW



CONCEPTUAL 3D DESIGN



DETAILS OF CAPACITY AND AREA

Sr	City	Capacity	Area
1	Layyah	2 MGD	7 Acres
		6 MGD	20 Acres
		7.5 MGD	25 Acres
2	Rajanpur	4 MGD	15 Acres
		6 MGD	25 Acres
3	Muzaffargarh	4 MGD	14 Acres
		14 MGD	50 Acres

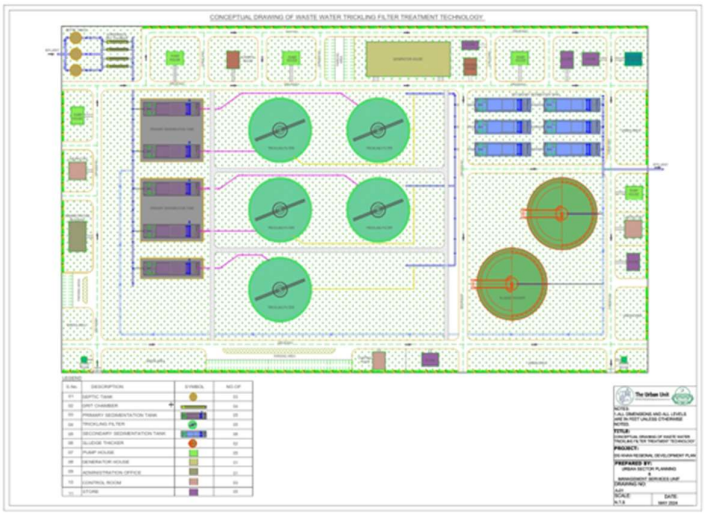
FACULTATIVE PONDS
ANAEROBIC PONDS
OFFICE BUILDING
STAFF QUARTER

WATER SUPPLY AND SANITATION SECTOR — The Urban Unit, Planning, and Management Services Unit

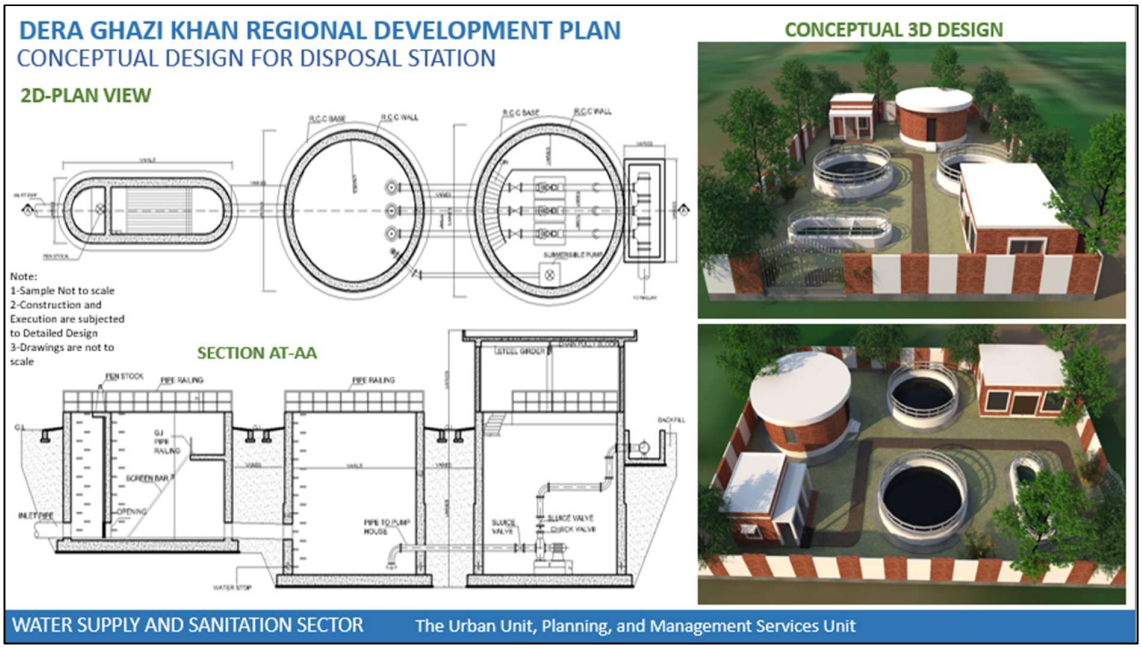
DERA GHAZI KHAN REGIONAL DEVELOPMENT PLAN

CONCEPTUAL DESIGN FOR Trickling Filter type WASTE WATER TREATMENT PLANT (DG Khan city)

2D-PLAN VIEW



WATER SUPPLY AND SANITATION SECTOR — The Urban Unit, Planning, and Management Services Unit


DERA GHAZI KHAN REGIONAL DEVELOPMENT PLAN
CONCEPTUAL DESIGN FOR DISPOSAL STATION
2D-PLAN VIEW
CONCEPTUAL 3D DESIGN
Note:
1-Sample Not to scale
2-Construction and Execution are subjected to Detailed Design
3-Drawings are not to scale
SECTION AT-AA
WATER SUPPLY AND SANITATION SECTOR
The Urban Unit, Planning, and Management Services Unit

The Urban Unit

TheUrbanUnit urbanunitGop urban_unit urban-unit

503 - Shaheen Complex, Edgerton Road, Lahore - Pakistan