



Integrated Water Resource Management Phase 2

Monography of the actual situation of sanitation and reuse For “Kharas”



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Monography of the actual situation of sanitation and reuse in Kharas

1 Introduction

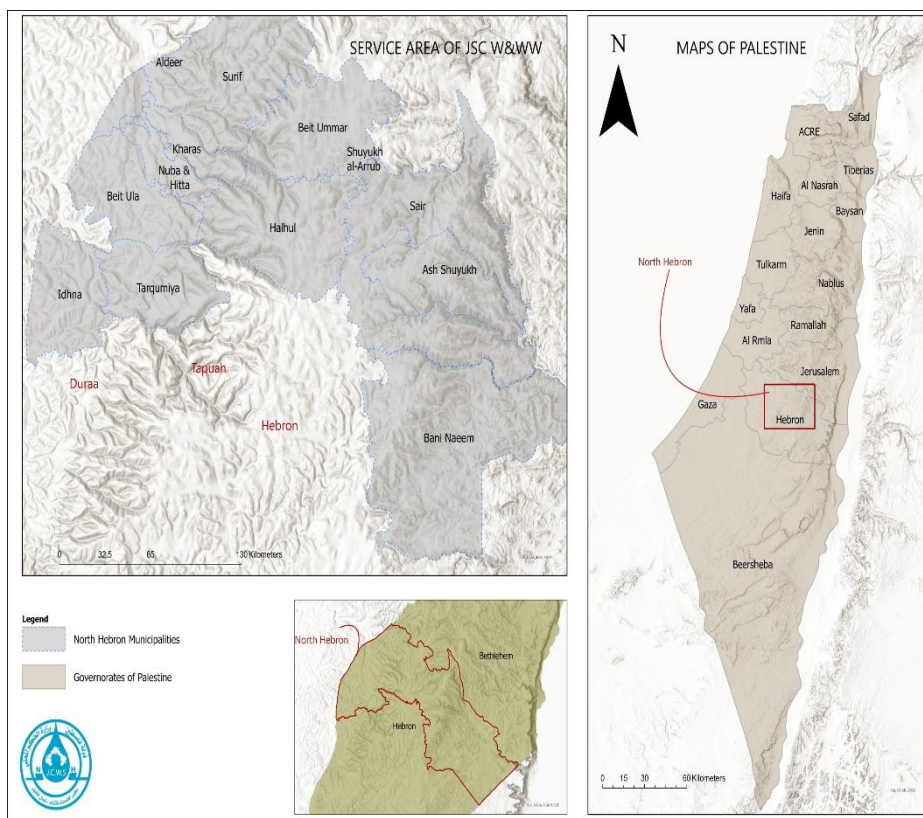
Kharas, located in the Hebron Governorate in the southern West Bank, is one of the key communities facing growing pressure on water and sanitation infrastructure due to population growth and limited natural water resources. Situated 12 km northwest of Hebron city, Kharas is surrounded by Halhul to the east, Nuba and Beit Ula to the south, Surif to the north, and the Green Line to the west. The village has a partially developed wastewater network, covering approximately 40% of its built-up area, and utilizes the Kharas Wastewater Treatment Plant (WWTP), commissioned in 2021, which operates based on an activated sludge treatment process. In 2022, a central water laboratory was established at the WWTP, funded by the Dutch government, to support monitoring and enhance the operational efficiency of wastewater treatment and reuse.

Despite these improvements, the broader North Hebron area continues to face significant challenges in sanitation coverage, wastewater management, and the sustainable reuse of treated water. Many areas still rely on decentralized solutions, and the growing agricultural demand underscores the need for an integrated, efficient, and community-driven approach to water resource management.

2 Joint Service Council for Water and Wastewater in North Hebron:

The **Joint Services Council for Water and Wastewater in North Hebron (JSC North Hebron)** is the governmental entity responsible for managing drinking water and wastewater services in the region. Established in 2019 through a collaborative initiative by 14 local authorities—including 11 municipalities and 3 village councils—the council oversees service delivery to more than 250,000 residents across an area of approximately 500 km².

The council's mandate includes the operation, maintenance, and expansion of water distribution networks and wastewater collection systems, with a



particular focus on enhancing treatment infrastructure such as the Kharas WWTP. It also plays a key role in promoting sustainable sanitation solutions and treated wastewater reuse in alignment with national strategies. Through its institutional coordination and technical oversight, JSC North Hebron serves as a central actor in improving water security and public health for the communities it serves, including Kharas and its neighboring localities.

3 Sanitation

3.1 Existing sewage network

The existing sewage network in the study area is only in Kharas and Nuba, in Kharas the network with total length about 22 Km covers 40% of the population, in Nuba the network with length about 12 Km covers 46% of the population, the both networks for Kharas & Nuba are shown in figure 1.

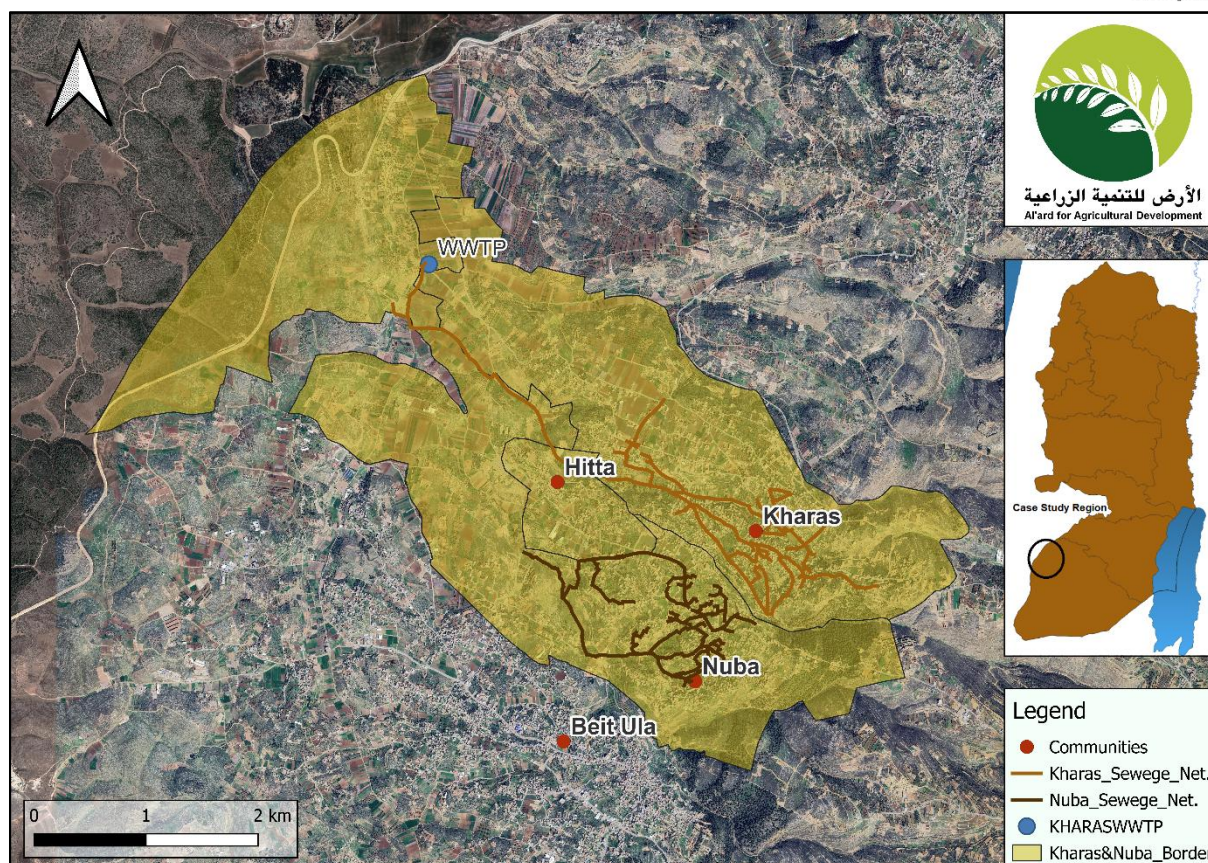


Figure 1: The Current Sanitation Networks in Kharas & Nuba

But the rest villages in the region such as Halhul & Beit Ula the sanitation network doesn't exist at the moment and the sewage system there is depend on septic and the description is shown in table below.

Table 1: description of the existing situation and the planned situation for 2045 of the sanitation networks

Network	Planned (2045)	Existing (2024)	Total Percentage
Date of construction			
Operational since			
Total length (Km) and percent	Kharas: (100%) Nuba: (100%) Beit Ula: (96.0%) Halhul: (20.0%) Beit Ummar: (20.0%)	Kharas: 22 Km (40%) Nuba: 14 Km (46%) Beit Ula: 0 (0.0%) Halhul: 0 (0.0%) Beit Ummar: 0 (0.0%)	
No. of households connected Note that the No. of households is measured by dividing the total inhabitants by 7 as it's at the current situation	Kharas: 2400(100%) Nuba: 1480(100%) Beit Ula: 3660 (96.0%) Halhul: (20.0%)	Kharas: 450 (30%) Nuba: 500(46%) Beit Ula: 0 Halhul: 0	

	Beit Ummar: (20.0%) Total:	Beit Ummar: 0 Total:	
No. of inhabitants connected	Kharas:16809 (100%) Nuba: 10356 (100%) Beit Ula: 25666 (96%) Halhul: 9943 (20%) Beit Ummar: 9943 (20%) Total: 69019	Kharas: 3170 (30%) Nuba:2995 (46%) Beit Ula: 0 Halhul: 0 Beit Ummar: 0 Total: 6165	

According to the Kharas Municipality that 90% of the households close to the network is connected so the problem of not connected is due to absence of the network.

3.2 Planning

The vision in the master plan for North Hebron for the study area, Kharas, as shown in table 1 above is to include Nuba and Kharas completely, in addition to including Beit Ula by 96% and both Halhul and Beit Ummar by 20% each, so that these quantities can be collected in the treatment plant currently in place, but of course taking into consideration the need to expand it so that it can treat the proposed quantity as shown in Figure 2.

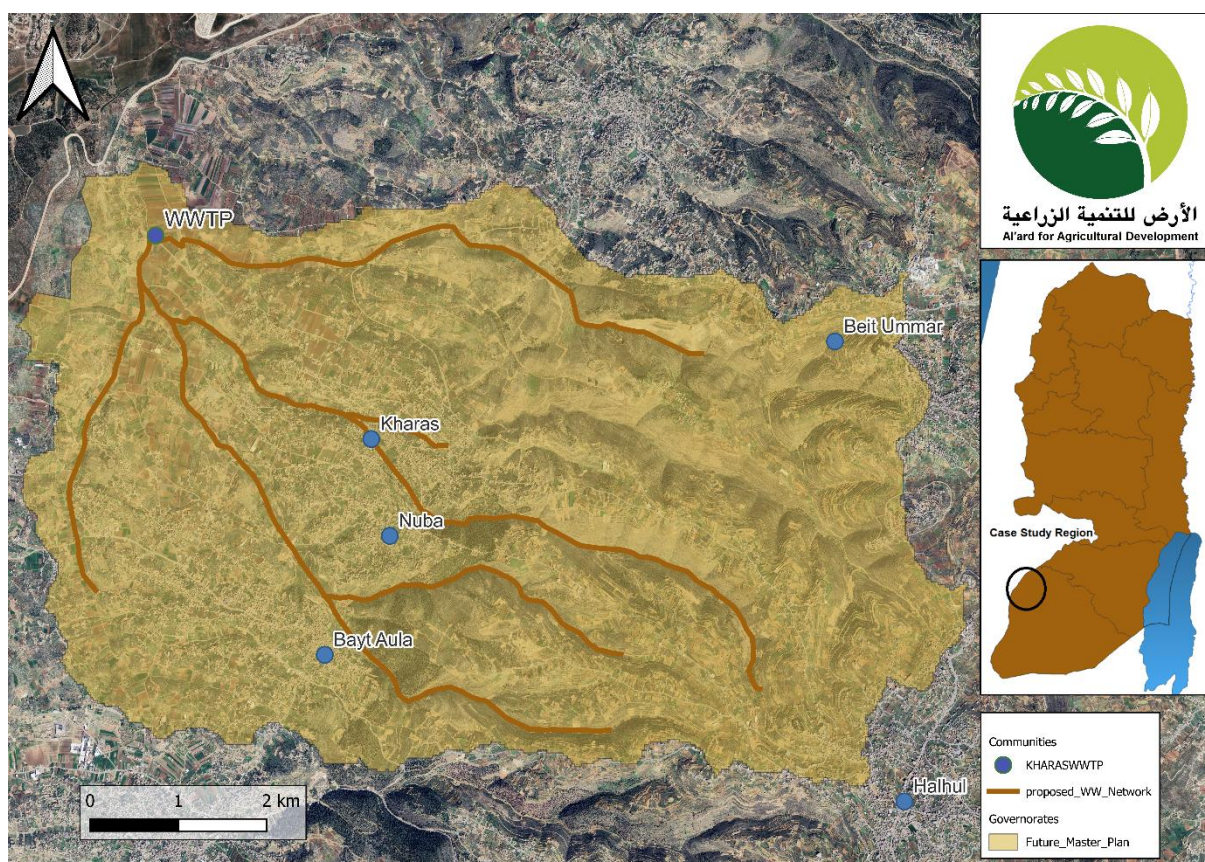


Figure 2: The Proposed Sanitation Network North Hebron (Kharas/Beit Ula)

3.3 Sceptic tanks and wild dumping sites

Emptying sceptic tanks into manholes through the network is absolutely unacceptable and rejected by the Kharas Municipality because of the damage it causes to the WWTP, as it contains a large amount of sediment. Therefore, the municipality's plan includes preparing a primary treatment unit for wastewater coming from the tanks before it begins the treatment stages in the WWTP. For now, tank drivers empty their tanks into the valley stream in a place after the WWTP.

3.4 Kharas wastewater treatment plant

The initial funding for this project was allocated for the rehabilitation of an older Wastewater Treatment Plant that employed wetland technology. However, after a thorough assessment conducted in collaboration with Kharas Municipality, it became evident that the location of the old station was no longer suitable due to its proximity to residential areas and the inefficiency of the wetland technology in meeting current wastewater treatment needs. Consequently, a decision was made to construct a new treatment plant employing activated sludge technology in a more suitable location. This approach offered higher treatment efficiency and lower operational costs.

This change was formalized and incorporated into the Master Plan for North Hebron, which was developed by the Palestinian Water Authority with support from the French Development Agency. The new WWTP was approved by all relevant stakeholders, including the PWA, as an integral component of the regional wastewater management strategy.

3.4.1 A Central Role in the Regional Wastewater Master Plan

The current WWTP in Kharas is envisioned as the nucleus of a future central treatment facility for North Hebron, according to the master plan developed by the PWA and the Joint Services Council for North Hebron (JSC-NH). This central facility is planned to expand in phases to serve multiple communities, including Kharas, Nuba, Beit Ula, and Hatta and part of Halhul. The phased expansion will increase the plant's capacity from its current 400 cubic meters to 2,000 cubic meters, then to 4,000 cubic meters, and ultimately to 6,000 cubic meters to meet the needs of these population centers.

The current WWTP was designed to adhere to rigorous standards based on the specific characteristics of raw wastewater in the region. The plant's design and technical drawings were reviewed and approved by the PWA, ensuring compliance with national wastewater treatment and reuse guidelines.

3.4.2 Enhancing Treatment Monitoring and Operational Efficiency

In 2022, a significant milestone was achieved with the establishment of a central water laboratory at Kharas WWTP. Funded by the Dutch Government and coordinated by the PWA and JSC-NH, this laboratory was designed to monitor key indicators of wastewater quality both before and after treatment. The purpose of this laboratory is to continuously evaluate and optimize the treatment

process,
improving operational efficiency and ensuring the treated water meets the required standards for agricultural reuse.

3.4.3 Current Challenges and Future Development

Although the WWTP is fully operational, it is currently functioning at only 50% of its designed capacity. One of the key challenges is the incomplete coverage of the sewage network and the need to connect additional areas, such as Nuba, to the plant. The untreated wastewater from Nuba is currently a significant source of pollution for the agricultural lands surrounding the treatment plant. Connecting Nuba to the WWTP would not only eliminate this pollution but also allow the plant to operate closer to its full capacity, enhancing its efficiency and impact.

To address this issue, a feasibility study is urgently required. The study will explore strategies to increase the plant's operating efficiency under the current conditions, ensuring the sustainability of water reuse practices while preparing for the plant's future expansion. This interim solution will help maximize the utility of the existing infrastructure while laying the groundwork for the next stages of the regional wastewater treatment plan.

3.4.4 Description of Treatment process

The treatment process at the Kharas Wastewater Treatment Plant (WWTP) begins with primary treatment, where the wastewater passes through coarse and fine screens to remove large debris. Following this, the wastewater flows into an aeration tank for secondary treatment, where it undergoes biological treatment to reduce organic matter. The treated water then moves into a clarifier tank, where sludge is separated from the treated water through a sedimentation process. After clarification, the water is temporarily stored in a holding tank before being pumped to the sand filter and chlorination units for disinfection. This final stage ensures that the treated water meets the required standards before reuse. Finally, the treated water is stored in an irrigation storage tank, ready for use in agricultural applications, as illustrated in the process flow diagram in Figure 3.

At the moment the water is treated with secondary treatment and discharging into the valley.

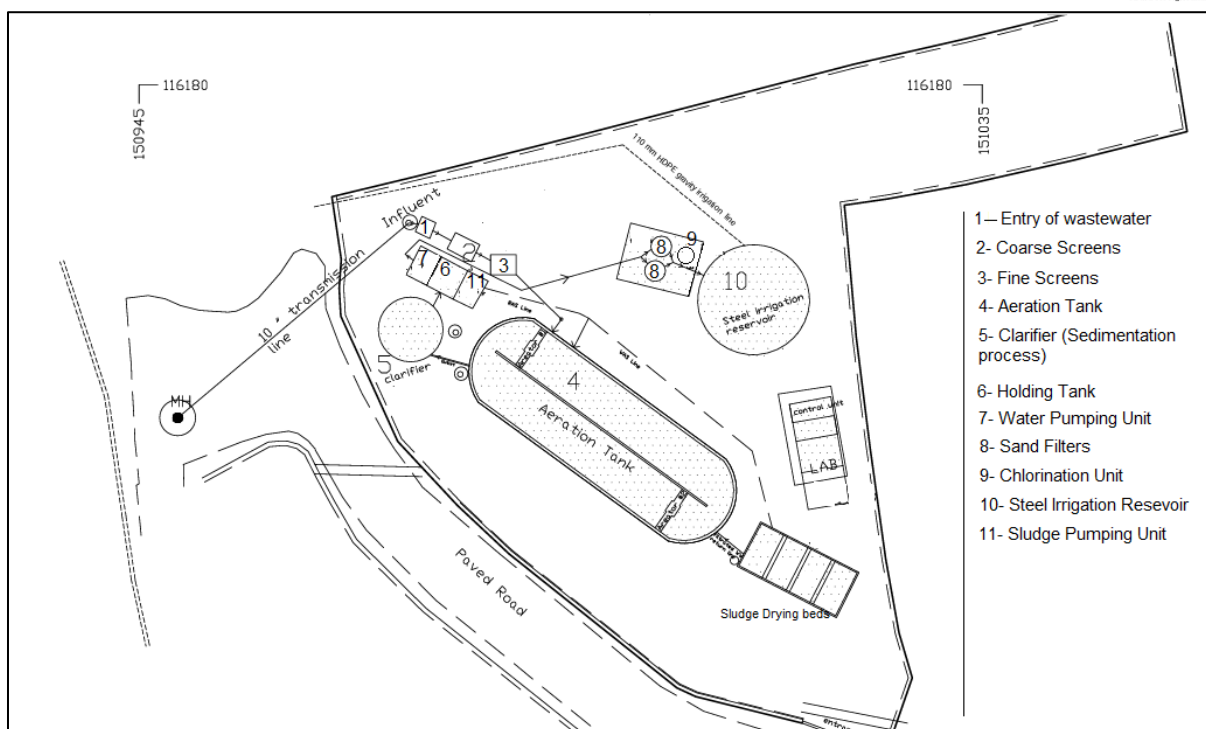


Figure 3: Sketch for the Treatment Procedure in Kharas WWTP [Kharas Municipality]

The main information of the WWTP in Kharas is shown in table 2 below.

Table 2: Information about the WWTP

WWTP	
Period of construction	2020
Operational since	2021
Treatment technology	Activated sludge
Types of treatment	Primary and secondary treatment Possibility of tertiary treatment by sand filter and chlorination
Nominative capacity (m ³ /day)	400 m ³ /day
Actual wastewater production (2024)	200-250 m ³ /day (60% of total capacity)

3.4.5 Quality of water produced by WWTP

Routine analyses done internally by WWTP

To ensure immediate and sustainable water quality and to monitor the plant's performance, a laboratory was established, which is a unit built within the treatment plant site to carry out the following operational tests; Chemical Oxygen Demand (COD), Total Nitrogen, PH, Temperature, Total Dissolved solids (TDS), Total Suspended solids (TSS), Turbidity, Ammonium, Electric conductivity (EC), Dissolved Oxygen (DO), Phosphorous (P). The regular check for most of parameters is 1-3 days per week but Some days he checks some parameters when he suspects something, so he checks a certain parameter to give him an indicator of the thing he suspects.

Official Analysis:

(The complete reports included in annex)

- **Two reports from Birzeit University Laboratory have provided valuable insights into the quality of the treated water.**

A. First Report: 3 August 2023

The first report, dated August 3rd, indicates that the concentration of parameters in the treated wastewater met Class A standards. However, there were exceptions:

- Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD):** The concentrations of BOD and COD were classified as Class C. Despite this classification, the values were very close to the threshold for Class A, indicating a minimal deviation in terms of biological oxygen requirements.
- Fecal Coliforms and E. coli:** The levels of fecal bacteria and E. coli were notably high. The Kharas Municipality attributed these results to the sample being taken before the chlorine disinfection stage.

B. Second Report: 18 September 2023

The second report, dated September 18th, provided an analysis of a subset of the parameters tested in the first report, according to Kharas Municipality they did the analysis for a subset of

the

parameters because all the parameters were in class A in the first test with secondary treatment so to minimal the cost of the test the analysis was for a part of the parameters:

- a. **BOD and COD:** In this report, the concentrations of BOD and COD were within Class A limits.
- b. **Fecal Coliforms and E. coli:** The levels of fecal bacteria and E. coli also met Class A standards.

- **Integrity of the Reports**

The integrity of both reports from Birzeit University Laboratory is maintained through rigorous sampling and testing protocols. The reports provide a comprehensive overview of the water quality, ensuring that all relevant parameters are thoroughly examined. The differences between the two reports highlight the importance of considering the timing of sample collection and the stages of the treatment process.

- **Findings**

The findings from these reports underscore the need for careful monitoring and treatment of wastewater to ensure it meets the required standards for reuse in irrigation. While the initial report indicated some areas of concern, the subsequent analysis showed significant improvements, particularly after the chlorine disinfection stage. The manual of chlorination unit is included in the annex and according to Kharas Municipality the concentration of chlorine injected to the water is 0.24 mg/l and this concentration is recommended from the designer. The duration which the water remain in the irrigation time is 16-24 hours and the only test for the chlorine concentration in the irrigation tank is included in the last official test with 176.44 ppm.

3.5 Existing network

According to Municipality of Kharas there's no previous irrigation network just transfer pipeline fixed with Kharas Municipality with length 1000 m downstream the WWTP shown in figure 6.

3.6 Water user association

There is no registered WUA association registered now.

After several meetings with MoA and directory of agriculture of North Hebron to understand the procedure which should be followed to register WUA, we conducted a meeting with the interested farmers who have lands around WWTP of Kharas to introduce to them the

importance of creation of WUA, then, the preparing required documents for start the process of creation WUA.

The progress in establishing WUA now can be described by that, the main problem in Kharas is that there's no formal ownership papers due to uncompleted licensing of lands in the targeted region around the WWTP yet, so that, we have meeting and contacting with MoA to discuss the method to solve this problem to facilitate establishing of WUA and the final result was that, the municipality should prepare license for farmers who want to be member of the Kharas WUA and it's not formal license to proof the ownership of the land, its just to facilitate the WUA establishment to proof that this farmer have the right to use this particular land in agriculture and there's a copy of this licence in annex.

Now the WUA will be formed with 15 members and their lands are shown in figure 4 below.

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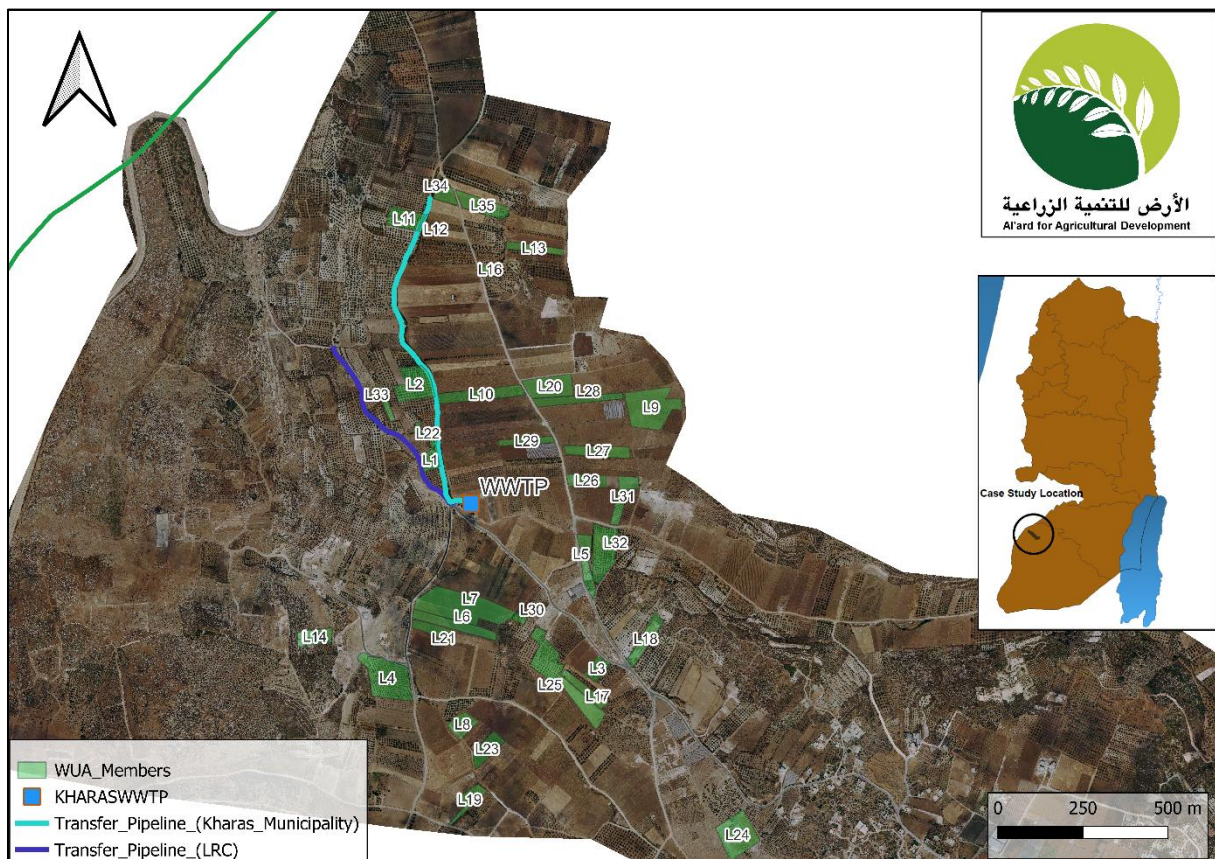


Figure 4:

Locations of Lands of the proposed WUA members

3.7 The available water resources

According to JSC the only source of water is from the municipality network. And according to Kharas Municipality the water network covers more than 95% of the population with total length 72Km and 1750 customers, as shown in figure 5.

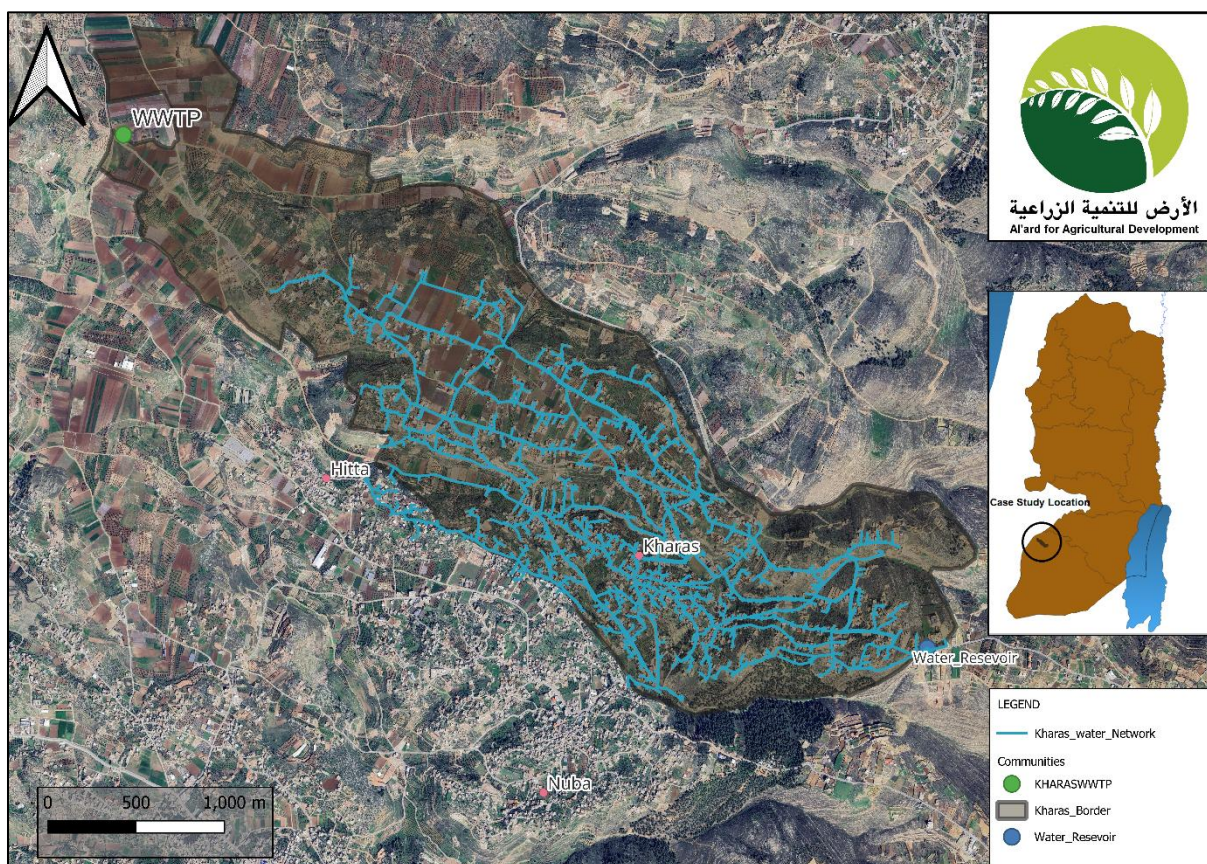


Figure 5: Water Network of Kharas

3.8 New projects

3.8.1 LRC project

LRC have a part of their project in the study area in Kharas and this project called Li Baladena project funded by Italian agency and include a lot of parts which are:

- A. **Land Capability study:** included study the land capability for a lot of criteria and the most part related to our project is the cropping classification of the land, and the criteria considered in this classification is shown in table 3 below.

Table 3: Land Capability Classification for cropping (LRC Capability study)

Class	Effective Soil depth (cm)	Texture of surface horizon	coarse fragments %	Stoniness %	Rock Outcrops%	PH, EC:mS/cm, CaCO ₃ , ESP:% , CEC:meq/100g	Drainage	Flooding Risk	Slope %	Erosion
I	>100	-	<15	-	-		-	absent or very rare	<4	Absent Slight
II	50-100	Clay>60, Silt>70, Sand>85	Surface Hor.:15-40, Subsurface Hor.:40-80	15-40	-	PH= 8.1-8.5, EC=2.4, CaCo3>40, CEC=5-15	Moderate or somewhat excessive	rare or occasional	4-8	Moderate
III	30-50		0	40-80	2-10	PH>8.5, EC=4-15, ESP=6-15, CEC<5	poor	frequent	8-18	Severe

The assessment of land capability for cropping classes has provided insightful information regarding the distribution of land capability across various landforms and mapping units.

- **Class I:**

The total area classified as Class I encompasses 796.21 dunums, accounting for 89.10% of the land suitable for cropping. This class is predominantly found on the plain landform within the study area, covering the entirety of the 796.21 dunums (figure 5).

The land is categorized as Class I due to its deep soil, which extends beyond 100 cm in depth, with the average soil depth being approximately 109 cm in this area. The presence of coarse fragments is minimal, averaging 5.50%, which is considered typical and poses no restrictions or limitations for plant root growth. Furthermore, the land is gently sloped, with an average gradient of 4%, coupled with a very low risk of flooding and an absence of erosion hazards. These conditions favor agricultural practices.

To maintain the productivity and long-term sustainability of Class I land, reasonable management inputs are necessary. These soils are naturally fertile or possess characteristics that make them highly responsive to fertilizer applications. Standard crop management practices, such as fertilization and manure addition, are sufficient to maintain productivity. Implementing crop rotations is also recommended.

The primary land use for Class I soil is rain-fed arable farming, with crops such as barley and wheat being predominant. Additionally, other uses, including irrigated vegetables and olive tree cultivation, are present throughout the plain.

- **Class III:**

Class III land covers a total of 97.41 dunums, representing 10.90% of the study area. This class is distributed across sloped landforms, predominantly located on the western side of the plain within the study area (refer to figure 6).

The classification of this land as Class III is primarily due to the moderately inclined slopes, which range from 8% to 18%, with the average slope for the representative area being 9.67%. The soil depth for this class is considered shallow, ranging from 30 cm to 50 cm, with an average depth of about 88 cm. This depth positively influences the soil's water-holding capacity and mitigates root limitations. Surface stoniness is another characteristic of Class III land, with an

average

of

27.3% stoniness, which may pose some challenges for certain crops. However, the absence of rock outcrops in Class III areas increases the variety of plants and agricultural practices that can be implemented.

The moderate slope is the primary limitation for Class III land compared to Class I and lands. When used for cultivated crops, the application and maintenance of conservation practices are more challenging. Land in Class III often requires specific conservation measures to mitigate the risk of erosion, which can adversely affect cultivation, seedling emergence, and harvesting. Consequently, fruit trees, particularly olive trees, are commonly cultivated in Class III areas.

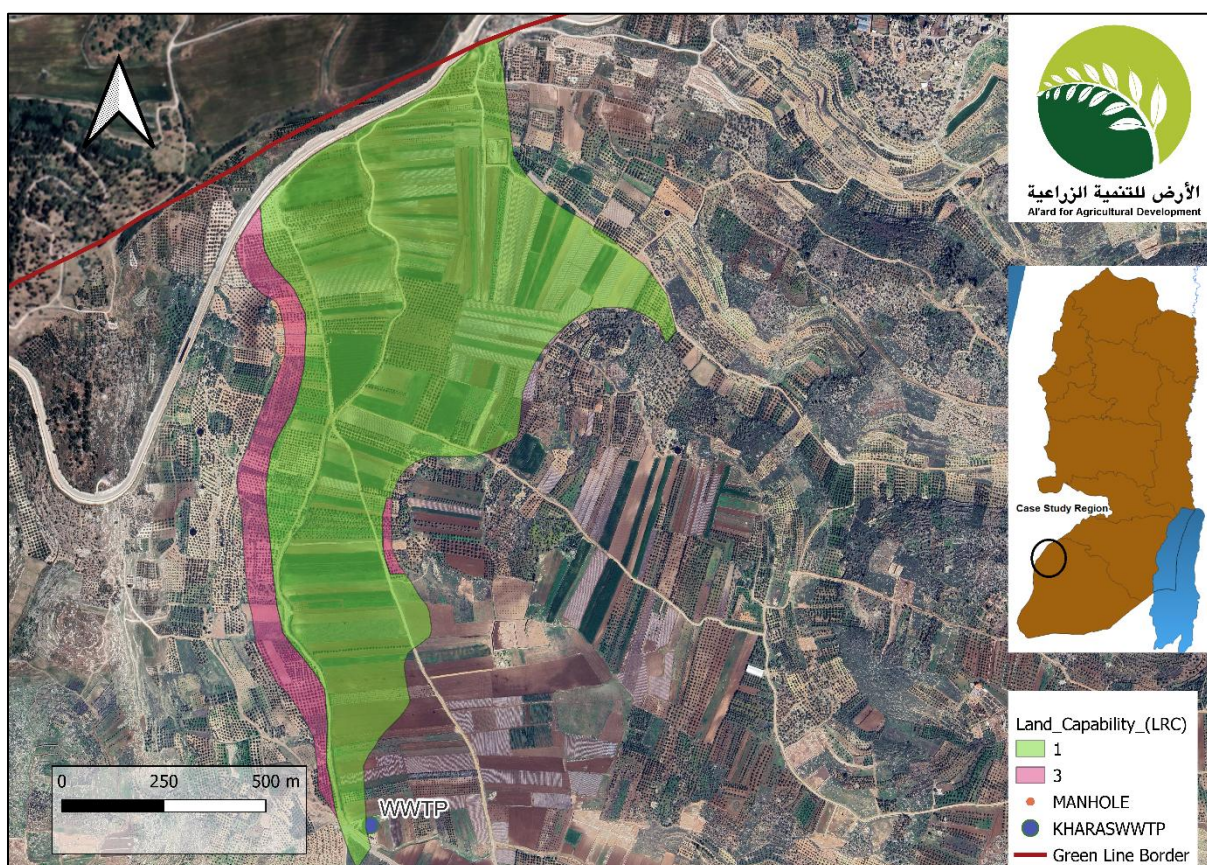


Figure 6: Land Capability Classification for Cropping (LRC Study)

- B. **Capacity building:** LRC projects included trainings for 49 farmers about using of treated wastewater in irrigation and almonds & olive trees and their pests.
- C. **Field work for Improvement of agricultural Sector:** This part is divided into four main activities:
 - a) **Lands Rehabilitation:** This activity is done for 13 farmers with total area of land 67.2 donums as shown in figure 7.

- b) **Drip irrigation networks:** This activity is done for 11 farmers with total area of land 40 donums as shown in figure 7

Table 4: the total quantities of irrigation networks and fittings

Total Quantities	16mm PL Quantities	50mm PL Quantities	Droppers Quantities	Tap coupler Quantities
Kharas	8000	600	1600	320

- c) **Distribution of Seedlings:** This activity is done for 7 farmers with total area of land 9.2 donums

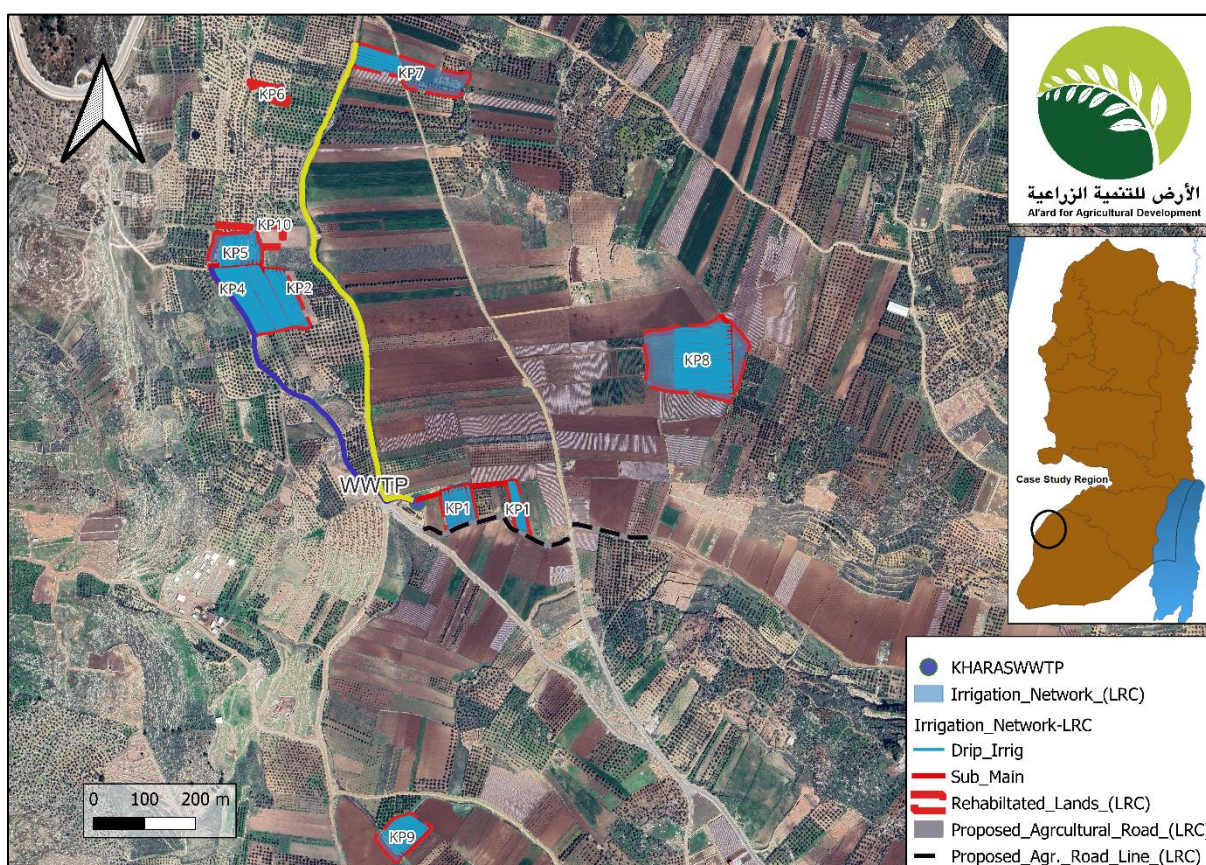


Figure 7: Services for Lands in LiBeladena Project