Palestinian National Authority

In partnership with

Palestinian Hydrology Group

For Water and Environmental Resources Development

Water and Wastewater Master Plan

For Tulkarem Governorate

Final Report

Ramallah, 2011

Table of Contents

List of Tables:

CHAPTER ONE:

CHAPTER TWO:

ANNEXES:

CHAPTER THREE:

CHAPTER FOUR:

CHPTER FIVE:

Table of Figures:

CHAPTER ONE:

CHAPTER TWO:

CHAPTER THREE:

CHAPTER FIVE:

List of Abbreviation

MCM	Million Cubic Meter
MOA	Ministry of Agriculture
MOH	Ministry of Health
PCBS	Central Bureau of Statistics
PHG	Palestinian Hydrology Group
PWA	Palestinian Water Authority

Acknowledgment

The Palestinian Hydrology Group expressing its sincere thanks to the Adour-Garonne River Bain Authority for their financial support to enable us from accomplishing this job. PHG also extends its thanks to the Team of our Partners ACAD, namely Ms. Mireille MURAWSKI and Eng. Roland HAUSWALD for their support and cooperation during the implementation of this master plan. PHG also express their thanks to the Palestinian Water Authority especially Mr. Ayman Jarrar and Mr. Adel Yasin for their support and cooperation. Special thanks go to all Municipalities and village councils in the Governorate for their cooperation, provision of data and support provided to our team. PHG is also thankful to all those who contributed with data or information or provided any support during this work. Finally, PHG appreciates the commendable efforts made by its team, especially Ayman Rabi, Abdellatif Khaled, Mohammad Marie', Sami Daowd, Sayel Wishahi, Omar Jibreel and Sahira Kusa to accomplish this work.

Preface

The water sector in the West Bank and Gaza has remained undeveloped over the past three decades of occupation. Since 1967 West Bank water resources have been controlled and managed by the Israeli Military Authority through a number of Military Orders. These orders have barred Palestinians from participating in the planning and management of water resources and prevented them from developing local water resources in concert with growing water needs.

In addition, the lack of investments in improving infrastructure (physical water losses reach 50% in some areas), the scattered nature of the water supply and management utilities with the absence of adequate rules and regulations and absence of stakeholder participation has resulted in the deterioration of the entire water system in the oPt.

In reality, the advent of the peace process was not merely an opportunity for greater use, but rather a challenge to form new and responsive public institutions to govern water usage. It is for that the Palestinian Water Authority (PWA) was established in 1995 and was assigned the task of formulating and implementing a comprehensive Water Law and strategy, which would entail setting up adequate rules and regulations including the development of water master plans and regulating the water sector in the West Bank and Gaza. Due to the fact that Palestinians have not gained yet the full control over their water resources and the issue has been left to the final status negotiation, PWA faced with many constraints to implement the strategy and enforce the Water Law.

The current master plan is developed under the cooperation convention signed between Adour – Garonne River Basin Authority and the Palestinian Water Authority in March 2009 to improve the planning and management of water and sanitation in the Northern Part of the West Bank and to consider Tulkarem District for the first phase of this agreement.

The development of the current master plan takes advantage of the “combined” efforts of both the Palestinian Hydrology Group (PHG) which is a local Palestinian NGO specialized in water management issues at local and international level and ACAD NGO which is a French Development Association specialized in international development in close cooperation and coordination with the Adour-Garonne River Basin Authority.

This project builds on the previous experience and work of all local and international agencies involved in water management in the District and it comes to address the backdrop of the comprehension of the challenges incurred by local water management, both in Palestine and within the District of Tulkarem.

Chapter One

Current Status of Water Resources, Supply and Sanitation Conditions

1. 1 Introduction

1.1.1 Scope and Relevance

This master plan focuses on water supply as both an economic and social good in the context of the goals of sustainable development and hygiene living conditions. Water supply basic needs include access to a safe and adequate supply of water for domestic use. The term domestic encounters: 1- Water for drinking, food preparation, bathing, laundry, dishwashing, and cleaning. 2- Water is such a fundamental resource on which people's lives and livelihoods depend. In most of the rural communities, households use water for productive activities such as farming and irrigating vegetable plots, livestock husbandry, or horticulture, home-based microenterprises and small industrial activities in towns and the City of Tulkarem.

Access to a safe and affordable supply of drinking water is universally recognized as a basic human right for the present and future generations and a pre-condition for the development; however, this was not secured under the Israeli occupation since 1967. Water shortage, poor water quality, or unreliable supplies are normal symptoms of the water supply system in the district. This has profound effects on people's well-being and their livelihood opportunities. Providing water alone is not enough, however, water can quickly become unsafe, and quality deteriorates and the transmission of diseases can occur in many ways. If people do not have adequate and appropriate sanitation facilities or the chance to develop good hygiene practices, diseases can be spread through the contamination of water resources or through water distribution networks.

Water supply in Palestine in general including Tulkarm District is a dynamic and developing sector. It means that, the data collected over the study period may drastically change over time. Many communities have ongoing water supply projects and on top of them Tulkarm City and suburbs. Other communities (like Al-Kafriyat) got a promise to start their water supply projects this year 2010. Most of the water supplies programs in the District are technically and financially oriented, randomly scattered, made by different local and international agencies, and in most cases have partial coverage.

The Master Plan will provide each community in the district with a plan of action for now and in the future. It will conclude with what conditions to ensure reliable/sustainable water services at affordable prices. This comes out in order to improve the quality of life, contribute to the fulfillment of national water strategies, and manage in a professional manner that sustains the proposed JWSC while maintaining its independence and accountability.

1.1.2 Purpose and Objective

The overall objective of this study is to create an integrated feasibility study and master plan for the sanitation and water supply and demand for Tulkarm district for the periods 2010, 2015 and 2025 that, is compatible with the Water and Sanitation National Master Plan. The plan also has the following specific objectives:

1. To study and create the future scenarios for water Supply-Demand and Sanitation for the localities in Tulkarem district;
2. To study and create the best and optimal institutional arrangements for the managing the water and sanitation sector in Tulkarem District, and creating a well studied and analyzed socioeconomic based tariff structure for the District.

1.2 Methodology

1.2.1 Literature Review:

PHG team has collected all the previous related studies, maps, for the targeted area and reviewed these studies. PHG engineers have also contacted PWA, Tulkarm city and other municipalities, councils and other institutions in the area to get the relevant data, studies and information.

1.2.2 Field Work and Data Collection

PHG has produced a comprehensive questionnaire/s for collecting all the related and needed data. The questionnaire has been checked in the field through PHG field engineers, and it was modified accordingly. Workshops have been conducted and arranged by PHG team for the stakeholders in the targeted localities before approving and filling the questionnaire. The aim of that was to inform the stakeholders about the aim of the study, what kind of information is needed, about the role of the local councils and the municipalities.

It should be mentioned that, after the discussion of the questionnaire and approving it by stakeholders, PHG team conducted the field visits to each locality and collected the information needed.

The questionnaire has been designed for local councils or municipalities to be answered by official representatives who could present the situation of his / her community properly. The questionnaire was divided into three main sections as follows:

Section One: general information about the community

Section Two: Covers information regarding the existing water network system and the sources of water supplying it. It included inquiries such as the main water source in each community, the quantity and quality of water delivered by the public network, pricing, and the frequency of water interruptions.

Section Three: The coverage and condition of wastewater network systems compared to cesspit systems.

Interviews*:*

Field visits to the municipalities and village councils more than once for each community in most cases to collect the required data.

Meetings with the technical staff in the large communities to discuss the existing sanitation system and the existing problems facing these systems and if there is proposed plans or projects to extend , modify or change of the existing system.

Verifications of raw data and cross check with the national plans and figures.

literature review concerning Tulkarem district (wastewater feasibility study, Al-Kafriat preliminary study of the wastewater collection & treatment system).

Stakeholders Consultation:

General meetings and oral discussions were conducted with local councils and municipalities for the purpose of attaining a wider and more comprehensive assessment of the general socioeconomic conditions in the targeted area. These meetings were meant to cover any data that may have not been obtained through the questionnaires.

Report Overview:

The current report describes the existing water supply and sanitation situation in Tulkarem Governorate. Moreover, it assesses the present situation, describes water supply and distribution system, operational measures, production facilities, water consumption, current level of service and gave a general description of the present situation of the whole governorate.

1.3 Study Area

1. 3.1 Physical Characteristics

Tulkarem Governorate is located at the northwestern part of West Bank with a total surface area of nearly 268 square kilometers. 36% of this area is cultivated by permanent crops, while the Palestinian Built-up Area form 7.1%.

For the purpose of this study the area is divided into three clusters as follows (Figure1):

Cluster1 comprises the middle part of Tulkarm District and extends along the catchment area of Wadi Zeimar between Beit Leed in the East and Tulkarem in the West. The municipalities and villages included in this cluster include Anabta, Rameen, Bal'a, Beit Leed, Iktaba (considered as part of Tulkarem), Irtah (part of Tulkarem municipality), Kafr El Labad, Kafr Rumman (part of Anabta municipality), Nur Shams Camp, Shuweika (part of Tulkarem municipality), Thenabeh (part of Tulkarem municipality), Tulkarem and Tulkarem Camp.

Cluster 2 comprises the northern part of Tulkarm District and extends along the green line area of Al-Sharawiya between Qifeen in the north and Tulkarem in the South. The municipalities and villages included in this cluster include are Dir Al-Gosoun, Attil, Zeita, Illar, Syda, Al-Nazleh Al-Sharqiya, Al-Nazleh Al-Wusta, Al-Nazleh Al-Gharbiya, Qifeen, Baqa Al-Sharqiya, Akkaba, Nazlat Issa, Al-Masqufa, Al-Jarushiya.

Cluster 3 comprises the southern part of Tulkarm District and extends along the green line area of Al-Kafriyat between Qifeen in the north and Tulkarem in the South. The municipalities and villages included in this cluster included are Jibarah, Al-Ras, Kufr Soor, Koor, Kufr Jammal, Kufr Zibad, and Kufr Abboush.

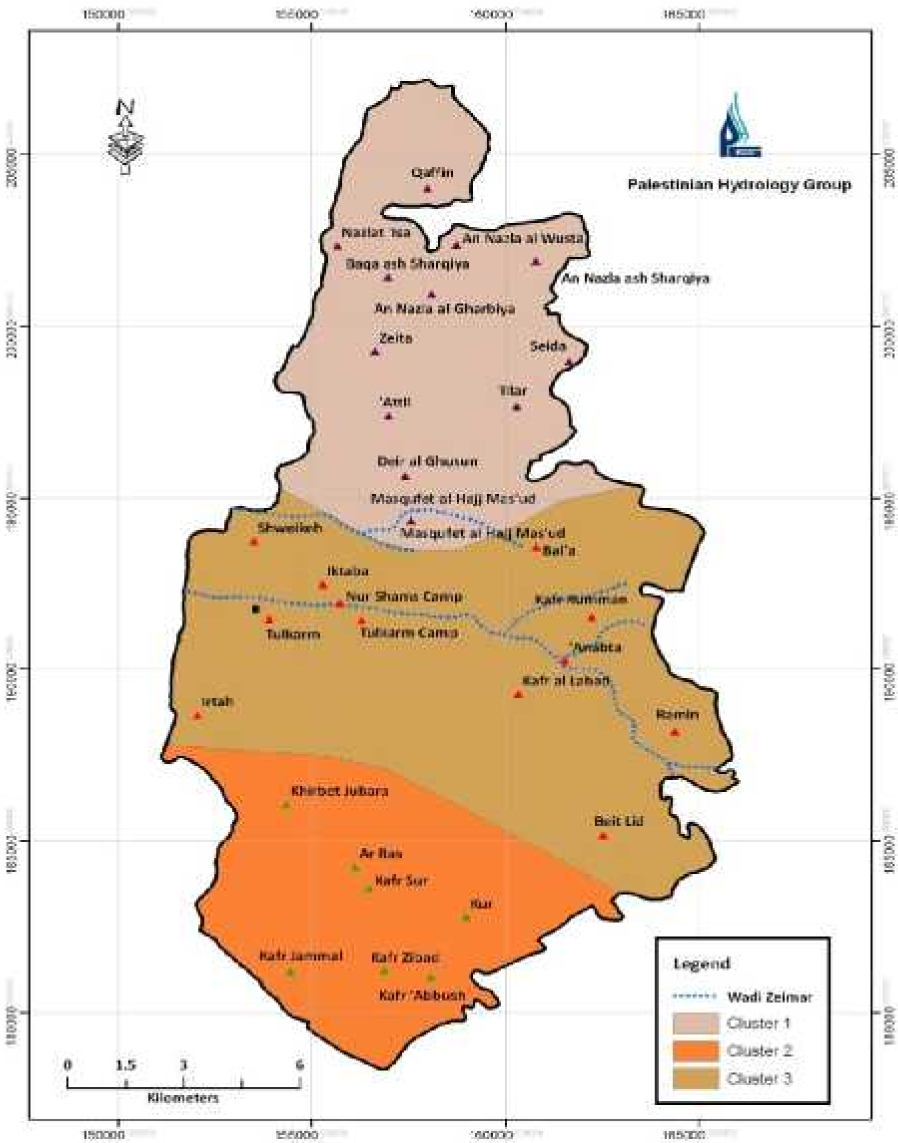


Figure (1): Tulkarem governorate

1.3.2 Topography:

Elevation is ranging between less than 50 meters above sea level (a.s.l) in the plain areas west of Tulkarem city to about 450 m above sea level in Bala'a area to the east (Fig. 2).

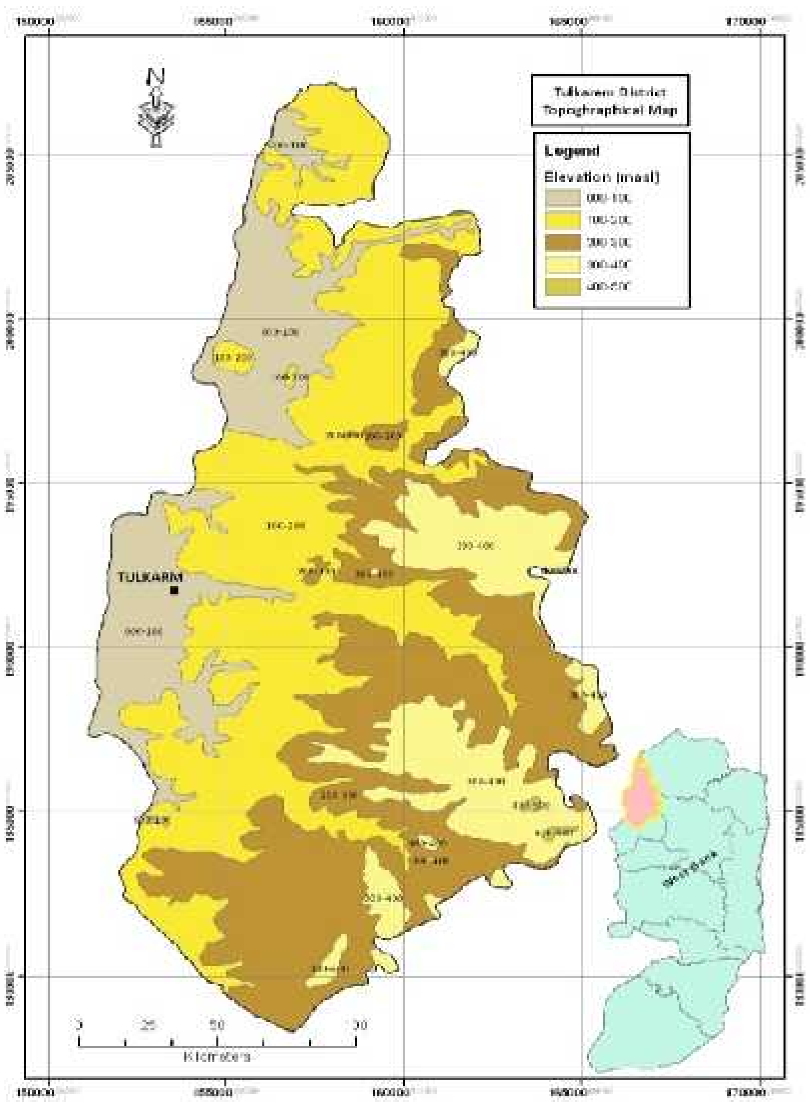


Fig. (2): Topographical Map.

1. 3.3 Soil:

The major soil types in the governorate are Brown and Pale Rendzina which composes of chalk materials and has varying depth from 0.5 m to 2 m; Grumusols which has a dominant clay soil texture and is a characteristic of areas with smooth to gently sloping topography, and Terra Rosa which composes of carbonate in general and has depth vary from 0.5 – 2 m (Fig. 3).

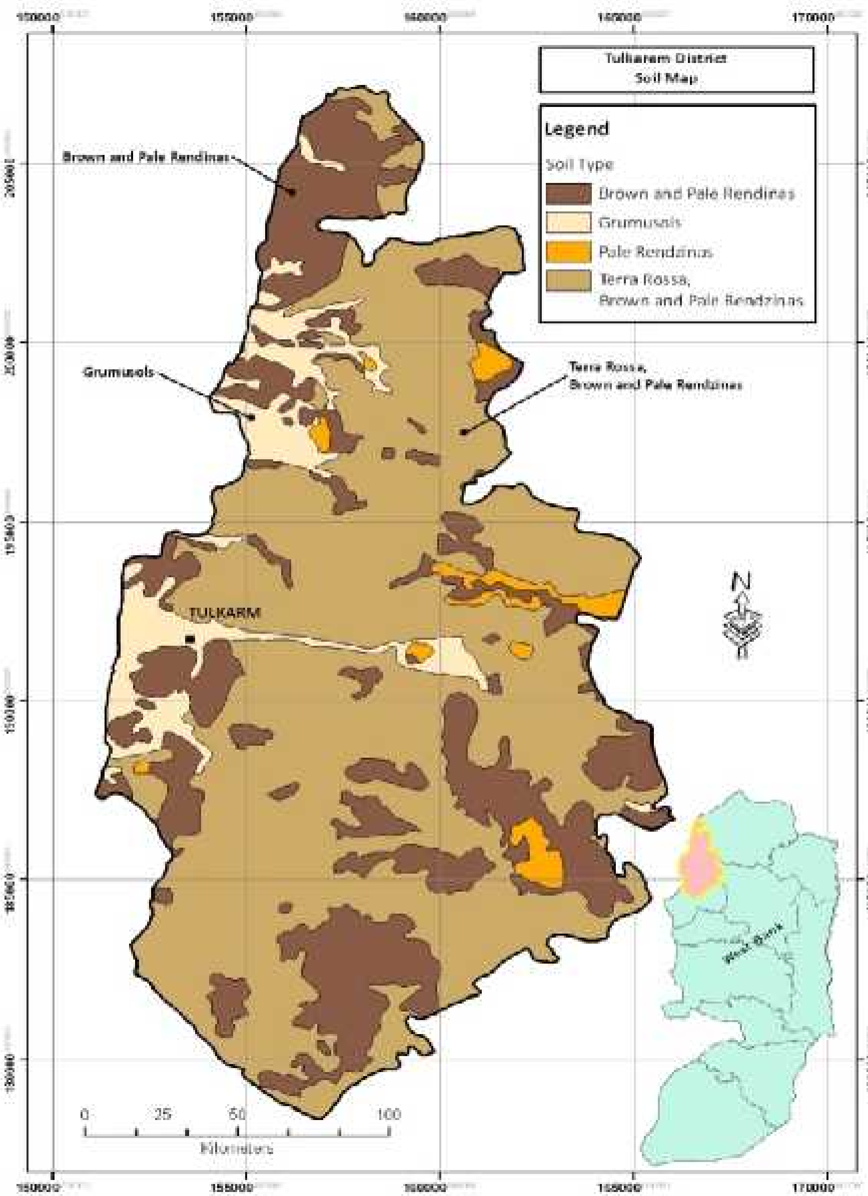


Fig. (3): Soil Map of Tulkarem Governorate.

1.3.4 Geology and Hydrogeology

Water bearing formations (Aquifers) in West Bank mainly composed of limestone and dolomite. Outcropping rocks (recharge area) of the water bearing formations are mainly characterized by its prominent craggy outcrop, well jointed, honeycombed, and karstified pavements features. In particular, weathering a long bedding planes and major joints that seems to be resolved at depth into a series of relatively small interconnecting fissures have given rise to cavern systems that are likely continues underground. These features increase the secondary permeability of the rock formations that in turn increase the storage capacity and increase the groundwater travel time. Thus, outcropping areas of these water bearing formations are hydrogeologically considered sensitive groundwater recharge areas.

Tulkarm governorate area forms part of the western groundwater basin which composed of two main sub aquifers namely upper and lower aquifers of Turonian – Cenomanian age and lower Cenomanian age respectively. Where, the groundwater flows towards the west (Fig. 6). While the groundwater level in the area varies between 20-50 meters above sea level. The western aquifer basin is recharged mainly from precipitation falling on the mountains of West Bank while the historical outlets of the basin were through Ras Al Ain (Auja) (Yarkon) and Al Timsah (Taninim) springs and hence the Israeli named the basin Yarkon - Taninim Basin. The average value of recharge of the West Aquifer Basin was estimated by several studies to vary from 340- 360 Mcm/yr and the most recent Israeli estimate of the basin is 425 Mcm/yr.

Transmissivity of Western Basin aquifers is characterized by its high values -In some wells transmissivity reaches more than 100,000 m2/day-.

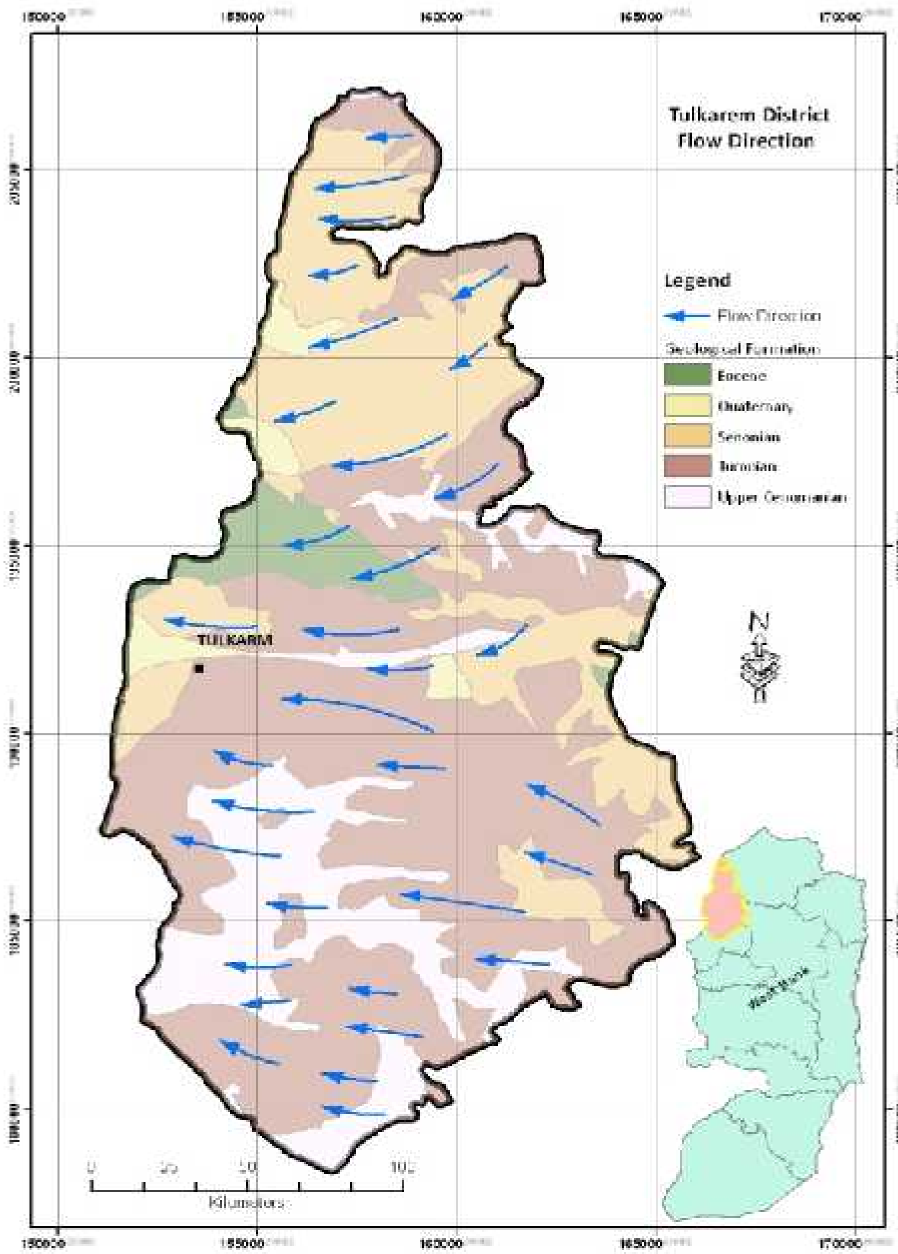


Fig. (6): Groundwater Flow Map.

1.3.5 Infiltration

The water infiltration percentage into the groundwater depends on many factors, such as the topography, the soil types, the rock formation, joints, and karstification, the rainfall depth and intensity, land use, vegetation, and the climate. Depending on the soil type, the infiltration values vary from less than 5mm/h to more than 26 mm/h.

Generally, infiltration into groundwater is estimated to be about 23% of the rainfall, where 73% of the rainfall evaporates directly from the ground, and 4.04 % of the rainfall goes as runoff.

1. 3.6 Hydrology and Climate

In general, Tulkarem governorate belongs to the sub-tropical zone which characterized by Mediterranean climate with long hot and dry summer, and short cool and rainy winter.

The average temperature is ranging between 10.9 and 26.1 c˚ in January, and August respectively. The mean maximum temperature ranges from 13.3 (January) to 29.6 c˚ (August), while the mean minimum temperature is ranging between 8.6 c˚ and 22.7 c˚ for the same months.

The average relative humidity reaches about 69 %. The minimum value of relative humidity is 62% which occurs in May during the Khamaseen weather. Maximum relative humidity of 76% is usually registered in February.

Winds direction and velocities vary according to the seasons of the year. The main wind direction is from west, southwest and northwest. Variation during winter is associated with the pattern of depressions passing from west to east over the Mediterranean. The main winds in the area are the southwest and northwest winds with an annual average wind speed of 3.4 km per day, at a height of 2 meters from ground surface. The Khamaseen, desert storm, may occur during the period from March to June. During the Khamaseen, the temperature increases, the humidity decreases and the atmosphere becomes hazy with dust of desert origin and eastern prevailing winds.

Rainfall in Tulkarem area usually begins in October and continues through May. About 60% of the annual rainfall occurs between December and February, while 20% of annual rainfall occurs in October and November. The annual average of rainfall reaches 601 mm, while the maximum monthly rainfall recorded in December of about 436 mm. In general, rainfall average increases within the governorate towards the north where it reaches 650 mm (Figure. 4).

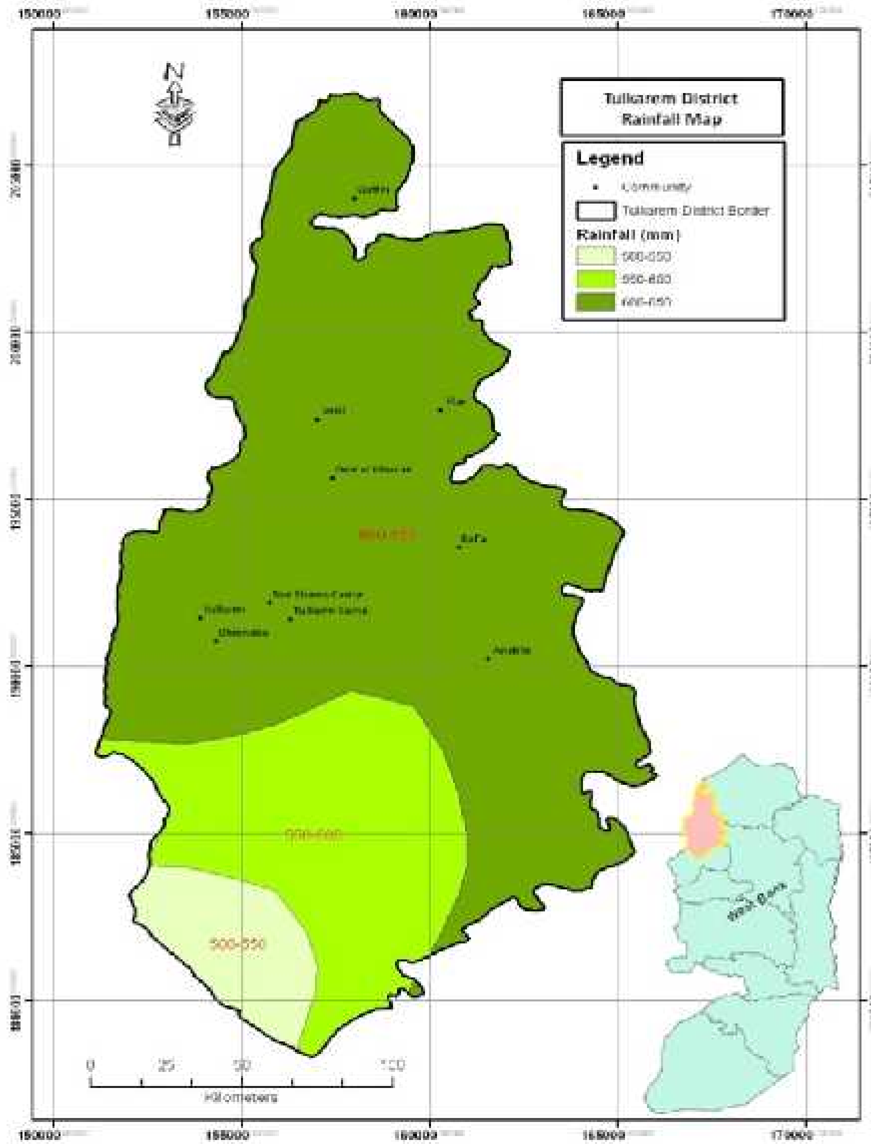


Figure (7): Rainfall Map of Tulkarm Governorate.

Due to high temperatures, intensive sunshine and low humidity in the summer months, evaporation has a high magnitude. However, evaporation in the study area rate lies between 1600 and 1800 mm per year.

The potential evapotranspiration (PET) amounts range between more than 100mm during the summer months, while it is decreased to less than 50mm in winter months, whereas April and November are transition months with about 75mm.

Table 1 summarizes the long term monthly average of major climate characteristics in Tulkarem Governorate.

Table (1): Long term monthly averages of climate parameters of Tulkarem.

Element	Month											
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	**Av.**
Mean Max. Temp.(c˚)	13.3	13.8	16.7	21.5	24.6	27.2	29.0	29.6	28.2	26.8	20.8	15.9	**22**
Mean Min. Temp.(c˚)	8.6	8.7	10.8	13.8	15.9	19.4	22.1	22.7	21.2	19.2	14.3	10.6	**16**
Mean Temp.(c˚)	10.9	11.2	13.7	17.6	20.2	23.3	25.5	26.1	24.7	23.0	17.5	13.2	**19**
Mean Wind Spee (Km/h)	4.3	4.1	3.8	3.4	3.3	2.9	2.9	2.7	2.6	2.9	3.8	4.0	**3.4**
Mean RH(%)	72	76	75	65	62	69	68	74	70	67	64	71	**69**
Total Rainfall (mm) *	110.9	103.5	86.6	18.2	3.7	0.1	0.0	0.0	0.0	25.9	90.3	162.1	**601**
Max Monthly Rainfall (mm)	330	390	181	113	34	6	2	0	19	92	367	436	
Total Monthly PET [mm]	37	31	46	72	92	95	108	104	100	100	75	48	

1.3.7 Runoff and Surface Catchment Areas

In general, the Western catchments drain to the Mediterranean Sea, while it considered trans-boundary catchments, as their flows originate from Palestinian territory and crosses the Green line. Regarding several studies the runoff coefficient was estimated to be about 4.04%.

The major valleys in the study area can be listed as follows: Wadi Zeimar , Wadi Massin, Wadi Qana and their tributaries (Fig. 5). This wadi’s show a temporary runoff only during winter months from November to March. However, the permanent flow of Wadi Zeimar is mainly originating from the domestic and industrial wastewater drained from Nablus in the upper catchment area and from Anabta and Tulkarem in the lower catchment area during the dry season. This Water of Wadi Zeimar is delivered to Emek Hefer Wastewater Treatment Plant beyond the green line. The treated water either used for irrigation or discharged to the Alexander River, 6.5 km from the Green line. Finally, The Alexander River drains its load into the Mediterranean Sea as the final receiving water body, north of the town of Netanya.

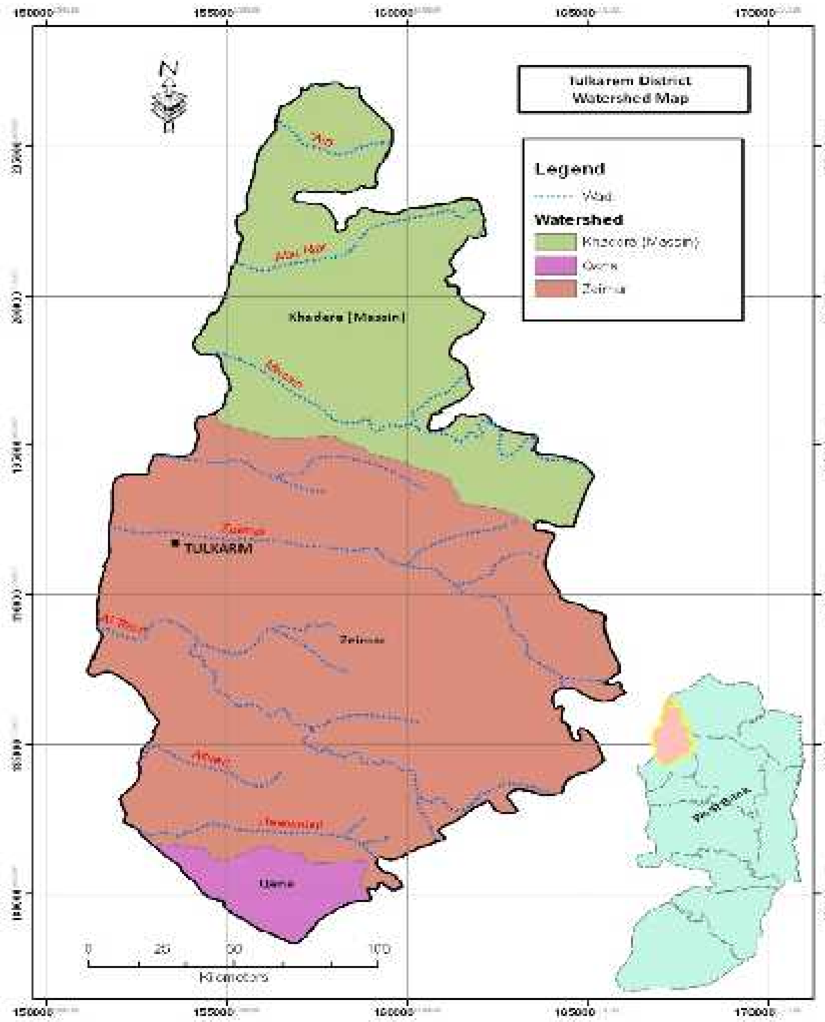


Figure (5): Watershed Map of Tulkarm Governorate.

1.4 Population and Socio- Economic Conditions

1.4.1 Population

Generally, the population in the occupied Palestinian territory (West Bank and Gaza Strip) reached 3,761,646 inhabitants of which 1,908,432 are males and 1,853,214 are females. Additionally, the number of families in the oPt reaches a total of 646,755 (Source: PCBS, census 2007).

Palestinian society is a young society with nearly 46% of the population below the age of 15. This is elaborated by the fact that the death rate in the oPt is 3.9 compared to 36.7 for the birth rate resulting in a natural growth rate of 3.3% in the oPt as a whole. According to the central Bureau of Statistics (PCBS), the average family size was found to be 5.8 individuals in 2008 while it was 6 individuals during the last census in 2004.

In the mean time, the population in the study area was found to be nearly 157,988 people with approximately 29,938 families.

The table below shows the population in each of the targeted communities.

Table(2): Number of population in Turkarem communities.

Locality Name	Pop 2025	Pop 2015	Pop 2010	Pop 2007	Pop 1997
Talkarem gov	233,744	188,032	165,791	157,988	120,836
Akkaba			267	254	195
Qaffin			8,801	8,387	6525
Nazlat 'Isa			2,449	2,334	1868
An Nazla ash Sharqiya			1,589	1,514	1230
Baqa ash Sharqiya			4,304	4,101	3055
An Nazla al Wusta			357	340	310
An Nazla al Gharbiya			983	937	661
Zeita			2,993	2,852	2346
Seida			3,074	2,929	2297

'Illar	6,496	6,190	5135
'Attil	9,484	9,038	7763
Deir al Ghusun	8,649	8,242	7061
Al Jarushiya	978	932	677
Al Masqufa	273	260	158
Bal'a	6,930	6,604	5444
Iktaba	2,797	2,665	1475
Nur Shams Camp	6,799	6,479	5891
Tulkarem Camp	11,167	10,641	10080
Tulkarem	53,834	51,300	33949
Anabta	7,691	7,329	5462
Kafr al Labad	4,275	4,074	3009
Kafa	424	404	260

Al Haffasi	165	157	120
Ramin	1,895	1,806	1568
Far'un	3,253	3,100	2382
Shufa	2,302	2,194	936
Khirbet Jubara	307	293	244
Saffarin	798	760	774
Beit Lid	5,241	4,994	4412
Ar Ras	567	540	378
Kafr Sur	1,172	1,117	936
Kur	275	262	242
Kafr Zibad	1,131	1,078	975
Kafr Jammal	2,544	2,424	1907
Kafr 'Abbush	1,529	1,457	1111

Total Tulkarem Gov.	165,791	157,988	120,836

As was shown in the table above, the number of population differs from community to another in the study area. Moreover, it is higher in towns and camps compared to other rural communities in the governorate.

Refugees' status

The population of people holding refugee status is concentrated in towns and the camps. In general, around (26) percent of the inhabitants of Tulkarem governorate are refugees.

Table (3): The refugees number regarding the locality in Talkeram

Locality Name	Registered Refugees from the population
Akkaba	0
Qaffin	427
Nazlat 'Isa	152
An Nazla ash Sharqiya	118
Baqa ash Sharqiya	953
An Nazla al Wusta	111
An Nazla al Gharbiya	56
Zeita	663
Seida	76
'Illar	612
'Attil	2,519
Deir al Ghusun	1034
Al Jarushiya	96
Al Masqufa	16

Bal'a	1653
Iktaba	1203
Nur Shams Camp	6,011
Tulkarem Camp	9,96
Tulkarem	19,949
Anabta	1265
Kafr al Labad	206
Kafa	17
Al Haffasi	11
Ramin	173
Far'un	852
Shufa	588
Khirbet Jubara	68
Saffarin	75
Beit Lid	1467
Ar Ras	89
Kafr Sur	131
Kur	21
Kafr Zibad	114
Kafr Jammal	214
Kafr 'Abbush	321
Total Tulkarem Gov.	41261

1.4.2 Number of families in the study area

PCBS recent statistics in 2008 regarding the Palestinian household structure demonstrates that the average family size in Tulkarem governorate is 5.3. The table below shows both the number of families and family size in the study area for each of the localities.

Table(4): number of households and family size:

Locality Name	No. of Families	Family size
Akkaba	41	6.2
Qaffin	1,587	5.3
Nazlat 'Isa	440	5.3
An Nazla ash Sharqiya	277	5.5
Baqa ash Sharqiya	762	5.4
An Nazla al Wusta	74	4.6
An Nazla al Gharbiya	156	6
Zeita	560	5.1
Seida	568	5.2
'Illar	1,142	5.4
'Attil	1,720	5.3
Deir al Ghusun	1,578	5.2
Al Jarushiya	183	5.1
Al Masqufa	47	5.5
Bal'a	1,202	5.5
Iktaba	463	5.8
Nur Shams Camp	1,216	5.3
Tulkarem Camp	1,962	5.4
Tulkarem	9,877	5.2
Anabta	1,440	5.1
Kafr al Labad	693	5.9
Kafa	75	5.4
Al Haffasi	27	5.8
Ramin	353	5.1
Far'un	633	4.9
Shufa	400	5.5

Khirbet Jubara	63	4.7
Saffarin	136	5.6
Beit Lid	947	5.3
Ar Ras	96	5.6
Kafr Sur	222	5
Kur	54	4.9
Kafr Zibad	208	5.2
Kafr Jammal	455	5.3
Kafr 'Abbush	281	5.2
Total Tulkarem Gov.	29,938	5.3

Size of the families at the study area (categories)

Table (5): Distribution of the family members on categories

Family size categories	1- 2	3- 5	6- 8	Total
Number	4926	10789	13993	29708
Percentage	16.5%	36.3%	47.2%	100

In general, around 50 percent of the families in Talkeram governorate contain of members between 1 – 5 members which consider small if compared to other communities in West Bank.

1.4.3 Age distribution

The PCBS 2007 census results show that the residents in Talkeram governorate is a young community, as the number of population that aged between 0-14 years old was 60,584 which contain 38.6 percent of the total governorate inhabitants.

1.4.4 Education characteristic

The number of the inhabitants at the governorate who attained the bachelor degree and higher reached 9,786 in 2007 which around 8.5 percent from the total of the inhabitants in the governorate, while 6,762 the inhabitants who are illiterate which around 5.9 percent of the total inhabitants.

The table below is showing the population distributed regarding the education level:

Table (6): Education attainment

illiterate	Can read and write	Elementary	Preparatory	Secondary	Associate Diploma	Bachelor	Higher Diploma	Master	Ph.D	Not Stated
6835	13393	26953	32284	20126	6052	8875	120	642	130	6117

The housing buildings in the study area

The table below is showing the number and the percentage of the total housing buildings in the study area.

Table (7): Number of housing buildings in all the Tulkarem communities

Villa	House	Apartment	Independent room	Tent	Marginal	Others	Not Stated	Total
471	12557	16444	24	1	12	2	170	29681
1.59%	42.31%	55.40%	0.08%	0.00%	0.04%	0.01%	0.57%	100%

The table below is showing the number of the public building in the study area such as the mosques, clinics, schools…etc

Table (8): public services at the study area

Schools	Clinics	Mosques	Services buildings	Other public buildings
43	38	92	12	1

Table (9): Private Households by Locality and Household Size, 2007

Locality	Total		Household Size							
	Population	Households	+8	7	6	5	4	3	2	1
Tulkarm Governorate	156,734	29,708	5,464	3,959	4,570	4,231	3,568	2,990	3,294	1,632
'Akkaba	252	40	15	3	6	5	5	4	2	-
Qaffin	8,323	1,575	275	228	236	246	194	164	173	59
Nazlat 'Isa	2,316	437	77	54	73	73	62	36	42	20
An Nazla ash Sharqiya	1,503	275	66	35	41	29	33	22	27	22
Baqa ash Sharqiya	4,070	756	156	105	106	114	68	73	88	46
An Nazla al Wusta	338	73	9	9	6	15	8	6	16	4
An Nazla al Gharbiya	931	155	43	23	18	24	14	16	14	3
Zeita	2,831	556	99	75	89	67	60	53	64	49
Seida	2,906	564	87	81	87	88	67	64	60	30
'Illar	6,143	1,133	264	138	151	143	117	98	140	82
'Attil	8,969	1,707	342	213	236	245	192	179	190	110
Deir al Ghusun	8,179	1,566	257	232	260	224	182	165	170	76
Al Jarushiya	926	182	25	28	33	20	24	22	22	8
Al Masqufa	258	47	4	12	11	8	4	4	4	-
Bal'a	6,554	1,193	260	170	179	143	143	107	133	58
Iktaba	2,644	459	112	71	59	64	55	49	36	13
Nur Shams Camp	6,430	1,207	239	166	187	142	148	105	149	71
Tulkarm Camp	10,560	1,947	423	247	254	271	235	197	221	99

Tulkarm	50,854	9,799	1,605	1,264	1,591	1,475	1,220	1,035	1,094	515
Anabta	7,274	1,429	227	208	203	211	174	163	139	104
Kafr al Labad	4,043	688	194	87	101	81	83	56	60	26
Kafa	401	74	7	16	14	16	8	6	3	4
Al Haffasi	156	27	10	1	4	1	4	3	3	1
Ramin	1,792	350	57	55	59	39	35	34	48	23
Far'un	3,076	628	86	63	99	109	87	67	82	35
Shufa	2,177	397	83	54	62	63	39	34	48	14
Khirbet Jubara	291	63	7	5	13	4	11	6	14	3
Saffarin	754	135	30	16	30	19	12	8	15	5
Beit Lid	4,956	940	166	130	165	126	110	89	96	58
Ar Ras	536	95	25	13	15	10	8	8	10	6
Kafr Sur	1,109	220	34	37	29	22	24	21	35	18
Kur	260	54	6	9	9	6	5	9	4	6
Kafr Zibad	1,070	206	35	24	43	23	21	20	23	17
Kafr Jammal	2,406	452	85	56	65	70	62	41	44	29
Kafr 'Abbush	1,446	279	54	31	36	35	54	26	25	18

Table (10): Number of Houses by Locality and Availability of Electricity in the Houses, 2007

Locality	Availability of Electricity				
	Households Total	Not Stated	No Electricity	Private Generator	Public Network

	(%)	(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)
Tulkarm Governorate	100.0	29,708	0.3	94	0.1	32	0.6	165	99.0	29,417
'Akkaba	100.0	40	0.0	-	0.0	-	0.0	-	100.0	40
Qaffin	100.0	1,575	0.1	1	0.0	-	1.1	18	98.8	1,556
Nazlat 'Isa	100.0	437	2.3	10	0.0	-	0.5	2	97.3	425
An Nazla ash Sharqiya	100.0	275	0.4	1	0.0	-	1.1	3	98.5	271
Baqa ash Sharqiya	100.0	756	0.3	2	0.0	-	1.1	8	98.7	746
An Nazla al Wusta	100.0	73	4.1	3	0.0	-	0.0	-	95.9	70
An Nazla al Gharbiya	100.0	155	0.0	-	0.0	-	0.6	1	99.4	154
Zeita	100.0	556	0.4	2	0.0	-	0.9	5	98.7	549
Seida	100.0	564	0.0	-	0.0	-	1.4	8	98.6	556
'Illar	100.0	1,133	0.4	4	0.3	3	0.7	8	98.7	1,118
'Attil	100.0	1,707	0.2	3	0.1	2	0.7	12	99.0	1,690
Deir al Ghusun	100.0	1,566	0.2	3	0.0	-	0.4	6	99.4	1,557
Al Jarushiya	100.0	182	0.5	1	0.0	-	0.5	1	98.9	180
Al Masqufa	100.0	47	0.0	-	0.0	-	2.1	1	97.9	46
Bal'a	100.0	1,193	0.1	1	0.2	2	0.3	4	99.4	1,186
Iktaba	100.0	459	0.2	1	0.0	-	1.3	6	98.5	452
Nur Shams Camp	100.0	1,207	0.1	1	0.0	-	0.0	-	99.9	1,206
Tulkarm Camp	100.0	1,947	0.1	1	0.0	-	0.0	-	99.9	1,946
Tulkarm	100.0	9,799	0.5	47	0.1	7	0.5	52	98.9	9,693
Anabta	100.0	1,429	0.6	9	0.3	5	0.2	3	98.8	1,412
Kafr al Labad	100.0	688	0.0	-	1.0	7	0.3	2	98.7	679
Kafa	100.0	74	0.0	-	0.0	-	0.0	-	100.0	74
Al Haffasi	100.0	27	0.0	-	0.0	-	0.0	-	100.0	27

Ramin	100.0	350	0.0	-	0.0	-	0.3	1	99.7	349
Far'un	100.0	628	0.5	3	0.1	1	1.0	6	98.4	618
Shufa	100.0	397	0.0	-	0.0	-	0.8	3	99.2	394
Khirbet Jubara	100.0	63	0.0	-	0.0	-	3.2	2	96.8	61
Saffarin	100.0	135	0.0	-	0.0	-	0.0	-	100.0	135
Beit Lid	100.0	940	0.1	1	0.3	3	0.9	8	98.7	928
Ar Ras	100.0	95	0.0	-	0.0	-	2.1	2	97.9	93
Kafr Sur	100.0	220	0.0	-	0.0	-	0.5	1	99.5	219
Kur	100.0	54	0.0	-	0.0	-	0.0	-	100.0	54
Kafr Zibad	100.0	206	0.0	-	0.0	-	0.5	1	99.5	205
Kafr Jammal	100.0	452	0.0	-	0.0	-	0.0	-	100.0	452
Kafr 'Abbush	100.0	279	0.0	-	0.7	2	0.4	1	98.9	276

Table (11): Number of Houses by Locality and Availability of Sewage System in the Houses, 2007

Locality	Availability of Sewage System									
	Households Total		Not Stated		No Sewage System		Cesspits		Public Sewage System	
	(%)	(No.)	(%)	(No.)	(%)	No of Households	(%)	(No.)	(%)	(No.)
Tulkarm Governorate	100.0	29,708	0.4	124	0.4	110	60.0	17,812	39.3	11,662
'Akkaba	100.0	40	0.0	-	0.0	-	100.0	40	0.0	-
Qaffin	100.0	1,575	0.3	5	0.1	1	99.6	1,569	0.0	-
Nazlat 'Isa	100.0	437	2.5	11	0.0	-	97.5	426	0.0	-
An Nazla ash Sharqiya	100.0	275	1.8	5	0.0	-	98.2	270	0.0	-
Baqa ash Sharqiya	100.0	756	0.4	3	0.3	2	99.3	751	0.0	-
An Nazla al Wusta	100.0	73	4.1	3	0.0	-	95.9	70	0.0	-

An Nazla al Gharbiya	100.0	155	0.0	-	0.0	-	100.0	155	0.0	-
Zeita	100.0	556	0.4	2	0.4	2	35.3	196	64.0	356
Seida	100.0	564	0.0	-	0.2	1	99.8	563	0.0	-
'Illar	100.0	1,133	0.5	6	0.1	1	99.4	1,126	0.0	-
'Attil	100.0	1,707	0.2	4	0.6	11	99.1	1,692	0.0	-
Deir al Ghusun	100.0	1,566	0.2	3	0.0	-	99.8	1,563	0.0	-
Al Jarushiya	100.0	182	1.1	2	0.0	-	98.9	180	0.0	-
Al Masqufa	100.0	47	0.0	-	0.0	-	89.4	42	10.6	5
Bal'a	100.0	1,193	0.4	5	0.0	-	99.6	1,188	0.0	-
Iktaba	100.0	459	0.2	1	0.0	-	78.4	360	21.4	98
Nur Shams Camp	100.0	1,207	0.1	1	0.2	2	0.2	3	99.5	1,201
Tulkarm Camp	100.0	1,947	0.1	1	0.0	-	0.1	1	99.9	1,945
Tulkarm	100.0	9,799	0.5	53	0.1	6	25.7	2,516	73.7	7,224
Anabta	100.0	1,429	0.6	9	3.9	56	37.2	531	58.3	833
Kafr al Labad	100.0	688	0.0	-	0.7	5	99.3	683	0.0	-
Kafa	100.0	74	0.0	-	0.0	-	100.0	74	0.0	-
Al Haffasi	100.0	27	0.0	-	14.8	4	85.2	23	0.0	-
Ramin	100.0	350	0.0	-	0.0	-	100.0	350	0.0	-
Far'un	100.0	628	0.5	3	0.0	-	99.5	625	0.0	-
Shufa	100.0	397	0.0	-	0.3	1	99.7	396	0.0	-
Khirbet Jubara	100.0	63	0.0	-	0.0	-	100.0	63	0.0	-
Saffarin	100.0	135	0.0	-	0.0	-	100.0	135	0.0	-
Beit Lid	100.0	940	0.2	2	0.0	-	99.8	938	0.0	-
Ar Ras	100.0	95	0.0	-	8.4	8	91.6	87	0.0	-
Kafr Sur	100.0	220	0.0	-	3.2	7	96.8	213	0.0	-
Kur	100.0	54	3.7	2	0.0	-	96.3	52	0.0	-

Kafr Zibad	100.0	206	0.0	-	0.0	-	100.0	206	0.0	-
Kafr Jammal	100.0	452	0.7	3	0.0	-	99.3	449	0.0	-
Kafr 'Abbush	100.0	279	0.0	-	1.1	3	98.9	276	0.0	-

1.4.5 The economy in the study area

The main economic features in the Palestinian Authority, distributed as percentages of the Palestinian Authority population, are summarized in

Table 12. This shows that the most important economic activity is services, followed by tourism and agriculture.

Table 12: Palestinian Population Main Economic Features

Economic Feature	2003	2007
The participating percentage of the work force (%)	40.4	**41.9**
Unemployment rate (%)	25.6	**21.5**
Agriculture, forestation and hunting (%)	15.7	**15.6**
Mining, quarries and transmutation industry (%)	12.5	**12.5**
Construction (%)	13.1	**11.0**
Trade, restaurants and hotels (%)	20.1	**19.5**
Transportation section, storing and communications (%)	5.8	**5.6**
Services and other categories (%)	32.8	**35.8**
Total (%)	**100**	**100**

Agriculture is the largest sector of the Palestinian economy, generating over 15% of the Gross Domestic Product of the West Bank and Gaza. In times of difficulty, the agricultural sector has acted as a buffer that absorbs large scores of unemployed people who lost their jobs in Israel or other local sectors of the economy. Various statistical data indicate that agriculture's contribution to employment rose from 12.7% in 1995 to 16% in 2004. The agricultural sector also plays a central role in achieving food security.

In the mean time unemployment rates vary from 9.1% in Jericho to 17% in Bethlehem while it is nearly 16.6% in Tulkarem district is.

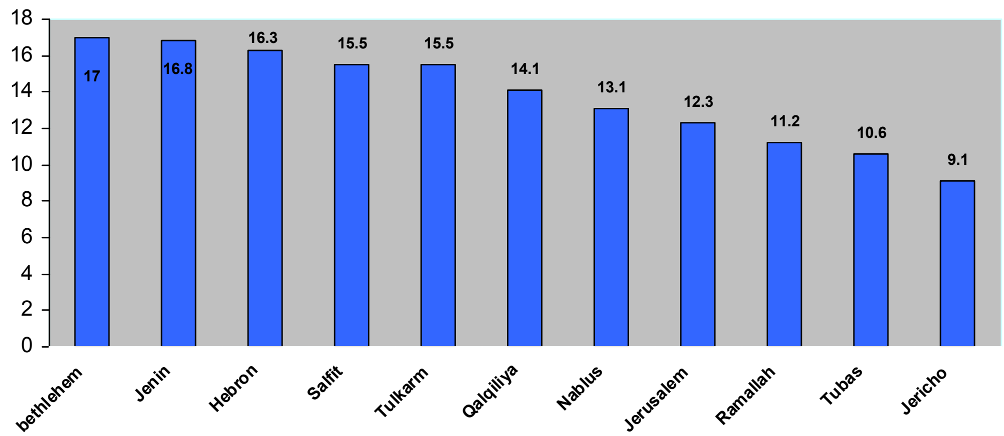


Figure 6: Unemployment in West Bank districts (PCBS, 2008)

Meanwhile, due to the lack of job opportunities in the target area the unemployment rate is considerably high and reaches up to 20-22% in some of the communities. Additionally, many of the inhabitants of this area were accustomed to working inside the green line, a phenomenon that has been halted following the events of the second Intifada through elongated periods of closure as well prohibition of access into Israel. As a result of the new political reality, inhabitants of the targeted communities alternated to working in agriculture with 50 percent of the population currently working in the sector, the rest of the population dwells on labor work in local or work illegally in Israel.

In brief, the inhabitants in Tulkarem governorate are living in very bad economic conditions as the daily per capita income is 2.1 $ according to PCBS census, which around 1200 – 1400 NIS per household (5.3 members) per month.

The poverty rate in Tulkarem district 22.5 (PCBS, Census, 2007) Tulkarem poverty rate considers approximate the same of West Bank poverty rates specifically the north communities.

The inhabitants of Tulkarem district distributed on different kind of economic activities and illustrated from the last PCBS census (2007) a big number of inhabitants who works in the Wholesale, Retail Trade sector and the agriculture sector as shown in the table below:

Table (13). Economic activities in Tulkarem governorate

Economic Activity	No. of Persons Engaged
Agriculture ,Farming Of Cattal and other Animals	952
Minng & Quarrying	53
Manufacturing	3,962
Electricity And Water Supply	92
Construction	166
Wholesale, Retail Trade & Repairs	5,602
Hotels and Restaurants	524
Transport , Storage & Communication	503
Financil Intermediaitons	221
Real Estate , Renting & Business Activities	352
Education	623
Health & Socail Work	623
Other Community, Social & Personal Service	789
Tulkarem Governorate	

The number of economic establishments in Tulkarem governorate attained around 6,150 which distributed between private establishments either companies or national and international organization. While the economic establishments in the Tulkarem city is 2,921 establishments distributed between shops, factories, workshops…etc

The households' income is eventually base on the type of economic activity and the type of the community. The table below will show the approximate average of the income per community linked into the main economic activity in the community.

Table (14): The economic activities and the income average regarding the locality

Locality Name	Economic main activities	Average monthly income (NIS)
Akkaba	Livestock, labor, agriculture	1200
Qaffin	Agriculture Retail Trade	1000 – 1200

Nazlat 'Isa	Agriculture, labor	1000
An Nazla ash Sharqiya	Labor	1000
Baqa ash Sharqiya	Agriculture and retail trade	1300
An Nazla al Wusta	Agriculture	1000
An Nazla al Gharbiya	Agriculture, labor	1200
Zeita	30% agriculture, 40% labor, 15% employees, 15% Retail Trade	1500 (the mean)
Seida	Agriculture, craft, labor	1400
'Illar	Agriculture 40%, textile and stones minng 10%, livestock 20%	1600
'Attil	20% Agriculture, 20% Wholesale, Retail Trade, 35% labor, workshops 10%	1600 (the mean)
Deir al Ghusun	Retail Trade and labor	1500
Al Jarushiya	Agriculture	1000
Al Masqufa	Labor, livestock	1100
Bal'a	50% Livestock (domestic animals), 30% Wholesale Retail , 20% labor	1700 - 2000
Iktaba	Agriculture	1100
Tulkarem	Wholesale, Retail trade, Manufacturing, services sector.	1700 - 2200
Anabta	Retail and wholesale trade, breakers	1600
Kafr al Labad	Agriculture and labor	1300
Kafa	Labor	1200

Al Haffasi	Agriculture	1000
Ramin	Agriculture and labor	1200
Far'un	Agriculture	1400
Shufa	Food manufacture, livestock	1600
Khirbet Jubara	Labor, agriculture	1600
Saffarin	Labor	1000
Beit Lid	30% Agriculture, 20% livestock, labor and employees 25%, 15% craft, 10% others	1600
Ar Ras	Agriculture and livestock	1400
Kafr Sur	Livestock (Fodder factory) caws, labor	1700
Kur	Labor and employees	1300
Kafr Zibad	wholesale trade (drinks factory) labor	1500
Kafr Jammal	Agriculture and livestock	1200
Kafr 'Abbush	Agriculture, labor and livestock	1400

1.5 Water Resources, Current Supply and Use

1. 5.1 Conventional Water Resources (surface and groundwater)

Renewable groundwater resources are considered the main potential water resources available in the study area. Groundwater in Tulkarem Governorate is mainly replenished by rainfall. However, there are other minor replenishment sources such as surface runoff, wastewater runoff, irrigation returns and leakage from water supply systems. Table 14 presents the quantification of each replenishment sources.

Table (15): Western Aquifer Basin Recharge (Mcm/yr) from different components according to aquifer formations for 93-98 period.

Aquifer formation	rainfall	rainfall runoff	wastewater runoff	water supply leakage	Sub-Total
Upper aquifer	244.92	16.99	1.55	5.47	268.93
Yatta	21.1	1.45	0.02	0.250	22.82
Lower aquifer	55.4	3.75	0.29	0.71	60.15
Sub-Total	321.42	22.19	1.86	6.43	351.9

Groundwater in the area is exploited by several public and private groundwater wells. Most of these wells were drilled before 1967, while only few wells were drilled recently after the creation of Palestinian National Authority. Like other wells in West Bank, wells in Tulkarem mostly characterized by its deteriorated condition due to the Israeli restrictions imposed on Palestinians for exploiting groundwater, developing and maintaining wells. Due to the geological nature of the western groundwater basin, wells mostly characterized by its considerable discharge capacity, and good water quality (Total dissolved solids TDS < 1000 mg / l).

The total number of functional wells in the governorate reaches about 66 wells (Table 9). Depth of these wells are ranging between 60 and 400 meters, while the water level is situated at a depth of 35 to 223 meters below the ground surface. Mostly the exploited aquifer is the Turonian-upper Cenomanian aquifer system. Domestic water is mainly taken from fifteen municipal wells that pumped about 6.79 million cubic meter in 2006 (Table 15), in addition to 0.81 Mcm was purchased from private agricultural wells (Table 16). The rest of wells mainly exploited for agricultural practices, the abstraction of these wells reaches about 5 Mcm.

Table (16): Domestic wells and their annual discharge.

Well Name	Annual Discharge (Mcm)
Kafr Zeibad	0.110
Shoofah	0.160
Zeita	0.226
Tulkarm 1	1.185
Tulkarm 2	0.369
Tulkarm 3	0.753
Tulkarm 4	1.434
Tulkarm 5	0.609
Tukarm 6	0.554
Deir Al Ghsoon	0.360
Bala'a	0.266
Qifeen	0.336
Anabta 1	0.048
Anabta 2	0.380
Anabta 3	0
Total	6.79

Table (17): Agricultural wells used partially for domestic purposes.

Well Name	Annual Discharge (Mcm)
Faroun	0.131
Kafr Al Labad	0.099
Ektaba	0.140

Al Nazlah Al Sharqiyah	0.070
Ateel	0.370
Total	0.81

1.5.2 Water Resources Quality and Sources of Pollution

The major groundwater pollution sources can be classified as natural sources, and that resulted from human activities. Natural sources commonly represented on one or more naturally occurring chemicals, leached from soil or rocks. The most common sources of human-induced pollution can be grouped into four categories: waste disposal practices; storage and handling of materials and wastes; agricultural activities; and saline water intrusion.

In the study area, infiltration of Wastewater that disposed in cesspits and that drained to Wadi Zeimar form the main source of groundwater pollution sources in the area. Percolation of wastewater into the groundwater increases the concentration of some chemical parameters. Nitrate level considers the main indicator of groundwater pollution by wastewater.

The concentration of nitrate shows high levels mainly in the wells situated adjacent to the drainage of Wadi Zeimar (Anabta well 2 > 100 mg\l), while this concentration becomes lower in the wells far from the wadi (Bala'a village council well < 20 mg\l). While, it also shows an increased trend with time as it shown in Figure 7 of Rafeeq Hamdallah well. Knowing that, the WHO guidelines for the nitrate level for drinking water should not exceed 50mg/l. The concentration ranges of the major chemical ions in groundwater wells are shown in Table (16).

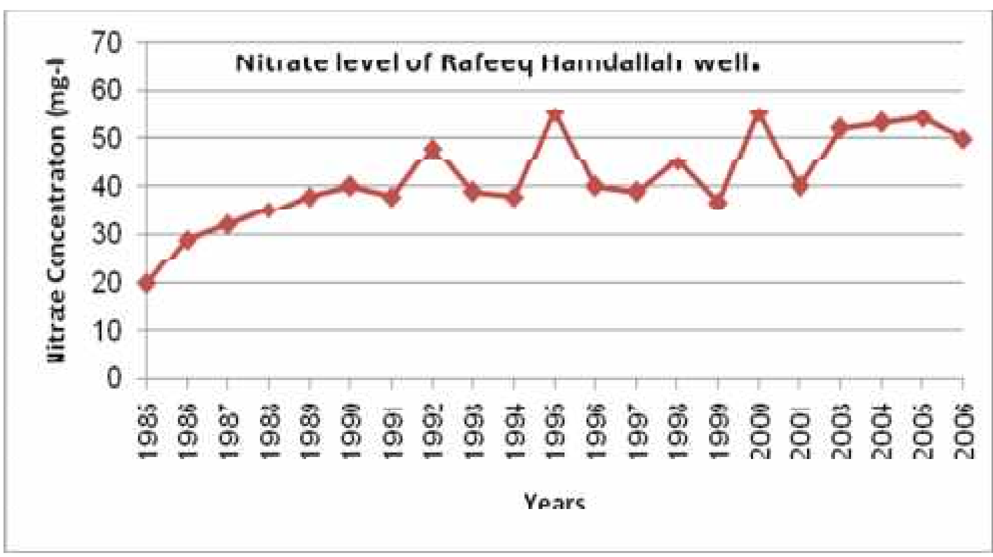


Fig. (7): Nitrate level of Rafeeq Hamdallah well.

Table (18): Concentration ranges of the main ions in groundwater wells.

Ion	Concentration Range (mg/l)	Ion	Concentration Range (mg/l)
PH	6.52-8.36	K	0.7-42
EC (micromho/cm)	160-2120	Cl	18-438
TDS	234-995	HCO3	162-404
Ca	15-111	SO4	5-136
Mg	20-64	NO3	10-163
Na	12-234	DO	2.7-8.7

Water abstracted from the drinking wells in Attil is biologically contaminated with high a accounts of fecal and total coliforms and now the municipality doesn't use those wells for drinking purposes, but they are used for irrigation.

1.5.3 Current Water Supply and Use

The water supply situation in the project area has considerably improved within the last 10 years. Almost 98 % of the population is connected to a water supply system. There are only three villages that are not connected to running water supply system, namely Saffarin, Kur and Akkaba. However, they are going to be connected this year. Currently, they rely on cisterns and water supplied by tankers.

Total water supplied to all communities is nearly 10 Mcm/year (based on the year 2008). Of this quantity nearly 7.2 Mcm is used and some 2.8 is lost or considered as unaccounted for water (UFW). The average loss percentage is nearly 28% while it varies from 6% to 45%. This percentage was calculated from the 23 communities that has data records on the water supply and use in the Governorate. However, Table 18, provides more details on the water supply source per community and the number of houses benefiting from what source of water.

Table (19): Occupied Houses by Locality and Main Source of Water in 2007

Locality	Total # of Households		Main Source of Water											
			Not Stated		Other		Water Tanks		Springs		Cistern (to gather rain water		Public Network	
	(%)	(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)
Tulkarm Governorate	100.0	29,708	0.4	113	0.5	136	0.6	191	1.4	418	7.6	2,272	89.5	26,578
'Akkaba	100.0	40	0.0	-	0.0	-	0.0	-	0.0	-	100.0	40	0.0	-
Qaffin	100.0	1,575	0.1	1	0.1	2	0.0	-	0.0	-	0.1	1	99.7	1,571
Nazlat 'Isa	100.0	437	2.3	10	0.0	-	0.0	-	0.0	-	0.0	-	97.7	427
An Nazla ash Sharqiya	100.0	275	0.4	1	0.0	-	6.5	18	0.0	-	41.5	114	51.6	142
Baqa ash Sharqiya	100.0	756	0.5	4	1.1	8	1.5	11	42.6	322	50.0	378	4.4	33
An Nazla al Wusta	100.0	73	4.1	3	0.0	-	0.0	-	54.8	40	20.5	15	20.5	15
An Nazla al Gharbiya	100.0	155	0.0	-	0.6	1	0.0	-	0.0	-	98.1	152	1.3	2
Zeita	100.0	556	1.1	6	0.0	-	0.0	-	0.0	-	0.0	-	98.9	550
Seida	100.0	564	0.0	-	0.0	-	0.0	-	0.0	-	29.3	165	70.7	399
'Illar	100.0	1,133	0.6	7	0.7	8	1.0	11	0.4	5	94.1	1,066	3.2	36
'Attil	100.0	1,707	0.2	3	0.9	16	0.1	1	0.1	1	1.8	30	97.0	1,656
Deir al Ghusun	100.0	1,566	0.2	3	0.1	2	0.0	-	0.0	-	0.0	-	99.7	1,561
Al Jarushiya	100.0	182	0.5	1	0.0	-	0.0	-	24.7	45	10.4	19	64.3	117
Al Masqufa	100.0	47	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-	100.0	47
Bal'a	100.0	1,193	0.3	3	0.0	-	0.0	-	0.0	-	0.8	10	98.9	1,180

Iktaba	100.0	459	0.2	1	0.0	-	0.4	2	0.0	-	0.0	-	99.3	456
Nur Shams Camp	100.0	1,207	0.1	1	0.0	-	0.0	-	0.0	-	0.0	-	99.9	1,206
Tulkarm Camp	100.0	1,947	0.0	-	0.1	2	0.0	-	0.0	-	0.1	1	99.8	1,944
Tulkarm	100.0	9,799	0.5	49	0.2	16	0.2	20	0.0	4	0.6	54	98.5	9,656
Anabta	100.0	1,429	0.7	10	0.1	1	0.0	-	0.0	-	0.1	1	99.2	1,417
Kafr al Labad	100.0	688	0.0	-	0.0	-	0.1	1	0.1	1	8.4	58	91.3	628
Kafa	100.0	74	0.0	-	97.3	72	0.0	-	0.0	-	2.7	2	0.0	-
Al Haffasi	100.0	27	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-	100.0	27
Ramin	100.0	350	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-	100.0	350
Far'un	100.0	628	0.5	3	0.2	1	0.0	-	0.0	-	0.0	-	99.4	624
Shufa	100.0	397	0.0	-	0.0	-	0.0	-	0.0	-	0.8	3	99.2	394
Khirbet Jubara	100.0	63	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-	100.0	63
Saffarin	100.0	135	1.5	2	0.0	-	91.9	124	0.0	-	3.7	5	3.0	4
Beit Lid	100.0	940	0.1	1	0.3	3	0.0	-	0.0	-	5.1	48	94.5	888
Ar Ras	100.0	95	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-	100.0	95
Kafr Sur	100.0	220	0.0	-	0.0	-	0.0	-	0.0	-	0.5	1	99.5	219
Kur	100.0	54	7.4	4	5.6	3	5.6	3	0.0	-	79.6	43	1.9	1
Kafr Zibad	100.0	206	0.0	-	0.0	-	0.0	-	0.0	-	1.9	4	98.1	202
Kafr Jammal	100.0	452	0.0	-	0.2	1	0.0	-	0.0	-	0.4	2	99.3	449
Kafr 'Abbush	100.0	279	0.0	-	0.0	-	0.0	-	0.0	-	21.5	60	78.5	219

The table shows that almost 89.5% of the households are connected to public water network while 7.6% still rely on cisterns and 1.4% relies on Springs as the mean of water supply.

1.6 Existing Water Supply Conditions and Management Challenges

1.6.1 Water Supply Infrastructure

Following to the detailed assessment that was conducted to define the current status of the water supply system and infrastructure, it was realized that most of existing water networks are relatively old and needs upgrading. The percentage of losses ranges between 6% and 50%. There is enough data on causes of losses or a plan how to reduce the water loss. In addition, Many communities get their drinking water from agricultural wells; there are no alternative domestic supply sources. These agricultural sources have limited capacity or were not developed to meet the escalating domestic demand. Up-to this minute there isn't any clear idea by these councils how they will get water apart from these wells. The Israeli authorities deliberately refuse to permit new domestic wells in the area so as to force these councils to get their domestic from the agricultural quota.

Water quality is usually tested by the Directorate of the Ministry of Health in the District, except for the city of Tulkarem; the municipality has its own laboratory and monitors the water quality. Usually the municipalities and village councils lack records of water quality, except when they have serious pollution. The test includes the water source, the distribution reservoir and sample of houses each month. Biological tests and residual chlorine are the routine tests unless other tests are specified for certain request by the municipalities.

The new houses usually built above the base elevation of the reservoir suffer from water cut during summer or can get water only during night. Therefore, these houses are usually supplied directly from the main supply pipeline or the municipalities install booster pumps on the main pipes and pumps water to them. On the contrary, other houses usually located at elevation far below the distribution reservoir can receive plenty of water or even suffer from high pressure and as a result water meters blow up.

1.6.2 Institutional Capacity

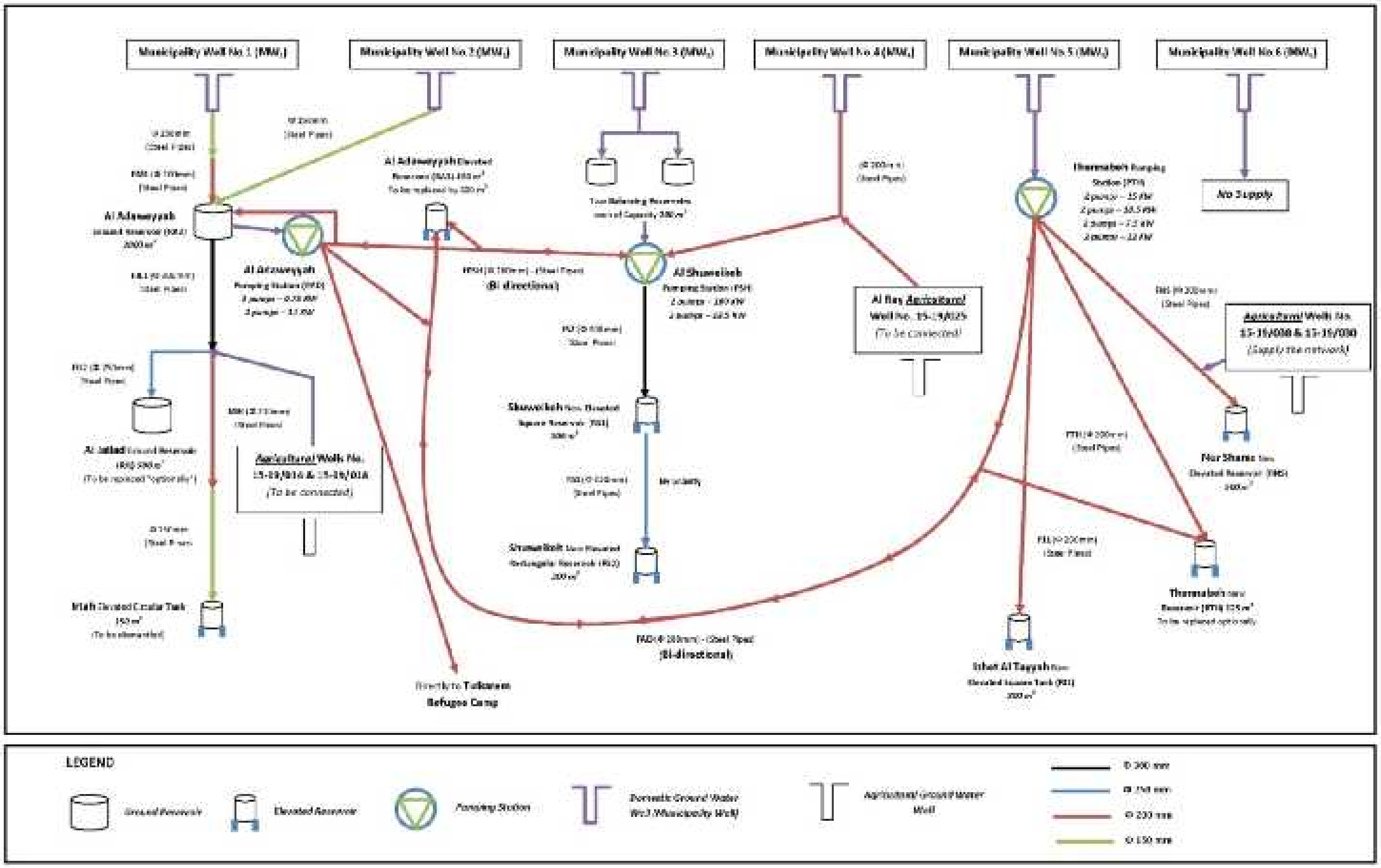
The village councils and municipalities are the water service provider. In most of cases, the technical staffs are neither qualified nor equipped with the necessary tools to carry the routine maintenance. These councils hire private workers to fix the emergency faults in water network supply system.

Despite the fact most of the village councils and municipalities acquire computer and internet services; the water archives are not available or the available data need further analyses. In most of cases we have to get the row data on consumption or costs and process them to reflect the existing conditions. At certain communities (relatively big one) they have no idea or data on customers' consumption and losses.

The village councils and municipalities lack strategic plans of water demand or alternative sources of water supply. Water tanks are the most reliable source in cases of emergency and water cut. The price of one cubic meter pulled by a truck is much higher than the one supplied by network. It can reach 20 NIS/m3 and depends on the tank size and the transport distance.

The main findings of the detailed assessment of the current water supply in each community are presented hereunder:

Tulkarem Water Supply System



Figure(8): Tulkarem Water Supply System

Community Profile

Table(20):Community Profile

Water Sources	Groundwater is the only source of water supply to Tulkarm City and suburbs. There are six main groundwater wells. The Municipality is working on drilling a new groundwater well to replace the existing well no. 2 at the same location. Meanwhile the Municipality buys water from Al-Taffal groundwater well number 15-19/038 during water cutoff or maintenance of municipal wells.	
Cisterns	% households with cisterns	No. of Cisterns
	0.1	Very few
Water Supply System	Storage Volume (m3)	The current storage capacity of the 11 existing reservoirs in the system adds up to 4,825 m3. One reservoir is expected to be replaced and another to be dismantled in the future to change the capacity to 4,525 m3.
	Area of Coverage	City of Tulkarm, Irtah, Shewikeh, Thenaba, and Khirbet at Tayyah, Izbat al Khilal, and Izbat Abu Khameish. Tulkarem Refugee Camp, Nur Shams Refugee Camp. Moreover, Tulkarem Municipality is the water supplier for Kafa, Al-Jarushiya and Al-Masqufa
	Age of Network	
	Last Date of Rehabilitation	2010
	Last Date of Extension	Continuously, but partly depends on the need
	Type of meters	Speed and volumetric (2000)
	No. of Connections	12000
	Connection Fees	190 JD
Water Use	% of Domestic Use	80
	% of Commercial and Industrial Use	20
	% of other uses	0
	Average use (l/c/d)	121

	% of losses	43
	Volume of Bulk Supply (m3), to who?	Al-Jarushiya and Al-Masqufa+Kafa+the camps
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	
	No. of Maintenance workers	
	No. of Accountants	2
	No. of Meter Readers	10 employees for water + (13 employees both for water and electricity)
	No. of Administrative Staff	
Comments and other Information		

Total Water Use

Table(21): Water Use

Year 2005													
Item	Jan.	Feb.	Mar.	April	may	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Supplied Water (m3)	354550	319450	373800	396440	425750	443590	477280	482430	448850	429730	350490	336110	4838470
Consumed water (m3)	169401	170403	164482	179444	203509	222944	242006	245372	232769	222005	230685	209137	2492157
Water meter accuracy													
Losses (m3)	185149	149047	209318	216996	222241	220646	235274	237058	216081	207725	119805	126973	2346313
Losses (%)	52.2	46.7	56	54.7	52.2	49.7	49.3	49.1	48.1	48.3	34.2	37.8	48.5
Year 2006													
Supplied Water (m3)	341201	300512	330523	332914	426145	471486	497827	494878	477069	454820	400181	377802	4905358
Consumed water	186075	165890	174352	187139	201530	239630	242935	243637	264610	228606	248431	212153	2594988

(m3)													
Water meter accuracy													
Losses (m3)	155126	134622	156171	145775	224615	231856	254892	251241	212459	226214	151750	165649	2310370
Losses (%)	45.5	44.8	47.2	43.8	52.7	49.2	51.2	50.8	44.5	49.7	37.9	43.8	47.1
Year 2007													
Supplied Water (m3)	369871	318072	389793	392994	463225	516646	534837	540718	511449	499160	396501	410112	5343378
Consumed water (m3)	210125	189555	181626	190527	228993	254445	262720	308021	268073	265083	249101	222270	2830539
Water meter accuracy													
Losses (m3)	159746	128517	208167	202467	234232	262201	272117	232697	243376	234077	147400	187842	2512839
Losses (%)	43.2	40.4	53.4	51.5	50.6	50.8	50.9	43	47.6	46.9	37.2	45.8	47
Year 2008													
Supplied	380901	341902	404773	424014	476405	502596	511167	542298	521729	475130	432611	408492	5422018

Water (m3)													
Consumed water (m3)	304961	205518	183014	222719	248224	255104	275412	276305	337158	304279	228766	253150	3094610
Water meter accuracy													
Losses (m3)	75940	136384	221759	201295	228181	247492	235755	265993	184571	170851	203845	155342	2327408
Losses (%)	19.0	39.0	54.8	47.5	47.9	49.2	46.1	49.0	35.4	36.0	47.1	38.0	42.9

Observations

Many of the existing agricultural wells inside the city are either stopped or work few hours every week. This was happened because; the expansion of residential areas came over the agricultural areas for these wells. Therefore, it is not an aim for the Municipality to buy these wells or use the quantity of water allocated for agriculture, but their quota is not used any way. Table.. below shows the basic information regarding the agricultural wells that the Municipality is intending to include in the water supply system. used.

Future Plans

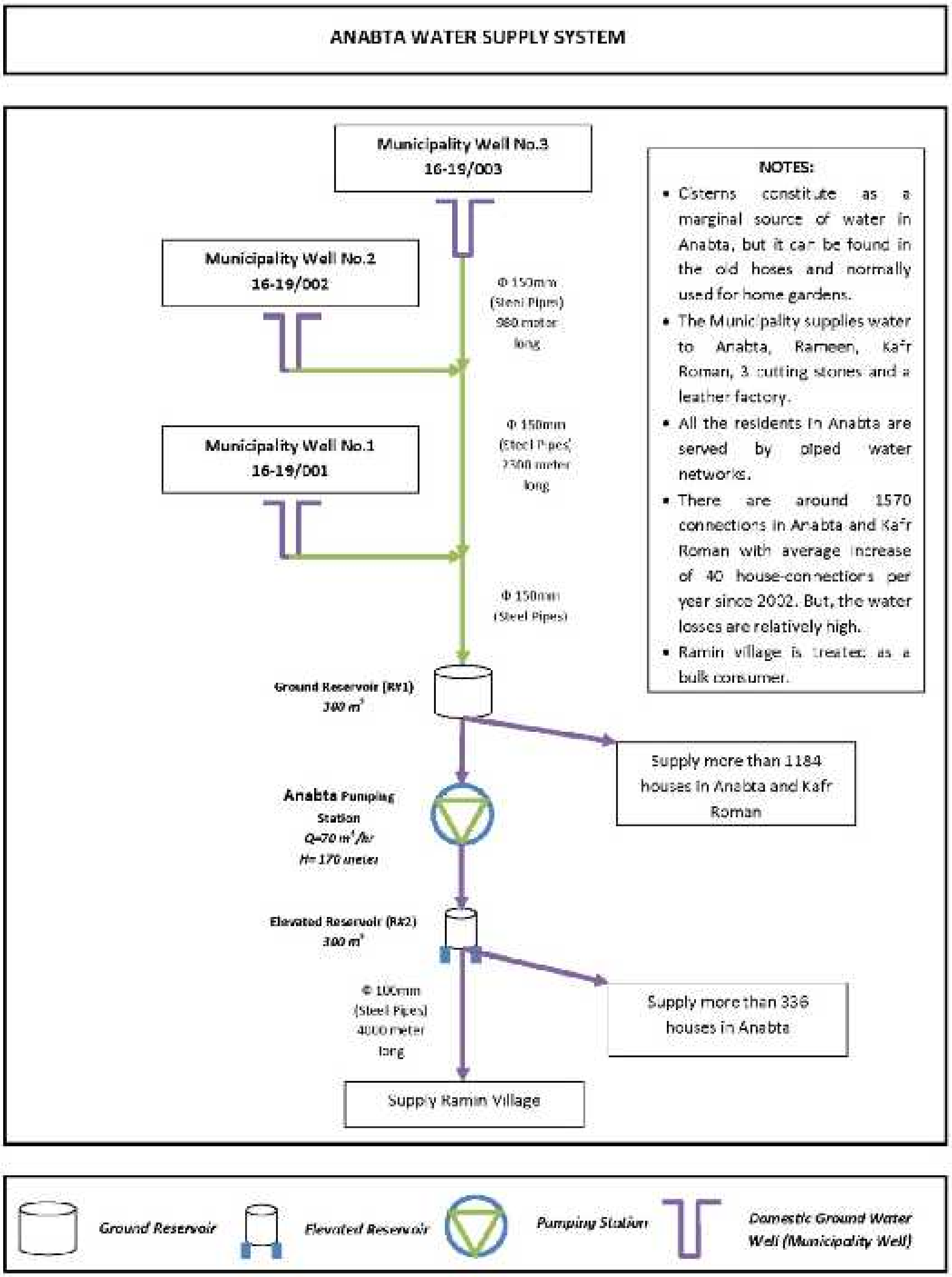
Many of the existing agricultural wells inside the city are either stopped or work few hours every week. This was happened because; the expansion of residential areas came over the agricultural areas for these wells. Therefore, it is not an aim for the Municipality to buy these wells or use the quantity of water allocated for agriculture, but their quota is not used any way. Table.. below shows the basic information regarding the agricultural wells that the Municipality is intending to include in the water supply system.

Table(22): The basic information regarding the agricultural wells

Well Id	Owner	x	y	z	Discharge	Comments
15-19/017 **No. 1**	Tulkarm Mun.	152397	190847	82	130 Or 155/6.5 bar	Depth 90 meter open hole, pumping pipes 8" and length 75 meters. The submersible turbine is 10" and 25 open stages. Work by electricity, and motor size 150 hp, at 1475 rpm. In the site of the well exist a standby diesel generator of capacity 200 kw at 1500 rpm.
15-19/018 **No. 2**	Tulkarm Mun.	152449	190953	92	100 at 5.5 bar	Depth 125 meter of 12" diameter, pumping pipes 6" and length 127 meters. The vertical turbine is 8" and 22 open stages. Work by electricity, and motor size 150 hp, at 1475 rpm. In the site of the well exists a standby diesel generator of capacity 200 kw at 1500 rpm.
15-19/046 **No. 3**	Tulkarm Mun.	152938	191842	68	135	Depth 157 meter of 18" diameter, pumping pipes 8" and length 100 meters. The vertical turbine is 11". Work by electricity, and motor size 150 hp, at 1475 rpm. In the site of the well exists a standby diesel generator of capacity 320

						kw at 1500 rpm.
No. 4	Tulkarm Mun.	153281	193768	100	145 Or 130 at 13 bar	Depth 125 meter of 14" diameter, pumping pipes 8" and length 107 meters. The vertical turbine is 11". Work by electricity, and motor size 150 hp, at 1475 rpm. In the site of the well exists a standby diesel generator of capacity 176 kw at 1500 rpm.
15-19/001A **No. 5**	Tulkarm Mun.	154456	191284	106	125	The borehole is not straight and the existing vertical turbine should be replaced by submersible one. Depth 186 meter of 18" diameter, pumping pipes 6" and length 107 meters. The vertical turbine is 9.5". Work by electricity, and motor size 150 hp, at 1475 rpm. In the site of the well exists a standby diesel generator of capacity 200 kw at 1500 rpm.
15-19/002A **No. 6**	Tulkarm Mun.	153453	190006	83	230	Depth 202 meter open hole, pumping pipes 8" and length 127 meters. The submersible turbine is 8". Work by electricity, and motor size 182 hp, at 1475 rpm. In the site of the well exist a standby diesel generator of capacity 200 kw at 1500 rpm.
15-19/001	Moh'd Sa'id Kamal	153130	191950	155	70	Full rehabilitation and connection to electricity
15-19/006	R’afat Qubbaj	155920	191840	95	70	Connection to electricity and protection against pollution
15-19/014	Rasheed Diyab	152.970	190.020	65	80	Full rehabilitation and connection to electricity
15-19/018	Abdul Karim Qasem	152.580	189.920	67	70	Full rehabilitation and connection to electricity

Anabta



Fig(9):Anabta Water Supply System

Community Profile

Table (23): Community Profile

Water Sources	3 groundwater wells owned by the municipality and producing 178 m3/hour. The water quality of one of the wells has high nitrate > 100mg/l.	
Cisterns	% households with cisterns	No. Of Cisterns
	30%	?
Water Supply System		
	Storage Volume (m3)	600m3 : 300m3 with a pump+ 300m3 distributing reservoir.
	Area of Coverage	Anabta, Kufur Rumman and Rameen
	Age of Network	The first established network was before 52 years, the existing network was in 1980.
	Last Date of Rehabilitation	1999
	Last Date of Extension	2001+2006+2008+2010
	Type of meters	1570 meters: 200 volumetric meters and the others are Speed (velocity)
	No. of Connections	1570
	Connection Fees	135 JD
Water Use		
	% of Domestic Use	95
	% of commercial and Industrial Use	5
	% of other uses	0
	Average use (l/c/d)	118
	% of losses	36
	Volume of Bulk Supply (m3), to who?	Rameen: 250m3 + Kufr Rumman: 5000m3+ Al-Kassarat area: 3503 / monthly

Water Service	Water is Managed by the Council?	Yes
	Total No. Of workers	11
	No. Of Maintenance workers	6
	No. Of Accountants	1
	No. Of Meter Readers	
	No. Of Administrative Staff	4
Comments and other Information	Despite of the re-new and install the water network, the loss of water is high and reaches 35-40%.	
	As a result of the financial hardship in the municipalities, they need help to have spare pump for the reservoirs, and need spare pieces with metal pipes and equipments.	
	The first reservoir (300m3 with pump station to the second reservoir) serves the areas in the same level which include 65% from the town. Whereas, the other areas (35%) are served from the second reservoir which include the high places that are higher than the level of the first reservoir.	

Total Water Use

Table(24): Total Water Use

Year 2005													
Item	Jan.	Feb.	Mar.	April	may	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Supplied Water	28176	29370	27330	35086	49000	59879	48006	48190	43174	38872	30803	26251	464137
Consumed water	14609	14358	13318	18527	32478	28199	28704	33754	25253	24832	18610	14655	267297
Water meter accuracy	1691	1762	1640	2105	2940	3593	2880	2891	2590	2332	1848	1575	27847
Losses	11876	13250	12372	14454	13582	28087	16422	11545	15331	11708	10345	10021	168993
Losses percentage	42%	45%	45%	41%	28%	47%	34%	24%	36%	30%	34%	38%	36%
Year 2006													
Supplied Water	27030	27685	25060	31659	34490	43910	46014	45468	46013	40635	31807	28255	428026
Consumed water	16101	13872	15218	16679	22562	28594	29814	32492	28694	26715	16695	18636	266072
Water meter accuracy	1622	1661	1504	1900	2069	2635	2761	2728	2761	2438	1908	1695	25682
Losses	9307	12152	8338	13080	9859	12681	13439	10248	14558	11482	13204	7924	136272
Losses percentage	34%	44%	33%	41%	29%	29%	29%	23%	32%	28%	42%	28%	32%
Year 2007													
Supplied Water	29015	25245	26545	33135	45728	46275	55042	55633	46315	45202	36681	26452	471268
Consumed water	15668	13632	16458	19550	28809	28228	35227	34492	28715	28477	20908	17194	287358
Water meter accuracy	1451	1262	1327	1657	2286	2314	2752	2782	2316	2260	1834	1323	23563
Losses	11896	10351	8760	11928	14633	15733	17063	18359	15284	14465	13939	7935	160347
Losses percentage	41%	41%	33%	36%	32%	34%	31%	33%	33%	32%	38%	30%	34%
Year 2008													
Supplied Water	34035	25420	31765	42695	40728	55275	55273	53512	49618	44727	37843	34142	505033
Consumed water	16441	15045	18810	23081	24280	38835	33598	31776	29268	28506	20265	18016	297921
Water meter accuracy	1702	1271	1588	2135	2036	2764	2764	2676	2481	2236	1892	1707	25252

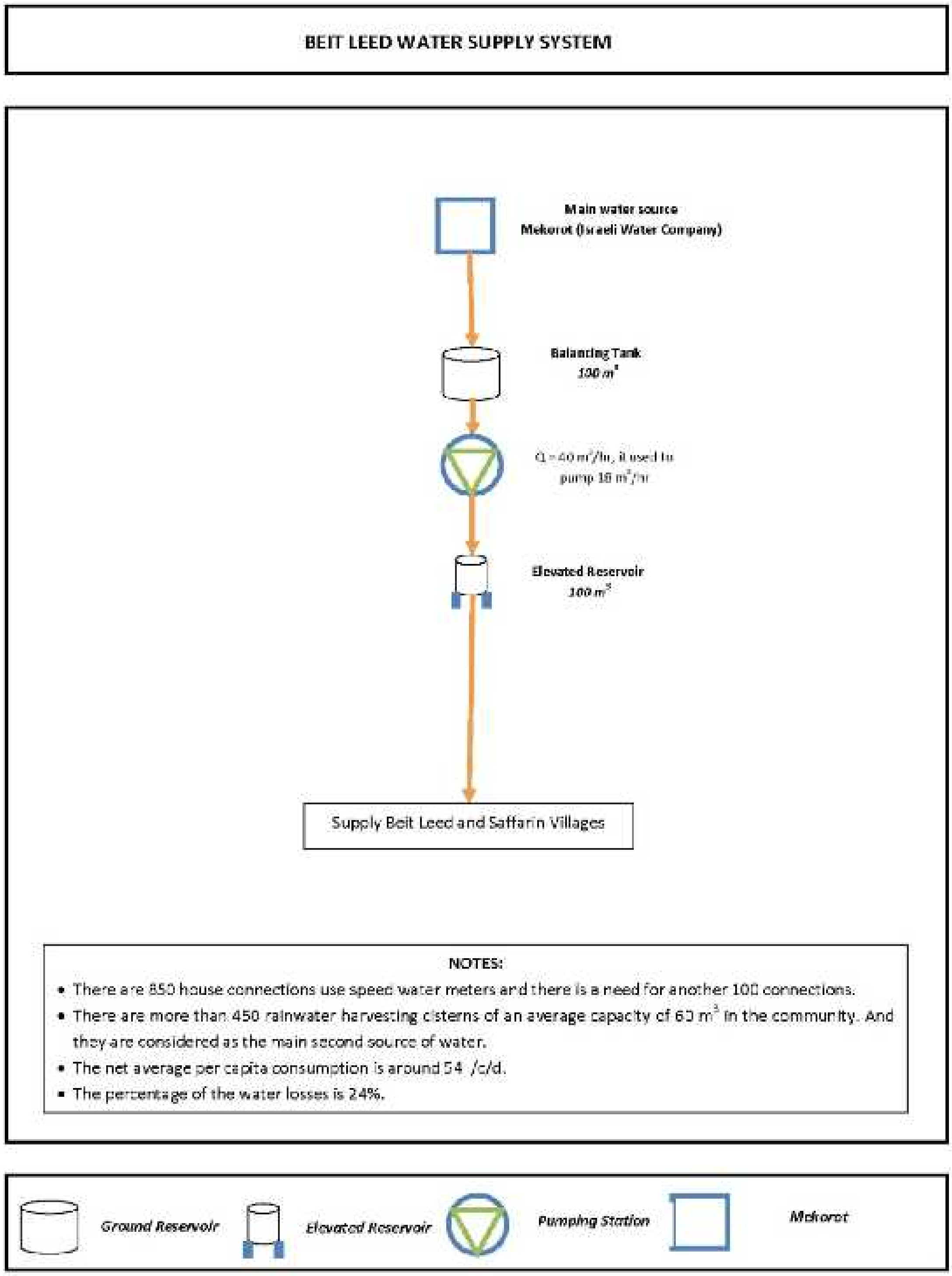
Losses	15892	9104	11367	17479	14412	13676	18911	19060	17869	13985	15686	14419	181860
Losses percentage	47%	36%	36%	41%	35%	25%	34%	36%	36%	31%	41%	42%	36%

Observations

There are around 1570 connections in Anabta and Kufur Romman and average increase of 40 house connections per year since 2002. Rameen village is treated as a bulk consumer with fixed tariff of 0.52 JD/ m3. Water losses are relatively high in Anabta because of: 1- Insufficient maintenance 2- Speed water meters is used.

Water quality is questionable especially that supplied from well#1. This may have health implication.

Beit Leed



Figure(10): Beit Leed Water Supply System

Community Profile

Table (25): Community Profile

Water Sources	Mekorot secondary source rainwater harvesting cisterns	
Cisterns	% households with cisterns	No. of Cisterns
		450
Water Supply System	Storage Volume (m3)	100 m3 balancing tank and 100 m3 reservoir
	Area of Coverage	
	Age of Network	16 years (Established in 1994)
	Last Date of Rehabilitation	
	Last Date of Extension	2008 - partly
	Type of meters	Speed (velocity)
	No. of Connections	850
	Connection Fees	120 JD (100 connection fees + 20 for insurance)
Water Use	% of Domestic Use	90%
	% of Commercial and Industrial Use	0
	% of other uses	10%
	Average use (l/c/d)	
	% of losses	
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	The municipality
	Total No. of workers	10
	No. of Maintenance workers	3
	No. of Accountants	2
	No. of Meter Readers	2

	No. of Administrative Staff	3
Comments and other Information	They need to maintain the water network and change the meters from speed to volumetric, and also to extend the water network.	

Total Water Use

Table(26): Total Water Use

Year 2008													
Supplied Water (m3)	8550	8590	9746	13015	11120	12150	11950	13410	11010	12980	9430	9780	131731
Consumed water (m3)	5384	5213	7851	10197	9081	10426	10994	10368	10215	7266	6551	6541	100087
Water meter accuracy													
Losses (m3)	3166	3377	1895	2818	2039	1724	956	3042	795	5714	2879	3239	31644
Losses (%)	37	39.3	19.4	21.7	18.3	14.2	8	22.7	7.2	44	30.5	33.1	24
Year 2009													
Supplied Water (m3)	8810	8690	8430	9390	11630	11240							
Consumed water (m3)	5647	5319	5900	7741	9006	10056	10528	8557					
Water meter accuracy													
Losses (m3)	3163	3371	2530	1649	2624	1184							
Losses (%)	35.9	0.4	0.3	0.2	0.2	0.1							

Observations

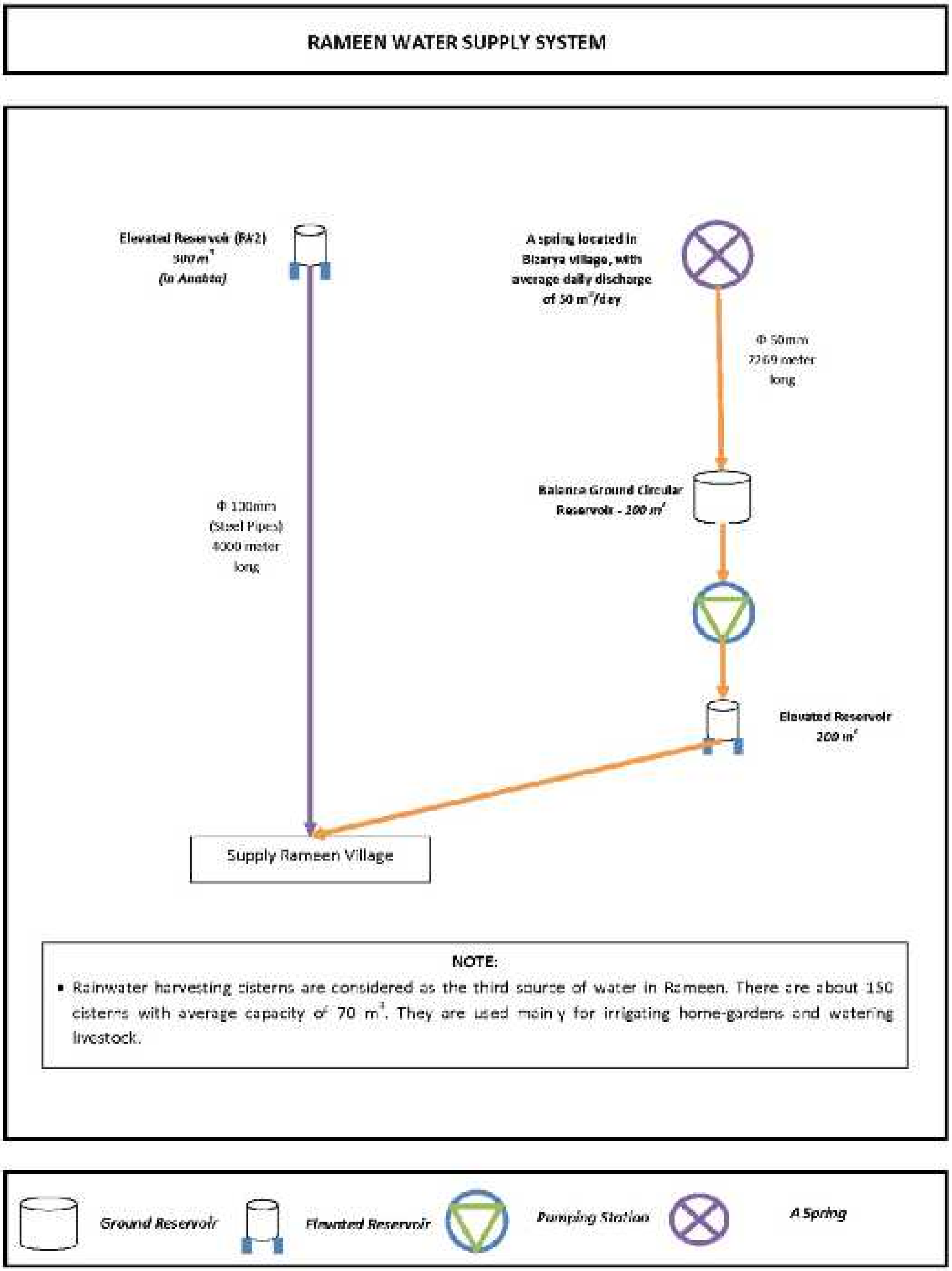
According to municipality representatives, the amount of water supplied by Mekorot is insufficient and is usually cut during the summer season in spite of the increased demand. These issues result in water interruptions in the village especially frequent during the summer season.

Additionally, the current available supply is with all means insecure as it is comes from an external source namely Mekorot, which has taken the custom of reducing water amounts supplied to Palestinian communities especially during the summer when its most needed. To add to the risk, the local council has no alternative sources to supplement the urgent needs of its community. Finally, the local security and economy will not be secure without an alternative water source especially since the main water source is not controllable locally.

To insure that water can reach all houses, the municipality divided the town into four service area. Three service areas receive water twice a week and one day for the old town. In some cases each of these service areas is divided into subzones to enable some houses to get some water. The municipality has put a schedule for filling and emptying the reservoir. The outlet opens at 21:00 o'clock and closes at 5:30, then at 10:00 o'clock it opens again. This strict operation during summer could only make it possible to distribute water equally between people. However, the demand is much higher than the supplied quantities, therefore; the municipality got a fund through the PWA and built a balance reservoir (100 m3) and a new pump station with new capacity of 40 m3/hr. This pumping rate will be enough to meet the community demand and Saffarin village as well. The water network was expanded in 2006 and 2008, but still there is an urgent need to reconnect 100 houses because the exiting connections are deteriorated.

There is 850 house connections use speed water meters. The community suffers from chronic water shortage and particularly during summer. Therefore, cisterns constitutes as the second source of water in Beit Leed. There are more than 450 citterns of an average capacity of 60 m3 in the community. Due to water cut in summer, there is a high demand by new built houses to dig their own cisterns. However, its cost is relatively high; for an average size of 70 m3, the construction of pear shape cistern costs around $US 3500, and concrete cistern around $US 5500

Rameen



Figure(11): Rameen Water Supply System

Community Profile

Table(27): Community Profile

Water Sources	The main water source supplying the village comes from Anabta Municipality. Residents also rely on a spring owned by Rameen situated in the village of Bizarya with an average discharge of 20 m3/day augmented in the network. Cisterns are mainly used for agricultural purposes	
Cisterns	% households with cisterns	No. of Cisterns
		150
Water Supply System	Storage Volume (m3)	100 m3 balancing tank and 200 m3 reservoir
	Area of Coverage	all
	Age of Network	13 years (Established in 1997)
	Last Date of Rehabilitation	
	Last Date of Extension	2008
	Type of meters	speed
	No. of Connections	365
	Connection Fees	150 JD
Water Use	% of Domestic Use	93
	% of Commercial and Industrial Use	2
	% of other uses/Agricultural	5
	Average use (l/c/d)	60
	% of losses	30
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	3
	No. of Maintenance workers	1
	No. of Accountants	1
	No. of Meter Readers	The same worker of the maintenance

	No. of Administrative Staff	1
	Pricing system	Increasing block tariff Consumption Category — Price 0 – 4 m3 (Minimum) — 16 NIS +5 NIS for maintenance 5 – 10 m3 — 4.6 NIS/m3 – 30 m3 — 5.9 NIS/m3 >30 m3 — 6.5 NIS/m3
Comments and other Information	The upper reservoir is damaged. The internal network to the houses is very damaged. The pumps need maintenance because are old.	
	The chlorine set is old.	
	They need to extend the network at least 1500 M.L	

Total Water Use

Table(28): Total Water Use

Year 2008													
Supplied Water (m3)	3412	3412	3412	3412	4500	10900	6600	4880	4239	6160	3190	3603	57720
Consumed water (m3)	2114	3085	2762	3198	4661	5127	4715	3782	3567	2845	2245	2536	40637
Water meter accuracy													
Losses (m3)	1298	327	650	214	-161	5773	1885	1098	672	3315	945	1067	17083
Losses (%)	38.0	9.6	19.1	6.3	-3.6	53.0	28.6	22.5	15.9	53.8	29.6	29.6	29.6
Year 2009													
Supplied Water (m3)	3637	3100	2840	4105	4115	6020							
Consumed water (m3)	3164	3600	3577	4116	4618	5748							
Water meter accuracy													
Losses (m3)	473	-500	-737	-11	-503	272							
Losses (%)	13.0	-16.1	-26.0	-0.3	-12.2	4.5							

Observation:

There is a public water network system in Ramin village delivering water from groundwater well in the nearby village of Anabta. While Ramin's water spring is used as a second source of water to the village, its yield however remains short of supplementing more than 6 percent of the local demand.

Main water problems in the village:

The water from Anabata well undergoes on spot chlorination at the source, a fact that explains why a much less chlorinated supply reaches the households of Ramin causing quality related issues.

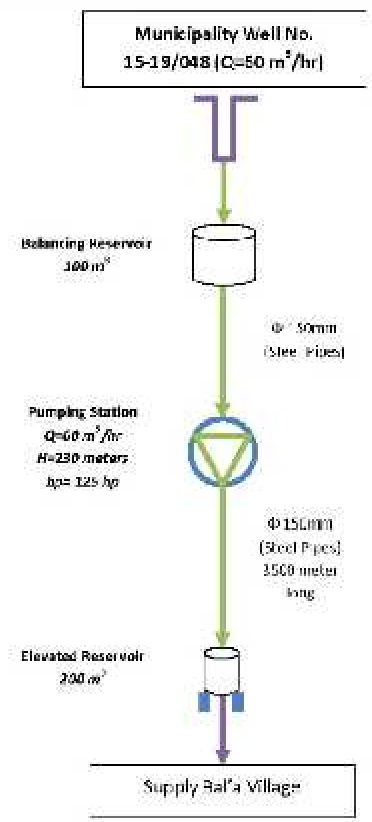
Most inhabitants in Ramin village don’t pay water bills causing the local council financial difficulties.

In Ramin village doesn’t possess an independent source of water with the exception of the spring (insufficient supply) therefore the community will remain mainly dependant on Anabta municipality to supply the water thus the community might be in jeopardy of water shortage and high water prices in the future.

Community water consumption mainly goes for domestic use. According to the village council there are no green houses or other types or irrigation; cattle exist and there around 1000 sheep which consume around 5% of the total supply. Other consumption types as commercial or industrial consumption are neglected or less than 2%. The average per capita consumption is around 60 l/c/d, however; the percentage of losses is 30%. The discharge of the spring is augmented in the network.

Bal'a

BAL'A WATER SUPPLY SYSTEM



NOTES:

- The Municipality Groundwater well is the only source of water which supply a network of 55 km long which contains 1350 house connections, 1100 out of them are using volumetric water meters.
- There are two main problems in the network (1) low pressure in high areas "i.e. no water" and (2) high pressure in the lower area "damage the water meter". Therefore, a new reservoir with higher elevation is recommended and better operation of the network.
- The agricultural demand is 35% of the total supply. There are 50 green houses, 200 dunums of field crops, 5000 sheeps and more than 1 million chickens.
- The net average per capita consumption is around 95 l/c/d, however, the percentage of losses is 31%.

Figure(12): Bal'a Water Supply System

Community Profile

Table(29): Community Profile.

Water Sources	The only source of water supplying the village is groundwater well no. 15-19/048 owned by Bal'a Municipality. Cisterns are only a marginal water source and are mainly used for agricultural purposes.	
Cisterns	% households with cisterns	No. of Cisterns
		500
Water Supply System	Storage Volume (m3)	100 m3 balancing tank and 200 m3 reservoir
	Area of Coverage	All houses , including farms
	Age of Network	15 years (Established in 1995)
	Last Date of Rehabilitation	
	Last Date of Extension	2008
	Type of meters	1100 volumetric meters
	No. of Connections	1350 domestic connections 225 agricultural connections
	Connection Fees	100 JD for domestic use, 150 JD for agricultural use
Water Use	% of Domestic Use	65
	% of Commercial and Industrial Use	
	% of other uses/Agricultural	35
	Average use (l/c/d)	95
	% of losses	31
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	The municipality
	Total No. of workers	13
	No. of Maintenance workers	4
	No. of Accountants	2

	No. of Meter Readers	2
	No. of Administrative Staff	3
	Pricing system	
Comments and other Information	They need main conveying pipeline from the reservoir (3000m 6"). Also, they need 2 pumping stations in order to operate the reservoir (500m3).	
	They want help in finding another source of water, because Bal 'a well productivity is decreasing from 90-60m3 / hour whereas there need is 120m3/hour.	

Total Water Use

Table (30): Total Water Use

Year 2008													
Supplied Water (m3)	11770	12160	16220	20270	25540	30380	42830	37530	36460	35940	36450	34740	340290
Consumed water (m3)	12176	12619	15846	18986	19558	26368	26652	26451	23553	19904	15932	16038	234083
Water meter accuracy													
Losses (m3)	-3.4	-3.8	2.3	6.3	23.4	13.2	37.8	29.5	35.4	44.6	56.3	53.8	31.2
Losses (%)	11770	12160	16220	20270	25540	30380	42830	37530	36460	35940	36450	34740	340290
Year 2009													
Supplied Water (m3)	21230	17850	19240	26890	34880	39590	41910	201590					
Consumed water (m3)	13672	14180	13020	17087	21587	24997	25974	130517					
Water meter accuracy													
Losses (m3)													
Losses (%)	35.6	20.6	32.3	36.5	38.1	36.9	38.0	35.3					

Observations

Municipal Water consumption mainly goes for domestic and agriculture use as well. According to the Municipality there are 50 green houses and 200 dunums of field crops. In addition to that there are 5000 sheep and more than 1 million chickens which consume around 35% of the total supply. This makes Bal'a an extremely sensitive case for water cut. Cisterns constitutes as a marginal source of water in Bal'a. Hardly to find a family that still uses cisterns for domestic purposes. The old houses which have 500 contain cisterns, but normally ignored by people since the network establishment in 1995.

Other consumption types as commercial or industrial consumption are marginal. The net average per capita consumption is around 95 l/c/d, however; the percentage of losses is 31%.

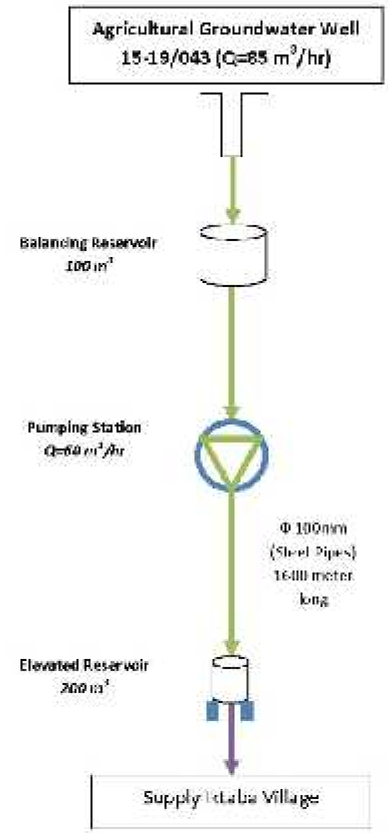
Water insufficiency has resulted in frequent interruptions in the network especially for elevated areas. The survey reveals that around 30 percent of elevated houses suffer from water interruptions during summer season. Municipality members have emphasized the community's need for storage tank in the high part of the village in order to distribute water to these areas with minimal interruptions.

Also, the water interruptions affect the agriculture sector and livestock specifically the chicken farms as those farms are using the tankered water to fill the water gap during the water interruptions at the community. Eventually, it is very difficult for the farm owners to rely mainly on such water tanks due to water high expenses and the insufficiency of water. In the same time, the farms owners are compelled to purchase those water tanks during the water interruptions despite the bearable losses in order to keep their farms existing.

The realistic solution to water supply problem should be by introducing an alternative groundwater well, or a main supply pipeline to another well in the area with booster pump. The reservoir is small and doesn't cover the whole community, and many houses are cut off of water most of day in the summer because of low pressure in the network. While many other houses have broken house connections and damages of the water meters because of the high pressure. Water losses are also relatively high. Water is chlorinated at the site of the well; and water quality is monitored by the Tulkarem Health Directorate.

Iktaba

IKTABA WATER SUPPLY SYSTEM



NOTES:

- The agricultural groundwater well is the main source of water supply, whereas, rainwater harvesting cisterns is considered as marginal source of water in Iktaba.
- 90% of the supplied water from the agricultural groundwater well goes for domestic and 10% goes for agricultural and industry.
- The water distribution network constructed in 1997 of 4", 3", 2" and 1" steel pipes. Most of lengths are 3", 2" of lengths 2500, and 4000 meters respectively.
- There are 580 house connections which use speed water meters, among them 60 houses lack water supply during summer due to low pressure in the network.
- The net average per capita consumption is around 100 l/c/d, however, the percentage of losses is 41%.

Figure(13): Iktaba Water Supply System

Community Profile

Table(31): Community Profile

Water Sources	The only source of water supplying the village is the agricultural groundwater well no. 15-19/043. Cisterns are only a marginal water source and are mainly used for agricultural purposes.	
Cisterns	% households with cisterns	No. of Cisterns
	50	90
Water Supply System	Storage Volume (m3)	100 m3 balancing tank and 200 m3 reservoir
	Area of Coverage	449
	Age of Network	13 years (Established in 1997)
	Last Date of Rehabilitation	Not rehabilitated since installation
	Last Date of Extension	Not expended since installation
	Type of meters	Speed (velocity) water meters
	No. of Connections	580
	Connection Fees	
Water Use	% of Domestic Use	90
	% of Commercial and Industrial Use	
	% of other uses/Agricultural and Industrial	10
	Average use (l/c/d)	100
	% of losses	41
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	5
	No. of Maintenance workers	2
	No. of Accountants	1
	No. of Meter Readers	1
	No. of Administrative Staff	2

Comments and other Information	Pricing system	
	There are 10 greenhouses consume 700m3 monthly, and there are 7 chicken farms consume 200 m3 monthly. Sheep percentage in the area is law, does not exceed 60 head of sheep.	
	Concerning the water network, it has not been expanded, where as, the pipes were been changed from 1/2" to 1", and from 1" to 2".	
	They need to change the old meters (from speed to volumetric). They need to drill a new groundwater well.	

Total Water Use

Table(32): Total Water Use

Year 2008												
Supplied Water (m3)	8780	7790	13250	15100	16730	17550	19030	17550	15980	12400	12170	11410
Consumed water (m3)	4520	5619	5668	8288	9706	7327	14661	10520	11243	7760	8151	6193
Water meter accuracy												
Losses (m3)	4260	2171	7582	6812	7024	10223	4369	7030	4737	4640	4019	5217
Losses (%)	48.5	27.9	57.2	45.1	42.0	58.3	23.0	40.1	29.6	37.4	33.0	45.7
Year 2009												
Supplied Water (m3)	9540	9820	10680	12630	16160	18240	20670					
Consumed water (m3)	5146	5412	5911	7074	8374	9444	11772					
Water meter accuracy												
Losses (m3)	4394	4408	4769	5556	7786	8796	8898					
Losses (%)	46.1	44.9	44.7	44.0	48.2	48.2	43.0					

Observation:

The main problems with water system in Iktaba could be confined in two major problems:

Water interruptions in instances when the well breaks down or pumpage is stopped, which impacts the village's economy.

The high percentage of water leakage affiliated to the current condition of the water public network.

Water interruptions have several negative impacts on the local community. In this regard, the agricultural sector in Iktaba village was severely affected by the water interruptions as well as other sectors that require water on a daily basis.

At the household level, water insufficiency and the constant supply interruption often compel people to purchase water tanks for high prices.

Municipal Water consumption mainly goes for domestic and agriculture use as well. According to the Village council there are 10 green houses and 20 dunums of field crops. In addition to that there are 500 sheep and more than 3000 chickens which consume around 8% of the total supply. Other consumption types as commercial or industrial consumption are important as well, such that concrete and brick factories. The net average per capita consumption is around 100 l/c/d, however; the percentage of losses is 41%.

Kufr Al Labad

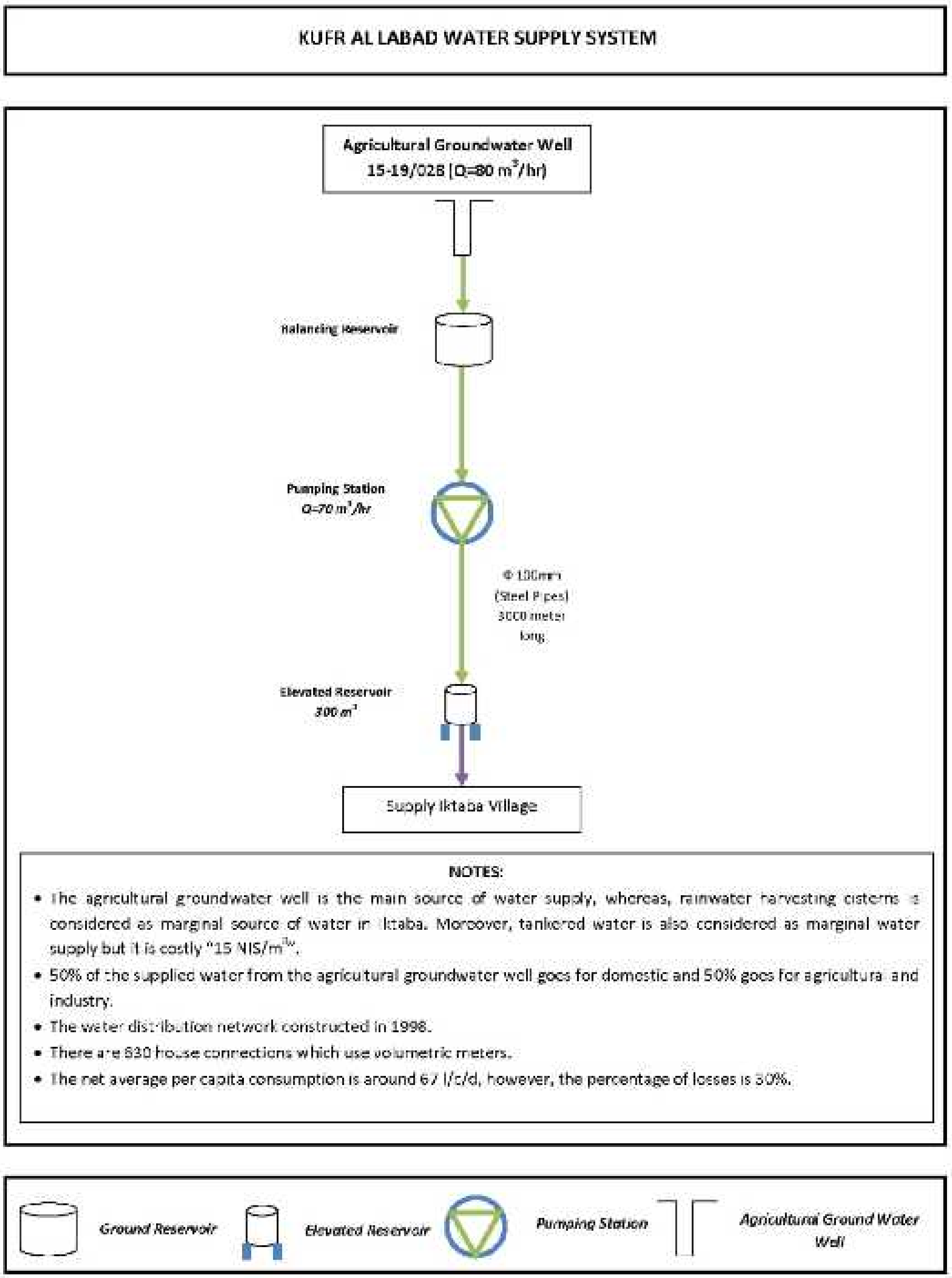
Water insufficiency is currently the major problem facing the village causing increased water interruptions during the summer season when demand is at its highest points for both agricultural and domestic sectors.

Therefore, the water insufficiency in the village directly harms the agriculture sector forcing farmers to abandon their cultivated lands in pursuit of other sources of income. Generally, the water interruptions during the summer caused a lot of losses in agriculture sector reaches around 20 thousands shekels annually.

Municipal Water consumption mainly goes mainly for domestic use. According to the Municipality there are 15 green houses and 500 sheep and 15000 chicken which consume around 10% of the total supply. Other consumption types as commercial or industrial consumption are marginal. The average per capita consumption is around 67 l/c/d, however; the percentage of losses is 30%.

The only water source in this locality is a private agricultural well supplying the public network for both domestic and agricultural use. The Supply system can be shown as follows:

Kufr Al Labad :



Figure(14): Kufr Al Labad Water Supply System

Community Profile

Table(33): Community Profile

Water Sources	The only source of water supplying the village is the agricultural groundwater well no. 15-19/028. Cisterns and tankers are only marginal water.	
Cisterns	% households with cisterns	No. of Cisterns
	60	
Water Supply System	Storage Volume (m3)	?? m3 balancing tank and 300 m3 reservoir
	Area of Coverage	all
	Age of Network	12 years (Established in 1998)
	Last Date of Rehabilitation	Not rehabilitated since installation
	Last Date of Extension	Not expended since installation
	Type of meters	Volumetric water meters
	No. of Connections	630
	Connection Fees	990 NIS including meter cost: 190 NIS
Water Use	% of Domestic Use	50
	% of Commercial and Industrial Use	
	% of other uses/Agricultural Use	50
	Average use (l/c/d)	67
	% of losses	30
	Volume of Bulk Supply (m3), to who?	Izbet Abu Ikhmeish:53m3+ Izbet Al-Khallal: 23m3+ Al-Hafasah: 32m3.
Water Service	Water is Managed by the Council?	The Municipality
	Total No. of workers	9
	No. of Maintenance workers	1
	No. of Accountants	2
	No. of Meter Readers	4
	No. of Administrative Staff	2
	Pricing system	
Comments and other	They need to extend the water network	

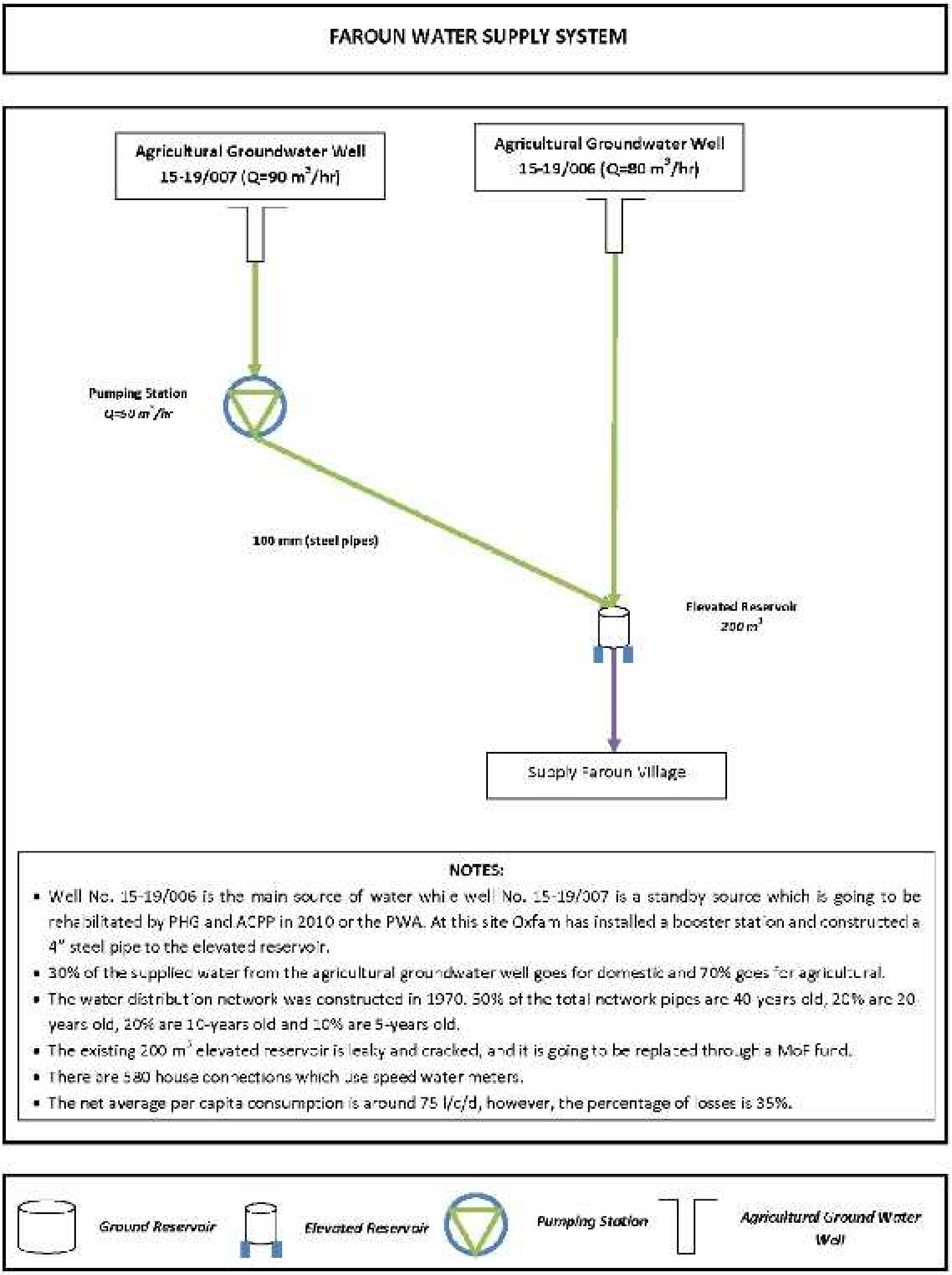
Information	

Total Water Use

Table(34): Total Water Use

Year 2008											
Supplied Water (m3)	6950	6700	9000	12000	12000	15250	15500	16500	16000	15000	9000
Consumed water (m3)	4769	3736	5684	8336	8105	9614	10899	11630	7809	13037	10120
Water meter accuracy											
Losses (m3)	2181	2964	3316	3664	3895	5636	4601	4870	8191	1963	-1120
Losses (%)	31.4	44.2	36.8	30.5	32.5	37.0	29.7	29.5	51.2	13.1	-12.4
Year 2009											
Supplied Water (m3)											
Consumed water (m3)											
Water meter accuracy											
Losses (m3)											
Losses (%)											

Faroun



Figure(15): Faroun Water Supply System

Community Profile

Table (35): Community Profile

Water Sources	The village relies on two agricultural groundwater wells 15-19/006 and 15-19/007 (standby).	
Cisterns	% households with cisterns	No. of Cisterns
	10%	25
Water Supply System	Storage Volume (m3)	200 m3 reservoir
	Area of Coverage	750 houses
	Age of Network	40 years (Established in 1970)
	Last Date of Rehabilitation	2008
	Last Date of Extension	2008
	Type of meters	100 volumetric + 650 speed
	No. of Connections	750
	Connection Fees	660 NIS
Water Use	% of Domestic Use	30
	% of Commercial and Industrial Use	
	% of other uses/Agricultural Use	70
	Average use (l/c/d)	75
	% of losses	35
	Volume of Bulk Supply (m3), to who?	(300-400 m3 monthly, for another area belongs to Faroun).
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	3
	No. of Maintenance workers	1
	No. of Accountants	1
	No. of Meter Readers	1
	No. of Administrative Staff	1

	Pricing system	Increasing block tariff Consumption Category — Price 0 m3 — 10 NIS 1 – 20 m3 — NIS/m3 21 – 50 m3 — 3.4 NIS/m3 >50 m3 — 4.0 NIS/m3
Comments and other Information	They need to develop the water network.	
	The area depends on agriculture (50%)	
	There are 50 greenhouses, 10 dunums citrus, 50 dunums planted with thyme.	

Total Water Use

Table (36): Total Water Use

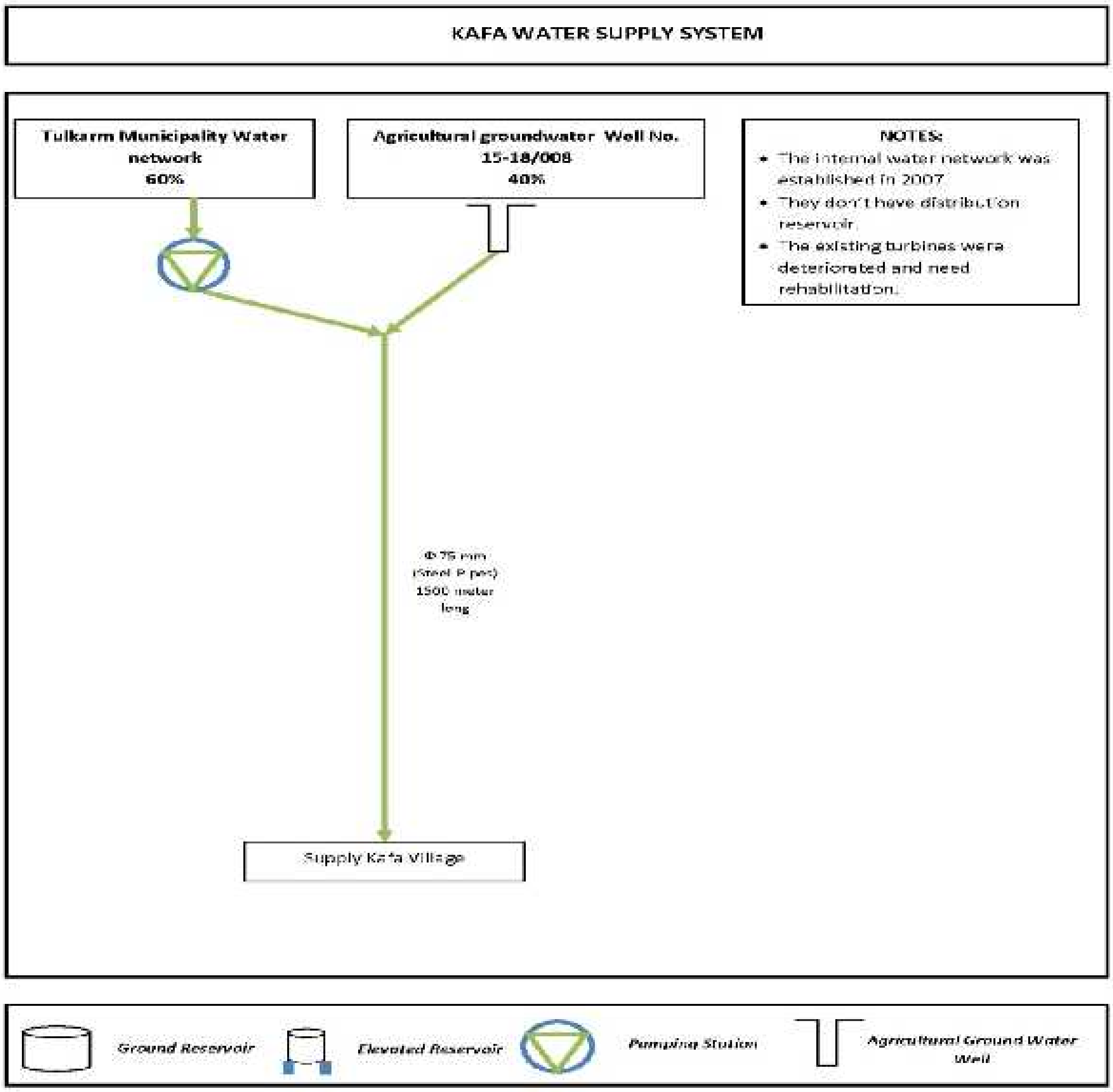
Year 2007												
Supplied Water (m3)	6990	7480	8900	7200	12320	13300	14000	13680	12870	12000	10450	10450
Consumed water (m3)	5222	4213	4360	6883	6554	8476	9790	9818	9623	8282	6187	5526
Water meter accuracy												
Losses (m3)	1768	3267	4540	317	5766	4824	4210	3862	3247	3718	4263	4924
Losses (%)	25.3	43.7	51.0	4.4	46.8	36.3	30.1	28.2	25.2	31.0	40.8	47.1
Year 2008												
Supplied Water (m3)	8500	6020	10000	12300	11980	13560	14190	14000	12860	10640	10800	8400
Consumed water (m3)	5316	4598	5317	6030	7272	9318	9890	10215	9366	8996	4808	5358
Water meter accuracy												
Losses (m3)	3184	1422	4683	6270	4708	4242	4300	3785	3494	1644	5992	3042
Losses (%)	37.5	23.6	46.8	51.0	39.3	31.3	30.3	27.0	27.2	15.5	55.5	36.2
Year 2009												
Supplied Water (m3)	11000	5240	12370									
Consumed water (m3)	6782	4031	5124									
Water meter accuracy												

Losses (m3)	4218	1209	7246
Losses (%)	38.3	23.1	58.6

Observations

Municipal Water consumption mainly goes for domestic use. According to the Village council there are many green houses and cultivated area, but they by water directly from the two wells. Other consumption types as commercial or industrial consumption are marginal. The average per capita consumption is around 75 l/c/d, however; the percentage of losses is 35%

Kafa



Figure(16): Kafa Water Supply System

Community Profile

Table (37): Community Profile

Water Sources	About 60% of the village relies on Tulkarm Municipality for their supply while the remaining 40% rely on agricultural groundwater well no. 15-18/008.	
Cisterns	% households with cisterns	No. of Cisterns
	100%	60
Water Supply System	Storage Volume (m3)	NA
	Area of Coverage	

	Age of Network	3 years (Established in 2007)
	Last Date of Rehabilitation	2007
	Last Date of Extension	2007
	Type of meters	Volumetric meters
	No. of Connections	65
	Connection Fees	600 NIS
Water Use	% of Domestic Use	20%
	% of Commercial and Industrial Use	
	% of other uses/Agricultural Use	80% for agricultural use, 2% from it for animal use
	Average use (l/c/d)	44
	% of losses	9
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	1
	No. of Maintenance workers	
	No. of Accountants	
	No. of Meter Readers	1
	No. of Administrative Staff	5
	Pricing system	
Comments and other Information	They need water reservoir, but they do not have land as public property.	
	There are 40-50 dunums of green houses and 10 dunums open areas. There are also 4 farms of animals consume 1-2%.	

Total Water Use

Table (38): Total Water Use

Year 2008						
Supplied Water (m3)						605
Consumed water (m3)						610
Water meter accuracy						
Losses (m3)						-5
Losses (%)						-0.8
Year 2009						
Supplied Water (m3)	386	638	847	530	571	
Consumed water (m3)	492	540	506	604	960	
Water meter accuracy						
Losses (m3)	-106	98	341	-74	-389	
Losses (%)	-27.5	15.4	40.3	-14.0	-68.1	

Observations

The distribution system in the village does not include a reservoir which is crucially needed. The exiting two turbines are in very bad condition and need immediate rehabilitation.

The domestic r network in the village attains it supply from two main groundwater wells, one of which is also connected to the agricultural network.

Main problems:

A large proportion of inhabitants are not willing to connect to the public water network because they are satisfied with the supply coming from the ground well that is connected to the agricultural network mainly because water is sold for much cheaper prices than the pubic network.

The second problem is that a lot of inhabitants supplied by the agricultural network which doesn't undergo standard quality checks. This source may be polluted and not perfectly fit for drinking purposes.

According to the project committee there are many green houses and cultivated area in the village, but they by water directly from the agricultural well 15-18/008. Other consumption types as commercial or industrial consumption are marginal. The average per capita consumption is around 44 l/c/d, however; the percentage of losses is 9%

Saffarin

According to the local council, the number of inhabitants in this community is decreasing directly as a result of water insecurity. Additionally, the water problem in Saffarin has entailed economic consequences affecting the community's coherence.

From a health perspective, water from tanks supplied to the community is considered of low standard quality due to the uninspected sources it comes from. Furthermore, this water is neither monitored for quality measures at the point when it reaches the community, leaving elevated chances for the generation of waterborne diseases.

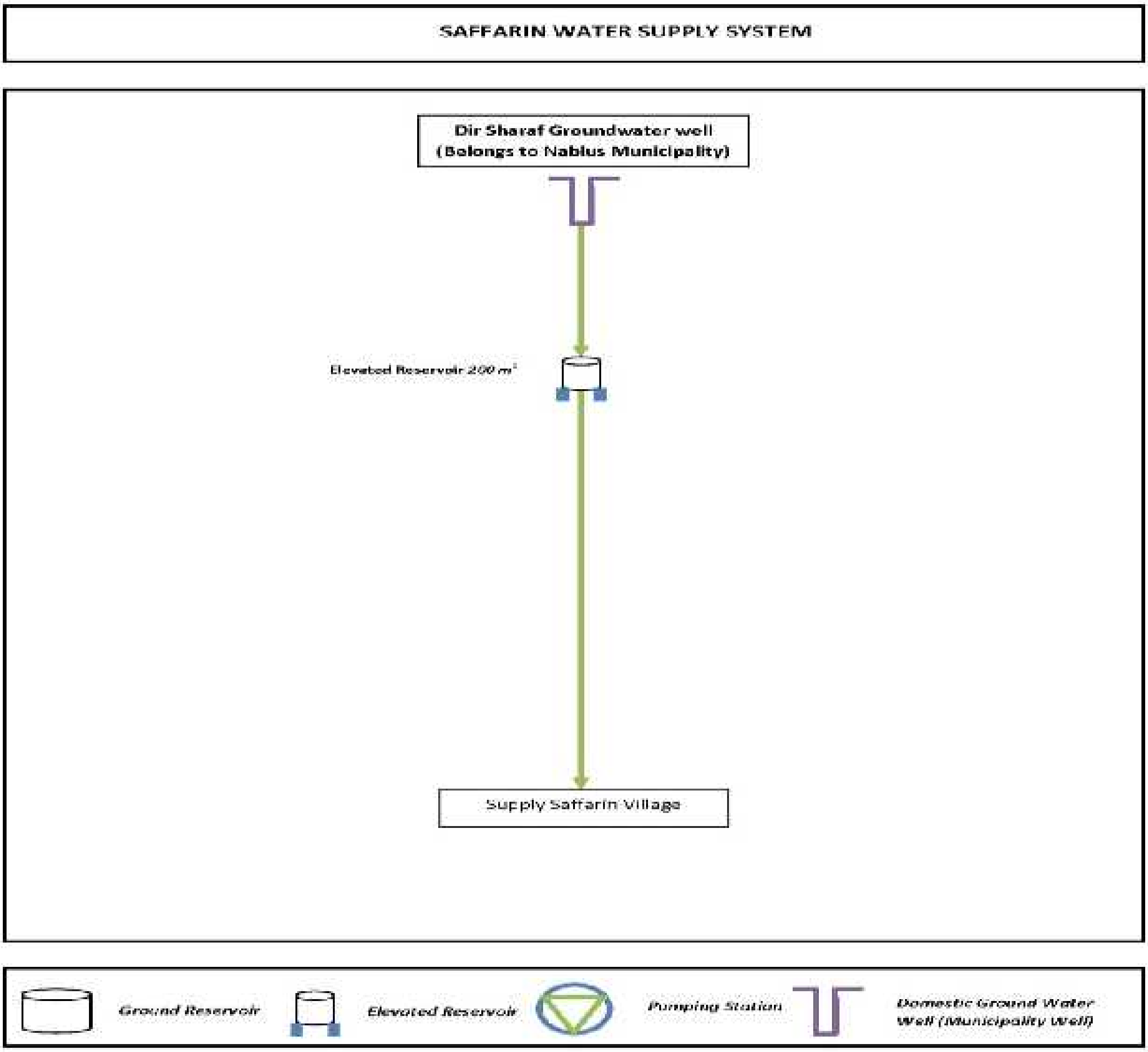
On a different note, the water originating from domestic water cisterns are not sufficient and incapable of satisfying community needs more than two months of a particular year.

The community has a lot of economic losses due to the water scarcity especially in the agriculture sector. These losses are estimated in thousands of shekels additionally the other sectors at the community were loaded of financial losses due water problem.

The community has been working to get water from Beit Leed, but these efforts have not been successful because there is no transmission line between the two communities, and the source of water (Mekorot) is not enough to supply both communities. Therefore, the community signed an agreement with agricultural well owners in Tulkarm to purchase water for 0.2 JD/m3. The distance is around 8.5 km against a static elevation of 240 meters. However, none of these solutions have been working. Therefore, the Village Council has to purchase water from Deir Sharaf groundwater well and fill the distribution reservoir for 10 NIS/m3. This could be the most non-logical technical and unfeasible financial solution, however; it is the only acceptable solution the Village Council said.

Currently, the village councils buys water via trucks and store in an elevated reservoir and distributes to households as shown in the diagram below.

Saffarin



Figure(17): Saffarin Water Supply System

Table (39): Community Profile

Water Sources	Deir Sharaf groundwater well owned by Nablus Municipality	
Cisterns	% households with cisterns	No. of Cisterns
		150
Water Supply System	Storage Volume (m3)	200 m3 reservoir
	Area of Coverage	all
	Age of Network	1 year (Established in 2009)
	Last Date of Rehabilitation	
	Last Date of Extension	
	Type of meters	
	No. of Connections	180
	Connection Fees	50 JD
Water Use	% of Domestic Use	95%
	% of Commercial and Industrial Use	
	% of other uses/Agricultural Use	5%
	Average use (l/c/d)	
	% of losses	9
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	4
	No. of Maintenance workers	1
	No. of Accountants	1
	No. of Meter Readers	The same worker of maintenance
	No. of Administrative Staff	2

	Pricing system	
Comments and other Information	They need fund to implement conveying water line from Kafa to Saffarin passing from Shofa village, that all the necessary procedures has been achieved in order to conduct and receive the water.	

Shoufa and Izbet Shoufa

The two communities in Shoufa and Izbet Shoufa are geographically separated from each other. To some extent the people are socially linked and share the same land; however, with time they become less connected or share common interests and projects. During the Intifada the settlement (Avni Hefits and the bypass road 574) closed the road between Shoufa and Izbet Shoufa. The main entrance to Shoufa from Tulkarm side is closed, and cut of services except from a long route through Anabta and the bypass road 574. The distance between Shoufa and Tulkarm City is around 6 kms; however, a result of closure it became more than 20 kms.

The two communities have the same village council; however, they don't share the same electric source or the solid waste services. Shoufa is still using diesel generators and have electricity for few hours' everyday. Izbet Shoufa is linked more to Tulkarm City with most of the infrastructure services including electricity and solid waste.

Water network exists since 1988 and cover only 80% of the houses. Water source is from a groundwater well 15-18/024 which owned by Shoufa Water Cooperative Committee. This well pumps around 30 m3/hr and this is far below the demand of the community. Therefore, Shoufeh suffers from water shortage during summer and buy water from well 15-19/030. The well capacity is very low compared to the aquifer capacity and nearby groundwater wells. The committee tried all possible means to improve its yield including Acidization thee times. However, the capacity didn't improve much and drawdown is high. This makes it not feasible to do any technical development or rehabilitation for the existing hole. The committee is working to get a permit to replace the well with new one. For this purpose the committee has been approaching the PWA, and The JWC to get the permit. According to them, they have got a verbal promise to replace the well.

Municipal Water consumption mainly goes for domestic and agricultural use. According to the Village council there are 80 green houses and 40 chicken farms which consume around 60% of the total supply. Other consumption types as commercial or industrial consumption are marginal. The average per capita consumption is around 196 l/c/d, however; the percentage of losses is 27%.

Shoufa Agricultural Cooperative is the main body who is in charge of water supply. The existing elevated tank needs rehabilitation since it leaks at several points. Water is used for domestic and agricultural, and in total there are 450 connections. There are 80 green houses, 40 chicken poultry, cows' farm and diary factory. This makes the consumption around 30% for other uses rather domestic. The house connections are used for agricultural purposes, and this causes stress on demand and less opportunity to regulate water distribution or allocation during the peak rates of consumption in summer times.

Main problems:

Water quality tests have revealed that the above mentioned well is polluted at the source. Although chlorination is applied to the supply, by the time it arrives to Shufa and Izbt Shufa the concentration of chlorine is much less.

The supply coming from the well is not sufficient (well's productivity is low (30m3/hr)) as between 40 – 60 percent of residents are forced to purchase water tanks to cover their needs. Additionally, this transaction is very costly causing residents to pay a much larger portion of their incomes on water than is internationally recommended. Some of the village inhabitants have decided to leave the community in search of better living conditions.

Domestic water supply -distributions network is used for agricultural purposes. However, this creates social conflicts, and possibility of water pollution.

The existing main transmission line is old and destroyed, and part of it is used by tenths of house connections before reaching the distribution reservoir.

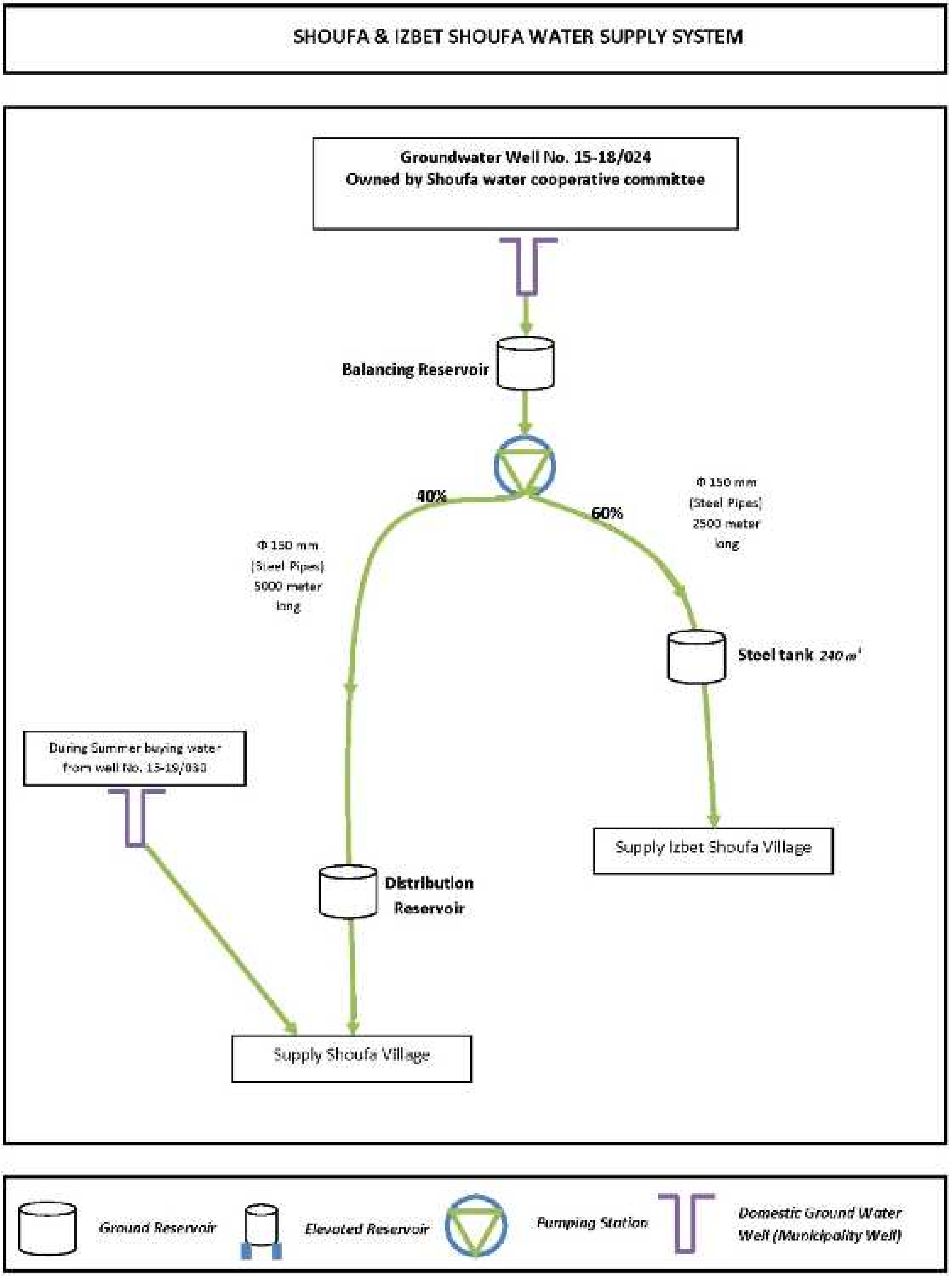
The main reservoir in Iz Shufa is open and made of steel. This is unhealthy water supply system, and should be abandoned immediately and whenever possible.

The site of the well is not protected against the surrounding pollution sources as wastewater flooding.

The existing tank in Shufa is old and leaky and needs rehabilitation or replacement.

Chlorination is not efficient and no residual chlorination at the end of the transmission line and for sure inside the water network in Shufa.

Shoufa and Izbet Shoufa



Figure(18): Shoufa and Izbet Shoufa Water Supply System

Table (40): Community Profile

Water Sources	Groundwater well no. 15-18/024 owned by Shoufa Water Cooperative Committee. Shoufa village also purchases water from well no. 15-19/030 during the summer.	
Cisterns	% households with cisterns	No. of Cisterns
		50
Water Supply System	Storage Volume (m3)	200 balancing tank and m3 reservoir
	Area of Coverage	All, but in summer partly
	Age of Network	22 years (Established in 1988)
	Last Date of Rehabilitation	
	Last Date of Extension	2007
	Type of meters	speed
	No. of Connections	450 (80% of the households)
	Connection Fees	220 JD
Water Use	% of Domestic Use	70
	% of Commercial and Industrial Use	3%
	% of other uses/Agricultural and Industrial Use	30
	Average use (l/c/d)	196
	% of losses	27
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	No, by the Shoufa Agricultural Cooperative
	Total No. of workers	11
	No. of Maintenance workers	2
	No. of Accountants	1
	No. of Meter Readers	1
	No. of Administrative Staff	7 (society administration)
	Pricing system	Increasing block tariff Consumption Category / Price 0 – 100 m3 / 2 NIS/m3

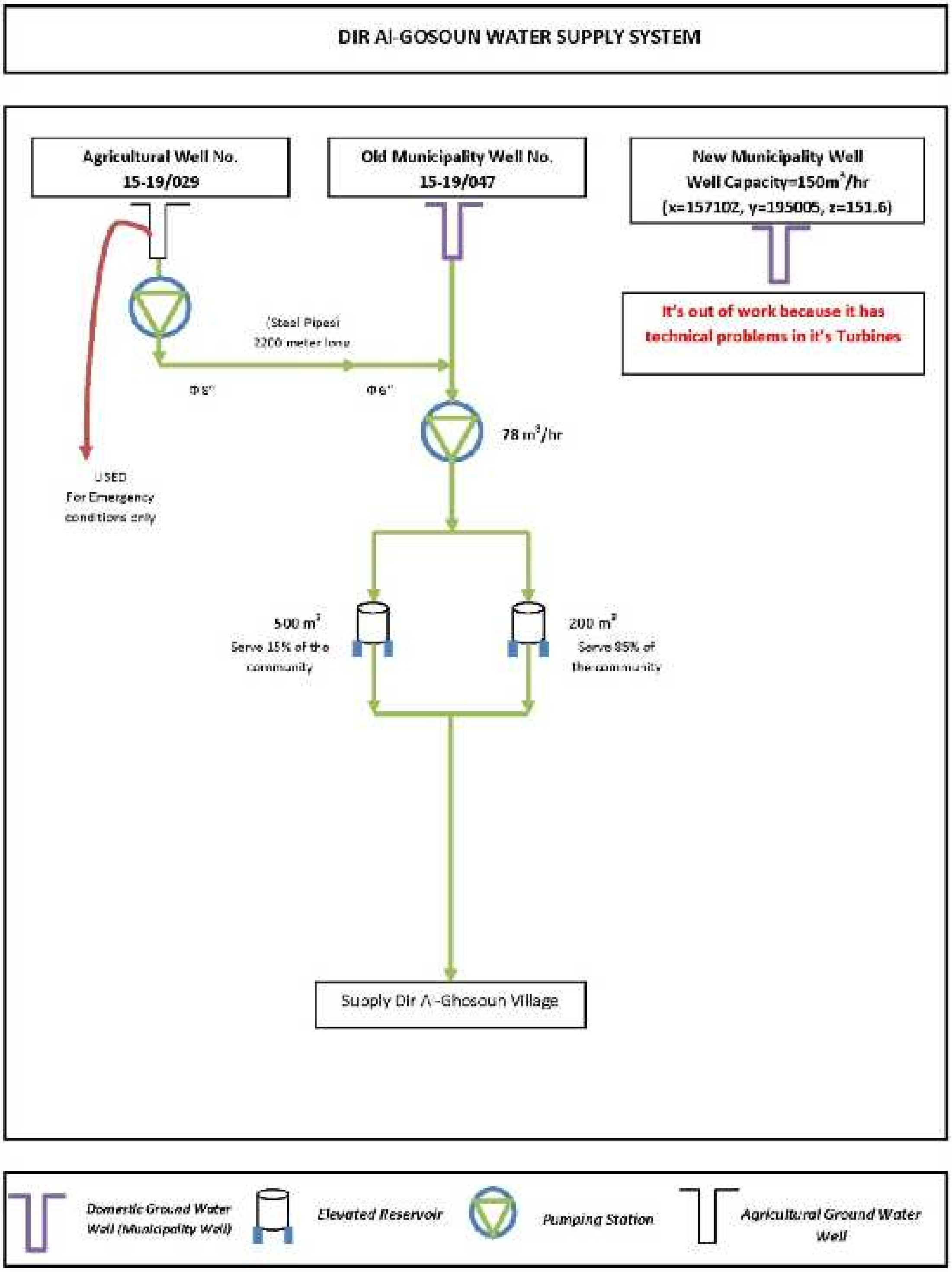
		>100 m3	3 NIS/m3
Comments and other Information	The well productivity is law, reaches 35m3/hour and is not enough, because it has a problem in the hole itself and needs a new one.		
	There is also a problem in the supporting line to the reservoir which has direct networks to the houses that prevent the water from reaching the high areas.		
	The water losses is high – between 30-35% as a result of the old network.		

Total Water Use

Table (41): Total Water Use

Year 2008												
Supplied Water (m3)				16400	17280	19200	21824	22816	22784	21700	17310	14800
Consumed water (m3)				12300	14150	14050	15240	15510	15400	15100	12117	12160
Water meter accuracy												
Losses (m3)				4100	3130	5150	6584	7306	7384	6600	5193	2640
Losses (%)				25.0	18.1	26.8	30.2	32.0	32.4	30.4	30.0	17.8
Year 2009												
Supplied Water (m3)	14000	14130	15850									
Consumed water (m3)	10220	10152	13500									
Water meter accuracy												
Losses (m3)	3780	3978	2350									
Losses (%)	27.0	28.2	14.8									

Deir al Ghosoun



Figure(19): Deir al Ghosoun Water Supply System

Table (42): Community Profile

Water Sources	Groundwater well no. 15-19/047 owned by the Municipality is the main water source. Agricultural well no. 15-19/029 is used in emergency cases.	
Cisterns	% households with cisterns	No. of Cisterns
	70%	
Water Supply System	Storage Volume (m3)	700 m3 reservoirs
	Area of Coverage	80%
	Age of Network	26 years (Established in 1984)
	Last Date of Rehabilitation	Partly -2009
	Last Date of Extension	2007
	Type of meters	1500: 200 volumetric meters and the others are speed.
	No. of Connections	1500
	Connection Fees	800 NIS including the meter cost
Water Use	% of Domestic Use	90
	% of Commercial and Industrial Use	10
	% of other uses/Agricultural and Industrial Use	
	Average use (l/c/d)	85
	% of losses	37
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	8
	No. of Maintenance workers	3
	No. of Accountants	1
	No. of Meter Readers	3
	No. of Administrative Staff	1

	Pricing system
Comments and other Information	They need to extend the main and distributing lines in order to cover all the areas.

Total Water Use

Table (43): Total Water Use

Year 2008												
Supplied Water (m3)	25650	23620	36830	39525	41455	42797	49773	49860	31607	24009	26206	24665
Consumed water (m3)	16909	14347	14950	18342	22681	25443	26987	26562	27674	21740	22716	21451
Water meter accuracy												
Losses (m3)	8741	9273	21880	21183	18774	17354	22786	23298	3933	2269	3490	3214
Losses (%)	34.1	39.3	59.4	53.6	45.3	40.5	45.8	46.7	12.4	9.5	13.3	13.0
Year 2009												
Supplied Water (m3)												
Consumed water (m3)												
Water meter accuracy												
Losses (m3)												
Losses (%)												

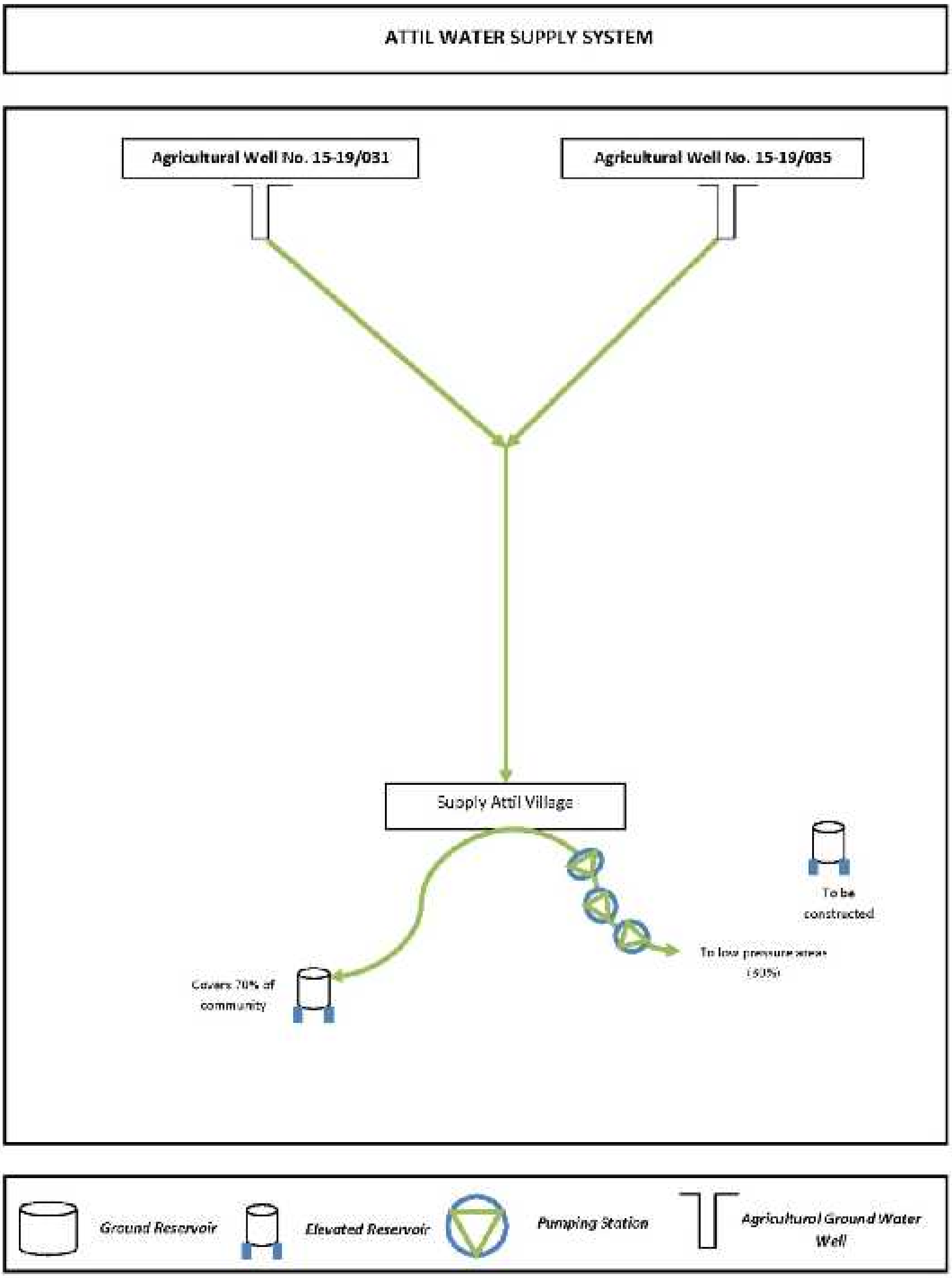
Observations

For emergency conditions when well breaks down, the municipality buys water from agricultural well 15-19/029 and uses an onsite online pump station. The well runs daily 16-18 hours per day in summer and 10-12 hours per day in winter.

Municipal Water consumption mainly goes for domestic use only. According to the Municipality there are few people who use domestic water for other consumption as for garniture and building construction. Agricultural water is available through groundwater wells in the area. Other consumption types as commercial or industrial (there is a pickle factory) consumption are important as well and consume around 10% of the total water supply. The average per capita consumption is around 85 l/c/d, however; the percentage of losses is 37%.

Attil

The reservoir needs full rehabilitations, because its plaster is losing and water leaks from several places. In addition to that the main fittings need replacement. Few years ago the water network losses had reached 56% and this was of the highest percentages compared with age and conditions of the water network. After doing the rehabilitations in the past four years the losses percentage was reduced to around 22%. The municipality is looking to go with the losses minimization project, and believes that after replacing the remaining 20% of network and installing volumetric water meters, the percentage of loss will be less than 10%. The municipality reported several problems in the volumetric meters and, may increase in the coming period. Accordingly the municipality is studying a proposal to install volumetric prepaid water meters, differ from the types installed in Attil. Municipal Water consumption mainly goes for domestic use only. There are six agricultural wells in Attil. According to the Municipality rarely you find people who use domestic water for other consumption as for garniture building construction. Agricultural water is available through groundwater wells in the area. Other consumption types as commercial or industrial consumption are marginal. Non domestic consumption is estimated around 10% of the total water supply. The average per capita consumption is around 94 l/c/d, however; the percentage of losses is 22%. The water system in Attil can be shown in the chart below:



Figure(20): Attil Water Supply System

Community Profile

Table (44): Community Profile

Water Sources	The community mainly depends on two groundwater agricultural wells 15-19/031 and 15-19/035. Agricultural well no. 15-19/029 is used in emergency cases.	
Cisterns	% households with cisterns	No. of Cisterns
Water Supply System	Storage Volume (m3)	200 m3 reservoir
	Area of Coverage	all
	Age of Network	32 years (Established in 1978)
	Last Date of Rehabilitation	
	Last Date of Extension	
	Type of meters	60% speed, 40% volumetric
	No. of Connections	97% of the households
	Connection Fees	150 JD
Water Use	% of Domestic Use	90
	% of Commercial and Industrial Use	
	% of other uses/Non-domestic use	10
	Average use (l/c/d)	94
	% of losses	22
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	The municipality
	Total No. of workers	9
	No. of Maintenance workers	3
	No. of Accountants	2
	No. of Meter Readers	2
	No. of Administrative Staff	2
	Pricing system	

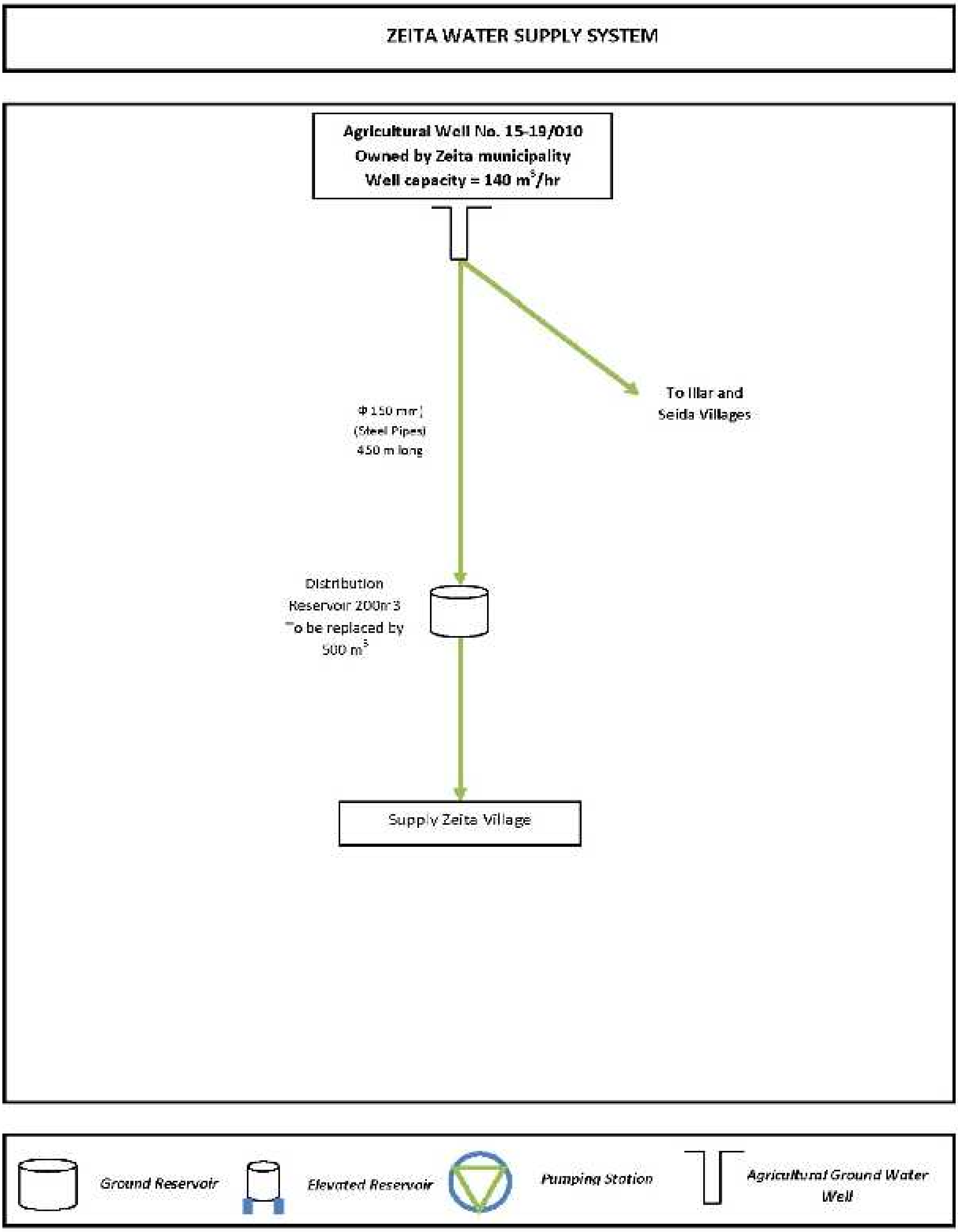
Comments and other Information	They always need maintenance for the network because it is old and damaged and loss of water reaches 28-30% monthly.

Total Water Use

Table (45): Total Water Use

Year 2008													
Supplied Water (m3)	29000	25000	30000	32000	35000	37000	38000	44000	45000	35000	28000	27000	405000
Consumed water (m3)	22000	19500	24000	25800	27000	30000	30000	34500	34700	27000	22000	20500	317000
Water meter accuracy													
Losses (m3)	7000	5500	6000	6200	8000	7000	8000	9500	10300	8000	6000	6500	88000
Losses (%)	24.1	22.0	20.0	19.4	22.9	18.9	21.1	21.6	22.9	22.9	21.4	24.1	21.7

Zeita



Figure(21): Zeita Water Supply System

Community Profile

Table (46): Community Profile

Water Sources	The community mainly depends on a groundwater well no. 15-19/010 owned by Zeita Municipality.	
Cisterns	% households with cisterns	No. of Cisterns
	5%	
Water Supply System	Storage Volume (m3)	200 m3 reservoir
	Area of Coverage	all
	Age of Network	31 years (Established in 1979)
	Last Date of Rehabilitation	1999
	Last Date of Extension	2010
	Type of meters	Speed (velocity) meters
	No. of Connections	570
	Connection Fees	750 NIS
Water Use	% of Domestic Use	40
	% of Commercial and Industrial Use	5
	% of other uses/Agricultural Use	55
	Average use (l/c/d)	240
	% of losses	6
	Volume of Bulk Supply (m3), to who?	25000M3 in summer and 5000m3 in winter for Seida and Illar villages
Water Service	Water is Managed by the Council?	The municipality
	Total No. of workers	6
	No. of Maintenance workers	1
	No. of Accountants	2
	No. of Meter Readers	1
	No. of Administrative Staff	2

	Pricing system
Comments and other Information	They need to rehabilitate the water network.
	They want another pump (spare), since the working hours reaches 18 hours / daily.

Total Water Use

Table (47): Total Water Use

Year 2008													
Supplied Water (m3)	15555	15921	20370	24560	25901	25920	28508	29790	30820	21720	15551	15720	270336
Consumed water (m3)	14922	12551	18133	23138	24968	25104	27881	28088	29608	20990	14652	14566	254601
Water meter accuracy													
Losses (m3)	633	3370	2237	1422	933	816	627	1702	1212	730	899	1154	15735
Losses (%)	4.1	21.2	11.0	5.8	3.6	3.1	2.2	5.7	3.9	3.4	5.8	7.3	5.8
Year 2009													
Supplied Water (m3)	21520	31980	40260	50630	27970	56930	55730	50930					
Consumed water (m3)	20475	30364	38622	49470	27472	51040	53730	48591					
Water meter accuracy													
Losses (m3)	1045	1616	1638	1160	498	5890	2000	2339					
Losses (%)	4.9	5.1	4.1	2.3	1.8	10.3	3.6	4.6					

Observation

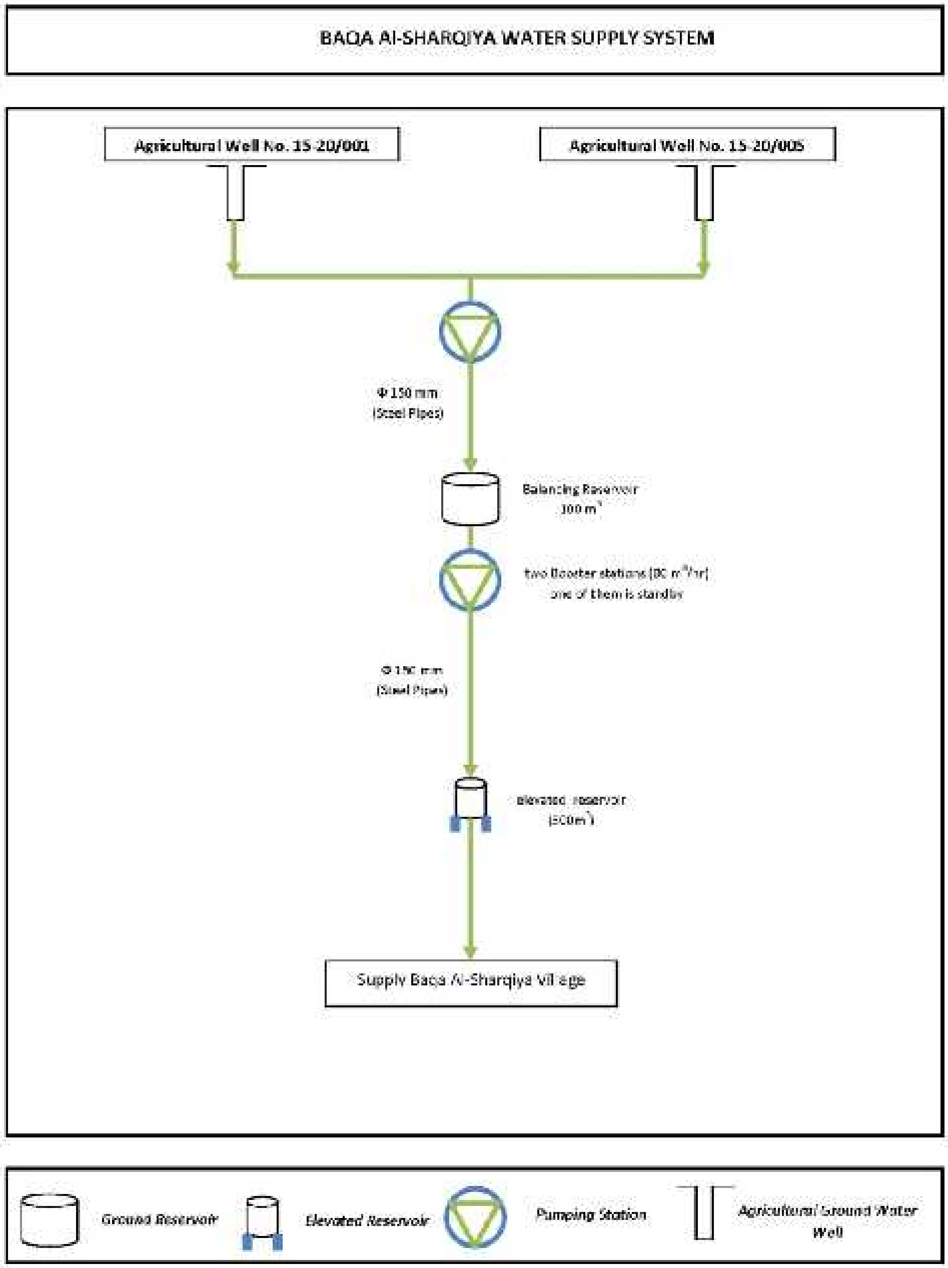
Then water is distributed to the whole community through water network established in 1979 and renewed in 1999 and the network covers all the community houses; however; 20% of the existing network needs rehabilitation. They are 570 house connections, but; their pipes are not isolated and water meters are of speed type.

Municipal Water consumption mainly goes mainly for domestic and agricultural use. According to the Municipality there are 100 green houses and 5 chicken farms, 4 sheep farms which consume around 55% of the total supply. Other consumption types as commercial or industrial (stone cutting, oil press, hollow concrete brick, and oil station) consumption are important as well and consume 5% of the total supply. The average per capita consumption is around 240 l/c/d however, the percentage of losses are 6%.

Baqa al Sharqiya

Municipal Water consumption goes mainly for domestic use. According to the Municipality there are 50 green houses and 1000 dunum cultivated with field crops in the town. Agricultural consumption relies on the groundwater water resources; particularly the water network was newly. Other consumption types as commercial or industrial consumption are marginal. The municipality estimated non domestic consumption as few percents or less than 10%. The average per capita consumption is around 82 l/c/d, however; the percentage of losses is 12%.

The price of water constitutes the main problem in the locality since it is sold for 2 NIS per cubic meter, which, as indicated by the municipality, doesn’t cover operational costs. According to the municipality, this price was set in order to provide an incentive for residents to switch from using of the agriculture network to the public drinking network.



Figure(22): Baqa al Sharqiya Water Supply System

Community Profile

Table (48): Community Profile

Water Sources	The community mainly depends on two groundwater wells 15-19/001 and 15-19/005.	
Cisterns	% households with cisterns	No. of Cisterns
		1000
Water Supply System	Storage Volume (m3)	100 m3 balance reservoir and 300 m3 reservoir
	Area of Coverage	All areas
	Age of Network	Constructed in phases between 2004 and 2009
	Last Date of Rehabilitation	
	Last Date of Extension	2009
	Type of meters	Volumetric meters
	No. of Connections	805
	Connection Fees	300 NIS
Water Use	% of Domestic Use	90
	% of Commercial and Industrial Use	Plastic factory – 20m3 / monthly
	% of other uses/Non-domestic Use	10
	Average use (l/c/d)	82
	% of losses	12
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	The municipality
	Total No. of workers	4
	No. of Maintenance workers	1
	No. of Accountants	1
	No. of Meter Readers	1
	No. of Administrative Staff	1

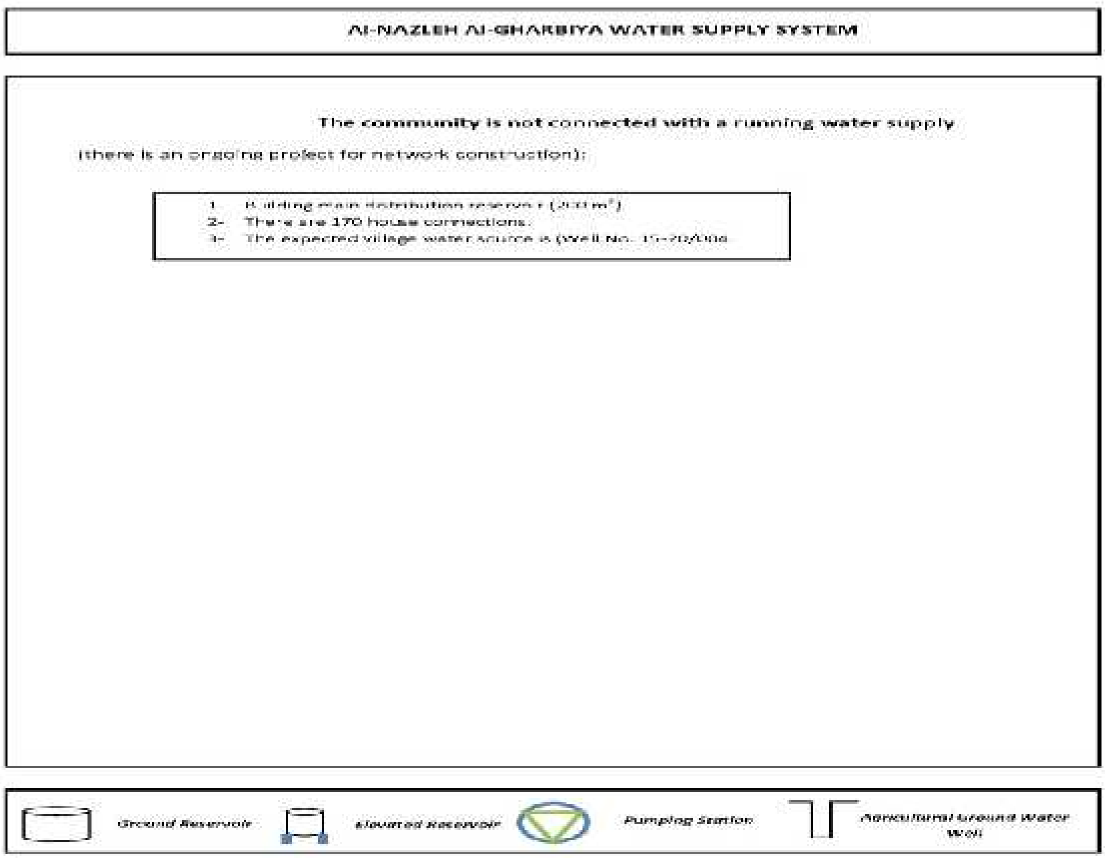
Comments and other Information	Pricing system	

Total Water Use

Table (49): Total Water Use

Year 2009													
Supplied Water (m3)	8090	7800	8500	10520	13350	14500	15650	16980	13850	13000	10830	8720	106880
Consumed water (m3)	7561	7626	7940	9333	11091	11794	14946	13325	12276	11706	9766	8124	93028
Water meter accuracy													
Losses (m3)	529	174	560	1187	2259	2706	704	3655	1574	1294	1064	596	16302
Losses (%)	6.5	2.2	6.6	11.3	16.9	18.7	4.5	21.5	11.4	10.0	9.8	6.8	13.0

Al Nazleh al Gharbiya



Figure(23): Al Nazleh al Gharbiya Water Supply System

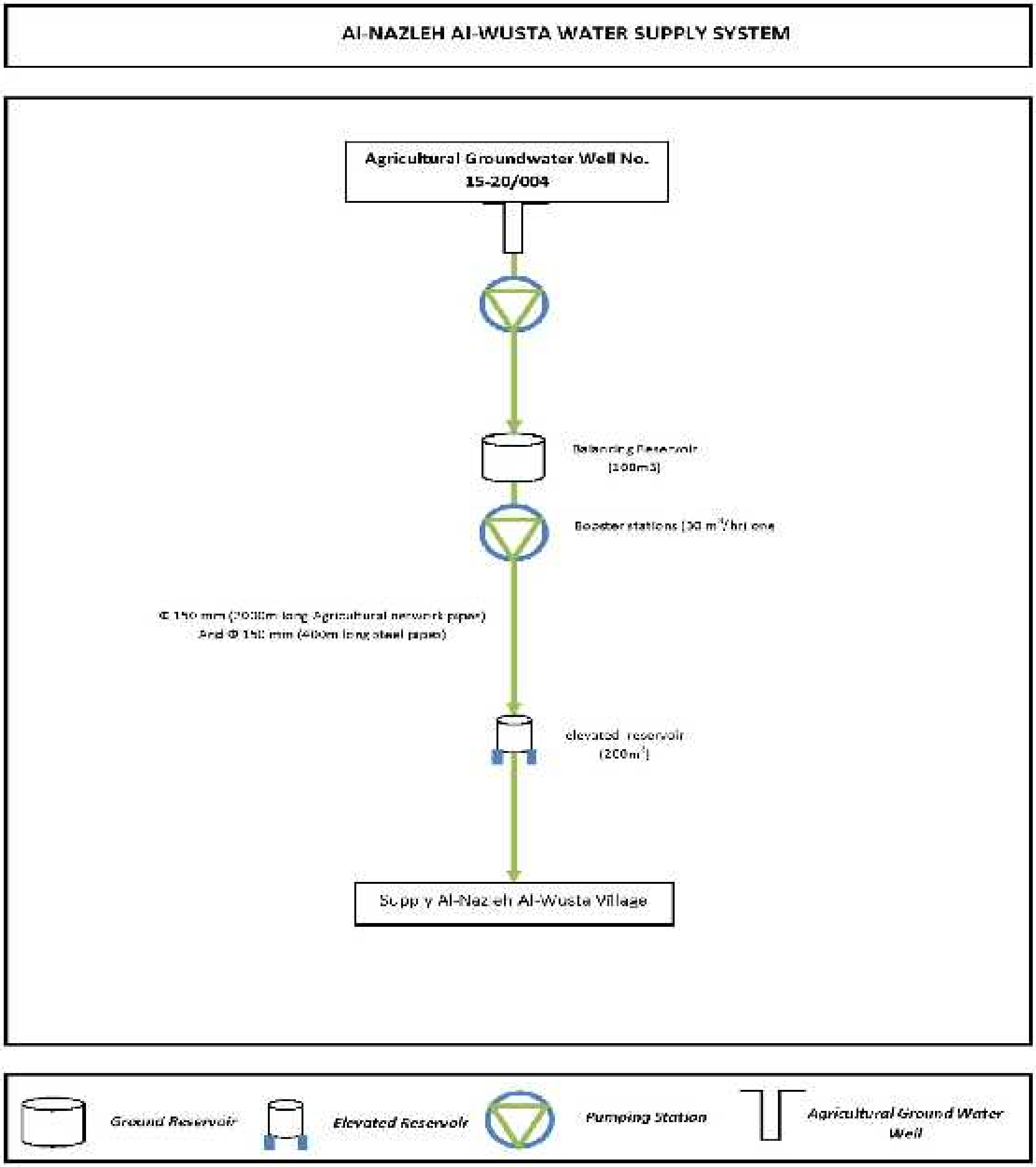
Community Profile

Table (50): Community Profile

Water Sources	Expected to be 15-20/004	
Cisterns	% households with cisterns	No. of Cisterns
	80%	160
Water Supply System	Storage Volume (m3)	200 m3 reservoir under construction
	Area of Coverage	180 houses
	Age of Network	Under construction- from 8 months
	Last Date of Rehabilitation	-

	Last Date of Extension	-
	Type of meters	Volumetric
	No. of Connections	170 under construction
	Connection Fees	600 NIS
Water Use	% of Domestic Use	85%
	% of Commercial and Industrial Use	
	% of other uses/Non-domestic Use	15%
	Average use (l/c/d)	
	% of losses	
	Volume of Bulk Supply (m3), to who?	2000M3 / monthly / for Al-Nazleh Al-Wusta
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	2
	No. of Maintenance workers	1 (the same person)
	No. of Accountants	
	No. of Meter Readers	
	No. of Administrative Staff	2
	Pricing system	Increasing block tariff Consumption Category — Price 0 – 5 m3 — 15 NIS >6 m3 — 3 NIS/m3
Comments and other Information	During the study period, the reservoir was under construction, but after updating the information, the reservoir has been achieved and No. of Connections are 180.	
	5% of water used for home gardens and not for agricultural use.	

Al Nazleh al Wusta



Figure(24): Al Nazleh al Wusta Water Supply System

Community Profile

Table (51): Community Profile

Water Sources	The community is supplied through the agricultural groundwater well no. 15-20/004.	
Cisterns	% households with cisterns	No. of Cisterns
	99%	60
Water Supply System	Storage Volume (m3)	100 m3 balancing tank and 200 m3 reservoir
	Area of Coverage	62 houses
	Age of Network	12 years (Established in 1998)
	Last Date of Rehabilitation	2009
	Last Date of Extension	2009
	Type of meters	volumetric
	No. of Connections	80
	Connection Fees	1000 NIS
Water Use	% of Domestic Use	60%
	% of Commercial and Industrial Use	
	% of other uses/Non-domestic Use	40% - agriculture
	Average use (l/c/d)	
	% of losses	30
	Volume of Bulk Supply (m3), to who?	1500m3/monthly, for Al-Nazleh Al-Gharbiya
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	4
	No. of Maintenance workers	By a company account per connection - 30 NIS for each
	No. of Accountants	1
	No. of Meter Readers	1
	No. of Administrative Staff	3

	Pricing system	1.5 NIS/m3 and 10 NIS for maintenance
Comments and other Information	There are two for the water: a new conveying water drinking line, and old agricultural line needs maintenance.	
	They need to develop and maintain the agricultural line because it has high loss of water and high maintenance.	
	There are nearly 30 dunums as green houses supplied with water from the agricultural line.	

Total Water Use

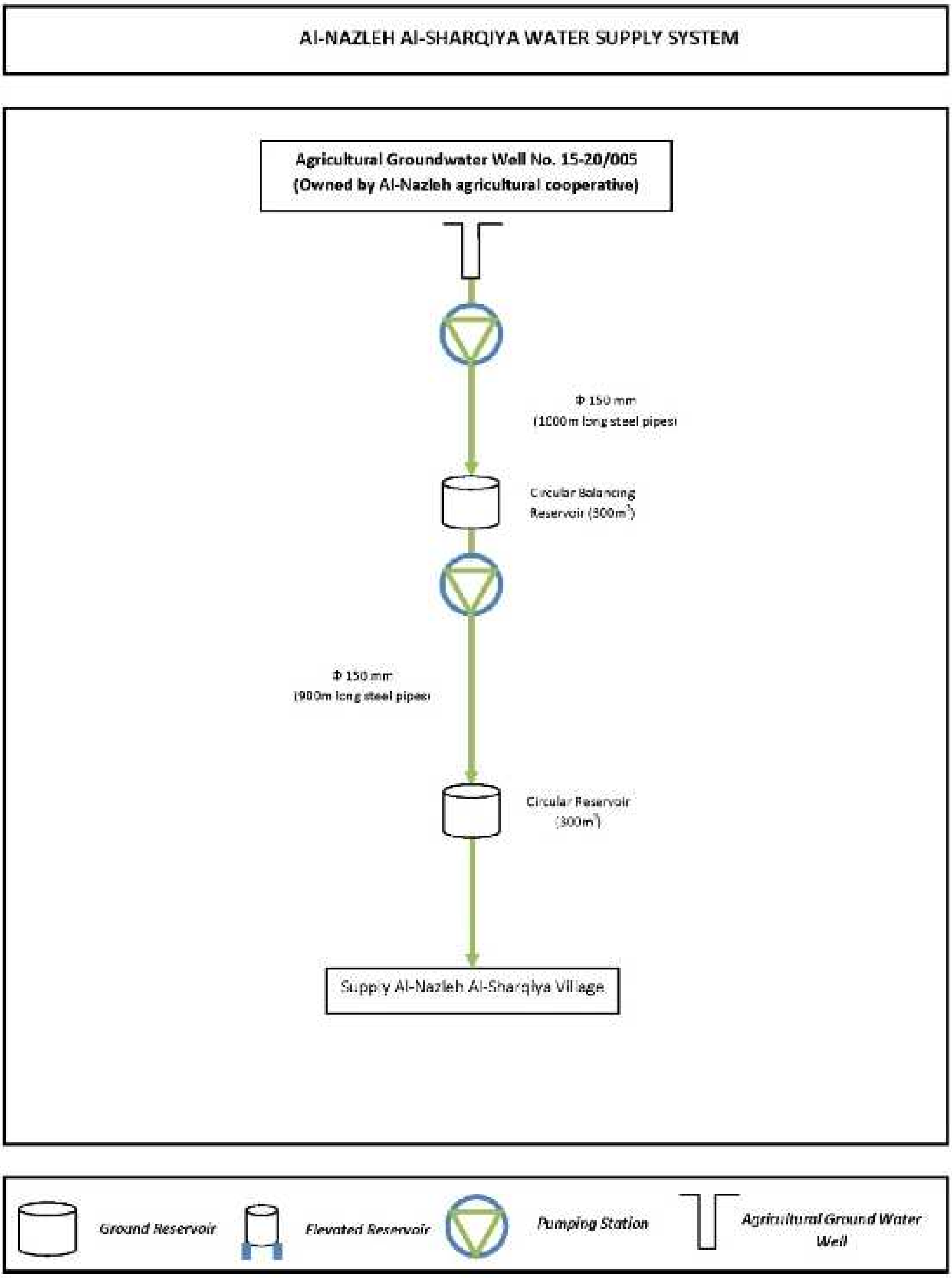
Table (52): Total Water Use

Year 2009					
Supplied Water (m3)	1604	1523	781	666	493
Consumed water (m3)	980	950	706	620	578
Water meter accuracy					
Losses (m3)	624	573	75	46	-85
Losses (%)	38.9	37.6	9.6	6.9	-17.2

Observations

Water consumption mainly goes mainly for domestic use. According to all green houses and field crops are irrigated directly from well15-20/004. Other consumption types as commercial or industrial consumption are marginal. The average per capita consumption is around 66 l/c/d, however; the percentage of losses is 21%. The percentage of losses will decrease sharply in the next readings to stable around 7%. The existing high percentage refers to the physical losses because, the water network stopped working for 9-years. During this period many activities were taking place, particularly asphalting the roads, and this caused hidden damages. The village council could not detect them in the first two months after resuming pumping, but later (in October 2009), the council repaired these punchers and losses dropped from 38% to 9%.

Al Nazleh al Sharqiya



Figure(25): Al Nazleh al Sharqiya Water Supply System

Community Profile

Table (53): Community Profile

Water Sources	The community is supplied through the agricultural groundwater well no. 16-20/005 owned by Al Nazleh Agricultural Cooperative.	
Cisterns	% households with cisterns	No. of Cisterns
	90%	260
Water Supply System	Storage Volume (m3)	300 m3 balancing tank and 300 m3 reservoir
	Area of Coverage	260 houses
	Age of Network	13 years (Established in 1997)
	Last Date of Rehabilitation	2009
	Last Date of Extension	
	Type of meters	Volumetric meters
	No. of Connections	250
	Connection Fees	350 JD
Water Use	% of Domestic Use	98%
	% of Commercial and Industrial Use	
	% of other uses/Non-domestic Use	2%-agriculture
	Average use (l/c/d)	55
	% of losses	44
	Volume of Bulk Supply (m3), to who?	No supply
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	3
	No. of Maintenance workers	1
	No. of Accountants	1
	No. of Meter Readers	1
	No. of Administrative Staff	2
	Pricing system	1.5 NIS/m3 and 10 NIS for maintenance

Comments and other Information	They changed the speed meters into volumetric by ministry of finance funding. They need to extend the network as a result of future housing expansion.

Total Water Use

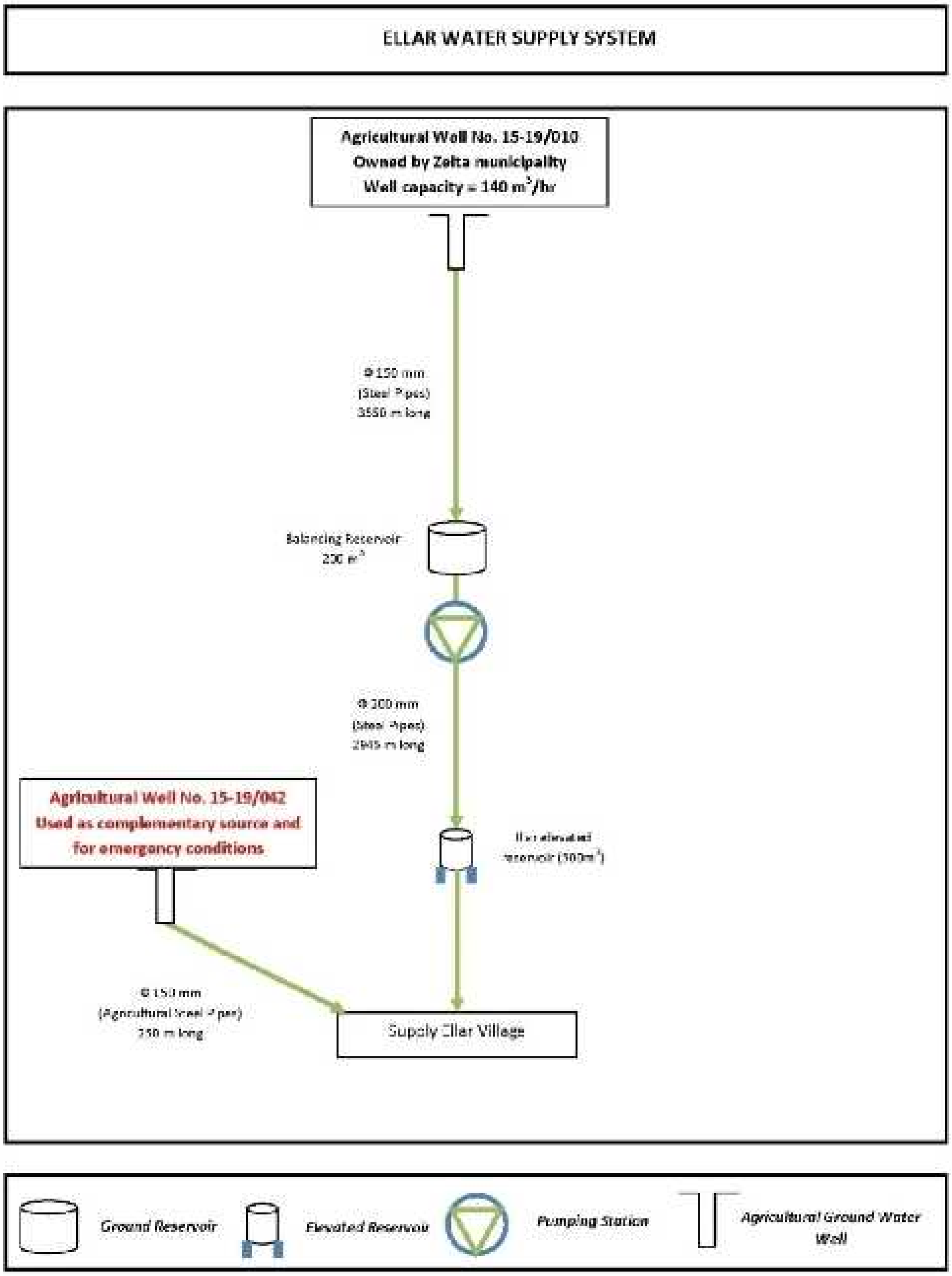
Table (54): Total Water Use

Year 2008										
Supplied Water (m3)						5200	4950	5320	6220	7300
Consumed water (m3)						3750	3540	2540	2190	1820
Water meter accuracy										
Losses (m3)						1450	1410	2780	4030	5480
Losses (%)						27.9	28.5	52.3	64.8	75.1
Year 2009										
Supplied Water (m3)	3690	2770	3350	4460	5290					
Consumed water (m3)	1746	1833	1639	1983	2818					
Water meter accuracy										
Losses (m3)	1944	937	1711	2477	2472					
Losses (%)	52.7	33.8	51.1	55.5	46.7					

Observations

The Village Council has taken the decision of connecting the households with prepaid meters since the rate of fee collection is low. Water consumption mainly goes mainly for domestic use. According to the village council all green houses and field crops are irrigated directly from well16-20/005. Other consumption types as commercial or industrial consumption are marginal. The average per capita consumption is around 55 l/c/d, however; the percentage of losses is 44 %.

Illar



Figure(26): Illar Water Supply Syste

Community Profile

Table (55): Community Profile

Water Sources	The community is supplied through the agricultural groundwater well no. 15-19/010 owned by Zeita Municipality in addition to agricultural well no. 15-19/042 used as a complementary source and in emergencies.	
Cisterns	% households with cisterns	No. of Cisterns
		1100
Water Supply System	Storage Volume (m3)	200 m3 balancing tank and 500 m3 reservoir
	Area of Coverage	all
	Age of Network	4 years
	Last Date of Rehabilitation	
	Last Date of Extension	
	Type of meters	Volumetric
	No. of Connections	1200
	Connection Fees	100 JD at the beginning of the project and now 150 JD
Water Use	% of Domestic Use	95
	% of Commercial and Industrial Use	
	% of other uses/Non-domestic Use	5
	Average use (l/c/d)	65
	% of losses	11
	Volume of Bulk Supply (m3), to who?	2430-8860m3 according to water consumption , to Seida village
Water Service	Water is Managed by the Council?	The municipality
	Total No. of workers	7
	No. of Maintenance workers	3
	No. of Accountants	2
	No. of Meter Readers	1

	No. of Administrative Staff	1
	Pricing system	
Comments and other Information	They need to extend the water network.	

Total Water Use

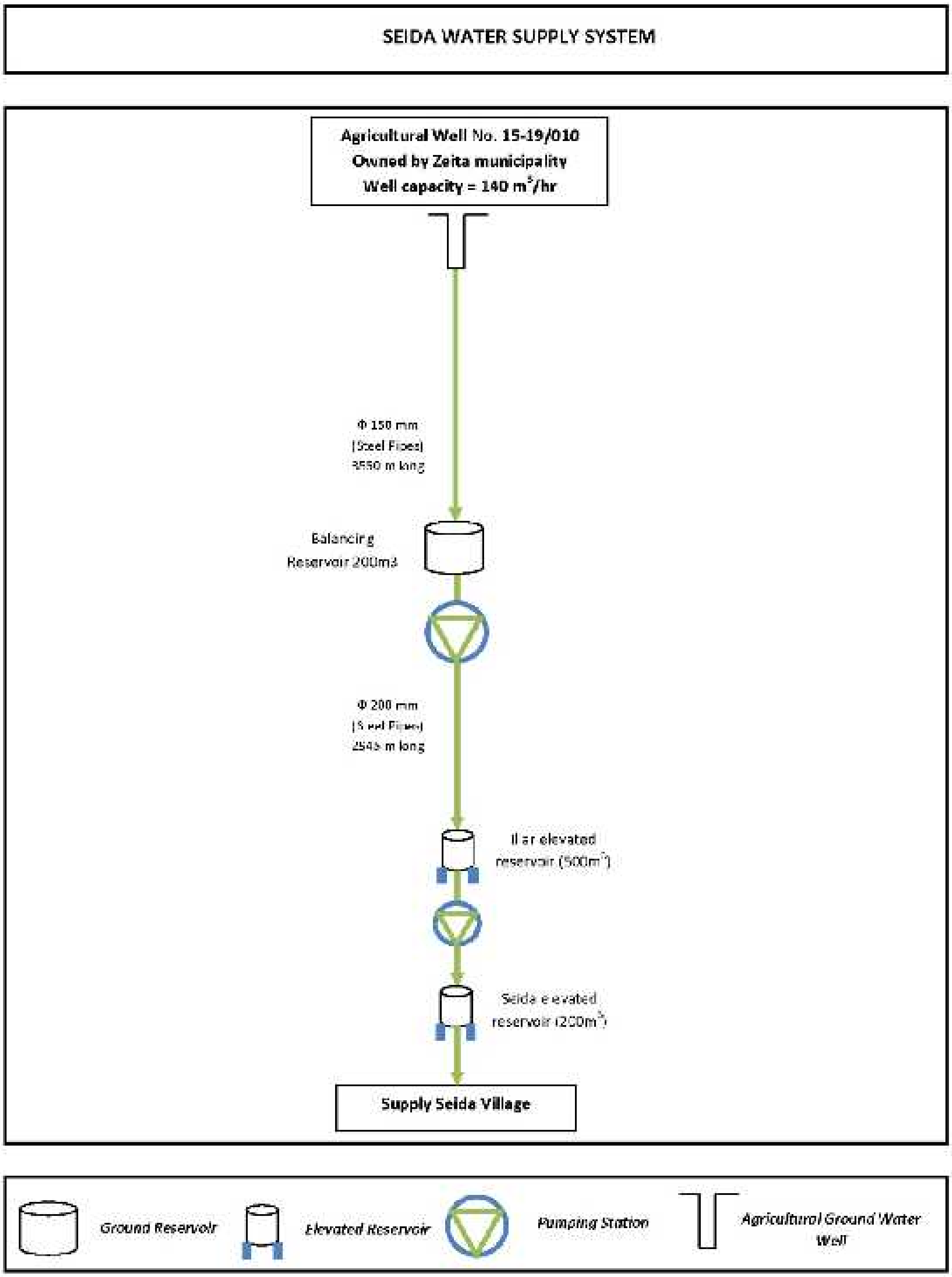
Table (56): Total Water Use

Year 2009													
Supplied Water (m3)	10183	10050	10470	12440	15760	17550	19640	19230	16690	15270	10020	9350	166653
Consumed water (m3)	9538	10268	8696	10928	13166	14640	16846	16213	17128	12763	8639	10384	149209
Water meter accuracy													
Losses (m3)	645	-218	1774	1512	2594	2910	2794	3017	-438	2507	1381	-1034	17444
Losses (%)	6.3	-2.2	16.9	12.2	16.5	16.6	14.2	15.7	-2.6	16.4	13.8	-11.1	10.5

Observations

Municipal Water consumption mainly goes mainly for domestic use. According to the Municipality there are no green houses or field crops in the town. The water network was newly constructed. Other consumption types as commercial or industrial consumption are marginal. The municipality estimated non-domestic consumption around 5%. The average per capita consumption is around 65 l/c/d, however; the percentage of losses is 11%.

Seida



Figure(27): Saida Water Supply System

Community Profile

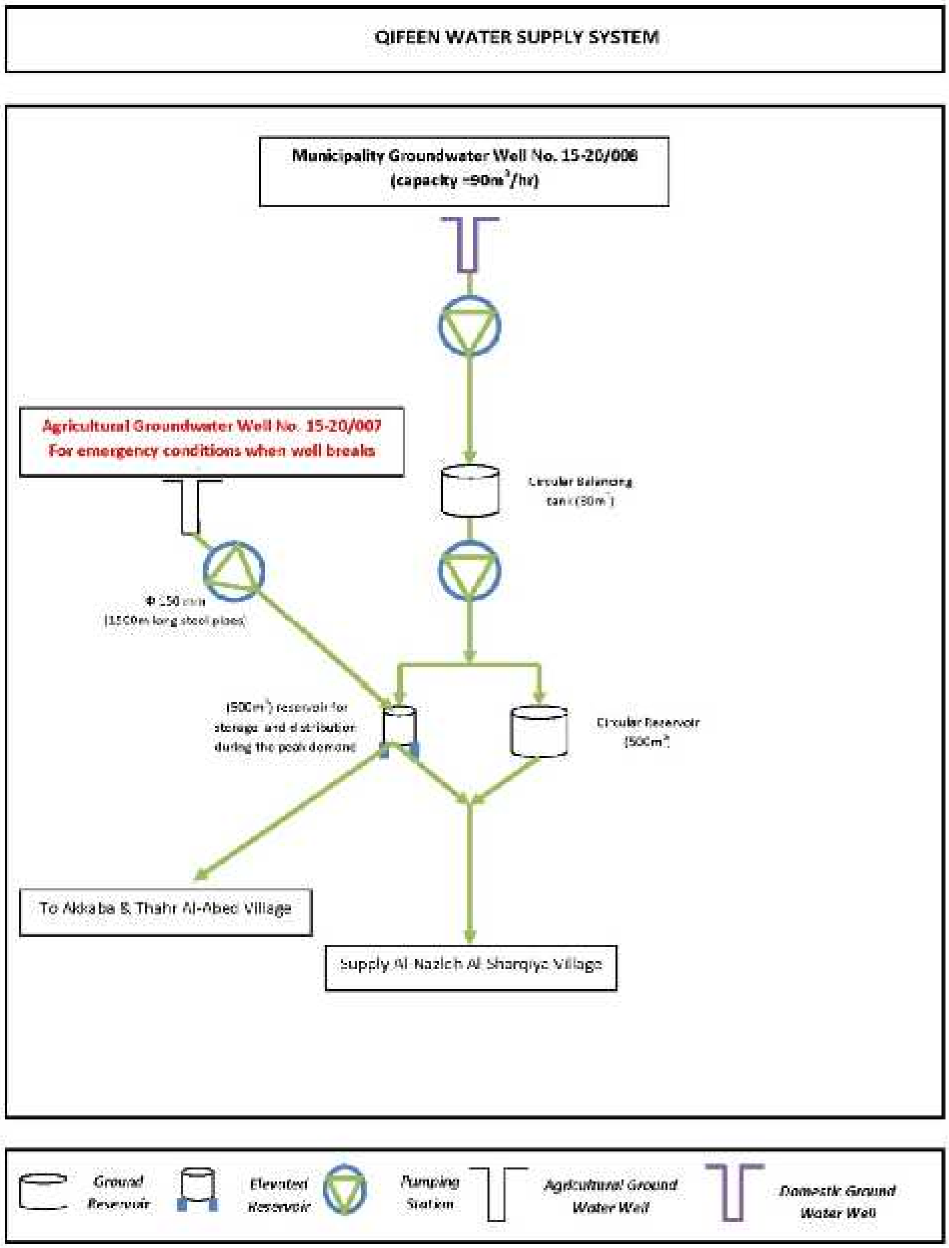
Table (57): Community Profile

Water Sources	The community is supplied through the agricultural groundwater well no. 15-19/010 owned by Zeita Municipality.	
Cisterns	% households with cisterns	No. of Cisterns
	99%	
Water Supply System	Storage Volume (m3)	200 m3 balancing tank and 200 m3 reservoir
	Area of Coverage	all
	Age of Network	3 years - 2007
	Last Date of Rehabilitation	
	Last Date of Extension	
	Type of meters	Volumetric
	No. of Connections	575
	Connection Fees	600 NIS
Water Use	% of Domestic Use	95
	% of Commercial and Industrial Use	
	% of other uses/Non-domestic Use	5
	Average use (l/c/d)	49
	% of losses	10
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	4
	No. of Maintenance workers	1
	No. of Accountants	1
	No. of Meter Readers	1
	No. of Administrative Staff	1

	Pricing system
Comments and other Information	They need to extend the network project – for 4000m.
	They may change the resource of water – Al-Nazleh Al –Sharqiya instead of Zeita which decreases the costs and the water costs for the consumers.

Municipal Water consumption mainly goes only for domestic use. According to the Municipality there are no green houses or field crops in the town. The water network was newly constructed. Other consumption types as commercial or industrial consumption are marginal. The municipality estimated non-domestic consumption around 5% The average per capita consumption is around 49 l/c/d, however; the percentage of losses is 10%.

Qifeen



Figure(28): Qifeen Water Supply System

Community Profile

Table (58): Community Profile

Water Sources	The community is supplied through the agricultural groundwater well no. 15-20/008 with a discharge capacity of 90 m3/hr. Agricultural groundwater well no. 15-20/007 is also used at times of emergency.	
Cisterns	% households with cisterns	No. of Cisterns
	60%	1800
Water Supply System	Storage Volume (m3)	80 m3 balancing tank and 1000 m3 reservoirs
	Area of Coverage	Qifeen, Akkaba and Thahr al Abed . 1750 houses
	Age of Network	11 years (Established in 1999)
	Last Date of Rehabilitation	
	Last Date of Extension	
	Type of meters	Speed (velocity) meters
	No. of Connections	1400
	Connection Fees	600 NIS
Water Use	% of Domestic Use	85
	% of Commercial and Industrial Use	5
	% of other uses/Agricultural and Commercial Use	10
	Average use (l/c/d)	87
	% of losses	43
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	6
	No. of Maintenance workers	2
	No. of Accountants	1
	No. of Meter Readers	1

	No. of Administrative Staff	2
	Pricing system	
Comments and other Information	2 reservoirs (200m3) have been built In Iqaba and Thaher Al-Abed villages, so, they will be supplied with water on 1/11/2010.	
	The well needs maintenance because the water network is old and water losses is high.	

Total Water Use

Table (59): Total Water Use

Year 2009		
Supplied Water (m3)	43700	51400
Consumed water (m3)	26220	30840
Water meter accuracy		
Losses (m3)	17480	20560
Losses (%)	40.0	40.0

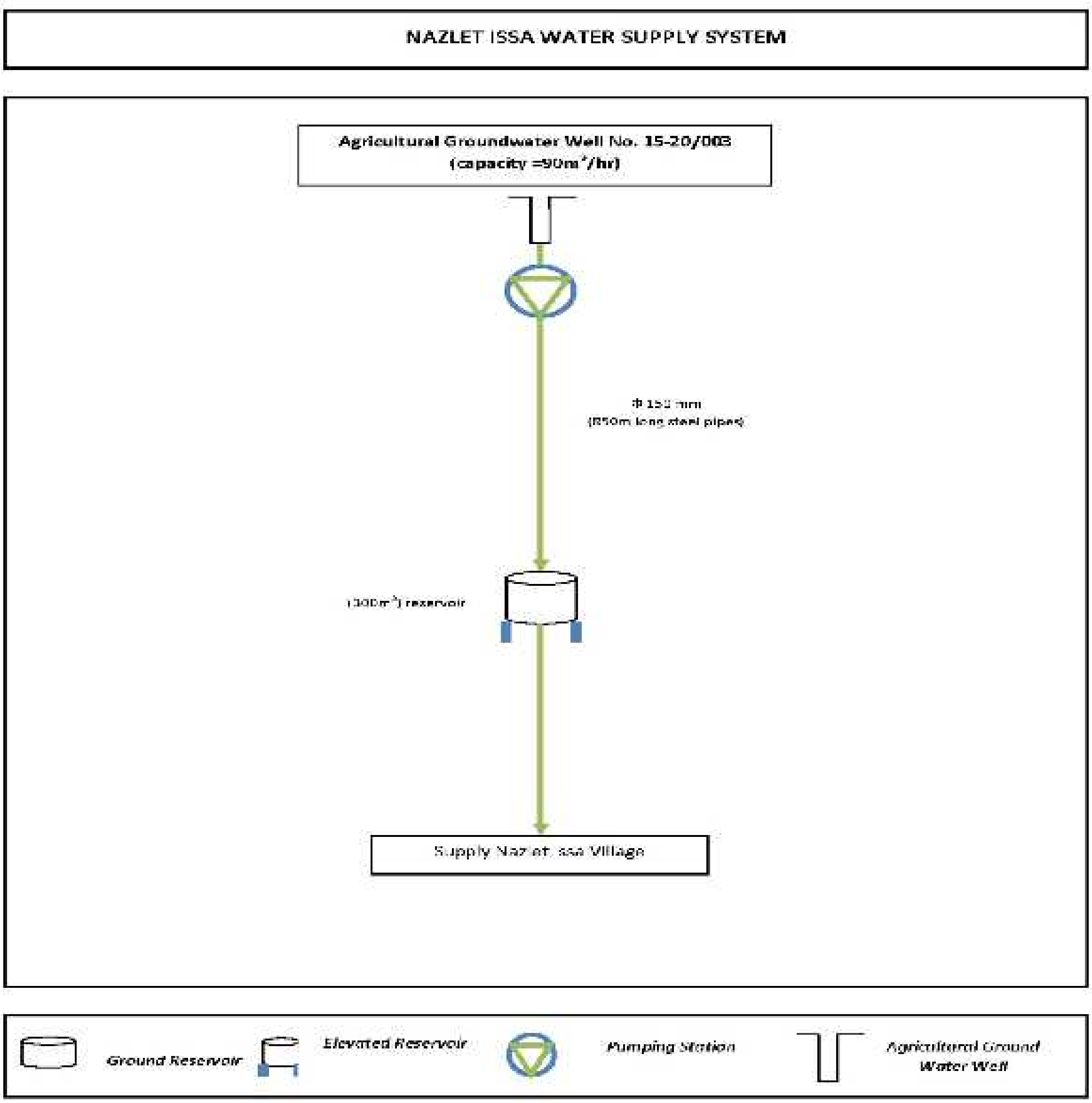
Observations

Municipal Water consumption mainly goes mainly for domestic use. According to the Municipality there are 25 green houses and 20 dunums of vegetables. Cattle are not common; only few chickens' farms are exiting. Agricultural and commercial consumption are around 10% of the total consumption. There are four industrial workshops, stone factory, hollow concrete factory and oil press which consume around 5% of the total supply. Other consumption types as commercial or industrial consumption are marginal. The average per capita consumption is relatively high around 87 l/c/d, however; the percentage of losses is 43%.

The high consumption reflects could refer to several issues: 1- the consumers don't pay the water fees and this explains why the municipality has a debt of more than three and half million

NIS as water fees on the people. This debt is also reflected on electricity fees, such 6 million NIS are owned by the people meanwhile the Municipality is indebted by 6.58 million NIS to the Ministry of Finance as electricity. 2- the water prices are relatively low and this is reflected by the tariff and the disability to develop the water project. 3- the high consumption could also refer to high percentage of losses.

Nazlet Issa



Figure(29): Nazlet Issa Water Supply System

Community Profile

Table (60): Community Profile

Water Sources	The community is supplied through the agricultural groundwater well no. 15-20/003 with a discharge capacity of 90 m3/hr.	
Cisterns	% households with cisterns	No. of Cisterns
	70% of the cisterns are not used.	250
Water Supply System	Storage Volume (m3)	300 m3 reservoirs
	Area of Coverage	Nazlet Issa – 395 houses
	Age of Network	8 years (Established in 2002)
	Last Date of Rehabilitation	
	Last Date of Extension	7/9/2010
	Type of meters	Speed (velocity) meters
	No. of Connections	400
	Connection Fees	500 NIS
Water Use	% of Domestic Use	95
	% of Commercial and Industrial Use	
	% of other uses/Non-Domestic Use	5
	Average use (l/c/d)	67
	% of losses	31
	Volume of Bulk Supply (m3), to who?	No supply
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	3
	No. of Maintenance workers	
	No. of Accountants	2
	No. of Meter Readers	1
	No. of Administrative Staff	3
	Pricing system	
Comments and other Information	They need to solve water loss problem, and need to change the meters from speed to volumetric ones.	

	They need to extend the network for 1000 M.L
	They use water more for agriculture. There are 200-250 dunums of greenhouses and 250 dunums for agriculture in general.

Total Water Use

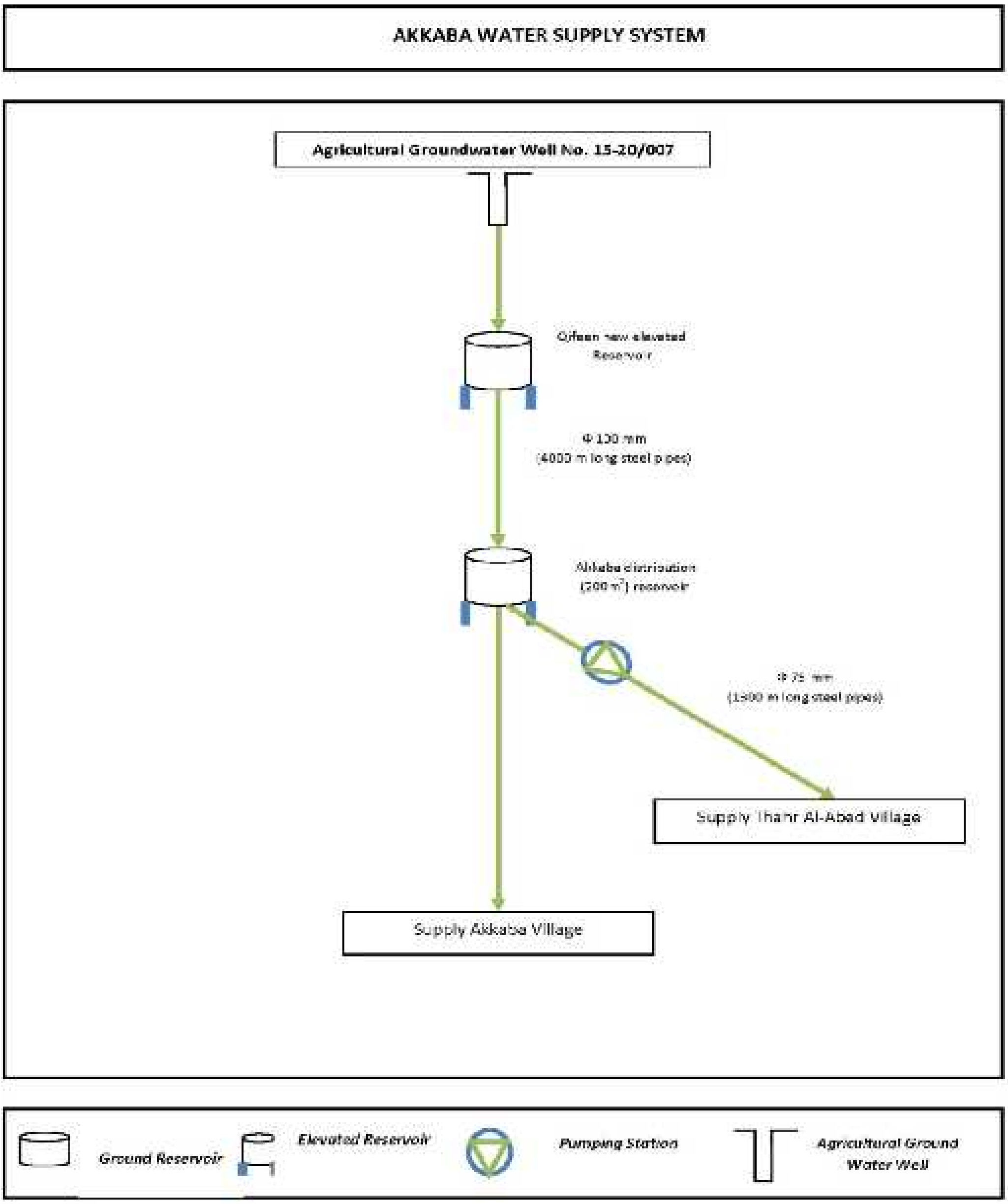
Table (61): Total Water Use

Year 2008												
Supplied Water (m3)	4800	4800	5380	8000	8000	8300	8400	9740	9740	6300	4610	6380
Consumed water (m3)	3386	2754	3863	5173	6015	6084	6713	6212	5954	5293	3072	3484
Water meter accuracy												
Losses (m3)	1414	2046	1517	2827	1985	2216	1687	3528	3786	1007	1538	2896
Losses (%)	29.5	42.6	28.2	35.3	24.8	26.7	20.1	36.2	38.9	16.0	33.4	45.4
Year 2009												
Supplied Water (m3)	6380	6380	2640	7160	7540	7540	9498	10430	9115	8380	4980	5480
Consumed water (m3)	3448	3456	3134	4160	5269		7078	6672	6638	5684	3679	
Water meter accuracy												
Losses (m3)	2932	2924	-494	3000	2271		2420	3758	2477	2696	1301	
Losses (%)	46.0	45.8	-18.7	41.9	30.1	100.0	25.5	36.0	27.2	32.2	26.1	

Observations: There are 400 house connections which use speed meters. The costs of new house connections are usually paid 50% for the village council and 50% by the consumer. The VC supervises the installation of new connections.

Municipal Water consumption mainly goes only for domestic use. According to the Municipality there are many green houses field crops, however, they are irrigated directly from the agricultural well 15-20/003. Cattle are not common and other consumption types as commercial or industrial consumption are marginal. The municipality estimated non-domestic consumption around 5%. The average per capita consumption is relatively high around 67 l/c/d, however; the percentage of losses is 31%.

Akkaba



Figure(30): Akkaba Water Supply System

Community Profile

Table (62): Community Profile

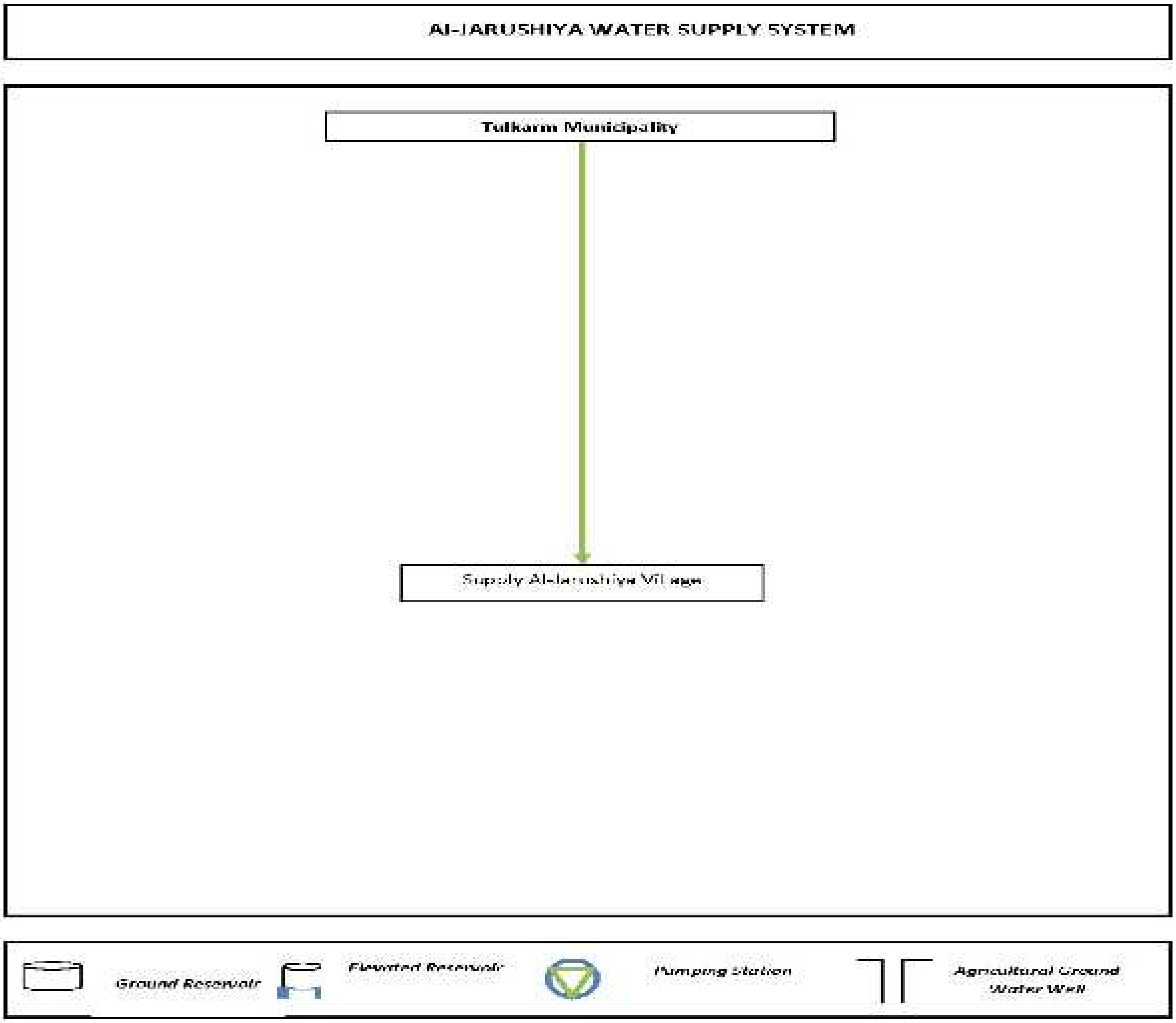
Water Sources	The main water source for the community are rainwater harvesting cisterns. The community is also supplied through water tankers. The agricultural groundwater well no. 15-20/007 will be the source supplying the network in the future.	
Cisterns	% households with cisterns	No. of Cisterns
	95%	70
Water Supply System	Storage Volume (m3)	200m3
	Area of Coverage	Akkaba – 60
	Age of Network	New from 2/2010
	Last Date of Rehabilitation	New 2010
	Last Date of Extension	New 2010
	Type of meters	Italian
	No. of Connections	60
	Connection Fees	300 NIS
Water Use	% of Domestic Use	1500m3/monthly – 90%
	% of Commercial and Industrial Use	
	% of other uses/Non-Domestic Use	10% (agricultural and animal use)
	Average use (l/c/d)	
	% of losses	
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	2
	No. of Maintenance workers	
	No. of Accountants	1
	No. of Meter Readers	1
	No. of Administrative Staff	5

	Pricing system	
Comments and other Information	They need to pump more water to the location because they take water only 50m3/daily from Awni Abdel hadi well.	
	There are new 120 head of sheep, also 10 sheep farms.	

Observations

There are few things that should be reviewed to ensure good service. 1- The difference in pressure (15 meters) between the two elevated reservoirs is not enough to pump water by gravity. Therefore, the whole idea to pump water to Qifeen reservoir then by gravity to Akkaba reservoir can be replaced through pumping water directly from well 15-20/007 to Akkaba reservoir. 2- There is no mention to chlorination in the projects, and it is vital to install a chlorination unit either the well's site or at Qifeen reservoir. 3- The water system project didn't include house connections, therefore is a main priority for the community.

Al Jarushiya



Figure(31): Al Jarushiya Water Supply System

Community Profile

Table (63): Community Profile

Water Sources	The community is supplied with water by Tulkarm Municipality	
Cisterns	% households with cisterns	No. of Cisterns
	100%	200
Water Supply System	Storage Volume (m3)	
	Area of Coverage	200 houses

	Age of Network	2 years (Established in 2008)
	Last Date of Rehabilitation	2008
	Last Date of Extension	2008
	Type of meters	Prepaid water meters
	No. of Connections	200
	Connection Fees	80 JD
Water Use	% of Domestic Use	95
	% of Commercial and Industrial Use	
	% of other uses/Non-Domestic Use	5
	Average use (l/c/d)	103
	% of losses	3
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	1
	No. of Maintenance workers	
	No. of Accountants	1
	No. of Meter Readers	
	No. of Administrative Staff	2
	Pricing system	
Comments and other Information	They need to build a reservoir for the area as a result for the high pumping of water which causes problems in the network.	
	They applied before 7 months to the water Authority to implement conveying line 4", but they have not received any answer.	

Total Water Use

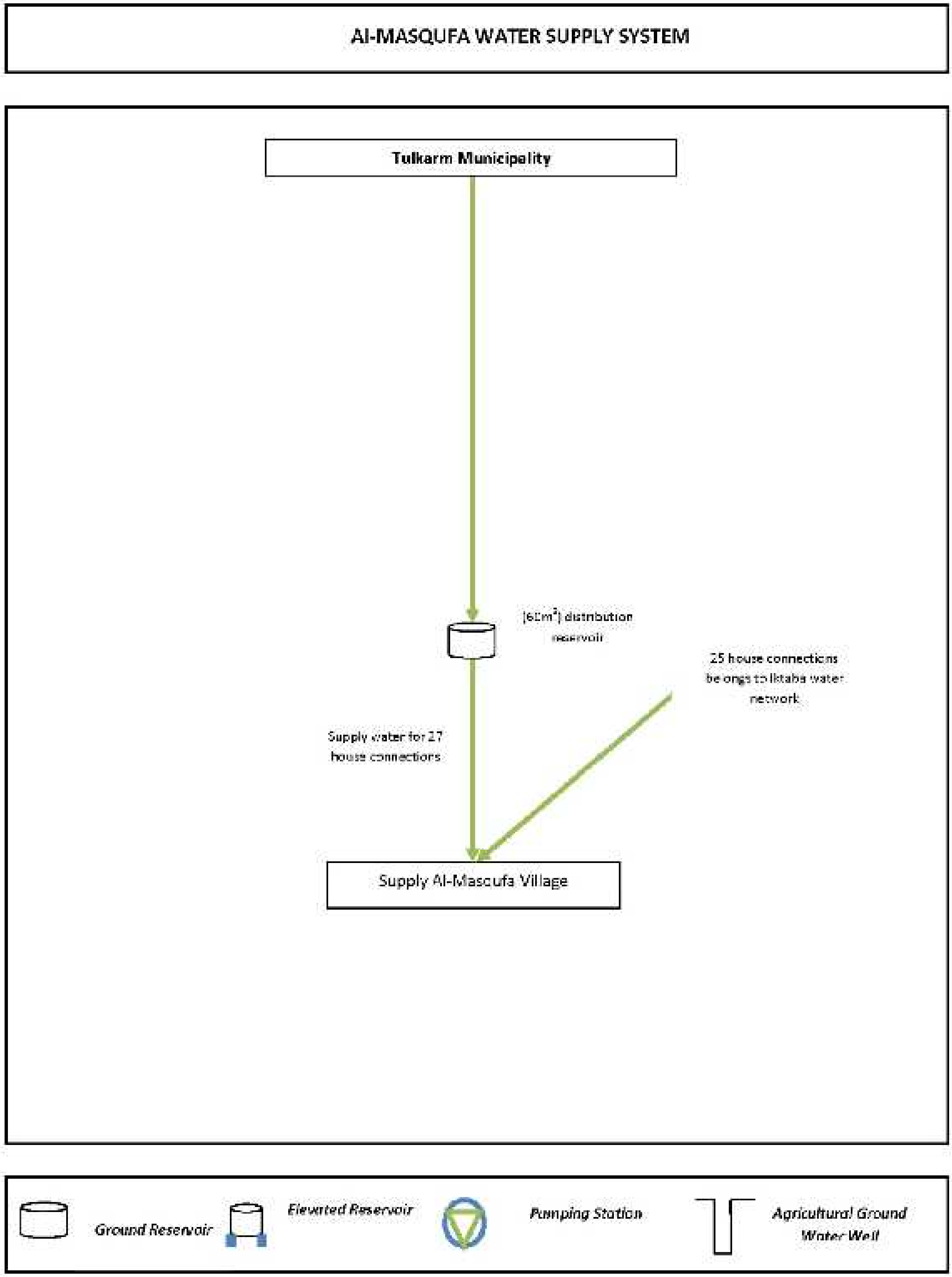
Table (64): Total Water Use

Year 2009												
Supplied Water (m3)	3002	2350	2228	3981	4827	4255	4239	3760	2172	2113	3002	2350
Consumed water (m3)	2985	2295	2798	3897	4785	4202	3995	3540	2035	2067	2985	2295
Water meter accuracy												
Losses (m3)	17	55	-570	84	42	53	244	220	137	46	17	55
Losses (%)	0.6	2.3	-25.6	2.1	0.9	1.2	5.8	5.9	6.3	2.2	0.6	2.3

Observations

Municipal Water consumption mainly goes only for domestic use. According to the Municipality cattle, are not common and other consumption types as commercial or industrial consumption are marginal. The municipality estimated non-domestic consumption around 5%. The average per capita consumption is relatively high around 103 l/c/d, however; the percentage of losses is 3%.

Al Masqufa



Figure(33): Al Masqufa Water Supply System

Community Profile

Table (65): Community Profile

Water Sources	The community is supplied with water by Tulkarm Municipality	
Cisterns	% households with cisterns	No. of Cisterns
	100%	
Water Supply System	Storage Volume (m3)	60 m3 reservoir
	Area of Coverage	Al Jarishiya in addition to 25 household connections from Iktaba
	Age of Network	2 years (Established in 2008)
	Last Date of Rehabilitation	2009
	Last Date of Extension	2009
	Type of meters	Volumetric meters
	No. of Connections	27 (in the village)
	Connection Fees	80 JD
Water Use	% of Domestic Use	95
	% of Commercial and Industrial Use	
	% of other uses/Non-Domestic Use	5
	Average use (l/c/d)	39
	% of losses	3
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	1
	No. of Maintenance workers	1 (the same person)
	No. of Accountants	
	No. of Meter Readers	
	No. of Administrative Staff	3

	Pricing system	
Comments and other Information	They need 20 volumetric meters.	
	They need 2" pipes – 800m + 1" pipes -300m+ 1/2" pipes – 300m. and a new pump.	

Total Water Use

Table (66): Total Water Use

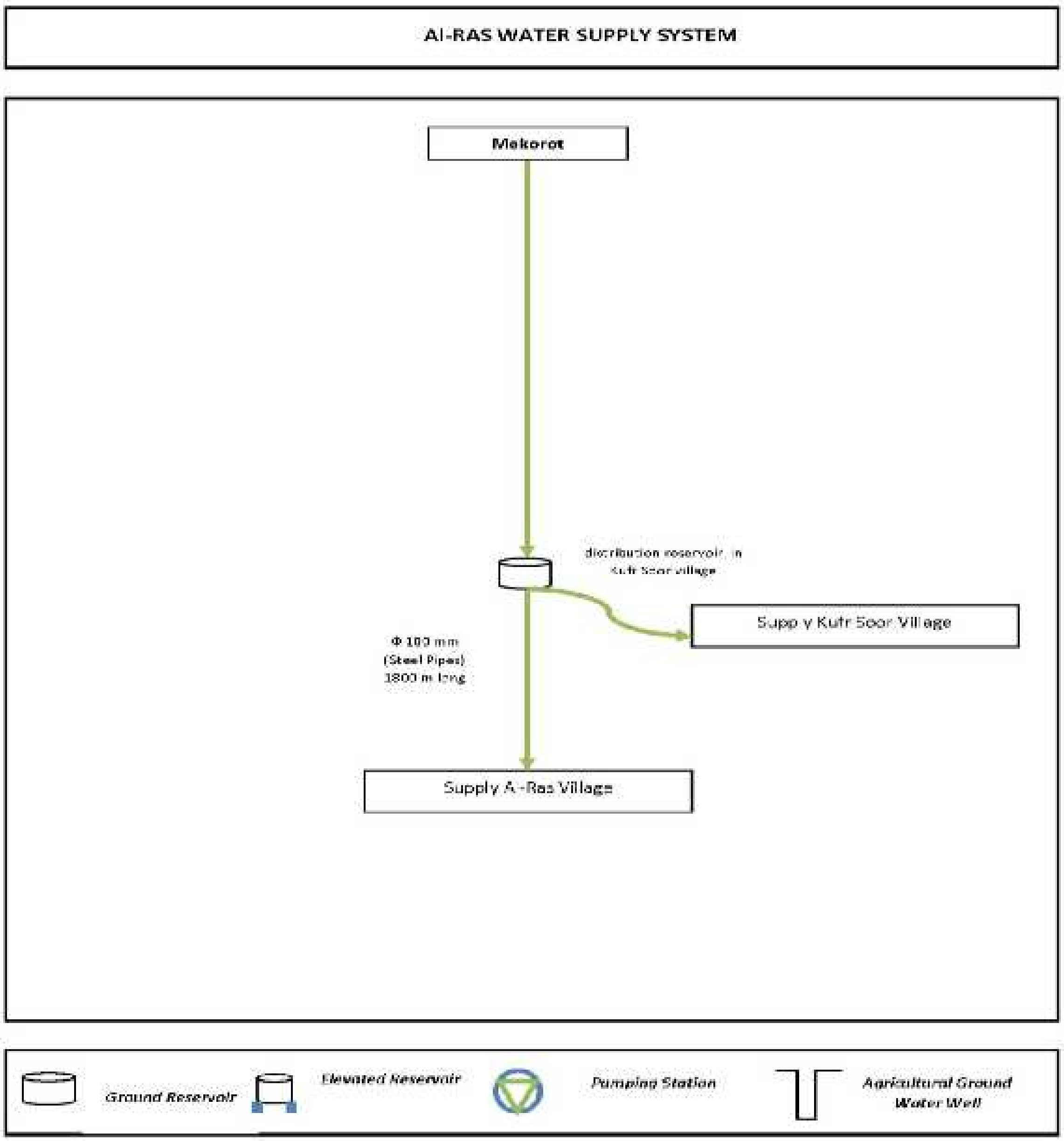
Year 2009												
Supplied Water (m3)	197	164	248	316	261	478	484	472	506	370	213	262
Consumed water (m3)	190	180	222	360	220	451	469	436	379	379	281	281
Water meter accuracy												
Losses (m3)	7	-16	26	-44	41	27	15	36	127	-9	-68	-19
Losses (%)	3.6	-9.8	10.5	-13.9	15.7	5.6	3.1	7.6	25.1	-2.4	-31.9	-7.3

Observations

The only project they need is the construction of new elevated reservoir to avoid high pressure and to ensure storage for a couple of days during the emergency and water cut.

Al Ras

Municipal Water consumption mainly goes only for domestic and agricultural use as well. According to the village council cattle and chicken are common farms in the community. The biggest farm for eggs production and poultry in Palestine is in the community. There are 3000 cows, 10000 turkeys and 50000 chickens. The other consumption types as commercial or industrial consumption are marginal, however; a fodder factory is there. The village council estimated non-domestic consumption around 15%. The average per capita consumption is relatively high around 78 l/c/d, however; the percentage of losses is 43%.



Figure(34): Al Ras Water Supply System

Community Profile

Table (67): Community Profile

Water Sources	The community is supplied with water by the Israeli Water Company Mekorot	
Cisterns	% households with cisterns	No. of Cisterns
	10%	20
Water Supply System	Storage Volume (m3)	60 m3 reservoir
	Area of Coverage	Al Ras and Kufr Sur
	Age of Network	26 years (Established in 1984)
	Last Date of Rehabilitation	2007
	Last Date of Extension	2007
	Type of meters	Speed (velocity) meters
	No. of Connections	150
	Connection Fees	350 NIS
Water Use	% of Domestic Use	85
	% of Commercial and Industrial Use	
	% of other uses/Non-Domestic Use	15
	Average use (l/c/d)	78
	% of losses	43
	Volume of Bulk Supply (m3), to who?	No supply
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	1
	No. of Maintenance workers	Lum sum payment: 2000 NIS yearly
	No. of Accountants	1
	No. of Meter Readers	1
	No. of Administrative Staff	6
	Pricing system	Increasing block tariff Consumption Category — Price 0 – 25 m3 — 3.5 NIS/m3

		26 – 40 m3	4.5 NIS/m3
		>40 m3	5.0 NIS/m3
Comments and other Information	The location needs new water meters, 180 volumetric meters, and is ready to participate on 50% from the costs.		

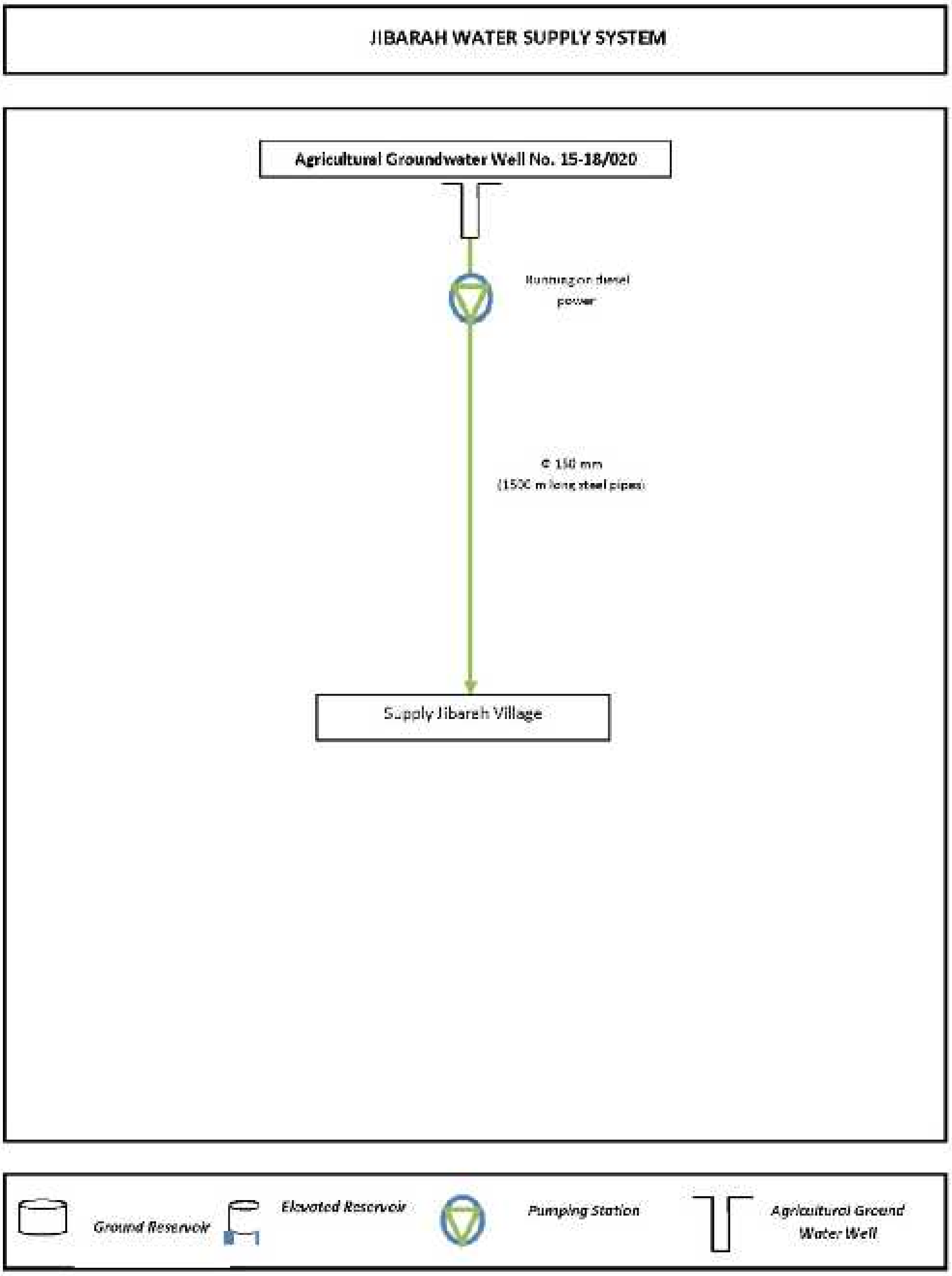
Total Water Use

Table (68): Total Water Use

Year 2008													
Supplied Water (m3)	1700	1600	1800	2600	2400	2600	2900	2700	2800	2200	2100	2200	27600
Consumed water (m3)	863	861	1086	1522	1565	1528	1600	1527	1507	1317	1363	938	15677
Water meter accuracy													
Losses (m3)	837	739	714	1078	835	1072	1300	1173	1293	883	737	1262	11923
Losses (%)	49.2	46.2	39.7	41.5	34.8	41.2	44.8	43.4	46.2	40.1	35.1	57.4	43.2
Year 2009													
Supplied Water (m3)	2000	1700	1400	1750	1800	3000	2800	3500	2800	2574	1962	1366	26652
Consumed water (m3)	775	729	696	937	1176	1775	1785	1773	1655	1731	1364	829	15225
Water meter accuracy													
Losses (m3)	1225	971	704	813	624	1225	1015	1727	1145	843	598	537	11427
Losses (%)	61.3	57.1	50.3	46.5	34.7	40.8	36.3	49.3	40.9	32.8	30.5	39.3	42.9

Observations: The high losses from the system are anticipated to be as a result of the speed meters which have to be replaced.

Jibarah



Figure(35): Jibarah Water Supply Syste

Community Profile

Table (69): Community Profile

Water Sources	The community is supplied with water from the agricultural groundwater well no. 15-18/020	
Cisterns	% households with cisterns	No. of Cisterns
		62
Water Supply System	Storage Volume (m3)	Agricultural network
	Area of Coverage	Jibarah – 60-62 houses
	Age of Network	46 years
	Last Date of Rehabilitation	2005
	Last Date of Extension	Before 2000
	Type of meters	They buy each hour/60m3 by 130 NIS
	No. of Connections	
	Connection Fees	
Water Use	% of Domestic Use	30%
	% of Commercial and Industrial Use	
	% of other uses/Non-Domestic Use	70% - agriculture
	Average use (l/c/d)	
	% of losses	
	Volume of Bulk Supply (m3), to who?	They supply Shofa: every 10 days and for 2 days (30-40 hours) 90m3/hour , because the area is law and near the village.
Water Service	Water is Managed by the Council?	By persons and not the council
	Total No. of workers	6
	No. of Maintenance workers	2
	No. of Accountants	1
	No. of Meter Readers	The same persons of the workers maintenance

	No. of Administrative Staff	3
	Pricing system	
Comments and other Information	All wells changed its operation from diesel to electricity except this well, which decreases the farmers and their planting as a result of high prices of water.	
	They need internal network with a reservoir for the village. There are high dept on the well.	
	The agricultural network serves 60-62 houses of the village, every farmer lives in a farm and has connection between the water line of the network to the cistern of the house.	

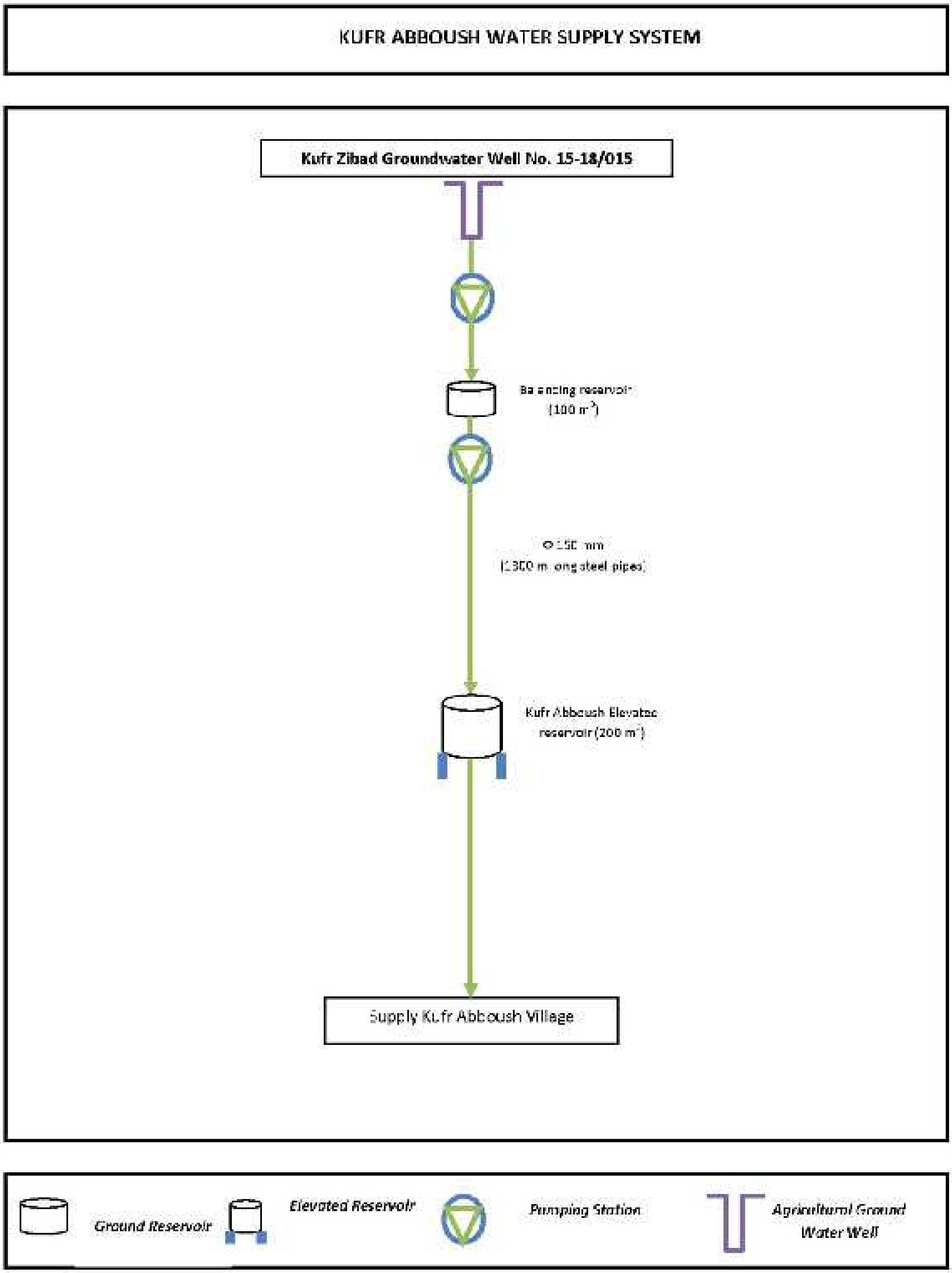
Total Water Use

Observations

The groundwater supplying the community still runs using a diesel generator although the electricity lines runs beside it which need an Israeli approval to supply the well.

Kufr Abboush

Municipal Water consumption mainly goes only for domestic use. According to the village council cattle are few and other consumption types as commercial or industrial consumption are marginal. The village council estimated non-domestic consumption around 8%. The average per capita consumption is relatively high around 87 l/c/d, however; the percentage of losses is 22%.



Figure(36): Kufr Abboush Water Supply Syst

Community Profile

Table (70): Community Profile

Water Sources	The community is supplied with water from the Kufr Zibad groundwater well no. 15-18/015 in addition to rainwater harvesting.	
Cisterns	% households with cisterns	No. of Cisterns
	80%	250
Water Supply System	Storage Volume (m3)	100 m3 balance tank and 200 m3 reservoir
	Area of Coverage	Kufr Abboush – 300 houses
	Age of Network	8 years (Established in 2002)
	Last Date of Rehabilitation	
	Last Date of Extension	
	Type of meters	
	No. of Connections	55% of the households
	Connection Fees	500 NIS
Water Use	% of Domestic Use	92
	% of Commercial and Industrial Use	
	% of other uses/Non-Domestic Use	8
	Average use (l/c/d)	87
	% of losses	22
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	2
	No. of Maintenance workers	
	No. of Accountants	1
	No. of Meter Readers	1
	No. of Administrative Staff	2

	Pricing system	5 NIS/m3 in addition to 6 NIS for maintenance
Comments and other Information	There are two kinds of networks: conveying pipeline 1800m, and internal network: 4000m.	
	The network needs to be extended, and change the pipes from 1/2" to 3" for 1000m, also 1/2" pipes for 1500m.	
	There are more than 500 head of cattle consume nearly 20m3- from domestic cisterns water monthly. There are only 2 greenhouses.	

Total Water Use

Table (71): Total Water Use

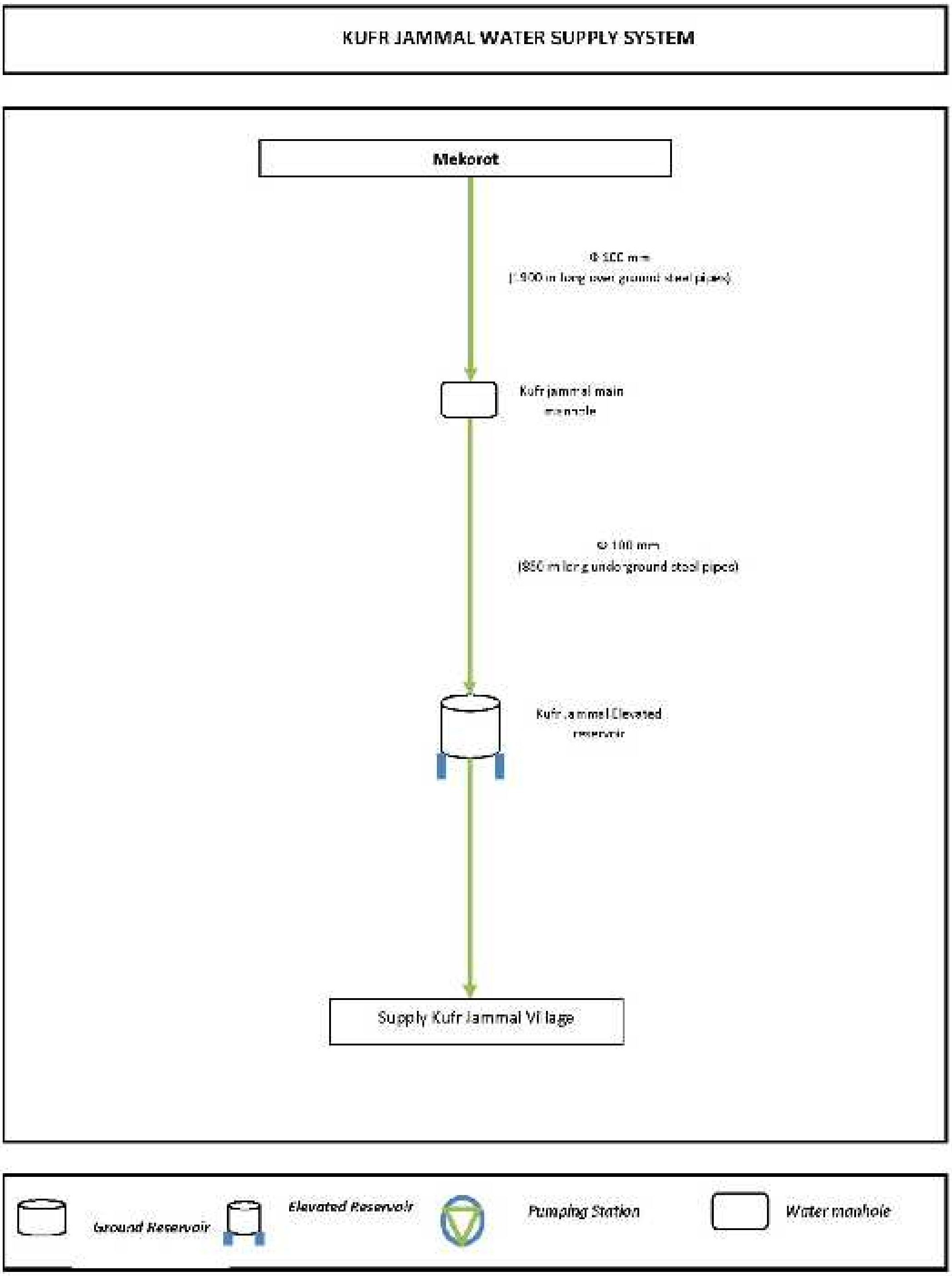
Year 2009													
Supplied Water (m3)	1720	1700	1810	2810	3740	4420	4930	4390	2250	2780	2170	1770	34490
Consumed water (m3)	1464	1400	1507	2033	3050	3100	3619	3292	2000	1989	1981	1540	26975
Water meter accuracy													
Losses (m3)	256	300	303	777	690	1320	1311	1098	250	791	189	230	7515
Losses (%)	14.9	17.6	16.7	27.7	18.4	29.9	26.6	25.0	11.1	28.5	8.7	13.0	21.8

Observations

The groundwater supplying the community still runs using a diesel generator although the electricity lines runs beside it. The main problems:

In general, the cost of water pumped from the groundwater well is considered expensive once compared to other sources, largely due to the fact that the generator is not connected to an electric line but is rather run by diesel fuel. This also results in numerous breakdowns and subsequent interruptions in the delivery of water to the benefiting communities.

Kufr Jammal



Figure(37): Kufr Jammal Water Supply System

Community Profile

Table (72): Community Profile

Water Sources	The community is supplied with water by the Israeli Water Company Mekorot.	
Cisterns	% households with cisterns	No. of Cisterns
	25%	200 (but not used except when it is necessary)
Water Supply System	Storage Volume (m3)	200 m3 reservoir
	Area of Coverage	Kufr Jammal – 500 houses
	Age of Network	24 years (Established in 1986)
	Last Date of Rehabilitation	
	Last Date of Extension	2008
	Type of meters	Speed (velocity) meters
	No. of Connections	550
	Connection Fees	400 NIS
Water Use	% of Domestic Use	95
	% of Commercial and Industrial Use	
	% of other uses/Non-Domestic Use	6
	Average use (l/c/d)	59
	% of losses	42
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	3
	No. of Maintenance workers	1
	No. of Accountants	1
	No. of Meter Readers	1
	No. of Administrative Staff	2

	Pricing system	3.5 NIS/m3
Comments and other Information	The location needs new water network because the current one is old and water loss is high.	

Total Water Use

Table (73): Total Water Use

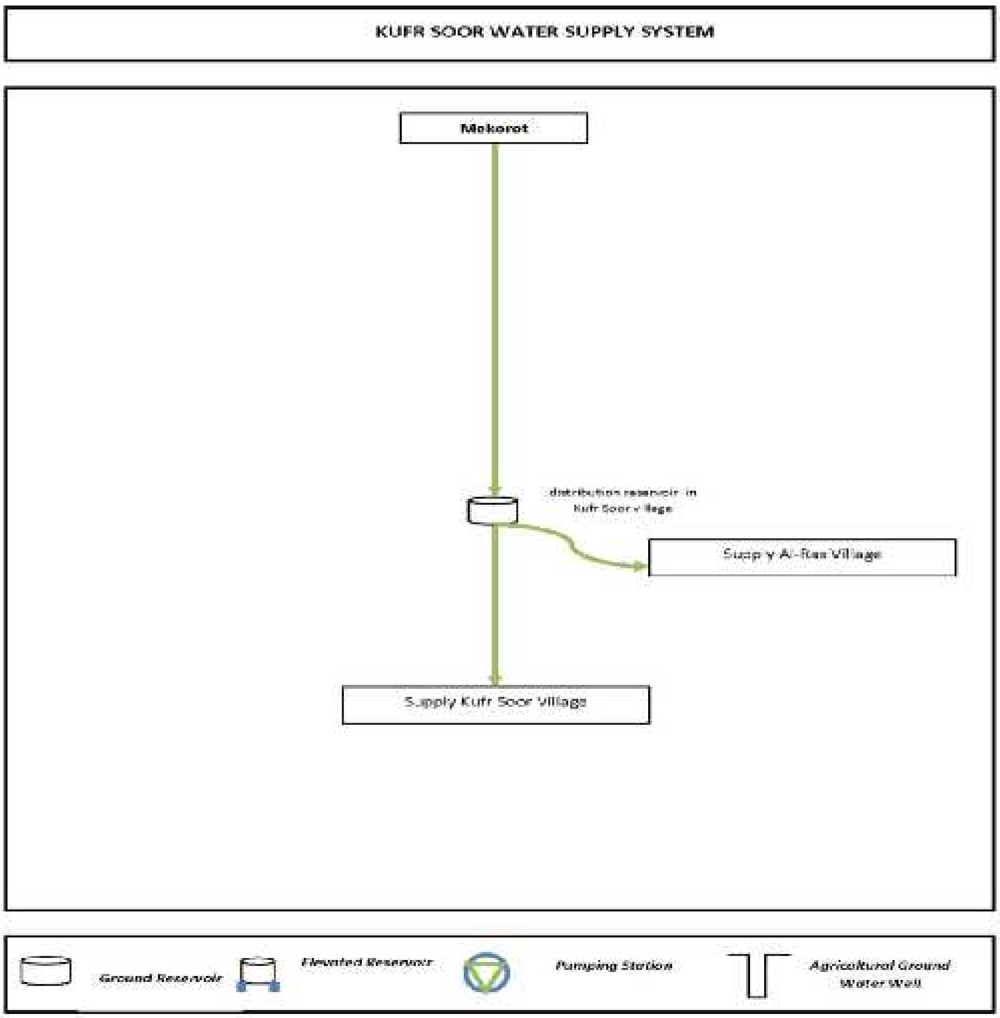
Year 2009													
Supplied Water (m3)	5590	5500	6550	5820	8580	7310	10000	10320	8810	8990	6620	7580	91670
Consumed water (m3)	3425	2759	3528	4375	4530	5575	6350	5680	5169	4975	3695	3075	53136
Water meter accuracy													
Losses (m3)	2165	2741	3022	1445	4050	1735	3650	4640	3641	4015	2925	4505	38534
Losses (%)	38.7	49.8	46.1	24.8	47.2	23.7	36.5	45.0	41.3	44.7	44.2	59.4	42.0

Observations:

Most of the old houses have cistern, however, the new don't. Cisterns are mainly used for emergency and water cut conditions. The analyses of the water consumption over supply show that the percentage of losses is extremely high. The average percentage of losses over the two years is 42%, and according to the village council this refers to the physical losses and speed meters had been used since 1986.

Municipal Water consumption mainly goes only for domestic use. According to the village council cattle, are not common and other consumption types as commercial or industrial consumption are marginal. The village council estimated non-domestic consumption around 6%. The average per capita consumption is relatively high around 59 l/c/d, however; the percentage of losses is 42%. The water network in Kafr Jammal requires urgent rehabilitation and maintenance due to system malfunctions causing a high percentage of water leakage from the network.

Kufr Soor



Figure(38): Kufr Soor Water Supply System

Community Profile

Table (74): Community Profile

Water Sources	The community is supplied with water by the Israeli Water Company Mekorot	
Cisterns	% households with cisterns	No. of Cisterns
	95	
Water Supply System	Storage Volume (m3)	3000 m3 public pool
	Area of Coverage	Kufr Soor, Kur and Al Ras
	Age of Network	26 years (Established in 1984)
	Last Date of Rehabilitation	Has been rehabilitated since establishment
	Last Date of Extension	2002
	Type of meters	Speed (velocity) meters
	No. of Connections	250 house connections 70 agricultural connections
	Connection Fees	500 NIS
Water Use	% of Domestic Use	60
	% of Commercial and Industrial Use	1%
	% of other uses/Non-Domestic Use	40
	Average use (l/c/d)	160
	% of losses	33
	Volume of Bulk Supply (m3), to who?	No supply
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	2
	No. of Maintenance workers	Lum sum payment, 2000 NIS yearly
	No. of Accountants	1
	No. of Meter Readers	1
	No. of Administrative Staff	3

	Pricing system	Increasing block tariff Consumption Category — Price Minimum — 6 NIS 0 – 30 m3 — NIS/m3 31– 50 m3 — 4.0 NIS/m3 51– 60 m3 — NIS/m3 >61 m3 — 6.0 NIS/m3
Comments and other Information	There are farms of cows consume 4000m- monthly, and chicken farms consume 500m3, and dunums of green houses.	
	They need volumetric meters and the council is ready to participate on 50% from the costs.	

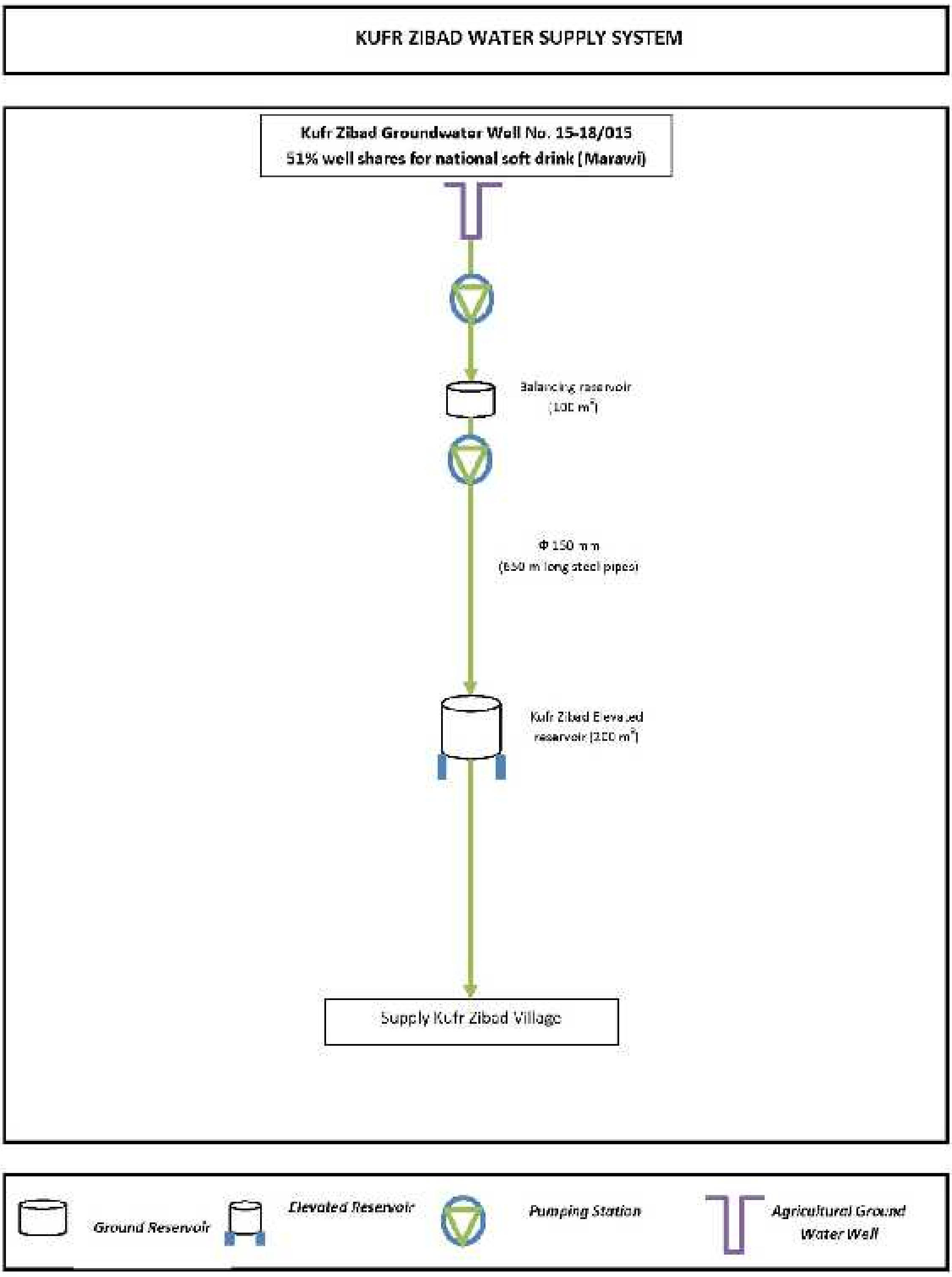
Observations

These villages do not control the water source and therefore rely on the Israel Company to provide their water needs, which also takes charge of the chlorination process. Moreover, the company imposes insufficient amount of the water regardless of the population water demands.

The existing network is assumed to be deteriorated and not enough to supply water for Kufr Soor and Al-Ras. Therefore; a rehabilitation project would not solve the problem as they did in the previous water network design.

Municipal Water consumption mainly goes for domestic use. According to the village council cattle, are common and other consumption types as commercial or industrial consumption are marginal. The village council estimated non-domestic consumption around 40%. The average per capita consumption is relatively high around 160 l/c/d, however; the percentage of losses is 33%.

Kufr Zibad



Figure(39): Kufr Zibad Water Supply System

Community Profile

Table (75): Community Profile

Water Sources	The community is supplied with water from the Kufr Zibad groundwater well no. 15-18/015	
Cisterns	% households with cisterns	No. of Cisterns
	80%	200
Water Supply System	Storage Volume (m3)	100 m3 balance tank and 200 m3 reservoir
	Area of Coverage	Kufr Zibad
	Age of Network	25 years (Established in 1985)
	Last Date of Rehabilitation	
	Last Date of Extension	
	Type of meters	Speed (velocity) meters
	No. of Connections	270
	Connection Fees	Consumer pays 66% of the costs (300 NIS)
Water Use	% of Domestic Use	85
	% of Commercial and Industrial Use	
	% of other uses/Non-Domestic Use	15
	Average use (l/c/d)	104
	% of losses	42
	Volume of Bulk Supply (m3), to who?	Kufr Sour+ Kur
Water Service	Water is Managed by the Council?	Yes
	Total No. of workers	3
	No. of Maintenance workers	1 (the same person)
	No. of Accountants	
	No. of Meter Readers	
	No. of Administrative Staff	2
	Pricing system	Increasing block tariff Consumption Category — Price 0 m3 (Minimum) — 10 NIS

		1 – 2 m3	15 NIS
		>3 m3	4 NIS/m3 in addition to 10 NIS
Comments and other Information	They need to maintain and rehabilitate the network because it is old and the loss is high.		

Total Water Use

Table (76): Total Water Use

Year 2008												
Supplied Water (m3)	2410	2540	3730	4320	4980	5560	5990	6560	5640	5520	4670	7480
Consumed water (m3)	1687	1830	2798	3020	3490	3780	4313	4592	3950	3754	3190	5480
Water meter accuracy												
Losses (m3)	723	710	932	1300	1490	1780	1677	1968	1690	1766	1480	2000
Losses (%)	30.0	28.0	25.0	30.1	29.9	32.0	28.0	30.0	30.0	32.0	31.7	26.7
Year 2009												
Supplied Water (m3)	4850	3990	4570	5170	5830	5780	5830	5790	4950	4760	3200	3070
Consumed water (m3)	3640	2953	3290	3620	4080	3930	4080	4060	3565	3475	2400	2305
Water meter accuracy												
Losses (m3)	1210	1037	1280	1550	1750	1850	1750	1730	1385	1285	800	765
Losses (%)	24.9	26.0	28.0	30.0	30.0	32.0	30.0	29.9	28.0	27.0	25.0	24.9

Observations

Drinking water sources are from Kufr Zibad groundwater well 15-18/015. This well is shared between the council (17% of the total shares), shareholders from Kufr Zibad and The National Soft Drink Company (Marawi). Fifty one percents of the wells shares are owned by this company. It supplies water to Kufr Abboush, Kufr Zibad and very soon Kur will get water from this well. However, and according to the village council and the Kafriyat Joint Service Council (KJSC), this well did not get any support; and it is still working diesel. The reason is because, part of the shareholders belong to a private company. This well is running on diesel power, however; the three phase electric power is close to the well (Kafriyat Electric Grid).

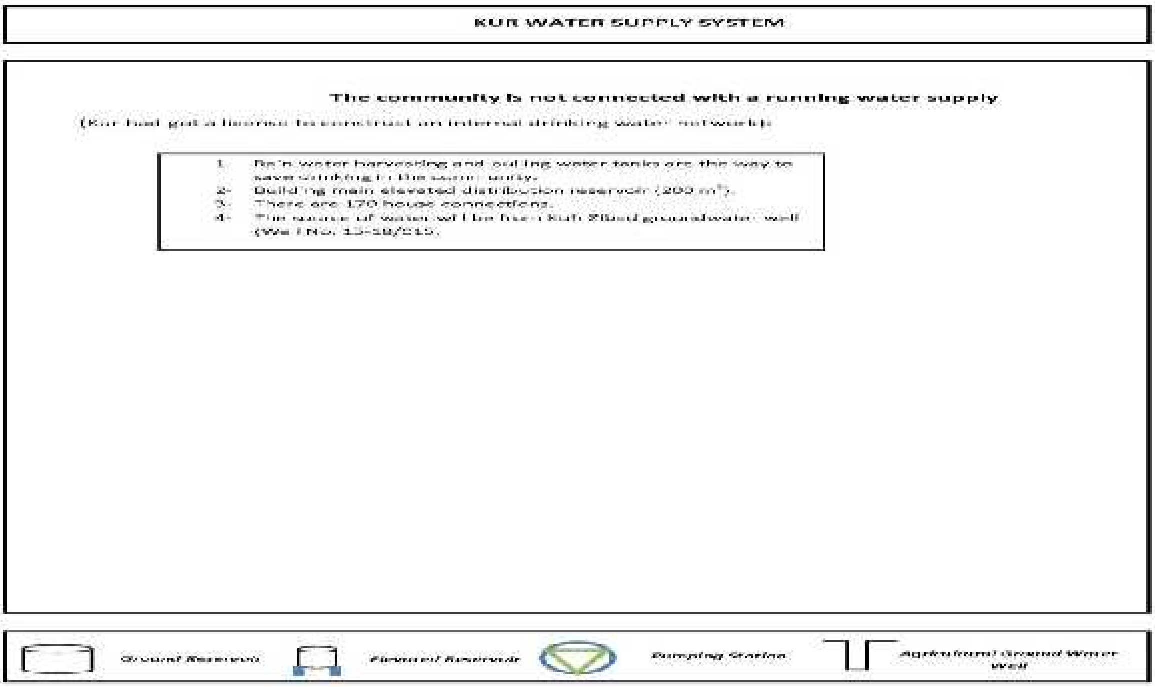
There is an open agreement between the village council and MARAWI (who operates the well) to supply unlimited amount of water to Kufr Zibad.

The water network was established in 1985. Therefore, it needs replacement and expansion.

Most of the houses have cisterns. However; the use is limited for watering the gardens and drinking tea according to village council. We think also, people consider cisterns as a stand by source to secure water supply during water cut, emergencies and unexpected water crisis. Therefore, the importance should not be marginalized as some people thought.

Municipal Water consumption mainly goes only for domestic use. According to the village council cattle, are not common and other consumption types as commercial or industrial consumption are marginal. There are two olive oil press and…. The village council estimated non-domestic consumption around 15%. The average per capita consumption is relatively high around 104 l/c/d, however; the percentage of losses is 42%.

Kur



Figure(40): Kur Water Supply System

Community Profile

Table (77): Total Water Use

Water Sources	The community relies on rainwater harvesting and tankering for water	
Cisterns	% households with cisterns	No. of Cisterns
	95	80 cisterns (from 87-90 houses)
Water Supply System	Storage Volume (m3)	3000 m3 public pool
	Area of Coverage	Kur
	Age of Network	NA
	Last Date of Rehabilitation	-
	Last Date of Extension	-
	Type of meters	-
	No. of Connections	-
	Connection Fees	-
Water Use	% of Domestic Use	100%
	% of Commercial and Industrial Use	
	% of other uses/Non-Domestic Use	
	Average use (l/c/d)	
	% of losses	
	Volume of Bulk Supply (m3), to who?	
Water Service	Water is Managed by the Council?	
	Total No. of workers	
	No. of Maintenance workers	
	No. of Accountants	
	No. of Meter Readers	
	No. of Administrative Staff	
	Pricing system	

Comments and other Information	They need to rehabilitate the pool.

Observations

There are 4 trucks at Kur, and size 4m3/tank. These trucks fill water from a neighboring community (Kufr Soor), and the cost of one cubic meter is 22 NIS. The public pool is leaky and needs inside cleaning, walls' treatment, casting the floor, and protection and maintenance of the inlet area. On the 22nd of December 2009, Kur had got a license to construct an internal drinking water network. The source of water will be from Kufr Zibad groundwater well 15-18/015.

General Conclusion

The availability of water supply to the various communities within the Governorate is highly variable. The costs of supplying water to the different communities are also variable. The fact that the community is an agricultural community, agriculture is a main water user as well as main contributor to the local economy. However, the unreliable water supply and frequent cut off have several impacts on the livelihood of the community. The impacts can be summarized in Table (73).

Table (78): The impact of water supply cut off on the Livelihood of Communities

Locality Name	Main impacts
Akkaba	17% of total monthly income goes to the water tanks in the village decrease agriculture production due to the water scarcity
Qaffin	Purchasing water tanks with high price affects the households income
Nazlat 'Isa	
An Nazla ash Sharqiya	Affects the irrigated agricultural lands very badly
Baqa ash Sharqiya	
An Nazla al Wusta	
An Nazla al Gharbiya	
Zeita	The water interruptions in the village cause losses

	in agricultural sector
Seida	The water interruptions in the village cause losses in agricultural sector
'Illar	
'Attil	The water interruptions in the village affects the greenhouses, agricultural lands especially the irrigated lands and the other workshops that requires water
Deir al Ghusun	
Al Jarushiya	
Al Masqufa	Purchasing water tanks and therefore affect the households income. Expense on purchasing water reaches 250 NIS per month
Bal'a	Water interruptions in Bal'a directly affects the livestock sector and this might have a lot of losses reaches more than 10,000 NIS besides the losses in agriculture sector
Iktaba	The agricultural sector in Iktaba village was severely affected by the water interruptions Purchasing water tanks and affect the households income
Tulkarem	1- Water interruptions are affecting all the workshops, craft, factories that requiring water. And might occur a lot of losses 2- water interruptions in the community is affecting services sector 4- affecting the construction sector 3- Affecting the household income by purchasing water tanks
Anabta	The water interruptions affects the breakers and other sectors that requires water
Kafr al Labad	the water interruptions during the summer caused a lot of losses in agriculture sector reaches around 20 thousands shekels annually

Kafa	The water interruptions affects the agricultural lands in the village
Al Haffasi	
Ramin	
Far'un	Water interruptions affects the agricultural lands in the village
Shufa	The water interruptions in the community affects the factory and other livestock sector
Khirbet Jubara	Water tanks
Saffarin	Around 18% of total monthly income goes to the water tanks in the village
Beit Lid	
Ar Ras	Affecting the livestock (caws farms) and might have a lot of losses
Kafr Sur	Affects the fodder factory and caws farms located in the community and might cause losses
Kur	11 percent of households income goes to water tanks due the water interruptions
Kafr Zibad	Affects the drink factory, other agricultural work in the village
Kafr Jammal	Affects the agriculture sector in the village
Kafr 'Abbush	

1.7 Current Status of Wastewater Collection, Treatment and Reuse

1. 7.1 Introduction

The current situation of the sewerage conditions in most Palestinian towns and villages is almost identical. In the study area most of the communities do not have collection systems. They use cesspits to dispose off the sewage from the houses. Cesspits are emptied by private tankers which are disposed nearby the Wadies or near the sides of the roads. Cesspits are basically small holes in the ground with 2 -3 m depth constructed with opening in the walls and no concrete bottoms to allow wastewater to infiltrate into the ground. The infiltration rate depends on the type of the soil. The cesspit needs evacuation when it fills with sewage. Most of cesspits are evacuated once or more each month. The number of evacuation depends on many factors like the volume of the cesspit itself, the quantity of the consumed water at the house and the nature of the soil of the cesspit.

Most of the existing cesspits are above fifteen years old and this means that the majority of these cesspits become less effective in infiltrating the sewage because they became blocked with the fine solids or the settled sludge. There were many cesspits that seep into the streets especially at the centre of villages where houses are dense. It causes social, health and environmental problems in these locations. Excavating a cesspit is difficult in these areas of dense houses, because of the limited area surrounding each house in these locations.

Most of the houses in the study area have their own cesspits and some of them share in the same cesspit. This happens especially in the case of extended families like the father and his sons or whom their houses beside his house. These cesspits are located near the houses. The average size of the cesspits ranges between 10-50m3. The total cost for construction of a new cesspit is between 1000-2000 $US. The average cost for evacuating one tank 6m3 volume from the cesspit and disposing is nearly about 18$ and it depends on the location of disposal. The number, size and condition of cesspits exist in the Governorate can be summarized in Table (74).

Table (79): The cesspit characteristic

Locality	Percentage of cesspits in the village	Size of the cesspits	Number emptying the cesspit /year	Number of tanks (each empty process)	Capacity of the tank (m3)	Cost of the tank	Disposal area regarding the village
Akkaba	100	30	4	1	3	50	**Village outskirts**
Qaffin	100	25		1	5	60	**Village outskirts**
Nazlat 'Isa	100	30	12	3	3	50	**Wad Abo Enar (Baga ash**

							Sharqiya)
An Nazla ash Sharqiya	100	25	24	2	5	80	**No specific place**
Baqa ash Sharqiya	100	60	24	1	5	50	**Wad Abo Enar and sometimes on the olive trees**
An Nazla al Wusta	100	30	2	2	5	70	**No specific place**
An Nazla al Gharbiya	100	30		2-3	5	50	**Wadi Abo Enar**
Zeita	10	10	12	1	7	50	**Wadi Abo Enar**
Seida	100	20		2	5	100	**No specific place**
'Illar	100	30-50	2	4	10	100	**In the surrounded land in the village and sometimes in agriculture lands**
'Attil	100	15	12	2	5	50	**Random Wadi**
Deir al Ghusun	100	10	24	2	5	60	**Random places**
Al Jarushiya	100	15	10	2	5	100	**Tulkarem treatment situation**
Al Masqufa	100	30	1	2	4-5	70	
Bal'a	100	25	2	2	3	60	**Wadi Ezzomer**
Iktaba	100	20	6	1	3	100	**Wadi Ezzomer**

Nur Shams Camp							
Tulkarem Camp							
Tulkarem	25	30	4	1-2	5-7	60	Wadi Ezzomer
Anabta	30	30	12	1	1	70	Wadi Ezzomer
Kafr al Labad	100	20	12	1	3	70	Wadi Ezzomer
Kafa	100	30	4	2	6	70	
Al Haffasi							
Ramin	100	25	12	2	3.5	50	Wadi Alkteas and discharge in Wadi Ezzomer
Far'un	100	10	2	2		70	No specific place
Shufa	99	30	12	1	5	70	Random lands in the village
Khirbet Jubara	100	30	6	3	3	50	Random lands in the village
Saffarin	100	30	2	2	4	60	Wadi Ezzomer
Beit Lid	100	25	2	3	4	60	Wadi Ezzomer
Ar Ras	100	25	3	2	4	40	Village outskirts + agriculture lands
Kafr Sur	100	30	1	1-2	4	60	Village outskirts
Kur	100	30	2	2	4	50	Village outskirts + agriculture lands

Kafr Zibad	100	20	12	1	5	45	**Random lands in the village and other wadis**
Kafr Jammal	100	30	12	1-2	4	40	**Random lands in the village**
Kafr 'Abbush	**100**	**35**	**2**	**2**	**4**	**50**	**Random lands in the village + agriculture lands**

Moreover, it was found that there are six communities that have partially sewage collection systems. The communities are Tulkarem City (The City, Shwiekha, Thinaba, Irtah) , Tulkarem Camp, Nur Shams Camp , Annabta, Zeita and Attil. ,

The current wastewater collection and treatment in these communities is presented hereunder for each community:

Tulkarem City:

It was found that nearly 75%-80% of the houses are connected to a sewage collection system in Tulkarem City which includes the City itself, Shwiekha, Thinaba and Irtah communities.

Tulkarem Municipality operates the sewerage system of Tulkarem and Shuweika while the sewerage systems in Tulkarem Camp and Nur Shams Camp are operated by UNRWA.

The Tulkarem trunk system consists of several trunk mains and one force main, which convey the sewerage to the existing ponds. The trunk main of Shuweika discharges the wastewater directly into the Wadi Zeimar.

The wastewater collected in Tulkarem City sewage system is pretreated in Tulkarem treatment plant located at the western part of the city adjacent to the green line. The treatment plant consists of one screen and three ponds Figure (#). The effluent of Pond 1 is discharged into Pond 3 nearby the outlet of the pond. Due to the short circuit flow and the corresponding short retention time, only very limited additional degradation of organic substances can be expected.

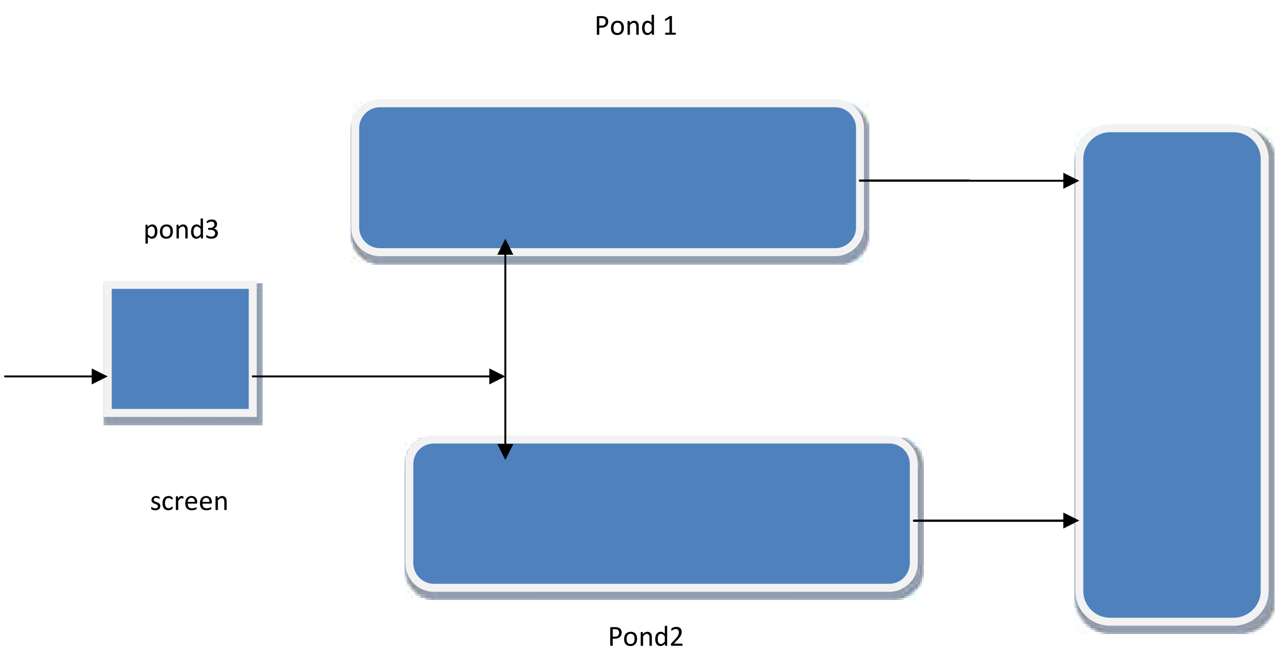


Figure (41): Flow scheme of existing Tulkarem WWTP

Originally the two ponds have been designed as facultative ponds, while the third pond should operate as a polishing pond. Today the ponds are visibly fully anaerobic due to overloading and accumulated sludge at the pond bottom and surface as shown in Figures (#). Table (#) also presents the volume and details if the ponds.

Since the ponds have been rehabilitated in 2004 – 2005 by the installation of a HDPE liner, no sludge has been removed. The screen is not working properly due to many problems with the control device. After passing the pond, the wastewater is discharged to a streambed located south of the WWTP conveying the sewage to the Israeli side where it is subsequently treated in the Emek Hefer WWTP.

Figure(42): Facultative Ponds of Tulkarem City

Figure(43):: Raw wastewater from Nablus City passing Anabta Town

Table (80): Surface area and volume of the ponds

	Unit	Pond1	Pond2	Pond3	Total
Surface area	M2	4370	3906	2182	10488
Bottom area	M2	1516	1472	407	3395
Depth	M	3.3	3.3	3.9	
Volume	M3	9418	8032	6926	24375

In Tulkarem City every house must pay a fixed subscription fee of 200 J.Ds when first connecting to the wastewater network. There is no tariff system as of yet concerning the wastewater services. In this regard, customers currently do not pay any monthly service charge for these wastewater services.

Anabta:

The sewerage system for Anabta (Anabta, Kufur Ruman) has been constructed in 1997 with a main sewage pipeline started from the east of the town towards the west along the main road. The project was financed by PECDAR. The diameter of that pipeline was 10" at the started point and ended with a diameter of 16". Part of the internal sewage network was implemented in 2000 and was financed by Save of the Children and the municipality. In 2008 and 2009 some sewage pipelines were implemented by the municipality . At present about 70 % of the sewerage network of Anabta have been constructed. The collected wastewater is discharged without any treatment to the Wadi.

Every sewage house connection in Anabta pay 8 NIS every month for the municipality for the maintenance of the sewage collection system. The connecting fees are 50 JD for each connection plus 1 JD for each 1m2 of the area of the building if its total area more than 100m2 or 100 JD if the area of the building less than 100m2. The owner of the house also pays the cost of the materials for the sewage house connection and the municipality implement the house connection.

Anabta is suffering from the raw sewage flowing from the west part of Nablus City, Figures #&# . The raw sewage flows into the Wadi crossing the town from the east to the west between the houses in the town causing serious problems such as odor, insects and also causing groundwater pollution especially in the wells adjacent to the wadi as indicated in the previous chapter (groundwater quality).

Zeita:

In Zeita village the sewage collection system is now covering 80%-85% of the houses in the village. The collection system was started in 2002. The system was designed and implemented by PHG and it was funded by Canadian SIDA. The project in that time was designed to serve 60 houses but the treatment plant now serve nearly 400 houses which means that it is over loaded. The components of that project were 1200m of 8" pipeline and a treatment plant in the north west of the village. The treatment plant was consists of a sedimentation tank 120m3, 1000m2 constructed wetland and 50m3 collecting reservoir. In 2004 UNDP funded the second phase with 2200m of sewage pipe lines. Moreover, in 2006 KFW funded the third phase through UNDP with additional 3000m sewer lines. PARC has implemented the fourth phase of the project in 2007-2008. It was 1300m pipeline and a new treatment plant south west of the village Figure (#). The new treatment plant was designed to serve 50 houses and it serves now 65 houses. The treatment plant consists (in this sequence) of a septic tank, an anaerobic up-flow gravel filter, an aerobic trickling filter, and a sand filter. The treated wastewater from this treatment plant is reused for irrigating 4.5 dunums of nut trees. In 2009 the fifth phase was implemented with 2000m pipelines.

The existing collection system in Zeita is not working adequately and many problems of clogging and flooding from the manholes happen in the village especially where the diameter of the pipes is 6". These problems emerged due to the fact the system which was designed at the beginning was not designed to cover the entire village. In addition, the implementation of the project on different phases by different actors without proper coordination and planning was also a main cause. The second problem is that the constructed wetland is overloaded since it was not designed to serve the current number of houses connected to it as shown in Figure (44)

Figure (44): Southern WWTP in Zeita

Figure (45): Existing Constructed Wetland in Zeita Village

Figure (46): Small scale WWTP IN Attil

Attil:

In Attil a pipe line of a diameter of 8" and with a length of 1900m and small treatment plant was constructed for a cluster of 43 houses in the village. The treatment plant consists of a septic tank, an anaerobic up-flow gravel filter, an aerobic trickling filter, and a sand filter as shown in Figure (46) The project was implemented by PARC. The treated effluent is used for irrigating 13 dunums of almonds and nuts trees in the area.

It was concluded that the total length of the sewer lines exists in these six communities namely at Tulkarem, Anabta, Zeita and Attil, is nearly 109 km with diameters varying from 150mm to 800 mm respectively as shown in Table (81).

Table (81): Pipe diameters and lengths for the existing sewerage system of Tulkarem (incl. Shuweika) , Anabta, Zeita and Attil

Community	Unit	Pipe diameter								
		150	200	250	300	350	400	500	600	800
Tulkarem	M		69676	4325	1072	1261	3875	5000	1411	245
Anabta	M	1699	6310	2864						
Zeita	M	3000	4000	2500					200	
Attil	M		1900							

The remaining communities have no collection and treatment system as indicated earlier. Yet, to highlight the current sanitation conditions in the Governorate, a summary of the major system characteristics is presented in Table (82) hereunder:

Table (82): The existing sanitation schemes and the type of problems encountered with the existing system.

Cluster	Village	population	Household No.	Sanitation system			Disposal site	Cost/tank ($)
				Septic tank (%)	cesspit	Collection system		
Al-Kafriat	Jubara	311	63	0	100%	0	Random lands in the village	14
	Ras	574	96	0	100	0	Village outskirts + agriculture	14

							lands	
	Kufur Sur	1187	222	5	95	0	Village outskirts	15
	Kur	278	54	0	100	0	Village outskirts + agriculture lands	14
	Kufur Zebad	1146	208	0	100	0	Random lands in the village and other Wadis	13
	kufur Jamal	2576	455	0	100	0	Random lands in the village	12
	Kufur Aboush	1548	281	0	100	0	Random lands in the village + agriculture lands	17
Sharawyia Cluster	Akkaba	270	41	0	100	0	Village outskirts	17
	Qaffin	8913	1,587	0	100	0	Village outskirts	18
	Nazlt Isa	2481	440	0	100	0	Wad Abu Nar (Baga Sharqiya)	17
	Al-Nazlha Shrqia	1609	277	0	100	0	No specific place	22
	Baqa Sharqia	4358	762	0	100	0	Wad Abu Nar and sometimes on the olive trees	14
	Al-Nazlha	361	74	0	100	0	No specific place	18

	Wasta							
	Al-Nazlha Gharbia	996	156	0	100	0	Wadi Abu Nar	17
	Zeita	3013	560	0	20	80	Wadi Abu Nar	14
	Seida	3113	568	0	100	0	No specific place	27
	Illar	6579	1,142	0	100	0	In the surrounded land in the village and sometimes in agriculture lands	27
	Attil	9605	1,720	0	97	3	Wadi	14
	Deir Al-Ghsoun	8759	1,578	0	100	0	Random places	17
Wadi Zeimar Cluster	Jarushia	991	183	0	100	0	Tulkarem treatment ponds	27
	Masqufa	276	47	0	100	0	Wadi Zeimar	18
	Bala	7019	1,202	0	100	0	Wadi Zeimar + agriculture lands	27
	Iktaba	2832	463	0	100	0	Wadi Zeimar	14
	Tulkarem	72891	13498	0	20	80	Wadi Zeimar+ Tulkarem treatment ponds	18
	Anabta	7789	1,440	0	30	70	Wadi	18

						Zeimar	
Kufur Labad	4330	693	0	100	0	Wadi Zeimar	18
Kafa	429	75	0	100	0	Random lands in the village	18
Ramin	1919	353	0	100	0	Wadi in the village and discharge in Wadi Zeimar	14
Faroun	3295	588	0	100	0	No specific place	18
Shoufa	2332	424	0	100	0	Random lands in the village	18
Beit leed	5307	945	9	91	0	Wadi Zeimar	17
Saffarin	808	147	0	100	0	Wadi Zeimar+ Random lands in the village	17

1. 7.2 Wastewater Disposal, Treatment and Reuse

In most houses cesspits are emptied nearly once or more each month. The frequency of cesspits emptying depends on many factors such as the nature of the soil, the quantity of water consumption, methods of construction of the cesspits and if there is a separation of grey and black wastewater.

The emptying of the cesspits is performed by using vacuum truck tankers owned by private sector. The wastewater is usually disposed in the nearby Wadies, agricultural lands and at road sides. Infiltration in soil causes underground water pollution, bad odor, soil salinization, environmental contamination, health problems and sometimes it ends with flooding in the streets and social problems between neighbors. Some houses empty their cesspits during the rainy days in the winter into the streets to avoid paying any money for that. The average cost of each truck service is nearly about 18$ per each 6m3 depending on the distance of the disposal

The raw sewage from the collection systems from Anabta, Nur Shams and Tulkarem Camps, and Shwekhia is disposed at Wadi Zeimar at different points without any kind of treatment. The treated effluent from the constructed wetland in Zeita is disposed in the nearby Wadi near the village and then to the green line. The effluent from the second treatment plant in Zeita in the south west of the village is used for irrigating 4.5 dunum of nuts trees beside the treatment plant. In Attil the effluent from the treatment is also used for irrigating 13 dunum of almonds and nuts trees.

1.7.3 Major Concerns Resulted from the Current Situation:

The raw untreated sewage from west Nablus city flowing through Wadi Zeimar crossing Tulkarem district from the east to the west and in between, the sewage from Annabta, Nour Shams and Tulkarem Camps. Eleven communities in the district located beside the two sides of the Wadi. Ten groundwater wells for domestic and a agricultural purposes are located near the Wadi and some of them are contaminated.

The raw sewage from Tulkarem City was pretreated in the ponds which are located in the west of Tulkarem City near the green line before entering the Israeli side to Emek Hefer treatment plant and it was treated and reused there and the Palestinian side pay for that.

In some areas in the district there is a danger of pollution of groundwater from the percolating sewage from the cesspits and the water of some wells in the district were contaminated. Information from Tulkarem Health Department about the number of water-borne diseases are summarized in Table (83) below:

Table 83: Water Borne diseases reported in Tulkarem Governorate

Year	Amoebiasis	Diarrhea	Typhoid &Paratyphoid	Hepatitis A
1996	N/A	N/A	18	428
1997	N/A	N/A	9	510
1998	N/A	N/A	4	187
1999	N/A	N/A	18	102
2000	49	2754	0	63
2001	78	4098	1	72
2002	22	4258	0	111

2003	33	5041	4	160
2004	43	5949	2	133
2005	78	4467	0	284
2006	62	3674	1	N/A

Source: final feasibility study

1.7.4 Public Perception

The public at large in the Governorate as well as the local councils and the existing Joint Service Councils of the three clusters are willing to cooperate and manage the waste water collection and treatment. The people in the study area are also willing to participate and pay their contribution in the construction of such projects of wastewater. They believe that the required fees for collection and treatment of the proposed project will cost less than the cost of evacuation their cesspits. People already realized the adverse effects resulted from the current poor sanitation conditions and they feel the crucial need for suitable solutions to limit these adverse effects.

1.8 Water and Wastewater Pricing and Fee Collection

1.8.1 Water Supply Services:

It is good to mention that the majority of village and municipal councils in the governorate have adopted Water tariffs. The tariff is based on block rate tariff where the councils are considering the simple cost recovery which enables the recovery of operation maintenance costs. Most of councils, if not all of them, ignore the depreciation costs in water pricing. This is resulted from the fact that only little number of councils is aware of cost analyses and cost recovery. The current price per cubic meter depends on who owns the water source and the pumping – transport costs. Therefore, the price for normal family consumption (5-15 m3/month) ranges between 2 NIS as Baqa Al-Sharqiya and 4.5 NIS as in Beit Leed. In addition, public willingness to pay and affordability which is subject to the to the prevailing economic conditions will also likely affects the ability of the councils to collect the fees properly and attain simple cost recovery.

In order to overcome such a problem of deficient fee collection many councils started to link the water bill to the pre-paid electricity meters whereby no one can charge his electricity meter if he doesn't pay his water bill. Therefore, collection fees have been improved sharply since 2008, the time they adopted this mechanism. However, the accumulated debts are still high due to the long previous period of low collection.

1.8.2 Sanitation Services

Due to the fact that only few communities have partial wastewater collection and treatment system in the Governorate, the tariff for wastewater services is not well developed. However, it varies from one place to another. For example, in the time that Tulkarem City with the largest customers doesn't charge for the use of the wastewater collection and treatment system and only charge fixed collection fee, Anabta has developed more advanced mechanism of charging fixed fee for connection and adopted additional fee of1JD for each m2 of house surface area if it is more than 100 m2 and also charging 8NIS as fixed monthly fee per household.

Accordingly, more appropriate tariff will be needed to enable the councils from operating the systems in a more sustainable manner. This issue will be addressed in more detail in Chapter 3 of this master plan.

Chapter Two

Water Supply and Demand

Analysis and Required Investment

2.1 Introduction

Water supply infrastructure in Tulkarem Governorate has considerably improved within the last 10 years. It is estimated that 98 % of the population are connected to water supply system, Saffarin, Kur and Akkaba are the remaining three communities which are not connected to municipal water supply network and they rely on cisterns and water supplied by tankers.

Water use in the communities connected to water supply as it was in 2008 is presented in Table 1.

Table (1): Total annual water use in 2008 and the corresponding per capita consumption per day.

Community	Annual supply 2008	Water Supply L/C/D	Registered Water Use	Water Use L/C/D	Loss %
Akkaba	7,563	80	7,563	80	No Network
Qaffin	485,084	153	277,348	87	43%
Nazlat 'Isa	84,450	97	58,003	67	31%
An Nazla ash Sharqiya	**55,460**	98	30,969	55	44%
Baqa ash Sharqiya	141,790	93	125,488	82	11%
An Nazla al Wusta	10,829	84	8,574	66	21%
An Nazla al Gharbiya	27,915	80	25,544	72	10%
Zeita	270,336	255	254,601	240	6%
Seida	64,467	59	58,148	53	10%
Illar	166,653	72	149,209	65	10%
Attil	405,000	120	317,000	94	22%
Deir al Ghusun	415,997	136	259,802	85	38%
Al Jarushiya	37,599	106	36,582	103	3%
Al Masqufa	3,971	40	3,848	39	3%
Bal'a	340,290	138	234,083	95	31%
Iktaba	167,740	169	99,656	100	41%
Tulkarm	5,422,018	213	3,094,610	121	43%

Anabta	505,033	185	323,173	118	36%
Kafr al Labad	146,274	105	103,277	74	29%
Kafa	7,218	48	6,617	44	8%
Ramin	57,720	86	40,637	60	30%
Far'un	133,250	115	86,484	75	35%
Shufa	218,094	267	159,899	196	27%
Khirbet Jubara	8,731	80	8,731	80	No Network
Saffarin	22,367	80	22,367	80	No Network
Beit Lid	131,731	71	100,087	54	24%
Ar Ras	27,600	137	15,677	78	43%
Kafr Sur	122,900	239	82,052	160	33%
Kur	7,796	80	7,796	80	No Network
Kafr Zibad	59,400	148	41,875	104	30%
Kafr Jammal	91,670	102	53,136	59	42%
Kafr 'Abbush	60,246	111	47,220	87	22%
	9,707,485	132	6,140,057	101	

Total water use in the governorate according to the billed quantity was nearly 6,140,057 m³ in 2008. Moreover, water losses were in the range of 3-43 % and total produced or supplied quantity was 9,707,485 m³/year. Based on metered water consumption and population figures provided by village councils and municipalities, the average per capita water consumption within the governorate differs significantly and can be classified under three categories as follows:

1- Relatively high consumption rate or above 200 l/c/d: Maximum per capita water use in Zeita, Shoufa, Kufr Soor and Tulkarem city is recorded as 240, 196, 160 and 121 l/c/d respectively. However; these figures include the agricultural and industrial uses as well while the true domestic consumption in these places is around 100 l/c/d.

2- Medium consumption rate (above 80 and less than 120 l/c/d): This category reflects the general and actual rates of water use or in other words; the case of no stress on water supply, and most of water use goes for household use. The communities that fall under this category are Baqa ash Sharqiya, Deir al Ghusun, Qaffin, Kafr 'Abbush, Attil, Bal'a Iktaba, Al Jarushiya, Kafr Zibad, and Anabta with average daily per capita water use of 82, 85, 87, 87, 94, 95, 100, 103, 104 and 118 respectively.

3. Low rate consumption (39 to 80 l/c/d). The main reasons behind the lower water use in this class can be listed as follows:

a. High prices of water or domestic water are expensive (Beit Leed)
b. Shortage of water supply and competition among users and houses (Beit Leed).
c. People are still using cisterns or agricultural sources as a second source of water (Kafa, Seida, Illar).

The Master Plan will draw a comprehensive plan of action for short, medium and long term to ensure reliable/sustainable water services at affordable prices in the governorate as a whole. This comes out in order to improve the quality of life, to contribute to the fulfillment of national water strategies, and to manage the proposed JWSC in a professional manner while maintaining its independence and accountability.

2.2 Methodology

2.2.1 General

After evaluating the water availability and capacity in the governorate, future water demand is projected for short, medium and long term periods of 2010, 2015 and 2025 respectively. Future water demand was analyzed in a way that complies with PWA recommended per capita water use levels.

Calculations of water demand were based on information provided by various municipal and village councils. However, where data was insufficient to directly calculate the per capita demand, it was estimated based on data from municipal systems with similar characteristics as well as on other national water statistics. In addition to the total annual demand figures, average and maximum daily demand, and peak hourly demand was also calculated. The reason for calculating these figures of demand is to enable the planners from designing municipal water supply systems properly in the future.

The definition of various terminologies used in this study is as follows:

Total Annual Demand is the total water quantity demanded by a community in a given year

Average day demand is the total annual water demand divided by the number of days in the year.

Maximum day demand is the maximum water demand in a single day in a given year. It is calculated to be equal 125% of the average daily value.

Maximum or peak hourly demand is the maximum volume of water that should be supplied to avoid water deficit. It equals a certain factor multiplied by year average hourly demand. It is assumed to equal 110% of the maximum daily value divided by 24 hours.

It is good to mention that Municipalities in Tulkarem Governorate provide water to residential, commercial, institutional and industrial customers.

Table 2 shows the calculations of the various demand types mentioned earlier and also the weight factors used to derive them. The weight factor mentioned in column 3 of table 2 reflects the percentage of total water quantity used by a community from the total quantity used in the Governorate. This factor was then used to calculate the other demand types.

Following to this calculation, total demand figures were calculated using the total population figures generated based on the population census conducted in 2007 by the Palestinian Central Bureau of Statistics (PCBS) as explained later.

Table (2): Weight Factor Calculation Maximum Monthly Consumption

Community	Total Annual Use (m3)	Weight Factor of Use over the District	Average Monthly Use (m^3)	Maximum Monthly Use (m3)	Minimum Monthly Use (m3)	Standard Deviation Monthly Use(m3)
Akkaba	7,563	0.08%	630	642	580	37
Qaffin	485,084	5.00%	40,424	59,200	23,904	23,506
Nazlat 'Isa	84,450	0.87%	7,038	9,740	4,610	3,792
An Nazla ash Sharqiya	55,460	0.57%	4,622	6,750	2,680	2,798
Baqa ash Sharqiya	141,790	1.46%	11,816	16,980	7,800	6,316
An Nazla al Wusta	10,829	0.11%	899	1,604	493	927
An Nazla al Gharbiya	27,915	0.29%	2,326	2,371	2,141	138
Zeita	270,336	2.79%	22,528	30,820	15,551	11,707
Seida	64,467	0.66%	5,372	8,170	2,590	3,710
Illar	166,653	1.72%	13,888	19,640	9,350	7,772
Attil	405,000	4.17%	33,750	45,000	25,000	12,909
Deir al Ghusun	415,997	4.29%	34,666	49,860	23,620	19,976
Al Jarushiya	37,599	0.39%	3,133	4,827	2,084	2,025
Al Masqufa	3,971	0.04%	331	506	164	251

Bal'a	340,290	3.51%	28,358	42,830	11,770	21,618
Iktaba	167,740	1.73%	13,978	19,030	7,790	7,188
Tulkarm	5,422,018	55.85%	451,835	542,298	341,902	124,559
Anabta	505,033	5.20%	42,086	55,275	25,420	19,767
Kafr al Labad	146,274	1.51%	12,190	16,500	6,700	7,119
Kafa	7,218	0.07%	601	847	386	336
Ramin	57,720	0.60%	4,810	10,900	3,190	4,449
Far'un	133,250	1.37%	11,104	14,190	6,020	5,070
Shufa	218,094	2.25%	18,175	22,816	14,000	6,738
Khirbet Jubara	8,731	0.09%	728	742	670	43
Saffarin	22,659	0.23%	1,888	1,924	1,738	112
Beit Lid	131,731	1.36%	10,978	13,410	8,550	3,483
Ar Ras	27,600	0.28%	2,300	2,900	1,600	878
Kafr Sur	122,900	1.27%	10,242	13,700	6,500	4,884
Kur	7,796	0.08%	650	662	598	38
Kafr Zibad	59,400	0.61%	4,950	7,480	2,410	3,043
Kafr Jammal	91,670	0.94%	7,639	10,320	5,500	3,372

Kafr 'Abbush	60,246	0.62%	2,874	4,930	1,700	2,384
Totals	9,707,485	100.00%				

2.2.2 Population Number and Growth

According to the 2007 census, conducted in December 2007 and January 2008, the total population in the Occupied Palestinian Territory (OPT) was 3,767,126, of which 2,350,583 (62.4 percent) were in the West Bank and 1,416,543 (37.6 percent) were in Gaza. The portion of the Jerusalem governorate had an estimated population of 225,416. In 2007, the number of refugees (registered and unregistered) was estimated at 1,605,402, and accounts for 42.6 percent of the total OPT population. According to 2007 census results, about 96.6 percent of OPT refugees were registered with UNRWA. There were an estimated 1,551,145 registered refugees in the OPT in 2007 with 599,436 in the West Bank (including Jerusalem) and 951,709 in Gaza. Thus, registered refugees accounted for 41.1 percent of the OPT population (25.5 percent of the West Bank population and 67.1 percent of the Gaza Strip population).

Total population in Tulkarem Governorate was 161226 people in 2008. The average population growth rate is estimated to be about 2.05% per year. Using the exponential average growth model in the governorate to project the future number of population, it is realized that population will double in nearly 28 years. Accordingly, the population of the governorate is expected to reach **167905, 185835, 227645** people by the years, 2010, 2015 and 2025 respectively as presented in Table 3. It is good to mention that these figures represent the natural population growth only.

Table (3): Population projections in Tulkarem Governorate

Community	2008	2010	2015	2025
	Population	Population	Population	Population
'Akkaba	259	270	299	366
Qaffin	8,559	8,913	9,865	12,085
Nazlat 'Isa	2,382	2,481	2,745	3,363
An Nazla ash Sharqiya	1,545	1,609	1,781	2,182
Baqa ash Sharqiya	4,185	4,358	4,824	5,909
An Nazla al Wusta	347	361	400	490
An Nazla al Gharbiya	956	996	1,102	1,350
Zeita	2,910	3,031	3,355	4,109

Seida	2,989	3,113	3,445	4,220
'Illar	6,317	6,579	7,281	8,919
'Attil	9,223	9,605	10,631	13,023
Deir al Ghusun	8,411	8,759	9,695	11,876
Al Jarushiya	951	991	1,096	1,343
Al Masqufa	265	276	306	375
Bal'a	6,739	7,019	7,768	9,516
Iktaba	2,720	2,832	3,135	3,840
Tulkarm	69,983	72,882	80,665	98,813
Anabta	7,479	7,789	8,621	10,560
Kafr al Labad	4,158	4,330	4,792	5,870
Kafa	412	429	475	582
Ramin	1,843	1,919	2,124	2,602
Far'un	3,164	3,295	3,646	4,467
Shufa	2,239	2,332	2,581	3,161
Khirbet Jubara	299	311	345	422
Saffarin	776	808	894	1,095
Beit Lid	5,096	5,307	5,874	7,196
Ar Ras	551	574	635	778
Kafr Sur	1,140	1,187	1,314	1,609
Kur	267	278	308	378
Kafr Zibad	1,100	1,146	1,268	1,553
Kafr Jammal	2,474	2,576	2,851	3,493
Kafr 'Abbush	1,487	1,548	1,714	2,099
Totals	**161,226**	**167,905**	**185,835**	**227,645**

2.2.3 Domestic Water Demand Projection

Domestic Water Demand Projections are based on the product of the revised population projections and the per capita usage projections including all categories of demand. This figure is highly affected by several factors, among which are the following:

1- The water availability in each locality. In general water demand increases with the continuous water supply and higher network pressure.
2- Water prices and tariff. Generally tariff should serve as a tool to rationalize water use where the higher quantities of water used the higher the price is paid. However; it does not apply to most of locations in the study area because customers don't pay the water bill and the collection percentage is less than 60%.
3- The high percentage of total losses (physical and administrative).

Part of the domestic municipal water demand will be defined as residential and household water demand. Residential demand includes single and multi-family residential household water use.

Residential demand constitutes more than 81% of the total municipal water demand as shown in Table 5. This is not surprising because domestic water is hardly enough to meet basic human needs. Similar results can be found in most of the places in West Bank, with exception of some rural communities where the water is available and the cost is low. Demand calculation for short term period of 2010 is based on minimum water use of 80-liters/capita/day. However, for medium and long term demand projections, weighted per capita water use figures are used.

Moreover, there are two constraints facing the realization of a realistic figure which reflects the per capita consumption. They are as follows:

a) Physical water scarcity, i.e., whether adequate quantities of water are available for meeting future development without affecting the environment or other water users;
b) The increasing costs of further water development and alternatives to compensate water shortage.

Therefore, demand projections in this study are based on the assumption that there is full control over existing water resources and it will be possible to develop additional water sources to meet future needs at affordable prices.

2.2.4 Industrial and Commercial Demand Projections

Industrial water demand will be defined as water used in the production process of manufactured products, including water used by employees for drinking and sanitation purposes. Commercial use includes water used by business establishments, public offices, and institutions, and combined as industrial water use. Residential and commercial water uses are usually categorized together because they are similar types of uses, i.e., each category uses water primarily for drinking, cleaning, sanitation, cooling, and landscape watering. However, in this study it is combined with industrial use because thousands of small commercial workshops or microenterprises are not differentiated from industrial consumption. The census counts results for people and housing published by the Palestinian Central Bureau of Statistics (PCBS) 2007, shows that there are 773 manufacturing, 3532 commercial establishments and 494 agricultural activities, animal and chicken farms in the district as shown in Table 4.

Table 4: Economic Activities in Tulkarem

Economic Activity	No. of Est.	No. of Persons Engaged		
		Total	Male	Female
Agriculture, Farming of Cattle and other Animals	494	707	636	71
Mining And Quarrying	4	71	70	1
Manufacturing	773	3,538	2,112	1,426
Electricity, Gas And Water Supply	43	66	66	0
Construction	14	77	73	4
Wholesale and Retail; Repair Of Motor Vehicles Motorcycles	2,610	4,066	3,757	309
Hotels and Restaurants	183	287	272	15
Transport, Storage and Communications	32	186	180	6
Financial Intermediation	35	178	139	39
Real Estate, Renting and Business Activities	134	298	248	50
Education	84	334	117	217
Health and Social Work	198	403	254	149
Other Community, Social and Personal Service Activities	195	329	261	68
Total	**4,799**	**10,540**	**8,185**	**2,355**

Total estimated commercial and industrial water use in the governorate accounts for nearly 10% of the total water consumption while the agricultural activities supplied by the domestic water systems use nearly 9% of the total domestic water supply as shown in Table 5. Based on this information, all non-residential water use are included within the domestic water demand and **equals 19 percent according to the information available from the various communities.**

2.2.5 Agricultural and livestock demand projections

The agricultural and livestock are minor users in some communities and major consumers in others. Agricultural consumption from municipal water supply in 2008 is around 9% as shown in Table 5

The existing dual use of water networks for domestic and agriculture is not recommended from technical and health reasons. However, agricultural wells are the main source of water for 14 communities and the only alternative source for 21 communities in the District. Table 6 shows that 15% of the total water supply in the district is from agricultural wells, 4% from Mekorot and 81% from own domestic wells. It is very important to notice that, agricultural wells are the only alternative source of water in the district and for all communities.

Therefore it is logical to separate the agricultural water from domestic water. Logically, water from municipal water sources is more expensive than agricultural sources; however, in these communities prices are not expensive as they should be. Future projection of water supply doesn’t mean to exclude the limited agricultural practices that exist in homes’ yards and gardens. Raising animals (sheep chicken poultry and cow farms) are the main source of income for many families in the area. The total figure estimated for future water consumption in this sector is around 9% of the total municipal consumption.

Table 5: Preliminary results on Industrial commercial consumption

Community	Annual Consumption 2008 /2009	L/C/D	Registered Consumption	L/C/D	Population 2008	Industrial Consum. %	Agricul. Commercial Consum. %	Qty Indust (m^3/yr)	Quantity Aggr/Commer (m^3/yr)
Akkaba	7,563	80	7,563	80	259	0%	5%	0	378
Qaffin	485,084	153	277,348	87	8,559	5%	10%	23,881	47,761
Nazlat 'Isa	84,450	97	58,003	67	2,382	2%	3%	1,689	2,533
An Nazla ash Sharqiya	55,460	98	30,969	55	1,545	2%	3%	1,109	1,664
Baqa ash Sharqiya	141,790	93	125,488	82	4,185	5%	5%	7,090	7,090
An Nazla al Wusta	10,829	84	8,574	66	347	2%	3%	212	318
An Nazla al Gharbiya	27,915	80	25,544	72	956	2%	3%	558	838
Zeita	270,336	255	254,601	240	2,910	5%	60%	13,519	162,228
Seida	64,467	59	58,148	53	2,989	2%	3%	1,289	1,934
Illar	166,653	72	149,209	65	6,317	2%	3%	3,333	5,000
Attil	405,000	120	317,000	94	9,223	5%	5%	20,251	20,251
Deir al Ghusun	415,997	136	259,802	85	8,411	10%	3%	41,600	12,480
Al Jarushiya	37,599	106	36,582	103	951	2%	3%	737	1,105

Al Masqufa	3,971	40	3,848	39	265	2%	3%	78	117
Bal'a	340,290	138	234,083	95	6,739	3%	35%	10,209	119,102
Iktaba	167,740	169	99,656	100	2,720	5%	8%	8,386	13,417
Tulkarm	5,422,018	213	3,094,610	121	69,983	15%	5%	815,169	271,723
Anabta	505,033	185	323,173	118	7,479	3%	2%	15,151	10,101
Kafr al Labad	146,274	105	103,277	74	4,158	2%	10%	3,197	15,983
Kafa	7,218	48	6,617	44	412	2%	5%	144	361
Ramin	57,720	86	40,637	60	1,843	2%	5%	1,154	2,886
Far'un	133,250	115	86,484	75	3,164	3%	2%	3,997	2,665
Shufa	218,094	267	159,899	196	2,239	10%	50%	21,809	109,046
Khirbet Jubara	8,731	80	8,731	80	299	2%	3%	175	262
Saffarin	22,659	80	22,367	80	776	0%	4%	0	906
Beit Lid	131,731	71	100,087	54	5,096	2%	10%	2,635	13,173
Ar Ras	27,600	137	15,677	78	551	5%	10%	1,380	2,760
Kafr Sur	122,900	239	82,052	160	1,140	5%	35%	4,978	34,849
Kur	7,796	80	7,796	80	267	0%	3%	0	234
Kafr Zibad	59,400	148	41,875	104	1,100	5%	5%	2,970	2,970

Kafr Jammal	91,670	102	53,136	59	2,474	3%	3%	2,750	2,750
Kafr 'Abbush	60,246	111	47,220	87	1,487	3%	5%	1,807	3,012
Total Supply in 2008		9707485						1,011,256	869,896
Total Indust. Comm. supply in 2008		1011256		% of Comm. supply in 2008		10%			
Total Agg. supply in 2008		869896		% of Agg. supply in 2009		9%			
Total Agg. Ind. Comm. in 2008		1881152		% Total Agr. Ind. Comm. in 2008		19%			

Table 6: Water Supply Source in Tulkarem Governorate

Community	Water Source Classification	Annual Consumption 2008/2009
Akkaba	Agg. Well	7,563
Qaffin	Dom. Well	485,084
Nazlat 'Isa	Agg. Well	84,450
An Nazla ash Sharqiya	Agg. Well	55,460
Baqa ash Sharqiya	Agg. Well	141,790
An Nazla al Wusta	Agg. Well	10,829
An Nazla al Gharbiya	Agg. Well	27,915
Zeita	Dom. Well	270,336
Seida	Dom. Well	64,467
Illar	Dom. Well	166,653
Attil	Agg. Well	405,000
Deir al Ghusun	Dom. Well	415,997
Al Jarushiya	Dom. Well	37,599
Al Masqufa	Dom. Well	3,971
Bal'a	Dom. Well	340,290
Iktaba	Agg. Well	167,740
Tulkarm	Dom. Well	5,422,018
Anabta	Dom. Well	505,033
Kafr al Labad	Agg. Well	146,274
Kafa	Agg. Well	7,218
Ramin	Dom. Well	57,720
Far'un	Agg. Well	133,250
Shufa	Agg. Well	218,094

Khirbet Jubara	Agg. Well	8,731
Saffarin	Agg. Well	22,659
Beit Lid	Mekoroth	131,731
Ar Ras	Mekoroth	27,600
Kafr Sur	Mekoroth	122,900
Kur	Mekoroth	7,796
Kafr Zibad	Dom. Well	59,400
Kafr Jammal	Mekoroth	91,670
Kafr 'Abbush	Dom. Well	60,246
Total District Supply in 2008		9,707,485
% of supply from Dom. Wells Sources		81%
% of supply from Aggr. Wells Sources		15%
% of supply from Mekoroth Sources		4%

2.2.6 Losses Calculation

The municipal water supply from the resource to consumer is controlled by the total water losses in the system. Total water loss is defined as the difference between the amount of water produced and the amount which is billed. Two types of water losses encounter the calculation of total water losses as follows:

1- Physical or real losses such that, physical water loss occurs in all distribution systems. Leakage comprises the real physical losses from pipes, joints and fittings, and also overflows from reservoirs. These losses can be severe, and may go undetected for months or even years. The larger losses are usually from burst pipes, or from the sudden rupture of a joint, while smaller losses are from leaking joints, fittings, service pipes, and connections. The volume lost will depend largely on the characteristics of the pipe network and the leak detection and repair policy practiced by the service provider, such as:

- the pressure in the network;

- Characteristics of soil cover and whether it allows water from leaking pipes to be visible at the surface;
- the “awareness” time (how quickly the loss is noticed);
- the repair time (how quickly the loss is corrected

2- Non-physical (management or apparent losses). Several reasons stand behind this type of losses as follows:

- Over-estimation of production—caused by: Inadequate or no measurement facility and inadequate calibration program for bulk meters.
- Under-estimation of consumption—caused by: under-registration of customers meters, inaccurate meters, stopped meters, inadequate meter maintenance / replacement policy, inadequate meter reading policy ,under-estimation of free supplies or operational use, and illegal connections;

The two losses types contribute to the calculations of total water loss. Water auditing and technical network evaluation must be done to determine which of the two types is more important and causes the high percentage of losses. Accordingly, such results will help in deciding which one has to be done first; a program of repair, maintenance and replacement or a new administrative water policy for better control of water meters and measurements.

The problem of losses becomes more vigorous in the case of weak billing and collection system. In that case, the total water loss is mixed between real and apparent losses and normally the municipalities draw their conclusion according to financial report item non-revenue water. However the real losses equal the amounts of non-revenue water minus the unbilled authorized consumption minus the apparent losses. The results can differ much from the original total percentage of losses.

Evaluation of the amounts of total losses shows that it reaches more than 40 % in Tulkarem, Iktaba, Al-Ras and Kufr Jammal and Al-Nazleh Al-Sharqiya. The previous figures are high for two reasons:

1- The apparent losses are high
2- Absence of maintenance program.

For this study we assumed better control of losses through institutional development program at both technical and administrative levels.

Table (7): The total losses forecast during planning period will look as follows:

Community	Real Total% of Losses in 2008	Expected % Losses in 2010	Expected % Losses in 2015	Expected % Losses in 2025
Akkaba	No Network	10%	15%	20%
Qaffin	43%	43%	30%	20%
Nazlat 'Isa	31%	30%	25%	20%
An Nazla ash Sharqiya	44%	40%	30%	20%
Baqa ash Sharqiya	11%	12%	15%	20%
An Nazla al Wusta	21%	15%	15%	15%
An Nazla al Gharbiya	Under construction	10%	15%	20%
Zeita	6%	6%	10%	15%
Seida	10%	10%	12%	15%
Illar	10%	10%	12%	15%
Attil	22%	21%	18%	15%
Deir al Ghusun	38%	38%	30%	20%
Al Jarushiya	3%	5%	10%	15%
Al Masqufa	3%	5%	8%	10%
Bal'a	31%	31%	25%	20%
Iktaba	41%	40%	30%	20%

Tulkarm	43%	40%	30%	20%
Anabta	36%	35%	25%	20%
Kafr al Labad	29%	30%	25%	20%
Kafa	8%	10%	15%	20%
Ramin	30%	30%	25%	20%
Far'un	35%	35%	30%	20%
Shufa	27%	27%	25%	20%
Khirbet Jubara	No Network	12%	15%	20%
Saffarin	No Network	10%	15%	20%
Beit Lid	24%	24%	20%	15%
Ar Ras	43%	40%	25%	20%
Kafr Sur	33%	30%	25%	20%
Kur	No Network	10%	15%	20%
Kafr Zibad	30%	30%	25%	20%
Kafr Jammal	42%	35%	25%	20%
Kafr 'Abbush	22%	22%	20%	20%

2.3 Water Master Plan Development for Tulkarem Governorate

2.3.1 Scenario Development

This study evaluates the plausible future scenarios of water availability and use under conditions of various demand patterns and with the explicit potential influence of economical and political factors. The scenarios were based on the information for use in managing emerging trade-offs within the municipal demand. The importance of explicit accounting for monthly variability in describing water supply and demand, in the summer months and conditions of the region, are also considered. Such detailed scenario simulations and inclusion of previously unaccounted for factors/uses can help to create awareness of potential future problems, improve water management practices and suggest management alternatives. The base year for scenario calculations was 2008.

Population growth and per capita water use are the main drivers of domestic water demand in each community. The population and per capita domestic water demand drivers can provide an estimate to the total domestic water demand. Such demand will be analyzed under various scenarios and likely be influenced by several factors such as political (occupation); demographic change; urbanization, industrialization and economic development; agricultural development and environment quality.

2.3.2 Factors Affecting Water Management under the Proposed Scenarios

Political Situation and Occupation:

Water availability varies substantially across the regions, and almost fixed over time. Groundwater is the main source of water in the District. Only four communities' are obtaining their domestic water from other sources (Israeli Water Company Mekorot). Although Tulkarem District has good water potential, yet its development for Palestinian use is restricted by the Israeli occupation authorities. A series of Israeli military orders, issued shortly after the illegal Israeli Occupation of Palestinian territory in 1967, transferred total control over all water resources to Israeli occupation authorities. Subsequently, Palestinians have been deprived of their rightful share of resources. For example, in December 19, **1968** the Israeli military order 291 declared all water resources to be Israeli property. Such military orders prohibit Palestinians from developing new water infrastructure without an

Israeli permit. Such permits were to be issued by the Israeli military officer in charge of water, and further, he can deny, amend and/or revoke permits without explanation.

After the signature of interim peace agreement in 1993, water issue has not been finalized and left for the final status negotiation. Article 40 of the interim agreement has been specifically devoted to water. The article acknowledged the Palestinian water rights without quantifying them or indicating how they can be quantified. Moreover, it maintained the status quo situation until final agreement is reached. This means that it is expected that the existing restriction on developing water resources from the Western Aquifer basin will continue and no additional sources can be expected from the aquifer in the short or medium term unless a final peace agreement is concluded in this period???

Demographic Change:

By the end of 2008, at least 7.1 million (67 percent) of the entire, worldwide Palestinian population (10.6 millions) were forcibly displaced persons. Among them were at least 6.6 million Palestinian refugees and approximately 427,000 internally displaced peoples (IDPs). The largest group of displaced Palestinians is made up of those who were forced to leave their homes and country in 1948 (the *Nakba*) and their descendants. These total approximately 5.7 million, a figure that includes the 4.7 million Palestinian refugees who are registered with and assisted by the UN Relief and Works Agency for Palestine Refugees (UNRWA) (often referred to as “registered refugees” or “Palestine refugees”), and a further one million refugees who were also displaced in 1948, but are not registered for assistance with UNRWA. The second major group of displaced Palestinians is comprised of those displaced for the first time from their homes and country in the 1967 war and their descendants. 1967 Palestinian refugees number approximately 955,247 persons. Internally displaced Palestinians can be divided into two groups. The first is composed of persons displaced in the area that became Israel in 1948. This group includes those who were displaced in the 1948 Nakba, (approximately 335,000 persons) as well as those subsequently displaced by Israel. No official data exists for this second category. The second group (approximately 129,000 persons) is composed of Palestinians internally displaced in the OPT since 1967 as a result of Israel’s occupation of the West Bank and Gaza (BADIL, 2008 – 2009). This figure includes Palestinian refugees who suffered subsequent secondary forced displacement inside the OPT, and whose numbers are estimated to be 37,000 persons at the end of 2008.

Based on this information, it is anticipated that part of the forcibly displaced people, especially those who are originally from Tulkarem District may return under any future political settlement which may not be expected in the short term.

Industrialization and Urbanization

Projecting future industrial and commercial demand was not easy due to the lack of information on the types of expected industries, their growth, water use and the extent of future water recycling and reuse in industry. Therefore, the 2008 will be adopted as the base year for industrial / commercial demand projections. Current daily industrial and commercial per capita water use is around 17 liters or the estimated total annual consumption of around 1,011,256 m^3/yr.

Agricultural Development:

The existing wells were drilled before 1967, however; the agricultural demand was increased and no new agricultural wells were drilled since that time. Each groundwater well has limited pumping quota per year that must not be exceeded. The total abstraction from these wells is nearly 11.2 Mcm/year as shown in Annex 1.

Because, of the increasing domestic water demand, many wells in the district have dual use. Therefore, agricultural wells are the only alternative source for domestic water in the foreseen future. This would mean that available fresh water for agricultural use will be less and therefore, irrigated agricultural areas will be reduced. However, treated wastewater effluent could serve as a potential source for the agricultural sector. It is expected that potential treated effluent will be nearly 6 Mcm/year 2015 and will reach 8.5 Mcm/ year in 2025. Such potential may be used for agriculture in some parts of the Governorate.

Environment Quality

It is important to maintain good environmental quality and consider the sustainable yield of water resources when developing the various water use scenarios to meet future developmental needs. It is also important to consider the ecosystems needs as part of the planning criteria in order to maintain the services that ecosystems provide for the environment and that ensures the provision of sufficient water quantity with adequate quality.

It is also of great importance to consider the environmental plans and environmental zoning that are developed to protect the environment during the development of any future economic, industrial or urban development plans. Pollution and environment degradation that may potentially result from these plans need to be eliminated and contained properly.

Proposed Scenarios

According to the above discussions, two possible scenarios are foreseen: Business as usual with more rationalization of water demand and Improved Water Management under Political Relieve scenarios.

1- Business-as-Usual Scenario under more Rationalized Demand (BAU - RD)

Assumptions

This scenario assumes that existing water management situation continues as is and the following assumptions prevail:

1. **Natural, Political and geopolitical conditions remain the same. This means that**:

   a. Water Resource capacity as well as constraints on developing new water supply sources and projects remain unchanged.
   b. Full control over the existing water supply sources (Domestic and Agriculture) remains in Palestinian hand.
   c. Population will grow naturally at 2.05% during the period 2010 and 2025.

2. Current Water Allocation and Management slightly changed and includes the following:

- **a.** Major agricultural use will be separated from the municipal water use starting after 2010.
- **b.** The quantity of water abstracted from agricultural wells for domestic use will remain without change by 2025.
- **c.** Industrial and commercial consumption will remain part of domestic use.
- **d.** Water transport is possible within the district.

3. Infrastructure improvements as well as per capita water use targets are achieved. This include:

a. Infrastructure will be rehabilitated so that percentage of losses will decrease gradually from its current rate of 37% in 2008 to 19.4% in 2025.

b. Municipal Demand will grow at 2% from 2010 to 2015, starting with 80 l/c/d as minimum consumption and ends with 100 l/c/d as minimum consumption. The results for each community depend on the starting rate of consumption. For the cases where the actual consumption is more than 80l/c/d as the case of Tulkarem City, Anabta and Zeita; the demand projection would start from these figures. Projections are then increased / decreased across the short term period (2010-2015) for each community. Per capita water demand is calculated as follows:

IF (base consumption* (1+ 2% growth)^5<=100,then 100l/c/d is considered otherwise assume base demand *(1+1% growth)^5) and the result must be greater than or equal 100 l/c/d.

It can be realized that the base figures range between 100-130 l/c/d in most of the communities with the exception of Zeita, Shoufa and Kufur Soor of 240, 196 and 160 l/c/d respectively (Figure 1). The high rates in these three communities refer to the agricultural use in Shoufa and Zeita, and selling water to other uses rather than drinking in Kufur Soor. Therefore, the per capita water demand calculation in this period has taken out the agricultural use from the calculation of demand to reflect a more reliable domestic water use figures.

c. Municipal Demand will grow at 1% between the years 2016-2025, and it start with 100 l/c/d as minimum consumption and ends with 120 l/c/d as minimum consumption. During this period per capita water use will be stabilized in the district. Differences in weighted per capita water use will be calculated according to the following formula:

IF (base consumption*(1+ 1% growth)^10<=120,then 120l/c/d is considered otherwise assume base consumption *(1+1% growth)^10) and the result must be greater than or equal 120 l/c/d.

The projected weighted per capita demand across the District is demonstrated in Figure 1.

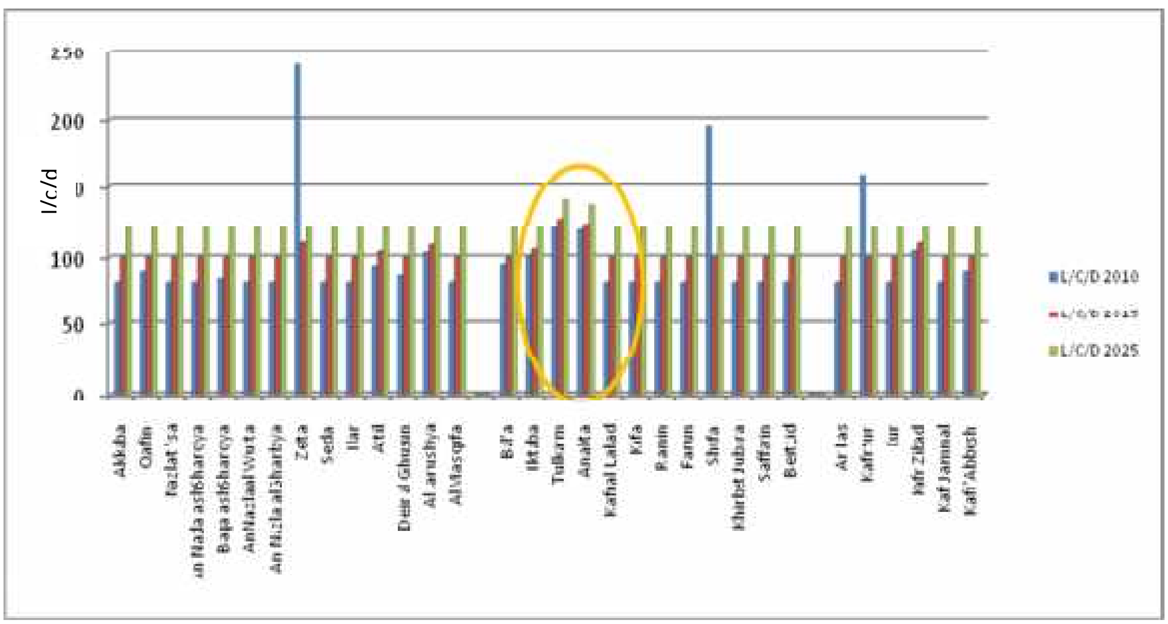


Figure 1: Projected Weighted Per Capita Demand 2010, 2015, 2025

It can be noticed from Figure 1, that most of the per capita demand are harmonized in the district and that there are no more huge discrepancy of use among the communities.

Results

The total water demand under the BAU - RD scenario is expected to increase by 3.7 %, 8.1% and 37.4% in the years 2010, 2015 and 2025 respectively as shown in Table 8. Detailed demand analysis for each community is based on the Maximum daily demand and average daily demand presented in Annex 1 – Table 3.

The percentage of losses will decrease from 35% in 2010 to 27% in 2015, and reaches 19% by the year 2025. This would save nearly 0.91 Mcm by the year 2015 and 1.64 Mcm by the year 2025.

Available domestic water supply values are based on the existing available domestic quantities mentioned earlier. During the period between 2010 – 2015, water supply will increase from 10,069,677 m^3/yr to 10,492,483 m^3/yr. One could notice that the increment in supply by the end of 2015 will be nearly 0.42 million m^3 more than 2010 supply and it will be nearly 0.78 Mcm more than supply in 2008. The increase in water demand will be compensated by the positive change in water losses which will be nearly 0.91 Mcm as mentioned earlier. However, at the end of the second period in 2025, the water supply will reach 13,342,798 m^3/y or an increment of more than 3.6 millions as shown in Table 8.

Table (8): BAU - Summary of annual domestic water demand

Item	Year 2008	Year 2010	Year 2015	Year 2025
Total Population	161,227	167,905	185,835	227,645
Weighted losses	36.75%	34.98%	27.02%	19.44%
Total Annual water demand including losses (m^3)	9, 707, 485	10, 069, 677	10, 492, 483	13, 342, 798
Total Annual Demand without losses (m^3)	6, 140, 057	6, 547, 793	7, 657, 872	10 ,749, 461
Average per capita daily water demand without losses	104.3	106.8	112.9	129.4
Average per capita daily water demand including losses	165.0	164.3	154.7	160.6
Quantity of additional water required compared with 2008 (m^3)	0	362, 192	784, 998	3, 635, 314
Percentage of additional water required Based on 2008 (m^3)	0.0%	3.7%	8.1%	37.4%
Percentage of additional water required in L/C/D Based on 2008(m3)	0.0%	2.34%	7.58%	19.35%
Increment in L/C/D Based on 2008(m^3)	0.0	2.5	8.6	25.0
Total Annual Per Capita Increment in Consumption (m^3)	0	153, 414	580, 640	2, 079, 972
Amount of water saved due to decrease in Losses based on 2008	0	282, 443	1, 614, 682	3, 652, 197

Table (9): BAU Municipal water demand including losses and deficit based on total domestic water availability in year 2008

Item	Year 2010	Year 2015	Year2025
Average Daily Supply BAU (m^3/D)	27, 588	28, 747	36, 556

Water Balance	2,215	1,056	-6,753
Maximum Daily Supply BAU (m^3/D)	34, 485	35, 935	45, 698
Water Balance	-4,682	-6,132	-15,895

2.4 Improved Water Management under Political Relieve Scenario

2.4.1 Assumptions

Under this scenario it is assumed that there will be some new political settlement whereby Palestinians will be able to control and manage their resources, they will be able to move freely within the West Bank and Gaza and between them and that no major political constraints that may restrict development and growth. Therefore, the main assumptions can be summarized as follows:

1. All assumptions listed under the BAU – RD scenario are valid under this scenario and will be considered.
2. In addition to natural population growth there will be some unnatural growth resulting from return of some forcibly displaced people from Diaspora, specifically those who are originally from Tulkarem District. In addition, it is expected that anticipated future economic growth may attract some internal migration of some people to live in the District. The fact that some industrial zones are proposed to be built in the District after 2015, may form a good potential economic opportunities for those who are unemployed. Moreover, its richness with fresh water will attract investments and improve the economy. Finally, its proximity to the central market in Israel makes it the gate for labor and goods exchange in future.

   It is expected that unnatural population growth in the district would equal 1% of the total population during the period 2015 – 2020 then 0.05% from 2021 - 2025.
3. Part of the freshwater used in agriculture can be shifted to domestic use. Moreover, future extra demand on agricultural water is assumed to be met from treated wastewater. Reuse will be restricted to some areas in accordance with environmental and natural sensitivity.
4. Developing nonconventional water sources such as major diversion structures and storage to capture surface runoff and flood flows is possible.

2. 4.2 Results

The total water demand under this scenario is projected to increase to 7.08, 8.01 and 11.86 Mcm by years 2010, 2015 and 2025 respectively as shown in Table 10. This would require supplying 10.88, 10.98 and 14.43 Mcm for the same periods. As noticed, the additional water supply to meet demand (including losses) in 2015 is slightly differing from 2010. This is because the percentage of losses will decrease sharply from 35% in 2010 to 27% in 2015. However, water demand will reach 9.31 Mcm in 2020 and goes up to 11.86 in 2025. This would require the supply of 11.93 and 14.43 Mcm of water during the same period. The reason behind this increase in required supply is because losses will decrease more slowly during this period in comparison with the previous period and will reach 19.4% of the water supply at the end of 2025.

The analyses of average water supply and demand during the period between 2010-2015 water supplies will not face any deficit of water supply in terms of water quantity but certainly would require additional infrastructure (pumping, storage and distribution systems). However, at the end of the second period or in 2025, the water supply deficit will reach 3 636 065 m^3. The analyses according to the maximum water supply and demand during the period between 2010-2015 becomes more bigger in a way that in 2010 the district suffers from a deficit of -5952 m^3/day and by 2015 it will reach 7462 m^3/day. The water deficit will reach around -20552 m^3/day in 2025. More details are shown in Table 10.

Table (10): IWMS percentages of domestic water demand increments

Item	Year 2008	Year 2010	Year 2015	Year 2025
Total Population	161,227	167,905	187,694	244,850
Weighted losses	36.7%	35.0%	27.0%	19.4%
Total Yearly supply (m^3)	9,707,485	10,888,359	10,982,430	14,637,979
Actual Consumption m^3/yr	6,140,057	7,080,140	8,015,457	11,856,763
l/c/d consumption	104.3	115.5	117.0	132.7
l/c/d supply	165.0	177.7	160.3	164.7
Quantity of Water Increment Based on 2008(m3)	0	1,180,874	1,274,945	4,930,494
Percentage of Increment Based on 2008(m3	0.0%	12.2%	13.1%	50.8%
Percentage of Increment in L/C/D Based on 2008(m3	0.0%	9.7%	10.8%	21.4%
Increment in L/C/D Based on 2008(m3	0	11	13	28
Total Annual Per Capita Increment in Consumption (m^3)	0	685,761	867,452	2,532,070
Amount of water saved due to decrease in Losses based on 2008	0	305,406	1,690,079	4,107,670

Table (11): Population growth and water supply trends based on improved water management scenario

Item	Pop. 2010	Pop. 2011	Pop. 2012	Pop. 2013	Pop. 2014	Pop. 2015	Pop. 2016	Pop. 2017
Based on Natural Growth on 2007 Census	167,905	171,347	174,859	178,444	182,102	185,835	189,645	193,533

Increment in population based on unnatural Population Growth (1% and 0.05%)	0	0	0	0	0	1,858	3,755	5,690
Total expected Population	167,905	171,347	174,859	178,444	182,102	187,694	193,400	199,223
L/C/D	116	116	116	116	116	117	117	117
Total expected Annual Consumption (m3)	7,080,140	7,225,283	7,373,401	7,524,556	7,678,809	8,015,457	8,282,387	8,531,761
weighted Average Losses	35%	33%	31%	29%	28%	27%	26%	25%
Total water Supply (m^3/year)	10,888,359	10,784,005	10,686,089	10,597,966	10,665,013	10,982,430	11,192,415	11,375,681

Continue Table (11): Population growth and water supply trends based on improved water management scenario

Item	Pop. 2018	Pop. 2019	Pop. 2020	Pop. 2021	Pop. 2022	Pop. 2023	Pop. 2024	Pop. 2025
Based on Natural Growth on 2007 Census	197,500	201,549	205,681	209,897	214,200	218,591	223,072	227,645
Increment in population based on unnatural Population Growth (1% and 0.05%)	7,665	9,681	11,737	12,787	13,858	14,951	16,066	17,204
Total expected Population	205,165	211,229	217,418	222,684	228,058	233,542	239,138	244,850
L/C/D	117	117	117	133	133	133	133	133
Total expected Annual Consumption (m3)	8,786,246	9,045,948	9,310,975	10,783,399	11,043,628	11,309,192	11,580,199	11,856,763
weighted Average Losses	24%	23%	22%	21%	20%	20%	20%	19%

Total water Supply (m^3/year)	11,560,850	11,747,985	11,937,147	13,649,873	13,804,535	14,136,490	14,475,249	14,637,979

Table (12): Estimated water demands in the study area IWMS Scenario.

2010				**2015**				**2025**			
Population	A.D.D (m^3)	M.D.D (m^3)	P.H.D (m^3)	Population	A.D.D (m^3)	M.D.D (m^3)	P.H.D (m^3)	Population	A.D.D (m3)	M.D.D (m^3)	P.H.D (m^3)
167,905	29,831	37,289	1,709	187,694	30,089	37,611	1,724	244,850	40,104	50,130	2,298

Table (13): IWMS Municipal water supply and deficit based on total domestic water availability in year 2008

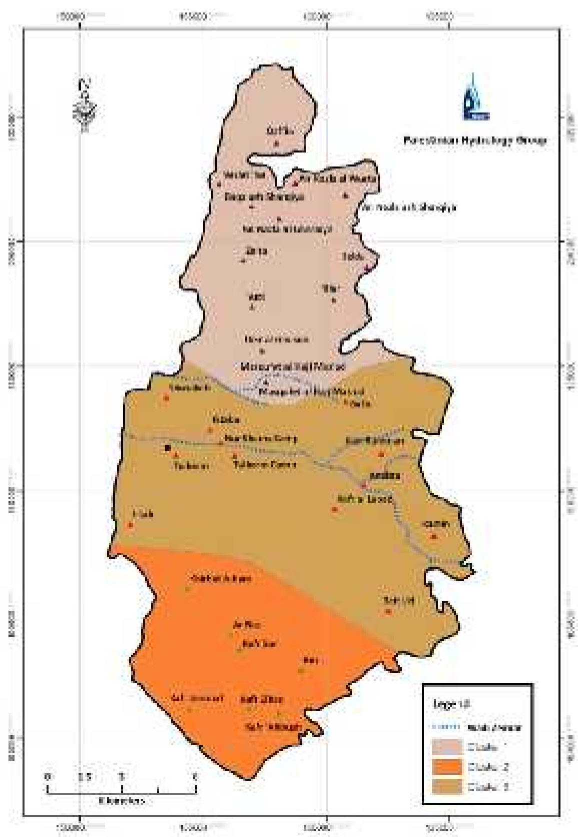
Item	2010	2015	2025
Average Daily Supply IWMS (m^3/D)	30,682	31,889	42,362
Water Balance Including domestic and Agricultural. Sources (m^3)	1,718	511	-9,962
Maximum Daily Supply IWMS (m^3/D)	38,352	39,862	52,952
Water Balance Including domestic and Agricultural. Sources (m^3)	-5,952	-7,462	-20,552

Based on this analysis, it can be concluded that daily deficit will be witnessed in all years when considering the maximum water demand while deficit will occur only during 2025 when average daily demand is considered.

2.5 Clustering Of Communities and Action Plans

2.5.1 Project Area

The Project Area is divided into three clusters in accordance with geographic proximity as follows:



Cluster1 comprises the middle part of Tulkarm District and extends along the catchment area of Wadi Zeimar between Beit Leed in the East and Tulkarem in the West. The municipalities and villages included in this cluster include Anabta, Rameen, Bal'a, Beit Leed, Iktaba (considered as part of Tulkarem), Irtah (part of Tulkarem municipality), Kafr El Labad, Kafr Rumman (part of Anabta municipality), Nur Shams Camp, Shuweika (part of Tulkarem municipality), Thenabeh (part of Tulkarem municipality), Tulkarem and Tulkarem Camp.

Cluster 2 comprises the northern part of Tulkarm District and extends along the green line area of Al-Sharawiya between Qifeen in the north and Tulkarem in the South. The municipalities and villages included in this cluster include are Dir Al-Gusoon, Attil, Zeita, Illar, Syda, Al-Nazleh Al-Sharqiya, Al-Nazleh Al-Wusta, Al-Nazleh Al-Gharbiya, Qifeen, Baqa Al-Sharqiya, Akkaba, Nazlet Issa, Al-Masqufa, Al-Jarushiya.

Cluster 3 comprises the southern part of Tulkarm District and extends along the green line area of Al-Kafriyat between Qiffeen in the south and Tulkarem in the north. The municipalities and villages included in this cluster included are, Faroun, Shoufa, Jibarah, Al-Ras, Kufr Soor, Koor, Kufr Jammal, Kufr Zibad, and Kufr Abboush.

2.5.2 Water Security Analysis in Tulkarem Governorate

The Average Daily Demand (ADD) reflects the total annual water supply required over the Tulkarem District. Meanwhile, the Maximum Daily Demand (MDD) reflects the capacity of resources and readiness to supply enough water over a certain period that exceeds the ADD. Therefore, it is not enough to have water resources to cover the total annual demand; but there must be standby resources for peak daily demands (PDD). It is also possible in certain wells to increase their capacity and the working hours so as to cover the demands which exceed the average daily demand and up-to the maximum daily demand. The peak hourly demand (PHD) reflects the pumping capacity of the resources and the storage facilities. Table (14) shows the District analyses of the municipal water supply and deficit including or excluding agricultural resources based on total domestic water availability in year 2008 and for both scenarios: BAU & IWMS. According to the terminology of clustering and the classification of the District into three clusters, Table (15) shows the ADD & MDD in the three clusters based on BAU scenario. Knowing the amounts of the water supply deficit in the District, we can derive the deficit by cluster as shown in Table (16). This Table shows the clusters and water deficit based on Average Daily Demand (m^3) and BAU. In order to compensate for the deficit under this scenario, additional water sources are proposed as shown in Table (17). In the same time Table (18) shows the Clusters and water deficit based on Maximum Daily Demand (m^3) and IWMS. While Table (19) shows the additional resources proposed to compensate for the deficit under the IWM

Table (14): Analyses of water security in the Tulkarem District

			M.D.D (m^3/d) 2010		M.D.D (m^3/d) 2015		M.D.D (m^3/d) 2025		Comments
Community	**Source of Drinking Water Supply**	**Maximum Daily Supply (m^3)**	**BAU**	**IWMS**	**BAU**	**IWMS**	**BAU**	**IWMS**	
Akkaba	Water tanks and cisterns. Water supply network under construction and source will be Agricultural well 15-20/007	Not limited by agreement (Well Capacity 1800m^3/d) (100)	30		44		69		The community did not reach final agreement with Qiffin Municipality to use their elevated reservoir the water supply will pass through Qiffin reservoir and this may add additional costs of pumping
Qiffin	Municipality Well 15-20/008	2,000	1,701		1,762		2,266		The source is enough, but no alternative for emergency or maintenance situation and could be easily connected to the agricultural well 15-20/007
Nazlat 'Isa	Agricultural well 15-20/003	Not limited by agreement (800)	354		458		631		The source is enough, but no alternative for emergency or maintenance situation and could be easily connected to the agricultural wells supply Baqa Al-Sharqiya 15-20/001 & 15-20/005
An Nazla ash	Agricultural well	Not limited by	268	**38352**	318	**39862**	409	**52952**	The source is enough, but no alternative for emergency or

Sharqiya	16-20/005	agreement (600)				maintenance situation and could be easily connected to the agricultural well supply15-20/004
Baqa ash Sharqiya	Two Agricultural wells 15-20/001 & 15-20/005	Not limited by agreement (1500)	509	709	1108	The two agricultural water sources are enough, even for emergency conditions. The community could be also connected to Nazlat Isa well 15-20/003
An Nazla al Wusta	Agricultural well 15-20/004	Not limited by agreement (200)	42	59	86	The source is enough and future connection to Al-Nazleh Al-Sharqiya well 16-20/005
An Nazla al Gharbiya	Agricultural well 15-20/004	Not limited by agreement (500)	111	162	253	The source is enough and future connection to Al-Nazleh Al-Sharqiya well 16-20/005
Zeita	Municipality well 15-20/010 + Agricultural well 15-20/011	(2000)	966	513	734	The sources are enough to cover future needs and emergency conditions.
Seida	Zeita Well 15-20/010	Expected (300)	346	489	745	At the moment the source is enough and Zeita could also increase the quota, but the village council is looking for alternative and less cost supply from well 16-20/005
Illar	Zeita Well 15-20/011 &15-19/042	Expected (700)	731	1034	1574	At the moment the source is enough and Zeita could also increase the quota, but the village council is looking for alternative and less cost

						supply from well 15-19/022 for additional and regular supply
Attil	Now two agricultural wells 15-19/031 &15-15-19/035 and in few months 15-19/036 and 15-19/021	Not limited by agreement (3000)	1416	1685	2298	The water supply is enough for now and in future, however; there is a crucial need to dig there own well to guarantee the water quality. The aquifer is sensitive to surface pollution and with the existing purification and monitoring techniques, water quality is not assured in the existing conditions
Deir al Ghusun	Municipality well 15-19/047 + Agricultural well 15-19/029	now 1600, and expected to be (3000) after solving the technical problem in the replacement well	1494	1731	2227	The source is enough for now and in future. Meanwhile the alternative agricultural source is already connected to the main source for emergency and water cut conditions. Most of the agricultural wells in Tulkarm district are either under rehabilitation or will be rehabilitated in the seen future. Some of these wells were rehabilitated twice in few years.
Al Jarushiya	Tulkarm Municipality	Linked to Tulkarm water supply	135	165	202	Linked to Tulkarm water supply and internal water needs as indicated PART SIX
Al Masqufa	Tulkarm Municipality	Linked to Tulkarm water supply	29	42	63	Linked to Tulkarm water supply and internal water needs as indicated PART SIX

Bal'a	Municipality well 15-19/048	design capacity 90 m^3/hr, existing capacity 60 m^3/hr or (1200) m^3/d	1210	1295	1784	Critical during summer, not enough for future supply. There should be a replacement groundwater well with higher capacity not less than 2500 m3/day. For emergency condition the community needs rehabilitation of the well and connection to Agricultural well 15-19/006 in Nour Shams Area.
Iktaba	Agricultural well 15-19/043	(600)	592	591	720	Water supply is safe for the time being, but not sure for future. Alternative options include connection to Tulkarm Network, or the agricultural well 15-19/044
Tulkarm	G. Well (1,2,3,4,5,6) and proposed 4-Agr. Wells	Now 850 m^3/hr or (17000) m^3/d. Agr. Wells capacity 4000 m^3/d	18435	18341	21716	Now the water sources are not enough during June, July, August, September or in case unexpected failure in any of the wells and critical over the rest of time There must be an immediate connection to the agricultural wells (15-19/018, 15-19/006, 15-19/014, 15-19/001) and at least a new domestic well. The city hasn't enough water storage for more than few hours. This situation is not safe for socio-economic, and health point of view. At least the city needs two storage tanks each has a capacity of 10000 m^3. The capacity of the proposed and together with the existing tanks would be enough to

									maintain enough supply for two days now.
Anabta	G. Wells 1,2,3 (16-19/001 & 16-19/002 & 16-19/003)	now 1300 m^3/d or (2200) when the municipality operates the polluted well # 1. At the end of Yr. 2010 the well # 3 will start working and this will insure safe quantity of 2500 m^3/d	1773		1788		2268		Now demand is critical and not safe from health point of view, because the municipality used to run the polluted well number 1 during the period between April to October and incase of maintenance so as to cover the demand of Anabta and Rameen. It is expected to have secure supply after operating well nom .3
Kafr al Labad	Agricultural well 15-19/028	not limited: (800) m^3/d	619		799		1101		The source is enough now and over the study period. However; no alternative source in case of water cut and emergency. It is proposed to connect the booster station with agricultural well 15-19/012
Kafa	Agricultural well 15-18/008+ Tulkarm Municipality	Linked to Tulkarm water supply	48		70		109		The community is linked to Tulkarm water supply. However, it need a storage reservoir of 200 m^3
Ramin	Anabta Municipality + local spring	linked to Anabta water supply +20 m^3/d from spring	274		354		488		Now and in the seen future the only source is linked to Anabta water supply which is safe as far as Anabta

						start the new well in operation.
Far'un	Two Agricultural wells: main well 15-19/006 & 15-19/007 for emergency	700 from well 15-19/004+ 500 from well 15-19/007 (1200)	507	651	838	It is safe for now and future. Water quality needs to be verified because the two sources are either in residential areas or intensively cultivated agricultural area.
Shufa	Agricultural well 15-18/024 and the community pull water from another agricultural well number 15-18/019	Not limited (650) m^3/d + defect quantity from well 15-18/019	781	430	593	not enough during most of the time. The well must be rehabilitated or replaced with a new one. Meanwhile, connect the booster station with the agricultural well 15-18/019 and 15-18/006
Khirbet Jubara	Agricultural well 15-18/015	(500)	35	51	79	The well is enough for Jibarah, but no alternative source. The closest supply from Tulkarm network or any of the following agricultural wells: 15-18/019 and 15-18/006
Saffarin	Now cisterns and water tanks from Anabta and fill inside the distribution Reservoir to the network	Linked Beit Leed or groundwater well 15-18/019	90	131	205	

Beit Lid	Mekoroth	very limited supply daily maximum of (400) m^3	698	918	1270	
Ar Ras	Mekoroth	Linked to Kufr Soor	96	106	146	Linked to Kufr Soor water source. The area includes industrial zone and no alternative water source. A new groundwater well is top priority to AL-Ras and Kufr Soor.
Kafr Sur	Mekoroth	The three comm. Soor, and Kur and the industrial zone (400- 500) m^3/d	339	219	302	Mekoroth has limited the maximum supply to 500 m3/day and this is not enough for most of time particularly during summer. A new groundwater well is top priority to AL-Ras and Kufr Soor.
Kur	Mekoroth and will be connected to Kufr Ziebad water source in this year	Linked to Kufr Soor Mekoroth connection point and Kufr Ziebad	31	45	71	Linked to Kufr Ziebad water supply system
Kafr Zibad	Private well 15-18/025	Not limited (500 m^3/day) well's capacity 800 m^3/hr	213	232	294	The source is enough for the three communities now, but not in future. Therefore; the three communities (Kufr Ziebad, Kufr Abboush and Kur)

									could share the proposed new groundwater well with Kufr Soor and Al-Ras or be linked to Kufr Jammal agricultural well 15-18/012
Kafr Jammal	Mekoroth and future potential to agricultural Well 15-18/012	300 m^3/d or when the settlement if satisfied. The agriculture well is not limited (500 m^3/day)	396		475		655		The agricultural well is a real source for supplying Al-Kafriyat, but has a problem of high drawdown when the near settlement well runs.
Kafr 'Abbush	Private well 15-18/025	Linked to Kufr Ziebad source of water	216		268		394		Same situation as Kufr Ziebad
Totals			**34485**	**38352**	**35935**	**39862**	**45698**	**52952**	

Note: In the cases where the maximum daily supply is not limited through agreement, the value presented in the table reflects the logical maximum supply according to the source capacity and deducting the demand by the agricultural sector. The above table shows that the maximum supply from existing Agricultural and domestic wells is around 36000 m^3/day. As shown in Annex 1 wells in Tulkarm District, the maximum potential of domestic groundwater wells (m^3/year) is 10878000 or 29803 m^3/day. This figure doesn't include the quantity of water can get from agricultural sources.

Table (15): ADD & MDD in the three clusters based on BAU

Average Daily Demand (m^3) /BAU

Cluster 1			**Cluster 2**			**Cluster 3**		
2010	2015	2025	2010	2015	2025	2010	2015	2025
19,122	19,594	23,940	6,375	7,171	9,920	2,091	1,981	2,696

Maximum Daily Demand (m^3) /BAU

Cluster 1			**Cluster 2**			**Cluster 3**		
2010	2015	2025	2010	2015	2025	2010	2015	2025
23,902	24,493	29,925	7,969	8,964	12,400	2,614	2,477	3,370

Table (16): Clusters and water deficit based on Average Daily Demand (m^3) and BAU

	Average Daily Demand (m3) Based on BAU								
Water Balance	2010			2015			2025		
	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3
	No Def.	No Def.	No Def.	No Def.	No Def.	No Def.	-4568	-1692	-492
	Maximum Daily Demand (m3) Based on BAU								
Water Balance	2010			2015			2025		
	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3
	-3,168	-1,173	-341	-4,149	-1,537	-447	-10,754	-3,984	-1,158

Table (17): Clusters and groundwater wells to compensate the deficit based on Average Daily Demand (m^3) and BAU

Water Balance	**Average Daily Demand (m3) Based on BAU**								
	2010			2015			2025		
	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3
	No Need.	No Need.	No Need.	No Need.	No Need.	No Need.	2/100	1/80	1/50
Water Balance	**Maximum Daily Demand (m3) Based on BAU**								
	2010			2015			2025		
	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3

	2/70	1/60	1/50	2/100	1/80	1/50	4/150	2/100[1]	1/70

Table (18): Clusters and water deficit based on Maximum Daily Demand (m^3) and IWMS

Water Balance Including domestic and existing Agricultural Sources	**Average Daily Demand (m^3) Based on IWMS**								
	2010			2015			2025		
	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3
	No Def.	No Def.	No Def.	No Def.	No Def.	No Def.	-6,740	-2,497	-726
	Maximum Daily Demand (m^3) Based on IWMS								
	2010			2015			2025		
	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3
	-4,027	-1,492	-433	-5,048	-1,870	-543	-13,904	-5,151	-1,497

[1] 2/100 means that we need two groundwater wells and each has a capacity of 100 m^3/hr

Table (19): Clusters and groundwater wells to compensate the deficit based on Maximum Daily Demand (m^3) and IWMS

	Average Daily Demand (m^3) Based on IWMS								
	2010			2015			2025		
	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3
Water Balance Including domestic and existing Agricultural Sources	No Need	No Need	No Need	No Need	No Need	No Need	3/120	1/120	1/50
	Maximum Daily Demand (m^3) Based on IWMS								
	2010			2015			2025		
	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3
	2/100	1/100	1/100	2/130	1/120	1/100	5/120	2/130	1/100

2.5.3 Storage Capacity Analysis

Storage facilities in Tulkarem District are limited to balance and distribution reservoirs which are usually built as part water network system. There are no storage places for emergency conditions or the peak demands. Meanwhile, there are no special reservoirs for firefighting including the industrial areas in the district. The roof tanks are the actual storage in the district. Most of the houses have their own roof tanks, and their sizes range between 1 and 2 m^3. The roof tank system is usually common where the water supply is intermittent, or water cut occasionally happens. The household water reserve is usually enough for few days, but for longer periods of water cut it is not enough. Cisterns are the most reliable storage facilities particularly in some of the rural areas. However, Tulkarem city and camps, hardly one can find a home cistern. Moreover, the main towns in the city like, Anabta, Attil, Deir Al-Ghosoun and Qifeen, cisterns are found in the old houses and usually used for nondrinking purposes. Table 20 shows that the existing storage of the entire network is not enough for one day in most of the cases. For example, Tulkarm city (after the new water project) has a storage capacity which is only enough for 6 hours based on MDD. Table (21) shows that the existing storages in hours are 8.18, 13.35, 13.78 in clusters 1, 2, 3 respectively. These figures are extremely annoying knowing that in cluster 1, where 67.7% of the existing demand in the district has only a storage capacity for approximately 8 hours only.

Tables 22 and 23 show the analyses of future storage based on BAU & IWMS scenarios. One day storage is adopted as the minimum criterion for the analyses of the size of storage tanks. For example, the BAU scenario shows that there must be an additional water storage facilities IN 210 to hold 16117 m^3, 3469 m^3 and 1174 m^3 in clusters 1, 2, 3 respectively. These figures will escalate to 22140 m^3, 4464 m^3, 1930 m^3 in 2025. Almost similar values are required for IWMS, which means in both scenarios water storage is a priority for future planning in the District.

Table (20): Storage capacity and the maximum daily demand

Community	Existing Storage	Maximum Daily Demand 2008	Storage Capacity (hr)	Maximum Daily Demand 2010	Maximum Daily Demand 2015	Maximum Daily Demand 2025
Akkaba	0	21	0	30	44	69
Qaffin	1000	1,910	13	1,701	1,762	2,266
Nazlat 'Isa	300	314	23	354	458	631
An Nazla ash Sharqiya	300	218	33	268	318	409
Baqa ash Sharqiya	400	548	18	509	709	1,108
An Nazla al Wusta	200	52	93	42	59	86
An Nazla al Gharbiya	200	76	63	111	162	253
Zeita	200	994	5	966	513	734
Seida	500	264	46	346	489	745
Illar	500	634	19	731	1034	1574
Attil	200	1,452	3	1416	1685	2298
Deir al Ghusun	700	1,608	10	1494	1731	2227
Al Jarushiya	0	156	0	135	165	202
Al Masqufa	60	16	88	29	42	63
Bal'a	800	1,382	14	1,210	1,295	1,784

Iktaba	300	614	12	592	591	720
Tulkarm	**4,125**	**17,493**	**6**	**18,435**	**18,341**	**21,716**
Anabta	1600	1,783	22	1,773	1,788	2,268
Kafr al Labad	300	532	14	619	799	1,101
Kafa	0	27	0	48	70	109
Ramin	200	352	14	274	354	488
Far'un	200	458	10	507	651	838
Shufa	440	736	14	781	430	593
Khirbet Jubara	0	24	0	35	51	79
Saffarin	200	62	77	90	131	205
Beit Lid	200	433	11	698	918	1270
Ar Ras	0	94	0	96	106	146
Kafr Sur	200	442	11	339	219	302
Kur	0	21	0	31	45	71
Kafr Zibad	200	241	20	213	232	294
Kafr Jammal	200	333	14	396	475	655
Kafr 'Abbush	200	159	30	216	268	394

Table (21): Storage capacity in 2008

Item	2008		
	Cluster 1	Cluster 2	Cluster 3
Total Storage (m^3)	7785	4500	1440
MDD (m^3)	22850	8090	2508
Storage Capacity (hr)	8.18	13.35	13.78

Table (22): Storage capacity based on BAU scenario

	Maximum Daily Demand (m^3) /BAU								
Clusters	**Cluster 1**			**Cluster 2**			**Cluster 3**		
Year	2010	2015	2025	2010	2015	2025	2010	2015	2025
Cluster Demand (m3)	23902	24493	29925	7969	8964	12400	2614	2477	3370
1-Day Storage Capacity (m3)	16117	16708	22140	3469	4464	7900	1174	1037	1930

Table (23): Storage capacity based on IWMS scenario

Clusters	**Maximum Daily Demand (m^3) /IWMS**								
	Cluster 1			Cluster 2			Cluster 3		
Year	2010	2015	2025	2010	2015	2025	2010	2015	2025
Cluster Demand (m3)	25947	26968	35824	9612	9991	13271	2793	2903	3857
1-Day Storage Capacity	18162	19183	28039	5112	5491	8771	1353	1463	2417

Table (24): Proposed Actions

Proposed Projects over the District: Business-as-Usual Scenario under more Rationalized Demand (BAU - RD) Phase 1 (2010-2015) in cluster 1

No.	Item Description	Unit	Unit price (Euro)	Quantity	Total price (Euro)
1-UP1C1	Construction of new Ground water Capacity 100 m^3/hr	L.S	400000	2	800000
2-U P1C1	Construction of storage Tanks 10000 m^3	L.S	600000	2	1200000
3- UP1C1	Construction of pump stations	L.S	200000	2	400000
4- UP1C1	Installing 8" main Supply pipelines	KM	70000	12	840000
5- UP1C1	Installing 8" main distribution pipelines	KM	70000	15	1050000
6- UP1C1	Installing 6" main distribution pipelines	KM	50000	20	1000000
7- UP1C1	Installing 4" main distribution pipelines	KM	40000	22	880000
8- UP1C1	Installing 3" main distribution pipelines	KM	30000	15	450000
9- UP1C1	Installing 2"+1" main distribution pipelines	KM	20000	25	500000
10-U P1C1	Internal Network fittings and accessories	L.S	1000000	1	1000000
					8120000

Business-as-Usual Scenario under more Rationalized Demand (BAU - RD) Phase 2 (2015-2025) in /cluster 1

No.	Item Description	Unit	Unit price (Euro)	Quantity	Total price (Euro)
1-UP2C1	Construction of new Ground water Capacity 150 m^3/hr	L.S	600000	4	2400000
2- UP2C1	Construction of storage Tanks 10000 m^3	L.S	600000	2	1200000
3-U P2C1	Construction of pump stations	L.S	300000	2	600000
4- UP2C1	Installing 8” main Supply pipelines	KM	70000	12	840000
5- UP2C1	Installing 8” main distribution pipelines	KM	70000	20	1400000
6- UP2C1	Installing 6” main distribution pipelines	KM	50000	25	1250000
7- UP2C1	Installing 4” main distribution pipelines	KM	40000	20	800000
8- UP2C1	Installing 3” main distribution pipelines	KM	30000	30	900000
9- UP2C1	Installing 2”+1” main distribution pipelines	KM	20000	40	800000
10- UP2C1	Internal Network fittings and accessories	L.S	2000000	1	2000000
					12190000

Business-as-Usual Scenario under more Rationalized Demand (BAU - RD) Phase 1 (2010-2015) in cluster 2

No.	Item Description	Unit	Unit price (Euro)	Quantity	Total price (Euro)
1-UP1C2	Construction of new Ground water Capacity 80 m^3/hr	L.S	400000	1	400000
2- UP1C2	Construction of storage Tanks 5000 m^3	L.S	400000	1	400000
3- UP1C2	Construction of pump stations	L.S	200000	3	600000
4- UP1C2	Installing 8” main Supply pipelines	KM	70000	8	560000
5-U P1C2	Installing 6” main distribution pipelines	KM	50000	12	600000
6-U P1C2	Installing 4” main distribution pipelines	KM	40000	15	600000
7- UP1C2	Installing 3” main distribution pipelines	KM	30000	18	540000
8-U P1C2	Installing 2”+1” main distribution pipelines	KM	20000	25	500000
9-U P1C2	Internal Network fittings and accessories	L.S	1000000	1	1000000
					5200000

Business-as-Usual Scenario under more Rationalized Demand (BAU - RD) Phase 2 (2015-2025) in /cluster 2

No.	Item Description	Unit	Unit price (Euro)	Quantity	Total price (Euro)

1-UP2C2	Construction of new Ground water Capacity 100 m^3/hr	L.S	400000	2	800000
2- UP2C2	Construction of storage Tanks 10000 m^3	L.S	500000	1	500000
3- P2C2	Construction of pump stations	L.S	200000	1	200000
4- UP2C2	Installing 8" main Supply pipelines	KM	70000	15	1050000
5- UP2C2	Installing 6" main distribution pipelines	KM	50000	20	1000000
6-U P2C2	Installing 4" main distribution pipelines	KM	40000	25	1000000
7- UP2C2	Installing 3" main distribution pipelines	KM	30000	30	900000
8- UP2C2	Installing 2"+1" main distribution pipelines	KM	20000	35	700000
9- UP2C2	Internal Network fittings and accessories	L.S	1000000	1	1000000
					7150000

Business-as-Usual Scenario under more Rationalized Demand (BAU - RD) Phase 1 (2010-2015) in cluster 3

No.	Item Description	Unit	Unit price (Euro)	Quantity	Total price (Euro)
1-UP1C3	Construction of new Ground water Capacity 50 m^3/hr	L.S	350000	1	350000
2- UP1C3	Construction of storage Tanks 1000 m^3	L.S	150000	1	150000
3- UP1C3	Construction of pump stations	L.S	150000	1	150000
4-U P1C3	Installing 6" main pumping pipelines	KM	50000	8	400000

5- UP1C3	Installing 4" main distribution pipelines	KM	40000	10	400000
6-U P1C3	Installing 3" main distribution pipelines	KM	30000	12	360000
7-UP1C3	Installing 2"+1" main distribution pipelines	KM	20000	20	400000
8-U P1C3	Internal Network fittings and accessories	L.S	500000	1	500000
9-U P1C3					2710000

Business-as-Usual Scenario under more Rationalized Demand (BAU - RD) Phase 2 (2015-2025) in /cluster 3

No.	Item Description	Unit	Unit price (Euro)	Quantity	Total price (Euro)
1-UP2C3	Construction of new Ground water Capacity 70 m^3/hr	L.S	350000	1	350000
2-U P2C3	Construction of storage Tanks 2000 m^3	L.S	200000	1	200000
3- UP2C3	Construction of pump stations	L.S	150000	1	150000
4- UP2C3	Installing 6" main distribution pipelines	KM	50000	10	500000
5- UP2C3	Installing 4" main distribution pipelines	KM	40000	12	480000
6- UP2C3	Installing 3" main distribution pipelines	KM	30000	20	600000
7- UP2C3	Installing 2"+1" main distribution pipelines	KM	20000	25	500000
8-U P2C3	Internal Network fittings and accessories	L.S	500000	1	500000
					3280000

IWMS Scenario Phase 1 (2010-2015) in cluster 1

No.	Item Description	Unit	Unit price (Euro)	Quantity	Total price (Euro)
1-IP1C1	Construction of new Ground water Capacity 100 m^3/hr	L.S	400000	2	800000
2- IP1C1	Construction of storage Tanks 10000 m^3	L.S	600000	2	1200000
3- IP1C1	Construction of pump stations	L.S	200000	2	400000
4- IP1C1	Installing 8” main Supply pipelines	KM	70000	20	1400000
5- IP1C1	Installing 8” main distribution pipelines	KM	70000	25	1750000
6- IP1C1	Installing 6” main distribution pipelines	KM	50000	30	1500000
7- IP1C1	Installing 4” main distribution pipelines	KM	40000	35	1400000
8- IP1C1	Installing 3” main distribution pipelines	KM	30000	30	900000
9-I P1C1	Installing 2”+1” main distribution pipelines	KM	20000	35	700000
10- IP1C1	Internal Network fittings and accessories	L.S	2000000	1	2000000
					12050000

IWMS Scenario Phase 2 (2015-2025) in cluster 1

No.	Item Description	Unit	Unit price (Euro)	Quantity	Total price (Euro)
1-IP1C1	Construction of new Ground water Capacity 120 m^3/hr	L.S	500000	5	2500000
2- IP1C1	Construction of storage Tanks 10000 m^3	L.S	600000	3	1800000
3- IP1C1	Construction of pump stations	L.S	200000	2	400000
4-I P1C1	Installing 8” main Supply pipelines	KM	70000	18	1260000
5- IP1C1	Installing 8” main distribution pipelines	KM	70000	20	1400000
6-I P1C1	Installing 6” main distribution pipelines	KM	50000	25	1250000
7-I P1C1	Installing 4” main distribution pipelines	KM	40000	30	1200000
8- IP1C1	Installing 3” main distribution pipelines	KM	30000	35	1050000
9- IP1C1	Installing 2”+1” main distribution pipelines	KM	20000	45	900000
10-I P1C1	Internal Network fittings and accessories	L.S	4000000	1	4000000
					15760000

IWMS Scenario :Phase 1 (2010-2015) in cluster 2

No.	**Item Description**	**Unit**	**Unit price (Euro)**	**Quantity**	**Total price (Euro)**
1-IP1C2	Construction of new Ground water well Capacity 120 m^3/hr	L.S	400000	1	400000

2- IP1C2	Construction of storage Tanks 5000 m^3	L.S	400000	1	400000
3- IP1C2	Construction of pump stations	L.S	200000	3	600000
4-I P1C2	Installing 8" main Supply pipelines	KM	70000	15	1050000
5- IP1C2	Installing 6" main distribution pipelines	KM	50000	18	900000
6- IP1C2	Installing 4" main distribution pipelines	KM	40000	25	1000000
7-I P1C2	Installing 3" main distribution pipelines	KM	30000	30	900000
8- IP1C2	Installing 2"+1" main distribution pipelines	KM	20000	35	700000
9- P1C2	Internal Network fittings and accessories	L.S	2000000	1	2000000
					7950000

IWMS Scenario :Phase 2 (2010-2015) in cluster 2

No.	Item Description	Unit	Unit price (Euro)	Quantity	Total price (Euro)
1-IP1C2	Construction of new Ground water Capacity 130 m^3/hr	L.S	400000	2	800000
2- IP1C2	Construction of storage Tanks 10000 m^3	L.S	400000	1	400000
3-I P1C2	Construction of pump stations	L.S	200000	3	600000
4-I P1C2	Installing 8" main Supply pipelines	KM	70000	20	1400000
5-I P1C2	Installing 6" main distribution pipelines	KM	50000	25	1250000

6- IP1C2	Installing 4" main distribution pipelines	KM	40000	30	1200000
7-I P1C2	Installing 3" main distribution pipelines	KM	30000	35	1050000
8- IP1C2	Installing 2"+1" main distribution pipelines	KM	20000	40	800000
9- IP1C2	Internal Network fittings and accessories	L.S	2000000	1	2000000
					9500000

IWMS Scenario :Phase 1 (2010-2015) in cluster 3

No.	Item Description	Unit	Unit price (Euro)	Quantity	Total price (Euro)
1-IP1C3	Construction of new Ground water Capacity 50 m^3/hr	L.S	400000	1	400000
2- IP1C3	Construction of storage Tanks 1000 m^3	L.S	150000	1	150000
3- IP1C3	Construction of pump stations	L.S	150000	1	150000
4- IP1C3	Installing 6" main pumping pipelines	KM	50000	12	600000
5-I P1C3	Installing 4" main distribution pipelines	KM	40000	12	480000
6- IP1C3	Installing 3" main distribution pipelines	KM	30000	14	420000
7- IP1C3	Installing 2"+1" main distribution pipelines	KM	20000	15	300000
8-I P1C3	Internal Network fittings and accessories	L.S	500000	1	500000

9- IP1C3					3000000

IWMS Scenario :Phase 2 (2015-2025) in cluster 3

No.	Item Description	Unit	Unit price (Euro)	Quantity	Total price (Euro)
1-IP2C3	Construction of new Ground water Capacity 70 m^3/hr	L.S	400000	1	400000
2-I P2C3	Construction of storage Tanks 2000 m^3	L.S	250000	1	250000
3-I P2C3	Construction of pump stations	L.S	100000	1	100000
4- IP2C3	Installing 6” main distribution pipelines	KM	50000	18	900000
5-I P2C3	Installing 4” main distribution pipelines	KM	40000	20	800000
6-I P2C3	Installing 3” main distribution pipelines	KM	30000	25	750000
7- IP2C3	Installing 2”+1” main distribution pipelines	KM	20000	25	500000
8- IP2C3	Internal Network fittings and accessories	KM	750000	1	750000
					4450000

Table (25): Summary Budget Needed for Investment under the two scenarios

Business-as-Usual Scenario

Cluster	**1**	**2**	**3**	**Total (Euro)**
Phase 1	8,120,000	5,200,000	2,710,000	16,030,000
Phase 2	12,190,000	7,150,000	3,280,000	22,620,000

Integrated Water Management Scenario

Cluster	**1**	**2**	**3**	**Total (Euro)**
Phase 1	12,050,000	7,950,000	3,000,000	23,000,000
Phase 2	15,760,000	9,500,000	4,450,000	29,710,000

Phasing of the Proposed Measures to Mitigate the Water Supply Deficiencies: Immediate Needs PHASE 1

Based on the detailed analysis presented earlier in this chapter, the needs for each community and list of priorities during the first phase were identified and quantified in details and presented hereunder. There are many common problems in between the communities and the solution is necessarily technical or financial.

The impact of population growth and demographic shift will add enormous pressure on the water system operation. This can result in increasing the running costs, but will decrease the production costs and improve profitability. While it is good to have some profit in the beginning, but that does not mean selling water and pricing at low rates or having a low percentage of collection. The limit factor for economic gains will be the lifespan of the existing or proposed projects. Many projects will deteriorate not far from 2025, and cost recovery of these projects is the only guarantee future expansion and continuous operation.

Phasing Of the Proposed Structural Solution to the Existing Water Supply Systems in Tulkarem District

Phasing the solutions is based on the following criteria:

- Availability of funds or external support and financial liquidity within the local councils to cover the proposed projects
- Technical and managerial capacity to operate effectively these projects
- Occupation and approval of these projects.

These three criterions will work independently or jointly to decide if this project or that project achieve the full feasibility. Sources of funds to build the water infrastructure are either external or internal. With the level of per capita income and the general economic power, it is still too early to cover the investment costs of these projects. The local authorities are expected to operate these projects and should build a financial system to recover the costs in a life span beyond the scope of this study. Therefore, it will remain a condition to transfer funds overseas to create these projects. External support is the backbone of the proposed projects. The exiting expertise at both levels of management and technical capacity are still not enough ensure adequate operation of these projects. Therefore, these projects should be coupled with a training and capacity building program to make sure that they will function efficiently and achieve sustainability over the design period. This may include root changes and reform in the structure of water supply and distribution in Palestine and in Tulkarm District as well. The third criterion will be the occupation which hindered in the past the process of development in Palestine. With water supply, no guarantee to achieve any progress or development if the occupation continues to maintain control over resources and approval of water infrastructural projects.

According to the previous criterions and based on the aforementioned scenarios, the analyses of need and priorities of the water supply/distribution systems are divides into three stages as follows:

1- Immediate projects as proposed by the local authorities and a result of needs assessment in this study for the year 2010
2- Short term projects over the period between 2010 and 2015
3- Long term project over the period between 2015 and 2025

Table (26): Tulkarm City

No	Item	Unit	Qty	Unit cost (€)	Total cost (€)	notes
1	6" pressure Pipes 3.96 mm lining from inside and layer of PE, from outside applied by the extrusion method 1.8 mm thickness warping from outside.	M	950	40	38000	To the direction of Irtah ,reservoir and the surrounding s area
2	Ditto but for 4"	M	3670	30	110100	housing of teachers + Iktaba Housing+ Izbet Nasser
3	Ditto but for 3"	M	5572	25	139300	East of Thenabeh + housing of teachers , Kawajah area
4	Galvanized Steel pipes 2"X3.65 mm coated from inside and outside with PE applied by the extrusion method 1.8 mm	M	3000	15	45000	East of Thenabeh + Iktaba , Kawajah area
5	Ditto but for 1"	M	1800	10	18000	East of Thenabeh + housing of Iktaba
6	Galvanized steel couple 2"	No	20	12	240	East of Thenabeh + Iktaba , Kawajah area
7	Nipple 2" standard (5 cm) galvanized	No	30	7	210	East of Thenabeh + Iktaba ,

						Kawajah area
8	Nipple 2" standard (10 cm) galvanized	No	30	10	300	East of Thenabeh + Iktaba , Kawajah area
9	Supply and Install elbow 6"x90, Sch 40	No	2	40	80	Irtah + Arrayes
10	Supply and Install elbow 6"x45, Sch 40	No	18	40	720	Irtah + Arrayes
11	Supply and Install elbow 4"x90, Sch 40	No	18	35	630	Housing of Iktaba + housing of teachers
12	Elbow 4"x45, Sch 40	No	9	35	315	Housing of Iktaba + housing of teachers
13	Elbow 3"x90, Sch 40	No	10	30	300	East of Thenabeh + housing of teachers + Kawajah area
14	Elbow 3"x45, Sch 40	No	7	30	210	East of Thenabeh + housing of teachers + Kawajah area
15	Galvanized elbow 2"/90	No	30	20	600	Iktaba + east of Thenabeh + Kawajah area
16	tee 4"x4" Sch 40	No	8	35	280	Housing of Iktaba + housing of teachers
17	tee 4"x3" Sch 40	No	3	35	105	East of Thenabeh + housing of teachers + Kawajah area
18	tee 8"x4" Sch 40	No	4	40	160	Housing of Iktaba + housing of teachers
19	tee 6"x4" Sch 40	No	4	40	160	Irtah cross + Irtah reservoir
20	tee 3"x3" Sch 40	No	10	25	250	East of Thenabeh + housing of teachers + Kawajah area
21	tee 3"x2" Sch 40	No	6	25	150	East of Thenabeh + housing of teachers + Kawajah area
22	Galvanized tee 2"x2"	No	10	20	200	East of Thenabeh + housing of teachers + Kawajah area
23	Gate valve 6" complete gaskets, flanges, and bolts	No	2	400	800	Irtah + Arrayes
24	Ditto for 4"	No	9	300	2700	Iktaba + housing of teachers + Izbet Nasser

25	Ditto for 3"	No	9	250	2250	East of Thenabeh + housing of teachers + Kawajah area
26	Ditto for 2"	No	25	150	3750	East of Thenabeh + housing of teachers + Kawajah area
27	Dresser 6" complete with ears and rods	No	2	200	400	beside the valves
28	Dresser 4" complete with ears and rods	No	9	150	1350	beside the valves
29	Dresser 3" complete with ears and rods	No	10	100	1000	beside the valves
30	Air valve 2" complete with closing valve and couple 2"	No	10	250	2500	East of Thenabeh + housing of teachers + Kawajah area
31	Emergency intake 2" complete	No	10	150	1500	in the middle and the streets entrances of the town
32	Install Water meter 6"X 25 ATM, (W.M-1) complete	No	2	800	1600	Irtah reservoir + Thenabeh G.wells
33	Ditto for 5"	No	2	700	1400	
34	Ditto for 4"	No	13	600	7800	
35	Ditto for 3"	No	4	500	2000	
36	Reducer 6"/5" for welding	No	6	30	180	
37	Reducer 6"/4" for welding	No	6	30	180	
38	Reducer 4"/3" for welding	No	6	20	120	
					384840	

Anabta town

In 2009, Anabta Municipality got a fund through ICRC in two phases: The phase 1 (1.6 million NIS) includes a drilling a new groundwater well as a replacement of the well number 3. This well was completed and has a discharge capacity of 80 m^3/hr. in addition to that, a new ground reservoir of a capacity of 1000 m^3 has been built. A pumping room, chlorination, control room in a closed yard are completed in April 2010. The second phase includes the supplying and installing the mechanical and electrical equipments for the new well, booster pumps, and constructing a main transmission line between reservoir 1 and 2. The second phase is expected to finish by the end of 2010. The distribution water network is included in either of the phases; therefore

Table (27): Shows the main need of the network.

TEM NO	Description	Unit	(Unit cost (€)	Qty.	Total cost (€)
1-1	**(1)Pipes and fittings**				
1-2	Supply of 4'' diameter, steel water pipeline, PE coating and internal cement lining	M.L	30	1830	54900
1-3	Supply of complete 4'' gate valve	Piece	300	4	1200
1-4	Supply of 4" elbow 90	Piece	35	5	175
1-5	Supply of 4'' elbow 45	Piece	35	5	175
1-6	Supply of 4'' dresser	Piece	150	5	750
1-7	Supply of T(4'' × 3'')	Piece	35	1	35
1-8	Supply of 3'' diameter, steel water pipeline, PE coating and internal cement lining	M.L	25	2440	61000
1-9	Supply of 3'' complete gate valve	Piece	250	4	1000
1-10	Supply of 3" elbow 90	Piece	30	5	150
1-11	Supply of 3'' elbow 45	Piece	30	5	150
1-12	Supply of 3'' dresser	Piece	150	5	750
1-13	Supply of(3'' × 2'') reducer	Piece	20	1	20
1-14	Supply of 2'' steel water pipeline, PE coating	M.L	15	3000	45000
1-15	Supply of 2'' valve	Piece	100	10	1000
1-16	Supply of 2'' steel elbow	Piece	15	15	225
1-17	Supply of 2'' steel coupling	Piece	10	10	100
1-18	Supply of steel Tee 2''	Piece	10	50	500
1-19	Supply of 2'' ×1'' steel tee	Piece	10	50	500

1-20	Supply of 2'' ×3/4'' steel tee	Piece	5	50	250
1-21	Supply of 2'' steel nibble,	Piece	10	30	300
1-22	Supply of 1'' steel water pipeline, PE coating	M.L	10	1500	15000
1-23	Concrete Manhole for 2'' valve depth 50- 70cm	Piece	50	10	500
1-24	Cast iron manhole cover diameter of 60 cm	Piece	100	8	800
1-25	Flange 3" & gaskets	Piece	30	8	240
1-26	Flange 4" & gaskets	Piece	35	8	280
	(2) Earth works				
2-1	Trench excavation for 4'' ,3"&2"pipe lines	M.L	5	7270	36350
2-2	Backfill with sand for 4", 3”& 2'' pipe lines	M.L	4	7270	29080
2-3	Excavation for chambers in any kind of soil	M3	50	80	4000
	(3) Pipe works				
3-1	Laying of 4", 3” pipes, including: welding, asphalting, cutting and shaping	M.L	3	4270	12810
3-2	Laying of 2” pipes includes: , fixing, asphalting, cutting and shaping	M.L	3	3000	9000
	(4)Concrete works				
4-1	Reinforced concrete valves chambers with concrete (B200)	M3	150	100	15000
4-2	Rubble concrete B 150 for road crossing	M3	150	80	12000
4-3	Asphalting for depth not less than 1 m.	ml	10	3000	30000
4-4	Testing and disinfection	L.S	2000	1	2000
	(5) pump unit				
1-5	Supplying in the site of the reservoir no.1 a pumping unit consisting of the following : An electric (vertical) pump Q = 60m^3/hr and TDH =190 m	Piece	50000	1	50000
	(6)maintenance unit				
1-6	Main Water Meter 6"	Piece	800	2+2	3200

2-6	Main Water Meter 4"	Piece	600	8+2	6000
3-6	Main Water Meter 3"	Piece	500	4+2	3000
4-6	Main Water Meter 2"	Piece	300	4+4	2400
5-6	Volumetric water meter 1/2' 10 bars	Piece	50	800	40000
6-6	Volumetric water meter 1/2' 16 bars	Piece	60	400	24000
7-6	Gate valve 6" complete	Piece	400	3+3	2400
8-6	Gate valve4" complete	Piece	300	8+4	3600
9-6	Gate valve 3" complete	Piece	250	8+4	3000
10-6	Gate valve 2" complete	Piece	150	20+20	6000
11-6	Air valve 3" complete	Piece	400	2	800
12-6	Air valve 2" complete	Piece	300	6	1800
13-6	Dresser 6" complete	Piece	200	4	800
14-6	Dresser 4" complete	Piece	150	10	1500
15-6	Dresser 3" complete	Piece	150	4	600
16-6	Dresser 2" complete	Piece	100	50	5000
17-6	Plumber tools	L.S	5000	1	5000
					494340

Beit Leed

Item	Description	Unit	Quantity	(Unit cost (€)	Total cost (€)
1	Steel pipes 4”	M.L	1200	30	36000
2	Steel pipes 3”	M.L	1000	25	25000
3	Steel pipes 2”	M.L	1500	15	22500
4	Steel pipes 1”	M.L	1000	10	10000
6	Volumetric water meters	piece	850	50	42500

7	House connection	house	850	200	170000
8	New elevated reservoir (500 m3)	L.S	1	250000	250000
					556000

Rameen:

Item	Description	Unit	Unit cost (€)	Quantity	Total cost (€)
1	Steel pipes 4”	M.L	30	500	15000
2	Steel pipes 3”	M.L	25	1000	25000
3	Steel pipes 2”	M.L	15	1500	22500
4	Steel pipes 1”	M.L	10	1000	10000
6	Volumetric water meters	piece	50	580	29000
7	House connection	house	200	50	10000
8	Booster pump ($40m^3$/75 m head)	L.S	50000	1	50000
9	Rehabilitation of the elevated and balance reservoirs	L.S	10000	1	10000
10	Concrete manholes	L.S	3000	6	18000
					189500

Bal’a

Item.	Description	unit	Unit cost (€)	Quantity	Expected cost (€)
1	Steel pipes 4”	M.L	30	2500	75000
2	Steel pipes 3”	M.L	25	3800	95000

3	Steel pipes 2”	M.L	15	8600	129000
4	Steel pipes 1”	M.L	10	3200	32000
6	Volumetric meters	Piece	50	1400	70000
7	Concrete manholes for 4”,3”,2”, 1”	Num.	500	50	25000
8	Fittings and accessories) (valves 4”,3”,2”,1”	L.S	30000	1	30000
9	Rehabilitation of the booster station and the chlorination unit	L.S	20000	1	20000
					476000

Iktaba

Item	**Description**	**unit**	**Unit cost (€)**	**Quantity**	**Expected cost (€)**
1	Steel pipes 4”	M.L	30	500	15000
2	Steel pipes 3”	M.L	25	1000	25000
3	Steel pipes 2”	M.L	15	1500	22500
4	Steel pipes 1”	M.L	10	1000	10000
5	Steel pipes 1/2”	M.L	8	2000	16000
6	Volumetric meters	Piece	50	580	29000
7	Concrete manholes for 4”,3”,2”, 1”	Num.	500	50	25000
8	Fittings and accessories) (valves 4”,3”,2”,1”	Piece	10000	50	500000
9	Rehabilitation of the booster station and the chlorination unit	L.S	20000	1	20000

10	Rehabilitation of the balance and elevated reservoirs	L.S	10000	1	10000
					672500

Kafr Al-Labad

Item nom.	Description	unit	Unit cost (€)	Quantity	Expected cost (€)
1	Steel pipes 4"	M.L	30	800	24000
2	Steel pipes 3"	M.L	25	1400	35000
3	Steel pipes 2"	M.L	15	2500	37500
4	Steel pipes 1"	M.L	10	3000	30000
6	Volumetric meters	Piece	50	650	32500
7	Concrete manholes for 4",3",2", 1"	Num.	500	80	40000
8	Fittings and accessories) (valves 4",3",2",1"	Piece	20000	1	20000
9	Rehabilitation of the booster station and the chlorination unit	L.S	25000	1	25000
10	New elevated reservoir capacity 500 m^3	L.S	250000	1	250000
					494000

Faroun

No	Item	Unit	Unit cost (€)	Quantity	Expected cost (€)
1	6" pipes (metal or lined)	Meter	40	480	19200
2	4" pipes (metal or lined)	Meter	35	720	25200
3	3" pipes (metal or lined)	Meter	25	600	15000
4	2" pipes (Galvanized or lined)	Meter	15	1500	22500
5	1" pipes (Galvanized or lined)	Meter	10	600	6000
6	1/2" pipes (Galvanized or lined)	Meter	8	300	2400
7	valve 6"	Piece	400	5	2000
8	valve 4"	Piece	300	4	1200
9	valve 3"	Piece	250	4	1000
10	valve 2"	Piece	150	12	1800
11	valve 1"	Piece	50	12	600
12	elbow 6"	Piece	40	6	240
13	elbow 4"	Piece	35	6	210
14	elbow 3"	Piece	30	6	180
15	elbow 2"	Piece	15	20	300
16	elbow 1"	Piece	10	30	300
17	T 6"	Piece	40	3	120
18	T 4"	Piece	35	3	105
19	T 3"	Piece	30	3	90
20	T 2"	Piece	15	12	180
21	T 1"	Piece	10	20	200
22	nipple 2"	Piece	10	20	200
23	nipple 1"	Piece	5	30	150
24	straight elbow 2"	Piece	5	10	50

25	straight elbow 1"	Piece	5	15	75
26	coupling 3"	Piece	25	4	100
27	coupling 2"	Piece	20	10	200
28	coupling 1"	Piece	10	20	200
29	Volumetric meters	Piece	50	580	29000
30	Rehabilitation of the booster station and the chlorination unit	L.S	20000	1	20000
					148800

Kafa:

The water network needs

No	**Item**	**Unit**	**Unit cost (€)**	**Quantity**	**Expected cost (€)**
1	A distribution elevated reservoir of capacity 200 m^3	L.S	90000	1	90000
2	Rehabilitation of the booster station	L.S	30000	1	30000
3	Expansion of the water network to cover the whole community	L.S	100000	1	100000
					220000

Saffarin:

Water network was established 2009; however, the community is not connected to any water source. There are 180 house connections and 200 m^3 elevated reservoir empty of water. The community has been working to get water from Beit Leed, but these efforts did not succeed because there is no transmission line between the two communities, and the source of water (Mekorot) is not enough to supply both communities. Therefore, the community did an agreement with agricultural well in Tulkarm to pull water for 0.2 JD/m3. The distance is around 8.5 kms against an elevation of

No	Item	Unit	Unit cost (€)	Quantity	Expected cost (€)
1	6” steel pipes from Beit Leed pump station to Saffarin elevated reservoir.	m.l	40	2200	88000
2	4” steel pipes from Well 15-18/019	m.l	35	8500	297500
3	Booster station (40 m^3/hr over TDH 220 m)	L.S	80000	1	80000
					465500

Shoufa and Izbet Shoufa:

No	Item	Unit	Unit cost (€)	Quantity	Expected cost (€)
1	A distribution elevated reservoir of capacity 200 m^3 in Shoufa	L.S	250000	1	250000
	A distribution elevated reservoir of capacity 200 m^3 in Izbat Shoufa	L.S	90000	1	90000
	Replacement well because Rehabilitation of the well 15-18/024 in not worthy	L.S	400000	1	400000
	6” steel pipes from the well to Izbet Shoufa (2500 m) and from the end of the existing 6 " supply pip to the elevated reservoir (1000 m) in Shoufa.	m.l	40	3500	140000
	4” steel pipes	M.L	35	300	10500
	2” steel pipes	M.L	15	600	9000
	1” steel pipes	M.L	10	450	4500
	Fittings and network accessories (6”+4”+2”+1” valves, dressers, elbows, etc.)	L.S	20000	1	20000
	New chlorination unit	L.S	15000	1	15000
	2 inches steel pipes	M.L	15	1000	15000

	Fittings (6,4,3,2 inches)	L.S	10000	1	10000
					964000

Dir Al-Ghosoun

The water project needs:

1- Elevated reservoir of capacity 500 m^3
2- Ground balance reservoir at the site of the municipality well of capacity 500 m^3, or 2 fiber glass ground reservoir and each of capacity of 100 m^3
3- Rehabilitation of 75% of the internal network
4- Transmission pipeline (1700 meter 8 inches diameter) between the well's site and the proposed new elevated reservoir.
5- Rehabilitation of the existing booster station and capacity of 140 m^3/130 meter head.
6- Fix the technical problems of the new well turbine

Item Num.	Description	Unit	Unit cost (€)	Quantity	Expected cost (€)
1	Elevated reservoir of capacity 500 m^3	L.S	20000	1	20000
2	Ground balance reservoir at the site of the municipality well of capacity 500 m^3, or 2 fiber glass ground reservoir and each of capacity of 100 m^3	L.S	150000	1	150000
3	Rehabilitation of 75% of the internal network	L.S	1000000	1	1000000
4	Transmission pipeline (1700 meter 8 inches diameter) between the well's site and the proposed new elevated reservoir.	L.S	100000	1	100000
5	Rehabilitation of the existing booster station and capacity of 140 m^3/130 meter head.	L.S	50000	1	50000

6	Fix the technical problems of the new well turbine	L.S	60000	1	60000
					1380000

Attil:

Water project needs in Attil:

Item Num.	Description	Unit	Unit cost (€)	Quantity	Expected cost (€)	Notes
1	Steel pipes 2" isolated with PE from outside and inside	M.L	15	10795	161925	Distributed over 49 streets and entrances
2	Concrete manholes for the 2" pipes	Num	50	65	3250	Ready made concrete 60*90 cm
3	House connection for the 2" pipes	Num	200	386	77200	Old house connections
4	Steel pipes 3" isolated with PE from outside and lined with cement from inside	M.L	25	10810	270250	Distributed over 18 streets and entrances
5	House connection for the 3" pipes	Num	200	297	59400	Old house connections
6	Reinforced Concrete manholes for the 3" pipes	Num	2000	26	52000	Built in the site 1.8*1.4*2.2 meter
7	Steel pipes 4" isolated with PE from outside and lined with cement from inside	M.L	35	2635	92225	Distributed over 5 streets and entrance
8	House connection for the 4" pipes	Num	200	89	17800	Old house connections
9	Reinforced Concrete	Num	2000	9	18000	Built in the site

	manholes for the 4" pipes					1.8*1.6*2.2 meter
10	Steel pipes 6" isolated with PE from outside and lined with cement from inside	M.L	40	2823	112920	Distributed over 3 streets
11	Reinforced Concrete manholes for the 6" pipes	Num	3000	5	15000	Built in the site 1.8*1.6*2.2 meter
12	Steel pipes 8" isolated with PE from outside and lined with cement from inside	M.L	50	4190	209500	Distributed over 3 streets
13	Reinforced Concrete manholes for the 8" pipes	Num	3000	6	18000	Built in the site 1.8*1.6*2.2 meter
14	Fittings (gate valves, non return valves dressers, air valves, etc..)	L.S	50000	1	50000	To replace the existing fitting on to control the new network.
15	Water network maintenance tools	L.S	30000	1	30000	Include wrenches of different size
16	Ground distribution reservoir (1000 m^3)	L.S	200000	1	200000	At new elevation 100 meter higher (x= 158330, y=196486 z=205 m.a.s.l) that the existing reservoir
17	Booster pump station including balance reservoir of 300 m^3	L.S	60000	1	60000	At the confluence of the supply pipes from the three wells. (x= 156850, y=197140 z=95 m.a.s.l)
					1447470	

Zeita:

Water project needs in Zeita:

Item Num.	Description	Unit	Unit cost (€)	Quantity	Expected cost (€)
1	Steel pipes 2” isolated with PE from outside and inside	M.L	15	3270	49050
2	Concrete manholes for the 2” pipes	Num	50	65	3250
3	House connection for the 2” pipes	Num	200	100	20000
4	Steel pipes 3” isolated with PE from outside and lined with cement from inside	M.L	25	635	15875
5	House connection for the 3” pipes	Num	200	150	30000
6	Reinforced Concrete manholes for the 3” pipes	Num	2000	15	30000
14	Fittings (gate valves, non return valves dressers, air valves, etc..)	L.S	15000	1	15000
15	Water network maintenance tools	L.S	10000	1	10000
16	Ground distribution reservoir (1000 m^3) to separate the agricultural consumers from the domestic network	L.S	200000	1	200000
18	Replacement of the standby booster at the well 15-19/011 by another one of capacity 110 m^3/hr and 1 km of 6” steel pipes. including balance reservoir of 300 m^3	L.S	60000	1	60000
					433175

Al-Nazleh Al-Gharbiya

The basic needs in water supply include:

Item Num.	Description	Unit	Unit cost (€)	Quantity	Expected cost (€)
1	House connections	Num.	200	60	12000
2	2" pipeline to connect the secondary school the remote houses with running water supply.	m.l	15	1100	16500
3	Reinstatement of 1 km for the destroyed roads and road crossings a results of the water network construction	m^2	20	1000	20000
					48500

Al-Nazleh Al-Wusta

Item Num.	Description	Unit	Quantity	Unit cost (€)	Expected cost (€)
2	2" steel pipes	M.L	400	15	6000
2	1" steel pipes	M.L	800	10	8000
3	Fittings and network accessories (6"+4"+2"+1" valves, dressers, elbows, etc.)	L.S	1	20000	20000
					34000

Al-Nazleh Al-Sharqiya

The immediate and basic needs of Al-Nazleh Al-Sharqiya network are shown in table…

Item.	Description	unit	Unit cost (€)	Quantity	Expected cost (€)
3	Steel pipes 2”	M.L	15	500	7500
4	Steel pipes 1”	M.L	10	1000	10000
	Steel pipes 3/4”	M.L	8	1000	8000
6	Volumetric meters	Piece	50	260	13000
8	4” valves	Piece	300	4	1200
9	2” valves	Piece	150	20	3000
10	1” valves	Piece	25	50	1250
11	Main float valve	Piece	4000	2	8000
12	Screen valve 4”	Piece	300	2	600
					52550

Ellar:

Ellar water network main needs

Item	Description	unit	Unit cost (€)	Quantity	Expected cost (€)
	steel pipes 6"	meter	40	100	4000
	steel pipes 4"	meter	35	100	3500
	steel pipes 3"	meter	25	100	2500
	steel pipes 2"	meter	15	5000	75000
	steel pipes 1"	meter	10	1000	10000
	steel pipes 3/4"	meter	8	1000	8000

elbows 6"	piece	40	10	400
dresser 6"	piece	200	5	1000
T-6"	piece	40	3	120
Reducer 6"-8"	piece	50	5	250
elbows 4"	piece	35	10	350
dresser 4"	piece	150	4	600
T-4"	piece	35	5	175
Reducer 4"-3"	piece	35	5	175
elbows 3"	piece	25	10	250
dresser 3"	piece	150	4	600
T-3"	piece	25	5	125
Reducer 3"-2"	piece	20	30	600
elbows 2"	piece	15	260	3900
dresser 2"	piece	50	40	2000
T-2"	piece	15	150	2250
Reducer 2"-1"	piece	10	200	2000
dresser 1"	piece	10	150	1500
Reducer 1"-3/4"	piece	5	200	1000
dresser 3/4"	piece	5	500	2500
Reducer 3/4"-1/2"	piece	5	500	2500
pressure reducing valve 4"	piece	1000	3	3000
pressure reducing valve 3"	piece	900	3	2700
pressure reducing valve 2"	piece	700	4	2800
gate valves 6"	piece	400	5	2000
gate valves 4"	piece	300	5	1500
gate valves 3"	piece	250	5	1250

gate valves 2"	piece	150	50	7500
gate valves 1"	piece	25	50	1250
gate valves 3/4"	piece	15	500	7500
volumetric water meter 16 bar	piece	60	500	30000
stand by booster pump 140 m^3/241 meter TDH	piece	30000	1	30000
				214795

Qifeen:

The main needs of the water network are as follows:

Item	Description	Unit	Unit cost (€)	Quantity	Expected cost (€)	Notes
1	2” distribution steel pipes	M.L	15	2272	34080	Total existing 2” pipes 5472 meter
2	3” distribution steel pipes	M.L	25	663	16575	Total existing 3” pipes 3107 meter
3	4” distribution steel pipes	M.L	35	950	33250	Total existing 4” pipes 3588 meter
4	6” distribution steel pipes	M.L	40	2005	80200	Total existing 6” pipes 3031 meter
5	Gate valves 6”	Num	400	10	4000	Total existing 6” valves 20
6	Gate valves 4”	Num	300	30	9000	Total existing 4” valves 40
7	Gate valves 3”	Num	250	20	5000	Total existing 3” valves 30
8	Gate valves 2”	Num	150	30	4500	Total existing 2” valves 35
9	Manholes 6”	Num	3000	4	12000	Total existing 6” manholes 6

10	Manholes 4”	Num	2500	30	75000	Total existing 4” manholes 40
11	Manholes 3”	Num	2000	20	40000	Total existing 3” manholes 30
12	Manholes 2”	Num	100	30	3000	Total existing 2” manholes 35
13	Volumetric water meters	Num	50	100	5000	Total 1000 existing water meters
					321605	

Nazlet Issa

The basic water network needs are shown in table…

Item	**Description**	**unit**	**Unit cost (€)**	**Quantity**	**Expected cost**
1	Volumetric meters	Piece	50	420	21000
2	Steel pipes 2”	M.L	15	3000	45000
3	Steel pipes 1”	M.L	10	1000	10000
4	Steel pipes 1/2”	M.L	8	2000	16000
5	2”, 1” accessories as elbows, Tess, reducers, records, plugs, isolation sheets, etc.	L.S	20000	1	20000
					112000

Akkaba:

Item	Description	unit	Unit cost (€)	Quantity	Expected cost
1	Chlorination unit	L.S	8000	1	8000
2	House connections	L.S	200	50	1000
	Volumetric water meters	Num	50	50	2500
					11500

Al-Jarushiya

Item	Description	unit	Unit cost (€)	Quantity	Expected cost
1	Distribution reservoir 200 m^3	L.S	9000	1	90000

Al-Masqufa

Item	Description	unit	Unit cost (€)	Quantity	Expected cost
1	3” supply pipeline	M.L	25	700	17500
2	Maintenance tolls	L.S	10000	1	10000
					27500

Al-Ras

Item	Description	unit	Unit cost (€)	Quantity	Expected cost
1	Distribution reservoir 200 m^3	L.S	90000	1	90000

Jibarah:

The community applied for establishing new drinking water network pump station, elevated reservoir, chlorination unit, and supply pipeline. The distribution network includes the construction of main supply steel pipeline 1600 meter 6”. Most of lengths are steel pipes 3”, 2”, 1 ” of lengths 800, 1500 and 3000 meters respectively. There are 60 houses and all are isolated behind the wall. The PWA estimated these costs as 400000 $US.

Kufr Jammal

The network water source is from Mekoroth and the water network was established in 1986. There is 4” steel pipeline over the ground that connects Kufr Jammal main manhole to Mekoroth water source. Then underground another steel pipeline from the manhole to the existing elevated reservoir (x=154326,180514, z=. The distances are around 1900, and 850 meters respectively. In 2008 the ANERA supported the rehabilitation of the reservoir and expansion of the network of an amount of 100000 $US. However, a new water network is still a priority for the community. The main components of the

The council replaced the main water meter and this improved the losses around 5%. However, the losses are still high and require more investigations including the replacement of the water meters.

Item No	Description Of Works	Unit	Unit cost (€)	Quantity	Total COST €	
	3'' nominal diameter pressure steel pipe trench excavation for 3” pipes	M.L	25	1290	32250	
	2'' nominal diameter pressure steel pipe trench excavation for 2” pipes	M.L	15	900	13500	
	1'' nominal diameter pressure steel pipe trench excavation for 1” pipes	M.L	10	410	4100	
	3''cast iron wedge gate valve	piece	300	12	3600	
	2''threaded gate valve for 16 bar	piece	100	10	1000	

	1'' threaded gate valve for 16 bar	piece	25	6	150
	manholes for3”gate valves	piece	2000	5	10000
	manholes for 2”gate valves	piece	100	10	1000
	manholes for 1”gate valves	piece	100	15	1500
	reinstatement the concrete where the pipelines pass underneath asphalted roads	m²	15	500	7500
	2”, 1” accessories as elbows, Tess, reducers, records, plugs, isolation sheets, etc.	L.S	20000	1	20000
	reinstatement the asphalt where the pipelines pass underneath asphalted and concrete roads or crossings	m²	15	1000	15000
					109600

Kufr Soor

Item No	**Description Of Works**	**Unit**	**Unit cost (€)**	**Quantity**	**Total COST €**
	3'' nominal diameter pressure steel pipe trench excavation for 3” pipes	M.L	25	1290	**32250**
	2'' nominal diameter pressure steel pipe trench excavation for 2” pipes	M.L	15	900	**13500**
	1'' nominal diameter pressure steel pipe trench excavation for 1” pipes	M.L	10	410	**4100**
	3''cast iron wedge gate valve	piece	250	12	**3000**
	2''threaded gate valve for 16 bar	piece	50	10	**500**
	1'' threaded gate valve for 16 bar	piece	10	6	**60**
	manholes for3”gate valves	piece	2000	5	**10000**
	manholes for 2”gate valves	piece	50	10	**500**
	manholes for 1”gate valves	piece	50	15	**750**

reinstatement the concrete where the pipelines pass underneath asphalted roads	m²	15	500	**7500**
reinstatement the asphalt where the pipelines pass underneath asphalted and concrete roads or crossings	m²	15	1000	**15000**
				87160

In Summary the total budget needed to meet the immediate needs in the Governorate is nearly 9.5 million euros.

ANNEXES

List of Agricultural Wells

Table(1): Wells in Tulkarem

Well-Owner	Well No.	X	Y	Use	Max Extraction (m^3/yr)
Sadeq Salem+Part.	15-18/001	151.420	181.120	Dual	135000
Abdulrahman Abu Saleh	15-18/005	151.620	181.150	Agr.	175000
Moh'd Abdulhaleem	15-18/006	152.500	187.950	Dual	110000
Moh'd Y. Omer	15-18/007	152.850	189.000	Dual	123000
Ismail Ateer	15-18/008	153.750	188.800	Dual	218000
Ahmed Abu Shanab	15-18/009	152.380	189.720	Agr.	220000
Hassan M. Issa	15-18/010	152.150	188.750	Agr.	163000
Moh'd Khader	15-18/012	154.500	181.500	Agr.	146000
Kufr Zibad Council	15-18/015	156.800	181.200	Dual	584000
Abdulla Shreim	15-18/017	153.150	189.550	Agr.	97000
Abdul Karim Qasem	15-18/018	152.580	189.920	Agr.	98000
Rasheed Hanoun+Part..	15-18/019	153.950	188.650	Agr.	185000
Wasfi Abdul Karim	15-18/020	153.870	187.320	Agr.	193000

Aref M. Qader	15-18/021	155.840	184.720	Agr.	165000
Ahmed M. Abu Shanab	15-18/022	151.760	189.500	Agr.	165000
Farouk Shaker	15-18/023	152.800	181.600	Agr.	69000
Shofah Cooperative	15-18/024	155.500	188.500	Dual	220000
Moh'd Sa'id Kamal	15-19/001	153.130	191.950	Agr.	86000
Khaled Hanoun	15-19/002	153.660	190.960	Agr.	109000
Ikab Freij + Part,	15-19/003	152.580	192.970	Agr.	188000
Ali Abu Saleh	15-19/004	152.400	193.040	Agr.	209000
Abdul R. Abu Saleh	15-19/005	152.600	192.750	Agr.	191000
Rafat Qubbaj	15-19/006	155.920	191.840	Agr.	105000
Najeeb Al Musa	15-19/007	159.950	191.500	Agr.	82000
Zeita Village Council	15-19/010	154.800	199.960	Dual	1314000
Abduljabbar Samara	15-19/011	155.530	199.800	Agr.	141000
Zubeida Sa’id	15-19/012	155.730	191.000	Agr.	119000
Hafez Hamdzllah	15-19/013	153.470	191.600	Agr.	120000
Rasheed Diyab	15-19/014	152.970	190.020	Agr.	75000

Abdulraheem Abu Bakir	15-19/015	153.240	190.180	Agr.	131000
Omar Karmi	15-19/016	151.900	190.300	Agr.	137000
Mustafa Al Sa'id	15-19/019	151.970	191.750	Agr.	129000
Abdulqader Kuzmar	15-19/020	152.700	191.650	Agr.	209000
Haseeb Amous	15-19/021	156.100	197.640	Dual	235000
Moh'd Mikawi	15-19/022	156.450	199.550	Agr.	175000
Rashed Samara + Part.	15-19/023	156.260	199.480	Agr.	205000
Abdulraheem Mir'eb	15-19/025	153.640	193.640	Agr.	222000
Hassan M. Khalil	15-19/028	156.800	190.100	Agr.	127000
Abdul Majeed Qasem	15-19/029	156.040	196.640	Dual	352000
Sadeq Jamous	15-19/030	154.770	190.910	Agr.	123000
Fares Abu Sabha	15-19/031	156.330	199.040	Dual	165000
Saleh Yaseen Hamdan	15-19/032	156.650	197.580	Agr.	219000
Khadouri Agr. School	15-19/033	151.720	191.000	Agr.	198000
Sa'id Jaber	15-19/034	153.750	193.150	Agr.	198000
As'ad Rabi + Part.	15-19/035	156.430	196.820	Dual	242000

Attil Coop.- Rashed S.	15-19/036	155.320	198.000	Dual	299000
As'ad Taffal + Part.	15-19/038	154.440	190.880	Dual	123000
Moh'd O. Safarini	15-19/039	154.200	190.200	Agr.	90000
Moh'd N. Barakat	15-19/041	155.960	198.340	Agr.	442000
Mah'd Abdulrazek	15-19/042	158.280	199.100	Agr.	400000
Rafiq Hamdallah	15-19/043	154.540	192.040	Dual	194000
Shakir Samarah	15-19/044	153.500	192.210	Agr.	225000
Tulkarem Municipality.	1+2+3+4+5+6			Dom.	6205000
Deir El Ghusun Village	15-19/047	157.500	195.450	Dom.	1095000
Bal'a Village Council	15-19/048	159.050	192.800	Dual	438000
Moh'd Khlaf	15-20/001	156.400	201.500	Agr.	244000
Moh'd Abu Shams	15-20/002A	156.450	200.470	Dual	595000
Moh'd Taher+ Part.	15-20/003	156.000	202.080	Agr.	237000
Fadel Kittaneh+Part.	15-20/004	157.500	201.030	Dual	345000
Aziz Mas'ud	15-20/005	1576.100	201.560	Agr.	194000
Saqer Al Sa'ed	15-20/006	156.100	200.200	Dual	234000

Awni Abdulhadi	15-20/007	157.550	203.310	Dual	151000
Qafin Village	15-20/008	158.140	204.280	Dom.	657000
Anabta Municipality	1+2+3			Dom.	803000
Jamil Awartani	16-19/011	160.020	190.980	Agr.	149000
Adeeb A. Kittaneh	16-20/005	161.930	201.000	Dual	68000
Total Existing Potential Ground Water Resources (m^3/year)					**22060000**
Agricultural Extraction License (m^3/year)					**11182000**
Domestic groundwater wells potential (m^3/year)					**10878000**

Table (2): The BAU per capita consumption forecasting based on 2008 data.

Community	Annual Consumption 2008/2009	L/C/D	Registered Consumption	L/C/D 2008	L/C/D 2010	L/C/D 2015	L/C/D 2025
Akkaba	7563	80	7563	80	80	100	120
Qaffin	485084	153	277348	87	87	100	120

Nazlat 'Isa	84450	97	58003	67	80	100	120
An Nazla ash Sharqiya	55460	98	30969	55	80	100	120
Baqa ash Sharqiya	141790	93	125488	82	82	100	120
An Nazla al Wusta	10829	84	8574	66	80	100	120
An Nazla al Gharbiya	27915	80	25544	72	80	100	120
Zeita	270336	255	254601	240	240	110	122
Seida	64467	59	58148	53	80	100	120
Illar	166653	72	149209	65	80	100	120
Attil	405000	120	317000	94	94	104	120
Deir al Ghusun	415997	136	259802	85	85	100	120
Al Jarushiya	37599	106	36582	103	103	108	120
Al Masqufa	3971	40	3848	39	80	100	120
Bal'a	340290	138	234083	95	95	100	120
Iktaba	167740	169	99656	100	100	105	120
Tulkarm	5422018	213	3094610	121	121	128	141
Anabta	505033	185	323173	118	118	124	137

Kafr al Labad	146274	105	103277	74	80	100	120
Kafa	7218	48	6617	44	80	100	120
Ramin	57720	86	40637	60	80	100	120
Far'un	133250	115	86484	75	80	100	120
Shufa	218094	267	159899	196	196	100	120
Khirbet Jubara	8731	80	8731	80	80	100	120
Saffarin	22659	80	22367	80	80	100	120
Beit Lid	131731	71	100087	54	80	100	120
Ar Ras	27600	137	15677	78	80	100	120
Kafr Sur	122900	239	82052	160	160	100	120
Kur	7796	80	7796	80	80	100	120
Kafr Zibad	59400	148	41875	104	104	110	121
Kafr Jammal	91670	102	53136	59	80	100	120
Kafr 'Abbush	60246	111	47220	87	87	100	120
District Annual Water Supply (m3)	9707485		6140057				
District Annual Registered	6140057						

Quantity (m3)	
District Total Population 2008/2009	161227
Average supply l/c/d	165
Average consumption l/c/d	104
District Amount of Water losses (m3)	3567428
District % of Losses	37%

Table (3): Estimated water demands in Tulkarem Governorate BAU Scenario

Community	**2010**				**2015**				**2025**			
	Population	A.D.D (m^3)	M.D.D (m^3)	P.H.D (m^3)	Population	A.D.D (m^3)	M.D.D (m^3)	P.H.D (m^3)	Population	A.D.D (m3)	M.D.D (m^3)	P.H.D (m^3)
'Akkaba	270	24	30	1.4	299	35	44	2.0	366	55	69	3.1
Qaffin	8913	1360	1701	77.9	9865	1409	1762	80.7	12085	1813	2266	103.9
Nazlat 'Isa	2481	284	354	16.2	2745	366	458	21.0	3363	504	631	28.9
An Nazla ash Sharqiya	1609	215	268	12.3	1781	254	318	14.6	2182	327	409	18.8
Baqa ash	4358	407	509	23.3	4824	568	709	32.5	5909	886	1108	50.8

Sharqiya												
An Nazla al Wusta	361	34	42	1.9	400	47	59	2.7	490	69	86	4.0
An Nazla al Gharbiya	996	89	111	5.1	1102	130	162	7.4	1350	203	253	11.6
Zeita	3031	773	966	44.3	3355	410	513	23.5	4109	587	734	33.7
Seida	3113	277	346	15.9	3445	391	489	22.4	4220	596	745	34.1
'Illar	6579	585	731	33.5	7281	827	1034	47.4	8919	1259	1574	72.1
'Attil	9605	1133	1416	64.9	10631	1348	1685	77.2	13023	1839	2298	105.3
Deir al Ghusun	8759	1196	1494	68.5	9695	1385	1731	79.3	11876	1781	2227	102.1
Al Jarushiya	991	108	135	6.2	1096	132	165	7.6	1343	161	202	9.2
Al Masqufa	276	23	29	1.3	306	33	42	1.9	375	50	63	2.9
Bal'a	7019	968	1210	55.5	7768	1036	1295	59.3	9516	1427	1784	81.8
Iktaba	2832	474	592	27.1	3135	472	591	27.1	3840	576	720	33.0
Tulkarm	72882	14748	18435	844.9	80665	14673	18341	840.6	98813	17373	21716	995.3
Anabta	7789	1419	1773	81.3	8621	1430	1788	81.9	10560	1814	2268	103.9
Kafr al Labad	4330	495	619	28.4	4792	639	799	36.6	5870	881	1101	50.4

TULKARM MASTER PLAN

Kafa	429	38	48	2.2	475	56	70	3.2	582	87	109	5.0
Ramin	1919	219	274	12.6	2124	283	354	16.2	2602	390	488	22.4
Far'un	3295	406	507	23.2	3646	521	651	29.8	4467	670	838	38.4
Shufa	2332	625	781	35.8	2581	344	430	19.7	3161	474	593	27.2
Khirbet Jubara	311	28	35	1.6	345	41	51	2.3	422	63	79	3.6
Saffarin	808	72	90	4.1	894	105	131	6	1095	164	205	9
Beit Lid	5307	559	698	32.0	5874	734	918	42.1	7196	1016	1270	58.2
Ar Ras	574	77	96	4.4	635	85	106	4.9	778	117	146	6.7
Kafr Sur	1187	271	339	15.5	1314	175	219	10.0	1609	241	302	13.8
Kur	278	25	31	1.4	308	36	45	2.1	378	57	71	3.2
Kafr Zibad	1146	171	213	9.8	1268	185	232	10.6	1553	235	294	13.5
Kafr Jammal	2576	317	396	18.2	2851	380	475	21.8	3493	524	655	30.0
Kafr 'Abbush	1548	173	216	9.9	1714	214	268	12.3	2099	315	394	18.0
Totals	**167905**	**27588**	**34485**	**1581**	**185835**	**28747**	**35933**	**1647**	**227645**	**36556**	**45695**	**2094**

Table (4): Weighted losses based on IWMS and BAU

Community	Weight Factor of Consumption over the District	Expected % in Losses 2010	Expected % in Losses 2015	Expected % in Losses 2025	Weighted Losses 2010	Weighted Losses 2015	Weighted Losses 2025
Akkaba	0.078%	10%	15%	20%	0.01%	0.01%	0.02%
Qaffin	4.997%	43%	30%	20%	2.15%	1.50%	1.00%
Nazlat 'Isa	0.870%	30%	25%	20%	0.26%	0.22%	0.17%
An Nazla ash Sharqiya	0.571%	40%	30%	20%	0.23%	0.17%	0.11%
Baqa ash Sharqiya	1.461%	12%	15%	20%	0.18%	0.22%	0.29%
An Nazla al Wusta	0.112%	15%	15%	15%	0.02%	0.02%	0.02%
An Nazla al Gharbiya	0.288%	10%	15%	20%	0.03%	0.04%	0.06%
Zeita	2.785%	6%	10%	15%	0.17%	0.28%	0.42%
Seida	0.664%	10%	12%	15%	0.07%	0.08%	0.10%
Illar	1.717%	10%	12%	15%	0.17%	0.21%	0.26%
Attil	4.172%	21%	18%	15%	0.88%	0.75%	0.63%
Deir al Ghusun	4.285%	38%	30%	20%	1.63%	1.29%	0.86%
Al Jarushiya	0.387%	5%	10%	15%	0.02%	0.04%	0.06%
Al Masqufa	0.041%	5%	8%	10%	0.00%	0.00%	0.00%

Bal'a	3.505%	31%	25%	20%	1.09%	0.88%	0.70%
Iktaba	1.728%	40%	30%	20%	0.69%	0.52%	0.35%
Tulkarm	55.854%	40%	30%	20%	22.34%	16.76%	11.17%
Anabta	5.203%	35%	25%	20%	1.82%	1.30%	1.04%
Kafr al Labad	1.507%	30%	25%	20%	0.45%	0.38%	0.30%
Kafa	0.074%	10%	15%	20%	0.01%	0.01%	0.01%
Ramin	0.595%	30%	25%	20%	0.18%	0.15%	0.12%
Far'un	1.373%	35%	30%	20%	0.48%	0.41%	0.27%
Shufa	2.247%	27%	25%	20%	0.61%	0.56%	0.45%
Khirbet Jubara	0.090%	12%	15%	20%	0.01%	0.01%	0.02%
Saffarin	0.233%	10%	15%	20%	0.02%	0.04%	0.05%
Beit Lid	1.357%	24%	20%	15%	0.33%	0.27%	0.20%
Ar Ras	0.284%	40%	25%	20%	0.11%	0.07%	0.06%
Kafr Sur	1.266%	30%	25%	20%	0.38%	0.32%	0.25%
Kur	0.080%	10%	15%	20%	0.01%	0.01%	0.02%
Kafr Zibad	0.612%	30%	25%	20%	0.18%	0.15%	0.12%

Kafr Jammal	0.944%	35%	25%	20%	0.33%	0.24%	0.19%
Kafr 'Abbush	0.621%	22%	20%	20%	0.14%	0.12%	0.12%
	Total Weighted District Losses				34.98%	27.02%	19.44%

Table (5): Weighted L/C/D based IWMS and BAU

Community	Weight Factor of Consumption over the District	Liters /P/C/D 2010	Liters /P/C/D 2015	Liters /P/C/D 2025	Weighted 2010 L/C/D	Weighted 2015 L/C/D	Weighted 2025 L/C/D
Akkaba	0.0008	80	100	120	0.062	0.078	0.093
Qaffin	0.0500	87	100	120	4.347	4.997	5.996
Nazlat 'Isa	0.0087	80	100	120	0.696	0.870	1.044
An Nazla ash Sharqiya	0.0057	80	100	120	0.457	0.571	0.686
Baqa ash Sharqiya	0.0146	82	100	120	1.200	1.461	1.753
An Nazla al Wusta	0.0011	80	100	120	0.089	0.112	0.134
An Nazla al Gharbiya	0.0029	80	100	120	0.230	0.288	0.345
Zeita	0.0278	240	110	122	6.675	3.063	3.384
Seida	0.0066	80	100	120	0.531	0.664	0.797
Illar	0.0172	80	100	120	1.373	1.717	2.060

Attil	0.0417	94	104	120	3.929	4.338	5.006
Deir al Ghusun	0.0429	85	100	120	3.626	4.285	5.142
Al Jarushiya	0.0039	103	108	120	0.400	0.420	0.465
Al Masqufa	0.0004	80	100	120	0.033	0.041	0.049
Bal'a	0.0351	95	100	120	3.336	3.506	4.207
Iktaba	0.0173	100	105	120	1.734	1.823	2.074
Tulkarm	0.5585	121	128	141	67.822	71.282	78.739
Anabta	0.0520	118	124	137	6.159	6.473	7.150
Kafr al Labad	0.0151	80	100	120	1.205	1.507	1.808
Kafa	0.0007	80	100	120	0.059	0.074	0.089
Ramin	0.0059	80	100	120	0.476	0.595	0.714
Far'un	0.0137	80	100	120	1.098	1.373	1.647
Shufa	0.0225	196	100	120	4.396	2.247	2.696
Khirbet Jubara	0.0009	80	100	120	0.072	0.090	0.108
Saffarin	0.0023	80	100	120	0.187	0.233	0.280
Beit Lid	0.0136	80	100	120	1.086	1.357	1.628

Ar Ras	0.0028	80	100	120	0.227	0.284	0.341
Kafr Sur	0.0127	160	100	120	2.023	1.266	1.519
Kur	0.0008	80	100	120	0.064	0.080	0.096
Kafr Zibad	0.0061	104	110	121	0.638	0.671	0.741
Kafr Jammal	0.0094	80	100	120	0.755	0.944	1.133
Kafr 'Abbush	0.0062	87	100	120	0.540	0.621	0.745
					116	117	133

Chapter Three

Wastewater Collection and Treatment Scenarios and Alternatives

3.1 Introduction

Wastewater collection and treatment in Tulkarem Governorate is still underdeveloped. Most of the communities are still using cesspits to dispose of their wastewater. However, Tulkarem city and three other towns have partial collection systems. They also have some treatment facilities that treat part of the wastewater generated as detailed earlier in chapter 1. The current method of wastewater disposal is forming a real threat to the local water resources and the environment.

The fact that the soil and surface geological formations in the Governorate have favorable conditions for good infiltration, they also allow the infiltration of different pollutants from the areas served with collection systems and no treatment system as well as areas that use the cesspits which may increases the vulnerability of the aquifers.

Some indications of biological contamination started to appear in some groundwater wells especially those adjacent to the wastewater flow paths and disposal areas such as Annabta and Attil.

Population of the area and their representatives in the local councils and in the existing Joint Service Councils of the three clusters in the district are willing to cooperate and manage the waste water collection and treatment. The people in the study area are also willing to participate and pay their contribution in the construction of such projects. They believe the required fees for collection and treatment of the proposed project will cost less than the evacuation cost of their cesspits. There are negative effects from the existing situation of sanitation and there is a crucial need for suitable solutions to limit these adverse effects on the nature.

The current chapter will shed lights on the proposed scenarios and alternatives for wastewater management in general and on the collection and treatment alternatives in particular.

3.1 .1 Wastewater Collection System

The master plan will provide a general design for the main collection sewer lines, where capacity and flow direction of wastewater will be defined. In addition, potential sites for wastewater treatment plants will also be defined. The design criteria and assumptions considered can be summarized as follows:

- Tulkarem district was divided into three clusters according to topographical, financial, ability of the management and the opportunities of reuse reasons. They are Al-Kafriat Cluster, Al-Sharawyia Cluster and Wadi Zeimar Cluster.
- The water consumption including the industry was assumed to be 100L/C/d in 2015 and 120L/C/d in 2025
- 80% of the consumed water is considered as wastewater.
- All the produced wastewater from the collective system or from the individual system must be treated in the proposed treatment plants.
- The collective systems will cover the dense areas in each community without any pumping inside the community in 2015 and to cover the areas which need pumping in the year 2025.
- The existing individual system (cesspits) in the scattered areas will continue to exist in 2015, but in 2025 the houses not served by the collection system must be served by individual septic tanks.
- The diameter of any pipe in the main collection system which is working under gravity is not less than 8".
- It is assumed that the BOD load per each capita is 45g/c/d in the year 2015 and 55g/c/d in the year 2025.
- The proposed system for the small and far communities is to be the same as the existing system in the year 2015 and to have a collection system in the year 2025.
- The wastewater treatment effluent must fulfill the requirements of the Palestinian Water Authority standards.
- All the calculation started from the year 2015 and ended in 2025

According to these assumptions, the produced wastewater effluent was calculated as 80% of water use in the short, medium and long term developed under chapter 4. The produced municipal effluent at each cluster is summarized in Table 1.

Table (1): Expected wastewater quantities and qualities in the three clusters

Al-Kafriat Cluster

2015								2025						
village	Population	Water consumption	Waste Water production	Unit pollutant load	Pollutant load	Collective sanitation	Individual sanitation	population	Water consumption	Waste Water production	Unit pollutant load	Pollutant load	Collective sanitation	**Individual sanitation**
	Hab.	m^3/d	m^3/d	Kg BOD/c/d	Kg BOD/d			Hab.	m^3/d	m3/d	Kg BOD/c/d	Kg BOD/d		
Jubara	345	35	28	0.045	16	0	100	423	51	41	0.055	23	60	**40**
Ras	635	64	51	0.045	29	80	20	778	93	75	0.055	43	90	**10**
Kufur Sur	1314	131	105	0.045	59	80	20	1610	193	155	0.055	89	90	**10**
Kur	308	31	25	0.045	14	80	20	377	45	36	0.055	21	90	**10**
Kufur Zebad	1268	127	101	0.045	57	80	20	1553	186	149	0.055	85	90	**10**
Kufur	2851	285	228	0.045	128	80	20	3492	419	335	0.055	192	90	**10**

Jamal														
Kufur Aboush	1714	171	137	0.045	77	80	20	2100	252	202	0.055	115	90	**10**
Total	**8435**	**844**	**675**		**380**			**10333**	**1240**	**992**		**568**		

Al-Sharawyia Cluster

2015								**2025**						
village	Population	Water consumption	Waste Water production	Unit pollutant load	Pollutant load	Collective sanitation	Individual sanitation	population	Water consumption	Waste Water production	Unit pollutant load	Pollutant load	Collective sanitation	**Individual sanitation**
	Hab.	m^3/d	m^3/d	Kg BOD/c/d	Kg BOD/d			Hab.	m^3/d	m3/d	Kg BOD/c/d	Kg BOD/d		
Akkaba	299	30	24	0.045	13	0	100	366	44	35	0.055	20	60	**40**
Qaffin	9865	987	789	0.045	444	60	40	12084	1450	1160	0.055	665	90	**10**

Nazlt Isa	2745	275	220	0.045	124	80	20	3363	404	323	0.055	185	90	**10**
Al-Nazlha Sharqia	1781	178	142	0.045	80	0	100	2182	262	209	0.055	120	90	**10**
Baqa Sharqia	4824	482	386	0.045	217	80	20	5909	709	567	0.055	325	90	**10**
Al-Nazlha Wasta	400	40	32	0.045	18	0	100	490	59	47	0.055	27	80	**20**
Al-Nazlha Gharbia	1102	110	88	0.045	50	0	100	1350	162	130	0.055	74	80	**20**
Zeita	3355	336	268		151	80	20	4110	493	395		226	90	**10**
Seida	3445	345	276	0.045	155	80	20	4220	506	405	0.055	232	90	**10**
Illar	7281	728	582	0.045	328	80	20	8919	1070	856	0.055	491	90	**10**
Attil	10631	1063	850	0.045	478	80	20	13023	1563	1250	0.055	716	90	**10**
Deir Al-Ghsoun	9695	970	776	0.045	436	80	20	11876	1425	1140	0.055	653	90	**10**
Total	**55423**	**5542**	**4434**		**2494**			**67892**	**8147**	**6518**		**3734**		

Wadi Zeimar Cluster

2015								**2025**						
village	Population	Water	Waste Water	Unit pollutant	Pollutant load	Collective sanitation	Individual sanitation	population	Water consumpti	Waste Water	Unit pollutant load	Pollutant load	Collective sanitation	**Individual sanitation**
	Hab.	m^3/d	m^3/d	Kg BOD/c/d	Kg BOD/d			Hab.	m^3/d	m3/d	Kg BOD/c/d	Kg BOD/d		
Jarushia	1096	110	88	0.045	49	0	100	1343	161	129	0.055	74	80	**20**
Masqufa	306	31	24	0.045	14	0	100	375	45	36	0.055	21	60	**40**
Bala	7768	777	621	0.045	350	80	20	9516	1142	914	0.055	523	90	**10**
Iktaba	3135	314	251	0.045	141	80	20	3840	461	369	0.055	211	90	**10**
Tulkarem	80656	10485	8388	0.045	3630	80	20	98802	13832	11066	0.055	5434	90	**10**
Annabta	8621	862	690	0.045	388	80	20	10561	1267	1014	0.055	581	90	**10**
Kufur Labad	4792	479	383	0.045	216	80	20	5870	704	564	0.055	323	80	**20**
Kafa	475	48	38		21	0	100	582	70	56		32	90	**10**
Ramin	2124	212	170	0.045	96	80	20	2602	312	250	0.055	143	90	**10**

Faroun	3646	365	292	0.045	164	80	20	4466	536	429	0.055	246	90	**10**
Shoufa	2581	258	206	0.045	116	0	100	3162	379	304	0.055	174	80	**20**
Beit leed	5874	587	470	0.045	264	80	20	7196	863	691	0.055	396	90	**10**
Saffarin	894	89	72	0.045	40	0	100	1095	131	105	0.055	60	70	**30**
total	**121968**	**146 16**	**11693**		**5489**			**149409**	**19905**	**15924**		**8217**		

In addition to the municipal effluent, there is some industrial effluent from certain factories and industries contribute to the increase in the produced effluent quantity and quality. However, there is no exact information about the quantity and quality of the produced sewage from the existing factories. For the planning issues we can assume that the industrial load will amount 10% of the domestic wastewater load in 2015 and 15% in 2025 in Kafriat and Sharawyia clusters and in Wadi Zeimar 15%in 2015 and 20% in the year 2025.

There is some small kinds of industries in the district contribute to the increase in the biological load of the waste water. The existing small factories or workshops discharge their sewage directly to the nearby wadies or in the collection system if it exists near the factory. The most important industries which affect the quality of the sewage are listed below in Table2.

Table 2: Produced industrial wastewater effluent in the three clusters

cluster	**Kafriat**			
community	Kufur Jamaal	Kufur Zebad	0 Kufur Aboush	Kufur sur
Oil olive mill (No.)	2	2	1	1
Fruit juice factory (No.)	0	1	0	0

cluster	**Sharawyia**						
community	Deir Ghsoun	Attil	Illar	Seida	Baqa Sharqia	Qaffin	Zeita
Oil olive mill (No.)	4	2	2	3	3	3	2
Pickle factory (No.)	0	1	0	0	0	0	0

cluster	Wadi Zeimar									
community	Ramin	Beit Leed	Annabta	Bala	Kufur El Labad	Kafa	Faroun	Iktaba	Tulkarem	Shoufa
Oil olive mill (No.)	1	2	2	2	1	0	1	1	7	1
Leather tannery (No.)	0	0	1	0	0	0	0	0	1	0
Dairy industry (No.)	0	0	0	0	0	0	0	0	1	1
Tahina industry (No.)	0	0	1	0	0	0	0	0	1	0
Slaughter House (No.)	0	0	0	0	0	0	0	0	1	1

The factory of fruit juice in Kufur Zebad (Marawi) is producing 1500 m3 wastewater per month on average. The factory is pre-treating its sewage effluent through sedimentation and then discharge the sewage in the near wadi.

For the olive oil mills, the existing system is cesspits. The daily quantity of the produced sewage mainly called Zibar is large. The average quantity of the produced sewage (Zibar+ washing water) is nearly 30 m3/day. The average operating period of the olive oil mill is nearly 60 days in the years of dense production and 30 days in the years of low production. The cesspit need to be evacuated by tankers more than once per day. The tankers get rid of the evacuated sewage in the nearby wadies. Due to the heavy BOD-load of the wastewater (nearly 78kg BOD/1m^3 sewage) , the Zibar and washing water is usually abandoned from municipal wastewater treatment plants. Each olive oil mill should treat its sewage onsite before discharge the effluent to the collection system.

For the wastewater from the Tahina factory, the average quantity of the produced wastewater is nearly1.5 m^3/day and the specific BOD_5 concentration is nearly 7000mg/l. For the two leather tannery factories, the one in Annabta produce nearly 3 m^3/day wastewater and the second in Tulkarem produce nearly 10m3/day. For the chicken slaughter house in Shoufa it produces nearly 20m^3/d of wastewater with an average BOD_5 load of nearly 20000-30000mg/l. the slaughterhouse produce in average 10m^3/d of sewage with an average BOD_5 OF 30000 mg/l. For the two diary factories, the sewage production is nearly 4m^3/d with BOD_5 concentration of nearly 9000-10000mg/l.

Based on this information, the design load of BOD5 will be modified to reflect the industrial contribution to the quality load. The final BOD5 load for each cluster is summarized in the following table 3.

Table 3: Final BOD load

cluster	**Domestic BOD5 load kg/d**		**Industrial BOD5 load kg/d**		**Total BOD5 load kg/d**		**Equivalent population**	
	2015	2025	2015	2025	2015	2025	2015	2025
Kafriat	380	568	38	85	418	635	9289	11545
Sharawyia	2494	3734	249	373	2743	4107	60956	74672
Wadi Zeimar	5489	8217	823	1643	6312	9860	140267	179273

3.2 Proposed Sanitation Alternatives

3.2.1 Individual sanitation

As mentioned earlier the existing individual sanitation system (cesspits) in the small and far communities, scattered houses, and zones need pumping in the large communities will continue during the year 2015. Moreover, all remaining scattered houses that are not served by collection systems in all communities in the district in 2025 will be served by a new individual sanitation system (septic tanks).

The septic tank consists of two compartments that collect wastewater from one or several adjacent houses. The volume of the septic tank depends on the number of houses that will be connected to it, but in general for one house a septic tank of a volume of $30m^3$ is a suitable volume. The septic tank is evacuated by tanker truck service and transport the sewage to the treatment plant or to any adjacent manhole in the wastewater network in the village- far away from houses.

3.2.2 Collective sanitation

The proposed collective system consists of main wastewater collection network with individual house connections that collects wastewater and transfer it by main trunk line to the proposed wastewater treatment plant. The proposed networks will cover large percentage of the high density areas and part of the medium density areas and any houses in the way of the trunk line in each village.

3. 2.3 Combined Sanitation System

The combined system will be a mix of the two alternatives mentioned above. A collection system and treatment plant must be initiated in the areas of dense houses. The condition to be connected or not should be topographically possible, and individual scattered houses don't require long pipe distances. Based on this suggestion, three zones have been identified as follows:

1. C1: high density area urban center (only collective system).
2. C2: mid-density area, suburban (mixed between the two systems).
3. C3: low density area (individual system).

Moreover, to compare the proposed alternatives, a small focus group was organized and the criteria listed earlier were used to score the most preferable method from stakeholder perspective. The scores and alternatives is presented in Table4.

Table4: Sanitation Alternative Scoring

Criteria	**Coefficient out of 3**	**SC 1 centralized**		**SC 2 mixed**		**SC 3 decentralized**	
Running cost / investment cost	**3 / 1**	**4**	**12**	**3**	**9**	**3**	**9**
Technical feasibility	**3**	**4**	**12**	**3**	**9**	**3**	**9**
Modularity	**2**	**4**	**8**	**3**	**6**	**2**	**4**
Sustainability in time	**3**	**3**	**9**	**3**	**9**	**3**	**9**
Management structure	**2**	**2**	**4**	**3**	**6**	**3**	**6**
Public acceptance	**1**	**2**	**2**	**3**	**3**	**3**	**3**
Water reuse	**3**	**1**	**3**	**3**	**9**	**2**	**6**
Environmental interest	**2**	**1**	**4**	**4**	**8**	**4**	**8**
Permit availability	**3**	**1**	**4**	**4**	**12**	**4**	**12**
Land availability	**3**	**1**	**4**	**4**	**12**	**4**	**12**
			54		**83**		**78**

Based on the scoring results it sounds that the combined sanitation alternative is the best one that can address the sanitation issue in the Governorate.

Based on this classification, the proposed best alternative that can address the sanitation issue in each community is summarized in Table 5.

Table (5): Clustering of population and collection network zoning

Wadi Zeimar Cluster																	
	2015							2025									
village	Pop	C1		C2		C3		Pop	C1			C2			C3		
	Pop	Pop	%	Pop	%	Pop	%	Pop	Ext.	Pop	%	Ext.	Pop	%	Ext.	Pop	%
Jarushia	1096	0	0	548	50	548	50	1343	269	269	20	123	671	50	-145	403	30
Masqufa	306	0	0	153	50	153	50	375	75	75	20	34	187	50	-41	112	30
Bala	7768	4661	60	2330	30	777	10	9516	2000	6661	70	-427	1903	20	175	952	10
Iktaba	3135	1254	40	1254	40	627	20	3840	1050	2304	60	-102	1152	30	-243	384	10
Tulkarem	80656	48394	60	24197	30	8066	10	98802	20768	69162	70	-4436	19760	20	1815	9880	10
Annabta	8621	5173	60	1724	20	1724	10	10561	2220	7392	70	388	2112	20	-668	1056	10
Kufur Labad	4792	2875	60	958	20	958	10	5870	1234	4109	70	216	1174	20	-371	587	10
Kafa	475	0	0	238	50	238	50	582	116	116	20	53	291	50	-63	175	30
Ramin	2124	1274	60	637	30	212	10	2602	547	1821	70	-117	520	20	48	260	10
Faroun	3646	2188	60	1094	30	365	10	4466	939	3126	70	-201	893	20	82	447	10
Shoufa	2581	1549	60	774	30	258	10	3162	665	2213	70	-142	632	20	58	316	10
Beit leed	5874	3524	60	1762	30	587	10	7196	1512	5037	70	-323	1439	20	132	720	10

Saffarin	894	179	20	358	40	358	40	1095	259	438	40	-29	329	30	-29	329	30
Total	**121968**	**71070**		**36027**		**14871**		**149409**	**31654**	**102724**		**-4962**	**31065**		**749**	**15620**	

Al-Sharawyia Cluster

	2015							2025									
village	Pop	C1		C2		C3		Pop	C1			C2			C3		
	Pop	Pop	%	Pop	%	Pop	%	Pop	Ext.	Pop	%	Ext.	Pop	%	Ext.	Pop	%
Akkaba	299	0	0	179	60	120	40	366	73	73	20	4	183	50	-10	110	30
Qaffin	9865	5919	60	2960	30	987	10	12084	2540	8459	70	-543	2417	20	222	1208	10
Nazlt Isa	2745	2196	80	412	15	137	5	3363	662	2858	85	-75	336	10	31	168	5
Al-Nazlha Sharqia	1781	712	40	712	40	356	20	2182	378	1091	50	-58	655	30	80	436	20
Baqa Sharqia	4824	2894	60	1447	30	482	10	5909	1242	4137	70	-265	1182	20	109	591	10
Al-Nazlha Wasta	400	80	20	200	50	120	30	490	67	147	30	45	245	50	-22	98	20
Al-Nazlha Gharbia	1102	220	20	551	50	331	30	1350	185	405	30	124	675	50	-61	270	20
Zeita	3355	2013	60	1007	30	336	10	4110	864	2877	70	-185	822	20	75	411	10
Seida	3445	2067	60	1034	30	345	10	4220	887	2954	70	-189	844	20	78	422	10
Illar	7281	4369	60	2184	30	728	10	8919	1875	6243	70	-400	1784	20	164	892	10
Attil	10631	6379	60	3189	30	1063	10	13023	2737	9116	70	-585	2605	20	239	1302	10

Deir Al-Ghsoun	9695	5817	60	2909	30	970	10	11876	2496	8313	70	-533	2375	20	218	1188	10
Total	**55423**	**32666**		**16783**		**5973**		**67892**	**14007**	**46674**		**-2661**	**14122**		**1123**	**7097**	

Al-Kafriat Cluster

	2015							2025									
village	Pop	C1		C2		C3		Pop	C1			C2			C3		
	Pop	Pop	%	Pop	%	Pop	%	Pop	Ext.	Pop	%	Ext.	Pop	%	Ext.	Pop	%
Jubara	345	0	0	207	60	138	40	423	85	85	20	4	211	50	-11	127	30
Ras	635	254	40	254	40	127	20	778	135	389	50	-21	233	30	29	156	20
Kufur Sur	1314	788	60	394	30	131	10	1610	338	1127	70	-72	322	20	30	161	10
Kur	308	154	50	92	30	62	20	377	35	189	50	21	113	30	14	75	20
Kufur Zebad	1268	761	60	380	30	127	10	1553	326	1087	70	-70	311	20	29	155	10
Kufur Jamal	2851	1711	60	855	30	285	10	3492	734	2445	70	-157	698	20	64	349	10
Kufur Aboush	1714	1028	60	514	30	171	10	2100	441	1470	70	-94	420	20	39	210	10
Total	**8435**	**4696**		**2698**		**1041**		**10333**	**2094**	**6791**		**-389**	**2309**		**192**	**1233**	

3. 3 Detailed Analysis of the Proposed Sanitation Options:

3.3.1 Proposed Wadi Zeimar Cluster Sanitation System:

A detailed study on the sanitation options was carried out in the area over the past ten years and covered most of the communities in this cluster which includes Beit Leed, Ramin, Annabta, Bala, Kufur Labad, Iktaba, Tulkarem (Tulkarem city, Nur Shams Camp, Tulkarem Camp, Irtah, Shwieka and Thinaba). The other communities were not covered by this study and therefore were not included in the proposed wastewater regional project for the area. The feasibility study was completed for project and there is also a commitment of 15 million Euro from KFW to fund the first stage of the project. However, according to the manger of the project the allocated fund is not enough to complete the first stage, because the final estimated cost of this stage was 20 million Euro. The allocated fund is only enough to implement the first stage without the main trunk line from Beit Leed to the treatment plant near Tulkarem City. The estimated cost of that line is nearly 5 million Euro.

It is proposed that we adopt the proposed alternative under this study for the communities and suggest some modifications to include the other communities in the cluster that were not considered in the study.

A joint Service Council for the Wastewater Management in the Tulkarem Region was founded in the year 2000. From 2000 to 2005 JSC was more or less not functional. The work of JSC resumed in 2006 with the 8 members presented in the following table 6.

Table 6: Members of Tulkarem JSC

No.	Member	Member	Contribution and Voting (in %)
1	Tulkarem Municipality	Tulkarem Municipality	35.5
2	Annabta Municipality	Annabta Municipality	11.0
3	Iktaba Village Council	Iktaba Village Council	6.2
4	Tulkarem Camp Services	Tulkarem Camp	13.7

	Committee	Services Committee	
5	Nur Shams Camp Services Committee	Nur Shams Camp Services Committee	10.3
6	Bala Municipality	Bala Municipality	9.6
7	Kufur El-Labad Municipality	Kufur El-Labad Municipality	7.5
8	Ramin Village Council	Ramin Village Council	6.2

The chief of the administrative board of JSC is the mayor of Tulkarem Municipality. The deputy is the mayor of Annabta Municipality. The mayor of Kufur El Labad is a member of the financial committee. The other three mayors and the two heads of the Refugee Camp Service Committees are members of the administrative board.

The sewerage measures to be implemented in the long run include the following physical project components, which have to be implemented by the JSC and industrial polluters:

1. Construction of a wastewater treatment plant and laying of trunk mains to connect the service areas to the treatment plant;

2. Introduction of sewerage networks in the villages within the project area and construction of transport facilities to connect them to centralized installations;

3. Introduction of adequate septic sludge collection procedures;

4. Installation of pre-treatment units in industrial plants;

5. Introduction of an environmentally sound effluent and sewage sludge disposal concept.

The physical project components will be implemented in stages. The initial construction stage must be accompanied by:

1. Provision of training and assistance to the operating staff during the initial operation phase;

2. Advice and support as required to initiate the implementation of industrial pre-treatment facilities and to establish proper monitoring and control system;

3. Prepare a draft regulations and by-laws for the operation of the sewerage facilities and the protection of groundwater;

4. Advice and support to introduce an effective environmental monitoring and control system.

5.Initiation of a public awareness program with the help of KfW.

Under the prevailing frame conditions, the proposed planning and implementation horizons are as in the following table 7:

Table 7: Implementation stages of Tulkarem wastewater project

Stage	Planning Horizon	Implementation period
1st implementation stage	2020	2009-2011
2nd implementation stage	2032	2019-2020

According to the proposed concept, stage 1 will consist of the following measures:

1. Construction of a wastewater treatment plant with pre-treatment units consisting of the following devices:

• pumping station;

• screening plant;

• septic sludge receiving facilities;

• grit chamber

2. Introduction and Extension of the following sewerage network components:

• Extension of the sewerage networks of Tulkarem, Annabta and Shwieka;

• Introduction of sewerage networks in Bala, Kufur Al Labad, Kufur Ruman, Ramin and Beit Leed;

• Construction of a trunk main along the wadi.

At the second stage the following measures will be implemented

1. Extension of the wastewater treatment plant towards biological wastewater treatment, sludge treatment, nitrogen removal and effluent reuse

2. Extension of the sewerage networks in Bala, Kufur Al Labad, Kufur Ruman, Ramin and Beit Leed.

However, for the communities that were not considered in the project such as Faroun, Kafa, Masqufa and Jarushia villages, they are part of the outskirts of Tulkarem city and in the future they will be part of the villages that take services from the municipality. Therefore, we propos that to join the collected sewage from these communities to the regional wastewater of Tulkarem or to construct a treatment plant for Masqufa, Jarushia and the northern part of Shwekhi and another one for Faroun and Kafa.

For Saffarin and Shoufa villages, for Saffarin there are two alternatives, the first one to join to the regional wastewater of Tulkarem project in the future. It will pump its sewage to Beit Leed. The second alternative is to construct a decentralized treatment plant for Saffarin and the south western part of Beit leed. For Shoufa ,the suggestion is to construct onsite treatment plant for the village.

Tables (8) and (8)presents the proposed quantities which the feasibility study suggested for the internal collection systems, house connections, and the main collectors in the first phase

Table(8): length of the internal collection system in 2015

Community	Internal collection system length (m)	Diameter	No. of house connections
Beit Leed	6750	10"	600
Kufur Ruman	2600	8"	220
Ramin	6850	10"	350
Kufur Labad	11750	10"	800
Bala	7350	10	1000
	3600	16	
	745	10" pressure pipe	
Iktaba	2230	10"	300
	450	12"	
	1410	16"	

Shwieka	90	10"	20
	900	16"	
Annabta	6925	8"	220
Tulkarem	400	8"	20
Main collectors	2100	10"	For all the communities until reaching the treatment plant
	4650	12"	
	300	16"	
	2300	20"	
	7150	24"	
	7	32"	
	40	35	

3.3.2 Proposed Al-Kafriat Sanitation System:

In this cluster there are seven communities sharing in Joint Services Council for Planning and Development. These communities are Al-Ras, Jubara, Kufur Sur, Kufur Zebad, Kufur Aboush, Kufur Jamal and Kur. These communities are close to each other except Jubara which is far away and isolated behind the Israeli's isolation wall and any collected sewage in the village needs pumping.

There are two alternatives for the treatment. The first alternative is a centralized wastewater treatment system for this cluster in northwest of Kufur Jamal beside the existing Wadi.

The second alternative is a mixed between centralized and decentralized treatment. A centralized treatment plant for Kufur Jamal, Kufur Aboush and Kufur Zebad is proposed to take place in northwest of Kufur Jamal beside the existing Wadi. Three small decentralized treatment plants one for Kur, the second for Jubara and the third one for Al Ras and Kufur Sur is proposed to take place between the two villages.

The expected length of collection system in summarized in table 9 and 10.

Table(9): length of the internal collection system in 2015

Community	Internal collection system length and main collectors (m)	Diameter	Total No. of house connections
Kufur Sur	6500	8",10"	197
Kufur Aboush	9800	8",10"	249
Kufur Zebad	9800	8",10"	184
Kufur Jamaal	8200	8",10"	403

Table(10) : length of the internal collection system in 2025

Community	Internal collection system length and main collectors (m)	Diameter	Total No. of house connections
Al-Ras	3800	8"	117
Kufur Sur	500	8"	271
	700	HDPE 6" pressure pipe (if it will be connected to centralized treatment plant)	
Kufur Aboush	500	8"	343
Kufur Zebad	700	8"	254
Kufur Jamaal	1000	8"	555
	500	HDPE 6" pressure pipe	
Kur	3800	8"	66
Jubara	2000	8"	51
	2700	HDPE 6" pressure pipe (if it will be connected to centralized treatment plant)	

3.3.3 Proposed Al-Sharawyia Sanitation System:

This cluster consists of twelve communities. Four of these communities which are Akkaba, Al-Nazlha Sharqia, Al-Nazlha Wasta, and Al-Nazlha Gharbia will not have collection systems in the first stage (2015), but they will have it in 2025. The existing cesspits system will still serve these villages until 2015.

For Baqa Sharqia there is a fund from Japanese through UNDP to implement the collection system in the year 2010. Not yet implemented. The total length of the collection system is 15km of 8",10",and 12". It was proposed to treat the raw sewage in Baqa Al-Gharbia on the other side of the green line.

For Zeita it is proposed to make replacement of the 6" pipes with 8" pipes with a length of nearly 3000m and to enlarge and make some modification on the existing constructed wetland treatment plant.

The other remaining six communities, a collection system in each community will be constructed.

The following tables 11 and 12 summarize the proposed length and diameter for these communities.

Table(11): length of the internal collection systems in 2015

Community	Internal collection system length and main collectors (m)	Diameter	No. of house connections
Qaffin	15500	8",10"	1054
Nazlt Isa	7000	8",10"	389
Attil	23000	8",10",12"	1523
Illar	15500	8",10"	1011
Seida	8000	8"	503
Deir Al-Ghsoun	19000	8",10"	1397

Table(12): length of the internal collection systems in 2025

Community	Internal collection system length and main collectors (m)	Diameter	No. of house connections
Qaffin	18500	8",10"	1937
Nazlt Isa	8000	8",10"	537
Attil	25700	8",10"	2099
Illar	17500	8",10"	1393
Seida	9000	8"	693
Deir Al-Ghsoun	21500	8",10"	1926
Akkaba	2000	8"	33
Al-Nazlha Sharqyia	4000	8"	338
Al-Nazlha Wasta	2000	8"	80
Al-Nazlha Gharbia	3000	8"	169
Baqa Sharqia	17000	8",10",12"	930
Zeita	11000	8",10"	687

The proposed treatment alternatives for this cluster are similar to the two other clusters. The first alternative is a centralized wastewater treatment system for this cluster in the west of Attil beside the existing Wadi. While the second alternative is to construct five treatment plants as follows:

- A centralized treatment plant for Attil, Deir Al Ghsoun, Illar, and Seida in west of Attil beside the existing Wadi.
- The second one for Qaffin and Akkaba.
- The third one is for Al Nazlha Al Sharqyia and Al Nazlha Al Wasta.
- The fourth one is for Baqa, Nazlha Isa.
- The fifth one which is the existing one for Zeita.

3.4 Proposed materials for the network

There are many types of pipes could be used for sewage networks and collecting systems. The available types in the local market are UPVC (Unplasticised Polyvinyl Chloride), high density polyethylene and reinforced concrete for large diameter.

3.5 Proposed dimension of the sewage network

The design diameters of the pipes must cover the productions quantities of sewage during the design period (30 years).

The smallest diameter of the conveyance pipes will not be less than 200 mm. For the internal network and for the house connections, the diameter will not be less than 150 mm. The pipes lengths are calculated by measuring the lengths of the roads from the aerial maps of the villages in zones C1 and C2 without pumping in 2015 and with pumping in these zones in the year 2025.

The house connections in Al-Kafriat and Sharawyia clusters are not considered as part of the estimated cost of the project, but they are considered as community contribution in the project unlike Wadi Zeimar cluster where the houses connections are considered part of the estimated cost as mentioned in the feasibility study. Tables 13, 14 and 15 show the number of houses that will be served under the two sanitation alternatives in the three clusters.

Table (13): The number of houses and percentages proposed for either of the two systems in Al-Sharawyia cluster

community	population		No. of households		% of houses to be connected to collection system		No. of houses to be connected to collection system		No. of houses individual sanitation system	
	2015	2025	2015	2025	2015	2025	2015	2025	2015	2025
Akkaba	299	366	45	56	0	60	0	33	45	22
Qaffin	9865	12084	1757	2152	60	90	1054	1937	703	215
Nazlt Isa	2745	3363	487	596	80	90	389	537	97	60
Al-Nazlha Sharqia	1781	2182	307	376	0	90	0	338	307	38
Baqa Sharqia	4824	5909	843	1033	80	90	675	930	169	103
Al-Nazlha Wasta	400	490	82	100	0	80	0	80	82	20
Al-Nazlha Gharbia	1102	1350	173	211	0	80	0	169	173	42
Zeita	3355	4110	624	764	80	90	499	687	125	76
Seida	3445	4220	629	770	80	90	503	693	126	77
Illar	7281	8919	1264	1548	80	90	1011	1393	253	155
Attil	10631	13023	1904	2332	80	90	1523	2099	381	233

Deir Al-Ghsoun	**9695**	**11876**	**1747**	**2140**	**80**	**90**	**1397**	**1926**	**349**	**214**
total	**55423**	**67892**	**9860**	**12078**			**7051**	**10822**	**2809**	**1256**

Table (14): The number of houses and percentages proposed for either of the two systems in Wadi Zeimar cluster

community	**population**		**No. of households**		**% of houses to be connected to collection system**		**No. of houses to be connected to collection system**		**No. of houses individual sanitation system**	
	2015	**2025**	**2015**	**2025**	**2015**	**2025**	**2015**	**2025**	**2015**	**2025**
Jarushia	**1096**	**1343**	**202**	**248**	**0**	**80**	**0**	**198**	**202**	**50**
Masqufa	**306**	**375**	**52**	**64**	**0**	**60**	**0**	**38**	**52**	**26**
Bala	**7768**	**9516**	**1330**	**1630**	**80**	**90**	**1064**	**1467**	**266**	**163**
Iktaba	**3135**	**3840**	**513**	**628**	**80**	**90**	**410**	**565**	**103**	**63**
Tulkarem	**80656**	**98802**	**14936**	**18296**	**80**	**90**	**11949**	**16467**	**2987**	**1830**
Annabta	**8621**	**10561**	**1594**	**1952**	**80**	**90**	**1275**	**1757**	**319**	**195**
Kufur Labad	**4792**	**5870**	**767**	**939**	**80**	**80**	**614**	**752**	**153**	**188**
Kafa	**475**	**582**	**83**	**102**	**0**	**90**	**0**	**92**	**83**	**10**
Ramin	**2124**	**2602**	**391**	**479**	**80**	**90**	**313**	**431**	**78**	**48**
Faroun	**3646**	**4466**	**651**	**797**	**80**	**90**	**521**	**717**	**130**	**80**
Shoufa	**2581**	**3162**	**469**	**575**	**0**	**80**	**0**	**460**	**469**	**115**
Beit leed	**5874**	**7196**	**1046**	**1281**	**80**	**90**	**837**	**1153**	**209**	**128**

Saffarin	**894**	**1095**	**163**	**199**	**0**	**70**	**0**	**139**	**163**	**60**
total	**121968**	**149409**	**22196**	**27190**			**16981**	**24236**	**5215**	**2954**

Table (15): the number of houses and percentages proposed for either of the two systems in Al-Kafryiat cluster

community	**population**		**No. of households**		**% of houses to be connected to collection system**		**No. of houses to be connected to collection system**		**No. of houses individual sanitation system**	
	2015	**2025**	**2015**	**2025**	**2015**	**2025**	**2015**	**2025**	**2015**	**2025**
Jubara	**345**	**423**	**70**	**86**	**0**	**60**	**0**	**51**	**70**	**34**
Ras	**635**	**778**	**106**	**130**	**80**	**90**	**85**	**117**	**21**	**13**
Kufur Sur	**1314**	**1610**	**246**	**301**	**80**	**90**	**197**	**271**	**49**	**30**
Kur	**308**	**377**	**60**	**73**	**80**	**90**	**48**	**66**	**12**	**7**
Kufur Zebad	**1268**	**1553**	**230**	**282**	**80**	**90**	**184**	**254**	**46**	**28**
Kufur Jamal	**2851**	**3492**	**504**	**617**	**80**	**90**	**403**	**555**	**101**	**62**
Kufur Aboush	**1714**	**2100**	**311**	**381**	**80**	**90**	**249**	**343**	**62**	**38**
total	**8435**	**10333**	**1527**	**1870**			**1165**	**1657**	**361**	**213**

3.6. Collection system components

3.6.1 Collectors

The pipes lengths are calculated by measuring the length of the roads from the aerial maps of the villages in zones C1 and C2 cluster without pumping in 2015 and with pumping areas in 2025.

3.6.2 Manholes

Manholes are used as means of access for inspection and cleaning. They are placed at intervals of 40-50ms and at points where any these conditions are existing:

- There is a change in pipe's direction;
- A change in the pipe's size;
- A considerable change in grade and drop of levels.

In average we consider the interval between two manholes is 30m.

3. 6.3 Location of proposed wastewater treatment plants:

Al- Kafriyat Cluster

Scenario 1:

For the first scenario, the centralized proposed location of the WWTP for Al-Kafriat Cluster will be north west of Kufur Jamal village near the wadi. The WWTP will treat the collected and evacuated cesspits sewage from the communities in the Cluster The Justifications behind choosing the southern site of the treatment plant are:

1. Potential of reuse, the area are characterized as an agricultural area and also the area is suffering from shortage of water for irrigation.
2. The residential areas are too far from the location of the treatment plant in case of odor pollution or failure of treatment plant.
3. The nearest cluster of groundwater wells in the area are agricultural wells, while the effluents design criteria of the treatment plant is fit with the guidelines with the agricultural use.
4. Access to treatment plant is easy for operation, maintenance and emergency.
5. Access to electricity power is easy

6. The location of the treatment plant don`t require further pumping to the natural stream, which passes adjacent to the plant.
7. The land is available for future expansion.

Scenario 2:

For the second scenario the centralized treatment plants is proposed as follows:

- For the three villages(Kufur Jamal, Kufur Aboush, and Kufur Zebad) will be in the same area as proposed for the centralized treatment plant for all the cluster.
- The proposed location of Kur decentralized treatment plant will be in the south west of the village.
- For Jubara the location will be in the north of the village.
- For Kufur Sur and Al Ras the location will be in the area between the two villages.

Al Sharawiyeh Cluster

Scenario 1:

For the first scenario In Sharawyia Cluster, it was proposed to:

- enlarge and make some modification on the existing constructed wetland treatment plant in Zeita village.
- Construct a new centralized WWTP in west of Attil town to treat the collected and evacuated cesspits sewage from the communities in the Cluster.

The proposed WWTP is located on the west of the existing ground water wells in the area. The direction of the flow of the ground water in the area is from east to west. The area around the proposed WWTP has a potential for reuse of treated wastewater. The drainage of the sewage in the area flow towards the west mostly by gravity.

Scenario 2

For the second scenario, the proposed location will be as follows:

- For four villages of Attil, Deir Al Ghsoun, Illar, and Seida the plant is the same as proposed under scenario 1.
- For Qaffin and Akkaba, the proposed location will be in the west north of Qaffin.
- For Al Nazlha Sharqia and Al Nazlha Al Wasta the proposed location will be near the wadi in the north west of Al Nazlha Wasta.
- For Baqa, Al Nazlha Al Gharbia and Nazlt Isa the proposed location in the south west of Baqa.

Wadi Zeimar Cluster

Scenario 1:

This scenario considers the same plant proposed by the Municipality of Tulkarem. The new Tulkarem WWTP has been approved by Israel on 10th July 2005 for construction. The approval has been given on condition that the design of the WWTP will be in accordance with the design criteria mentioned in the MoU signed by the Joint Water Committee on 21st December 2003. The proposed WWTP will be in an area east of the green line and south of Wadi Zeimar. This site (called 4/S) with an area of about 80 dunums (8 ha).

Scenario 2

The second scenario for wadi Zeimar proposes the following:

- A treatment plant in the area for the communities of: part of Beit Leed, Ramin, Annabta, Kufur Labad, Bala, Iktaba, Nur Shams Camp, Tulkarem Camp, Iktaba and Tulkarem city.
- For Faroun and Kafa, the proposed location for the treatment plant in the north of Faroun.
- For Saffarin and the south western part of Beit Leed a treatment plant in the north western of Saffarin.
- For Masqufa, Jarushia, and the northern part of Shwiekha a treatment plant is suggested in the south western of Al Jarushia.

3.7 Requirements for wastewater treatment system and for sludge treatment in West Bank.

After defining the proposed location sites for the WWTPs, it is required to define the

Parameters which will be used to choose the treatment system during the feasibility study.

- Guidelines and quality legal requirements
- Technical parameters
- Effluent quality requirements for reuse
- Operation and maintenance requirements
- Investment cost

3.8 Treatment requirements and treated wastewater quality

According to the Memorandum of Understanding (MoU) on Guidelines and Technical Criteria for Sewage projects, which was signed between the Israeli- Palestinian Joint Water Committee; following are specific requirements for the selection and design of the type of the treatment process:

- The main effluent disposal solution characteristics (for the West Bank wastewater treatment plants) must be suitable for reuse in irrigation of agricultural crops.
- All wastewater treatment plants shall be designed and operated in modular design, to allow for future adjustment and expansion. The first phase shall provide treatment to a minimum of a secondary level. In the second phase, wastewater treatment plants are to be upgraded to achieve tertiary level of treatment.
- Effluent quality should not exceed, in the first phase the following values:
    1. BOD_{max}=20 mg/L, TSS_{max}=30mg/L, TN_{max}=25mg/L, in the second phase, the effluent produced should not exceed the values listed in schedule 2.
    2. The quality of the effluent shall be in accordance with its designated end-use, as detailed in **Tables (16) and** (17**)**

Table (16): Effluent Disposal Options

End use	Quality	Treatment type	Suitable crops
Irrigation in areas of high hydrological sensitivity	**1**	**Secondary treatment by activated sludge and tertiary treatment including nutrient treatment, additional filtration and disinfection.**	**Unrestricted crops including public parks, gardens and sports grounds.**
Irrigation in areas of medium/low hydrological sensitivity	**2**	**Secondary treatment by activated sludge and disinfection, or equivalent**	**Olives, peanuts, citrus, fruit, vegetables for cooking, fruit for canning and trees**
Irrigation of inedible crops	**3**	**Anaerobic ponds, oxidation ponds or aerated lagoons.**	**Cotton, sugar beets, cereals, green and dry fodder, seeds**
Discharge into Wadies/streams/rivers(incl. all their tributaries)	**4**	**Secondary treatment by activated sludge and tertiary treatment including nutrient treatment, additional filtration and disinfection.**	**Unrestricted crops, including public parks, gardens and sports grounds**

Table (17): Effluent Quality Criteria

	1, 4		**2, 3**	
Pollutant	**Average**	**Maximum**	**Average**	**Maximum**
BOD5(mg/L)	**10**	**15**	**20**	**40**
TSS(mg/L)	**10**	**15**	**30**	**60**
COD(mg/L)	**70**	**100**	**100**	**150**
EC(ds/m)	**1.4(1)**		**1.4**	
PH	**6.5-8.5**	**7.0-8.5(4)**	**6.5- 8.5**	
Chloride (CL)(mg/l)	**250(1), 400(4)**		**250**	
Boron (B) (mg/l)	**0.4(1)**		**0.4**	
Sodium (Na) mg/l	**150(1), 200(4)**		**150**	
SAR	**5(1)**		**5**	
Fecal Coliform (MPN/100ml)	**10(1), 200(4)**	**10(1), 100(3)**	**10**	
Total Nitrogen	**10(4), 25(1)**	**15(4), 40(1)**	**25**	**40**
Silver (Ag) mg/l	**0.05**		**0.05**	
Arsenic (As) mg/l	**0.1**		**0.1**	
Cadmium (Cd) mg/l	**0.01(1), <0.005(4)**		**0.01**	
Chromium (Cr) mg/l	**0.1(1), 0.5(4)**		**0.1**	
Cobalt (Co) mg/l	**0.05(1)**		**0.05**	

3.9 Requirements for Sludge Treatment

The MoU also sets minimum requirements concerning the sludge treatment, as follows:

The treated sludge should contain less than 2 million MPN(Most Probable Number) or CFU(Colony-Forming- Units) of bacteria per gram of total solids, as calculated by geometric mean of density of Fecal Coliform in the sludge samples (minimum of 7 individual grab samples). Sludge should be stabilized according to one of the following methods or by any equivalent method, according to advanced western standards, such as: composting thermophilic aerobic digestion, thermophilic anaerobic digestion, heat treatment and heat drying.

(1) **Anaerobic digestion**: if stabilized by anaerobic digestion (at temperature 33-38 degree), the mean cell residence time should not exceed 15 days and the mass of volatile solids in the sludge should be reduced to a minimum of 38%.
(2) **Aerobic digestion**, if stabilized by aerobic digestion, the mass of volatile solids in the sludge should be reduced to a minimum of 385 or alternatively, SOUR (Specific Oxygen Uptake Rate) for treated sludge should be less than 2mg O2/hour/gram VS (Volatile Solids) of sludge at 20 degree.
(3) **Stabilization** by alkali addition of sufficient alkali is required to raise PH to a minimum of 12 and maintain a PH>12 for 2 hours and a PH>11.5 for additional 22 hours."

3.10 Possible Treatment Technologies

The required effluent disposal standards during the first phase are 20mg/l for BOD, 30mg/l for TSS and 25mg/l for total nitrogen. It is proposed to reuse the effluent for irrigation, since most of the surrounded area is used for agriculture. A reduction in fecal Coliform to < 200 fecal/100ml is required. The treatment process therefore needs to be relatively performing on a large range of parameters.

Moreover, the range of possible secondary treatment processes that can produce the required high quality effluent is very wide. It extends from the large area, long detention, aerated ponds method, at one extreme to the compact, short detention, highly mechanized methods, such as the activated sludge family, at the other extremes.

The possible treatment process technologies that could be expected to meet the requirements can be summarized hereunder. The advantages and disadvantages of the possible processes are also compared and discussed.

3.11 Waste Stabilization ponds

Wastewater treatment ponds are a natural biological process which is non-mechanized. Ponds are relatively cheap and easy to construct but they required a large areas. Aerobic stabilization lagoons are large, earthen basins of wastewater where the treatment is provided by natural processes involving the use of both algae and bacteria. Natural aeration processes are used to supply some or all of the oxygen needed by the bacteria to metabolize organic matter and reduce the BOD. Stabilization lagoons have become very popular in small communities, because they are simple and economical to operate, requiring minimal operation and maintenance, namely one sludge removal of the primary lagoon once every two to three years and one sludge removal of the secondary lagoon once every five years. Aerobic lagoons are designed with a maximum depth of 1.5 m. A large surface area is then required to maximize the natural aeration capacity of the system. The rate of surface area may range from 6 to 10 m^2/inhabitants depending on the variation of water temperature. This area requirement includes only the lagoons themselves, with no allowance for access roads or other facilities. With a maximum depth of 1.5 m, the retention time is about 60 days, which is the minimum required to achieve a significant reduction in Coliform counts (reduction of about 104). The process would be expected to meet the discharge requirements regarding Coliform and, with addition of tertiary sand filters, the requirements for SS and BOD. The standards for nitrogen would probably not be met. However, the most significant disadvantage is the large size of the plants, and the availability of site therefore has to be carefully evaluated.

3.11.1 Extended Aeration Process

In this method, detention times in the aeration tank are much longer (20-40 hrs. as against 4-8 hrs. in activated sludge). As a result its aeration basins are larger and require more area, but it can handle raw sewage without prior treatment, it produces smaller quantities of waste sludge which need further treatment and disposal and its effluent is of a high quality. In extended aeration process no primary treatment is given to the sewage, because the extended aeration is provided for the purpose of aerobically digesting and destroying the majority of the biological sludge produced. In Palestine, it is currently in operation in Al-Beirha WWTP.

Advantages

1) No primary sedimentation tank is required.
2) No fly or odor nuisance.
3) More stable than other process.
4) No need for sludge digestion because of the high degree of stabilization of surplus sludge.
5) Less sensitive to shock loads relative to activated sludge process.

Disadvantages

1) Large power requirements
2) Large aeration tank relative to the conventional activated sludge process.

3.11.2 Trickling filters

In this process filter media is place in a bed 2-3 ms deep. The settled sewage is distributed over the surface of the filter media by revolving distributors. A microbiological film grows on the filter media and oxidizes the organic matter.

The advantages and disadvantages of trickling filters

Advantages

1) Power requirements are small compared with activated sludge processes.
2) Little skill required for operation.

Disadvantages

1) High construction cost
2) Fly and odor nuisance
3) It is not much resistant against shock loads

The trickling filters are particularly adapted where the incoming wastewater is concentrated and where the discharge requirements are not to strict. But for our case, several additional steps of treatment would be required to treat nitrogen, to further reduce BOD and SS and to reduce the Coliform count. The trickling filter process is therefore not recommended for the treatment plants in this project.

3.11.3 Activated Sludge

The activated-sludge process is one of the most common treatment processes and is currently in operation in the Gaza Strip. The process can be designed in many modified forms, including: selection of the reactor type, oxygen requirements and transfer, types of settling tanks, but fundamentally theoretical aspects of the process are similar:

Wastewater is introduced into a reactor (aeration basin) where an aerobic bacterial culture is maintained in suspension. The reactor contents are referred to as the “mixed liquor”. In the reactor, the bacterial culture carries out the conversion of the organic matter into biological solids (biological cells).

The aerobic environment in the reactor is achieved by the use of diffused or mechanical aeration, which also serves to maintain the mixed liquor in a completely mixed regime.

After a specific period of time, the mixture of biological solids is passed into a settling tank, where some of the settled sludge is recycled to maintain the desired concentration of organisms in the reactor and the remainder is removed from the system.

The level at which the biological mass in the reactor should be kept (mean cell - residence time) depends on the desired treatment efficiency and other considerations like: nature of the wastewater, local environmental conditions, etc.

Different parameters can be used for the design of the activated-sludge process:

The food to micro-organism ratio or mass loading defined as the mass of BOD applied per day to the treatment system divided by the mass of mixed liquor suspended solids (MLSS) in the aeration tank.

The mean cell-residence time or sludge age that is the ratio of the mass of MSS in the aeration tank to the mass of sludge removed per day from the system.

The volume loading defined as the mass of BOD applied per day to the treatment system divided by the aeration tank volume.

The activated sludge process was initially designed for removal of dissolved organic pollution (expressed as BOD, COD and SS), where removal rates up to 90%-95% can be expected depending on the design parameters. In the later years, the removal of nitrogen by biological nitrification and denitrification has been largely developed, requiring an increase of the sludge age in the tank and specific mixing, aeration and recycling arrangements. It has also been shown that biological phosphorus reduction can be achieved if an anaerobic tank is added at the inlet of the biological reactor and this development is now gaining more and more interest.

Aeration equipment for injecting oxygen into the MLSS can consist of mechanical aerators or diffused air systems that blow air into the MLSS.

Final settling tanks are used to separate the biological solids produced in activated sludge from the treated wastewater. Settling tanks are mainly designed on the basis of an overflow rate. Overflow rates may range from 0.5 to 0.7 m/h at peak flows.

It should be pointed out that an activated-sludge process does not provide any significant reduction in coliform counts (only a factor 10 to 100). Where coliform reduction is required, as the case is here, a tertiary treatment should be added to the treatment train, most often consisting in sand filtration and disinfection by chlorine or UV radiation.

Provided with tertiary disinfection, the activated sludge process would meet the set performance requirements in this specific case.

3. 11.4 Membrane Bio Reactors

The membrane bioreactor technology combines a biological treatment of pollutants (BOD, N, P) with a membrane separation of the biomass and the treated water. The biological treatment used in an activated sludge process with high sludge concentration. The solid-liquid separation is carried out by microfiltration membranes, which most often are submerged directly in the aeration tank. The membranes may be flat sheet membranes, hollow fiber membranes or tubular membranes. The microfiltration membranes have a pore size in the range of 0.1 to o.4 microns, which retains suspended solids, bacteria and macro-viruses but not the micro-viruses.

Advantages

1) There is no need for sedimentation tanks
2) The biological reactor is smaller than the reactor in the activated sludge because of the higher MLVSS concentrations.
3) The process is well adapted for median sites (between 10000 and 80 000 habitants)
4) The quantity of the produced sludge is smaller by 40% than an activated sludge process.
5) Wastewater treated with membrane technology has very high quality and the process is therefore used where the requirements on the level of treatment are particularly high as in the case of irrigation reuse or aquifer recharge.
6) Land area requirement will be significantly lower as for the other process
7) The equipment (membranes, aerators, electric equipment..;) who represent 50 % of the cost of a WWTP should be gradually done according to the increase in the quantities of waste water.

Disadvantages

1) The capital cost of the membrane bioreactor plant is slightly higher than a conventional activated sludge plant but should be the same if we add a tertiary treatment.
2) Membranes must be replaced every 5-10 years of operation.

3.12 Comparison of Processes and Discussion

The advantages and disadvantages of the suitable treatment processes are listed **Table (18),** and allowing a comparison between them. A number of the described processes have been eliminated already at this stage since they cannot meet the requirements and only the remaining processes are compared.

Table (18): The advantages and disadvantages of the suitable treatment processes

Process	Advantages	Disadvantages
Membrane bioreactors	• **Very high treatment performances, also on fecal Coliform.** • **No chlorination or UV disinfection required.** • **Low sludge production.** • **Compact process, easy to cover.** • **Modular construction and easy automation.**	• **Some uncertainty regarding the membrane life length and related replacement cost.** • **Investment costs are the same as the extended aeration process** • **Complex process operation.**
Stabilization ponds	• **Uncomplicated, reliable and stable process.** • **Good bacteria removal, no further disinfection required.** • **Low sludge production.** • **Low investment and operating costs.**	• **Large space required.** • **Cost of the land required** • **Risk of flies and mosquitoes.** • **Low removal rate of phosphorus and nitrogen** • **Risk of algae growth** • **Large loss of water (evaporation, infiltration..)**
Activated sludge	• **Proven and reliable process.** • **Stable performances at variations in hydraulic load.** • **Moderate cost for the base process.** .	• **Additional tertiary treatment required to meet treatment requirements.** • **High sludge production.** • **Relatively high land requirements.** • **Large basins, difficult to cover.** • **Long start-up of the biological process, cannot treat peak loads.**
Extended aeration process	• **No primary sedimentation tank is required.** • **No fly or odor nuisance.** • **More stable than other process.** • **No need for sludge digestion because of the high degree of stabilization of surplus sludge.** • **Less sensitive to shock loads relative to activated sludge process.**	• **Large power requirements** • **Large aeration tank relative to the conventional activated sludge process.** • **Final disinfection process required**

Only the membrane bioreactor, activated sludge process and extended aeration process with the complement of a disinfection process can provide the treatment level to the required discharge for wastewater reuse as mentioned in the MoU of the Israeli- Palestinian Joint Water Committee.

Stabilization pond could be used but only with the process with reed.

The feasibility study should define the system after a technical and economical study depending of the evolution of the cost of those different systems.

3.13 Sludge Treatment

Due to the low rate of industrial wastewater of the total, the produced sludge should be of such quality that it meets the requirements and can be reused in agriculture without problems. It is therefore anticipated for the purpose of this study that the sludge from the treatment plants of this project will be used as soil amendment in the agriculture. The process selection for the sludge treatment will be based on this assumption.

Three different steps in the sludge treatment can normally be distinguished:

thickening, stabilisation and dewatering. Sometime, thickening and dewatering can be combined or stabilisation be omitted. An additional drying stage could also sometimes be required.

3.13.1 Sludge Thickening

The excess sludge which is withdrawn from the secondary clarifier has dry solids sludge, thus very liquid, "dirty water". The purpose of sludge thickening is to concentrate the solids to a solid’s content of around 30 g/l or 3%. After thickening the sludge remains as liquid, but with the volume reduced to around ¼ of the initial volume. Sludge thickening is generally carried out either by gravity thickeners, air flotation or drainage screens.

Gravity thickener is the most common type of sludge thickening device. It gives excellent results on primary sludge and acceptable results on digested secondary sludge. The principle and the operation are simple and robust. Gravity thickeners cannot be used if biological phosphorus removal is used, since anaerobic conditions will appear in the thickener with subsequent phosphorus release as result.

Dissolved air flotation is used when the sludge is light and difficult to settle, typically for unstabilised activated sludge or sludge from biofilters. It is also a preferred option when biological phosphorus removal is used. The process is although more complicated to operate and more costly in operation and maintenance.

Drainage screens are mainly used in small treatment facilities and can be an interesting and space saving.

3.13.2 Sludge Stabilization

The purpose of the sludge stabilization is to reduce the content of organic matter in the sludge and thereby reduce the potential for further fermentation or putrefaction and, in the same time, eliminate offensive odors. The stabilization will also reduce pathogens in the sludge to some extent. The processes used are:

- Anaerobic digestion.
- Aerobic digestion.
- Lime stabilization.
- Thermal treatment.

Anaerobic digestion by methane fermentation is a powerful mean of removing substantial quantities of organic matter. The process most generally used is mesophilic digestion at 35°C. For normal wastewater treatment sludge, a reduction of 45 to 50% of the organic matter content can be expected. The digestion is producing biogas, mainly consisting in methane and carbon dioxide. A part of the produced biogas is used for the heating of the digester and the surplus can be used for heating other facilities or for producing electricity for the aerators of the plant.

Aerobic stabilization is usually employed in open-air units provided with air diffusers or surface aerators. The aerobic stabilization is rather energy consuming and is therefore rarely used as a specific unit. However, in an extended aeration activated sludge process, sludge is partly aerobically stabilized within the treatment process.

The fermenting capacity of sludge can be temporarily reduced by adding chemical agents in bacteriostatic dosages. **Lime** is the most widely used reagent because it is cheap, offers the right sludge. Lime can be added to the liquid sludge or to the dewatered sludge. The advantage of lime treatment is the absence of heavy investments in civil works and equipment, but this saving should be seen in the light of the relatively high operating

Thermal treatment is principally used for conditioning of the sludge by release of bound water in the cells and for deactivation of pathogenic agents. As a matter of fact, in many cases it is a combination of these processes that are used. In an extended aeration process, sludge is first partly stabilised in the aeration tank, thus aerobic digestion, before undergoing anaerobic digestion. The digested sludge is then often treated with lime in order to improve the physical properties and to ensure that the sludge could be stored for long time without any renewed fermentation. Sludge in stabilization ponds undergoes anaerobic stabilization in the ponds and will not need any further stabilization after having been removed.

3.13.3 Sludge Dewatering

The purpose of the dewatering process is to further reduce the moisture content in the sludge, thereby also reducing the volume. Typically, dewatered sludge has dry matter content between 20% and 40% depending on the process, which means a tenfold reduction of the volume. The degree of dewatering depends on the type of equipment being used and it should be selected depending on the final destination of the sludge. Where sludge should be transported over long distances, additional drying up to 60% or even 90% DS could be considered in order to reduce the transportation costs. Some kind of chemical conditioning is most often required to improve the dewatering characteristics of the sludge. Various types of chemicals are used: metal salts such as ferric chloride and aluminum sulphate, polymers (very commonly used) and lime. The most commonly used dewatering devices and their performances are given in the following **Table (19)**

Dewatering of sludge on **drying beds** is a very inexpensive solution, but is limited by the large surface areas required. About 0.25 m² of land per person equivalent is required, which would double the required surface for an activated sludge plant. In the case of a stabilization pond plant, where the sludge quantities are smaller and the sludge contains less organic matter, the drying beds can be an interesting option.

Table (19): The most commonly used dewatering devices and their performances

Device	Performance for stabilised biological sludge	Energy consumption
Centrifuge	**20% - 30%**	**55-70 kWh/ton dry matter**
Belt filter	**18% - 26%**	**40 kWh/ton dry matter**
Plate filter press	**30% - 40%**	**30-40 kWh/ton dry matter**

3.14 Land Requirement

The outline design of sewage treatment plants undertaken at this stage is in particular for the purpose to verify that the surface areas required are available. Therefore, the assumptions presented in table 20 have been used for the assessment of the areas and the area needed per treatment type for each cluster is presented in Table 20.

Table 20: Land Requirement for the plant

Process	Land requirement
Membrane bioreactor	**0.15 m²/population equivalent**
Stabilization ponds with reeds	**6 m²/population equivalent**
Stabilization pond	**10 m2/population equivalent**
Activated Sludge process	**0.3 m²/population equivalent**
Extended aeration process	**0.4 m²/population equivalent**

Table (21): required area per each type of treatment per each cluster

Type of treatment	Al-Kafriat Cluster			Sharawyia Cluster			Wadi Zeimar Cluster		
	Equivalent population	(m2/p)	surface (ha)	Equivalent population	(m2/p)	surface (ha)	Equivalent population	(m2/p)	surface (ha)
Membrane bioreactor	11545	0,15	0.17	74672	0,15	1.12	179273	0,15	2.69
Stabilisation pond	11545	10	11.55	74672	10	74.67	179273	10	179.27
Stabilisation pond with Reed	11545	6	6.93	74672	6	44.80	179273	6	107.56
Activated Sludge	11545	0,3	0.35	74672	0,3	2.24	179273	0,3	5.38
Extended aeration	11545	0.4	0.46	74672	0.4	2.99	179273	0.4	7.17

3.15 Re-Use Opportunities

If properly treated, through WWTP, wastewater could be used as an additional water resource for specific applications such as irrigation purpose. If we consider the whole produced waste water is treated, an additional water resource could be found.

Considering scarcity problems of water in the future especially for irrigation, reuse opportunity is a key point to sanitation solution choice. Table 22 summarizes the quantities of potential sewage that can be treated.

Table 22: Quantities of treated effluent

cluster	Treated quantity of sewage Mm3/year (2015)	Treated quantity of sewage Mm3/year (2025)
Al-Kafriat	**0.25**	**0.36**
Sharawyia	**1.62**	**2.38**
Wadi Zeimar	**4.27**	**5.81**

3.16 Actual Agricultural Land Use

Tulkarem district has an area of 253 km2 of which about 210 km2 (83%) are suitable for agricultural purposes. However, the actually cultivated land in the year 2005 was 156 km2, which is 62% of the total area and 74% of the land suitable for agricultural purposes.

On most of the arable land fruit trees are planted, mainly rain-fed olive trees, but also irrigated citrus trees. Vegetables are planted on open areas and in greenhouses. There are about 8,000 permanent and temporary greenhouses in the Tulkarem district. Cucumber is the most commonly cultivated type of greenhouse vegetable with a total cultivated area estimated at 1,500 dunums. The average output is 6-8 tons of cucumber per dunum. Tomatoes, Jew’s mallow and peppers are also cultivated and grown in greenhouses.

Broad bean, chick peas and cucumber are amongst the most common rain-fed vegetables in the district. Wheat and barley represent the main types of rain-fed grains, with the total area cultivated reaching 6,894 and 1,339 dunums, respectively. Citrus trees (most commonly orange and Clementine) represent the most common type of irrigated trees, with the total area cultivated reaching 3,700 dunums. Olive trees dominate the rain-fed trees, covering over 114,785 dunums of land (Tulkarem Department of Agriculture, 2003/2004). Table 23 shows the irrigated agricultural areas the crop type in the governorate.

Table (23): Agricultural area and products in the Tulkarem district

Product	Area [donum]	Area [percentage]	Yield [Mg]
Fruit trees	**134,264**	**85.9**	**39,542**
Olive trees	**114,785**		
Citrus tree	**3,700**		
Other fruit trees	**15,779**		
Vegetables	**10,302**	**6.6**	**53,519**
Cucumber	**1,500**		
Field Crops	**11,727**	**7.5**	**6,170**
Wheat	**6,894**		
Barley	**1,339**		

Source: The economics of Agriculture in the Tulkarem and Qalqilya Districts: Improving the Profitability of Farmers

Affected by the Separation Wall; Palestine Economic Policy Research Institute; 2005

Most of the agricultural land lies in the northern part of Tulkarem district. The area of fertile land used for agriculture within the boundaries of Tulkarem municipality is shrinking yearly due to the vivid construction activities. Hence, for the reuse of treated wastewater in agriculture, the areas located north of Tulkarem municipality (Attil, Zeita) and in the south (Faroun) should be taken in consideration. The eastern part of Tulkarem district is mountainous and the transfer of treated wastewater is not economically feasible.

3.17 Sludge Reuse and Sludge Quality

Wastewater treatment processes produce a sludge which has to be disposed of conventional secondary sewage treatment plants. Typically they generate a primary sludge in the primary sedimentation stage of treatment and a secondary, biological, sludge in final sedimentation after the biological process. The characteristics of the secondary sludge vary with the type of biological process and, often, it is mixed with primary sludge before treatment and disposal. Approximately one half of the costs of operating secondary sewage treatment plants in Europe can be associated with sludge treatment and disposal. Land application of raw or treated sewage sludge can reduce significantly the sludge disposal cost component of sewage treatment as well as providing a large part of the nitrogen and phosphorus requirements of many crops. Thus sewage sludge will contain, in addition to organic waste material, traces of many pollutants used in modern society. Some of these substances can be phytotoxic and some of the are toxic to humans and/or animals. So it is necessary to control the concentrations in the soil of potentially toxic elements and their rate of application to the soil. In accordance with the Israeli-Palestinian Joint Water Committee guidelines, before sludge reuse it must be stabilized (by lime addition, anaerobic or aerobic digestion) and de-watered.

3.18 Sludge application

Based only on the design flow of 23434 m^3/d a rough estimate of the total solids production (projected wastewater production in the year 2025 from all the treatment plants in the district), yields about 9374 ton/year. One m^3 effluent generates about 0.4 kg of dry sludge. Sewage sludge contains useful concentrations of nitrogen (3 to 9 %), phosphorus (4 to 6%) and organic matter (30 to 50 %). The availability of the phosphorus content in the year of application is about 50% and is independent of any prior sludge treatment. Nitrogen availability is more dependent on sludge treatment, untreated liquid sludge and dewatered treated sludge releasing nitrogen slowly with the benefits to crops being realized over a relatively long period. Liquid an aerobically-digested sludge has high ammonia-nitrogen content which is readily available to plants and can be of particular benefit to grassland. The organic matter in sludge can improve the water retaining capacity and structure of some soils, especially when applied in the form of dewatered sludge cake.

It is possible to apply 1 to 2 tons of dry sludge per dunum each 2 or 3 years. About 4700 dunums per year could be benefitted by sludge applications, i.e. 1 to 2 % of the cultivated area.

To minimize the potential risk to the health of humans, animals and plants it is necessary to coordinate sludge applications in time with planting, grazing or harvesting operations. Sludge must not be applied to growing soft fruit or vegetable crops nor used where crops are grown under permanent glass or plastic structures. Treated sludge can be applied to growing cereal crops without constraint, but should not be applied to growing fruit within 3 months of harvesting or to fruit trees within 10 months of harvesting. When treated sludge is applied before planting such crops as cereals, grass, fodder, sugar beet, fruit trees, etc., no constraints apply but in the case of soft fruit and vegetables, the treated sludge should not be applied within 10 months of crop harvesting.

3.19 Parameters for Comparison between Sanitation Schemes

The main parameters that will be used to compare between the different sanitation schemes can be summarized as follows:

- The collective systems will cover the dense areas in each community without any pumping inside the community in 2015 and to cover the areas which need pumping in the year 2025.
- There is no need to change the existing individual system (cesspits) in the scattered areas in 2015, but in 2025 the houses not served by the collection system must be served by individual septic tanks.
- Wastewater from the collective and individual sanitation systems cannot be disposed without treatment, considering hydro geologic context and legal issue (MoU), and therefore must be treated.
- Wastewater reuse for irrigation is possible and recommended considering the wide range of possible reuse in this field and the scarcity of water in the area.
- Treatment process, in the quality standards imposed by the MoU, are achievable through various treatment processes. The choice of treatment process will therefore depend on technical and cost considerations.
- The proposed system for the small and far communities is to be the same as the existing system in the year 2015 and to have a collection system in the year 2025.
- O&M must be reduced to the minimum, considering the low local experience on sanitation, the difficulties encountered on O&M to date (overflowing cesspits, no control on disposal sites, old tanker trucks).

In addition to those specific parameters, some general conditions must be taken into consideration:

- Investment cost and availability of funding,
- Available space for WWTP construction,
- Local social and political context (*which is in West Bank case of prime importance*)

Based on these considerations, and particularly on cost consideration, each cluster will have its own sanitation system (collection, treatment, and reuse).

3.20 Proposed Scenarios for the sanitation systems in the district

The proposed scenarios for each cluster are Consistent with the above assumed parameters.

Two scenarios are proposed for each cluster. The first one is a centralized treatment plant in each cluster. The second scenario is mixed between centralized and decentralized treatment.

The structure of those two scenarios is detailed in the following table 24.

Table (24): Wastewater Scenarios

DESCRIPTION OF THE TWO SCENARIOS STUDIED			
N° Scenario	**Number WWTP**	**DESCRIPTION OF THE AREAS FOR WWTP**	**Number of EH to be served in 2025, (including industries)(*)**
SCENARIO 1	**4**	**WWTP Al Kafriat :** North- west of Kufur Jamal	11545
		WWTP Al Sharawyia : West of Attil	74672
		WWTP Wadi Zeimar: North-west of Tulkarem city	176111
		WWTP Shoufa: Shoufa	3162
SCENARIO 2	**14**	**WWTP Al Kafriat :** North- west of Kufur Jamal for (Kufur Jamal, Kufur Zebad, Kufur Aboush)	8217
		WWTP of Kur : Kur village	433
		WWTP of Jubara: Jubara village	486
		WWTP of Kufur Sur: Kufur Sur+ Al Ras villages	
		WWTP Wadi Zeimar: North-west of Tulkarem city for for	

	seven communities(the eastern and northern part of Beit Leed, Ramin, Annabta, Kufur Labad, Bala, Iktaba, Tulkarem(the city , the two camps, the southern part of Shwiekha, Irtah)).	2746
		162600
	WWTP of Jarushia: Masqufa. Al Jarushia and the northern part of Shwiekha.	
	WWTP of Faroun: for Faroun and Kafa	
	WWTP of Saffarin: for Saffarin and the northern and western part of Beit leed	
		2600
	WWTP Shoufa: Shoufa	
		6057
	WWTP Al Sharawyia : West of Attil centralized wastewater treatment for the four communities in the cluster(Attil, Deir Al Ghsoun, Illar, and Seida).	
		4768
	WWTP Qaffin: Qaffin and Akkaba	
		3162
	WWTP Al Nazlha A l Wasta: for Al Nazlha Al Sharqia and Al Nazlha Al Wasta	
		43744
	WWTP Baqa Al Sharqyia: for Baqa Al Sharqyia, Al Nazlha Al Gharbia, and Nazlha Issa	
	WWTP Zeita: for ZEITA	
		14318
		3072
		12215

4726

3.20.1 Southern cluster (Al-Kafriat) scenarios

Wastewater is collected in each zone according to its typology (**Table 25**), and then transferred through transfer scheme to the WWTP for treatment and further reuse for irrigation purpose.

Table (25): Kafriat cluster scenario 1

Collection Mode and treatment			Zone C1		Zone C2		Zone C3
			By gravity	By pumping	By gravity	By pumping	
2015	Closed and large communities		Collective network	Existing cesspits	Collective network	Existing cesspits	Existing cesspits
	Small and far communities		Existing cesspits				
2025	All communities in the cluster	Centralized WWTP	Collective network	Collective network	Collective network	Septic tank	Septic tank

Table (26): Kafriat cluster scenario 2

		2015			2025			
		Kufur Jamal, Kufur Aboush, Kufr Zebad	Kufur Sur	Kur, Jubara, Al Ras	Kufur Jamal, Kufur Aboush, Kufr Zebad	Kufur Sur, Al Ras	Kur	Jubara
		Treatment plant 1	Treatment plant 2	Existing cesspits	Treatment plant 1	Treatment plant 2	Treatment plant 3	Treatment plant 4
Zone C1	By gravity	Collective network			Collective network			
	By pumping	Existing cesspits			Collective network			
Zone C2	By gravity	Collective network			Collective network			
	By pumping	Existing cesspits			Septic tank			
Zone C3		Existing cesspits			Septic tank			

3.20.2 Wadi Zeimar Cluster Scenarios

Table (27): Scenario 1

Collection Mode and treatment			Zone C1		Zone C2		Zone C3
			By gravity	By pumping	By gravity	By pumping	
2015	Closed and large communities		Collective network	Existing cesspits	Collective network	Existing cesspits	Existing cesspits
	Small and far communities		Existing cesspits				
2025	All communities in the cluster	One Centralized WWTP in Tulkarem and one decentralized WWTP in Shoufa	Collective network	Collective network	Collective network	Septic tank	Septic tank

Table (28): Wadi Zeimar cluster scenario 2

Collection Mode and treatment			Zone C1		Zone C2		Zone C3
			By gravity	By pumping	By gravity	By pumping	
2015	The eastern and northern part of Beit Leed, Ramin, Annabta, Kufur Labad, Bala, Iktaba, Tulkarem(the city , the two camps, the southern part of Shwiekha, Irtah).	Treatment plant 1	Collective network	Existing cesspits	Collective network	Existing cesspits	Existing cesspits

2025						
Saffarin, southern and western part of Beit leed	Faroun, Kafa	Shoufa	The eastern and northern part of Beit Leed, Ramin, Annabta, Kufur Labad, Bala, Iktaba, Tulkarem(the city , the two camps, the southern part of Shwiekha, Irtah).	Masqufa, Jarushia, Saffarin, Kafa	Faroun	Shoufa
Treatment plant 4	Treatment plant 3	Treatment plant 2	Treatment plant 1	Existing cesspits	Treatment plant 3	Treatment plant 2
Collective network						
Collective network						
Collective network						
Septic tank						
Septic tank						

Masqufa, Jarushia, northern part of Shwiekha	Treatment plant 5

3.20.3 Sharawyia Cluster Scenarios

Scenario 1:

For this cluster, it was proposed two scenarios as explained below in table 29.

Table (29): Sharawyia cluster, sanitation system per zones and up to year 2025

Collection Mode and treatment			Zone C1		Zone C2		Zone C3
			By gravity	By pumping	By gravity	By pumping	
2015	Closed and large communities		Collective network	Existing cesspits	Collective network	Existing cesspits	Existing cesspits
	Small and far communities		Existing cesspits				
2025	All communities in the cluster	Centralized WWTP	Collective network	Collective network	Collective network	Septic tank	Septic tank

Table (30): Sharawyia cluster scenario 2, sanitation system per zones and up to year 2025

Collection	Zone C1	Zone C2	Zone C3

Mode and treatment

2025			2015					
Baqa Al Sharqyia, Al Nazlha Al Gharbia, Nazlha	Al Qaffin and Akkaba	Attil, Deir Al Ghsoun, Illar, and Seida	Al Nazlha Al Gharbia, Al Nazlha Al Sharqia, Al Nazlha Wasta, Akkaba	Zeita	Baqa Al Sharqyia, Al Nazlha Isa	Qaffin	Attil, Deir Al Ghsoun, Illar, and Seida	
Treatment plant 3	Treatment plant 2	Treatment plant 1	Existing cesspits	Treatment plant 4	Treatment plant 3	Treatment plant 2	Treatment plant 1	
Collective network				Collective network				By gravity
Collective network				Existing cesspits				By pumping
Collective network				Collective network				By gravity
Septic tank				Existing cesspits				By pumping
Septic tank				Existing cesspits				

Al Nazlha Al Zeita Sharqia Al Nazlha Al Wasta	
Treatment plant 5	Treatment plant 4

3.21 Cost Estimate and phasing of the proposed systems

The cost estimate of the proposed collection systems, individual sanitation system, and treatment for the three clusters. Phasing of the implementation and funding is also done.

3.21.1 Methodology Applied For Cost Estimates

Previous cost estimates for wastewater networks collection and treatment system from previous projects were analyzed and then compared to the expected tender prices.

The following general conditions are assumed:

- All cost estimates use 2010 prices
- All imported equipment are exempted from tax and duties
- Construction work will be carried out by selected local contractors through competitive bidding
- Cost of land acquisition is not included.
- All costs are in euro currency

3.21.2 Unexpected Costs - Contingencies

They cover variations on the unit prices which are known at the moment of cost estimates and related to the cost of the material, equipment, transport, energy, salaries, etc… both for local and imported goods. A ratio of 10% above the base costs is considered.

3.21.3 Detailed Engineering and Preparation of Tender Documents

As usual practices, a 10 % overhead ratio is usually applied on base costs and unexpected costs.

3.21.4 Tendering, Evaluation, Selection and Work Supervision

A 5 % overhead on base costs and unexpected costs is applied to cover costs under this item.

3.21.5 Project Management

The cost of this item varies widely with the option which will be finally considered; nevertheless the cost for the project management should not exceed a percentage of 5 % on base costs and unexpected costs.

3.21.6 Capital Costs

3. 21.6.1 Individual Sanitation Component

Individual sanitation cost includes the material and construction of septic tanks. Unit cost for ST is provided by local contractors

3.21.6.2 Internal Collection Network

Internal collection network includes all cost of constructing the wastewater collection system to the waste water treatment plant for the three clusters. The cost includes also the trunk main pipe lines between the villages in each cluster.

3.21.6.3 Booster Pumping Stations & Collecting Chambers

An average unit cost of 100 000 € is applied for every booster station equipped with collecting chamber for transferring sewage from any community or more than one community to another community or to the WWTP . An average cost of 50000€ is applied for every booster with collecting chamber for transferring sewage inside the community.

3.21.7 Summary of Investment Costs

The following Tables summarize the investments cost (capital + over cost) for the project in the three clusters, considering phased investment (2010 and 2015) and (2020 and 2025). O&M are not considered at that stages, or the revenues from reused treated water. It could be anticipated that part of this revenue will be dedicated to O&M fund, to be studied and established as part of a proper study.

3.21.8 Cost estimate for the WWTP

A t this stage of a master plan it is not possible to estimate very precisely the cost of the WWTP. It is the feasibility study which will precise this cost according to the following elements:

- The process
- The capacity of the WWTP depending of the quantities of pollution and of water.
- The ability to treat the sewerage of individual sanitation
- The requirement of the quality of the treated water
- The cost of the land

However, we can make rough estimation of the cost with suitable processes depending on the existing Al-Beirh WWTP and the estimation of the proposed of Nablus west and Hebron treatment plants. The cost analysis can be summarized in Table 31 for the first scenario and Table 32 for the seconds scenario.

Table 31: Detailed cost estimates

Al-Kafriat scenario1 (2015)

Item No.	project	unit	unit cost(€)	Jubara	Al-Ras	Kufur Sur	Kufur Zebad	Kufur Aboush	Kufur Jamal	KUR	Total Quantity	Total Cost(€)
1	Sewage Collection system											
1.1	supplying 8" UPVC pipes	M.L	15	0	0	5000	8000	7000	7000	0	27000	405000
1.2	supplying 10" UPVC pipes	M.L	30	0	0	1500	1800	2800	1200	0	7300	219000
1.6	Supplying ready made Manholes	No.	600	0	0	217	327	327	273	0	1143	686000
1.7	Excavation trenches for the pipes and manholes	M.L	20	0	0	6500	9800	9800	8200	0	34300	686000
1.8	Backfilling trenches with sand and basecoarse	M.L	20	0	0	5200	7840	7840	6560	0	27440	548800
1.9	Backfilling trenches with sand and soil	M.L	12	0	0	1300	1960	1960	1640	0	6860	82320
1.1	Installing the pipes and manholes	M.L	6	0	0	6500	9800	9800	8200	0	34300	205800
1.11	Asphalt Reinstatement	M.L	10	0	0	5200	7840	7840	6560	0	27440	274400
2	treatment plant	unit	4000000	1							1	4000000
	Total cost(2015)											7107320
	Grand Total of collection and treatment											9239516
3	Septic Tanks											

3.1	Excavation for the septic tank	No.	200	0	0	0	0	0	0	0	0
3.2	Supplying and casting reinforced concrete B-300	M3	100	0	0	0	0	0	0	0	0
3.3	Supplying reinforcing steel bars	Ton	900	0	0	0	0	0	0	0	0
	Total cost (2015)										0
	Grand Total of individual sanitation										0
	Total Grand for two systems										9239516

Al-Kafriat scenario1 (2025)

Item No.	project	unit	unit cost(€)	Jubara	Al-Ras	Kufur Sur	Kufur Zebad	Kufur Aboush	Kufur Jamal	KUR	Total Quantity	Total Cost(€)
1	Sewage Collection system											
	supplying and installing 6" HDPE pressure pipes	M.L	60	2700	0	700	0	0	500	0	3900	234000
1.1	supplying 8" UPVC pipes	M.L	15	2000	3800	500	700	500	1000	3800	12300	184500
1.2	supplying 10" UPVC pipes	M.L	30	0	0	0	0	0	0	0	0	0
1.6	Supplying readymade Manholes	No.	600	67	127	17	23	17	33	127	410	246000
1.7	Excavation trenches for the pipes and manholes	M.L	20	2000	3800	500	700	500	1000	3800	12300	246000
1.8	Backfilling trenches with sand and basecoarse	M.L	20	1600	3040	400	560	400	800	3040	9840	196800
1.9	Backfilling trenches with sand and soil	M.L	12	400	760	100	140	100	200	760	2460	29520

1.1	Installing the pipes and manholes	M.L	6	2000	3800	500	700	500	1000	3800	12300	73800
1.11	Asphalt Reinstatement	M.L	10	1600	3040	400	560	400	800	3040	9840	98400
2	pumping unit inside the community	unit	50000	0	0	0	0	0	1	0	1	50000
3	pumping unit between the communities	unit	100000	1	0	1	0	0	0	0	2	200000
	Total cost(2025)											1075020
	Grand Total of collection and treatment											1397526
4	Septic Tanks											
4.1	Excavation for the septic tank	No.	200	34	13	30	28	38	62	7	212	42400
4.2	Supplying and casting reinforced concrete B-300	M3	100	374	143	330	308	418	682	77	2332	233200
4.3	Supplying reinforcing steel bars	Ton	900	34	13	30	28	38	62	7	212	190800
	Total cost (2025)											466400
	Grand Total of individual sanitation											606320
	Total Grand for two systems											2003846

Scenario 1 Sharawyia 2015

Item No.	project	unit	unit cost(€)	Akkaba	Qaffin	Al-Nazlha Sharqyia	Al-Nazlha Gharbia	Al-Nazlha Wasta	Baqa Sharqyia	Nazlt Isa	Zeita	Attil	Deir Ghsoun	Illar	Seida	Total Quantity	Total Cost(
1	Sewage Collection system																
	supplying and installing 6" HDPE pressure pipes	M.L	60	0	1900	0	0	0	1000	0	0			1200	0	6100	366000
1.1	supplying 8" UPVC pipes	M.L	15	0	9000	0	0	0	0	5000	0	17000	15000	13000	9000	68000	1020000
	supplying 10" UPVC pipes	M.L	25	0	3500	0	0	0	0	2000	0	4000	3000	2500	0	15000	375000
1.2	supplying 12" UPVC pipes	M.L	30	0	2400	0	0	0	3000	0	0	3700	2600	3200	0	14900	447000
1.6	Supplying readymade Manholes	No.	600	0	497	0	0	0	100	233	0	823	687	623	300	3263	1958000
1.7	Excavation trenches for the pipes and manholes	M.L	20	0	14900	0	0	0	3000	7000	0	24700	20600	18700	9000	97900	1958000
1.8	Backfilling trenches with sand and basecoarse	M.L	20	0	11920	0	0	0	2400	5600	0	19760	16480	14960	7200	78320	1566400
1.9	Backfilling trenches with sand and soil	M.L	12	0	2980	0	0	0	600	1400	0	4940	4120	3740	1800	19580	234960

1.1	Installing the pipes and manholes	M.L	6	0	14900	0	0	0	3000	7000	0	24700	20600	18700	9000	97900	587400
1.11	Asphalt Reinstatement	M.L	10	0	11920	0	0	0	2400	5600	0	19760	16480	14960	7200	78320	783200
2	pumping unit inside the community	unit	50000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	pumping unit between the communities	unit	100000	0	1	0	0	0	1	0	1	0	0	1	0	4	400000
5	Treatment plant	unit	13000000	1													13000000
	Total cost(2015)																22695960
	Grand Total of collection and treatment																29504748
5	Septic Tanks																
5.1	Excavation for the septic tank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.2	Supplying and casting reinforced concrete B-300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.3	Supplying reinforcing steel bars	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total cost (2015)																0
	Grand Total of individual sanitation																0

Total Grand for two systems	**295047 48**

Sharawyia scenario 1 (2025)

Item No.	project	unit	unit cost(€)	Akkaba	Qaffin	Al-Nazlha Sharqyia	Al-Nazlha Gharbia	Al-Nazlha Wasta	Baqa Sharqyia	Nazlt Isa	Zeita	Attil	Deir Ghsoun	Illar	Seida	Total Quantity	Total Cost(€)
1	Sewage Collection system																
	supplying and installing 6" HDPE pressure pipes	M.L	60	1500	0	0	0	0	0	0	0		1200	0	0	2700	162000
1.1	supplying 8" UPVC pipes	M.L	15	2000	3000	4000	3500	3000	2000	1000	4000	2700	2500	2000	1000	30700	460500
	supplying 10" UPVC pipes	M.L	25	0	0	2000	0	0	0	0	0	0	0	0	0	2000	50000
1.2	supplying 12" UPVC pipes	M.L	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.6	Supplying readymade Manholes	No.	600	67	100	200	117	100	67	33	133	90	83	67	33	1090	654000
1.7	Excavation trenches for the pipes and manholes	M.L	20	2000	3000	6000	3500	3000	2000	1000	4000	2700	2500	2000	1000	32700	654000
1.8	Backfilling trenches with sand and basecoarse	M.L	20	1600	2400	4800	2800	2400	1600	800	3200	2160	2000	1600	800	26160	523200
1.9	Backfilling trenches with sand and soil	M.L	12	400	600	1200	700	600	400	200	800	540	500	400	200	6540	78480
1.1	Installing the pipes and manholes	M.L	6	2000	3000	6000	3500	3000	2000	1000	4000	2700	2500	2000	1000	32700	196200
1.11	Asphalt Reinstatement	M.L	10	1600	2400	4800	2800	2400	1600	800	3200	2160	2000	1600	800	26160	261600
2	pumping unit inside the community	unit	50000	0	0	0	0	0	0	0	0	0	1	0	0	1	50000
3	pumping unit between the	unit	100000	1	0	0	0	0	0	0	0	0	0	0	0	1	100000

	communities																
	Total cost(2025)																3189980
	Grand Total of collection and treatment																4146974
4	Septic Tanks																
4.1	Excavation for the septic tank	No.	200	22	215	38	42	20	103	60	76	233	214	155	77	1255	251000
4.2	Supplying and casting reinforced concrete B-300	M3	100	242	2365	418	462	220	1133	660	836	2563	2354	1705	847	13805	1380500
4.3	Supplying reinforcing steel bars	Ton	900	22	215	38	42	20	103	60	76	233	214	155	77	1255	1129500
	Total cost (2015)																2761000
	Grand Total of individual sanitation																3589300
	Total Grand for two systems																7736274

Scenario 1 Wadi Zeimar (2015)

Item No.	project	unit	unit cost(€)	Jarushia	Masqufa	Bala	Iktaba	Tulkarem	Annabta	Kufur Labad	Kafa	Ramin	Faroun	Shoufa	Beit leed	Saffarin	Total Quantity	Total Cost(€)
1	Sewage Collection system																	
	supplying and installing 6" HDPE pressure pipes	M.L	60	0	0	0	0	0	0	0	0			0	0	0	0	0
1.1	supplying 8" UPVC pipes	M.L	15	0	0	0	0	0	0	0	0	0	7500	5000	0	0	12500	187500

	supplying 10" UPVC pipes	M.L	25	0	0	0	0	0	0	0	0	0	1000	1000	0	0	2000	50000
1.2	supplying 12" UPVC pipes	M.L	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.6	Supplying ready made Manholes	No.	600	0	0	0	0	0	0	0	0	0	283	200	0	0	483	290000
1.7	Excavation trenches for the pipes and manholes	M.L	20	0	0	0	0	0	0	0	0	0	8500	6000	0	0	14500	290000
1.8	Backfilling trenches with sand and basecoarse	M.L	20	0	0	0	0	0	0	0	0	0	6800	4800	0	0	11600	232000
1.9	Backfilling trenches with sand and soil	M.L	12	0	0	0	0	0	0	0	0	0	1700	1200	0	0	2900	34800
1.1	Installing the pipes and manholes	M.L	6	0	0	0	0	0	0	0	0	0	8500	6000	0	0	14500	87000
1.11	Asphalt Reinstatement	M.L	10	0	0	0	0	0	0	0	0	0	6800	4800	0	0	11600	116000
2	pumping unit inside the community	unit	50000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	pumping unit between the communities	unit	100000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Treatment plant for the regional project	unit	25000000	1													1	25000000
5	Shoufa treatment plant	unit	400000	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
	Total cost(2015)																	26687300
	Grand Total of collection and treatment																	34693490
6.1	Septic Tanks																	
6.2	Excavation for the septic tank	No.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.3	Supplying and casting reinforced concrete B-300	M3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

6.4	Supplying reinforcing steel bars	Ton	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total cost (2015)																	0
	Grand Total of individual sanitation																	0
	Total Grand for two systems																	34693490

Scenario 1 Wadi Zeimar (2025)

Item No.	project	unit	unit cost(	Jarushia	Masqufa	Bala	Iktaba	Tulkarem	Annabta	Kufur Lahad	Kafa	Ramin	Faroun	Shoufa	Beit leed	Saffarin	Total Quantity	Total Cost(
1	Sewage Collection system																	
	supplying and installing 6" HDPE pressure pipes	M.L	60	1200	700	0	0	0	0	0	0			0	0	500	2400	144000
1.1	supplying 8" UPVC pipes	M.L	15	3000	3000	2000	1000	6000	1500	1500	4000	1000	1000	1000	1500	3000	29500	442500
	supplying 10" UPVC pipes	M.L	25	0	0	0	0	3000	500	0	0	0			0	0	3500	87500
1.2	supplying 12" UPVC pipes	M.L	30	0	0	0	0	1000	0	0	0	0	0	0	0	0	1000	30000
1.6	Supplying readymade Manholes	No.	600	100	100	67	33	333	67	50	133	33	33	33	50	100	1133	680000
1.7	Excavation trenches for the pipes and manholes	M.L	20	3000	3000	2000	1000	10000	2000	1500	4000	1000	1000	1000	1500	3000	34000	680000

1.8	Backfilling trenches with sand and basecoarse	M.L	20	2400	2400	1600	800	8000	1600	1200	3200	800	800	800	1200	2400	27200	544000
1.9	Backfilling trenches with sand and soil	M.L	12	600	600	400	200	2000	400	300	800	200	200	200	300	600	6800	81600
1.1	Installing the pipes and manholes	M.L	6	3000	3000	2000	1000	10000	2000	1500	4000	1000	1000	1000	1500	3000	34000	204000
1.11	Asphalt Reinstatement	M.L	10	2400	2400	1600	800	8000	1600	1200	3200	800	800	800	1200	2400	27200	272000
2	pumping unit inside the community	unit	50000	0	0	0	0	0	0	0	0	0	0	0	0		0	0
3	pumping unit between the communities	unit	100000	1	1	0	0	0	0	0	0	0	0	0	0	1	3	300000
	Total cost(2025)																	3465600
	Grand Total of collection and treatment																	4505280
4	Septic Tanks																	
4.1	Excavation for the septic tank	No.	200	50	26	163	63	1830	195	188	10	48	80	115	128	60	2956	591200
4.2	Supplying and casting reinforced concrete B-300	M3	100	550	286	1793	693	20130	2145	2068	110	528	880	1265	1408	660	32616	3261600
4.3	Supplying reinforcing steel bars	Ton	900	50	26	163	63	1830	195	188	10	48	80	115	128	60	2956	2660400

Total cost (2015)	651320 0
Grand Total of individual sanitation	846716 0
Total Grand for two systems	129724 40

Table 32: Detailed cost scenario 2

Al-Kafriat scenario2 (2015)

Item No.	project	unit	unit cost(€)	Jubara	Al-Ras	Kufur Sur	Kufur Zeibad	Kufur Aboush	Kufur Jamal	KUR	Total Quantity	Total Cost(€)
1	Sewage Collection system											
1.1	supplying 8" UPVC pipes	M.L	15	0	0	5000	8000	7000	7000	0	27000	405000
1.2	supplying 10" UPVC pipes	M.L	30	0	0	1500	1800	2800	1200	0	7300	219000
1.6	Supplying ready made Manholes	No.	600	0	0	217	327	327	273	0	1143	686000
1.7	Excavation trenchs for the pipes and manholes	M.L	20	0	0	6500	9800	9800	8200	0	34300	686000
1.8	Backfilling trenches with sand and basecoarse	M.L	20	0	0	5200	7840	7840	6560	0	27440	548800
1.9	Backfilling trenches with sand and soil	M.L	12	0	0	1300	1960	1960	1640	0	6860	82320
1.1	Installing the pipes and manholes	M.L	6	0	0	6500	9800	9800	8200	0	34300	205800
1.11	Asphalt Reinstatement	M.L	10	0	0	5200	7840	7840	6560	0	27440	274400

2	**treatment plant1**	**unit**	**1,000,000**	**0**	**1**		**0**			**0**	**1**	**1000000**
	treatment plant2	**unit**	**4,000,000**	**0**	**0**		**1**			**0**	**1**	**4000000**
	treatment plant3	**unit**	**500,000**	**0**	**0**		**0**			**0**	**0**	**0**
	Total cost(2015)											**8107320**
	Grand Total of collection and tratment											**10539516**
3	**Septic Tanks**											
3.1	**Excavation for the septic tank**	**No.**	**200**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3.2	**Supplying and casting reinforced concrete B-300**	**M3**	**100**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3.3	**Supplying reinforcing steel bars**	**Ton**	**800**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Total cost (2015)											**0**
	Grand Total of individual sanitation											**0**
	Total Grand for two systems											**10539516**

Al-Kafriat scenario2 (2025)

Item No.	project	unit	unit cost(€)	Jubara	Al-Ras	Kufur Sur	Kufur Zeibad	Kufur Aboush	Kufur Jamal	KUR	Total Quantity	Total Cost(€)
1	Sewage Collection system											
	supplying and installing 6" HDPE pressure pipes	M.L	60	0	0	0	0	0	500	0	500	30000
1.1	supplying 8" UPVC pipes	M.L	15	2000	3800	500	700	500	1000	3800	12300	184500
1.2	supplying 10" UPVC pipes	M.L	30	0	0	0	0	0	0	0	0	0
1.6	Supplying ready made Manholes	No.	600	67	127	17	23	17	33	127	410	246000
1.7	Excavation trenchs for the pipes and manholes	M.L	20	2000	3800	500	700	500	1000	3800	12300	246000
1.8	Backfilling trenches with sand and basecoarse	M.L	20	1600	3040	400	560	400	800	3040	9840	196800
1.9	Backfilling trenches with sand and soil	M.L	12	400	760	100	140	100	200	760	2460	29520
1.1	Installing the pipes and manholes	M.L	6	2000	3800	500	700	500	1000	3800	12300	73800
1.11	Asphalt Reinstatement	M.L	10	1600	3040	400	560	400	800	3040	9840	98400
2	pumping unit inside the community	unit	50000	0	0	0	0	0	1	0	1	50000
3	pumping unit between the communities	unit	100,000	0	0	0	0	0	0	0	0	0
2	treatment plant1	unit	1,000,000	0	0		0			0	0	0
	treatment plant2	unit	4,000,000	0	0		0			0	0	0

	treatment plant3	unit	500,000	1	0		0			1	2	1000000
	Total cost(2025)											2559020
	Grand Total of collection and tratment											3326726
4	Septic Tanks											
4.1	Excavation for the septic tank	No.	200	34	13	30	28	38	62	7	212	42400
4.2	Supplying and casting reinforced concrete B-300	M3	100	374	143	330	308	418	682	77	2332	233200
4.3	Supplying reinforcing steel bars	Ton	900	34	13	30	28	38	62	7	212	190800
	Total cost (2025)											466400
	Grand Total of individual sanitation											606320
	Total Grand for two systems											3933046

Sharawyia scenario2 (2015)

Item No.	project	unit	unit cost(€)	Akkaba	Qaffin	Al-Nazlha Sharqyia	Al-Nazlha wusta	Al-Nazlha Gharbyia	Baqa Sharqyia	Nazlt Issa	Zeita	Attil	Deir Ghsoun	Illar	Seida	Total Quantity	Total Cost(€)
1	Sewage Collection system																
	supplying and installing 6"	M.L	60	0	0	0	0	0	0	0	200			1200	0	1200	72000

	HDPE pressure pipes										0						
1.1	supplying 8" UPVC pipes	M.L	15	0	9000	0	0	0	0	5000	0	1700 0	15000	1300 0	9000	68000	1020000
	supplying 10" UPVC pipes	M.L	25	0	3500	0	0	0	0	2000	0	4000	3000	2500	0	15000	375000
1.2	supplying 12" UPVC pipes	M.L	30	0	2400	0	0	0	3000	0	0	3700	2600	3200	0	14900	447000
1.6	Supplying ready made Manholes	No.	600	0	497	0	0	0	100	233	0	823	687	623	300	3263	1958000
1.7	Excavation trenchs for the pipes and manholes	M.L	20	0	1490 0	0	0	0	3000	7000	0	2470 0	20600	1870 0	9000	97900	1958000
1.8	Backfilling trenches with sand and basecoarse	M.L	20	0	1192 0	0	0	0	2400	5600	0	1976 0	16480	1496 0	7200	78320	1566400
1.9	Backfilling trenches with sand and soil	M.L	12	0	2980	0	0	0	600	1400	0	4940	4120	3740	1800	19580	234960
1.1	Installing the pipes and manholes	M.L	6	0	1490 0	0	0	0	3000	7000	0	2470 0	20600	1870 0	9000	97900	587400
1.11	Asphalt Reinstatement	M.L	10	0	1192 0	0	0	0	2400	5600	0	1976 0	16480	1496 0	7200	78320	783200
2	pumping unit inside the community	unit	50000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	pumping unit between the communities	unit	10000 0	0	0	0	0	0	0	0	1	0	0	1	0	1	100000
4	Treatment plant1	unit	8,000,	0		0		0			0	1				1	8000000

			000							
	Treatment plant2	unit	500,000	0	0	0	1	0	1	500000
	Treatment plant3	unit	4,000,000	0	0	1	0	0	1	4000000
	Treatment plant4	unit	3,000,000	1	0	0	0	0	1	3000000
	Total cost(2015)									24601960
	Grand Total of collection and tratment									31982548

5	Septic Tanks																
5.1	Excavation for the septic tank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.2	Supplying and casting reinforced concrete B-300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.3	Supplying reinforcing steel bars	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total cost (2015)																0
	Grand Total of individual sanitation																0
	Total Grand for two systems																31982548

Sharawyia scenario2 (2025)

Item No.	project	unit	unit cost(€)	Akkaba	Qaffin	Al-Nazlha Sharqyia	Al-Nazlha Gharbyia	Al-Nazlha wusta	Baqa Sharqyia	Nazlt Issa	Zeita	Attil	Deir Ghsoun	Illar	Seida	Total Quantity	Total Cost(€)
1	Sewage Collection system																
	supplying and installing 6" HDPE pressure pipes	M.L	60	1500	0	0	0	0	0	0	0		1200	0	0	2700	162000
1.1	supplying 8" UPVC pipes	M.L	15	2000	3000	4000	3500	3000	2000	1000	4000	2700	2500	2000	1000	30700	460500
	supplying 10" UPVC pipes	M.L	25	0	0	2000	0	0	0	0	0	0	0	0	0	2000	50000
1.2	supplying 12" UPVC pipes	M.L	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.6	Supplying ready made Manholes	No.	600	67	100	200	117	100	67	33	133	90	83	67	33	1090	654000
1.7	Excavation trenchs for the pipes and manholes	M.L	20	2000	3000	6000	3500	3000	2000	1000	4000	2700	2500	2000	1000	32700	654000
1.8	Backfilling trenches with sand and basecoarse	M.L	20	1600	2400	4800	2800	2400	1600	800	3200	2160	2000	1600	800	26160	523200
1.9	Backfilling trenches with sand and soil	M.L	12	400	600	1200	700	600	400	200	800	540	500	400	200	6540	78480
1.1	Installing the pipes and manholes	M.L	6	2000	3000	6000	3500	3000	2000	1000	4000	2700	2500	2000	1000	32700	196200
1.11	Asphalt Reinstatement	M.L	10	1600	2400	4800	2800	2400	1600	800	3200	2160	2000	1600	800	26160	261600

2	pumping unit inside the community	unit	50000	0	0	0	0	0	0	0	0	0	1	0	0	1	50000
3	pumping unit between the communities	unit	100000	1	0	0	0	0	0	0	0	0	0	1	0	2	200000
4	Treatment plant1	unit	8,000,000	0		0			0		0		0			0	0
	Treatment plant2	unit	500,000	0		1			0		0		0			1	500000
	Treatment plant3	unit	4,000,000	0		0			0		0		0			0	0
	Treatment plant4	unit	3,000,000	0		0			0		0		0			0	0
							Total cost(2025)										3789980
							Grand Total of collection and tratment										4926974
4	Septic Tanks																
4.1	Excavation for the septic tank	No.	200	22	215	38	42	20	103	60	76	233	214	155	77	1255	251000
4.2	Supplying and casting reinforced concrete B-300	M3	100	242	2365	418	462	220	1133	660	836	2563	2354	1705	847	13805	1380500
4.3	Supplying reinforcing steel bars	Ton	900	22	215	38	42	20	103	60	76	233	214	155	77	1255	1129500
							Total cost (2015)										2761000

Grand Total of individual sanitation	3589300
Total Grand for two systems	8516274

Wadi Zeimar scenario 2 (2015)

Item No.	project	unit	unit cost(€)	Jarushia	Masqufa	Bala	Iktaba	Tulkarem	Anabta	Kufur Labad	Ramin	Beit leed	Kafa	Faroun	Shoufa	Saffarin	Total Quantity	Total Cost(€)
1	Sewage Collection system																	
	supplying and installing 6" HDPE pressure pipes	M.L	60	0	0	0	0	0	0	0	0				0	0	0	0
1.1	supplying 8" UPVC pipes	M.L	15	0	0	0	0	0	0	0	0		0	7500	5000	0	12500	187500
	supplying 10" UPVC pipes	M.L	25	0	0	0	0	0	0	0	0		0	1000	1000	0	2000	50000
1.2	supplying 12" UPVC pipes	M.L	30	0	0	0	0	0	0	0	0		0	0	0	0	0	0
1.6	Supplying ready made Manholes	No.	600	0	0	0	0	0	0	0	0		0	283	200	0	483	290000
1.7	Excavation trenchs for the pipes and manholes	M.L	20	0	0	0	0	0	0	0	0		0	8500	6000	0	14500	290000
1.8	Backfilling trenches with sand and basecoarse	M.L	20	0	0	0	0	0	0	0	0		0	6800	4800	0	11600	232000

1.9	**Backfilling trenches with sand and soil**	**M.L**	**12**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1700**	**1200**	**0**	**2900**	**34800**
1.1	**Installing the pipes and manholes**	**M.L**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**8500**	**6000**	**0**	**14500**	**87000**
1.11	**Asphalt Reinstatement**	**M.L**	**10**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6800**	**4800**	**0**	**11600**	**116000**
2	**pumping unit inside the community**	**unit**	**50000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3	**pumping unit between the communities**	**unit**	**100000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4	**Treatment plant for the reginoal project**	**unit**	**25000000**	**1**												**1**	**25000000**
5	**Shufa treatment plant**	**unit**	**500,000**	**0**		**0**								**1**	**0**	**1**	**500000**
	Faroun treatment plant	**unit**	**500,000**	**0**		**0**						**1**			**0**	**1**	**500000**
	Saffarin treatment plant	**unit**	**500,000**	**0**		**0**						**0**			**1**	**0**	**0**
	Jarushia, Maqufa treatment plant	**unit**	**500,000**	**0**		**0**						**0**		**0**	**0**	**0**	**0**
	Total cost(2015)																**27287300**
	Grand Total of collection and tratment																**35473490**

6.1 Septic Tanks

6.2	**Excavation for the septic tank**	**No.**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6.3	**Supplying and casting reinforced concrete B-300**	**M3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6.4	**Supplying reinforcing steel bars**	**Ton**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Total cost (2015)															**0**
	Grand Total of individual sanitation															**0**
	Total Grand for two systems															**35473490**

Wadi Zeimar scenario 2 (2025)

Item No.	**project**	**unit**	**unit cost(€)**	**Jarushia**	**Masqufa**	**Bala**	**Iktaba**	**Tulkarem**	**Anabta**	**Kufur Labad**	**Ramin**	**Beit leed**	**Kafa**	**Faroun**	**Shoufa**	**Saffarin**	**Total Quantity**	**Total Cost(€)**

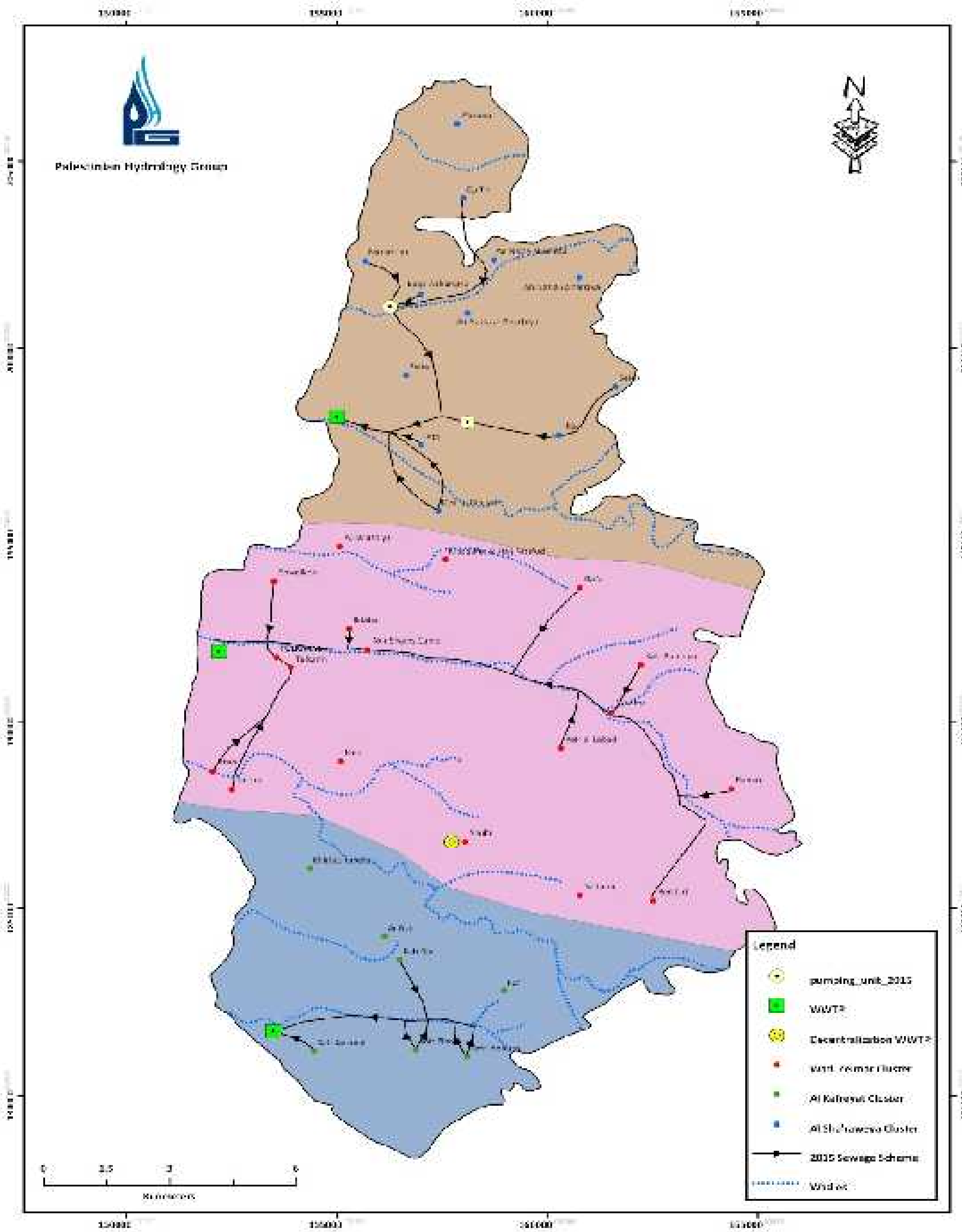
1	Sewage Collection system																	
	supplying and installing 6" HDPE pressure pipes	M.L	60	0	0	0	0	0	0	0		0	0		0	0	0	0
1.1	supplying 8" UPVC pipes	M.L	15	3000	3000	2000	1000	6000	1500	1500	1000	1500	4000	1000	1000	3000	29500	442500
	supplying 10" UPVC pipes	M.L	25	0	0	0	0	3000	500	0	0	0	0			0	3500	87500
1.2	supplying 12" UPVC pipes	M.L	30	0	0	0	0	1000	0	0	0	0	0	0	0	0	1000	30000
1.6	Supplying ready made Manholes	No.	600	100	100	67	33	333	67	50	33	50	133	33	33	100	1133	680000
1.7	Excavation trenchs for the pipes and manholes	M.L	20	3000	3000	2000	1000	10000	2000	1500	1000	1500	4000	1000	1000	3000	34000	680000
1.8	Backfilling trenches with sand and basecoarse	M.L	20	2400	2400	1600	800	8000	1600	1200	800	1200	3200	800	800	2400	27200	544000
1.9	Backfilling trenches with sand and soil	M.L	12	600	600	400	200	2000	400	300	200	300	800	200	200	600	6800	81600
1.1	Installing the pipes and manholes	M.L	6	3000	3000	2000	1000	10000	2000	1500	1000	1500	4000	1000	1000	3000	34000	204000
1.11	Asphalt Reinstatement	M.L	10	2400	2400	1600	800	8000	1600	1200	800	1200	3200	800	800	2400	27200	272000
2	pumping unit inside the community	unit	50000	0	0	0	0	0	0	0	0	0	0	0	0		0	0
3	pumping unit between the	unit	10000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

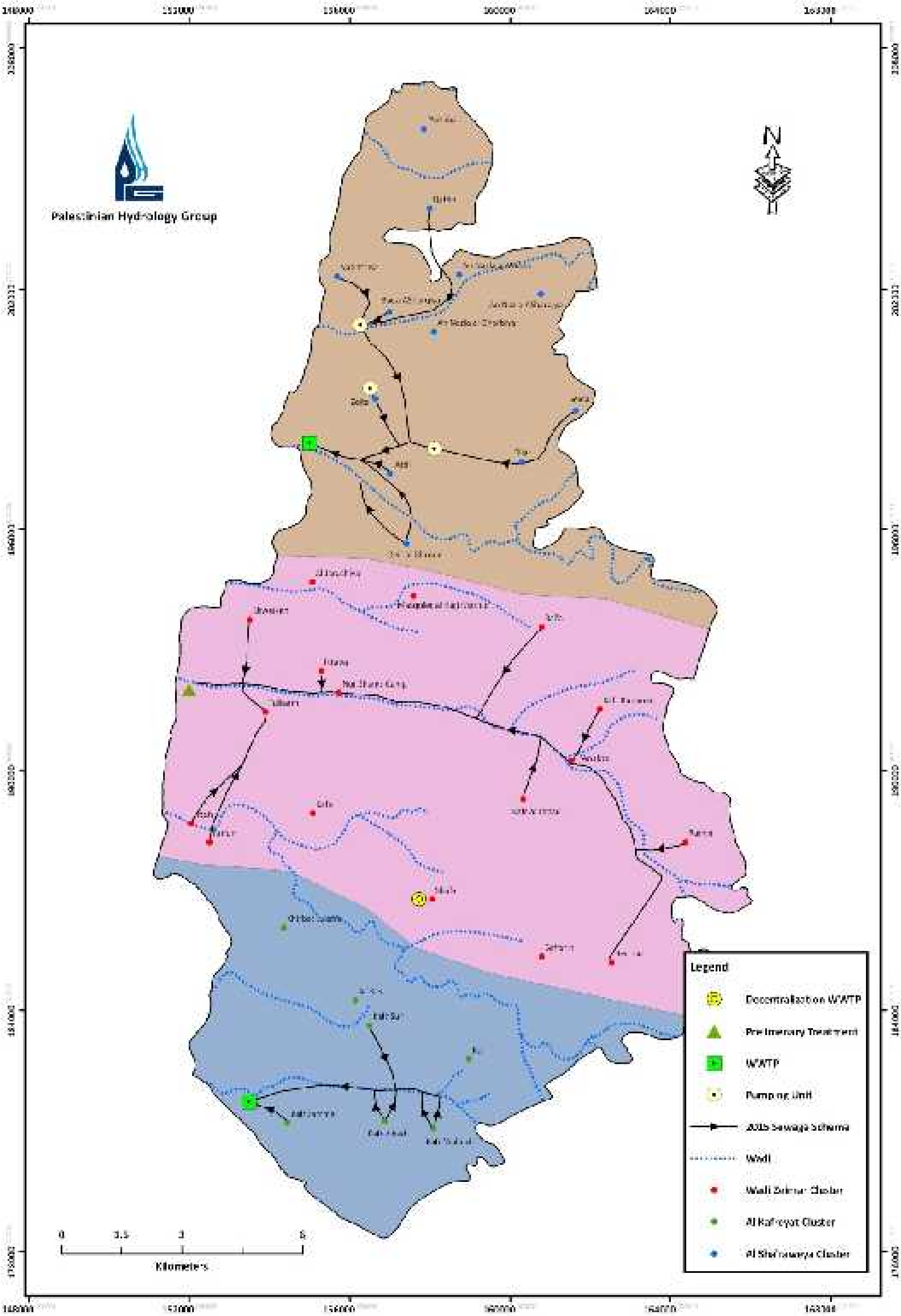
	communities		**0**															
4	**Treatment plant for the reginoal project**	**unit**	**25000000**	**0**													**0**	**0**
5	**Shufa treatment plant**	**unit**	**500,000**	**0**	**0**									**0**	**0**	**0**	**0**	**0**
	Faroun treatment plant	**unit**	**500,000**	**0**	**0**									**0**	**0**	**0**	**0**	**0**
	Saffarin treatment plant	**unit**	**500,000**	**0**	**0**									**0**	**0**	**1**	**1**	**500000**
	Jarushia, Maqufa treatment plant	**unit**	**500,000**	**1**	**0**									**0**	**0**	**0**	**1**	**500000**
	Total cost(2025)																	**4465600**
	Grand Total of collection and tratment																	**5228080**
4	**Septic Tanks**																	
4.1	**Excavation for the septic tank**	**591200**	**200**	**50**	**26**	**163**	**63**	**1830**	**195**	**188**	**48**	**128**	**10**	**80**	**115**	**60**	**2956**	**591200**
4.2	**Supplying and casting reinforced concrete B-300**	**3261600**	**100**	**550**	**286**	**1793**	**693**	**20130**	**2145**	**2068**	**528**	**1408**	**110**	**880**	**1265**	**660**	**32616**	**3261600**
4.3	**Supplying reinforcing steel bars**	**2660400**	**900**	**50**	**26**	**163**	**63**	**1830**	**195**	**188**	**48**	**128**	**10**	**80**	**115**	**60**	**2956**	**2660400**
	Total cost (2015)																	**6513200**

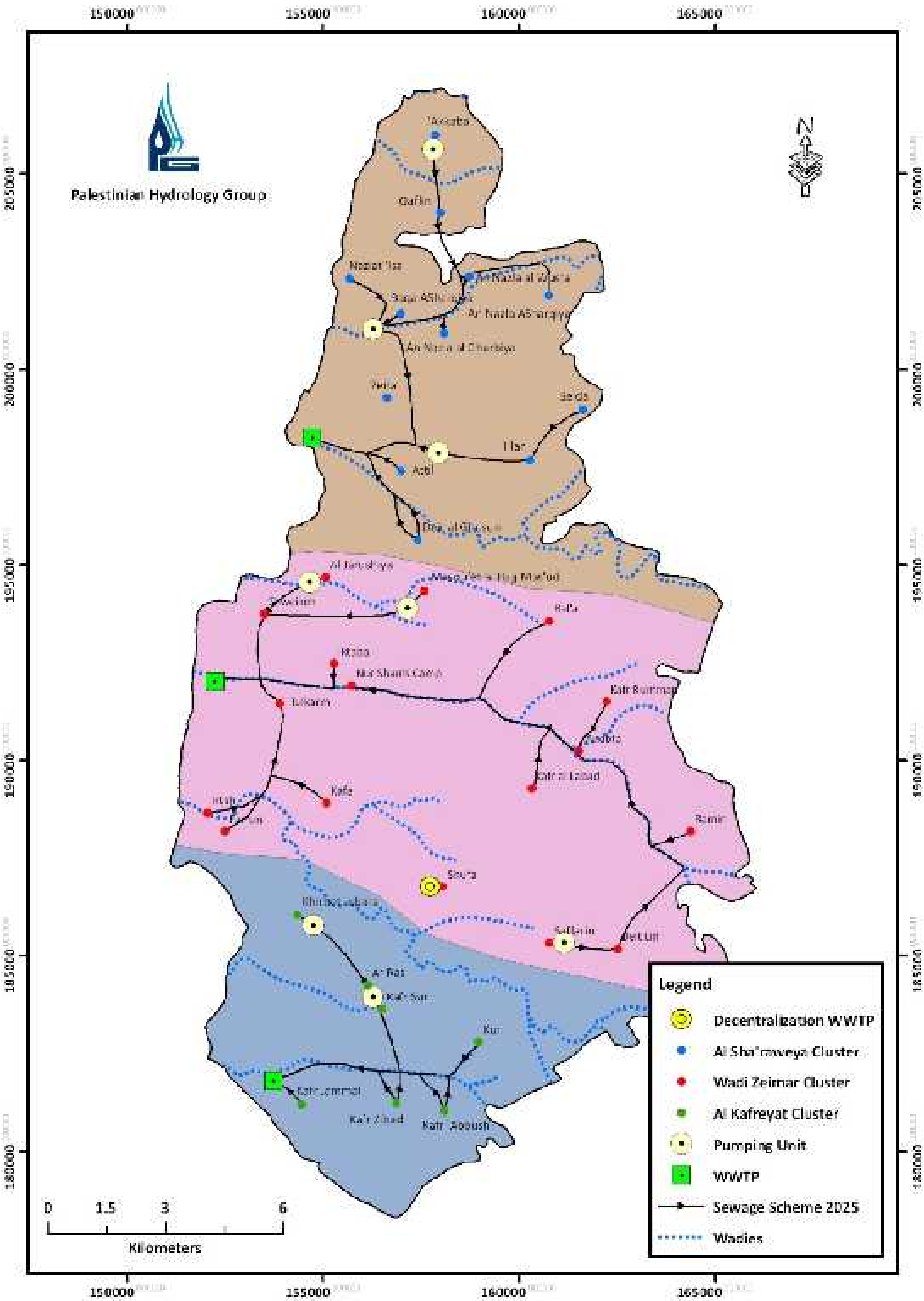
Grand Total of individual sanitation	**8467160**
Total Grand for two systems	**13695240**

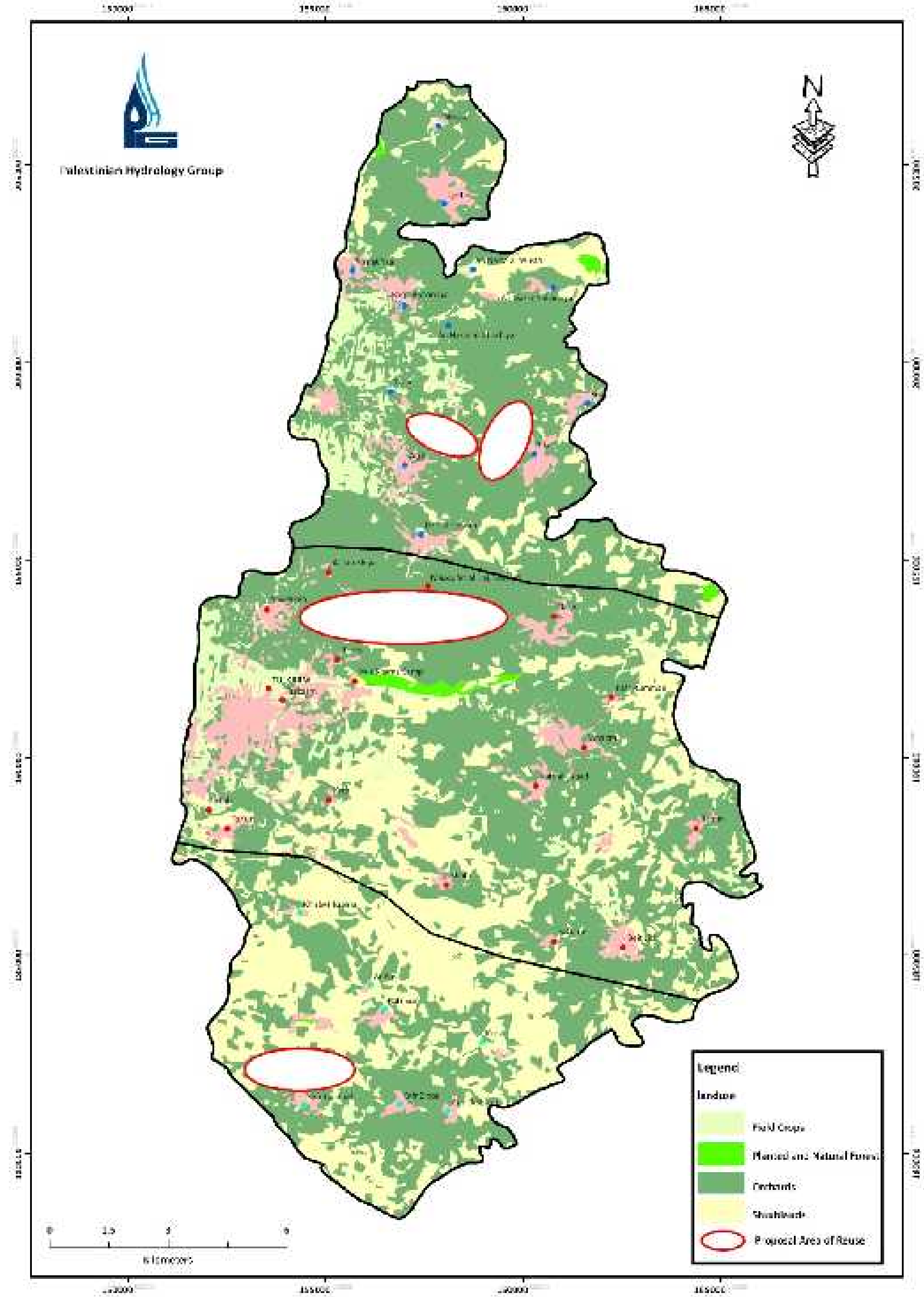
ANNEXES

Annex 1: Figures for Sanitation Alternatives




Palestinian Hydrology Group
N
Legend
Decentralization WWTP
WWTP
Pumping Unit
Wadi
Kilometers


150000
155000
160000
165000
180000
185000
190000
195000
200000
205000
Palestinian Hydrology Group
N
Qaffin
Illar
Seida
Bal'a
Nur Shams Camp
Tulkarm
Kafa
Kafr al Labad
Ramin
Shufa
Saffarin
Ar Ras
Kafr Sur
Kur
Kafr Zibad
Kafr 'Abbush
0 1.5 3 6
Kilometers
Legend
Decentralization WWTP
Al Sha'rawaya Cluster
Wadi Zeimar Cluster
Al Kafreyat Cluster
Pumping Unit
WWTP
Sewage Scheme 2025
Wadies


Palestinian Hydrology Group
N
Legend
landuse
Field Crops
Planted and Natural Forest
Orchards
Shrublands
Proposed Area of Reuse
Kilometers

Chapter Four

Tariff Structure for Tulkarem Governorate

4.1 Introduction:

The water sector in the West Bank and Gaza has remained undeveloped over the past three decades of occupation. Since 1967 West Bank water resources have been controlled and managed by the Israeli Military Authority through a number of Military Orders. These orders have barred Palestinians from participating in the planning and management of water resources and prevented them from developing local water resources in concert with growing water needs.

In addition, the lack of investments in improving infrastructure (physical water losses reach 50% in some areas), the scattered nature of the water supply and management utilities with the absence of adequate rules and regulations and absence of stakeholder participation has resulted in the deterioration of the entire water system in the oPt.

In reality, the advent of the peace process was not merely an opportunity for greater use, but rather a challenge to form new and responsive public institutions to govern water usage. It is for that the Palestinian Water Authority (PWA) was established in 1995 and was assigned the task of formulating and implementing a comprehensive Water Law and strategy, which would entail setting up adequate rules and regulations including proper water pricing system for the West Bank and Gaza. Due to the fact that Palestinians have not gained yet the full control over their water resources and the issue has been left to the final status negotiation, PWA faced with many constraints to implement the strategy and enforce the Water Law. Accordingly, no final regulation on water pricing policy has been formulated as of yet.

The current water pricing mechanisms reflects mainly accounting costs of supply and allocation at each locality, while neglecting many of the economic, social and environmental costs aimed at generating a higher level of efficiency in the sector. As a result, public satisfaction with the current service hasn't been met in most of the areas in the West Bank.

In an earlier research study done by PHG it was shown that the pricing policies used by various municipalities varied substantially, with tariffs ranging anywhere from 0.19 $/m3 (in Qalqiliya) to as high as 1.69 $/m3 (in Bethlehem). However, it may reach nearly 3$/ m^3 in some localities where no proper water supply system exist. Water obtained by Tankers may cost 5-6 $/ m^3 in the areas lacking water supply services in the same time the quality they get is much lower.

As we would suspect, in the areas where the tariffs were artificially low, water consumption was found to be unnaturally high. Were tariffs were artificially high water use was dramatically lower. To further exacerbate the situation, it was shown that no local water utility in the West Bank was recovering accounting costs in excess of 85%. In some areas cost recovery was as low as 62%. It is worth noting that these recovery costs do not take into account any social or environmental cost. Not only that there are several other problems facing the water supply bodies in the West Bank which affect their ability to provide better services for their customers. Among these factors, their management competence and ability to collect the bills and others can be listed. Figure (1) shows the existing situation in the major water supply bodies across the West Bank.

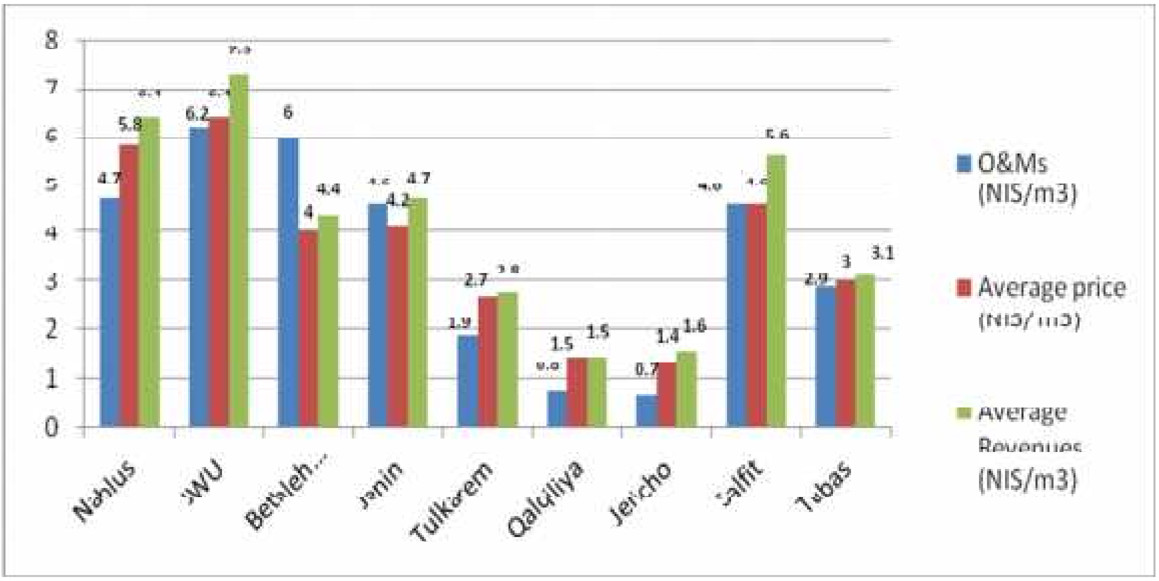


Figure 1: Existing situation in the major water supply bodies across the West Bank

As cab be noticed from Figure 1, the lowest water prices are found in areas with relatively rich of water (Tulkarem, Qalqilia and Jericho). However, this advantage does not justify proceeding with the current tariff systems which is generally low.

4.2 Pricing of Water

4.2.1 Criteria for water pricing structures

A water pricing structure needs to be well thought during its development and implementation. It should consider the following:

a) Water-pricing should reflect the full costs. These costs should take into account delivery of water; operation and maintenance of infrastructure (i.e. pipe networks, reservoirs, pumping stations); asset replacement; future capital expenditure and the environmental protection and restoration costs associated with water use;
b) pricing for water and related services must be transparent
d) there should be some incentives to promote efficiency of water use;
e) there should be an exponential pricing structure in place. Thus, consumers should pay more for the last cubic meter of water they use than for their first one used.

Water utilities must collect enough revenue to meet expenses. This revenue primarily comes from customers who pay for the water service provided. In principle, water prices should reflect the full cost encountered in the supply of water. However, it is too often the case that the water utilities have not based water rates on the full cost of providing the water or the revenue needed to operate the system. Historic under pricing and lack of public awareness has created a dilemma for water utilities and become one of the central challenges of modern environmental management; namely, how to provide safe drinking water at an affordable price to its citizens.

Similar to the pricing of other commodities, the price of water has an effect on usage. The price can theoretically be used to motivate water conservation. Though the degree of this effect varies, experience in many communities indicates that pricing must be used in combination with other conservation efforts (e.g., awareness raising) to be effective. Pricing seems to be most effective in reducing residential peak use and commercial and industrial average use (Abu-Kishk Katkhuda, 1999).

4. 2.2 Types of Water Pricing Structures

There are several water pricing structures exist, they vary from the flat rate pricing, lifeline pricing to the Increasing Block Tariff (IBT) pricing structures. This later is the most widely used and accepted pricing system, it also meets the most number of criteria listed earlier. Empirically, however, the implementation of an IBT system can be extremely complicated, and can carry with it a number of undesirable effects if not addressed from the outset of its formulation.

An IBT structure, like that of a “lifeline” system is designed to meet the basic needs of the entire population while fully recovering economic costs for the utilities involved. Under an IBT, the water utility charges the consumer a unit price for the first number of specified units used. This initial amount is what comprises the first block. Ideally, this first block should be considered as a “lifeline” quantity, and is provided at a price intentionally set below marginal cost. From this point, a second “block” starts where the price of water per cubic meter increases. This price stays to a given level of consumption. Following that level, the third block starts, and the price increases again accordingly. This repeats itself for the total number of blocks. The effect this has is to subsidize the first “block” for low income families, so everyone can meet their basic requirements for domestic water consumption.

One of the strongest arguments in support of IBTs are that they promote equity through the use of a cross subsidy from the rich to the poor. At first glance it seems to meets the definitions of both horizontal and vertical equity that equals are treated equally and unequal are treated unequally.

Secondly, an IBT structure is designed to promote the conservation of water. As the price per unit of water increases with each block, it is assumed that given water is a normal good, consumption will decrease. People will be less likely to use water in wasteful ways or in ways where its benefit is below its cost.

Although IBT water tariff structures are the most common form of water pricing currently found in developing countries, there are a number of problems that need to be examined during its implementation. When designing an IBT system, there are three key decisions that must be made: **(1) the number of blocks must be determined, (2) the quantity of water designated to each block must be chosen, and (3) the prices to be charged for each block must be established**.

One of the most frequent difficulties in formulating an IBT price structure are the decisions involved in the setting of the volume for the initial block. Often times the first block is set at a level, which far exceeds the minimum “lifeline” requirement. Political and public pressure can make it difficult for municipalities and utilities to set the initial block at low enough level. Both the WHO and the World Bank have determined that the basic water need for an average family of five is around 4-6 cubic meters per month. The problem arises when one observes that the initial block found in most IBTs in developing countries is rarely close to this level. On average, the initial block was set much closer to 15 cubic meters per month (more than three times the minimum requirement). This is because a high first block not only benefits the poor, but also the upper and middle classes.

The type of water pricing schemes currently exists in the West Bank vary from the flat rate water pricing structures to the increased block tariff water pricing in the best cases. It is possible that there are some other types of water pricing schemes exist but it is not within the scope of this work to study the different types of existing water rate structures.

4.2.3 Implementation of Water Pricing Structure

The greatest challenge before policy makers will be to develop a practical, implementable system to sensitize consumers to the acute scarcity of water and incentivize lower consumption. Doing this through increased prices alone could be difficult. Even at today’s prices of water, which is often excludes the price of water itself, utilities are unable to pass on all costs to consumers. Therefore, most governments will have their work cut out for them to implement scarcity pricing for water.

In addition to laying out a road map for implementing the scarcity pricing of water, policy makers should also clearly spell out which sections of society are to get subsidized water and how they expect society to pay for this subsidy. Once these areas are addressed, policy makers should allow water utilities to run like any other commercial business within the confines of these two pillars of policy.

4.2.4 Important Factors for a Successful Water Pricing Structure

Many authors have listed several key factors that may influence the success of any water pricing structure. The most common factors are listed below:

- Community participation
- Willingness to pay
- Information
- Financial situation
- Ability of consumers to pay
- Ability of the supplier to deliver
- Institutional and organizational context
- Possibilities for taking sanctions

4.2.5 Difficulties Concerning Pricing of Water

The dilemma that often faced by the public authorities when pricing water is to balance the contradictions between the different demands from high-income and low-income householders in the same geographical area.

The political aspects of setting a tariff according to the real cost is immense in an environment where the poor do not have access to many of their basic needs, and there are large inequalities in society. The price of water is part of the welfare role played by the public authorities. At the same time they play the game set by the technocrats, opting for global technical solutions but not taking into consideration the subsequent feasibility for customers who are unable to pay properly for the service.

Not only are the users responsible for paying for the water. There is also a high responsibility on the side of the policy makers and the water utilities. A citizen can be willing to pay more for the water, but this citizen must also obtain sufficient quantity of water with adequate quality.

If utilities are to accept their responsibility to increase water supply capacities, they have to improve their financial performance by covering the cost they incur for treating, transmitting and distributing water.

4.2.6 Pricing of Water in Palestine: Reality and Challenges

Water Law No. 3 for the year 2002 declares water as a public property and states that every person has the right to receive sufficient water of an adequate quality for basic water consumption and sanitation needs. According to section 2 article 7, Palestinian Water Authority has been granted full responsibility over managing water resources and sanitation in Palestine. It was mandated to issue licenses and permits for the uses of water resources and for the discharge of pollutants; to assure optimal utilization of water resources for public uses (by monitoring water use and sources of pollution, as well as by enforcing licenses and permits); to regulate existing water institutions; to establish regional water and wastewater utilities; and to prepare a National Water Master Plan. In addition, article (20) of the Water Law (No. 3) states that " a uniform tariff system for water services to be placed in Palestine with the aim to encourage water users to conserve water resources and to achieve optimal use of them under the regulation to be issued for this purpose. "

Accordingly, the Palestinian Water Authority in cooperation with the Ministry of Local Governments, municipalities and institutions as well civil society organizations that have a relationship with water have prepared a draft tariff system regulation in 2002 and modified it in 2008 which consists of two parts:

Part I: A legal document to be approved by the National Water Council.

Part II: Implementation procedures of the tariff policy.

Article 5 of the regulations sets the objectives of the draft tariff structure as follows:

1. **Cost recovery:** The tariff structure and prices set shall ensure cost recovery for the individual utilities whereby revenues exceed costs. The water utilities shall increase revenue collection in the following stages until full cost recovery is achieved:
Phase 1: revenues cover operating and maintenance costs.
Phase 2: revenues cover operating and maintenance costs and the proportion of fixed assets depreciation based on the true value.
Phase 3: revenues cover operating and maintenance costs as well as the rate of fixed assets depreciation based on the true value, and loan interest (if any).

2. **Social justice:** the tariff structure takes into account the ability of poor families to pay for water to meet their basic domestic consumption.

3. **Economic efficiency:** The tariff structure shall set an economic price for the higher consumption levels to encourage conservation and signal future prices to the consumers.

Furthermore, PWA has developed a standard block range as a guidance to be applied in the water tariff as well as the price per cubic meter in each block. It is summarized in Table 1.

Table 1: Proposed blocks and price per m3 in each block

Customer Categories	Tariff Structure Blocks or Bands (cubic meters/month)				
	0 to 5	**6 to 10**	**11 to 20**	**21 to 30**	**> 31**
Domestic	1.0	1.5	1.5 to 2.0	2.0 to 2.5	2.5 to 3.0
Public Agencies	1.0	1.5	1.5 to 2.0	2.0 to 2.5	2.5 to 3.0
Commercial	2.0 to 3.0	2.0 to 3.0	2.5 to 4.0	2.5 to 4.0	2.5 to 4.0
Industrial	2.0 to 3.0	2.0 to 3.0	2.5 to 4.0	2.5 to 5.0	2.5 to 6.0

Source PWA, Water Tariff Policy 2002.

As can be seen from the table above, the price per cubic meter of water in the highest levels of domestic consumption may be up to three times more than water used in the lowest level. Similarly, industrial water consumption is priced up to three times higher than domestic consumption.

PWA also proposed a model for calculating the price per cubic meter. It requires well documented information on the assets, operation and maintenance expenses, volume of water supplied and volume of water billed and other related information.

However, there were several challenges facing the Palestinian Water Authority in implementing water pricing policy in the oPt. PWA had to deal with all the different laws, regulations and military orders prevailed in the Palestinian Territory prior to the establishment of the Palestinian Authority in 1995. The main issues and challenges recorded in this respects are the following:

1. It was recognized that there is a need to deal with the legal distinctions between water ownership and water administration which have been preserved by earlier legal developments. This to be done either through the development of existing administrative structures or the creation of new ones.
2. As to existing administrative structures, a specific right exists for the determination of water tariffs.
3. Local Government Law#1 for the year 1997, grants the local Municipalities and local councils the authority to develop their own water tariffs and grants the Ministry of Local Governments the responsibility to approve such tariffs.

Under these challenges, developing a water pricing structure that may overcome most of the constraints and issues mentioned above, remain to be developed for all water suppliers in the West Bank. The main challenge however, may appear during the implementation of such structures and what type of resistance by various users might emerge. Based on this information and in line with the objectives and gridlines of the Palestinian Water Authority Water Tariff Policy, PHG tried to develop a water tariff structure for Tulkarem District.

4.3 Tariff Structure Development for Tulkarem District

4.3.1 Background

The existing water supply management in the District is highly scattered and weakly organized. There are many actors charged with the task of supplying and distributing water for the communities. The lack of cooperation between those actors has been one of the major factors contributing to the inefficient methods of pricing. The result of this is that we find areas where a low- income household is spending more than 10% of their yearly income on household water use alone. Water pricing depends mainly on the source of water, mean of transport and distribution. For areas with piped water systems, pricing is done by the municipality or the village council. For the partially piped or un-piped communities the water prices depend on costs of pulling water through water trucks.

The low prices charged for drinking water in the District as well as the small percentage of customers who actually pay their water bills contributes to the inefficient management of water and ends up in providing a poor service. In some communities, the water projects fee collection rates were less than 30%, even when water charges are below the cost of project operation and maintenance. This creates serious problems both for municipalities and, in the long run, for customers who will in the end receive poor water supply services. If the fees collected do not cover the costs of a water supply project, its sustainability, without continued government subsidies, will be at risk.
Not only that, but in many cases, fees will also need to include a charge for the cost of capital required to construct the project. This charge for capital is important for future water supply investments.

The objective of proper pricing is to encourage people to rationalize water use and to optimize the output or net economic returns per unit of water used. As water scarcity increases, the importance of water use efficiency objective is likely to grow and be given a higher priority. Efficiency is used in the economic sense: maximizing benefits subject to technical and physical limitations. Minimizing network water losses means maximizing efficiency in water use and eventually the society's benefits over time. In practical terms, improving water use efficiency means increasing the value of water unit input per unit of water consumed. To achieve both objectives water service provider should move on two parallel tracks:

1. the technical development of the physical water supply system; and
2. the institutional development of the existing municipalities and village councils.

The existing pricing schemes are mainly reflect part of the direct costs of water supply. While neglecting many terms of costs including depreciation costs, economic, social and environmental costs aimed at generating a higher level of efficiency in the sector. As a result, public satisfaction with the current pricing policies hasn't been met in most of the areas in the West Bank. Even in the areas where the water tariff is low and water consumption is high people willingness to pay is still low.

The following section presents the current water pricing structures of domestic water in the District.

4.3.2 Current Water Pricing Systems in the District

4. 3.2.1 Volumetric Pricing

With volumetric water pricing, the charge is based on the amount of water delivered and registered through water meters. The economic optimal pricing rule requires that price should be set equal to the marginal cost of providing the water, and it requires accurate measurement of water through meters.

4. 3.2.2 Water Pricing and Cost Recovery

As results of low percentage of water collection fees, the Village Councils and Municipalities usually announce a subsidy program, from time-to-time, to encourage customers to pay their water debts. Such program often cause additional burden on the local councils. The collected bills are much less than the actual debt and accounts for less than 60% of the accumulated debt. Therefore, debt subsidy program is neither the right mechanism to overcome the accumulated debt problem nor the right mechanism to increase customers' willingness to pay their water bills to ensure cost recovery.

A review of the water pricing system over the District reveals that local councils are unaware of the main items that must be included in setting the unit price of water. The financial loss in water project is usually compensated by the accumulation of debts or through paying the debts from other financial sources or profitable projects like the electricity. In the end the water project will continue to be a burden living from other projects. This would have negative implications on project sustainability and the level of service that people demand.

Improving cost recovery clearly involves more than just charging higher fees or spending more subsidies on fee collection. Rather, which water costs are to be recovered and what mechanisms should be used to recover them have to be specified. The full costs of providing domestic water can be divided into three categories as follows:

- direct project costs;
- environmental costs; and
- marginal user costs.

Direct costs refer to costs stemming from the process of capturing and delivering domestic water, which can be broken into fixed costs and variable costs. Fixed costs include all investments in water infrastructures such as, water supply and distribution networks, building reservoirs and pump stations and installing house connections, plus depreciation and interest payment on the investment. Higher level administrative costs and some operational and maintenance costs not involved with actual water delivery are also considered fixed costs because they do not vary with the amount of water delivered. Variable costs consist of the operational and maintenance costs of water delivery, lower level administrative costs (usually temporary labor costs during the time of water delivery), and costs of supplying water, which include, material costs, conveyance costs, groundwater extraction costs, and costs due to water loss. These costs vary with location, water supply method, technology, and seasonal changes in power tariff. Direct project costs are the easiest of the three to measure. Most projects take only direct costs into account in determining full cost recovery.

Environmental costs could substantially raise the total costs of projects. These costs include any damage to the surrounding ecosystem during and after the construction of water project. However, rarely water projects in practice include environmental costs as part of their full cost to be recovered. Therefore they will not be included in the current water pricing analyses.

Marginal user cost is defined as the present value of future sacrifices implied by current resource use. It involves the higher costs of obtaining future water supplies because more accessible and less expensive water resources are used up first. In an extreme case, water resources are completely used up in the current period. This cost is especially relevant for groundwater resources with little or no recharge. Excluding marginal user costs in the price of groundwater often results in overuse of the resource and depletion of the aquifers. Although marginal costs are important they will not be included in the analyses of pricing and recovery costs in this report. The reason is that this value is under debate and is more related to future alternative scenarios of water supply and opportunity costs which are out of the scope of this study. Therefore the only costs to be included in this study are the direct costs.

Based on the information above, the next concern is what percentage of total costs should be charged to citizens? In many cases, who should bear the full costs of providing water is not clear. Whether the customers should pay the full costs or the local authorities should pay part of these costs is still not determined. Due to the fact that water supply is not a secondary service, any higher costs associated with this service could have negative implications on the low-income families and hygiene conditions.

Among the direct costs, it is very important to decide if depreciation of investment has to be included or not. Theoretically yes, it must be included, otherwise who then should pay for upgrading and rehabilitating the infrastructure? How the water service can be sustainable? Of course when considering this the existing socio-economic conditions must be taken into account. Therefore, depreciation will be calculated as part of cost recovery analyses, and will be left to the responsible authority to apply it.

4.3.2.3 Overview of the Water Pricing and Tariff in Tulkarem District

Generally speaking all communities in Tulkarem adopt the increasing block tariff system except 8 communities that charging a flat rate per cubic meter and a fixed amount for maintenance per month. The average price for all communities who are served with water network is nearly 3.77 NIS/m3 while it ranges from 1.5 in Annazleh Al Wusta to 5.67 in Illar as shown in figure 2.

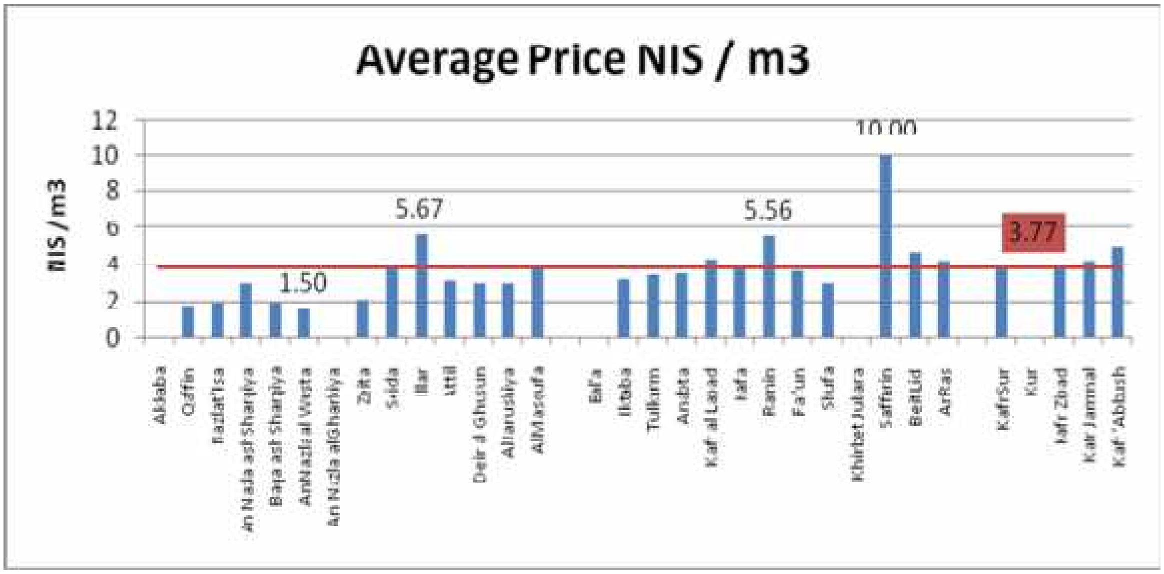


Figure 2: Average price per cubic meter in Tulkarem Governorate

Each village or municipal council is setting their own price as well as the block range. Many of them consider the first block as 0-5 m3 as recommended by PWA but many don't. The main pricing structures exist in Tulkarem Governorate can be summarized for each community as follows:

4.4 Water Tariff in Tulkarem City

There are two tariff systems, one for individual household and the second for multi story buildings. The block range are the same but priced differently as shown in Table xxx

Table 2: Water tariff in Tulkarem City

Domestic Consumption (single house)		**Domestic Consumption (complex or multi-story building share one water meter)**	
Block (m^3)	**Price**	**Block (m^3)**	**Price**
0-5	**17 nis+ 2 nis for maintenance + 2 nis for sanitation**	**0-5 minimum consumption**	**34 nis + 2 nis for maintenance + 2 nis for sanitation**
6-30	**2.5 nis**	**6-30**	**3.5 nis**
≥31	**3.5 nis**	**31 and above**	**4.5 nis**

Water Tariff Anabta

Table (3): Anabta water Tariff

Block (m^3)	Price (NIS)
1-5	**14.5 (2.9 NIS/m3)**
6-15	**2.41**
16-25	**2.81**
26-50	**3.13**
≥51	**6.2**
Bulk Supply to Ramin	**0.52 dinar (2.5 NIS) and reduction 1% overall bill**

Water tariff Beit Leed

They buy their water from the Israeli company Mekorot at 2.6 NIS/m^3. The main tariff structure is shown in Table

Table (4) : Tariff structure in Beit Leed

Block	Price (NIS)	Note
0-5	21.5	3.5 nis/m^3+ 4 nis maint
6-10	3.5	
11-20	4.5	
21-30	5.5	
≥31	6.0	
Bulk Supply	5.5	Saffarin (water tanks)

The village council is keeping a record of water use of its customers under each block so they can better control large water users. This experience is very good and recommended to be transferred to other councils to do the same. The main water quantities used under each block is summarized in Table 5.

Table (5): Water consumption by block in 2008 in Beit Leed

Block (m3)	Quantity (m^3)	Percentage
0-5	10132	11.0%
6-10	21521	23.4%
11-20	30790	33.5%
21-30	12234	13.3%
31 >	12909	14.1%
Wholesale	4221	4.6%
Total	91807	100%

Water Tariff in Rameen:

The water tariff includes the costs of pumping, operation but not the depreciation costs on investments. In addition a monthly fee that covers meter and network maintenance is charged for all subscribers. Accordingly, the tariff is fixed for all uses as shown in Table 6.

Table(6) : Tariff Structure at Rameen

Block Range (m^3)	Price NIS/m^3	Maintenance Fees
0-4	16.00 NIS	
5-10	4.60 NIS/m^3	5 NIS / month
11-30	5.90	

	NIS/m^3
>31	6.50 NIS/m^3

Water Tariff in Bala'

The first block 0-5 m3 they charge 15NIS plus 5 NIS for maintenance. The tariff structure is shown in Table 7.

Table(7) : Tariff Structure in Bala'

Block Range (m^3)	***Price NIS/m^3***
0-5	4 NIS/m^3
6-20	2.50 NIS/m^3
21-50	3.50 NIS/m^3
≥51	4.00 NIS/m^3

Water Tariff in Iktaba

The village council buys water from the well at a rate of 1.2 NIS/m^3. The water tariff includes the costs of pumping, operation but not the maintenance and depreciation costs on investments. The tariff is fixed for all uses as shown in Table 8

Table(8) : Tariff in Iktaba

Block Range (m^3)	***Price NIS/m^3***
0-5	16.00 NIS
6-30	3.00 NIS/m^3
>31	3.50 NIS/m^3

Water Tariff in Kafr Al-Labad

The VC, buys water from the well at a rate of 1.5 NIS/m^3. The water tariff includes the costs of pumping, operation but not the maintenance and depreciation costs on investments. The tariff is fixed for all uses as follows:

Table(9) : Tariff in Kafr Al-Labad

Block Range (m^3)	***Price NIS/m^3***
0-3	15.00 NIS
4-15	3.00 NIS/m^3
16-40	4.50 NIS/m^3
> 41	5.00 NIS/m^3

Water Tariff in Faroun

The village council buys water from the well at a rate of 1.4 NIS/m^3. The water tariff includes the costs of pumping, operation but not the maintenance and depreciation costs on investments. The tariff is fixed for all uses as follows:

Table(10) : Tariff in Faroun

Block Range (m^3)	**Price NIS/m^3**	**Fixed Fee (NIS)**
0	-	10
1-20	2.50 NIS/m^3	
21-50	3.40 NIS/m^3	
>51	4.00 NIS/m^3	

Water Tariff in Kafa

The project committee buys water from Tulkarem Municipality at a rate of 2.5 NIS/m^3. Then, they pump it to the customers in Kafa. The operation of the booster pump costs around 0.5 NIS/m^3. The water tariff is fixed for all uses as follows:

Table(11) : Tariff in Kafa

Block Range (m^3)	***Price NIS/m^3***
0-5	**20.00 NIS**
≥6	**3.50 NIS/m^3**

The water tariff includes the costs of pumping, operation but not the maintenance and depreciation costs on investments.

Water Tariff in Saffarin

The village council used to buy water from Anabta Municipality, however; Anabta wells' are under construction. Therefore, the council did an agreement to buy water from Nablus Municipality in Dir Sharaf well for limited time period. The council get a donation for Kuwait Fund and bought two 10 m^3 tanks. The price of one cubic meter from the source is 6 NIS, Or the filling cost for the 10 cubic meter tank is 60 NIS. Transport costs are around 4NIS/m3. The village council boost the water to the elevated reservoir and sell water to customers at **fixed rate of 10 NIS/m3**. This process looks ridicules, but it is the only way to run the network and make people hopeful according to the council.

Water Tariff in Shoufa and Izbet Shoufa

Water is used for domestic and agricultural, and in total there are 450 connections. Water tariff is fixed for domestic and agricultural uses despite the amount of consumption as follows:

Table (12) : Tariff in in Shoufa and Izbet Shoufa

Block Range (m^3)	Price NIS/m^3
0-100	2.00 NIS/m^3
>101	3.00 NIS/m^3

There are 80 green houses, 40 chicken poultry, cows' farm and diary factory. This makes 30% of the consumption is for uses other than domestic. The house connections are used for agricultural purposes, and this causes stress on demand and less opportunity to regulate water distribution or allocation during the peak rates of consumption in summer times.

Water tariff at Dir Al-Ghosoun

The existing water tariff includes the costs of pumping, operation and maintenance, but not depreciation costs on investments. The well runs daily 16-18 hours per day in summer and 10-12 hours per day in winter. The tariff is applied can be summarized as follows:.

Table(13) : Tariff in Dir Al-Ghosoun

Block Range (m^3)	Price NIS/m^3
0-8	23.00 NIS
9-50	2.00 NIS/m^3
>51	4.00 NIS/m^3

This tariff doesn't apply to the industrial consumption which another fixed rate of 2.5/ m^3.

Water Tariff in Attil

The existing water tariff includes the pumping costs, operation and maintenance, but not depreciation costs on investments. The tariff is fixed over all uses as follows:

Table(14) : Tariff in Attil

Block Range (m^3)	***Price NIS/m^3***
0-5	22.00 NIS
6-30	2.00 NIS/m^3
>31	3.00 NIS/m^3

Water Tariff in Zeita

The municipality buys water from the two wells for 1 NIS/m^3. It covers operation and maintenance, but not depreciation costs on investments. The tariff is fixed for all uses as follows:

Table(15) : Tariff in Zeita

Block Range (m^3)	**Price NIS/m^3**
0-4	12.00 NIS
>5	1.20 NIS/m^3

This tariff applies to all users including the agricultural sector. Almost 100 green houses are connected to the water supply network.

Water tariff Baqa Al-Sharqiya

The municipality buys water from both wells and pays 1NIS / m^3. The existing water tariff can hardly cover the operation and maintenance, but not depreciation costs on investments. The tariff is fixed over all sectorial uses as follows:

Table(16) : Tariff in Baqa Al-Sharqiya

Block Range (m^3)	Price NIS/m^3
0	10.00 NIS
>1 m^3	2.00 NIS/m^3

Water Tariff in Al-Nazleh Al-Wusta

The village council pays 1.2 NIS/m^3, and sells it for 1.5 NIS/m^3 in addition to 10 NIS for the minimum consumption. The village council is expecting to increase the price to more 2 NIS/ m^3 due to the high amounts of losses.

Water Tariff in Al-Nazleh Al-Sharqiya

The village council pays 1.5 NIS/m^3, in addition to 0.5 NIS/m^3 for pumping water from the balance reservoir to the elevated reservoir. The council sells it for all users as follows:

Table(17) : Tariff in Al-Nazleh Al-Sharqiya

Block Range (m^3)	Price NIS/m^3
0-5	15.00 NIS
>6	3.00 NIS/m^3

Water Tariff in Ellar

There is no rate for minimum consumption, but instead; the consumers pay the actual consumption. The existing water tariff is fair to the consumers benefit. It covers operation and maintenance, but not depreciation costs on investments. The tariff is fixed over all type of uses as follows:

Table (18) : Tariff in Ellar

Block Range (m^3)	Price NIS/m^3
0-25	3.00 NIS/m^3
26-35	4.00 NIS/m^3
36-50	5.90 NIS/m^3
>51	10.00 NIS/m^3

This tariff applies to all users including the agricultural sector; such that 100 green houses are connected to the water supply network.

Water Tariff in Seida

There is no rate for minimum consumption, but instead; the consumers pay the actual consumption. The existing water tariff is fair to the consumers benefit. It covers operation and maintenance, but not depreciation costs on investments. The tariff is fixed over all type of uses as follows and applies to all users including the agricultural sector; the village council calculated the cubic meter cost as follows:

Table (19) : Tariff in Seida

Example 10/2009

Item	Quantity	Unit
Consumption	6240	m^3
Primary cost/m3	1.4	Nis
Electricity	5252.22	Kw
Price/kilowatt	0.7	Nis
Operation costs		
West pump	1000	Nis
Ellar pump	1500	Nis
Admin	200	Nis
Ellar water bill	15112.56=6240*1.4+52 52.22*0.7+2700	Nis
Cost per cubic meter	2.421885	Nis
Selling price/m^3	4	Nis

Water Tariff in Qifeen

The existing water tariff includes the costs pumping, operation and maintenance, but not depreciation costs on investments. The tariff is fixed for all uses as follows:

Table(20) : Tariff in Qifeen

Block Range (m^3)	Price NIS/m^3
0-6	12.00 NIS
7-40	1.50 NIS/m^3
>41	2.00 NIS/m^3

This tariff applies to the agricultural and industrial consumption.

Water Tariff in Nazlet Issa

The VC, buys water from the well at a rate of 1.5 NIS/m^3. The water tariff includes the costs of pumping, operation but not the maintenance and depreciation costs on investments. The tariff is fixed for all uses as follows:

Table(21) : Tariff in Nazlet Issa

Block Range (m^3)	Price NIS/m^3
0	10.00 NIS
≥1	2.00 NIS/m^3

Water Tariff in Al-Jarushiya

They get water from Tulkarm Municipality. The council buys water at a rate of 2.5 NIS/m^3 as fixed price despite the time and the quantity. There are 200 house connections and use the pre-paid water meters. According to the village council, they have no problems with these meters and fees collection is very efficient. They are able to pay the monthly bills in addition 2000 NIS from the previous debts. Water quality is monitored by Tulkarem Municipality and they have no records of pollution over the past period. **They sell water at fixed price of 3 NIS/m^3** and whatever is the quantity. Network maintenance is supervised by the village council and new connections also. The new customer pays 80 JD as a lumps sum fee to connect to the water network.

Water Tariff in Al-Masqufa

They get water from Tulkarm Municipality. They buy water at a rate of 2.5 NIS/m^3 as fixed price despite the time and the quantity. There are 52 house connections and 25 of them belong Iktaba water network Therefore, the village council is responsible 27 connections only. The council sells it for all users as follows:

Table(22) : Tariff in Al-Masqufa

Block Range (m^3)	Price NIS/m^3
0-5	20.00 NIS
≥6	3.50 NIS/m^3

Water Tariff in Al-Ras

The village council pays 2.95 NIS/m^3 and sells it back to the consumers as follows: from zero-25 m^3 the price is 3.5 NIS/ m^3 .From 26-40 the price 4.5 NIS/m^3 and from 41 and more the price is fixed 5 NIS/ m^3.

Table(23) : Tariff in Al-Ras

Block Range (m^3)	Price NIS/m^3
0-25	3.50 NIS/m^3
26-40	4.50 NIS/m^3
≥41	5.00 NIS/m^3

Water Tariff in Kufr Abboush

The cost per cubic meter is 3.8 NIS and the council sells water for 5 NIS/m^3 in addition to 6 NIS for maintenance.

Water Tariff in Kufr Jammal

The village council pays 2.95 NIS/m^3 and sell it back to the consumers as follows:

Table(24) : Tariff in Kufr Jammal

Block Range (m^3)	Price NIS/m^3
0-25	3.50 NIS
26-40	4.50 NIS/m^3
≥41	5.00 NIS/m^3

Water Tariff in Kufr Zibad

The village council buys one cubic meter for 4 NIS. Then the council sells water according to the following tariff: zero consumption for 10 nis/water meter. The first block stars from one or two cubic meters for 15 NIS. If consumption exceeds 3 cubic meters the price is fixed 4 nis/m3 plus10 nis as the cost for minimum consumption.

Table(25) : Tariff in Kufr Zibad

Block Range (m^3)	Price NIS/m^3
0	10 NIS
1-2	15 NIS
≥3	4.00 NIS/m^3

Water Tariff in Kufr Soor

The village council pays 2.6 NIS/m^3 and sells it back to the consumers as follows: 6 nis as minimum consumption.

Table (26) : Tariff in Kufr Soor

Block Range (m^3)	Price NIS/m^3
0-30	3.50 NIS/m^3
31-50	4.00 NIS/m^3
51-60	5.90 NIS/m^3
≥61	6.00 NIS/m^3

Proposed Water Tariff for Tulkarem Governorate

Analysis of Current Block Settings and Prices

Based on the existing information on water tariff listed above, we realized that most water supply providers have no basis for considering the block range. We also realized that most pricing structures don't comply with the objectives of adequate pricing policy recommended by PWA. For example we realized that the price per cubic meter at the first block is the highest where it ranges from 2 – 5 NIS /m3 while the block price range from 10 to 27 NIS as shown in Figure 3.

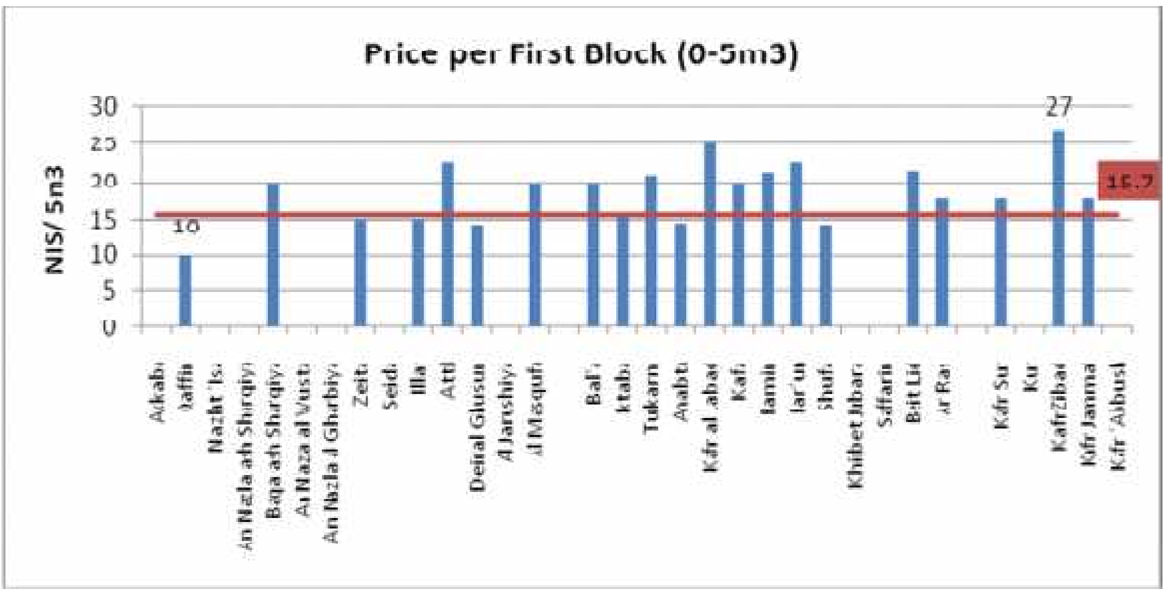


Figure 3: Price per first block (0-5 m3)

It can be noticed that the pricing structures don't match with the policy objective of the social justice where theoretically, the one who use less should pay less and those who use more should pay more and should compensate for those who use less which generally they are the poorer ones. The current structures are exactly opposite. If one uses less he / she pays more which also doesn't encourage water conservation at certain points especially in the areas where the price per cubic meter is already low.

Moreover, the available information shows that there is no clear mechanism in setting the price per m3. It was not easy to understand how the price is being calculated due to the lack of information from most of the councils. However, as indicated earlier the price ranges from 1.5 – 5.6 NIS.

Cost Recovery Analysis

Due to the fact that no cost information was available from most of the councils, it was hard to analyze the cost recovery for most of them. Therefore, we considered a sample of 7 water suppliers for whom information on water production and supply cost is available and tried to understand whether they attain cost recovery or what percentage of the cost they recover. During the calculation we considered the billed water quantities and not the produced ones to get better understanding of the cost recovery. Figure 4 shows the cost per cubic meter produced in these seven councils and also the weighted average cost per cubic meter which is nearly 1.5 NIS.

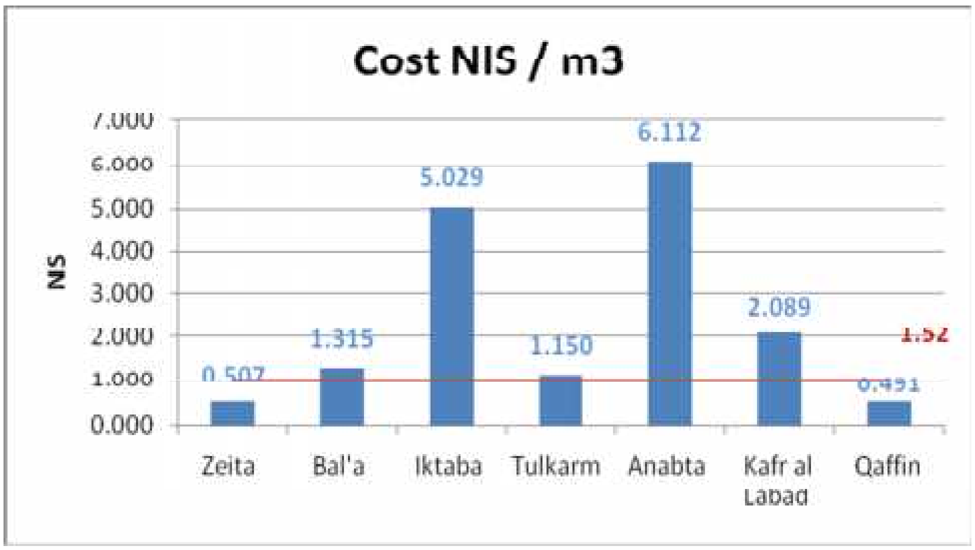


Figure 4: Cost per m3 (NIS)

As can be noticed from figure 4, production cost is highly variable. It varies from nearly 0.5 NIS in Qaffin and Zeita to 6.1 NIS in Anabta. This huge variation may result from the volume of operation and the size of water supplier as well as the efficiency of supply system. Moreover, the fact that there are no independent accounts maintained for the water supply within these entities, it is not easy to define the exact reason for this variation. Yet, the most probable reason remains the size of the supplier and the associated costs as well as the efficiency of the system and the associated losses. For example, the losses in Anabta are nearly 36%. They also have some relatively high expenses where the average monthly expenses are nearly 74,554NIS. They also run in deficit in 8 months of the year where the return generated from selling water is less than expenses as shown in figure 5.

Figure 5: Monthly Profit / Loss in Anabta

Although the net end year balance is positive, still there is something wrong in the operation or management of the water supply system. More detailed and through analysis will be needed to understand the main causes of the high price and also to develop a better management and operation of the water supply service at the town.

When we looked into another example where data was available, we realized that the situation in Bala is a little bit better where average monthly expenses are nearly 25,645NIS while they run four months in deficit as shown in Figure 6.

Figure 6: Monthly profit / loss Bala'

This also indicate a similar pattern of operation to Anabta and may be resulted from non customer payment of their bills in certain months where the revenue generated is less than the expense and this causes the deficit in the given month. When it comes to April Month, the Municipality invested some money in the network maintenance and this is what caused the big jump in the deficit. However, the operation seems better.

According to this analysis and when the income and expenses from the water supply in the seven water supply entities were compared it was realized that the expense is more than return from water sold in several entity especially the big ones as shown in Figure 7. When we also compared the average price per cubic meter versus the average cost we also realized that in some water supply entities the cost is higher than the price charged as shown in figure 8. Therefore, cost recovery from the current management and pricing is also not achieved in most of them.

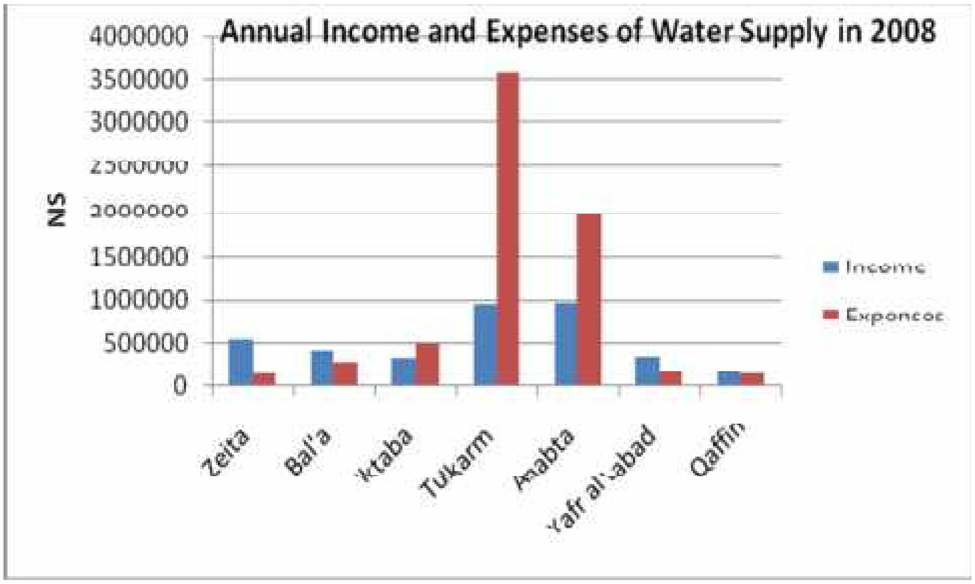


Figure 7: Income and Expenses of Water Supply in 2008

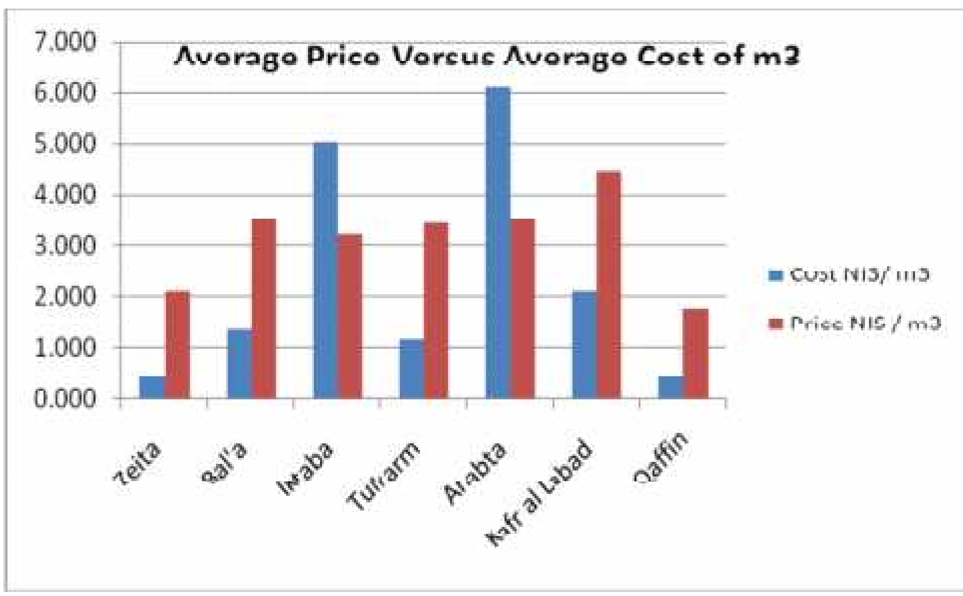


Figure 8: Comparison between average cost and average price of m3

We noticed that in both Anabta and Iktaba the deficit is also related to inaccurate pricing as shown in figure 8 as well as other potential reasons mentioned earlier.

Proposed Tariff Structure of Tulkarem Governorate

Following to this analysis of the costs and pricing exists in the Governorate we realized that it is important to improve the pricing structure in a way that answers the major policy objectives proposed by PWA and recognized also globally as a requirement for sound water pricing structure. The main objectives are:

Water pricing structure should:

1. Ensure social equity
2. Attain Cost recovery
3. Encourage water conservation and more rational water use

To address these objectives, existing block water tariff can be modified to reflect the basic water needs and taking into account the needs of the poor and marginal people. Accordingly, the first block should be determined in a way that address such needs and that poor people can afford paying for obtaining water for their basic needs. Based on our per capita water use analysis presented in the previous chapter, the average per capita water use in the governorate was nearly 90 liters per day. Moreover, the average family size in the Governorate is nearly 5.3 persons.

Accordingly, the first block should be 16 m3/month based on 90 l/c/d and 6 individual per household. However, the minimum use defined by most of the water supply entities is ranging between 0 – 5 m3. This also coincides with the recommendation of PWA and matches the minimum water requirement or basic human needs. However, this minimum water use block is priced differently in a manner that doesn't take the interest of the poor into account. Therefore, we propose to set the price per cubic meter under this block to be below the weighted average cost of 1.5 NIS in the Governorate. We may propose 1.2 NIS/m3 for the first 5m3 used. After that each cubic meter used within the first block should be priced at the cost plus or at price slightly higher than the cost. Of course since production cost varies substantially among the different suppliers in the Governorate we may consider the weighted average cost again to define the price per m3 under the first block, say 1.5*1.3 = 2 NIS/m3. Then increase the blocks volume and increase the prices accordingly to ensure that the higher water quantity is used the more is paid per m3 used.

It is good to mention that during the survey conducted at the Governorate, people were asked about what they think the right price for water should be, in an attempt to measure the willingness of people to pay and to see how much they are aware of the existing water prices. We realized that 65% of the people responded to this question and 35 didn't respond. Out of those responded the majority believe that the price should be 3NIS and more as shown in Figure 9.

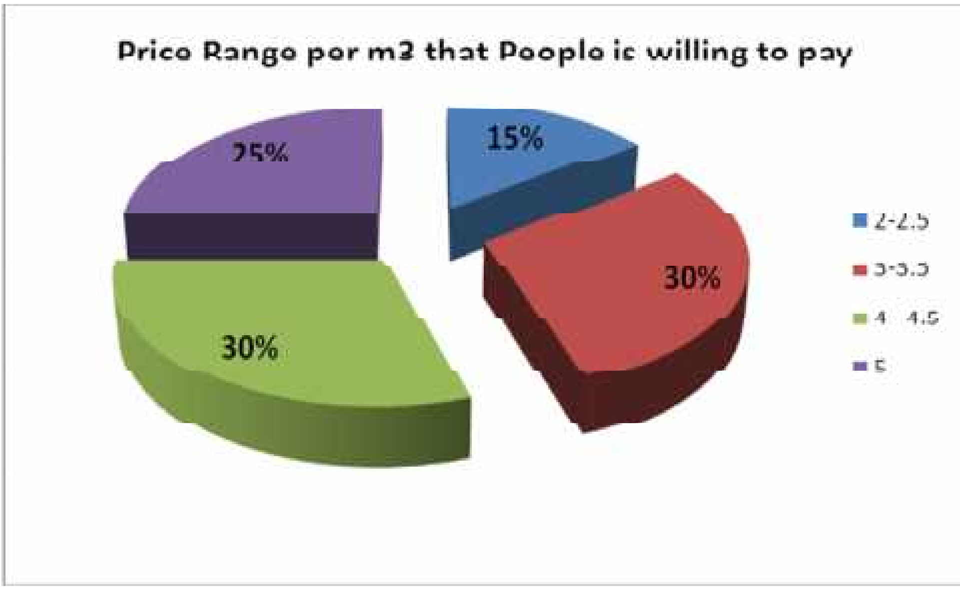


Figure 9: Price range that People are willing to per m3.

As can be noticed, 60% of those responded believe that the price should be between 3 – 4.5NIS/m3 while 25% believe that it should be 5NIS/m3 and only 15% believe that it should be between 2 – 2.5 NIS/m3.

In addition, the average price per m3 as indicated by the respondents was nearly 3.8 NIS which almost the same as the current average price per m3 applied in the Governorate as shown in Figure 10.

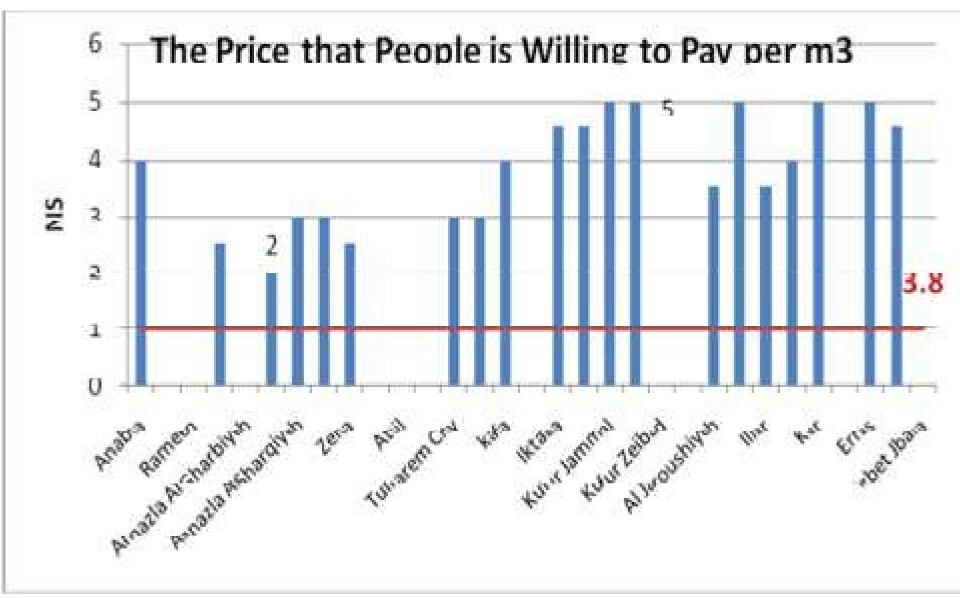


Figure 10: The price that People is willing to pay per m3

Based on this information and analysis, we may consider water tariff in the Governorate that may capture what people is willing to pay and what actual costs incurred at the time being in the different municipalities and councils. So the price should start from 2NIS as the minimum price that people is willing to pay and slightly more than 5 NIS defined as the maximum that people is willing to pay to allow for covering the cost in some areas which may reach 6 NIS and higher and also to encourage the rational water use and environmental sustainability of the resources. Accordingly, the proposed water tariff for the entire governorate can look like the proposed tariff shown in Table 1.

Table (27): Proposed Tariff for Tulkarem Governorate

Type of consumption	Tariff blocks (m^3)						
	0 - 16		17 to 30	31 to 45	46 - 60	61 - 80	>80
Domestic	0 – 5	6 to 16					
	Price NIS / m3						
	6	2	3	4	5	6	7
Institutional	20		3.5	4.5	5.5	6	7
Commercial	30		3.5	5	6	7	7.5

The fact that municipalities are charging fixed fees to customers equally regardless of the quantity they use makes the price per cubic meter at the first block very high. This is why it is important to reconsider this policy and the fixed fee to be charged proportionally to the quantity of water used. In this way more social equity can be attained. It is proposed to charge a minimum of 5NIS for the first block after the minimum use of 5m3. After that, from the second block onward charge a minimum of 10 NIS for the second and third block, 15 NIS for the fourth and fifth block and 20 NIS for the last block.

Based on the proposed tariff above it can be realized that the more water is used the more is paid. Figure 9999 shows the percentage of monthly income spent on water according to the block range or quantity of water used. It can be deduced from the figure that average spending of households will be nearly 2% of their monthly income if they use the quantity set within the first block of 0-16 m3. This percentage reaches 5% of the average monthly income when the water used reaches 30 m3. It then increases to reach almost 30% of the average monthly income. Of course the high water use is assumed that it will go for production and thus will no longer be for domestic use. Moreover, the average income level will be higher for such households and therefore this figure is not applicable. It is also important to notice that the first 5 m3 is provided at almost less than 1% of the monthly income which ensures that everyone will get the basic water need.

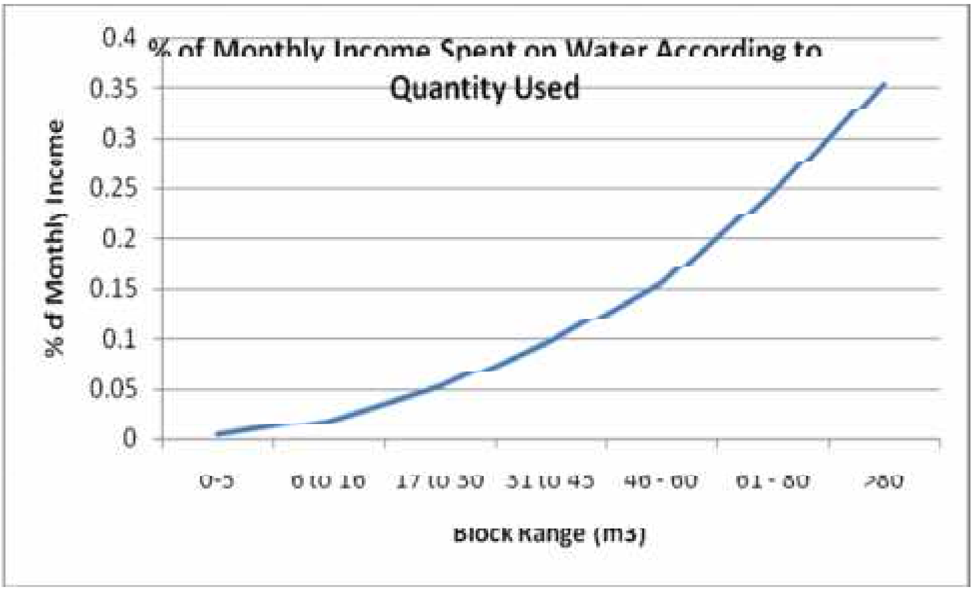


Figure 12: % of Monthly Average Income Spent on Water According to Quantity Used

ANNEXES

FINANCIAL INFORMATION

Tulkarem City: Water project Incomes for 2008- 2009

Item	Yr 2008 (NIS)	Yr 2009 (NIS)
Revenue collected	646,170.99	1,987,938.48
Water Meters	32,010.	10,470.26
Water tanks	242,457	220,240.80
New connection fees	44,783.90	47,494.89
Contribution by customers in Material costs		
tenders and announcements fees		
penalties		
Re connection		
Collected debts	2,119,529.40	1,962,654.14
Total Income	3,084,951.29	4,228,798.57
Expenditures on water project in years 2008-2009		
Salaries 2008- 2009		
Item	Yr 2008 (NIS)	Yr 2009 (NIS)

water employees salaries	1,582,855.60	1,842,885.62
labor costs	858,098.50	1,056,233.27
Health Insurance	1,300.00	149,816.69
End of Service Allocations	242,596.98	262,723.84
Work termination indemnities	5,087.0	3,848.00
incentives	32,600.0	3,070.00
Work Insurance	26,188.80	20,000.00
External collectors		2,051.00
Over time	13,281.00	43,023.00
Total	2,762,007.88	3,383,651.42
Operation and maintenance costs		
Item	Yr 2008 (NIS)	Yr 2009 (NIS)
Oil and fuel	237,952.40	163,311.71
Motor and pumps maintenance	178,121.00	428,147.00
water network Maintenance	192,191.00	273,235.00
Bought water from other sources	10,740.00	17,055.00

chlorination	55,938.00	19,950.00
electric power costs	68,544.00	1,120,000.00
water meter maintenance	4,050.00	
maintenance tools	4,395.00	6,999.00
Labs expenditures		
cars maintenance	4,966.00	20,179.00
cars insurance	21,286.00	38,603.00
reservoirs maintenance		
	798,183.40	2,087,479.71

General administrative expenses, industrial Indirect Costs

Item	Yr 2008 (NIS)	Yr 2009 (NIS)
Phone and post costs	12,514.11	12,795.10
water and electricity		48,570.05
office accessories	8,766.00	2,209.80
Hospitality	5,330.00	140.00

Publication and announcements	4,250.00	10,900.00
clothing	8,340.00	2,652.00
transportation and travel	6,809.00	7,085.40
local and mobile calls	53,576.75	21,983.70
furniture	6,976.00	1,575.00
office equipments	10,794.00	1,400.80
	117,355.86	109,311.85
Total expenditure on project	3,677,547.14	5,580,442.98
Balance of incomes and expenditures	-592,595.85	-1,351,644.41
Accumulated debts of customers is around	34,000,000	

Water project incomes/outcomes 2007-Anabta

Monthly income (NIS)										
1	2	3	4	5	6	7	8	9	10	11
49558	44286	55421	60113	88345	87855	112132	109003	89779	90976	66915
204	496	1249	879	2015	910	596	3433	1875	633	806

0	0	678	648	1080	270	432	2318	1122	456	432
0	0	810	1110	1350	270	840	3558	1650	558	858
522	93	90	738	1068	1476	1620	912	960	1443	258
3282	3575	3895	3311	3128	4456	8219	14551	10629	7456	8525
12694	11754	15062	16602	21173	28292	27430	26603	26112	16878	19162
21981	22076	22204	22127	23627	24217	25817	25837	34045	25355	28288
4840	4720	4840	4700	3640	5445	4050	4095	6173	5439	4819
917	917	917	917	917	917	917	967	967	967	967

0	0	200	0	0	0	0	0	0	2200	0
4536	280	6400	1050	3500	4789	46	0	910	0	30
1029	1226	323	2083	1252	12238	1369	1235	2405	12397	318
3703	3703	3703	3703	3703	3703	3703	3703	3703	3703	3703
6265	6265	6265	6265	6265	6265	6265	6265	6265	6265	6265
1106	1106	1106	1106	1106	1106	1106	1106	1106	1106	1106
-11113	-10933	-6847	148	23411	-3599	33458	33038	1151	9414	-4430

Water project Incomes in 2008-Anabta

Monthly income (NIS)

1	2	3	4	5	6	7	8	9	10	11
55219	50569	59077	70739	74581	122304	102184	97323	90860	88159	67003
1649	2123	1110	3277	1453	777	1225	1368	2885	1166	1155
1006	1061	588	1803	1012	248	446	644	546	498	297
1459	1485	1017	2777	1265	0	0	0	0	0	1045
141	123	117	759	390	2319	1497	1542	963	1128	2265
12561	11892	5132	5126	5627	6670	8026	7878	15047	6857	10077
14257	18168	20257	21238	16425	28000	28000	28000	28573	26724	19000
29584	30155	31206	30284	30534	29984	30771	30563	31864	31952	33321

2850	1350	1350	1350	1350	1350	4386	1350	1500	1500	1500
967	967	947	947	947	947	947	947	947	1022	1022
0	0	0	0	0	0	0	0	0	0	0
9000	892	5038	0	229	3450	950	0	0	0	0
670	1588	715	5220	5332	6002	1047	2304	9113	1967	4707
3740	3740	3740	3740	3740	3740	3740	3740	3740	3740	3740
6328	6328	6328	6328	6328	6328	6328	6328	6328	6328	6328
1117	1117	1117	1117	1117	1117	1117	1117	1117	1117	1117
-21882	-21082	-14155	2487	6292	33422	17046	15566	-4901	7488	-13577

Water project balance in Beit Leed

Income

Item	**Amount (NIS)**
Water sold by consumers bills	**450013**
Real Collection amount	**307434**
Remaining dept for this year	**138817**
Previous debt	**630616**
Total depth accumulated	**769433**
Changing moving water meters	**124**
New house connections	**1410**
Wholesale	**24365**
Other	**33276**
Total (2008)	**509188**

Expenses

Item	Amount (NIS)
water purchased prices	325941

pumping power costs	81813.59
maintenance costs	1200
Employee salaries fixed and variable	44944.2
Other costs	0
Depreciation, insurance (not included)	0
Total (2008)	453898.79

Water Tariff Bala'a Water project incomes/outcomes

Water project Incomes in 2008

item	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	Total
water prices	15795	10877	14010	21684	28587	33517	42467	44432	44734	46454	44461	40344	387362
new connections fees	2090	3539	1925	3334	5434	2708	3900	2285	2456	1045	1155	4915	34786
water pulled by tankers	0	0	3105	0	0	0	0	111	50	0	0	0	3266
Tenders and announcements fees	0												1150

Contribution by customers in Material costs	0	350
Connection and disconnection fees	0	792
new connections debts	0	138
Debts	7000	105000
Total	24885	532844

Bala Water project expenditures in 2008

Item	Month											
	1	2	3	4	5	6	7	8	9	10	11	12	
water employees salaries	3576	3576	3576	5020	5455	5020	5020	5020	5020	5020	5020	6470	57793
labor costs	50	1450	550	270	445	420	1250	450	948	0	1700	400	7933
over time labor costs	0	55	0	266	239	53	0	0	310	0	70	2675	3668
oil costs	0	0	0	1380	25	0	0	0	0	0	0	0	1405
maintenance of pumps and motors	0	0	0	0	0	1400	0	98	0	0	0	0	1498
water network maintenance	802	0	0	53541	70	0	1140	0	0	0	1182	0	56735
chlorination	0	0	78	0	0	0	215	362.5	110	725	0	362.5	1853
electric power costs	0	0	0	0	38607.5	0	57980.6	38752.4	0	0	0	0	135340.6
water meters maintenance	0	0	0	2100	0	0	0	0	0	0	0	3600	5700
maintenance tools	0	0	0	0	1000	0	69	0	0	0	672	0	1741
clothing	0	0	0	0	0	0	0	10000	10000	10000	0	0	30000

general appliances	190	3894	0	0	0	0	0	0	0	0	0	0	4084
Total	4618	8975	4204	62577	45841.53	6893	65674.65	54682.91	16388	15745	8644	13507.5	307750.59

Bala Water project Incomes from 1/1/2009-31/7/2009

item	Month							
	1	2	3	4	5	6	7	
water prices	44241	26109	31214	25353	34301	55679	56150	273047
new connections fees	220	1120	1055	1665	4250	3296.75	3575	15181.75
water pulled by tankers	0	0	0	0	0	0	50	50
tenders and announcements fees	600	0	450	0	0	0	0	1050
Contribution by customers in Material costs	0	0	1400	1500	1000	0	0	3900
Connection and disconnection fees	0	50	50	0	50	50	0	200
Debts	7800	5000	5500	5000	5500	10000	10000	48800
Total	52861	32279	39669	33518	45101	69025.75	69775	342228.8

Bala Water project expenditures from 1/1/2009-31/7/2009

Item	Month							
	1	2	3	4	5	6	7	
water employees salaries	7070	7070	7070	7070	7070	7070	7070	49490
labor costs	400	400	400	1540	1330	820	520	5410
over time labor costs	0	0	1978	1286	1643	832	651	6390
oil costs	600	0	0	0	460	2600	0	3660
maintenance of pumps and motors	0	0	0	0	1030	470	400	1900
water network maintenance	0	0	151116	12211	34295	7550	39400	244572
chlorination	0	0	0	580	0	0	0	580
electric power costs	0	30663.3	27155.5	0	29004.7	39107.4	107506	233437
water meters maintenance	3000	0	890	0	0	0	0	3890
maintenance tools	13400	0	340	0	72	0	0	13812

clothing	300	0	0	0	0	0	0	300
general appliances	550	1904	0	250	400	0	0	3104
Total	25320	40037.4	188949.5	22937	75304.7	58449.4	155546.9	566545

Iktaba Water project expenditures and income in year 2008

month	Bought (m³)	Water bill (NIS)	Power costs	supplies	Labor	losses (m3)	losses (NIS)	Total expenses	Sold (m3)	Sold (NIS)	actual collection	maintenances	New connectio	Total income
1	8780	9306	4710	1924	3220	4260	10650	29810	4520	13786	8098.54	348	2100	16234
2	7790	7945	3610	1771	2900	2258	5645	21871	5532	16273	7581.33	348	0	16621
3	13250	13780	2971	600	3212	7582	18955	39518	5668	16638.5	6177.67	348	0	16986.5
4	15100	18120	5896	157	3369	6812	17030	44572	8288	23516	5609.31	348	2100	25964

5	16730	20075	7648	1128	3882	7024	17560	50293	9706	27616.5	7009.95	351	2280	30247.5
6	17550	21060	7114	3000	3272	10223	25557.5	60003.5	7327	23924	8633.94	353	5780	30057
7	19030	22836	7923	820	3995	4369	10922.5	46496.5	14661	48323	6660.42	6	5600	53929
8	17550	21060	6233	1927	4405	7030	17575	51200	10520	34302	7511.95	363	1500	36165
9	15980	19176	5414	160	3323	4737	11842.5	39915.5	11243	36676.5	6634.48	368	2600	39644.5
10	12400	14880	9773	100	4135	4640	11600	40488	7760	25276.5	6542.55	366	2300	27942.5
11	12170	14604	5699	3341	5140	4019	10047.5	38831.5	8151	27054	5738.89	368	2240	29662
12	11410	13692	5331	886	5180	5217	13042.5	38131.5	6193	20352	5513.32	369	140	20861

	167740	196534	72322	15814	46033	68171	170427.5	501130.5	99569	313738	81712.35	3936	26640	344314

Water project expenditures and income in year 2009

month	Bought (m3)	Water bill (NIS)	Power costs	supplies	Labor	losses (m3)	losses (NIS)	Total expenses	Sold (m3)	Sold (NIS)	actual collection	maintenances	New connectio	Total income
1	9540	11447	5331	2966	5330	5020	12550	37624	4520	17263.5	15825.47	378	3000	20641.5
2	9820	11784	4077	0	5482	4288	10720	32063	5532	18028.5	16225.49	372	8860	27260.5
3	10680	12816	2973	353	5090	5012	12530	33762	5668	20191.5	19207.05	377	2500	23068.5
4	12630	15156	4194	772	4875	4342	10855	35852	8288	23364.5	21055.76	381	0	23745.5
5	16160	19392	4680	2643	10077	6454	16135	52927	9706	27231	57241.14	382	2000	29613

Kafr Al-Labad water balance for year 2008

Month	Bought (m^3)	Sold (m^3)	Losses (m^3)	Loss %	Water Bill (NIS(	Collection (NIS(	Balance (NIS(	Main	Total
1	6950	4769	2181	31.38%	9035	19353.5	10318.5	0	10318.5
2	6700	3736	2964	44.24%	8710	15988.5	7278.5	0	7278.5
3	9000	5684	3316	36.84%	13500	22568.5	9068.5	0	9068.5
4	12000	8336	3664	30.53%	18000	31831.5	13831.5	0	13831.5
5	12000	8105	3895	32.46%	18000	31001.5	13001.5	0	13001.5
6	15250	9614	5636	36.96%	22875	36304	13429	0	13429.0
7	15500	10899	4601	29.68%	20925	40807.5	19882.5	0	19882.5
8	16500	11630	4870	29.52%	24750	43416.5	18666.5	0	18666.5
9	16000	7809	8191	51.19%	24000	30539.5	6539.5	0	6539.5
10	15000	13037	1963	13.09%	22500	48394	25894	0	25894.0
11	9000	10120	-1120	-12.44%	13500	38080.5	24580.5	0	24580.5

Attil Water project budget in year 2008

Income items	Value (NIS)	Expenditures items	Value (NIS)
Water fees	389982	Water bought costs	758490
New connection and customers contribution	38985	Water project maintenance	291197
		Water meters and other tools	16285
		Salaries	88944
Total income	428967	Total Expenditures	1154916

Illar municipality calculated the cubic meter cost as follows:

Item	Cost (NIS)
Water price from the source per cubic meter	1.2
Electricity costs per cubic meter	0.3
Salaries (fixed and variable) and other administrative costs per cubic meter	0.73
Pump depreciation per cubic meter	0.11

Network depreciation per cubic meter	**0.5**
Public water consumption and losses per cubic meter	**0.2**
Other costs per cubic meter	**0.2**
Marginal profit	**0.36**
Selling price per cubic meter	**3.6**

Qifeen water project monthly Incomes in 2008												
item	1	2	3	4	5	6	7	8	9	10	11	12
water prices	15124.5	15432	12653.4	13339.55	10049	8360.55	16760.5	13894.5	9218	2015.5	3556	7752
new connections fees	1500	1790	1200	2500	4750	900	600	3800	2700	2380	200	1200
Debts			100				950	500	500	480	50	
water pulled by tankers	400			10								530
Total	17024.5	17222	13953.4	15849.55	14799	9260.55	18310.5	18194.5	12418	4875.5	3806	9482
Qifeen water project monthly expenditures in 2008												
Item	1	2	3	4	5	6	7	8	9	10	11	12
water employees salaries	8885.08	5297.09	5293.09	5417.09	5318.09	6318.09	5218.09	5218.09		4718.09	4818.09	5018.09
labor costs	640	400	400	300	400	400	400	400		760	1490	940
oil costs												
maintenance of pumps and motors										1077	7457	2700
water network maintenance	410	2088	1765	2034	3113	6075.5	5023	11846		6459	4180	220

other costs											1058	
chlorination										1350		
Total	9935.08	7785.09	7458.09	7751.09	8831.09	12793.59	10641.09	17464.09	0	14364.09	19003.09	8878.09
Qifeen water project monthly Incomes in 2009												
item	1	2	3	4	5	6	7	8	9	10	11	12
water prices	6762	13106.5	6724	7423.5	27025.5	25571.5	15339	17693	6360.5	5871	10668.5	
new	1800	3000	650	2600	800	800	1850	3500	2200	2050	1550	
Debts					700							
water pulled				50		140	550	110		4000	1020	
Total	8562	16106.5	7374	10073.5	28525.5	26511.5	17739	21303	8560.5	11921	13238.5	0

Qifeen water project monthly expenditures in 2009

Item	1	2	3	4	5	6	7	8	9	10	11	12
water employees salaries	5218.09	13118.09	4718.09	4718.09	4418.09	4418.09	4318.09	6233.44	8169.44		3619.44	
labor costs	520	510	400	250	550	400	400	400	400		400	
oil costs												
maintenance of pumps and motors		5400				150	2300		60			
water network maintenance	14354	10003	9880	5152	13933	9713	3335.5	3488	350		3155	
other costs												
chlorination	1350					1350			1450			
Total	21442.09	29031.09	14998.09	10120.09	13933	16031.09	3335.5	10121.44	10429.44	0	7174.44	0

Al-Ras water project in the years 2008 and 2009

Month./year	buying	selling	loss	% loss	expenditures	income	balance
Jan-08	1700	863	837	49%	4964	4153.5	-810.5
Feb-08	1600	861	739	46%	4672	4085.5	-586.5
Mar-08	1800	1086	714	40%	5256	4968.5	-287.5
Apr-08	2600	1522	1078	41%	7592	6891.5	-700.5
May-08	2400	1565	835	35%	7008	7039.5	31.5
Jun-08	2600	1528	1072	41%	7592	6697	-895
Jul-08	2900	1600	1300	45%	8468	7039	-1429
Aug-08	2700	1527	1173	43%	7884	6684.5	-1199.5
Sep-08	2800	1507	1293	46%	8176	6663	-1513
Oct-08	2200	1317	883	40%	6424	5809.5	-614.5
Nov-08	2100	1363	737	35%	6132	4770	-1362
Dec-08	2200	938	1262	57%	6424	4305	-2119
Summary	27600	15677	11923	43%	80592	69106.5	-

TULKARM MASTER PLAN

2008							11485.5
Jan-09	2000	775	1225	61%	5840	3707	-2133
Feb-09	1700	729	971	57%	4964	3553.5	-1410.5
Mar-09	1400	696	704	50%	4088	3408	-680
Apr-09	1750	937	813	46%	5110	4311.5	-798.5
May-09	1800	1176	624	35%	5256	5165	-91
Jun-09	3000	1775	1225	41%	8760	7625.5	-1134.5
Jul-09	2800	1785	1015	36%	8176	9734	1558
Aug-09	3500	1773	1727	49%	10220	7857.5	-2362.5
Sep-09	2800	1655	1145	41%	8176	7402.5	-773.5
Oct-09	2574	1731	843	33%	7516	7801.5	285.42
Nov-09	1962	1364	598	30%	5729	6557	827.96
Dec-09	1366	829	537	39%	3989	4104	115.28
Summary 2009	26652	15225	11427	43%	77824	71227	-6596.84

Water supply and consumption in Kufur Soor for 2007-2009

Municipal Water consumption mainly goes only for domestic use. According to the Municipality, cattle are not common and other consumption types as commercial or industrial consumption are marginal. The average per capita consumption is relatively high around 160 l/c/d, however; the percentage of losses is 33% as shown in the table below.

Kufr Sour 2007

Month	Bill Quantity (Mekoroth)	Bulk meter (m^3)	Collected quantity (m^3)	Water loss (m^3)	% of loss	Money collected (NIS)	Money paid(NIS)	Balance (NIS)
Jan-07	3260	4200	2911	1289	31%	11324	8516	2808
Feb-07	5090	5000	2851	2149	43%	11163	13274	-2111
Mar-07	5180	5400	3878	1522	28%	14985	13508	1477
Apr-07	7270	6400	4942	1458	23%	18053	18902	-849
May-07	8330	8300	6515	1785	22%	23839	21698	2141
Jun-07	9200	9500	7132	2368	25%	25547	23960	1587
Jul-07	11450	10000	8198	1802	18%	29619	29810	-191
Aug-07	10720	11000	8418	2582	23%	30782	27912	2870
Sep-07	7660	10700	7522	3178	30%	27691	19956	7735
Oct-07		8800	8006	794	9%	30333	32072	-1739
Nov-07		6500	6672	-172	-3%	24373	22686	1687
Dec-07		6000	4770	1230	21%	17957	24948	-6991
Totals	68160	91800	71815	19985	22%	265666	257242	8424

Kufr Sour 2008: WATER PRICE 2.6 NIS

Month	Bill Quantity (Mekoroth)	Bulk meter (m^3)	Collected quantity (m^3)	Water loss (m^3)	% of loss	Money collected (NIS)	Money paid(NIS)	Balance (NIS)
Jan-08	7530	9100	4669	4431	49%	17756	19615	-1859
Feb-08	7300	6600	4157	2443	37%	15927	19020	-3093
Mar-08	8020	8400	5588	2812	33%	21192	20892	300
Apr-08	12260	11400	7300	4100	36%	27126	31916	-4790
May-08	10760	11000	7793	3207	29%	29390	28016	1374
Jun-08	11770	11700	9122	2578	22%	38190	30642	7548
Jul-08	10970	11400	8440	2960	26%	33299	28562	4737
Aug-08	13650	12000	8180	3820	32%	30818	35530	-4712
Sep-08	11180	13100	8524	4576	35%	33593	29108	4485
Oct-08	12430	6500	6705	-205	-3%	27809	32358	-4549
Nov-08	9600	13700	5896	7804	57%	32209	25000	7209
Dec-08	8500	8000	5678	2322	29%	22419	23856	-1437
Totals	123970	122900	82052	40848	33%	329728	22100	5213

Kufr Sour 2009

Month	Bill Quantity (Mekoroth)	Bulk meter (m^3)	Collected quantity (m^3)	Water loss (m^3)	% of loss	Money collected (NIS)	Money paid(NIS)	Balance (NIS)
Jan-09	8040	8000	5328	2672	33%	21758	20944	814
Feb-09	7880	8000	4718	3652	46%	19427	20528	-1101
Mar-09	8310	7400	4404	2996	40%	18888	21646	-2758
Apr-09	7230	9100	5206	3894	43%	21150	18838	2312
May-09	9966	8000	5350	2650	33%	21551	25992	-4441
Jun-09	13334	12500	8700	3800	30%	33799	34708	-909
Jul-09	12610	11800	8552	3248	28%	33522	32826	696

TULKARM MASTER PLAN

Aug-09	12700	11000	9504	1496	14%	38349	33060	5289
Sep-09	12160	9900	7270	2630	27%	28622	31656	-3034
Oct-09	12650	10700	6796	3904	36%	26771	32930	-6159
Nov-09	9550	9000	6152	2848	32%	21329	24870	-3541
Dec-09	10340	10000	4200	6140	61%	16787	26924	-10137
Totals	124770	115400	76180	39220	34%	301953	26884	-22969

Chapter Five

Institutional Setup

5.1 Background

Water management in the West Bank and Gaza is being constrained by several political, technical and economic factors. Such constraints have adversely affected the overall performance of the water sector and resulted in creating a large gap between the services provided and the demand. The lack of investments in improving infrastructures (physical water losses reach 50% in some areas) during the occupation time, the scattered nature of the water supply and management utilities with the absence of adequate rules and regulations and the absence of stakeholder participation in managing the supply has resulted in the deterioration of the entire water management system.

However, following to the creation of the Palestinian Water Authority (PWA) in1995, some improvements in the regulatory aspect as well as investment in the sector have been witnessed. Yet, according to article 40 of the Oslo Interim Agreement both Palestinians and Israelis agreed to establish a joint water committee (JWC) with a main task to discuss and approve the implementation of water and wastewater projects in the West Bank. The official Palestinian representative in the JWC is the Palestinian Water Authority (PWA). To enable PWA to organize its work a new law number 2 was issued then finally substituted by water law (Law # 3). Law #3 overrules all previous laws and decrees. By the virtue of article 2 of the law, all water resources have been declared as public property.

According to article 7, PWA has full responsibility over managing water resources and sanitation in Palestine. In addition, PWA is responsible for regulating, supervising and coordinating all water and wastewater issues in Palestine.

Section 3- article 8, deals with the creation of the National Water Council (NWC). NWC is the main body responsible for setting water policies and supervising the work of PWA.

Section 7, article 25 states that Regional Water Utilities (RWU) will be established, based on the desire of the local utilities and water user associations, to provide water and wastewater services for Palestinian communities. A special by-law will be established for this purpose. In the mean time Section 11, article 41 states that local village and municipal councils, government bodies and NGOs continue to provide water and wastewater services until the RWUs are established.

Accordingly, local municipal and village councils continue to manage the water supply and basic sanitation services in Palestine. Most of these councils lack adequate infrastructures, technical skills, and human and financial resource capacity. They can’t attain cost recovery and therefore, are operating under deficits all year around.

In the mean time only a minor percentage of the produced wastewater effluent is being collected in the West Bank and a very small part of it is being treated. The existing on-site sewage disposal in rural areas (almost 96% of households in the West Bank villages use cesspits) is not adequate and often causes contamination to local water sources such as springs and other groundwater sources. This in turn causes critical community and environmental health risks.

Furthermore, there is no systematic and continuous monitoring for the wastewater quality in most of the urban areas in the West Bank.

5.2 Water Sector Governance

The current and anticipated future setup of the water supply and sanitation management is organized under four levels as follows:

- Decision-making level,
- Regulatory level,
- Development and supply level
- Service provision level,

A. Figure (1) shows the water management setup

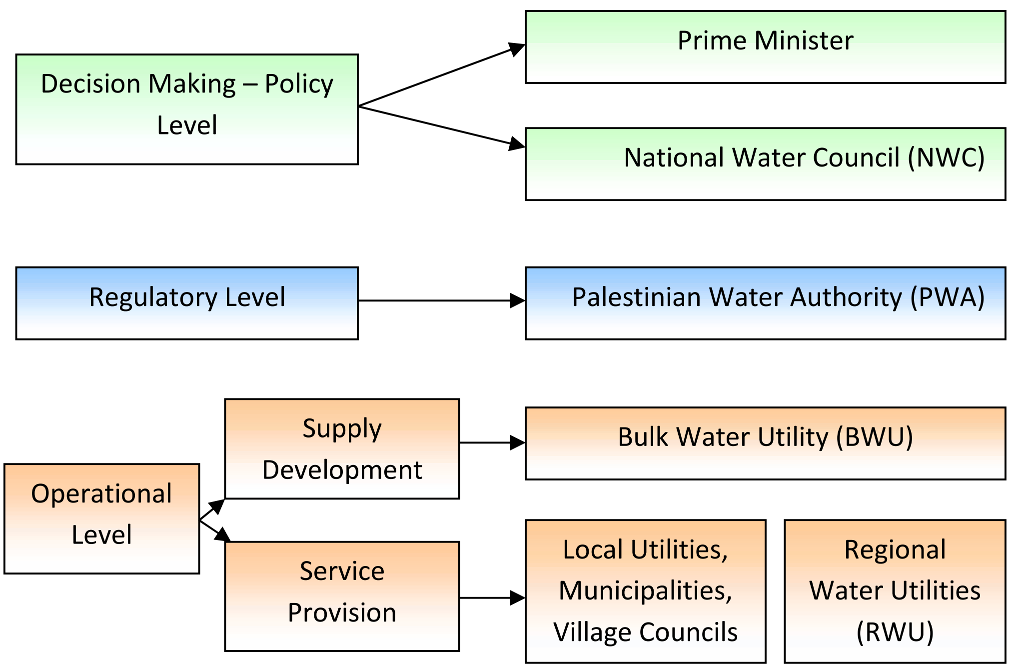


Figure 1: Water Management Setup

As can be seen from Figure 1 the first level, the National Water Council is headed by the Prime Minister and includes 11 representatives of almost all ministries, authorities, civil society organizations, research and development institutions that directly relate to the water and sanitation sector and one representative of the proposed future regional water utilities. Even though the NWC has been created officially, it is not really functional for the moment.

The second level includes Palestinian Water Authority as a regulator and the third level includes the West Bank Water Department and a similar one in Gaza, which are responsible for the monitoring and bulk supply development. The fourth level includes the water service providers. There are ten major water utilities that supply water to the public in the West Bank. Two of them are public water supply utilities: Jerusalem Water Undertaking (JWU) and Bethlehem Water Supply & Sewage Authority (WSSA) while the other eight are water divisions of large municipalities (Nablus, Hebron, Jenin, Tulkarem, Qalqilya, Jericho, Salfit and Tubas municipalities).

The proposed future institutional setup almost preserves the first two levels as they are while anticipating some changes at the operational level, at service provision level as provided by the water law #3. It proposes to create 4 or 5 Regional Water Utilities (RWU), 3 or 4 in the West Bank and one in Gaza (currently established CMWU) to provide water and wastewater services in more efficient manner. The proposed RWU's will potentially absorb all councils and utilities that currently provide services in the sector. It will unify the service levels and will develop common regulations.

5. 3 Water Supply Management in the West Bank

Water supply in the West Bank is being secured either from local sources (wells and springs) or purchased in bulk from the Israeli company Mekorot. This later constitutes the largest portion and may reach to 55% of the total water supplied for domestic use in the West Bank. The Management of this water is organized as follows: PWA regulates the sector and monitors the performance of service providers as well as monitors the resources. West Bank Water Department manage the bulk water and deals with the Israeli Company Mekorot on behalf of all the small and medium water providers; finally the water service providers which include various types of water utilities, municipal and local village councils distribute the supply and manage it at community level, Figure (2).

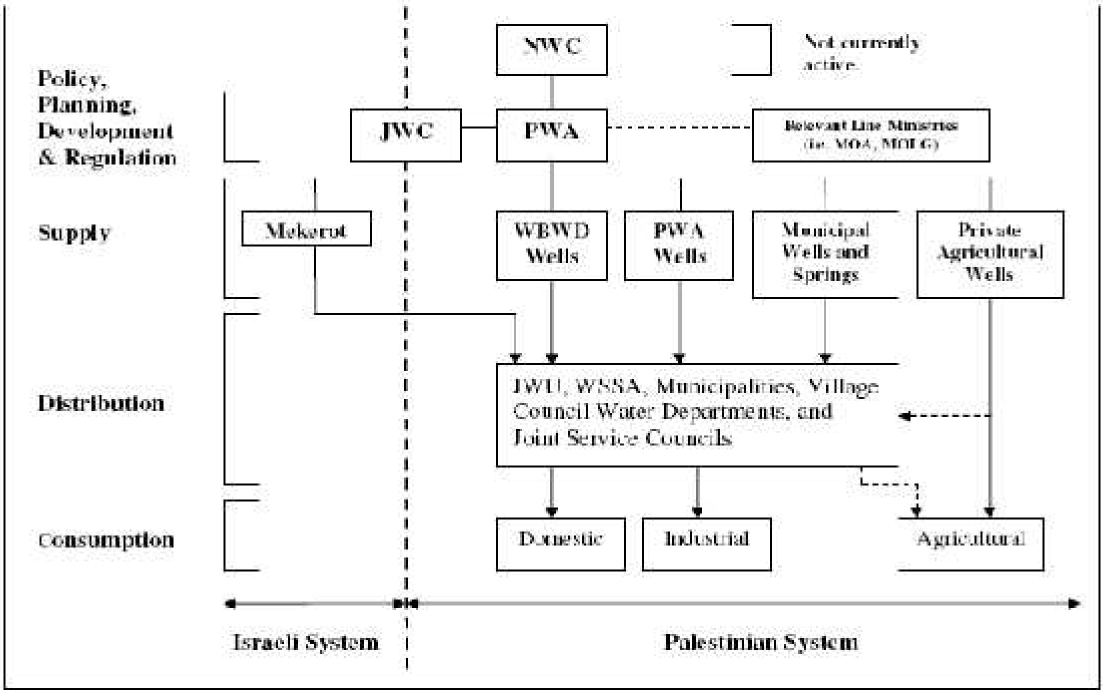


Figure 2: Water Supply Management in the West Bank

Salih (1998) reported that there are two water supply management models in the West Bank. The first one is the delegated public management model and the second is direct management model. In the first category, a utility is established to serve more than one municipality. Such municipalities delegate the water supply management to the utility while they, together with representative of the government, form the management board who supervises the work and performance of the utility. There are two utilities established during the mid sixties during the Jordan ruling of the West Bank, they are the Jerusalem Water Undertaking (JWU) currently runs the water sector in Ramallah, Albireh and Jerusalem Governorates and the Water Supply and Sewage Authority (WSSA) runs the water supply and sewerage services in the Bethlehem Governorate.

In the direct management model, the municipalities or village councils manage the water services directly. Municipalities are responsible for raising the capital cost needed for investment which is generally secured from external financial aid sources (national or international agencies). Municipalities are then own, manage and operate the infrastructure. Direct public management is the most dominant management mode in Palestine.

5.4 Major Water Service Providers in the West Bank

Introduction

According the information compiled by PWA for the year 2007, it is shown that almost 43% of the population connected to water supply is served by 10 major utilities / municipalities while 57% are served by 230 smaller municipal or village councils. Almost 45% of the water supply to these utilities and councils are secured from local sources (wells and springs) and 55% is purchased from the Israeli water company Mekorot through the West Bank Water Department. Table 1 summarizes the main features of the major water service providers in the West Bank.

Table 1: Major water service providers in West Bank

Name	Served Population	# of Customers (connections)	# of Employees (water section)	Total annual water quantity sold
Tubas	22,000	2,173	10	334,943
Salfeet	10,000	1,824	6	354,367
Jericho	22,000	3,974	13	2,241,437
Qalqilia	47,500	7,102	21	2,591,580
Tulkarem	67,300	11,365	77	2,858,656
Jenin	53,000	8,754	101	1,473,970
WSSA	130,000	13,000	40	2,804,335
JWU	300,000	45,122	196	10,421,850
Nablus	207,919	37,706	289	5,344,325
Hebron	163000	16000	45	4,492,293
Total	1,022,719	147,020	798	32,917,756

Source: PWA files (not published), PHG survey (2009).

The Palestinian Water Authority has been working to monitor and regulate the water and wastewater services provided by those different service providers. PWA has developed a number of tools and policies that once approved by the relevant legislators and government bodies they will help regulate the sector better. Among these tools and policies, bylaws and regulations that governs the work of the water and wastewater service providers. The bylaws set the main guidelines for providing the service. It also provides the mechanism for monitoring the performance of the service providers. It also sets the major obligations of the service providers and the limitations of their operations. The bylaw also provides for the necessity of adopting the tariff policy which was also developed by PWA in order to help develop a unified water tariff in the West Bank and Gaza and also to help protect water resources from over exploitation and achieve the optimum and sustainable use of these resources. The policy also will help the various service providers to benefit from its basic structure to enable them from designing tariff structures that can ensure at least the first level of cost recovery.

In addition, PWA has developed other regulations that organize the connection to wastewater collection systems operated by the various service providers. However, all these bylaws, regulations and policies are not yet approved by relevant government bodies and therefore are not yet applied.

5.5 Water Service Providers in Tulkarem District

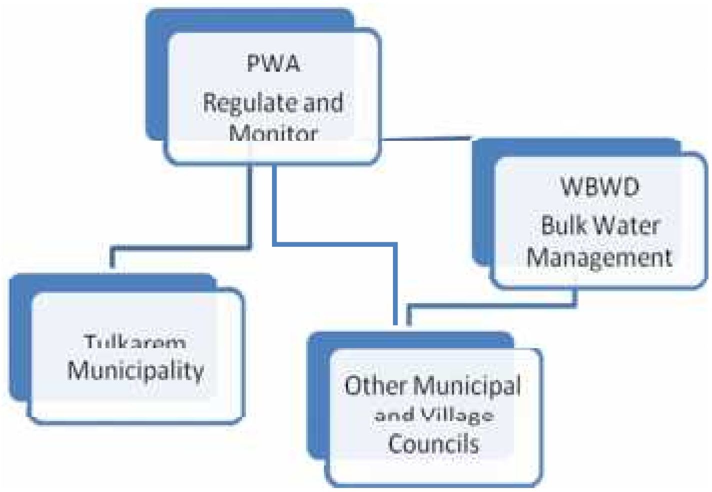
Following to the information listed above and due to the fact that there is no final decision on how water will be managed at national level, it is expected that water management in Tulkarem may likely be organized under three management patterns as follows:

1. **Short Term** : Individual or Direct water management (Existing situation continues)
2. **Medium Term**: Organization may take two forms:
    a. Combined mode of management where we will find individual council water supply as well as Delegated Public Management (water utilities or Joint Service Councils).
    b. Fully Delegated water management model (Joint Service Councils).
3. **Long Term**: Regional Water Utilities

Although private sector involvement in providing water and wastewater services is an option, yet it is not perceived as favorable option at this time. This was indicated by the relevant stakeholders who were present at the workshop on 30 March 2011. The following sections analyze the three management types and provide examples from the District.

1. Short Term: Direct Water Management Model (Village councils and Municipalities)

Under this management model, the individual village and municipal councils will continue providing the service during the coming five years until 2015.



2. Medium Term:

a. Combined Management Model (Individual Councils and Joint Service Councils)

It is likely that a number of councils and municipalities which have geographic proximity and some common interests may join efforts to maximize the resources they have and reduce costs to provide better services for their customers, may join efforts and form a Joint Service Councils. A good example on this is AL Kafriyat Joint Council for Planning and Development. This council may potentially be developed to include water and sanitation services as well. In the mean time some individual municipal or village councils especially those remote ones may prefer to keep supplying water in the same way they do right now. Accordingly, Figure 4 shows the expected structure of water management under this scenario.

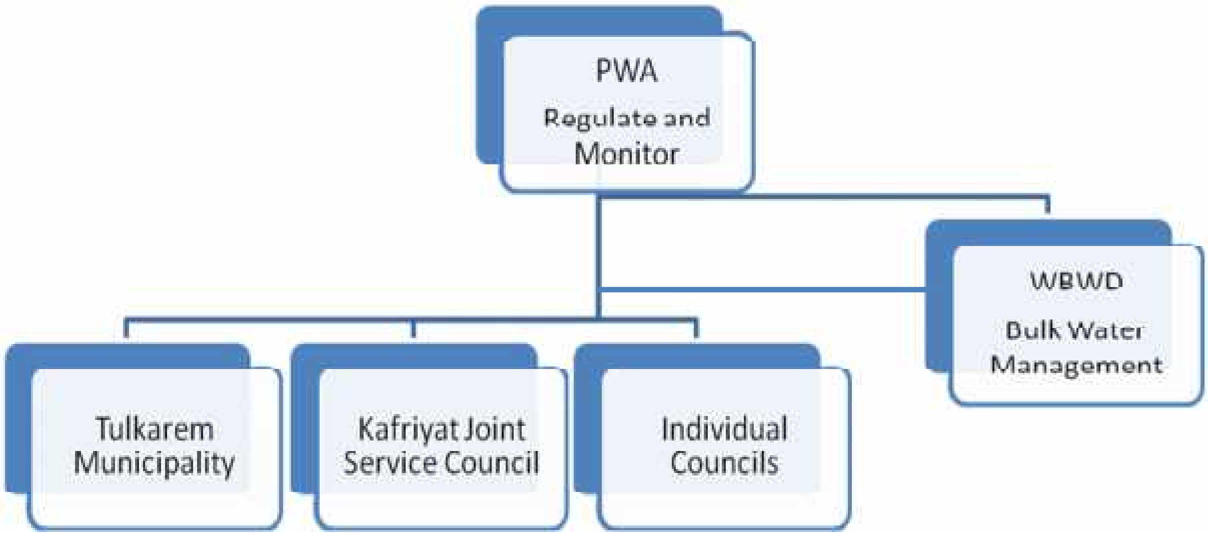


Figure (3): Alkafriyat council already started and summarized as follows:

Al-Kafriyat Joint Council for Planning and Development:

The council was established in 1998 following to the agreement of the heads of seven councils in the south of Tulkarm which are: Kufr Jammal, Kufr Zibad, Kufr Abboush, Kufr Soor, Koor, Al-Ras and Jibarah councils.

The council was established with the aim to organize the management and operation of solid waste collection and disposal. In 2000, they got a fund of 1,000,000 dollar from the Belgium Cooperation. Accordingly, the council expanded the type and quality of services to include issuing building permits in the 7 councils. This fund enabled the Joint Council to cover the administrative costs and implement several projects. The council recruited a surveyor, and engineer to issue the housing permits and to follow the projects. The council gets 30% of the fees paid for the building new houses. During the period between 2000 and 2008, the council constructed a new building and swimming pool for the public; meanwhile, the council bought a jack hammer. They become an important source of income for the council and could cover most of the salaries and running costs for the council. According to the MoLG evaluation, the council was ranked as successful one in terms of management and quality of service.

In 2008, the Belgium Cooperation renewed a fund 530,000 Dollar. At the time being, the council has a multi story building, a surveying unit, a jack hammer, a swimming pool (annual rent 50,000 NIS) and park, electric crane, store house, pre-paid electric meters. The council prepared a strategic plan for the seven communities and expanded the services to include maintenances of electric grid, fixing the e-paid electric meters, in addition to the previous services. Therefore, the council increased the number of employees as shown in Table 1. The annual budget 2010 shows that the council is able to cover the running and operation costs through the fees and the other sources of income. The board of trustee is members in the community councils. Each community assigns one member to the council, and they regularly once every month. The sub-committee as for example the housing committee meets when necessary.

Table (2): Al-Kafriyat council staff

Position	Salary (nis)	Notes
Director of the council	3100	
Secretary and accountant	2400	
Civil engineer	3000	Including transportation
Building and sanitation monitor	2300	Including transportation
Crane and solid waste cars driver	2500	
Jack hammer driver	2500	
Solid waste workers	1900*2	

The council is ambitious to expand its levels of services to include drinking water and sanitation in future. For this purpose, the council is planning to become the municipality of the seven communities and keep only one employee in each community to facilitate charging the electric meters and communicate between the community and the municipality. The council members are working seriously to bring this idea to the ground. They did several meetings and discussed all the matters that could challenge or block this idea. Hopefully, they were able to overcome these challenges including the financial differences. The MoLG is reluctant to this idea, however; the time is very short to the coming elections. Therefore, the council is working on the social background in the seven communities to bless the idea and not to face unexpected difficulties in the last minute before the elections. The council is now working to develop a joint plan for housing and infrastructure.

b. Fully Delegated water management model (Joint Service Councils).

Under this model it is anticipated that joint service councils will be established to cover the entire district. It is also anticipated that the existing situation will be considered and expanded. For example, kafriyat council may be expanded to include other neighboring communities and Tulkarem Municipality may include other communities and become one Joint Service Council. Therefore, it is possible to divide the District into five joint service councils who may join efforts and share resources and maximize benefits while reducing costs and risks in providing better water supply and sanitation services to their customers. The proposed five councils are presented in Figure 3.

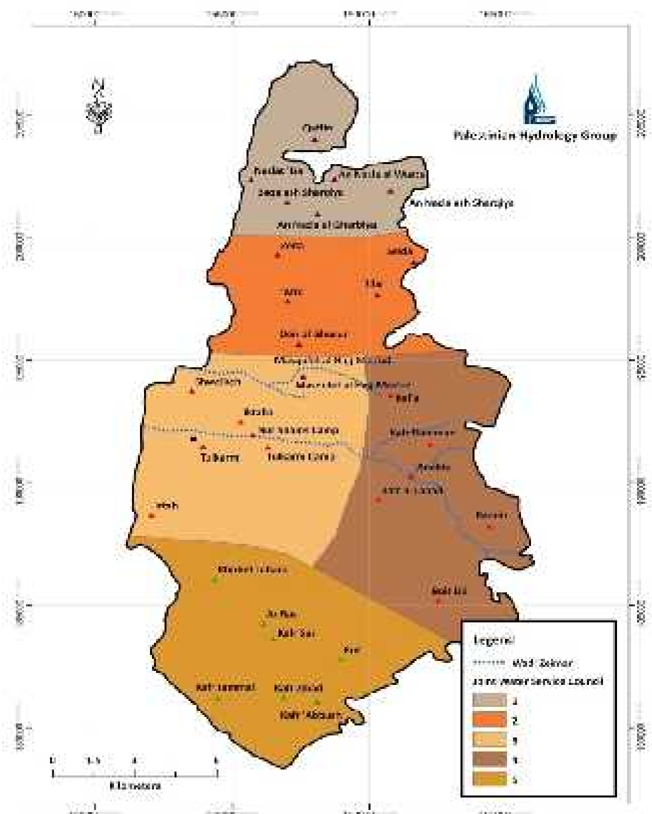
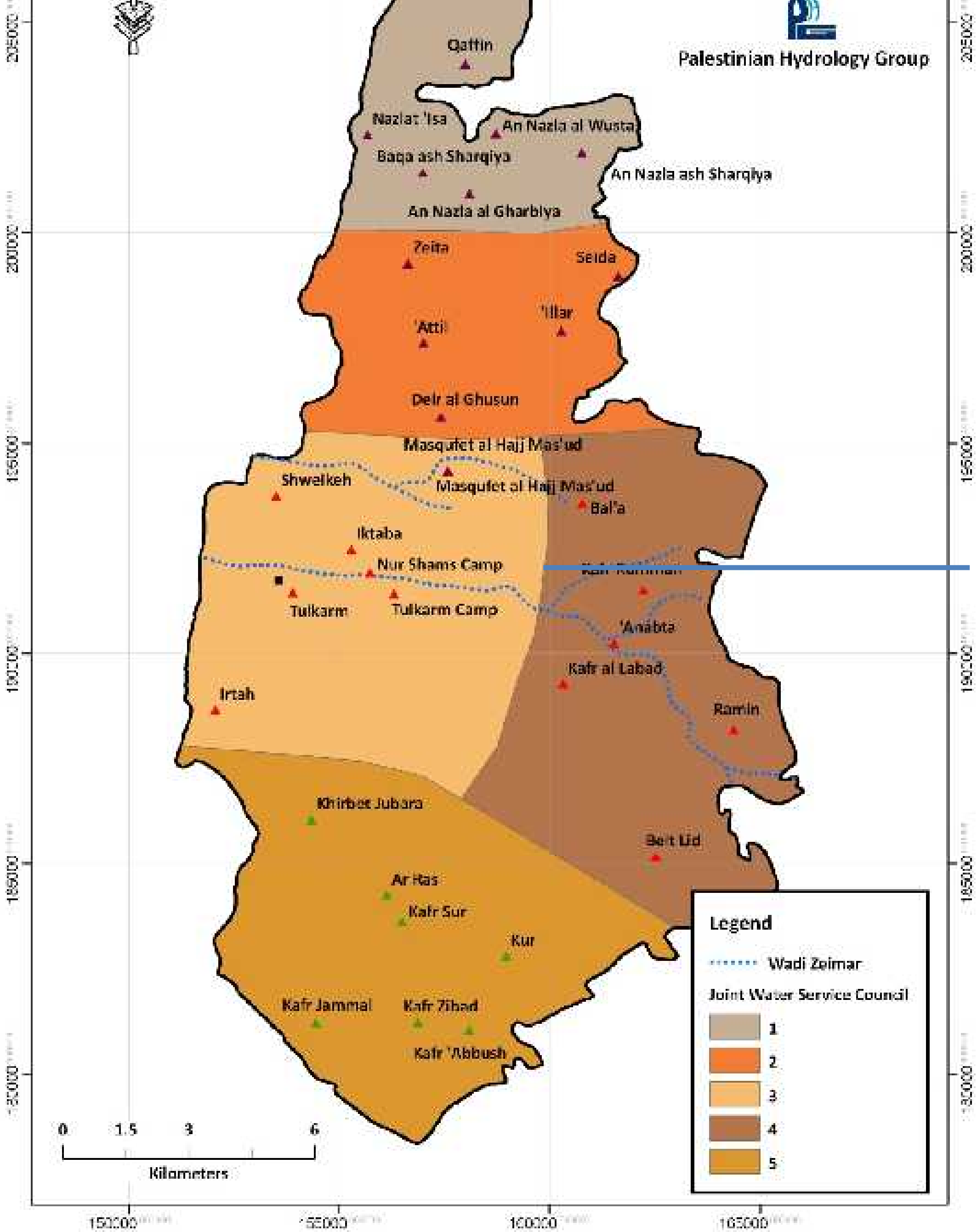


Figure (4): Proposed institutional setup under second scenario

Based on this scenario the water management structure will look like the following:



WDWD
lk Water
nagement

ulkarem
ern part
general
ntribute
tructure

Chapter Six

Conclusions and Recommendations

6.1 Water Supply:

6.1.1 Conclusions

The main conclusion that was concluded under this master plan for water supply component can be listed as follows:

- Total population Tulkarem Governorate was 161226 people in 2008. The population will double in nearly 28 years. Accordingly, the population of the governorate is expected to reach **167905, 185835, 227645** people by the years, 2010, 2015 and 2025 respectively at growth rate of 2.02%.

- The Governorate is relatively water rich Governorate compared with other areas in the West Bank where nearly 96% of the supply (9.7 Mcm/yr) is secured from Municipal and agricultural wells and the remaining 4% is purchased from the Israeli company Mekorot.

- Almost 81% of the water supplied through the domestic network is used for domestic purposes while 10% is used for industrial and commercial and 9% is used for agricultural activities.

- Almost 98% of the communities are connected to running water supply system.

- The daily per capita water use after losses varies from 39 liter to 160 liter with an average of 100 liter across the governorate.

- Most of existing water networks are relatively old and needs upgrading. The percentage of losses ranges between 6% and 50%. There is enough data on causes of losses or a plan how to reduce the water loss.

- Many communities get their drinking water from agricultural wells; there are no alternative domestic supply sources. These agricultural sources have limited capacity and not developed to meet the escalating domestic demand.
- The Israeli authorities deliberately refuse to permit new domestic wells in the area so as to force these councils to get their domestic from the agricultural quota.

- The expected water demand under BAU will reach 13.3 and this may encounter a total deficit or gap of supply of around 3.6 MCM toward the year 2025. However, demand is expected to reach 14.4 MCM under the IWM scenario and the gap will be slightly higher and my reach3.7 MCM. The reason is because losses will be stabilized at nearly 19%.

- Total investment needed to improve both supply and demand management to reduce the gap between supply and demand will reach 39 M€ under the BAU scenario while it will reach 53

M€ under the IWM scenario. However, the immediate needs or the short term investment needed during the first phase will cost nearly 9.5 M€.

- The village councils and municipalities are the water service provider. In most of cases, the technical staffs are neither qualified nor equipped with the necessary tools to carry the routine maintenance. These councils hire private workers to fix the emergency faults in water network supply system.

- Water tariff is mainly calculated based on operation and maintenance costs. Most of councils if not all ignore the depreciation costs in water pricing. This could refer to the fact that few types of councils are aware of costs analyses and cost recovery.

- In general, the councils adopted block tariff system as the pricing methodology. However, it was not clear how the blocks were defined or how the price in each block was determined.
- It is expected that public willingness to pay or affordability will decrease due to the prevailing economic conditions.

- The price per cubic meter depends on who owns the water source and the pumping – transport costs. Therefore, the price for normal family consumption (5-15 m^3/month) ranges between 2 NIS as Baqa Al-Sharqiya and 4.5 NIS as in Beit Leed.

- Water collection fees have been improved sharply since 2008 as a result of linking the water bills to pre-paid electric meter charging. However, the customers' debts are still high due to the long period of low collection.

- Despite the fact that most of the village councils and municipalities have computer and internet services; the water archives are not available or the available data need further analyses. In most of cases we have to get the row data on consumption or costs and process them to reflect the existing conditions. At certain communities (relatively big one) they have no idea or data on customers' consumption and losses.

- The village councils and municipalities lack strategic plans of water demand or alternatives sources of water supply. Water tanks are the most reliable source in cases of emergency and water cut. The price of one cubic meter pulled by a truck is much higher than the one supplied via network. It can reach 20 NIS/m^3 and depends on the tank size and the transport distance.

- The water storage facilities for firefighting or emergency conditions are not available. Distributions reservoirs are the main water storage; however, the capacity could hardly be enough for one day supply. Roof water tanks are usually used in most communities; there capacity ranges between one to two cubic meters and ideally, this is enough for few days.

- Due to limitations and restrictions on residential areas (areas A, B, C), the locations of the distribution reservoirs are normally don't cover the whole community. The new houses usually built above the base elevation of the reservoir suffer from water cut during summer or can get water only during night. Therefore, these houses are usually supplied directly from the main supply pipeline or the municipalities install booster pumps on the main pipes and pumps water to them. On contrary, other houses usually located at elevation far below the distribution reservoir can receive plenty of water or even suffer from high pressure and as a result water meters blow up.
- Water quality is usually tested by the Directorate of the Ministry of Health in the District, except for the city of Tulkarem; the municipality has its own laboratory and monitors the water quality. Usually the municipalities and village councils lack records of water quality, except when they have serious pollution. The test includes the water source, the distribution reservoir and sample of houses each month. Biological tests and residual chlorine are the routine tests unless other tests are specified for certain request by the municipalities.

- Water losses both apparent and administrative are high in the governorate and may reach 45%.

6.1.2 Recommendations

The main recommendations that this master plan is foreseeing for improving water management can be listed as follows:

- The existing dual use of water networks for domestic and agriculture is not recommended from technical and health reasons. Therefore it is recommended to separate the agricultural water from domestic water.

- It is recommended to estimate the losses in a better way. Therefore, municipalities and councils are advised to follow the steps listed below:
    - Estimate of the apparent losses and real losses each separately. To do that, consider the three main factors that contribute to the apparent losses which are: unauthorized consumption + customer metering inaccuracies + systematic data handling errors. The latter two factors may be excluded from the calculation because volumetric meters are used and systematic errors in data reading or entry could be avoided. This means we are left with one unknown for apparent losses which is normally related to illegal connections. This factor could be cross checked through irregular visits to the customers or where expected to have higher consumptions of their holding than being registered. A result of this step would come of an estimate of the unauthorized consumption and should be deducted from the total loss through amendment/penalty program.
    - Specify the terms of the authorized consumption which include all the customers of: billed metered + billed unmetered + unbilled metered + unbilled unmetered. It is important to specify the customers of each category and even subcategory. The latter category may

include schools, public parks, charitable organizations public tabs, fire hoses or mosques could consume large quantities of water particularly when they don't pay for water. In case any of these categories is missing, it will be added and all customers have to be metered. A result of this step would come of an estimate of the authorized consumption particularly the customers who are classified as unbilled unmetered. This quantity will be deducted from the total loss through amendment-metering program.

- Calculate the final total water loss which equals to: Existing total water loss – apparent losses (unauthorized consumption) – the quantities of (billed unmetered, unbilled unmetered). Accordingly the new percentage decides the real percentage of losses which is attributed to physical losses. In case, this new percentage is still high, then inspection detection program must be carried out.

- It is recommended that more water sources be dedicated specifically for domestic supply and not to be on the expense of agricultural quota.

- It is recommended to build the capacity of the existing councils and municipalities and optimize water management through the establishment of Joint Service Councils and perform collective management.

- It is important to account for depreciation in calculating the price in order to ensure service sustainability.

- It is recommended that the proposed water tariff be adopted. For this to materialize, councils are advised to test the proposed tariff structure for a trial period of 3 – 4 months and compare the results.

- It is important to rehabilitate the water infrastructure and reduce losses at least to the proposed level of 19%. This should be carried out in parallel to the improvement in institutional setup and adaptation of proper water tariff.

1. Sanitation

Conclusions

- It is concluded that most of the communities in the Governorate have no wastewater collection and treatment systems. Only four communities have partial collection and two have partial treatment systems.
- The most common type of wastewater disposal in the communities that have no collection system is the cesspits.
- Raw wastewater flowing in the valleys causing some pollution threats to the adjacent water sources. It also led to the spread of some water born diseases in the Governorate.
- There is an urgent need to develop a solution for the sanitation problem and people are willing to take their responsibility and share.
- It was concluded that the combined sanitation alternative (centralized and individual solution) is the best alternative to address the problem.
- The total cost anticipated to improve wastewater collection and treatment in the governorate is nearly 73.4 M€ during the first phase of 2015 while it will be 40.7 M€ during 2025.

Recommendations

- It is recommended to develop wastewater collection and treatment alternatives for the entire governorate immediately. It is important to make detailed feasibility of the proposed scenarios and alternatives.
- It is important to consider the most appropriate wastewater treatment technology that meets most of the criteria defined in the master plan.
- It is important to promote the capacity of service councils to enable them from managing both water supply and sanitation.
- It is important to develop a proper tariff for wastewater services.