National Water Strategy for Palestine

Toward Building a Palestinian State from Water Perspective

PALESTINIAN WATER AUTHORITY

DRAFT COPY

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1. Background

1.1. National Water Strategy

The purpose of this document is to present the Palestinian National Authority framework of action in the water sector for the sustainable management of water resources in the Palestinian territories.

Sustainable management of water resources is vital to the Palestinians' long term prosperity. Water is essential for human and other life and crucial for the development of agriculture and industry, as every sector depends on secure and sustainable access to water.

Despite the limited water resources available and the importance of water to a healthy future, there have been instances where the value of water has been overlooked. The sustainable management of water resources does not offer easy solutions as the country has always suffered from water scarcity. Thus, legal and administrative measures need to be continually updated based on a plan developed from a strategy, which is in turn the expression of a national water policy.

In addition, this strategy forms part of a framework derived from an integrated water resources assessment carried out by the Palestinian Water Authority (PWA) in consultation with the key stakeholders identified by the Government, the major promoter of both the policy and strategy.

Responsibilities for implementing the measures proposed in this strategy document will be shared between various stakeholders, including:

- Office of the Prime Minister
- Ministry of Finance
- Ministry of Agriculture
- Ministry of Environmental Affairs
- Ministry of Local Governorate
- Ministry of Health
- Water Service providers and their representative association
- Negotiations Affairs Department

The Strategy title is referred to as the National Water and Wastewater Strategy. This strategy has been developed under the auspices of the Palestinian Water Authority, with the involvement of all major stakeholders of the water sector in the Palestinian Territories.

1.2. Purpose statement

The national strategy provides the planning and management framework necessary for the protection, conservation, sustainable management and development of water resources and for the improvement and sustainable management and provision of water supply and wastewater services and standards in the Palestinian Territories. The policy and the strategy aim to:

(a) Reinforce the Palestinian Authority's approach to sustainable water resources management by ensuring that all arms of government work together in the pursuit of shared water resources management goals; and

(b) Establish a framework for the coordinated development, regulation and financial sustainability of water supply and wastewater services to ensure concerted efforts towards improved water systems management, rehabilitation and maintenance.

The National Water Policy and Strategy will also act as a platform for ensuring close collaboration and cooperation among all water-related agencies and stakeholders at the national, governorate, municipal and local levels. As such, the National Water Policy and Strategy should be treated as a living document to accommodate changes that will further strengthen the national framework and reflect water management at all levels.

1.3. Previous Reference

The National Water Strategy is in line with National Water Policy (2012 – 2023) the Strategy for the Water and Wastewater Sector (2011-2013), the Draft Water Resources Management Strategy (1997), the National Water Policy (1995), Water Sector Strategy Planning Study (WSSPS, 2000), Water National Plan (NWP) 2000 and Coastal Aquifer Management Plan (CAMP)1999-2004.

Part 1: Baseline

2. General

2.1. Population

The Palestinian population has grown rapidly over the last forty years and, in 2008, the PCBS estimated that growth for the 2010/15 period will be 3.75%/year, stimulating a rise in the demand for water.

The urban population was estimated to make up 70% of the country's total population in 2010 and this percentage is still increasing, with growing numbers using more water-consuming household equipment (showers, bathrooms, washing machines).

		1997	2007	2010	2015	2020
Gaza	urban		1 346 000	1 530 000	1 856 000	2 152 000
	rural		77 000	86 000	102 000	118 000
	TOTAL	**1 022 207**	**1 423 000**	**1 616 000**	**1 958 000**	**2 270 000**
West Bank	urban		1 260 000	1 483 000	1 860 000	2 054 000
	rural		1 117 000	1 213 000	1 366 000	1 508 000
	TOTAL	**1 873 476**	**2 377 000**	**2 696 000**	**3 226 000**	**3 562 000**
Total		**2 895 683**	**3 800 000**	**4 312 000**	**5 184 000**	**5 832 000**

Source: PCBS, 2008

Table 1. PCBS population projections up to 2020 (Including Jerusalem Old City)

2.2. National economy and GDP

Over the last nine years (following the second intifada period), the Palestinian economy has expanded rapidly nearly every year (with the exception of 2006), at an average rate of 5.8 %/year.

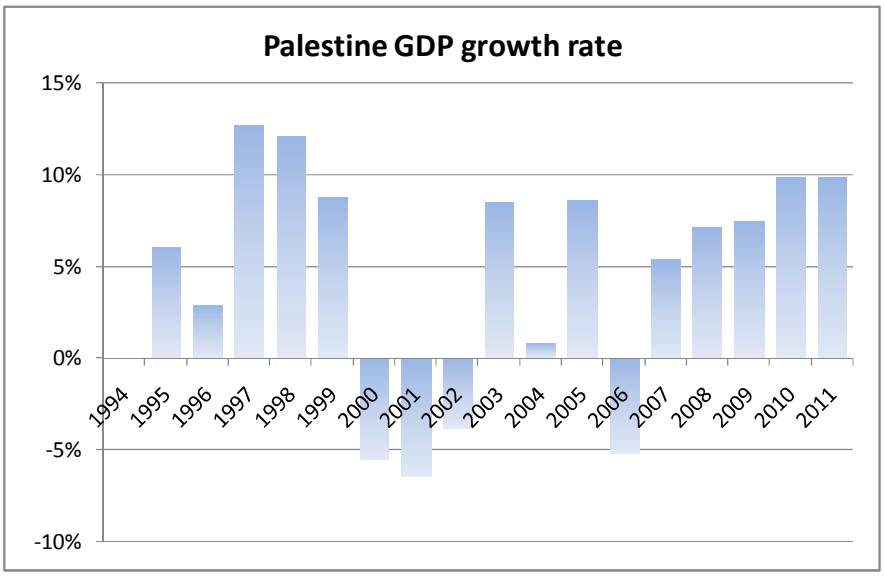


Figure 1. Palestine GDP annual growth rate.

This rate of growth is higher than the population growth rate and GDP/capita has increased from US$1,300/capita to US$1,600/capita over 7 years.

Economic Indicators – West Bank & Gaza	2004	2005	2006	2007	2008	2009*	2010	2011
Gross Domestic Product (GDP) (US$ millions) **	4,198.4	4,559.5	4,322.3	4,554.1	4,878.3	5,241.3	5,757.3	6,323.0*
GDP per Capita (US$) **	1,317.0	1,387.2	1,275.4	1,297.9	1,356.3	1,415.7	1,509.9	1,609,6*
Growth rate		8.6%	-5.2%	5.4%	7.1%	7.4%	9.8%	9.8%

Source: PIPA web-site

* Preliminary estimates and will be revised

** Data excludes parts of Jerusalem which was annexed by Israel in 1967

***GDP and GDP per capita provided in the Table are based on constant prices. 2004 is the base year.

Table 2. GDP and GDP/capita evolution

It can reasonably be supposed that GDP/capita will continue to rapidly expand during the 2012-2032 period due to the country's main economic strengths (a literate and educated population, a dynamic diaspora maintaining commercial and financial links with their homeland, potential development of exchanges with neighboring countries, etc.). Nevertheless, a considerable factor in this economic growth has been and remains international assistance and support, which could change and slow the growth in the future in the absence of political progress

Nevertheless, Israeli occupation and the restrictions imposed on the circulation of goods and persons, as well as on investment, are major constraints that hinder the economic development of Palestine. As such, they must be taken into account when considering the feasibility of any investment, including investment in the water and sanitation sector.

2.3. Health and environment

Although environmental conditions are difficult in Palestine (as a result of the very high population density: by 2011, the population density was 456 persons/km² in the West Bank and 4,353 persons/km² in the Gaza Strip), sanitary conditions have much improved over the last few decades as a consequence of better education and an improving health care system[1]. As a result of this improving sanitary environment, life expectancy has risen, infant mortality has decreased and most health indicators are among the best in the region.

	Infant Mortality Rate (per 1000)	Under-five moratality rate (per 1000)	Maternal mortality rate (per 100 000)	Life expectancy at birth (women)
Morocco	36.8	33	110	75
Algeria	27.7	30	120	74
Egypt	27.2	21	82	73
Syria	25.8	15	46	76
Turkey	23.07	15	23	77
Tunisia	22.5	16	60	77
Lebanon	21.8	15.3	26	77
Albania	18.6	14.2	31	75
Jordan	14.9	21	59	75
West Bank	14.5	21	13	77
Greece	5.1	5	2	83
Israel	4.1	4	7	83
Italy	3.4	4	5	84

Main data source: globalhealthfacts

Table 3. Basic health indicators.

The infant mortality rate was 24.2 per 1,000 live births between 1999 and 2003. The main causes of infant mortality are premature delivery, low birth weight, respiratory system diseases, and congenital anomalies. (PCBS, Palestinian Children - Rights and Numbers, 2005.) This rate has continued to improve over the past ten years and is now only 14.5 / 1000, one of the lowest values in the Mediterranean region.

An important achievement of the health sector in Palestine is the serious drop in child mortality due to poor quality water and poor sanitation. According to the most recent annual report from the Ministry of Health (MoH, 2011), diarrhea and gastroenteritis are no longer public health issues in the West Bank, with 0 deaths among children in 2010.

However, sanitary conditions are worse in the Gaza Strip, where the very high population density (4,353 inhab/km^2), combined with the Israeli-imposed embargo, makes development of a good sanitation service more difficult.

[11] Over the last two decades, the infant and under-five mortality rates have steadily declined (and are now well below the regional average), while life expectancy has increased significantly (4 years longer on average than the typical person in the region). Total health spending stands at about 13% of GDP, which is among one of the highest rates in the region. (World Bank. West Bank and Gaza Public Expenditure Review. Vol. 1: From Crisis to Greater Fiscal Independence, Feb. 2007).

Water quality monitoring in Gaza has revealed very high nitrate pollution in coastal aquifers. High nitrate levels are primarily caused by the infiltration of sewage into water resources, as well as by over application of N-Fertilizers.

2.4. Institutional framework

The PWA was created in 1995, through a Presidential decree (N° 2/1996), to regulate the water sector, improve and sustain water resources, and to undertake planning and service delivery provision. The roles and responsibilities of the main water institutions in the water sector are detailed in the 2002 Water Law No 3. In general, the Water Law lacks clarity as it neglects to define the exact nature of and relationships between the sector institutions. The Water Law defines the roles and responsibilities of the PWA and the National Water Council (NWC), but fails to offer any guidance on other institutions (e.g. Ministry of Agriculture) and to define the overall sector architecture under which the NWC and the PWA have to operate. The Water Law does, however, provide PWA with jurisdiction over the utilities responsible for water provision and sewage water services.

At present, the relative roles, responsibilities and relationships of water sector institutions are in need of clarification. The unclear mandates and undefined relationships between key sector institutions, including central and local government, civil society and private actors, are severely hampering the ability of the PWA to lead, develop and regulate this suboptimal and exogenously constrained sector.

The institutions and institutional framework created since 1995 to manage water resources and water uses, including the provision of water and wastewater services, are not considered properly fit for purpose and, consequently, do not meet the needs of the people in Palestine. The lack of clear institutional mandates has contributed to a situation in the Palestinian water sector of ineffective governance and weak capacity, which, when combined with the occupation-related restricting factors, hinders the development of integrated water resources management, infrastructure development and service provision policies, strategies and regulations.

The ongoing Israeli occupation and control over the vast majority of shared water resources complicates sector regulation by the Palestinian Government in general and by PWA, in particular. Both have only limited control over the country's water resources because Israel controls most the water resources shared with Palestine, in violation of good international practices regarding the management of transboundary water resources.

3. Water resources in Palestine

3.1. Surface water resources

Surface water resources in Palestine are very scarce. There are currently very few surface water resources in the West Bank (and none anymore in the Gaza Strip, where the main wadi –Gaza Wadi- has been dried by water abstraction, upstream, in Israel). Most of the Wadis flow only for a few weeks a year, usually as flash flood after thunderstorms, and this resource is hard to use and capture as, in most valleys, the complicated geological/geographical features are not simple to the construction of large storage dams (few plains, karstic limestone substratum).

The main permanent surface water resource is the Jordan River, which is used heavily for irrigation and domestic water supply by Israel. Since 1967 the Palestinians do not have access to this resource. It is a trans-boundary resource, shared between Jordan, Syria, Lebanon, Israel and Palestine. The integrated management of this resource and the conclusion of a basin wide agreement is a key component of any long-term strategy.

However, the following facts should be considered:

- Jordan River, It mainly consists of two parts: the Upper Part that's flows from the river headwaters (Hasbani, Banias and Leddan) into Lake Tiberias, while the Lower Part is the continuation of flow from Lake Tiberias to the Dead Sea at an altitude of 425 meters below sea level. Historically, the quantity of water flowing into the Lower Jordan River and discharging into the Dead Sea is estimated 1400 MCM/y. This amount decreased dramatically during the past six decades and is presently no more than 30 MCM/y (FOEME-2010). This huge reduction in flow is mainly due to diversion of its water by Israel of more than 500 million cubic meters through the National Israel Water Carrier that extends south to the Negev, in addition to the construction of many dams upstream. Moreover, natural factors such as evaporation also had an adverse impact on Jordan River flows. Furthermore, the Jordan River is threatened by the discharge of large quantities of untreated wastewater from Israeli settlements located along south of Lake Tiberias, water status report in 2011, PWA.;
- West Bank Wadis: The long-term average annual flow of flood water through wadis in the West Bank is about 165 MCM/y. Generally, the West Bank wadis are classified into eastern wadis (toward the Jordan Valley and the Dead Sea) and western wadis (towards the Mediterranean) by the direction of flow. Currently, about 2 MCM/y is being harvested through several agricultural bonds in Jordan Valley and a small scale dam in Al Auja Area.
- Wadi Gaza- It originates at the eastern upstream where Israel is trapping the natural flow. This action dries the Wadi, except in very wet years, making the use of any remaining surface water resources is very limited. The annual average flow of this wadi is about 20 MCM/y.

3.2. Groundwater resources

Palestine is mostly reliant on groundwater where the majority of Palestinian water supply comes from this source either by wells or springs. The total renewable groundwater resources have been estimated as 578-814 Mm^3/year in West Bank and around 55-60 Mm^3/year in Gaza Strip.

In the West Bank, groundwater resources are contained in deep (karstic) limestone and dolomite aquifers. Most large production Wells are 200-800 meters deep and the water table lies between 100 and 450m below the surface. These aquifers are commonly divided into three main aquifers-Basins (Western, Eastern and North-Eastern). The Western and North Eastern aquifer basins flow to Israel where it constitutes one of the main groundwater resources.

In Gaza, groundwater resources are contained in a shallow sandy aquifer, extending eastward to Israel and southward to Egypt. There are more than 5000 water wells, most of them are for agriculture purposes with an average depth of 40-70 meters and the water table lies between 20-50m below the ground surface. Gaza is a dry area and local aquifer recharge is very limited (55-60 Mm^3/year on average). Abstraction by all users (Israelis, Egyptians and Palestinians) already far exceeds natural recharge. Consequently, the aquifer has been depleted and suffers from seawater intrusion.

Aquifer-Basin	Area within West Bank (Km^2)	Average rainfall (mm) 2010/2011	Recharge Volume 2010 /2011 (MCM)	Long-term Average Recharge (MCM)
Western Aquifer	1,767	407	311	318-430
Northeastern Aquifer	981	433	134	135-187
Eastern Aquifer	2,896	281	153	125-197
West Bank Total	5,644	347	598	578-814
Coastal Aquifer	365	225	33	55-60
Palestine Total	6,009		631	633-874

Source: PWA, 2012c

Table 4. Recharge estimate for the main aquifers.

3.3. Non-conventional resources

Due to the scarcity of water resources (natural scarcity and inequitable sharing of water rights between Palestinians and Israelis), the Palestinian government has already started to focus on the development of non-conventional resources:

- Desalination of sea water : There is only one sea water desalination plants located in the middle area of Gaza Strip (Deir El Balah) with total capacity of 600 m3/day (0.25 MCM/y) by using two beach wells and it will be expanded to about 1000 m3/d (0.35MCM/y) by year 2013. A large sea water desalination plant with capacity of 55mcm/y as a first phase is scheduled to be constructed by year 2017 and to be located in the central part of Gaza Strip and to be enlarged to capacity of 129mcm/y by year 2035. The desalinated water will be mixed with the groundwater produced and distributed to the consumer through the distribution facilities. By this additional water as well as other water and wastewater management issues it is expected that the coastal aquifer can be recovered to its original steady state. Generally, the additional desalinated sea water will impact significantly on the water tariff therefore the distribution

system efficiency should be improved with efficient surface provider capable to cover the operation and maintenance costs of that new facilities.

Sea water resource is not available for the West Bank, except as part of a long-term, some proposed desalinated quantity could be converted from Gaza to West Bank or through equitable agreement with Israel;

- Desalination of brackish ground water: Small pilot Desalination projects for Brackish Water exist mainly at the Jordan Valley through private sector with total capacity less that 0.5 MCM /Year and are used mainly for Agricultural uses. A large facility is planned downstream Fashka Springs, near the Dead Sea (with a scheduled production capacity of at least 22 Mm^3/year by the year 2022); this project will be a practical for increasing water supply for the southern Part of the West Bank, the project will be extended to produce 40 MCM/yr in the future.

  In Gaza there are one hundred Water Vendors through Brackish water desalination plants with capacity of 20-40m3/day and operated for 4-6 hours/day, with total capacity on 2-3MCM/Year for the purpose of drinking water supply of Gaza people.

  More than 80% of the Gaza people are using that water for fulfilling their drinking and cooking water needs. The remaining people use in-house RO units through desalinating the water network. In addition to that, there are 8-Ground Water Desalination Plants operated by the CMWU in the southern parts of the Gaza Strip (Khan Youis- Deir Al Balah and Rafah) and distributed through the domestic distribution networks mixed with the water Well, with capacity of 1MCM/y.

- Reuse of treated wastewater: In Gaza Strip there are different small demonstration reuse activities as a pilot projects in scattered areas with total reuse quantities of around 1 MCM/ year. As for West Bank, there are no real activities or projects for reuse (small scale projects on community level are implemented such as Anza, Attil, Kharas). However, some reuse projects are proposed in North-West Nablus, Jericho, Tayaseer and Auja areas in the short-term vision. An additional water resource will be made available through the scheduled major development of wastewater treatment plants; this resource is already under development in the Gaza Strip (with a scheduled production capacity of 10 Mm^3/year) in North Gaza. Further developed should be done in both Gaza and the West Bank; this potential resource could be relatively large (see chapter 17), but its development raises some important issues that are yet to be resolved.

3.4. Abstraction from water resources

Groundwater resources have been carefully monitored, assessed and modeled by hydro-geologists over the last 50 years and this formed the basis for the interim water sharing agreement included in Oslo 2 that extends from 1995 to 2000 (see below)[2].

Use	Oslo Agreement (MCM)				Utilization 2011(MCM)			
	Western	NE	Eastern	Total	Western	NE	Eastern	Total
Israel	340	103	40	**483**	≈411	≈103	150***	**664**
Palestine	22	42	54	**118**	25	20	42	**87****
Additional Quantity for Palestinian Development	__	__	78*	**78**	__		0	**0**
Basin Total	**362**	**145**	**172**		**436**	**123**	**192**	

Source: PWA, 2012c

*The 78 MCM is to be developed from the Eastern Aquifer and other agreed upon sources in West Bank (stated in Oslo II)

**This Number does not include the Water quantity produced by the unauthorized wells

***The 150 includes Dead Sea springs

Table 5. Water interim allocation for all usages, as per the Oslo 2 Agreement

According to this interim agreement which was expired since 12 years ago (2000), Palestinians should have access only to 118 Mm^3/year (i.e. 18% of the resource), while the current utilization 87MCM/Yr (less that the allocated quantity in Oslo II Agreement). This is clearly insufficient and unfair to meet the West Bank's 2.65 million inhabitants' 2012 demand for water and the water shortage will only increase further with population growth.

In Gaza, the total abstracted volume in 2011 for municipal uses is about 92.8 MCM in addition to 4.2 MCM/y supplied from Mekorot and for agricultural use is about 86 MCM with total supplied volume of about 183 MCM. This means that the total recharge is only one third of total abstractions.

3.5. Water resources at risk

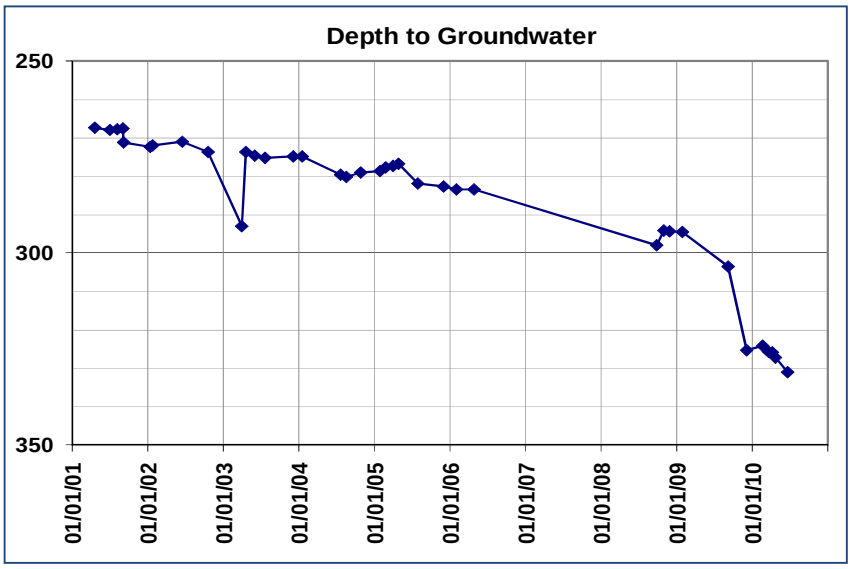
3.5.1. Groundwater depletion

Water abstraction, by Israelis, already exceeds the thresholds agreed in Oslo and many sub-aquifers are mined and suffer from depletion. This depletion is particularly marked mainly in the southern part of the Eastern aquifer, which is subject to unlimited abstraction by Israeli wells that are significantly affecting the nearby Palestinian wells. In addition, the continuation of severe drought has also negative impact on aquifers recharge. As a result, in some places, the drawdown has been more 70m in just ten years in southern part of the West Bank and this is considered as great threatening to the groundwater system in this area (PWA, 2012b).

The costal aquifer is also depleted as a result of un-equilibrium between the total water abstraction and its renewable amount, where the water level has been declined during the last few years to about 10-15 years below sea level and that hydro geological means the coastal aquifer damages through the invasion of the seawater to large parts of the inland coastal aquifer as well as upward leakage of the underneath saline water. As a result of that depletion, the groundwater salinity has been increased

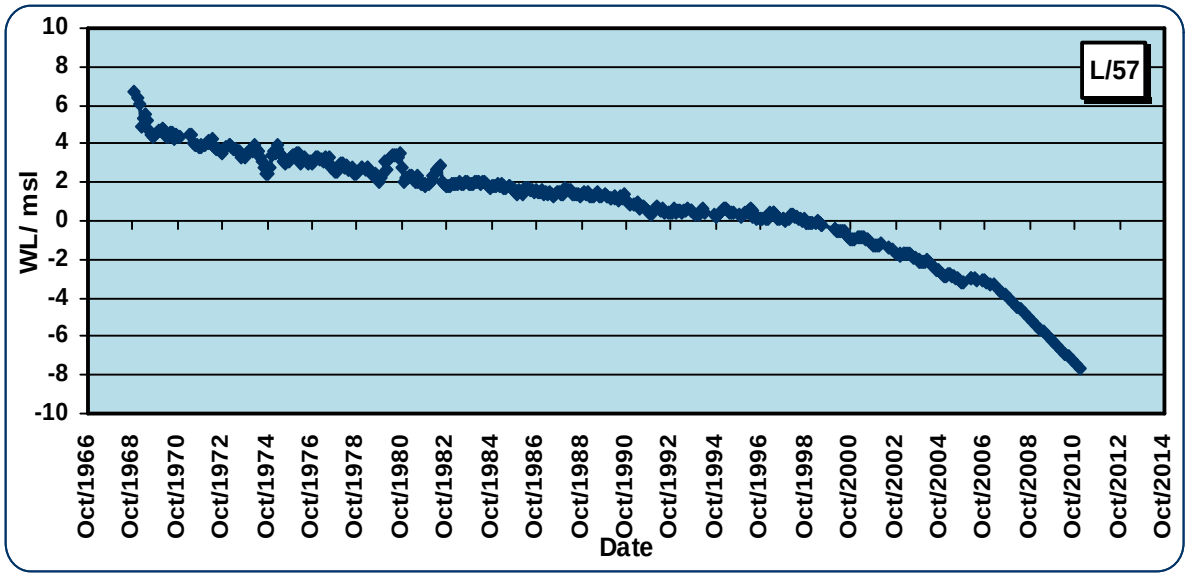
[2] NB: there are some Palestinian reservations on the estimated potentiality, especially for the Eastern aquifer resource.

significantly to unaccepted limit, where more than 90% of the pumped water exceeds WHO drinking limit (250mg/l) in terms of chloride concentration and it is generally in the range of 200-1000mg/l-Cl with continuous increase in line with aquifer depletion. It is expected that the groundwater quality of the coastal aquifer will be out of use by the year 2016 and the aquifer system will be collapsed completely by 2020 if no action was taken in terms of additional water resources as well as integrated water resources management.



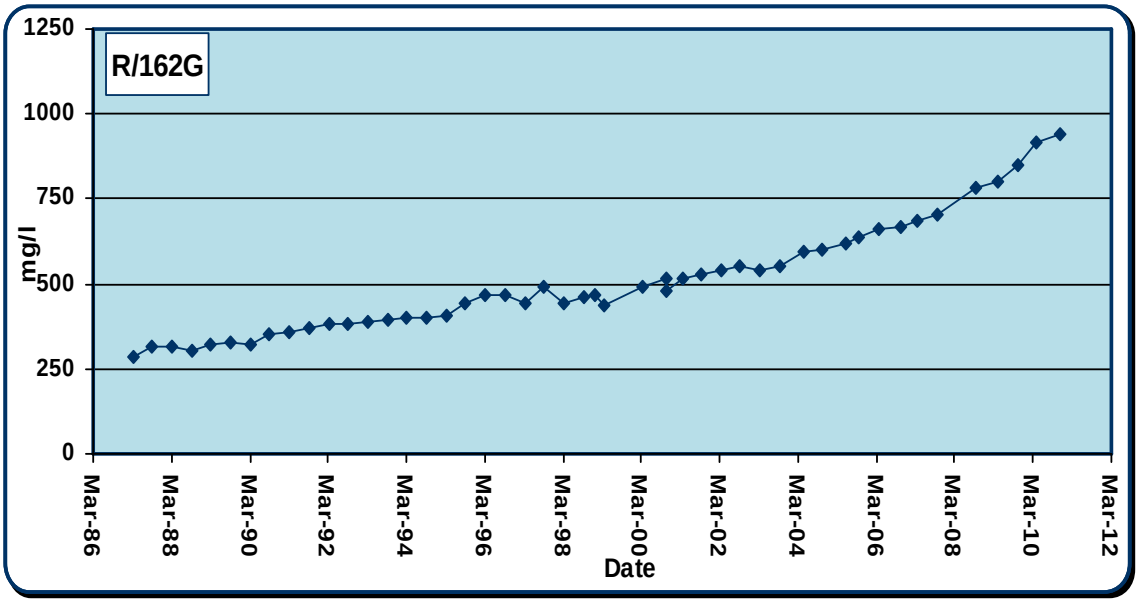
Source : piezometer monitored by PWA WR Department

Figure 2. Representative for Southern Part of the Eastern aquifer depletion



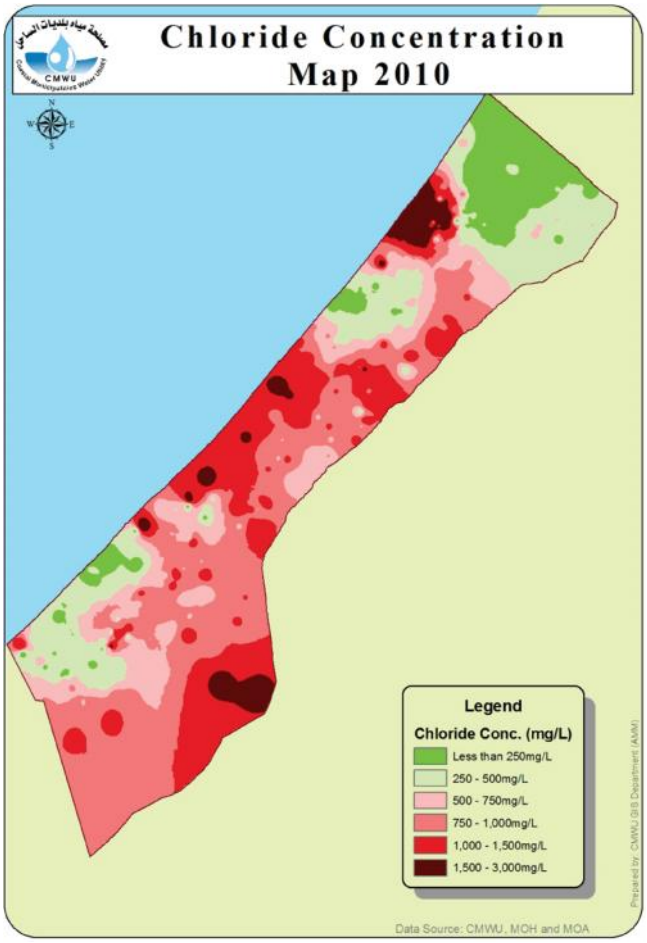
Source : piezometer monitored by PWA Gaza

Figure 3. Representative of Water level Decline in Gaza



source : PWA Gaza

Figure 4. Representative Chloride concentration trend in the Gaza Strip.

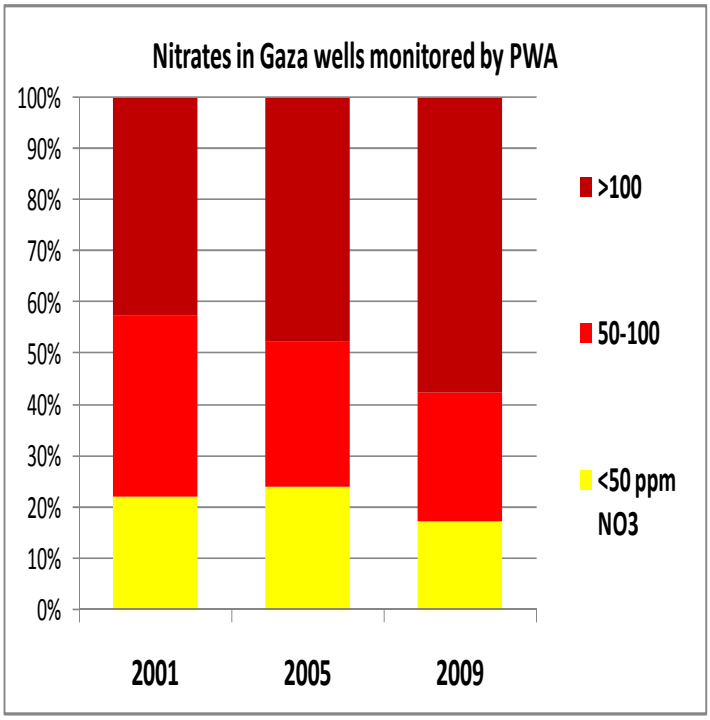


source : CMWU, 2011

Figure 5. Groundwater pollution by chlorides in Gaza strip.

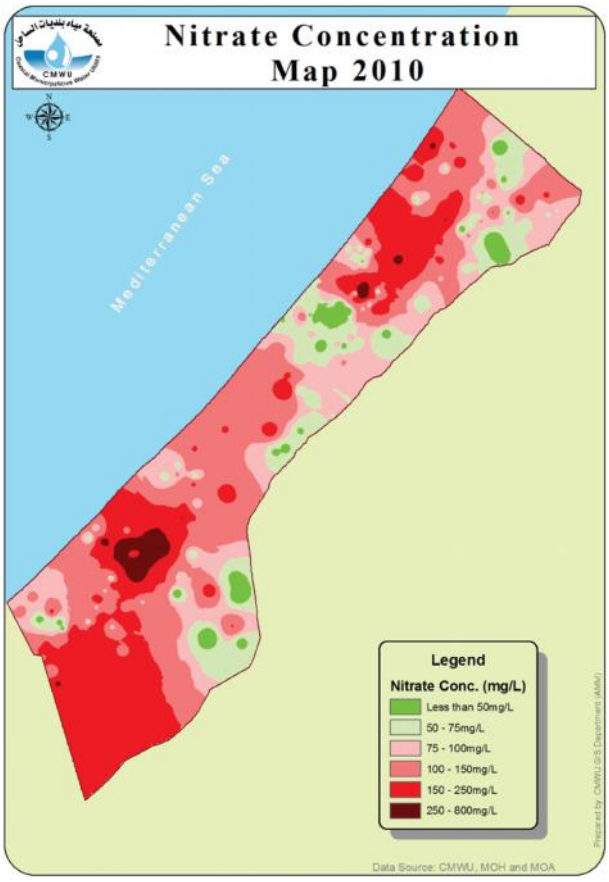
3.5.2. Nitrate pollution of groundwater resources

The population across Gaza Strip is very dense, and discharge huge amounts of pollutants per km^2 (organic matter, nitrogen, etc). Where, around 70% of the urban area are served by wastewater collection system and many people is still using cesspits or septic tanks for dumping their raw wastewater, with its negative impact on the groundwater pollution as a result of the wastewater leakage through the highly permeable unsaturated sandy zone . As recorded, groundwater pollution by nitrates is already widespread in the Gaza Strip and the majority of the wells utilized for domestic water contain more nitrates than the WHO-recommended drinking limit (50 mg/l) as indicated in figs.6&7 and this percentage is still growing with higher concentrations under urban areas.



Source: PWA, 2012.

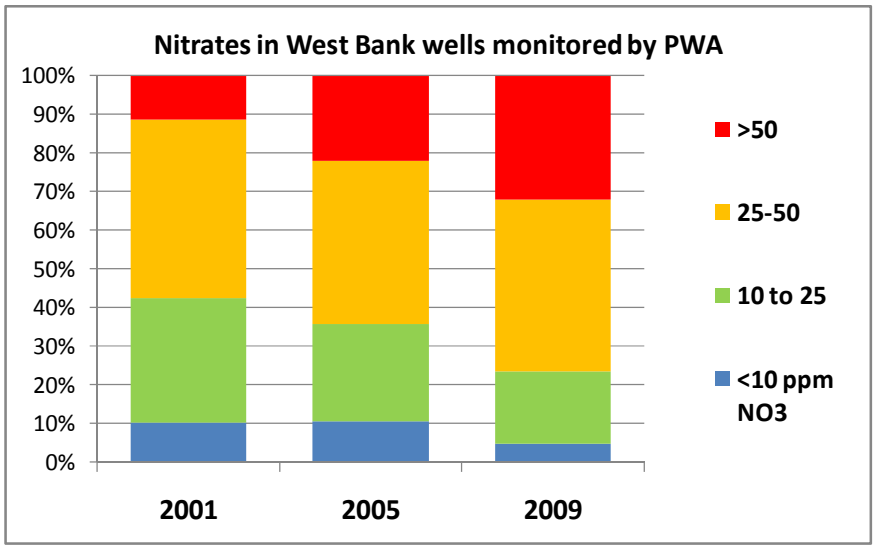
Figure 6. Groundwater rising pollution by nitrates in the Gaza Strip.



source : CMWU, 2011.

Figure 7. Map of nitrate pollution in the Gaza Strip

Although population density is lower in the West Bank, the combination of poor sanitation facilities and aquifer vulnerability (karstic aquifers) is causing nitrate contamination levels to rise, accordingly an urgent mitigation measures and protection plans are needed. Figure 8 shows nitrates concentration in representative wells from 2001 to 2009.



TPAT computation from PWA water quality data base

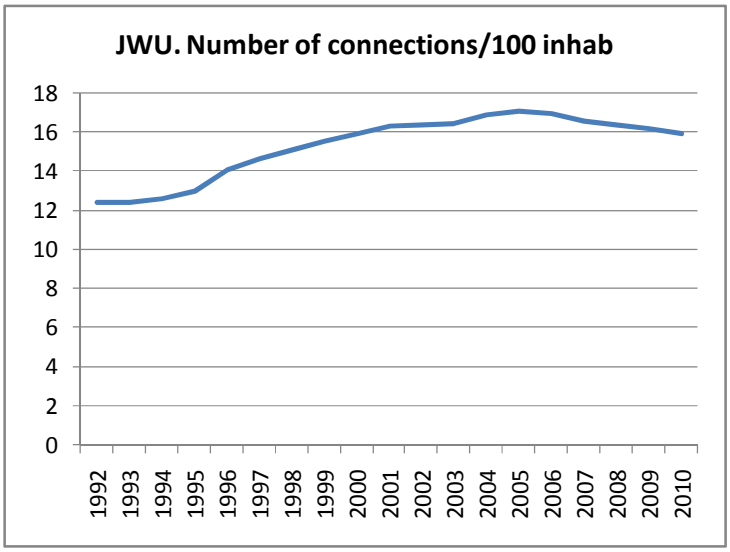
Figure 8. Percentage of wells with nitrates in excess in West Bank.

4. Water services level, coverage and quality

4.1. Service level and coverage

The most common level of service in Palestine is an individual household connection to a piped system. Over the last few decades, collective supply points have virtually disappeared and are no longer cited, except in zones where there is no piped water supply.

The connection rate (expressed as the number of connections per 100 inhabitants) has been increasing steadily in all urban areas and currently stands at 14 to 18 connections per 100 inhabitants. As the average household is considered to include 6.5 persons (PCBS estimates), it can be considered that, in urban areas, service coverage through household connections is almost complete and that future growth will be directly dependent on the development of new residential areas and the natural expansion of urban areas.



Data source: JWU web site.

Figure 9. Evolution of the connection rate within JWU service area.

The connection rate does not provide a fully comprehensive picture of actual service coverage, however, as a significant number of customers who have a connection are without a reliable service and are thus obliged to call on tankers to provide them with additional water. This private service delivery is not part of the water public service and these customers cannot, therefore, be considered covered by the public service.

4.2. Water made available per person

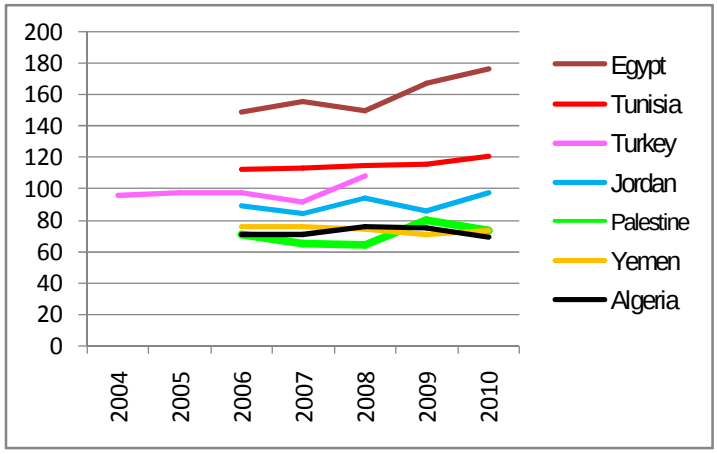
The total amount of water distributed in the West Bank and Gaza provides each person with an average of; 96 liters per capita per day (lcd) in Gaza (95% of Gaza water with unaccepted quality), 72 lcd in the West Bank and 82 lcd at the national level. These figures have relatively decreased over the past 7 years in the West Bank and with slight increase in Gaza.

	2004	2005	2006	2007	2008	2009	2010
Palestine	85	83	81	83	88	82	82
West Bank	*80*	*78*	*76*	*79*	*86*	*75*	*72*
Gaza	*91*	*90*	*89*	*88*	*91*	*92*	*96*

TPAT calculations – Various PWA data sources

Figure 10. Water made available per person in Palestine (consumption)

The 82 lcd is not a particularly high value[3]. It is one of the lowest ratios in the region, similar to domestic water provision in Algeria and Yemen, where the water services are generally considered to be poor and unreliable.



TPAT calculations - Data source: IB Net

Figure 11. Water made available per person in selected Middle East countries

4.3. Inequalities among regions

The quantity of water made available to customers varies widely from region to region (see

Governorate	Pop 2011	Water Prod	Water billed	UFW	Prod/capita	Billed/capita	Av. Tarrif	Max. tariff
		Mm3/year	Mm3/year		lcd	lcd	ILS/m3	ILS/m3
West Bank								
Bethlehem	194,095	11.30	7.50	34%	160	106	4.6	15.0
Hebron	620,418	17.30	12.60	27%	76	56	5.4	20.0
Jenin	281,158	5.70	3.90	31%	56	38	4.3	19.0
Jericho	46,718	3.80	2.90	24%	223	170	2.5	5.0
Jerusalem	147,489	4.70	3.10	33%	87	58	4.1	
Old City	242,950							
Nablus	348,023	15.00	10.20	32%	118	80	4.5	15.0
Qalqiliya	100,012	4.70	3.40	28%	129	93	4.1	18.0
Ramallah	310,218	16.60	12.50	25%	147	110	4.1	9.7

[3] As an illustration, domestic water distribution in Europe is in the 100 – 150 lcd range; in Israel, it is 250 lcd; and in Kuwait, 2,000 lcd.

Salfit	64,615	2.50	1.80	27%	106	76	4.4	5.0
Tubas	56,642	1.50	1.10	29%	73	53	5.1	25.0
Tulkarm	168,973	5.20	3.30	36%	84	54	3.1	20.0
Total West Bank Excluding Old City	2,581,311 2,338,361	88.30	62.30	30%				
Gaza								
North	309,345	21.90	11.80	46%	194	105		
Gaza	537,890	36.20	21.00	42%	184	107		
Middle	236,198	15.20	8.30	45%	176	96		
Khan Younis	301,136	15.20	8.40	45%	138	76		
Rafah	195,598	9.20	5.40	41%	129	76		
Total Gaza	1,580,167	97.70	54.90	44%				

Data source: PWA, 2012 b

Table 6 **Error! Reference source not found.**). These quantities reflect local water resource availability, as well as the investments made over recent years to improve the water service reliability and water quantities in some cities.

The northern and southern parts of the West Bank are particularly affected by a lack of water. This is due to the Israeli restrictions that prevent Palestinians from drilling new wells, rehabilitating existing wells and transporting water from region to region.

Due to water scarcity, many communities hire water tankers for their supply and pay as much as 20 ILS/m^3 for their water. This is reflected in the average tariff per governorate, which is relatively high in Hebron, Jenin and Tubas, i.e. in those governorates where many communities are obliged to use water tankers, with tariff rising up to 20 ILS/m^3, and in some communities even more. The strategy will focus on improving the service in these areas.

Governorate	Pop 2011	Water Prod	Water billed	UFW	Prod/capita	Billed/capita	Av. Tarrif	Max. tariff
		Mm3/year	Mm3/year		lcd	lcd	ILS/m3	ILS/m3
West Bank								
Bethlehem	194,095	11.30	7.50	34%	160	106	4.6	15.0
Hebron	620,418	17.30	12.60	27%	76	56	5.4	20.0
Jenin	281,158	5.70	3.90	31%	56	38	4.3	19.0
Jericho	46,718	3.80	2.90	24%	223	170	2.5	5.0
Jerusalem	147,489	4.70	3.10	33%	87	58	4.1	
Old City	242,950							
Nablus	348,023	15.00	10.20	32%	118	80	4.5	15.0
Qalqiliya	100,012	4.70	3.40	28%	129	93	4.1	18.0
Ramallah	310,218	16.60	12.50	25%	147	110	4.1	9.7
Salfit	64,615	2.50	1.80	27%	106	76	4.4	5.0
Tubas	56,642	1.50	1.10	29%	73	53	5.1	25.0
Tulkarm	168,973	5.20	3.30	36%	84	54	3.1	20.0
Total West Bank Excluding Old City	2,581,311 2,338,361	88.30	62.30	30%				
Gaza								
North	309,345	21.90	11.80	46%	194	105		
Gaza	537,890	36.20	21.00	42%	184	107		
Middle	236,198	15.20	8.30	45%	176	96		
Khan Younis	301,136	15.20	8.40	45%	138	76		
Rafah	195,598	9.20	5.40	41%	129	76		
Total Gaza	1,580,167	97.70	54.90	44%				

Data source: PWA, 2012 b

Table 6. Inequalities among governorates expressed in water availability and tariff.

Note: Max. Tariff includes Water Tankers prices

The majority of those inhabitants with no piped water supply are located within 4 governorates:

- Hebron Governorate, 31 communities (27,551 inhabitants) are still not served by the water supply network and pay very high tariffs for tanker water; the water piped to customers amounts only to 55 lcd;
- Jenin Governorate, 9 communities (19,013 inhabitants) are still without access to the water supply network and pay very high tariffs for tanker water; the water piped to customers amounts only to 41 lcd;
- Nablus Governorate, 16 communities (47,235 inhabitants) are still not served by the water supply network and pay very high tariffs for tanker water; the average water piped to customers at the governorate level amounts to 84 lcd, as Nablus city itself is well serviced

- Tubas Governorate, 8 communities (13,653 inhabitants) are still not served by the water supply network and represents 24.1% of the governorate population.

Governorate	Population	Number of Communities	served Communities	Served population	Un-served Communities	Un-served Population	Un-served Population
Jenin	281,158	72	63	262,145	12.5%	19,013	6.8%
Tubas	56,642	19	11	42,989	42.1%	13,653	24.1%
Tulkarem	168,973	35	33	167,880	5.7%	1,093	0.6%
Nablus	348,023	62	46	300,788	25.8%	47,235	13.6%
Qalqilya	100,012	33	32	98,209	3.0%	1,803	1.8%
Salfit	64,615	20	20	64,615	0.0%	0	0.0%
Jericho	46,718	13	13	46,718	0.0%	0	0.0%
Ramallah	310,218	75	74	309,383	1.3%	835	0.3%
Jerusalem	147,489	30	28	145,939	6.7%	1,550	1.1%
Bethlehem	194,095	44	44	194,095	0.0%	0	0.0%
Hebron	620,418	87	56	592,867	35.6%	27,551	4.4%
Total	**2,338,361**	**490**	**420**	**2,225,628**	**14.3%**	**112,733**	**4.8%**
					of communities		of population

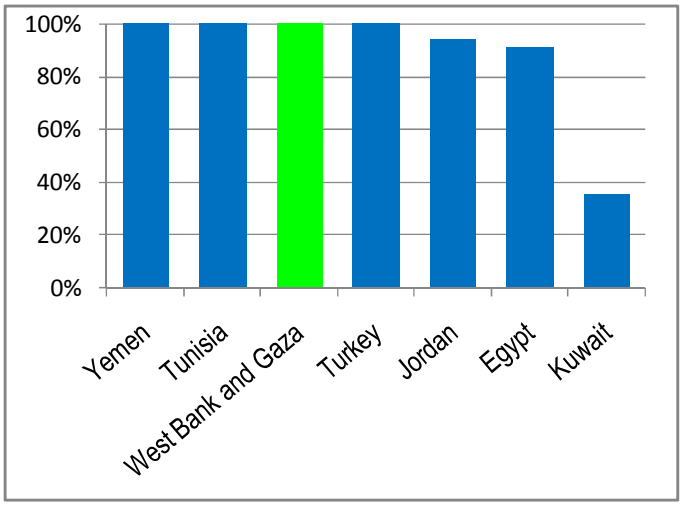
Data source: PWA, 2012 b

Table 7. Served and Unserved communities with population.

4.4. Metering

Metering (and invoicing, based on meter readings) is considered a relevant tool for limiting water wastage and encouraging customers to fix leaks and repair their plumbing equipment. In the Middle East, where water scarcity is a serious concern, metering is paramount for ensuring the proper and sustainable management of water resources.

As in most Middle East countries (except for the Gulf countries, where water wastage is not yet considered a crucial issue), most of the water connections in the West Bank and Gaza Strip are metered.



TPAT calculations - Data source: IB Net

Figure 12. Metering rate in selected Middle East countries

4.5. Pressure and reliability of the service

Most Palestinian localities have no continuous water service. The water operator manages to pipe water to each section of the network for a few hours per day (or a few hours every two days or even more) and customers have to invest in storage facilities if they wish to have water available all day long. This is why most of the houses in Palestine have roof tanks. As there is insufficient pressure in the network, many customers also invest in booster pumps, which they use to fill their roof tanks.

As the network lacks pressure for several hours of every day, it becomes very vulnerable to contamination by wastewater infiltration. In addition, intermittent water distribution causes the network to deteriorate at a faster rate and reduces its lifespan. For these two reasons, the strategy includes specific investment to improve pressure management and aims to provide 24/7 service to more and more customers.

4.6. UFW and NRW

Unaccounted for water (UFW) is calculated as the difference between water produced and water billed to customers. It is expressed in %. This figure aggregates leakages in the network (distribution losses) and water that is stolen. UFW estimates are based on production metering and customer metering, as well as on estimation where metering is difficult or inaccurate.

Non-revenue water (NRW) is the addition to UFW of the % of water that has been accounted for, but not billed (e.g. mosque, camps, fire fighting, ect). It is generally slightly higher than UFW and it is expressed in %.

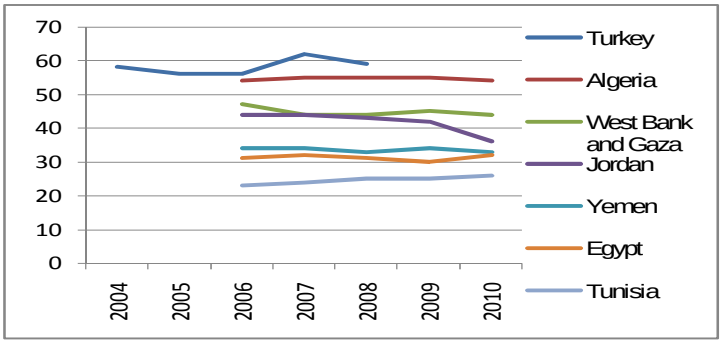
In the West Bank, UFW has been calculated as 24 to 36% by PWA.

In Gaza, PWA has calculated that UFW stands at 41 to 46 % which, by international standards, is extremely high for an area that is almost flat. According to CMWU officers, a significant part of this UFW equates to stolen water.

4.7. Collection Rates

In West Bank the average collection rate is of 65-75%, while in Gaza average collection rate is 25- 50 %.

In addition to UFW, most service providers in Palestine suffer from low bill collection rates and NRW is very high. When compared with neighboring countries (such as Jordan or Egypt, not to mention Israel), it is clear that the performances of the country's water providers with regard to NRW are poor. For this reason, the strategy includes investment specifically aimed at reducing NRW.



TPAT calculations - Data source – IB Net

Figure 13. Average NRW ratio for Middle East countries

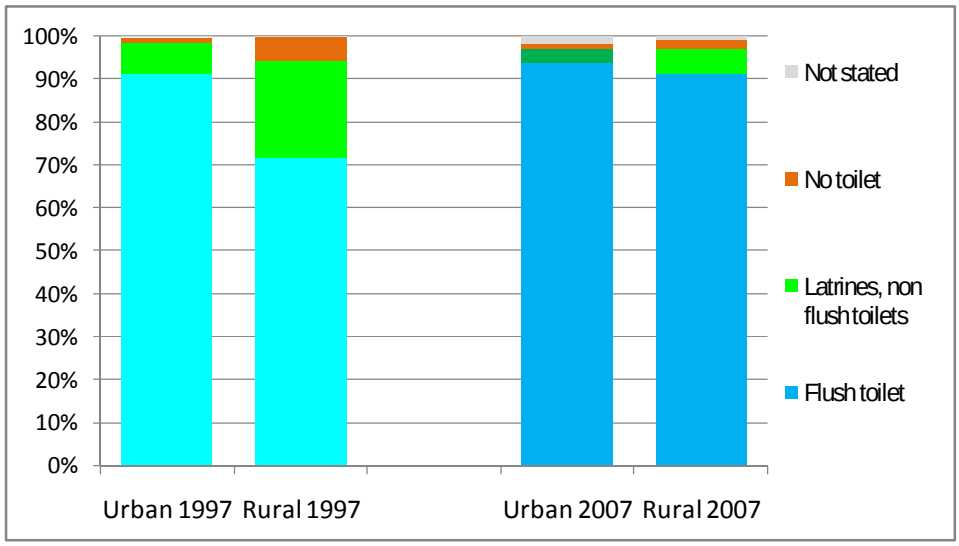
5. Waste water services organization, coverage and quality

5.1. Household level of sanitation equipment

The Millennium Development Goals (MDG) Joint Monitoring Program, led by WHO and UNICEF (JMP, 2012b), classifies households into 3 categories based on their sanitation facilities:

- households using flush-toilets, considered the best standard of service;
- those using non-flush toilets (i.e. latrines);
- and those without the use of toilets.

According to the PCBS census (1997 and 2007), a very large majority of households use flush toilets (93%), and this percentage remains high even in rural areas (91.1%). The level of facilities among rural households grew significantly over the 1997-2007 period and has doubtless continued to rise ever since.



TPAT calculation. Data source : JMP (2012b).

Figure 14. Percentage of household equipped with diff. standards of sanitation facilities by 2007

(and 1997 data are provided for comparison).

5.2. Sewerage

5.2.1. Localities with sewerage

The PCBS information portal (PCBS. 2012b) reports that 61% of households are living in localities with sewerage (92% in Gaza and 41% in the West Bank).

Governorate	Sewered localities	Population 2010 in sewered localities	Unsewered localities	Population 2010 in unsewered localities	% popul. In non sewered localities
Palestinian Territory	**94**	**2,433,661**	**463**	**1,577,799**	**39%**
West Bank	**71**	**1,022,821**	**453**	**1,453,519**	**59%**
Bethlehem	8	85,688	37	101,195	54%
Hebron	4	210,552	88	405,543	66%
Jenin	3	61,468	77	220,888	78%
Jericho and Al Aghwar	0		14	45,433	100%
Jerusalem	24	261,618	20	81,680	24%
Nablus	12	153,617	52	153,098	50%
Qalqiliya	5	59,343	29	49,066	45%
Ramallah and Al-Bireh	9	99,009	66	204,720	67%
Salfit	1	9,313	19	53,824	85%
Tubas	0		21	54,765	100%
Tulkarm	5	82,213	30	83,307	50%
Gaza Strip	**23**	**1,410,840**	**10**	**124,280**	**8%**
North Gaza	5	297,269	0	0	0%
Gaza	4	531,414	1	3,144	1%
Deir AL-Balah	10	217,856	1	5,010	2%
Khan Yunis	2	194,157	6	97,580	33%
Rafah	2	170,144	2	18,546	10%

TPAT calculation. Data source: PCBS, 2012b

Table 8. Sewerage coverage in Palestine.

The population living in localities with no sewerage (39% of the country's population) relies on on-site sanitation systems (septic tanks, cesspits, pit latrines, etc.).

In the border regions of the West Bank, some Palestinian villages are connected to Israeli wastewater treatment systems.

The % of the population living in localities with sewerage is particularly low in rural areas, but is also low in some large urban areas, such as Jericho and Tubas. It is much lower overall in the West Bank (41% of the total population lives in localities with sewerage) than in the Gaza Strip (92%).

5.2.2. Population connected to sewers

Not all of those households living in localities with sewerage are connected to the sewers and the overall connection rate (% of connected households) is lower than the % of the population living in localities with sewerage.

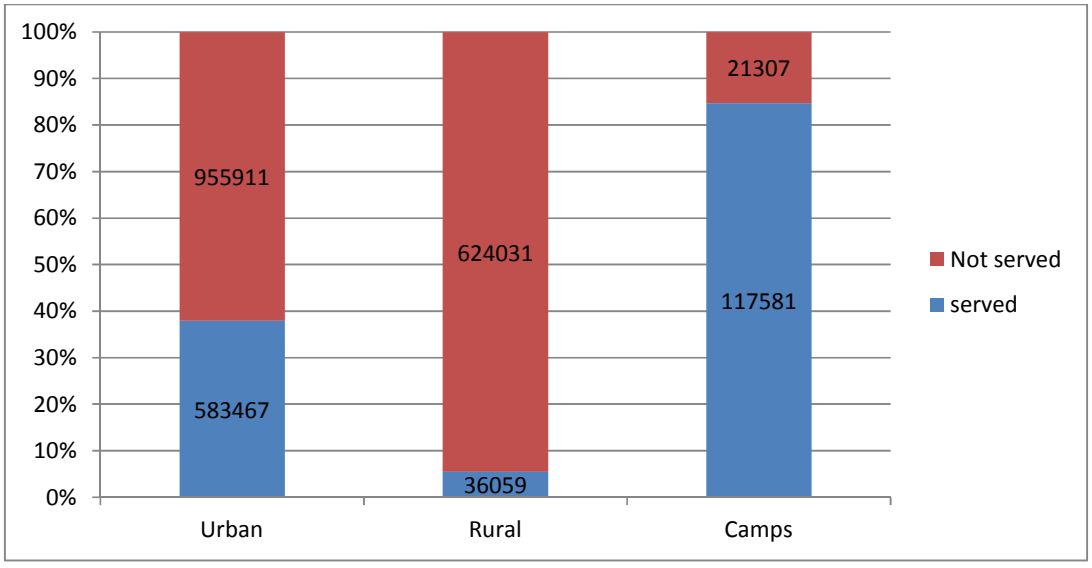
According to the PWA survey, around 46% of the total population of the occupied Palestinian State were served by conventional sewage networks (31% of the West Bank population and 70% of Gaza's population)

Governorate	Population	Population connected to sewerage network	Population not connected to sewerage network	percentage connected to sewerage network	Percentage not connected to sewerage network
Jenin	281,158	43,861	237,297	15.6%	84.4%
Tubas	56,642	1,076	55,566	1.9%	98.1%
Tulkarm	168,973	72,996	95,977	43.2%	56.8%
Nablus	348,023	180,276	167,747	51.8%	48.2%
Qalqiliya	100,012	50,906	49,106	50.9%	49.1%
Salfit	64,615	6,655	57,960	10.3%	89.7%
Ramallah	310,218	78,485	231,733	25.3%	74.7%
Jericho	46,718	0	46,718	0.0%	100.0%
Jerusalem	147,489	50,441	97,048	34.2%	65.8%
Bethlehem	194,095	81,908	112,187	42.2%	57.8%
Hebron	620,418	170,615	449,803	27.5%	72.5%
TOTAL	**2,338,361**	**737,220**	**1,601,141**	**31.53%**	**68.47%**

Source: PWA, 2012 d

Table 9. Population connected to sewage network or by governorate in West Bank.

The percentage of population connected to sewage networks varies according in urban, rural or refugee camp.



Source: PWA,2012d

Figure 15. Population Served and unserved by locality type in West Bank

In Urbana areas; Hebron, Nablus, Jenin, Tulkarem, Ramallah and Al Bireh have either totally or partially wastewater networks. Jericho and Tubas still lack wastewater collection networks

United Nations Relief and Works Agency for Palestine Refugees (UNRWA) has constructed wastewater networks in the majority of West Bank camps, such as Jenin, Balata, Askar, Jalazoun, Dheisheh, etc. while wastewater collection services are still unavailable in Jericho camps (As-Sultan and Aqbat Jabr). Wastewater network services are provided to 85% of the refugee camps. . Of the served refugee camps, more than 95% of them are connected to a sewage network. While in Gaza Strip, all the refugee camps are served by sewerage network connection.

In the rural population of the West Bank, which accounts for 28.5% of the total population, less than 30 towns or cities in the West Bank are connected in part to a piped sewage network. Other communities discharge their wastewater into unlined cesspits.

Around two thirds (72%) of the population in the Gaza Strip is served by sewage network system and the remainder disposes raw wastewater into cesspools, open drains and vaults. Khan Younis Governorate in the south of Gaza represents the poorest area in wastewater collection as well as poor treatment and infrastructure. It is estimated that the coverage of wastewater network in North area is around 80%, Gaza around 90%, Middle area 75%, Khan Younis 40% and Rafah 75%.

5.3. Management arrangement for sewers and WWTPs

For West Bank:

In most cases, municipalities are presently in charge of:

- investing in new sewers or extensions (with PWA support);
- maintaining the sewers (cleaning services);
- connecting houses.

Large municipalities and Utilities such as WSSA, Nablus Hebron, Ramalah , Jenin , Al Bireh and Salfit municipalities are operators responsible for sewerage interims of operation, maintenance and expansion. It is worth mentioning that the JWU will take over this responsibility soon.

For Gaza:

The main water operator (CMWU) and the Municipal Department are in charge of sewerage and WWTPs for the Gaza Strip:

- house connections,
- operation and maintenance of sewers and WWTPs,
- investments (with support from PWA).

The sewerage fee is charged by the CMUW and municipalities with the same bill of the water.

5.4. On-site sanitation

5.4.1. Type of frequently utilized on-site facilities

In areas not connected to the sewer network, wastewater is discharged into on-site sanitation systems (septic tanks, percolating cesspits and Wadis). In West Bank, it has been estimated that 41.17 Mm3 of wastewater is infiltrated into cesspits (PWA Annual Status Report, 2011). . In Gaza, 35MCM/Yr is

disposed into the sea of the partially treated effluent in addition to 8.4 MCM/yr is infiltrated into ground water, and 18MCM/yr is infiltrated to the ground Water through Cesspits sewage networks.

5.4.2. Constraints and impacts

On-site sanitation facilities (especially septic tanks) can be efficient at removing biological contamination (bacteria, viruses); however, the exact level of efficiency is dependent on both the facility's design and the final infiltration device. If the tanks are not waterproof, wastewater can contaminate groundwater resources, especially when in limestone areas.

Moreover, septic tank efficiency for removing nitrogen and phosphate is generally very low. It means that most nitrogen and phosphate will ultimately infiltrate the groundwater.

5.4.3. Sludge removal and treatment

In areas not connected to the sewer network, wastewater is discharged into percolating pits. Cesspits are emptied by vacuum tankers, which usually dump their contents in open areas, valleys, sewage networks and/or dump sites (Palestinian Hydrology Group: Palestine Water for Life Campaign 2006, quoted by Görlach et al. 2011). The existing WWTP have not been designed to specifically treat the sludge collected from septic tanks, but some treatment plants accept these trucks, as Al Bireh WWTP.

Most vacuum trucks are owned by small private companies.

5.5. Wastewater treatment plants

5.5.1. WW production and collection by sewers

In 2005, around 66 Mm3 of wastewater was generated in the occupied Palestinian State, of which 36 Mm3 was produced in the West Bank and 30 Mm3 in the Gaza Strip. About 35.5 Mm3 of wastewater, or 55.3% of the total wastewater volume produced in 2005, was collected by the sewage network (ARIJ, 2007, quoted in Görlach et al. 2011).

Recently, the Wastewater quantities generated in the West Bank was estimated at approx 62 MCM/yr including municipal, Industrial wastewater, in addition to 35 MCM/yr of untreated wastewater discharged by settlements and industrial zones into the West Bank environment (PWA, 2012d). The total collected quantities from the sewerage networks is either treated in Palestinian central treatment plants like Al-Bireh or small collective treatment plants like Zeita and Attil. Wastewater is also dumped into surface water streams (Wadis) and then either treated in Israeli treatment plants like Jenin, Tulkarm, West Nablus, Beit Jala, and Hebron, or disposed into Wadis.

In 2011, around 15 MCM/yr of wastewater is collected from several areas is dumped in wadis, and then treated in WWTP's inside the green line. At the expense of the Palestinian people, and treatment costs are directly deducted, every month, by the Israeli government from the Palestinian clearance account without any positive valuation of the treated waters. This water is reused by the Israelis.

Governorate	Total generated into Wastewater (MCM/yr)	Wastewater flows into Israel (MCM/yr)	Wastewater flows into Wadi (MCM/yr)	Wastewater flows to Treatment Plant (MCM/yr)	Wastewater into Cesspits (MCM/yr)
Jenin	3.99	1.1	0	0	2.9
Tubas	1.05	0	0.11	0	0.94
Tulkarm	3.64	1.46	0	0	2.18

Nablus	10.5	4.02	3.21	0	3.27
Qalqiliya	3.29	2.19	0	0	1.1
Salfit	1.75	0	0.29	0	1.46
Ramallah	12.32	0.8	0.44	1.83	9.25
Jericho	2.66	0	0	0	2.66
Jerusalem	3.29	0.4	0.26	0	2.63
Bethlehem	7.91	1.17	1.64	0	5.1
Hebron	12.11	3.83	0.42	0	7.86
TOTAL	**62.51**	**14.97**	**6.38**	**1.83**	**41.17**

Source: PWA,2012d

Table 10. Estimates of Generated Wastewater in the West Bank

In Gaza Strip, the collected wastewater through the sewage network system is pumped to five wastewater treatment plants (WWTPs), as shown in **Error! Reference source not found.**.

Governorate	Coverage %	Wastewater Generated MCM/Yr
North Area	80	8.40
Gaza	90	21.90
Middle area	75	3.65*
Khan Younis	40	3.65
Rafah	75	3.65
TOTAL	72	41.25

*** no treatment in the Middle area and the WW is diverted to the Wadi Gaza**

Table 11. The coverage of wastewater network and Generated wastewater in Gaza Strip, 2011

5.5.2. Actual treatment capacity

The wastewater treatment infrastructure in the West Bank is clearly unable to handle the amount of wastewater collected.

Throughout this period, wastewater from Palestinian cities has been and is still discharged into Wadis and natural waterways. In some cases, water even flows inside of the green line, where it is collected and treated in treatment plants built originally to treat Israeli Wastewater or plants build specifically to treat the Palestinian wastewater crossing the border. Examples of this are Yad Hanna WWTP that was built in Emek Hefer in 2003 to treat wastewater from Tulkarm and West Nablus. Shoket WWTP that was built in 2009 to treat wastewater flowing from Hebron. Those two treatment plants were financed by deducting funds from the Palestinian tax money collected by Israeli's.

There has been three Wastewater Treatment Plant constructed in Tulkarem, Jenin, Ramallah. These primary treatment lagoons have formed the only significant Wastewater treatment in recent years. The ponds that were built in the mid-1970s had not been improved or upgraded until the advent of the Palestinian National Authority and the creation of the PWA in 1996. Despite the increase in wastewater quantities flowing into those ponds and plants they were all operating beyond their maximum capacities. The result of this has led to partially treated waste water being discharged in areas surrounding these plants. The result of this has been multiple environmental and sanitary problems.

There are three central wastewater treatment plants (WWTPs) located in Al-Bireh, Ramallah, and Jenin cities in addition to the Tulkarm pre-treatment wastewater plant. AL-Bireh Treatment Plant was built in 2000abd has treatment capacity of up to 2-5.5 MCM/day.

The largest Palestinian wastewater treatment plants (WWTPs) are located in the Gaza Strip, more specifically in Beit Lahiya, Gaza and Rafah. While, in Khan Younis the existing plant is just collection pond with partially treatment. Its worth mentioning that; there is no treatment facility in the Middle area and a total of 3.7 MCM/Y of its raw wastewater is diverted to the Wadi Gaza. The total treated wastewater (treated partially) from Gaza, Khan Younis, and Rafah WWTP's are discharged to the sea around 30 MCM/Yr. Around 8.4 MCM/y of partially treated in Beit Lahia WWTP is infiltrated into the groundwater. Accordingly the wastewater flow in Gaza Strip is around 42MCM/Yr.

All the existing WWTPs in Gaza Strip are function at moderate efficiency rates (45-70%); they also operate above their actual capacity and are in need of upgrade and maintenance. As shown above, 71% of all the partially treated wastewater in Gaza Strip is discharged to the environment (Wadi gaza and the sea).

WWTP capacity is much more limited in the West Bank. The five WWTP described in the table below have a total capacity of 12,000 m3/day (= 4.5 Mm3/year) and two are out of order. The actual treatment capacity is less than 10% of the wastewater from the sewer system

Name	Population served	Capacity (m^3/day)	Inflow (m^3/day)	Construction date	Type of treatment	Efficiency %
West Bank						
Al-Bireh	50000	5,750	5,000	1998	single stage activated sludge	95
Ramallah	25000	1400	2,400	1970's, rehabilitated 2002-2003	Aerated lagoons	30
Jenin	40000	9250	3,000	1970's, rehabilitated 2011-2012	Aerated lagoons	Not working-under rehabilitation
Tulkarem	75000	15000	4,000	1970's, rehabilitated in 2004	Aerated lagoons	20
Gaza						
Beit Lahiya	236,298	12,000	23,000	1976	Stabilization ponds and aerated lagoons	70
Gaza	446,416	70,000	60,000	1977	Anaerobic ponds followed with bio-towers	60
Middle area			> 10,000*	1998	Without treatment	
Rafah	150,725	12,000	10,000	1983	Anaerobic ponds followed with bio-towers	45
Khan Younis	200,000	10,000	> 10,000	2007	Anaerobic lagoons followed by aerobic lagoon	45

*Wastewater generated without treatment

Sources:: PWA, 2012 d

Table 12. Main WWTP in the Gaza Strip and West Bank.

5.5.3. Capacity and outlook of scheduled WWTP

Most municipalities, in cooperation with the Palestinian Water Authority (PWA), have been and are planning to set up many new wastewater treatment plants. Treatment plants construction is ongoing for Nablus West, Jericho and also 5 WWTPs for small communities (EU funded). Others are already funded (Tayaseer and Ramallah), and still others are partially funded such as Hebron and Nablus East

However, the instability of the situation, along with other political and social factors, has delayed and even frozen the development of many all planned wastewater treatment plants (HWE).

Part 2. Demand for water and sanitation services

6. Strategy and implementation

6.1. The long-term scenario

The long-term water and sanitation sector strategy is designed for a fully independent Palestinian State. This vision has many practical implications for the strategy. Under this scenario:

- Palestinian people will recover their full rights over natural water resources according to the 1967 border, including East Jerusalem (surface water from the Jordan River Basin, as well as groundwater in the West Bank and the Gaza Strip); it will provide Palestinians with a significantly increased volume of water, enabling water service improvements to be implemented for domestic customers and the development of economic activities that require water (agriculture and industry);
- Palestinian people will recover their full access to irrigable land, especially in the Jordan Valley, where the potential for profitable irrigated agriculture is very high;
- The Palestinian administration (at the central and local level) will be fully entitled to plan and implement all necessary water and wastewater facilities (wells, storage tanks, water and wastewater networks, wastewater treatment plants, etc.) in accordance with their own strategic plans;
- The importation of hydraulic equipment will no longer be restricted;
- The JWC will be replaced by co-operation mechanisms that will be designed to ensure the sustainable management of transboundary water resources by Palestine and neighboring countries (Israel, Lebanon, Syria, Jordan) based on equitable utilization of the shared water resources.

6.2. Long-term strategic objectives

The national strategy for the water and sanitation sector is based on planning for the State of Palestine. Palestinians will attain their full water rights and hence current restrictions on water use will be alleviated. This would entail improvements in the service provided to customers (hours of service, pressure, water quality), as well as service coverage being expanded to include the few localities that are not currently connected to the water supply network, in addition to improve the Wastewater services to include collection treatment and reuse.

The strategy will be designed to achieve a set of strategic quantitative objectives, as defined in the next chapter.

6.3. Short term implementation plan

In the present situation, PWA and Service Providers face a number of additional constraints linked to Israeli military occupation (difficulties and restrictions accessing land and water resources, abnormal delays and difficulties importing equipment, etc),and permitting construction of Treatment Plants especially in Area C.

In view of these constraints and restrictions, the short-term implementation plan includes only investments and actions that can be completed in the present political situation (taking the military occupation-related constraints into account). As soon as these constraints have been removed, the implementation plan will be revisited and updated to match the long-term strategy.

Under the current situation, few additional water resources will become available to meet the growing demand of Palestinian citizens, farmers and industries. For this reason, PWA will invest in coping strategies: UFW reduction programs, drilling new wells, water harvesting, desalination of brackish springs, treated wastewater reuse for irrigation, improving irrigation efficiency, evolving the crop pattern, restricting the use of water for industry.

Sub-scenarios have been further developed for the West Bank and the Gaza Strip, as the context and constraints of the two regions are very different.

The first implementation plan will be designed to cover the next five years (2012-2017) but can be updated at any time, as and when the political situation evolves.

An overlapping period of some years is also to be considered to manage the transition period between the current situation and Independence.

7. Synthesis of strategic objectives

7.1. Aims of the strategy

The strategy aims to improve the water and sanitation services provided to Palestinian citizens over the next 20 years. For this reason, the criteria used to design the strategy have been defined from the customers' / citizens' point of view:

- Increasing the quantity of water delivered to customers;
- Maximizing the volume of water made available for irrigation;
- Providing all citizens with good access to a reliable source of water, with an affordable tariff for the poorest;
- Reducing inequalities among regions and localities;
- Improving the quality of the water delivered to customers;
- Improving the sanitation to Protect the natural water resources from pollution and excessive depletion;
- Improving the quality and reliability of the service;
- Ensuring the financial sustainability of water operators;
- Maximizing the benefits of irrigation (crops, jobs, revenue);
- Facilitating the development of industry.

7.2. Sector performance indicators

The strategy has been defined through a set of quantitative objectives that reflect the improvements made to the water and wastewater services delivered to customers. Such quantitative objectives will make it possible to: (a) evaluate the progress made towards implementing the strategy over the next 20 years and (b) estimate the level of investment required for strategy implementation.

The objectives (and relevant performance indicators) have been selected to provide a comprehensive description of the sector from the customers' viewpoint (i.e. output based), rather than from the point of view of planners (i.e. input based).

Aims of the strategy	Performance indicator	Comments
Increasing the quantity of water delivered to customers	Volume of domestic water available at tap (expressed in liter per day per capita)	This amount of water includes domestic, small shops, schools, administration, i.e. all customers excepting irrigation and industries supplied by they own
	Volume of water made available for industry	According to comparison with neighbours
	UFW	Expressed as a % of domestic + industrial WS
	Water produced through various sources (groundwater, desalination, import)	This objective will be reached through two complementary activities: increasing production and reducing UFW
Maximizing the volume of water made available for irrigation	volume of water made available to farmers	Other indicators (such as irrigation efficiency, revenue per dunum,…) will be defined by MoA and are not included in the Water sector Strategy
Providing all citizen with a good access to a reliable source of water	Number of un-served communities	A community (> 100 persons) is considered as served when it gets piped water supply + house-connection for all households ready-to-pay for this service
	Number of connection per 100 inhabitants	no comment
	Number of working house-connection	% of household has been proposed as an alternative indicator, but it requires comprehensive house-hold surveys, that are beyond the capacities of water operators
Reducing inequalities among regions and localities	Inequalities regarding access to water	Minimal volume of water available at tap (expressed in liter per day per capita) in each Governorate
	Inequalities regarding water tariff	Range of average tariff among water service operators
Improving the quality of the water delivered to customers	% of samples containing free chlorine residual	Samples must be collected at the level of the end-user. Intermediate measures are used for monitoring purposes but not included into the final calculation.
	% of samples free from total coliform contamination	
	% of samples free from fecal coliform contamination	
	% of samples with < 50 ppm nitrate	
	% samples with < 1000 TDS	
Improving the sanitation to protect the natural water ressources from pollution by wastewater	% of households connected to a sewer or a satisfactory on-site sanitation device (septic tank + infiltration bed)	no comment
	% of sewered water that is treated in a WWTP	no comment
	WWTP average efficiency regarding BOD, COD, TSS	Calculated as the % of pollutant removed
	WWTP average efficiency regarding nitrogen	
	% of treated wastewater that is reused for irrigation	Taking into account that irrigation is seasonal
Improving the reliability of service	% of customers getting water everyday	These customers can use roof tanks to improve their level of comfort if water is not flowing 24h
	% of customers benefiting 24h service	24h pressure is the best protection against pollution and will be easied by larger storage capacities
Ensuring financial sustainability of water operators	% of operators operating independently (autonomous)	autonomy (regarding accounts and staff) is a pre condition to financial sustainability assessment
	% of metered connections	as a prerequisite to monitor UFW
	working ratio = Operation & Maintenance (O&M) costs and Administrative costs (Excluding depreciation) / Operating revenue.	this calculation does not includes depreciation, whose value is subject to too many manipulations. For this reason, a sustainable operator needs to have a working ratio between 130 ant 150% (depending of the facilities he is supposed to replace after a while)
	collection efficiency	is the % of bills paid in less than 12 months

Table 13. Aims of the strategy and type of performance indicators

7.3. Strategic objectives for 2032

The strategic objectives have been fixed, taking into account the following hypothesis:

- Palestinians will get full rights of access and use of land based on 1967 border and to their rights on water resources based on international law. Consequently, the amount of water made available for the country will be much greater than at present;
- the Palestinians will succeed in negotiating fair water sharing agreements with neighboring countries, for trans-boundary water resources (Jordan River, Gaza Wadi and groundwater);
- the population will increase dramatically, because of demographic expansion plus many returnees coming back to the country.

The strategy developed under this scenario is ambitious in terms of both the service provided to citizens (quantity and quality of water) and economic development (irrigation and industry). It is based on:

- the equitable sharing of transboundary water resources (groundwater and rivers) with neighboring countries (Jordan, Syria, Lebanon, Israel and Egypt);
- the optimal use of all available water resources, from both an environmental, economic and social perspective (health, revenue, jobs);
- the sustainable use of these resources (voluntary limited rate of abstraction and resource protection);
- Create the Regional Water Utilities to provide water and wastewater services based on the economic basis that ensure the sustainability to provide a good services to the costumers'

The strategic objectives have been translated in figures, according to the set of selected performance indicators.

The value of each performance indicator has been fixed separately for the Gaza Strip and for the West Bank.

Aims of the strategy	Objective indicator	Strategic objectives for 2032		Comments
		Gaza	West Bank	
Increasing the quantity of water delivered to customers	water available per person (lcd)	120	120	this ratio (120 lcd) is similar to the ratio observed in modern European countries.
	expressed as a % of domestic WS	10%	10%	similar to the ratio observed in neighboring countries (Jordan, Lebanon, Israel, Egypt)
	UFW (%)	20%	20%	this objective is ambitious, but unavoidable in the water scarcity situation of Palestine. UFW reduction is considered as a cost-effective source of water.
	groundwater (Mm^3/year)	38	234	this volume has been calculated as the difference between the water demand and the volume of water provided by import and desalination
	desalination (Mm^3/year)	129	40	In the West Bank, desanitation capacities are almost limited to Fashka springs. In Gaza, they are limited by the investment capacity of PA.
	import (Mm^3/year)+Purchase	14	120	In the Gaza Strip, the objective is to replace import by local production (desalination). In the West Bank, import will increase significantly, as desalination opportunities are limited.
Maximizing the volume of water made available for irrigation	water made available (Mm3/year)	67	479	Other indicators (such as irrigation efficiency, revenue per dunum,…) will be defined by MoA and are not included in the Water sector Strategy
Providing all citizen with a good access to a reliable source of water	number of un-served communities	0	0	A community (> 100 persons) is considered as served when it gets piped water supply + house-connection for all households ready-to-pay for this service
	number conn./100 inhab	20	20	See detailed calculations in next chapter
	number of connections	644,000	1,266,000	
Reducing inequalities among regions and localities	water available per person (lcd): minimal average per governorate	120	120	This minimal volume per capita in each Governorate as be calculated as 70% of the national average
	range of tariff	200%	200%	this range means that the highest water tarif in the country is not more than twice the lowest tarif

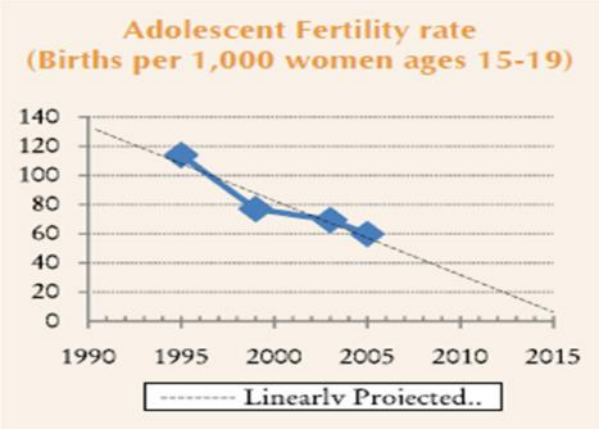
Aims of the strategy	Objective indicator	Strategic objectives for 2032		Comments
		Gaza	West Bank	
Improving the quality of the water delivered to customers	% with free chlorine	100%	100%	this objective is already almost reached
	% free from total colif.	100%	100%	this objective is already almost reached
	% free from fecal colif.	100%	100%	this objective is already almost reached
	% of customers serviced with < 50 ppm nitrate	90%	100%	As most groundwater contain > 50 ppm nitrate in the Gaza Strip, it will be difficult to serve 100% of Gaza communities with < 50 ppm nitrate
	% of customers serviced with < 1500 ppm TDS	100%	100%	this objective will be reached in Gaza with the development of desalination plants
Improving the sanitation to protect the natural water ressources from pollution by wastewater	% of households connected to a sewer or a satisfactory on-site sanitation device (septic tank + infiltration bed)	95%	75%	
	% of sewered water that is treated in a WWTP	95%	80%	
	WWTP average efficiency regarding BOD, COD, TSS	90%	90%	no comment
	WWTP average efficiency regarding nitrogen	50%	50%	no comment
	% of treated wastewater that is reused for irrigation	50%	60%	See chapter 17 and annexes
Improving the reliability of service	% of customers getting water everyday	100%	100%	no comment
	% of customers benefiting 24h service	10	10	the volume of storage (expressed in hours of supply) is a key factor of good management of pressure and reliability of chlorination
Ensuring financial sustainability of water operators	% of autonomous water utilities	100%	100%	all operators will be independant from municipalities (this has no implication on their public or private status)
	% of metered connections	100%	100%	this objective is already almost reached
	working ratio	130%	150%	this ratio means that utilities are financiallly autonomous
	collection efficiency	95%	95%	no comment

Table 14. Strategic objectives for 2032 (continued)

8. Population growth

8.1. Hypothesis

The population of Palestine has been increasing at a very high rate for the last ten years: 3.5 %/year (PCBS, 2010). The growth rate will remain very high over the coming years, but is expected to slow down slightly as a result of changes in education and family structure, as has been observed in other Mediterranean countries. A clear illustration of this trend is the decrease in the fertility rate among young women over the past decade (see figure below).



Source: MDG Progress Report, MoPAD, 2010.

Figure 16. Adolescent fertility rate in Palestine

8.2. Demographic trends

For the purposes of the water sector strategy, a demographic projection has been made , which includes:

- a progressive decrease from the present rate to a more modest rate by 2032;
- a dramatic inflow of Palestinian returnees as a consequence of a final agreement with Israel.

It is based on MoPAD demographic projections for the 2007-2050 period of time. In this document, 5 scenarios have been proposed. After discussion between MoPAD and PWA, it was agreed to consider two of these 5 scenarios most relevant for development of the national water strategies (so-called scenario 4 and 5).

Palestine population projections used for the water sector strategy

	Source: MopAD	2012	2017	2022	2027	2032
Scenario 4	West Bank with scen 4	2,649,020	3,459,901	4,674,040	5,563,943	6,333,980
Scenario 4	Gaza Strip with scen 4	1,644,293	2,007,780	2,406,429	2,794,534	3,221,051
Scenario 4	**Palestinian Territory**	**4,293,313**	**5,467,681**	**7,080,469**	**8,358,477**	**9,555,031**
Scenario 5	West Bank - scen 5	2,649,020	3,473,267	4,742,596	5,713,113	6,548,006
Scenario 5	Gaza Strip - scen 5	1,644,293	1,994,680	2,339,313	2,645,554	3,002,518
Scenario 5	**Palestinian Territory**	**4,293,313**	**5,467,948**	**7,081,910**	**8,358,667**	**9,550,523**

Table 15. Demographic hypotheses (MoPAD).

These two scenarios have been used for demographic projections at the regional level (the Gaza Strip and the West Bank). In both cases, total population increases from 4.29 million inhabitants to 9.55 million inhabitants. The main difference between the two scenarios is the number of people moving from region to region (Gaza to the West Bank and vice versa). This population shift will become easier within the State of Palestine (people will no longer be constrained by closure of the Gaza Strip), but it is not easy to predict how many households will actually move and in which governorate they will settle.

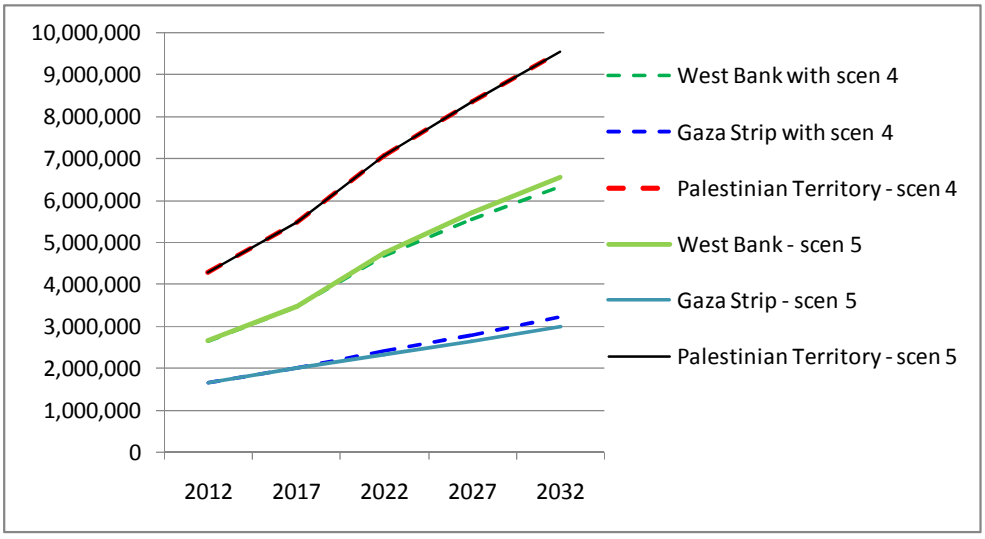


Figure 17. Demographic projections for the 2012-2032 period.

9. Demand for domestic water

9.1. Strategic objectives for per capita water allocation

In the present situation in Occupied Palestinian State (with water shortages in many localities), one of the most relevant water service parameters is the quantity of water made available to each citizen (expressed in liters per day and per capita). The total amount of water supplied in the West Bank and Gaza provides each person with an average of 96 liters per capita per day in Gaza, 72 lcd in the West Bank and 82 lcd at the national level (see Figure 10).

The strategy aims to improve customer satisfaction, providing customers with access to a reliable, permanent source of good quality tap water, at an affordable price. As a result, there is likely to be an increase in domestic water consumption. Nevertheless, this increase will be constrained not only by the customers' capacity and willingness-to-pay for this service, but also by consumers' support of the national policy aiming to limit water wastage and over-abstraction of limited water resources.

The strategy has been build with an objective to provide 120 lcd in both regions (the Gaza Strip and the West Bank).

9.2. Projected demand for domestic and industrial water

Using this hypothesis, the demand for domestic water has been calculated for both the Gaza Strip and the West Bank and are presented in the table below (detailed figures are presented in the annex).

In these tables, the demand for industry has been added, in order to facilitate comparisons with the tables included in chapter 12.

West Bank Water supply		baseline	short term	long-term strategy		
		2012	2012-2017	2017-2022	2022-2027	2027-2032
Demand	water available per person (lcd) at the end of each period (excluding industry)	72	78	88	103	120
	population (MoPAD)	2,649,020	3,473,267	4,742,596	5,713,113	6,548,006
	domestic water demand (Mm3/day)	70	99	152	215	287
	industrial water demand (as % of domestic)	3%	4.75%	6.50%	8.25%	10%
	industrial water demand (Mm3/year)	2.1	4.7	9.9	17.7	28.7
	total demand (domestic + industry) (Mm3/year)	72	104	162	233	315

TPAT calculation

Figure 18. Projected demand for domestic water in the West Bank.

Gaza Strip Water Supply		baseline	short term action plan	long-term strategy		
		2012	2012-2017	2017-2022	2022-2027	2027-2032
Demand	water available per person (lcd) at the end of each period (excluding industry)	96	102	108	114	120
	population (MoPAD)	1,644,293	1,994,680	2,339,313	2,645,554	3,002,518
	domestic water demand (Mm^3/year)	58	74	92	110	132
	industrial water demand (as % of domestic)	3%	4.75%	6.50%	8.25%	10%
	industrial water demand (Mm3/year)	1.7	3.5	6.0	9.1	13.2
	total demand (domestic + industry) (Mm3/year)	59	78	98	119	145

TPAT calculation

Figure 19. Projected demand for domestic water in the Gaza Strip.

10. Demand for industrial water

10.1. Baseline

As yet, there are no large industrial facilities (chemical plants, cement factories, etc.) consuming high volumes of water in Palestine. Most industries are just small factories and they use the urban water supply network as their sole source of water. Many of these industries are billed as conventional customers (as are many shops). The water operators in Ramallah and Nablus estimate that these small industries use 3% of the total urban water supply[4].

At country level, 3% of urban water equates to 2.7 Mm^3/year in the West Bank and 2.6 Mm^3/year in Gaza.

In addition to the urban water supply systems, some industrial facilities use private wells. Almost all of these wells are registered as irrigation wells, as PWA has not issued abstraction rights for industry wells. According to PWA estimations, this industrial consumption is very low, as farmers already struggle to find sufficient water to irrigate their land and are thus unwilling to resell this water to industry.

10.2. Projected demand for industry

The 3% ratio is lower than that observed in neighboring countries. It can be explained by the constraints that industry in Palestine has been facing over the past 40 years (difficulties accessing land, markets, suppliers, etc.).

Once the political constraints have been removed, the market opportunities for Palestinian industries will increase and more investors will venture to develop small factories. Nevertheless, heavy industry requiring huge amounts of water (paper, chemical, mining, etc.) will still be constrained by the limited water resources available in the Middle East.

The long-term strategy is based on the hypothesis that:

- the demand for water for industry will rise from 3% of urban water supply to 10%;
- most of these industrial plants will be supplied by Regional Water Utilities;
- Wherever possible, the treated waste water will be a source to meet the demand for water in some industries or PWA may authorize the use of private wells for industry, on a case-to-case basis, in accordance with the National Water Policy[5].

[4] This figure seems rather low, but it is similar to what is observed in similar countries: Jordan (3%), Israel (5.7%) and Lebanon (11%).

[5] Policy statement: "*It is the National Policy of Palestine to allocate water rights for economic benefit (agriculture, industry, tourism…) between different users according to economic benefits to Palestine (in terms of revenue, job creation and food security) and in agreement with national development plans. in order to preserve the limited resources available for agriculture*".

Production needs for industry

Baseline - Estimated production 2012 (Mm3/year)

Water utilities in Palestine (CMWU, JWU, Nablus WD) estimate that 3% of domestic water supply is used by small industries

	industry share	Production for domestic	Industry share (Mm3/year)
Gaza (Mm3/yr)	3%	70.0	2.1
West Bank (Mm3/yr)	3%	58.0	1.7
		Total	**3.8**

Long-term Strategy

The long term strategy aims to provide opportunities for industry development. It is based on a significant increase of industry water supply (10% of domestic water demand), because with an easier access to water resources, the Government will encourage additional investments in light industry allowing for job-creation.

	industry share	Domestic water demand	Industry water demand
Gaza (Mm3/yr)	10%	132.0	13.2
West Bank (Mm3/yr)	10%	286.8	28.7
		Total	**41.9**

Table 16. Anticipated water production needs for industry.

11. Demand for irrigation water

11.1. Irrigable land

The Ministry of Agriculture (MoA) conducts periodic censuses of the land suitable for irrigated agriculture, taking all relevant features into account (quality of soil, field slope, accessibility, etc.).

According to the most recent data, there are 745,000 dunum (equivalent to 75,000 ha) of irrigable land in Palestine (82% in the West Bank and 17.9% in the Gaza Strip).

Obviously, the demand for irrigation water cannot be based on these figures alone, as water resources are a major constraint when developing irrigation schemes. For this reason, demand has been assessed here on the basis of IRRIGATED, rather than IRRIGABLE, land.

Irrigable Land (in dunum)		
Governorate	Area	%
Jenin	163,000	*21.9%*
Tubas	82,000	*11.0%*
Tulkarm	27,500	*3.7%*
Qalqilia	17,500	*2.3%*
Salfit	49,000	*6.6%*
Nablus	68,000	*9.1%*
Ramallah	35,000	*4.7%*
Jerusalem	3,000	*0.4%*
Jericho	45,000	*6.0%*
Bethlehem	12,000	*1.6%*
Hebron	110,000	*14.8%*
Sub-Total WB	***612,000***	*82.1%*
Gaza Strip	***133,000***	*17.9%*
Total Palestine	**745,000**	

Sources: PCBS (2008)
MoA records (December 2008)
Agricultural Statistics 2006/2007

Table 17. Irrigable land in Palestine

11.2. Water needs per dunum

The amount of water required per dunum varies from one place to another and is dependent on rainfall, temperature, quality of soil, etc. It also depends on the type of crop being grown and the irrigation technology used (submersion, sprinklers, drip irrigation, etc.).

For overall planning purposes, MoA recommends using a figure of 740 m^3/dunum/year[6]. This figure has been calculated to take the recent and considerable development of drip irrigation into account.

There is still some room for improvement, however, and the MoA considers that overall efficiency gains of 10% will be achieved over the next 20 years.

11.3. Irrigated land and projected demand for irrigation

Actual (and future) irrigated land is evaluated by cross-referencing the water used (and available) for irrigation figures with water needs per dunum.

If the current political situation (military occupation) persists, it is considered that the amount of water available for irrigation will be severely constrained. Some agricultural wells will be taken over for domestic water purposes. At the same time, more and more treated wastewater will be available for reuse in irrigation, in accordance with the National Water Policy[7].

[6] This figure is a national average, taking into account zones where the irrigation needs are only 500 m^3/dunum (e.g. the Gaza Strip) and zones where it exceeds 1000 m^3/dunum (as the lower slopes of Jordan Valley).

[7] Policy Statement *"Treated wastewater represents a potential resource and should be optimized for agricultural, recharge and aquaculture purposes*."

The Comprehensive Peace Agreement to be signed between Palestine and Israel will include agreements on the equitable shares in transboundary water resources (these agreements, where needed, will also involve the other riparian countries sharing the same resources: Jordan, Syria, Lebanon, and Egypt):

- Jordan River;
- Western aquifer Basin in the West Bank;
- Eastern Aquifer Basin
- North-Eastern aquifer Basin in the West Bank;
- Coastal aquifer in the Gaza Strip.
- Wadi Gaza

The additional amounts of water made available upon the attainment of {Palestinian Water Rights will enable Palestine to develop an ambitious irrigation program in the West Bank.).

The amount of water available for irrigation in Gaza will still be constrained by the intrusion of seawater into the Coastal aquifer and the land availability.

Within the State of Palestine:

- the groundwater resources available for irrigation will decrease in Gaza, because PWA will impose limits on abstraction rights in order to control aquifer invasion by seawater as well as less land available, due to urban expansion;
- the groundwater resources available for irrigation will increase dramatically in the West Bank, as Palestinians will attain their water rights in the Jordan River and shared aquifers;
- PWA and MoA will encourage the reuse of treated wastewater for agriculture, including the construction of facilities to store and transport this water; this strategy will provide the main source of additional irrigation water in the Gaza Strip; in the West Bank, the availability of other (cheaper) water resources will deter PWA from investing too much in the long distance transfer of treated wastewater.

Policy statement : "*It is the National Policy of Palestine to treat all produced wastewaters to a quality sufficient to meet national standards for safe and productive reuse and support the distribution and productive reuse of treated wastewater.*

Irrigated land and water needs for irrigation

Baseline: estimated water use 2012 (Mm3/year)

Water use estimation, based on irrigated land (MoA census)

	type of resource	available for irrigation (Mm^3/year)	m^3/year per dunum	potentially irrigated land (dunum)
Gaza	Coastal aquif.	86	741	116,059
	Wastewater Reuse	1	741	1,306
	Total Gaza	**87**		**117,366**
West Bank	West.Aquif.			
	N-East.Aquif.	51	741	68,826
	East.Aquif.			
	Dams	2	741	2,699
	Total West Bank	**53**		**71,525**

Long-term Strategy

The final Peace Agreement to be signed between Palestine and Israel will include agreements regarding the fair sharing of transboundary water resources. Large additional resources will be available in West Bank (Western and North Eastern aquifers, Jordan Valley surface water).

	type of resource	available for irrigation (Mm^3/year)	m^3/year per dunum	potentially irrigated land (dunum)
Gaza	Coastal aquif.	32	741	43,185
	Dams	10	741	13,495
	TWW reuse	25	741	33,701
	Total Gaza	**67**		**90,381**
West Bank	West.Aquif.			
	N-East.Aquif.	51	741	68,826
	East.Aquif.			
	TWW reuse	83	741	112,195
	Jordan Valley	300	741	404,858
	Dams	45	741	60,729
	Total West Bank	**479**		**646,608**

Table 18. Anticipated irrigated land.

Part 3. Sustainable development of water resources

12. UFW and production needs for domestic and industrial water

12.1. UFW reduction hypotheses

Taking into consideration both the water scarcity and the number of communities without a proper water service, the present level of UFW (24 to 36% in the West Bank and 41 to 46% in the Gaza Strip) can be deemed excessive; thus the strategy aims to reduce this UFW rate.

Reducing UFW will require major investment in the distribution networks (leakage detection, illegal connection detection, pressure management, pressure districts, etc.) and at customer connection level[8]. This is not an easy task, however, and very few water companies worldwide have succeeded in significantly and permanently reducing UFW. Separate strategic objectives for UFW have been established for each region and each scenario.

	Gaza Strip	West Bank
Long-term Strategy	Palestinians have full access to the country's water resources. Nevertheless, the natural resources are limited (due to the climatic conditions in the country and the very high population density). UFW reduction is considered as a very important component of the strategy. Each UFW program will be compared (cost/advantage analysis) against alternative options, such as additional wells or bulk water supply from other regions or other countries.	
Strategic objective	**20%**	**20%**
Comments	The strategic objective in Gaza is ambitious (reducing UFW from 41-46 % to 20%) because water production is expensive in Gaza (desalination plant). However, this objective can be achieved, because the Gaza Strip is a virtually flat, densely populated area with integrated water systems. As such, it is less difficult to implement a comprehensive pressure management scheme.	The strategic objective in the West Bank is more modest (reducing UFW from 24-36% to 20%), because it is a mountainous area, where pressure management is difficult. Moreover, the region includes many isolated villages with small water systems, managed by local communities, not all of which will be incorporated into the service area of modern regional water utilities.

Table 19. UFW reduction hypotheses.

12.2. Content of the UFW-reduction program

The actions required to achieve the UFW strategic objectives consist of both physical investment and utilities reforms, including (but not limited to):

- the division of the water networks into pressure districts (this kind of investment is especially relevant in areas with large differences in elevation, such as Ramallah, Nablus, Bethlehem, etc.);
- leakage detection and repair programs (such programs can be implemented by the service providers or outsourced to specialized service providers);
- an improved metering system (bulk water metering, as well as customer metering);

[8] An indication as to the scale of this investment is provided by the UFW reduction program in Nablus city: US$20 million has been invested in the UFW-reduction program over 5 years, improving the service for 232,000 inhabitants, i.e. US$86 per capita.

- illegal connection detection and removal;
- etc.

The strategic objectives for UFW reduction are to be met within twenty years (i.e. by 2032) and the required investment is to be made during the 2012-2032 period.

12.3. Production needs

Taking into account the strategic objectives for both domestic and industrial water supply, as well as the UFW objectives, the water production/import needs have been calculated for the two regions.

West Bank Water supply		baseline	short term	long-term strategy		
		2012	2012-2017	2017-2022	2022-2027	2027-2032
Production needs	**UFW (%)**	**32%**	**29%**	**26%**	**23%**	**20%**
	Production needs	**105**	**146**	**219**	**302**	**394**
	groundwater abstraction	54	71	105	160	234
	from springs (Mm3/year)	*9*	*12*	*13*	*13*	*13*
	from wells (Mm3/year)	***45***	***59***	***92***	***147***	***221***
	desalination (Mm^3/year)	**0**	**0**	**22**	**32**	**40**
	Purchased from Mekorot+Import (Mm^3/year)	**51**	**75**	**92.25**	**109.5**	**120**

Figure 20. Production/import needs in the West Bank.

Gaza Strip Water Supply		baseline	short term action plan	long-term strategy		
		2012	2012-2017	2017-2022	2022-2027	2027-2032
Production needs	**UFW (%)**	**42.0%**	**36.5%**	**31.0%**	**25.5%**	**20.0%**
	Production needs	**102**	**123**	**142**	**160**	**181**
	groundwater abstraction	93	58	58	46	38
	from springs (Mm3/year)	*0*	*0*	*0*	*0*	*0*
	from wells (Mm3/year)	***93***	***58***	***58***	***46***	***38***
	desalination (Mm^3/year)	**4**	**55**	**70**	**100**	**129**
	Purchased +import (Mm^3/year)	**5**	**10**	**14**	**14**	**14**

Figure 21. Production/import needs in the Gaza Strip .

13. Groundwater resources management

13.1. Allocation of right-to-use water to Palestinians

Oslo 2 Agreement

In the long-term scenario, the Palestinian water rights will be negotiated with Israel and the other riparian countries, in accordance with international law and best practice with regard to the management of transboundary water resources.

In the mean time, the temporary allocations of water utilization to Palestinians is regulated by the Oslo 2 Agreement (see Table 5).

The Oslo 2 Agreement was mostly based on actual water abstraction at that time (1995), although it also included a slight increase to allow for population growth. Its aim was to regulate water allocations over a 5-year interim period, until a final agreement is reached between Palestine and Israel. This interim period was not supposed to last 20 years, however, and, for this reason, the Oslo 2 Agreement utilization figures no longer meet the minimal requirements of the Palestinian people. Although there is an urgent need to amend these figures (due to population change and other environmental and socio-economic factors), this agreement is still frequently cited as a reference during discussions at JWC meetings.

Additional comments:

- under the Oslo 2 interim Agreement, the Israelis are to supply 5 additional Mm3/year to Gaza and Palestinians are authorized to develop an additional 78 Mm3/year in the West Bank (compared with their water use in 1995);
- the resource for this additional 78 Mm3/year should be the Eastern aquifer basin or another agreed resource in the West Bank;
- the Oslo 2 interim Agreement does not clearly deal with abstraction rights on the Coastal aquifer (Gaza Strip); it does not include any figures on either the Israeli or Palestinian abstraction rate in 1995. It merely states that both sides should maintain the existing utilization.

13.2. Long term strategy - State of Palestine- = Final agreement with neighbors

The Comprehensive Peace agreement will be based on fair and equitable negotiations between countries sharing water resources:

- The Jordan River surface water resource (a water resource shared by Jordan, Syria, Lebanon, Israel and Palestine);
- The Gaza wadi (shared by Palestine and Israel)
- The Western aquifer (shared by Palestine and Israel);
- The North-Eastern aquifer (shared by Palestine and Israel);
- The Eastern aquifer (shared by Palestine and Israel);
- The Coastal aquifer (shared by Palestine, Egypt and Israel).

These negotiations will be based on international law and the best practice employed in other similar negotiations.

Nevertheless, international law and existing treaties do not provide definitive rules for allocating water rights between two (or more) countries sharing the same water resource (Phillips D.J.H, Shaddad A. et al. 2009). Abstraction rights discussions will focus on a number of criteria (population living in the basin, equality, prior utilization, basins area, recharge area, alternative sources that can be used in each country, environmental constraints, etc.).

As it is not possible to predict the outcome of these negotiations, the long-term strategy is based on a general overview of the resources that will be made available to Palestinians, but does not set out definitive figures for these resources.

13.2.1. Additional wells

Addition source of water by new wells should be considered on the long term Strategy from the three groundwater aquifers (basins). Due to several hydrogeological and climate change factors, it is expected that the Implementable number (abstraction rates) of all new wells will be less than the approximated or simplistic water rights, therefore the remaining quantities should be considered by swapping within the final negotiation with Israel. However, the following figures show the reliability of additional water from drilling new wells in the three aquifers (basins) within the long-term perspectives:

13.2.2. Western aquifer

The Western aquifer is the most productive because its recharge area receives most of the rainfall. Therefore, more new wells should be drilled along the whole basin from north to south in order to utilize a total quantity of 110-130 Mm3/year by the year 2032 for different uses. Furthermore, the development of any wells under the future situation is subject to negotiations with Israel concerning final allocation and the number of wells that are to be agreed upon on a case-by-case basis through co-operation mechanisms.

13.2.3. North-Eastern aquifer

This aquifer is a potential resource for the Nablus, Jenin and part of Tubas Governorates.

PWA has already identified that about 60-80 Mm^3/year could be developed from this basin by drilling several new deep production wells in Jenin, Nablus and Tubas areas by the year 2032.

13.2.4. Eastern aquifer

Even the southern part of this aquifer suffers from water table depletion in certain zones, an additional new wells need to be carefully sited so as not to interfere with existing wells. About 32 Mm^3/year (20 Mm^3/year from new wells +12 Mm^3/year from Dead Sea well field) of groundwater could be developed from these new proposed wells. Moreover, PWA presumed that the existing 38 Israeli wells that pumping more than 40 Mm^3/year should be finally transferred (handover) to its responsibility. Therefore, a total quantity of 90-100 Mm3/y could be developed by wells from the Eastern Basin by the year 2032.

There are a number of large brackish springs on the slopes of the Dead Sea, in the Bethlehem and Hebron governorates (Fashka Springs), which have an annual average discharge of 100 Mm^3/year. Many of these springs are too brackish to be used directly for domestic water supply purposes and have not yet been used to their full capacity. The long term strategy aims to develop this resource as:

- These springs are not too far from the Hebron and Bethlehem governorates[9], where many localities suffer from water shortages;
- The springs are not far from irrigable land in the Jordan Valley.

[9] Although there is a huge elevation difference and pumping costs are likely to be relatively high.

PWA plans to develop this resource with different types of program:

- firstly, a desalination plant with a 40 Mm3/year production capacity (reverse osmosis) to produce domestic water;
- 15 Mm3/year of the brackish water to be used for irrigation schemes in Jericho, from springs with less than 2 g/l TDS.

13.2.5. Coastal aquifer

The coastal aquifer has been overused in recent decades. Groundwater abstraction in the Gaza Strip only has reached 178.8 Mm^3/year[10], whereas the natural aquifer recharge on this portion of the aquifer is estimated to be only 55 Mm^3/year (Yacoubi, 2012). For this reason, the long term strategy aims to reduce total groundwater abstraction in the Gaza Strip from the current rate of 178.8 Mm^3/year to 70 Mm^3/year in 2032.

13.2.6. Reallocated treated wastewater and irrigation wells

The strategy includes a large development of wastewater collection (sewerage and cesspool sludge collection) and the construction of new wastewater treatment plants, in agreement with statements in the National Policy.

The development of efficient wastewater treatment plants will provide an additional water resource over the coming years that could be used for irrigation purposes.

In order to reduce the gap between water demand and water resources, the strategy aims to organize a swap with farmers, exchanging this new water resource for good quality wells currently being used for irrigation.

Implementing such a reallocation will be a rather complex operation, requiring the co-operation of various stakeholders. The bases for the exchange will be as follows:

- wastewater will be treated in high performance treatment plants in order to produce “reuse quality water”, for irrigation and/or infiltration;
- PWA and MoA will develop the mechanisms to encourage farmers to use the treated wastewater in agriculture;
- the reallocation will be organized during the irrigation period; and through Water Users Associations . For farmers that do not require irrigation water , then WWTP release will be used for infiltration and the recharge of aquifers.

13.3. Short-term strategy

13.3.1. Additional wells

According to the Oslo II Agreement, Palestinians are entitled to extract 118 Mm^3/year from groundwater (by wells and springs) in the West Bank. The current utilization is about 87Mm^3/year and so PWA is entitled to invest in additional production capacities of at least 31 Mm^3/year to fulfill the interim allocation of Oslo II which is 118Mm^3/ Yr. However, and due to the severe restrictions and delayed imposed by Israelis in JWC, about 17 Mm^3/y could be developed only during the short term strategy through drilling several new production wells in the three West Bank basins.. Moreover, rehabilitation of existing wells and

[10] For the total abstraction in 2011 = domestic + irrigation.

springs could improve 5% of the current available quantities, while the impact of Climate Change (mainly drought) on water resources could reduce the quantities by 5%.

13.3.2. Western aquifer

The Western aquifer is the most productive because its recharge area receives most of the rainfall. However, the Oslo II Agreement gives Palestine very limited abstraction allocations from this aquifer (22 Mm^3/y). Furthermore, the development of any wells under the present situation is subject to negotiations with Israel and the short-term (transitional) strategy includes only a very limited number of wells that are to be agreed upon on a case-by-case basis in the JWC. The plan is to develop about 5 Mm3/year as additional quantity from new wells in western part of Hebron and also rehabilitation of the existing wells in Qalqilia and Tulkarem, so the total quantity will reach to 30 Mm^3/year by the year of 2017 instead of 25 Mm^3/y in 2011. However, if this option is not success through JWC since the Palestinians will pump more than their allocated quantity in Oslo Agreement, PWA needs to develop a temporary-partial swapping allocation plan between this basin and the other basins (Northeastern and Eastern) in order to increase the Palestinian allocation in the Western Basin during the short term period.

13.3.3. North-Eastern aquifer

This aquifer is a potential resource for the Nablus, Jenin and part of Tubas Governorates.

Considering the current extraction rate of 15 Mm^3/year from existing wells in this basin, the PWA has already identified that about 6 Mm^3/year as could be developed additional quantity from drilling new wells. This will give an overall quantity of 21 Mm^3/y from wells by the year 2017. The development of any wells under the present situation is subject to negotiations with Israel through JWC. Therefore, the additional quantity of 6 Mm^3/year could be developed mainly by drilling new 4 production wells (Janzur, Kefert, Beit Qad and Shuhada wells) up to 2017.

13.3.4. Eastern aquifer

In the Eastern aquifer, the current abstraction rate is far below the threshold fixed by the Oslo II Agreement and PWA is entitled to drill additional wells.

However, this aquifer suffers from water table depletion in certain zones and additional wells need to be carefully sited so as not to interfere with existing wells.

Within the short term Strategy, PWA intends to develop about 4 Mm3/Yr through new wells as additional quantity from Ground Water. The 4 Mm3/Yr will be extracted through 4-5 new drilled deep production wells in Al Auja Area (Jericho District) and in the Eastern Part of the Herodian Area (Hebron – Bethlehem District).

13.3.5. Coastal aquifer

The coastal aquifer has been overused in recent decades. Groundwater abstraction in the Gaza Strip only has reached 178.8 Mm^3/year[11], whereas the natural aquifer recharge on this portion of the aquifer is estimated to be only 55 Mm^3/year (Yacoubi, 2012). Consequently, the level of the aquifer has dropped by 10 to 20 meters over the last 40 years; furthermore, because it is a coastal aquifer, brackish and salt water has begun to penetrate the aquifer, mixing with the soft water (see source : CMWU, 2011

Figure 5).

[11] For the total abstraction in 2011 = domestic + irrigation.

The Short Term strategy aims to reduce the total groundwater abstraction in the Gaza Strip to 153M3/yr in order to bridge the gap between water supply and demand. Some new wells could be built, but would not be considered an additional resource as they would replace existing wells that are to be closed because of poor water quality (chloride or nitrate levels exceed domestic water standards).

Groundwater resources in Palestine

Aquifer basins	Average recharge (Mm^3/year)	Actual abstraction (Mm^3/year)		5-years investment plan (Mm^3/year)	Long-term strategy (Mm^3/year)	Implementable (Mm^3/year)
		Israel	Palestine	Palestine	Palestine	Palestine
West Bank - Western aquifer	318-430a	411	25	30	100 to 300c	100 to 130c
West Bank - Eastern aquifer	125-197a	150	42	46	150	90-100
West Bank - N-E aquifer	135-187a	103	20	26	80 to 100c	60-80
Gaza Strip - Coastal aquifer	55-60a		178.8	153	70	70

a Source: PWA 2012 c

b source: PWA Gaza, 2012

c these figures are not the official PA position for future negotiation; it is just a very simplistic estimation of abstraction rights sharing between Israeli and Palestinian customers, aiming to illustrate the volume of resources in the long-term scenario.

Figure 22. Expected Groundwater utilization during short and long term perspectives in Palestine.

It is worth mentioning that as the Implementable number (abstraction) from the Ground Water Aquifer is less than the approximated or simplistic water rights, the remaining quantities should be considered by swapping within the final negotiation with Israel.

13.3.6. Swapping treated wastewater and irrigation wells

The strategy includes a development of wastewater collection (sewerage and cesspool sludge collection) and the construction of new wastewater treatment plants, in agreement with statements in the National Policy.

The development of efficient wastewater treatment plants will provide an additional water resource over the coming years that could be used for irrigation purposes.

In order to reduce the gap between water demand and water resources, the strategy aims to organize a swap with farmers, exchanging this new water resource for good quality wells currently being used for irrigation.

Implementing such a swap will be a rather complex operation, requiring the co-operation of various stakeholders. The bases for the exchange will be as follows:

- wastewater will be treated in high performance treatment plants in order to produce “reuse quality water”, for irrigation and/or infiltration;
- each user of irrigation water from an existing well will be granted the same quantity of treated wastewater (“one m3 for one m3”); the government will organize the free transport of treated

wastewater to the farmers' fields; due to excessive transfer costs, some wastewater treatment plants, on the border with Israel, will not be used for irrigation;

- Each user of irrigation water from an existing well will be granted the same quantity of treated wastewater (ex: "one m3 for two m3"); the government will organize the free transport of treated wastewater to the farmers' fields.
- MoA, PSI and MoH will define a limited list of crops for which irrigation with wastewater is permitted and considered safe;
- the swap will be organized during the irrigation period; and through Water Users Associations .
- taking all these various constraints into account, the potential additional water resource is relatively limited in the West Bank (see chapter 17).

Studies on a number of infiltration facilities in the Gaza Strip are already underway and the strategy aims to maximize this equipment as a core component of PWA Integrated Water Resources Management (IWRM).

14. Desalination

In the current situation, fresh water supply by desalination is taking place in Gaza Strip by large-scale desalinization Plant of seawater.

14.1. Increasing water production capacity in Gaza

The investment program to develop production in Gaza has been designed by PWA and is presented in a draft note that forms the principal basis of this chapter (Yacoubi A. 2012). This investment program is based on some main assumptions:

- the abstraction rate in the coastal aquifer is already excessive and has led to seawater intrusion; it must be reduced in order to restore aquifer capacity;
- additional water from Mekorot is not a reliable source (because of political interference by the Israeli government) and cannot be considered as a major source of water for the Gaza Strip;
- the desalination of seawater is the main potential additional resource;
- the use of treated wastewater for irrigation will be developed over the coming years.

14.1.1. Desalination of seawater

The Gaza Strip borders the Mediterranean Sea, a nearly unlimited source of saltwater. This resource can be used for soft water production in Palestine, as it is in other Mediterranean countries (Israel, Algeria, Spain, Greece, etc.). Seawater desalination technologies are mature and there are a significant number of competing manufacturers of reliable equipment on the market (many of them with good track records of producing desalination plants of the same category as those planned in Gaza).

The main constraints for the construction of large desalination plants in a low-income and blockaded country such as the Gaza Strip are:

- the cost of equipment;
- the running costs of the desalination plants (power, equipment renewal);
- power production or import;
- Israeli restrictions on access to materials and equipments;
- difficulty in attracting investment due to the conflict and risks of Israel targeting the installation as it previously did with the Gaza power station.

PWA has identified a large desalination project for Gaza, with a 55 Mm^3/year capacity by 2017 (to be expanded to 129 Mm^3/year in the future). The plant site has been secured (along the coast) and preliminary negotiations are under way with development banks.

Additional equipment could be installed on the same site or on other similar sites in the Gaza Strip.

14.1.2. Desalination of brackish water

The south-eastern part of the Coastal aquifer provides brackish water (3 to 5 g/l) that is not suitable for domestic water or irrigation. This water could be desalinated for emergency with limited capacity at a lower cost and with lower power consumption than seawater. The desalination of brackish water could provide a cost-effective alternative resource with reduced production costs and power consumption.

15. Purchasing from neighboring countries

15.1. Recent bulk supply from Mekorot

Over 33% of the West Bank's water supply comes from water imported from Mekorot systems (PWA data, 2012). To a certain extent, these imports offset the constraints imposed by the Israeli government regarding the construction of new wells and import levels have been increasing over the last few years.

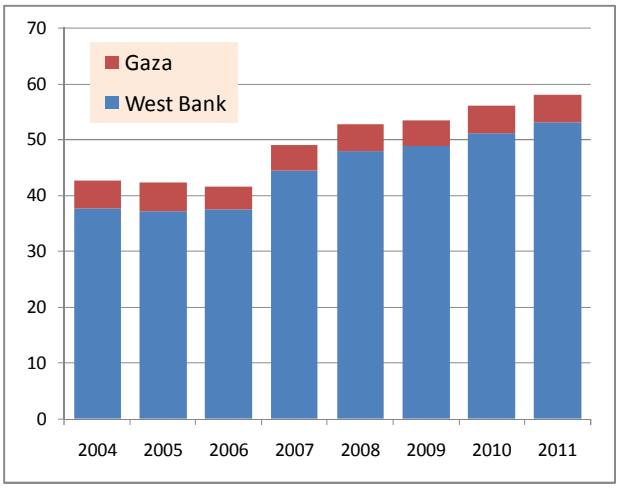


Figure 23. Annual quantity of water purchased from Mekorot for domestic use (in Mm^3/year)

TPAT calculation. Data source: PWA, 2012

15.2. Purchasing from Israeli System

Gaza currently imports some of its water from the Israeli water utility (Mekorot): 5 Mm^3/year. This represents only 3% of the region's water consumption. Israel is under an obligation to supply and addition 5 Mm^3/year under the interim agreement and negotiations over the implementation of that obligations are quite advanced with a tentative price agreed.

On the long-term, it is not anticipated any significant increase in water import as Mekorot itself is becoming increasingly reliant on expensive desalination water and Israelis have expressed willingness to increase water sales, but price could be rather high. Moreover, negotiations with Mekorot are tainted by the complex political relationship between the two countries and it is not advisable for the Gaza Strip to rely on such a water resource.

Although the constant political issues with Israel discourage PWA from relying on water supply from this country, however and considering operation cost for desalination, the strategy has been developed on the hypothesis that imports from Israel (or any other country) to Gaza will be increase.

15.3. Long-term strategy

The Mekorot water resource has comparative disadvantages:

- it is controlled by an external source and is out of PWA hands and dependent on difficult negotiations with Mekorot (an Israeli state-controlled utility);
- the supply points at which the water is piped into Palestine have to be negotiated with Mekorot, who prioritize the management of its own bulk water supply system; however, these priorities do not correspond to the priorities of Palestinians (WBWD need a higher share of the water imported

from Mekorot to be piped into the southern part of the country – Hebron Governorate - rather than into the northern region);

- the Mekorot selling price is high (2.7 ILS/m^3) and this will probably increase in the future, as more and more of Mekorot's water is produced through very expensive desalination plants.

For this reason, the long-term strategy should consider the import from other countries, and not only rely on a dramatic increase in the quantity of water purchased from Mekorot. Accordingly, the strategy considers the Mekorot water resource as an option that needs to be evaluated on a case-by-case basis through a commercial agreement, but not as a general source of water for Palestine.

15.4. Short-term (for the next 5 years)

Some governorates in Palestine suffer from a very large water deficit (e.g. in the Jenin, Hebron, Bethlehem. Tubas and Qalqilya Governorates). In order to rapidly improve the supply situation in these regions, additional purchase from Israeli System is considered as a viable option, as it can be implemented in the short-term.

Two different sets of negotiation will be undertaken by PWA:

- negotiations on the total amount of water bought from Mekorot, to increase this volume from 56 Mm^3/year in 2012 (51 in West Bank and 5 in Gaza) to 85 Mm^3/year(75 in West Bank and 10 in Gaza);
- negotiations to review the water supply points: (a) increasing the amount piped into the South of the West Bank, where few alternative resources can be mobilized in the short-term, as well as to the Gaza Strip and (b) reducing the amount supplied into the North of the West Bank.

16. Surface water resource management

16.1. Surface Water Resources

16.1.1. West Bank catchment area

Some 33 main wadis originate in the West Bank and flow either westward to the Mediterranean Sea or eastward to the Jordan valley and the Dead Sea. Some of these wadis are monitored by PWA and the total resource has been estimated as follows (see PWA. 2012c and **Error! Reference source not found.**):

- Wadis flowing westward to the Mediterranean Sea: 16 wadis with a 122.7 Mm^3/year average total runoff;
- Wadis flowing eastward to the Jordan Valley: 9 wadis with a 20.6 Mm^3/year average total runoff;
- Wadis flowing eastward to the Dead Sea: 8 wadis with a 21.5 Mm^3/year average total runoff.

16.1.2. Wadis flowing through the Gaza Strip

The main river crossing the Gaza Strip is the Gaza wadi, whose average annual run-off has been estimated to be 20 Mm^3/year. This river almost dried since Israelis have captured the runoff upstream the Gaza Strip.

With many of its tributaries having been dammed inside Israel for irrigation purposes, this wadi is no longer flowing and is not monitored by PWA.

16.1.3. Jordan River

The Jordan River is the main water resource in the region. Its catchment area is shared among 5 riparian countries (Palestine, Jordan, Syria, Lebanon and Israel). The historical total average resource is estimated to be 1,400 Mm^3/year (PWA. 2012c).

This resource is already over-used by the riparian countries (Israel, Jordan and Syria) and the remaining flow in the lower part of the Jordan River is less than 30 Mm^3/year and very salty and polluted. This low volume is not enough to maintain sound environmental conditions along the river (not to mention the Dead Sea, whose mean water level is decreasing by more than 1 m per year).

16.2. Present level of surface water use in Palestine

As they have been denied access to the majority of these resources, Palestinians currently make very limited use of surface water. There is only one significant dam (Auja Dam), which has a water flow regulation capacity of 0.5 Mm^3/year.

16.3. Long-term surface water strategy

Jordan River

Under a basin-wide agreement, a significant share of the Jordan River surface water resource will be available for use by Palestinians in the lowest part of the Jordan Valley.

The national strategy is to use this resource in the lowest parts of the country (in the Jenin, Tubas and Jericho governorates), (a) firstly, to restore irrigated agriculture in the Jordan Valley and (b) secondly, to top up the domestic water supply of those localities that experience water stress and where accessing groundwater would require unreasonably high levels of investment.

This water resource will be channeled through a main water carrier, similar to the East Ghor Canal built in Jordan. Designs for a West Ghor Canal were drawn up 50 years ago and these can be considered a first hypothesis for this facility; however, additional studies are to be undertaken before a final design is selected.

The water sector strategy does not fix the volume of water to be collected from the Jordan basin, because the specific allocations per riparian country will be agreed upon in a basin-wide agreement.

An initial proposal was made 50 years ago, during preliminary negotiations between Israel and the Arab League. This proposal (the so-called Johnston proposal) was to allocate water to the Palestinians, to be channeled through the West Ghor Canal. In 1955, this proposal was considered a sound basis for discussion for irrigation water; however, it was never formally endorsed by either the Israeli party or the Arab League. Moreover, the demographic and economic figures used to build this proposal are no longer valid and it is not the purpose of this strategy to set objectives for future negotiations.

For this reason, the strategy does not define a figure for this future water resource. International negotiations between riparian states commonly take into account the population living in the river basin, as well as the recharge in the watershed and of the surface water. Based on such criteria, Palestinians could claim between 200 and 400 Mm3/year (see table on the next page).

Nevertheless, negotiations will also take the other water resources (groundwater, wadis, access to sea water for desalination, etc.) into account. As a result of these uncertainties:

- the strategy does not provide a figure for the future surface water resource from the Jordan River as this will be subject to negotiation;
- for the same reason, the strategy does not include the sizing of the future West Ghor Canal;
- the strategy considers that most of this resource will be used for irrigation in the Jordan Valley and that the corresponding irrigation schemes will be sized in accordance with the volume of water allocated to Palestinians;
- the inclusion of these schemes into the short-term investment plans will be deferred until negotiations have been successfully completed.

	Palestine
Population leaving inside the Jordan basin	1,500,000
Surface of land included in the Jordan basin (km^2)	3,000
Runoff + Infiltration (mm/year)	123
Water recharge in the basin (Mm3/year)	370

	Palestine
Population leaving inside the Jordan basin	15%
Surface of land included in the Jordan basin	16.4%
Water recharge in the basin (surface + groundwater)	29.9%

	Palestine
Allocation of Jordan water according to Unified Plan (so-called Johnston proposal 1955)	*720 (Palestine + Jordan)*
Allocation according population (Mm^3/year)	189
Allocation according to surface (Mm^3/year)	211
Allocation according to water recharge (Mm^3/year)	385

TPAT calculation

Table 20. Sharing of the Jordan River water resource, based on the different criteria commonly used for the management of transboundary water resources.

Surface Water Harvesting from Major Wadis

The long-term plan intends to collect about 45 Mm3/year from major wadis in the West Bank for various purposes including artificial recharge; and to collect about 10 Mm3/year from Wadi Gaza as indicated in table below. The collected water in the West Bank will taking place through small and large scale structures in major wadis as following:

Wadi	Proposed Harvesting Quantity Mm3/y	Purposes
Qilt	3.0	Domestic and agriculture
Auja	3.5	Agriculture and Artificial Recharge
Fara'a	5.0	Agriculture and Artificial Recharge
Al Mukalak	3.0	Agriculture and Domestic
Al Khudera	9.0	Agriculture and Domestic
Qana	9.0	Agriculture and Domestic
Sarida	9.0	Agriculture and Domestic
Al Moqata'a	3.0	Agriculture and Domestic

Table 21. Proposed Harvesting Quantities from various Wadies in West Bank

However, a detailed engineering survey and feasibility study need to be carried out to indentify the actual scale, number and the suitable location of the interventions (harvesting structures) needed to be constructed in each proposed wadi.

16.4. Surface water short-term development strategy

Under the present situation (status quo and no peace agreement), the Jordan River resource is not accessible to Palestinians and is thus not taken into consideration in the short-term investment plan.

This investment plan is limited to rain harvesting systems, which are to be installed in the wadis that flow from the West Bank catchment areas. The water collected by these small dams will be used for irrigation only and to somehow for artificial recharge, because:

- in the short-term, there are no plans to develop surface water treatment plants for domestic water supply;

- this resource varies widely from year to year and does not constitute a reliable source of domestic water supply.

The short-term investment plan is sized for the collection of 10 Mm^3/year. A detailed list of projects is included in the annex of this report (see Appendix 6).

It should be noted, however, that under the present situation, these investments remain subject to JWC approval and to no-objection from ICA, as most of the rain harvesting systems will be located in area C.

Surface water resources in Palestine					
River basins	Average runoff (Mm^3/year)	Actual abstraction (Mm^3/year)		5-years investment plan (Mm^3/year)	Long-term strategy (Mm^3/year)
		Israel	Palestine	Palestine	Palestine
West Bank - wadis flowing towards Mediterranean Sea	122.7[a]	?	2	5	30
West Bank - wadis flowing towards Jordan Valley	20.6[a]	0	0	5	15
Gaza Strip - wadis flowing towards Mediterranean Sea	21.5[a]	20	0	0	10[b]
Jordan River	1300	800[a]	0	0	200 to 400[b]

a source: PWA, 2012c

b these figures are not the official PA position for future negotiation; it is just a very simplistic estimation of abstraction rights sharing between Israeli and Palestinian customers, aiming to illustrate the volume of resources in the long-term scenario.

Table 22. Surface water resources and use.

17. Reuse of treated wastewater for irrigation

17.1. Baseline

In Palestine, as in most Mediterranean countries, there is a growing awareness of the benefits of using treated wastewater as a valuable additional water source. This is clearly expressed in the National Water Policy:

- *"Treated wastewater represents a potential resource and should be optimized for agricultural, recharge and aquaculture purposes;*
- *It is the National Policy to treat all wastewater produced to a quality sufficient to meet national standards for safe and productive reuse and to support the distribution and productive reuse of treated wastewater.*
- *It is the National Policy to strengthen treated wastewater reuse through sound contractual arrangements between the producers and the users".*

Despite this formal recognition of the importance of reuse, formalized reuse of wastewater in Palestine remains minimal at the present time. The majority of existing WWTPs discharge directly into wadis or the Mediterranean Sea.

Some farmers pump this water directly out of the wadis and use it for irrigation purposes. This activity is not regulated and there is no guarantee that the quality of the water being pumped is suitable for irrigating the kind of crops grown. However, the mere existence of these irrigated fields demonstrate that (a) there are no cultural constraints inhibiting the use of treated wastewater for agricultural purposes and (b) there is a demand for such water on the part of the farmers.

17.2. Regional perspectives for reuse

Wastewater reuse is well-established in other Middle Eastern and Mediterranean countries; thus, there are numerous lessons that can be learned by understanding the practices of others and applying them to the local conditions.

In Israel, wastewater reuse is a core component of IMWR and the country claims to be reusing as much as 450 Mm^3/year of treated wastewater (Shellef, 2012).

In Jordan, 106,600 dunum are considered as irrigated by treated wastewater (Duqqah et al.), most of it (91,000 dunum) after mixing with fresh water in the Jordan Valley.

In Algeria, treated wastewater reuse has been on the Ministry of Water Resources' agenda for 30 years; however, project implementation has proved very difficult due to legal and administrative constraints.

17.3. Potential water resources

The table below provides an initial, tentative estimate of the potential water available from the (existing and future) WWTPs, as well as the potential for developing irrigation. These estimates are based on the following hypothesis:

- Population: MoPAD scenario;
- Population connected to a sewer (number of connections);
- Volumes collected and treated ;
- Volumes available for irrigation during the irrigation period;

- Irrigable surface area;
- Potential irrigated surface area.

This estimation is based on the hypothesis that all the constraints faced by the reuse of wastewater in Palestine have been removed.

	Present situation	5 year plan	Long-term strategy			
	2012	2017	2022	2027	2032	
West Bank						
Treated ww available for irrigation or infiltration	2.1	25.2	51.0	87.3	138.6	
Irrigation share	*0%*	*25%*	*60%*	*60%*	*60%*	*60%, taking into account a longer irrigation period in Jordan Valley*
Resource for reuse in irrigation (Mm^3/year) from Treated Wastewater	0.0	6.3	30.6	52.4	83.1	
Residual resource for infiltration (aq. Recharge or to the Wadi)	2.1	18.9	20.4	34.9	55.4	
Ground Water resource in Irrigation (Mm3//year)	51.0	51.0	51.0	51.0	51.0	
Dams for Irrigation (Mm3/year)	2.0	10.0	20.0	30.0	45.0	
Jordan River (Mm3/Year)	0.0	0.0	200.0	250.0	300.0	
Total Available quantity for Irrigation (Mm3/year)	**53.0**	**67.3**	**301.6**	**383.4**	**479.1**	
Irrigable land (dunum)	612,000	612,000	612,000	612,000	612,000	*according to MoA land census*
Irrigation needs	*741*	*741*	*741*	*741*	*741*	*source: MoA*
Potential irrigated land (in dunum)	**71,525**	**90,818**	**407,051**	**517,397**	**646,608**	
% of irrigable land	**11.7%**	**14.8%**	**66.5%**	**84.5%**	**105.7%**	
Gaza						
Treated ww available for irrigation or infiltration	32.3	47.5	62.7	79.3	99.9	
Irrigation share	*3%*	*25%*	*25%*	*25%*	*25%*	
Resource for reuse in irrigation (Mm^3/year) from Treated Wastewater	1.0	11.9	15.7	19.8	25.0	*25%, taking into account 6 months irrigation per year*
Residual resource for infiltration (aq. Recharge or to the sea)	31.3	35.6	47.0	59.4	74.9	
Ground Water resource in Irrigation (Mm3//year)	86.0	75.0	50.0	40.0	32.0	
Dams for Irrigation (Mm3/year)	0.0	0.0	10.0	10.0	10.0	
Total Available quantity for Irrigation (Mm3/year)	**87.0**	**86.9**	**75.7**	**69.8**	**67.0**	
Irrigable land (dunum)	133,000	128,000	123,000	118,000	113,000	*according to MoA land census + urban expansion reducing available land*
Irrigation needs	*741*	*741*	*741*	*741*	*741*	*source: MoA*
Potential irrigated land (in dunum)	**117,366**	**117,250**	**102,128**	**94,217**	**90,381**	
% of irrigable land	**88.2%**	**91.6%**	**83.0%**	**79.8%**	**80.0%**	

Source: TPAT calculations

Table 23. Potential reuse of treated waste water.

17.4. Strategy for the development of treated wastewater reuse in agriculture

Over the last decade, a number of small-scale reuse schemes have been developed in Palestine for experimentation and demonstration purposes, in Gaza, El Bireh and Al Jalazoun (HWE). The results of these experiments (plus those of the regional experience) have been sufficient to prompt rapid progression to the next stage: medium-sized pilot projects, extending over a few thousand dunums.

The short-term strategy (next 5 years) aims to implement such pilot projects downstream from three, already well-known, WWTPs: El Bireh, and Nablus West (West Bank) and Gaza. These pilot programs will not wait for the completion of a new institutional framework or the creation of new agencies. They will be implemented by the existing agencies: PWA, MoA, JWU, CMWU and farmers' associations.

In order to mobilize the farmers more rapidly, awareness-raising campaigns will be conducted to inform potential users of the benefits and safety of water reuse. This water reuse can include the simplest of greywater reuse by households, through to the much larger irrigation schemes that use either stormwater or water from treatment plants. The use of mass media will be considered as a means of promoting reuse and its associated benefits and messages.

17.4.1. Completing the regulatory framework

PWA and MOA will develop the mechanism to encourage the farmers to use the treated wastewater in agriculture taking into consideration the economic view.

EQA, PSI, MoA and PWA will work together to develop and enforce all regulations pertaining to the Environmental Limit Values (standards and guidelines) for wastewater reuse.

Additional regulation will be developed over the next five years, covering:

- investment in treated wastewater carriers (defining ownership, rules for implementation, funding arrangements);
- right-of-use;
- tariff-setting mechanisms.

17.4.2. Assessing and costing opportunities for reuse

Opportunities for the further development of wastewater reuse will be investigated, taking both environmental and health constraints into account.

As can be seen in Table 23, given the WWTPs under construction (or in the design phase) in the Occupied Palestinian State, the volume of water that could be available for irrigation is relatively high (27 Mm^3/year by 2017 and 39 Mm^3/year by 2022).

The short-term strategy (next 5 years) includes:

- a detailed assessment of the irrigable land located downstream from a future WWTP or that could be supplied with a moderate pumping head (< 50 meters);
- a rapid appraisal of the investment and running costs of the facilities to be constructed for each of the schemes (canal, storage, pumping stations), in order to enable a robust business model to be built for each reuse scheme.

17.4.3. Organizing reuse management

The Strategy considers that clear and concise institutional arrangements will be defined within 5 years for the sustainable management of reuse schemes, as well as for ensuring the equitable distribution of water between farmers.

Reused wastewater will be affordable to agricultural users, bearing in mind that there are mutual benefits on both sides (farmers and the treated wastewater supplier): The Service Provider is responsible to treat wastewater into agreed Standards and after that PWA with Governmental bodies will organize utilization of this water towards potential application with farmers and other Stakeholders through clear mechanism. Wherever large scale wastewater reuse is carried out, scientific monitoring will be conducted by an approved laboratory. Instituting such monitoring will help minimize any potentially detrimental impacts on the environment and, more specifically, on the soil and underlying aquifers. PWA, in association with the Environmental Quality Authority, will coordinate and manage these studies.

NGOs will be encouraged and supported the development of water reuse projects, where appropriate. It is, important to involve the private sector.

18. Integrated Water Resources Management

18.1. Water resources monitoring

Because the water resources are scarce in Palestine, monitoring the water resources is paramount.

PWA is in charge to collect, gather and publish data regarding the water resources (groundwater level and quality, river flow and quality, etc)

Such information is published in periodic reports, such as the "Status report of water resources in the occupied territories – 2011 (PWA, 2012c). Monitoring influent and effluent Wastewater quality should be enhanced.

18.2. Improving water allocation among communities

The national water strategy goes beyond defining national average indicators for coverage, service level or water quality. It aims to reduce the differences among all Palestinian citizens and regions. To this end, the national strategy includes the implementation of actions at three levels:

- Inter-regional: transferring bulk water from region to region in order to reduce inequalities[12];
- Inter-community: interconnecting the water systems run by different operators and reallocation management;
- Inter-customer: implementing tariff policies that aim to facilitate access to the service by the poor.

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18.3. Annual Assessment of Water Budget

Since all natural water resources in Palestinian territories are renewable, it is highly recommend assessing the water budget annually. This includes the differences between all water inflow and outflow components of the aquifer systems. This step will enhance the management of all water resources and identify any other new potential resources, as well as, it will define the utilization priority of water resources per each sector.

18.4. Alleviation of Climate Change and Flood Risks

In Palestine, water and agriculture sectors are likely to be most vulnerable to climate change impacts that will represent great environmental, social and economic threats. Climate change is likely to increase competition for scarce natural resources and trigger further restricted access to land and water resources. In the last few years, there are marked changes observed due to climate change concluded mainly in drought, rainfall variation-shifting, minimum and maximum temperatures and extreme events represented mainly by flash floods in the major wadis.

The main objectives that must be considered to ensure reliable alleviation of climate change and flood risks impacts in the Palestine include:

[12] Aquifer swapping (inter and intra swapping) will be considered, to ensure fair distribution of water among regions. PWA (water resources development Dept) is now developing the position paper concerning this important issue for the strategy implementation.

- Ensuring water security to meet future increases in demand for water and enable the socio-economic development.
- Enabling the equitable allocation of water resources among competing water uses for sustainable development of water resources
- Deploying the principles of Integrated Water Resource Management (IWRM).
- Developing a protection program against flash flood risks as advocated by IWRM principles.

Therefore, there is a need to develop a specific practical plans aim at alleviate the adverse impacts of climate change and flood risks. The plans should include all necessary measures and actions to (at least) halt the process of decreasing water availability and minimize the threats of floods; and also to guarantee the sustainability of local livelihoods and suitable welfare conditions for the most vulnerable share of the population.

The measures may comprehend the following actions:

- Promoting efficient use of existing water resources by imposing water conservation measures.
- Options for Increasing fresh water resources in Palestine (see TPAT activity 2.5) and
- Building sanitation system components in a way that they are either not affected by flooding or that water can evacuate quickly (elevated sludge drying beds, constructed wetland).

18.5. Vulnerability Assessment and Delineation of Protection Plans.

Most of Palestinian sources for drinking water are considered to be under real threaten from several sources of pollution, so an urgent action and measures need to be formulated to ensure reliable protection at current status and future perspectives. Therefore, formulating reliable protection zones based on detailed and advanced vulnerability assessment for all major water resources is essential. This step should include also developing recreation zones and drafting national guidelines for these resources in cooperation with all related stakeholders.

18.6. Water users/customers consultation

PWA is not the only responsible body for the strategy implementation. All stakeholders' active contribution will be necessary for the success of this ambitious sector development.

Part 4 Water and wastewater services improvement

19. Water service delivery improvement

19.1. Improvement of customer service

19.1.1. Water service coverage and number of connections

In Palestine, piped water service is already provided to > 90% of communities, servicing > 95% of households and the connection rate is very high (14 to 18 connections per 100 inhabitants). The strategic objective is fixed as 100% of communities serviced with piped water systems by 2032 and 20 house connections per 100 inhabitants.

19.1.2. Reliability and quality of service

West Bank

In West Bank, most of the water systems do not supply water 24h/day everywhere. The most frequent service option is to deliver water every day during few hours and let the customer manage this shortage. A significant number of houses are equipped with roof tanks (and eventually a small booster pump) in order to cope with this irregular service provision. Such service delivery is not suitable to preserve water quality. When the pressure gets negative, polluted water tends to enter into the pipes. The strategy aims to improve pressure management in the network, through the construction of additional storage tanks and booster stations and dividing the largest networks into separate sectors. The strategic objective is fixed as 10 hours storage capacity (equivalent to a 50% of households benefiting from 24h service.

Gaza

In Gaza, none of the water systems supply water 24h/day everywhere. The most frequent service option is to deliver water every day during few hours and let the customer manage this shortage. A majority of all houses are equipped with roof tanks (and eventually a small booster pump) in order to cope with this irregular service provision. The strategic objective is fixed as 10 hours storage capacity (equivalent to 206,000 m3) and 90% of households benefiting from 24h service.

Comment: the strategic objectives is more ambitious in Gaza than in West Bank, because urban population is much larger and could benefit from modern system management, whereas West Bank has still a lot of small rural systems, with huge differences in altitude, making it much more difficult to provide water 24h.

19.1.3. Quality of water

West Bank

In West Bank, groundwater quality is satisfactory in most wells. These waters require just a simple chlorination before use for domestic water supply, because they are almost originating from karstic aquifers, vulnerable to fecal contamination (by wastewater seeping from septic tanks or fissured sewers). The strategic objective is fixed as 100% of water systems equipped with chlorination systems by 2032.

The only recorded problem in West Bank is the increasing nitrate pollution (by agriculture and poor sanitation facilities). Although the level of pollution is lower in West Bank than in Gaza, this issue will be taken into account. The strategic objective is fixed as 100% of water systems delivering water with <50 mg/l NO3 by 2032. For this purpose, water from wells exceeding this threshold will be mixed with other resources before distribution. If not possible, it will be used for irrigation or industrial purposes only.

Gaza

Groundwater in Gaza Strip has a very poor quality. The main aquifers have been contaminated by sea water intrusion (chloride, sulfate) and by nitrogen release (by agriculture and poor sanitation facilities). Two strategies will be implemented to restore domestic water quality: desalination of sea and brackish water and mixing water from different origins.

The strategic objective is fixed as a production of a large volume of desalinated water by 2032. This water, containing no chloride and no nitrate will be mixed with groundwater in the suitable ratio, in order to get 100% of water used for domestic purposes meeting national quality standards.

The strategic objective is fixed as 100% of water systems equipped with chlorination systems by 2032.

Gaza Strip	**Present situation**	**5 year plan**	**Strategic objectives**			
	2012	2017	2022	2027	2032	
Total population	1,644,293	1,994,680	2,339,313	2,645,554	3,002,518	*MoPAD scenario 5*
Connections and network extensions						
Connection rate (conn./100 inhab)	*14.0*	*14.8*	*15.9*	*17.6*	*20.0*	*strategic objective*
Connection number	230,000	295,000	371,000	465,000	600,000	
5-years growth (nr new connections)		65,000	76,000	94,000	135,000	
Tertiary network extensions (ml)		650,000	760,000	940,000	1,350,000	*based on 10 ml/connection*
Production capacity						
Water available per capita (lcd)	*96*	*102*	*108*	*114*	*120*	*strategic objective*
Water distributed (Mm³/year)for Domestic use	58	74	92	110	132	
Water distributed (Mm³/year)for Industrial Use	1.7	3.5	6.0	9.1	13.2	
UFW	*42%*	*37%*	*31%*	*26%*	*20%*	*strategic objective*
Water produced/imported (Mm3/year)	102	123	142	160	181	
including groundwater	93	58	58	46	38	*strategic objective*
import (Mekorot)+ Purchase	5	10	14	14	14	
and desalination plants	4	55	70	100	129	
Storage capacity						
Water produced annually	102	123	142	160	181	
Water produced daily	280,324	335,625	389,953	438,221	495,415	
Hours of storage	*2*	*4*	*6*	*8*	*10*	*strategic objective*
Storage capacity (m³)	23,000	55,000	97,000	146,000	206,000	
Additionnal storage capacity to be build (m³)		32,000	42,000	49,000	60,000	

Table 24. Strategic objectives for water supply in the Gaza Strip.

West Bank	Present situation	5 year plan	Strategic objectives			
	2012	2017	2022	2027	2032	
Total population	2,649,020	3,473,267	4,742,596	5,713,113	6,548,006	*MoPAD scenario 5*
Connections and network extensions						
Connection rate (conn./100 inhab)	*14.0*	*14.8*	*15.9*	*17.6*	*20.0*	*strategic objective*
Connection number	370,000	514,000	754,000	1,005,000	1,309,000	
5-years growth (nr new connections)		144,000	240,000	251,000	304,000	
Tertiary network extensions (ml)		1,440,000	2,400,000	2,510,000	3,040,000	*based on 10 ml/connection*
Production capacity						
Water available per capita (lcd)	*72*	*78*	*88*	*103*	*120*	*strategic objective*
Water distributed (Mm^3/year)for Domestic use	70	99	152	215	287	
Water distributed (Mm^3/year) Industrial Use	2	5	10	18	29	
UFW	*32%*	*29%*	*26%*	*23%*	*20%*	*strategic objective*
Water produced (Mm3/year)	105	146	219	302	394	
including groundwater	54	71	105	160	234	*strategic objective*
import (Mekorot)+ Purchase	51	75	*92*	*110*	*120*	*strategic objective*
and desalination plants	0	0	22	32	40	
Storage capacity						
Water produced annually	105	146	219	302	394	
Water produced daily	288,899	399,695	600,643	827,270	1,080,421	
Hours of storage	*2*	*4*	*6*	*8*	*10*	*strategic objective*
Storage capacity (m^3)	24,000	66,000	150,000	275,000	450,000	
Additionnal storage capacity to be build (m^3)		42,000	84,000	125,000	175,000	

Table 255. Strategic objectives for water supply in the West Bank.

20. Wastewater collection and treatment

20.1. Sewerage and wastewater collection

In the West Bank, sewers exist mostly in the oldest urban Communities (Jenin, Hebron, Nablus, Qalqilya, Tulkarem, some districts of Ramallah, etc.), covering 71 (out of 524) localities and 1.02 (out of 2.48) million inhabitants. Where sewers exist, not all houses are connected and the overall connection rate to sewers is estimated to be 31% in West Bank (see chap. 5).

In the Gaza Strip, sewers have been installed in most urban Communities, covering 23 (out of 33) localities and 1.41 (out of 1.53) million inhabitants. Where sewers exist, not all houses are connected and the overall connection rate to sewers here is estimated to be 70% (see chap. 5).

The strategy aims to build additional sewer networks in all urban localities and extend the existing sewers to neighboring rural areas (where feasible), in order to collect the largest possible volume of wastewater and limit groundwater contamination by pathogens and nitrates.

The sewerage coverage rate will still be higher in the Gaza Strip than in the West Bank, because this is a densely populated and flat area in which building a comprehensive sewerage network is more necessary and easier than in the West Bank. In the West Bank, a significant share of the population lives in remote and small villages, meaning on-site sanitation is a more cost-effective option.

Within the short term strategy, there is a need to construct more sewage collection system or expand the existing collection systems in urban areas and in some rural area

The long term strategic objectives have been defined as:

- 95% in the Gaza Strip and 75% in the West Bank population are actually connected to a sewer

20.2. Planned new wastewater treatment plants

In the West Bank, there are currently few wastewater treatment plants (WWTPs) in place; however, a number of additional WWTPs have been designed and are in the planning or even construction phase (see Table 26).

It is unclear if all these projects will be completed by the due date, as the Israeli administration (through the JWC or the ICA) is severely hindering and constraining construction of these WWTP.

There are already large WWTPs in place in Gaza and additional capacities are under construction, with little interference from the Israeli administration (except for the constraints imposed on the import of construction materials).

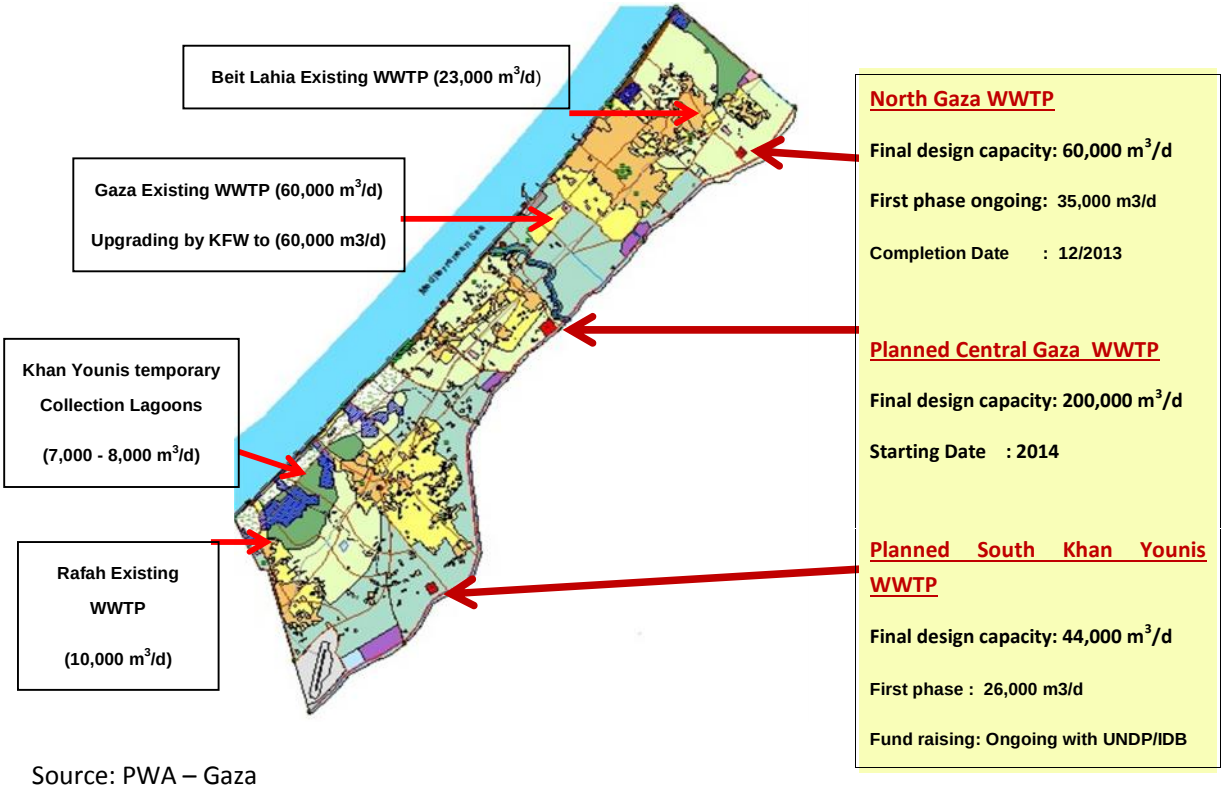
Within the short term strategy, it is expected to:

- complete the ongoing projects to construct regional treatment plants
- complete ongoing projects to construct community level WWTP
- Secondary or tertiary Treatment of 12 -15 MCM/year of Wastewater in West Bank and 40 MCM/year in Gaza strip
- Reuse at least 25% of the treated wastewater in Agriculture
- reducing the treatment inside the green line to less than 6MCM by the end of the Short Term (2017)

Treatment Plant	Governorate / Service areas	Status	Capacity to be installed (m^3/day)		
			Short term (2017)	Mid term (2022)	Long term (2032)
West Bank					
Bethlehem Industrial Zone (phase1)	Bethlehem	Implementation phase	100	100	100
Bethlehem Industrial Zone (phase2)	Bethlehem	Planning phase	300	400	500
Wadi Al'Aroub WWTP	Hebron	Design phase	1,020	1,080	1,200
West Bethlehem Rural area	Bethlehem / Battir, Husan, Nahalin, Wadi Fukin and Alwalajeh	Feasibilty study	0	0	5,000
Hebron Regional WWTP	Hebron	Feasibilty study	10,500	12,750	15,000
Misilya TP	Jenin	Design phase	240	320	400
Jenin TP	Jenin	Rehabilitation phase	4,500	6,750	9,000
Construction 6 WTTP's (Al-Yamun, Qabatiya, Ya'abad, Azzun, Tarqumiya, Dura)		Completed design	10080	13,440	16,800
Jericho sewerage project	Jericho	Implementation phase	3,840	7,680	9,600
Nablus West	Nablus	Construction phase	7,200	9,600	12,000
Beit Hasan WWTP	Nablus	Design phase	60	80	100
Al-Bireh TP	Ramallah	Extension and modifications phase	5,750	5,750	5,750
Al-Tireh WWTP	Ramallah	Tendering phase	1,200	1,600	2,000
Al-Rihan Compact WWTP	Ramallah	Implementation phase	416	520	520
The Diplomatic Compound WWTP	Ramallah	Implementation phase	400	500	500
Ramallah-Beitunya TP	Ramallah	Finished feasibiltiy study	6,000	8,000	10,000
Construction small scale WTTP's (Taybe, Ramoun, Anza, Beit Dajan, Sir, Hajja)		Implementation phase	1,440	1,920	2,400
Tubas-Tayasir sewerage project	Tubas / Tayasir, Aqaba and Al'Aqaba	Tendering for Design phase	1,800	2,400	3,000
Nablus East Sewerage WWTP	Nablus	Design phase	8,400	11,200	14,000
North East Jerusalem WWTP	Jerusalem	Sanitation and base line study	0	0	5,000
Rawabi WWTP Project	Ramallah	Feasibilty study	0	0	6,000
		Sub Total West Bank	63,246	84,090	118,870
Gaza Strip					
N.Gaza WWTP	N.Gaza	Under construction	35,000	35,000	60,000
Central Gaza WWTP	Central Gaza	Planned	60,000	200,000	200,000
South Khan Younis WWTP	Khan Younis	Planned	26,000	44,000	44,000
		Sub Total Gaza	121,000	279,000	304,000
		Total capacity (m^3/day)	**184,246**	**363,090**	**422,870**

Table 26. Scheduled WWTP (in the planning or construction phase).

In Gaza Strip, it is expected to close Beit Lahiya Treatment Plant as soon as the New North Gaza Treatment Plan starts operating, and close the Existing Gaza Treatment Plan as soon as Central Gaza WWTP operate, and close Temporary Khan Younis WWTP as soon as South Khan Younis operates.



Source: PWA – Gaza

Figure 24. Existing and planned WWTPS in the Gaza Strip.

20.3. Additional WWTPs to be planned in the West Bank

In the present situation, less than one third of households are connected to a sewer, channeling wastewater to an operational WWTP and the efficiency of some of these WWTP is below the design efficiency. The strategy aims to increase the percentage of wastewater treated and to improve the average rate of efficiency of the WWTPs.

The long term strategic objectives for 2032 have been defined as:

- 75% of households will be connected to a sewer;
- 80% of sewered water will be properly treated.

In order to meet this strategic objective, additional WWTPs, with more than 300,000 m3/day capacity, need to be planned and constructed by 2032.

West Bank	Present situation	5 year plan	Strategic objectives (long-term = Statehood)			
	2012	2017	2022	2027	2032	
Total population	2,649,020	3,473,267	4,742,596	5,713,113	6,548,006	*MoPAD scenario 5*
% households living in sewered localities	*41%*	*55%*	*68%*	*81%*	*94%*	
% households actually connected to a sewer	*31%*	*42%*	*54%*	*65%*	*75%*	
Sewered population	821,196	1,458,772	2,572,515	3,715,967	4,939,996	
Unsewered population (on-site sanitation)	1,827,824	2,014,495	2,170,081	1,997,147	1,608,009	
Water used per capita (lcd)	72	78	88	103	120	
Water used (m^3/day) - average	190,729	270,915	417,348	588,451	785,761	
% used water that is rejected	*80%*	*80%*	*80%*	*80%*	*80%*	*international benchmark*
Water collected by sewers (m^3/day) - average	47,301	91,027	181,105	306,196	474,240	
Total WWTP capacity (m^3/day)	**5,750**	**68,996**	**139,840**	**239,230**	**379,620**	
Existing plants (m^3/day)	5,750	5,750	5,750	5,750	5,750	
WWTP in planning or construction phase		63,246	84,090	101,480	118,870	
Additional WWTP needed to be planned (m3/day)		0	50,000	132,000	255,000	
% sewered water that can be treated	*12%*	*76%*	*77%*	*78%*	*80%*	*% with projected WWTPs*

Source: TPAT calculations.

Table 27. Strategic objectives for sewerage and WWTP in the West Bank.

20.4. Additional WWTPs already planned in the Gaza Strip

In the present situation, three quarter of households are connected to a sewer, channeling wastewater to an operational WWTP but the efficiency of some of these WWTP is below the design efficiency. The strategy aims to increase the percentage of wastewater treated and to improve the average rate of efficiency of the WWTPs.

The strategic objectives for 2032 have been defined as:

- 95% of households will be connected to a sewer;
- 95% of sewered water will be properly treated.

In order to meet this strategic objective, additional WWTPs need to be planned and constructed by 2032. The projects whose implementation has been planned by PWA will be sufficient to meet this objective.

Gaza Strip	Present situation	5 year plan	Strategic objectives (long-term = Statehood)			
	2012	2017	2022	2027	2032	
Total population	1,644,293	1,994,680	2,339,313	2,645,554	3,002,518	*MoPAD scenario 5*
% households living in sewered localities	*92%*	*93%*	*94%*	*95%*	*96%*	
% households actually connected to a sewer	*70%*	*80%*	*85%*	*90%*	*95%*	
Sewered population	1,151,005	1,595,744	1,988,416	2,380,999	2,850,746	
Unsewered population (on-site sanitation)	493,288	398,936	350,897	264,555	151,772	
Water used per capita (lcd)	96	102	108	114	120	
Water used (m^3/day) - average	157,852	203,457	252,646	301,593	360,302	
% used water that is rejected	*80%*	*80%*	*80%*	*80%*	*80%*	
Water collected by sewers (m^3/day) - average	88,397	130,213	171,799	217,147	273,672	*international benchmark*
Total WWTP capacity (m^3/day)	**104,000**	**213,000**	**291,000**	**303,500**	**316,000**	
Existing plants (m^3/day)	104,000	92,000	12,000	12,000	12,000	
WWTP in planning or construction phase		121,000	279,000	291,500	304,000	
Additional WWTP needed to be planned (m3/day)		0	0	0	0	*No need for additional WWTP*
% sewered water that can be treated	*118%*	*164%*	*169%*	*140%*	*115%*	*% with projected WWTPs*

Source: TPAT calculations.

Table 28. Strategic objectives for sewerage and WWTP in the Gaza Strip.

21. Institutional Reform

21.1. Background

The current setup of the water supply and sanitation management is organized under four levels mainly; decision-making level, regulatory level, development and supply level and service provision level:

- The National Water Council is headed by the President. The NWC has not held a single meeting since its establishment, due to the fact that; Article No. 6 of the Water Law states that the PWA falls under the jurisdiction of the President of the Palestinian National Authority. The Water Law has not been altered in accordance to the Basic Law, by which the post of Prime Minister was created in 2003. As a result, discordance in the PWA's reference was created as Article 9/69 from the Basic Law granted the Ministerial Council complete jurisdiction over all public institutions, excluding the National Water Council (NWC). The aforementioned situation restricts the PWA's efforts, specifically in regards to the issuance of laws and regulations in various aspects related to water. These laws and regulations were supposed to have been formulated by the NWC and submitted to the Prime Minister for approval.
- Palestinian Water Authority is the regulator
- The West Bank Water Department and a similar one in Gaza, which are responsible for the monitoring and bulk supply development.
- Water service providers: There are 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 others are water divisions of large municipalities (such as : Nablus, Hebron, Jenin, Tulkarem, Qalqilya, Jericho, Salfit and Tubas municipalities).

The historical situation of institutions and their legal foundations suffer from an unprecedented fragmentation on the levels of their internal institutional and legal aspects, in addition to the Israeli occupations, Israeli domination at the JWC and Civil Administration and their jurisdiction in area C that required permits for project construction.

PWA's began working to understand the reality of the sector and its contradictions in order to determine what can be done to stop the deterioration of services and work on reversing the situation.

The PWA requested independent bodies to conduct assessments on the reality of the water sector and factors which influence it. These assessments included:

- "PWA Audit", funded by the Norwegian Government regarding good governance of the water sector
- World Bank prepared a study to evaluate the water sector since the establishment of the PWA. Accordingly, the World Bank published a report entitled: "Assessment of Restrictions on Palestinian Water Sector Development - April 2009". The report held Israel accountable for much of the deterioration of the water sector in the occupied Palestinian territories and recommended that the PWA conduct a comprehensive reform of the water sector.

- The World Bank's report was followed by another one published by Amnesty International entitled: "Palestinians Denied Fair Access to Water – October 2009". The report also held Israel accountable for much of the water crisis in the occupied Palestinian territories.

These reports emphasized the extent of the Israeli occupations influence in prohibiting the development of the water sector during the past 14 years. The reports stated that this situation resulted in the following:

- A noticeable decline in the levels of water services, with respect to both the quality and quantities of available water.
- It also resulted in nearly ceasing sanitation services and their development, which in turn increased environmental damage and reduced the capabilities of treating/recycling wastewater, which has the potential to be used as an unconventional resource that could be utilized for agricultural and environmental purposes. This was primarily a result of the terms of the Oslo II Agreement of 1995, which placed restrictions on the sector during the transitional stage and as a result of the continuance of the Israeli occupation of vast portions of Palestinian land (approximately 61%).

In addition, various Internal and External factors considered as core obstacles to overcome (Audit Report, 2009):

- Strong fragmentation in the water sector;
- Problems with the institutional arrangement, in particular unclear roles of the different actors as well as coordination problems;
- The application of the inherited laws
- Capacity Building requirements at all levels;
- Notable short comings in enforcement of laws and policies;
- Shortage of funds and release of funds in a timely manner for priority projects;
- A strong emphasis on crisis management rather than long term management;
- The sector needs to be further decentralized if PWA is to assume its determined role;
- Insufficient data and information, particularly in terms of reliability, accessibility and sharing;
- Poor coordination and low transfer of information between Ministries/Authorities and water sector stakeholders;
- Public awareness in relation to water and wastewater related issues is limited;
- In general there is a lack of support for the PWA in negotiations with the JWC and ICA on approaches to enable the expeditious implementation of pending projects of a high priority.

21.2. The Cabinet of Minister Decision on the Reform Plan

On December 14th 2009 the Cabinet of Ministers of the Palestinian National Authority endorsed an "Action Plan for Reform" towards the definition and implementation of a comprehensive program of institutional and legislative reform in the Palestinian water sector. The overall reform is expected to include the reorganization of the water sector and the institutions within, capacity building, and the revision of strategies and policies, when necessary, as a result of any change that takes place in the architectural arrangement of the sector.

21.2.1. Sector Reform Objectives

The reform objectives have been defined as follows:

- With regards to institutions, the Sector Reform will establish strong (capable) and sustainable institutions within a legal framework that clearly defines their roles, responsibilities and the interface (relationship) between them.
- With regards to infrastructure needs, the Sector Reform will improve water supply and sanitation strategies, policies, investment programs, project designs, and the implementation of projects, in an effort to substantially accelerate infrastructure development.
- With regards to service provision, the Sector Reform aims to accelerate equitable access to a quality service, while providing improved efficiency and cost-recovery of effectively regulated water operators.
- With regards to water resources management, the Sector Reform will help to build the institutional knowledge, policies, and monitoring and enforcement capacities, as part of an effort to achieve a more sustainable water resources management strategy.
- With regards to water consumers, the Sector Reform will aim at improving water demand management awareness in line with the development of water conservation policies.

21.2.2. Sector Reform Plan

The reform plan consists of several fundamental elements (programmes) which are closely interrelated.

- The Institutional Water Sector Review (IWSR) shall propose a preferred institutional arrangement which will be derived by consensus;
- The Legislative Review (LR) shall addresses the identified weaknesses within the current law and provide a new water law that will be compatible with the newly proposed institutional arrangement;
- a Capacity Building Program (Technical Planning Advisory Team – TPAT) – which aims to provide capacity building and technical assistance to enable the PWA during the transition period to develop a new strategic vision according to the new structure, and to develop policies, strategies, regulations, master planning plans and investment plans for water resources and service provision.
- Organizational Reform (OR) and Change Management (CM) program which aims to change the administrative and organizational structure of the PWA to coincide with the new structure that will be suggested by the IWSR. This will be done in accordance with a new integrated institutional vision

In the short term, the reform programs shall aim to:

- rectify utility service procedures in a way that will ensure equitability in the provision of high quality service, improve capabilities, recover operating costs of water facilities and organize them more effectively.
- achieve more sustainable management of strategic water resources by means of enhancing: institutional knowledge, policies, monitoring capabilities, following up and the application of the water law, increase awareness of managing water demand, by means of applying policies that will help to preserve the water resources.

The long term goals of the reform program are:

- to establish strong/capable institutions within the framework of sustainable development and a legal framework that shall clearly define the roles, responsibilities and interrelationship between institutions in the water and wastewater sector, as well as those institutions that share responsibility on the periphery of the sector.
- emphasizing infrastructure requirements, the reform program will also focus on improving the strategies and investment policies regarding the supply of water and sewage provision and project design and implementation. This will be done to expedite the growth of the infrastructure in a way that will fulfill the country's requirements.

21.3. Legislation Development

1. A new Water Law is under development to define the general structure and function of the institutions governing and managing the water sector and clarify the responsibilities of the different ministries involved in the water sector. The new law shall also define legal issues related to water.
2. Several By laws for Water and Wastewater will be developed, in addition to the Water Tariff Bylaw, Regional Bylaw, Water and Wastewater Connection Bylaw.
3. Introduce strict controls on the use of groundwater including the elimination of the free abstraction and limiting the abstraction quantity based on the aquifer safe yield. Enforcement measures against illegal use, abuse and deteriorating groundwater conditions shall be introduced.
4. Establishment of water resources protection legislation to legally implement water resources protection zones for drinking water resources.

21.4. Institutional Structure and Function Development

The Palestinian Water Authority (PWA) is currently looking for to perform a variety of functions, namely political and strategic (ministerial), regulatory, bulk utility operations, and project management services. The combination of functionality is causing PWA to engage in a crisis management process which in turn has imposed its ability to perform and deliver its mandated services. Accordingly, the institutional reform will be enacted to restructure the water sector based on functional roles to cover governmental level and Water Management Level, considering the following issues:

1. The reorganization of Water Sector includes splitting the PWA into a ministerial functions and regulatory function.
2. Developing a turnaround strategy for WBWD to become a National Water Utility

   In recent time, the WBWD has not performed well financially. There is a high unaccounted-for water (UFW) factor stemming from technical and administrative losses. Billing and collection is below acceptable rates and it is currently carrying a huge debt.

   A turnaround strategy to be implemented will see the organization operate on a business-like platform, using a commercially acceptable accounting system; operating and maintaining its assets according to internationally recognized practices, and incorporating a tariff setting mechanism that in the initial stages will target recovery of O & M costs.

3. Reorient the Project Management Unit of PWA to become more responsive to sector institutions needs. PMU will be reorganized to become an Agency capable to provide technical assistance - capacity building support to service providers.

   The current functionality of the PMU is essentially project implementation focused. It provides project oriented services to Donor funded projects; those services include water supply system design and review, construction supervision, procurement and contract management.

The reform will structure opportunities for greater private sector engagement through various business models. The specific roles and responsibilities of these functional roles will be defined through legislation.

21.4.1. Palestinian Water Authority (PWA)

Palestine water Authority essential functions will include the following:

- Prepare and implement effective policy;
- Develop and enforce pragmatic legislation;
- Produce and continually update strategic, technical (master) and investment plans;
- Prepare and implement a series of focused communication strategies and programmes;
- Facilitate an Integrated Water Resource Management programme;
- Maintain effective and successful relations with the international donor community;
- Support community involvement and provide public awareness campaigns to the organizations in the Water Management mechanism.
- Enhance Research and capacity development

  The PMU will provision of technical assistance and capacity development support to the utilities in accordance with the development plans and on the basis of the Authority recommendations

  The JWC will be replaced by co-operation mechanisms that will be designed to ensure the sustainable management of transboundary water resources by Palestine and neighboring countries (Israel, Lebanon, Syria, Jordan) based on equitable utilization of the shared water resources.

21.4.2. Regulatory Water Council

Creation of independent Regulatory Water Council with the following essential functions:

- Develop and implement an economic regulation model and regulate the establishment of prices and tariffs;
- Issue licenses;
- Regulate public service obligations, and the quality of service provided. Promote the use of benchmarking and Develop programmes for performance incentives and penalties;

21.4.3. National Water Utility

The National Water Utility will be created as a state-owned public shareholding company, and all its shares shall be owned and held by the State, and may not change its status, or sell any of its shares to the public or to any private party unless and until it attains viability and financial sustainability.

The National Bulk Water Utility will obtain a service provision license and will be subject to supervision and regulation by the regulatory water council, and operate in the most cost effective manner to carry out the following primary tasks:

- Produce, treat or organize treatment of water from wells, and any other water resources, as per licenses issued under this Law and Regulations.
- distribute all water available to it in bulk to service providers or privates, as per obtained licenses and the official water tariff in force to Water Service providers and private users;
- Drill, operate and maintain wells, transmission pipe mains, facilities, associated pumping stations and equipment;
- Purchase water from other available water sources subject to the approval of the Ministry;

21.4.4. Regional Water Utilities

Regional Water Utilities shall be established by PWA in consultation with the relevant Stakeholders.

The Regional Water Utilities shall exercise, deliver and perform the primary functions, tasks and responsibilities as listed hereunder:

- Maintain, operate and extend the coverage of the existing Water Services infrastructure in accordance with the license and a capital investment and work program;
- Supply of water to all customers in its service area;
- Provide waste water services including collection and removal and treatment of waste waters;

21.4.5. Water Users associations

Water users' associations (WUAs) are very important institutional partners in irrigation water management. PWA will establish Water User Associations with relevant Stakeholders to manage supply Agricultural water services at local level in an integrated manner.

PWA encourage the establishment of customer association to present customer rights.

21.5. Commercial Practices

- Encourage operation using best commercial practices within a regulated water market. More business-like approaches to water resources management will save water and reduce governmental cost subsidies. Water utilities must run like businesses with a focus on customer service, providing a quality product that is properly valued and paid for by customers. The high losses within the water distribution systems must be reduced and quickly brought in line with international best practices. It must be stressed that better commercial practices necessitates providing a better product to consumers. A partnership between consumers and utility companies must be establish where consumers can expect to receive improved service and utilities can expect to receive an adequate tariff for that service.
- The transition from subsidized and inefficient providers of a public service to a new structure that allows for commercial providers of a valuable commodity.

Benefits from adoption of commercial practices include:

- Reductions in man-power required per unit of water delivered to customers.
- Increases in revenue from outsourcing billing, collection and customer service to private companies.
- Potential reduction in tariff rate increases due to reduced operating costs.
- Integration of technology into operations and management to substitute for labor, leading to increased efficiencies in water deliveries, reductions in water losses and reduced costs.
- Introduction of innovative approaches to reducing water demand, thereby increasing water supply, e.g., rebate programs for retrofitting low water use fixtures.
- Introduction of a tariff system that covers operation and maintenance.

- Particular attention will be pay to the needs of the poor while improving commercial practices.

21.6. Private Sector Participation

Private Sector Participation involvement in the Water and Wastewater Sector is a management tool to achieve the following goals:

- Enhance upgrading the efficiency of water use and consumption and enhance the efficiency of O&M
- Encourage the private sector to invest and to participate activity in the national economy
- Job Creation
- Rationalizing of public expenditures

21.7. Water Pricing and Cost Recovery

To Determine the cost of services and thus the prices that must be paid for these services is one of the most important activities that should be considered , because of its importance and direct effect on the customers and the institution that offers this service.

It is the Consumer right to receive good service against paying suitable price, and the Water tariff mechanism shall be considered as a tool to promote cost recovery of Water and Wastewater services.

22. Investments required in the Water and Sanitation sector

22.1. Unit costs analysis

For the purpose to assess the investment needs for strategy implementation, unit costs for the main items have been estimated, based on (a) investments made by PWA during recent years and (b) most recent cost estimates presented in PWA approved projects documents.

22.2. Costing investment needs

Achieving the strategic objectives by 2032 will require large investment (a) in new facilities, (b) in the refurbishment of old facilities and (c) in permanent water system renewal, that are necessary to keep UFW under control.

These investments have been valuated, based on three main sources of information:

- the projects implemented by PWA, its PMU and the water utilities during the last 5 years (these projects provide the most reliable information, regarding the cost of works and equipment in the on-going situation of Palestine);
- the replacement expenditures engaged by some of the main water utilities (JWU, Nablus, CMWU), keeping in mind that their level of expenditure is constraint by their low level of revenue; it means that a suitable maintenance of the systems they are running would probably require additional expenditures;
- cost estimates provided by well known consulting firms for new project under development (desalination plants, comprehensive sewerage, wastewater treatment plants).

The investments needs have been summarized in the tables below. More details are provided in Annexes (detailed investment estimates, methods for calculation and sources of information).

Water supply investment needs in M$		short term	long-term strategy			20 years
		2017	2022	2027	2032	
Production	Gaza	101	343	289	272	**1,005**
	WB	73	239	195	237	**743**
Storage	Gaza	25	36	45	58	**164**
	WB	38	76	114	158	**386**
Distribution	Gaza	62	49	69	102	**281**
	WB	137	123	139	178	**577**
Total (in M$)		**435**	**866**	**851**	**1,005**	**3,157**
Total (in MSh)		**1,609**	**3,204**	**3,147**	**3,718**	**11,679**

Table 29. Investment needs to improve water services (2012-2032).

Sanitation investment needs in M$		short term 2017	long-term strategy 2022	2027	2032	20 years
Sanitation (plot level)	Gaza	33	106	136	171	**446**
	WB	53	138	220	306	**716**
Sewerage	Gaza	28	90	116	146	**381**
	WB	45	118	188	261	**612**
Treatment	Gaza	53	227	89	89	**456**
	WB	40	44	27	27	**139**
Total (in M$)		**251**	**723**	**776**	**1,000**	**2,750**
Total (in MSh)		**927**	**2,674**	**2,873**	**3,701**	**10,175**

Table 30. Investment needs to improve wastewater services (2012-2032).

23. Challenging issues for Strategy Implementation

23.1. Challenges faced by PWA

The long-term Strategy aims to transform completely the water and sanitation sector in Palestine, bringing sector performances to the level of a developed country in 20 years only. To implement this Strategy, PWA and PA will face some major constraints:

- the limited capacity-to-invest (at the level of central and local government);
- the limited capacity-to-implement many investment programs in the same time;
- the limited capacity of the existing service providers to run so many more facilities (not to speak of their capacity to run sophisticated equipments, such as desalination plants and modern wastewater treatment plants);
- the unsolved and very sensitive issue of the abstraction rights (allocation of abstraction rights among competing users);
- the very low level of cost recovery (especially in Gaza)

These issues need to be tackled by the new sector organization that is under development by PWA.

23.2. The limited capacity-to-invest

The level of investment for the Strategy implementation has been estimated as 22 Billion ILS in 20 years, i.e. 1100 Million ILS/year.

This is less than what has been proposed in the Palestine National Plan for the 2011-2013 period: 5.5 billion ILS in three years, i.e. 1,800 Million ILS/year (PWA, 2011). By comparison, it could be considered that the 20 years Strategy is reasonable, according to the level off investments (and the level of efforts) that the PA has already decided to engage for the coming years. Nevertheless, the investment plan needs to be compared also with the recorded capacity to invest of the water sector in Palestine, because this sector is facing many difficulties.

During the last three years, PWA has recorded each year US$ 20-30 million investment in water and sanitation facilities (70 to 100 million ILS). Although these figures are impressive, they represent only a small percentage of the scheduled investment pace of the Strategy and there is a risk that the planned investments are not implemented in due time.

To increase the investment capacity in the WSS sector, the Strategy promotes:

- channeling a higher share of water investments through the autonomous water utilities (e.g. all network extension programs, including storage tanks and pumping stations);
- channeling a higher share of sanitation investments through the municipalities (e.g. all sewer networks, including lifting systems and house connections);
- implementing a limited number of 5-year framework contracts approved by PWA with large works contractor allowing fast track procurement procedure;
- Private Sector should play an important role in large facilities as the desalination plants and the main WWTPs.

23.3. The limited capacity of the existing service providers to run so many more facilities

The management of the additional complex facilities that will be implemented during the next 20 years could be a burden for municipalities or service providers, if sound rules of the game are not clearly defined. For this reason, the Strategy will be supported by a clear allocation of risks and resources to the institution in charge of each facility:

- Bulk Utility:
  - main water carriers and booster stations, transporting bulk water from region to region
  - desalination plants
- Regional Utility:
  - Existing local production wells and pumps
  - water distribution networks
  - sewers
  - WWTPs
- Water associations and/or Private Sector will organize and run the reuse system in coordination with PWA relevant Stakeholders.

23.4. The very sensitive regulation of water rights allocation

Because the water resources are scarce, there is a competition among different users to access these resources and water-rights need to be allocated, according to very clear and transparent rules.

This is clearly expressed in the National Water Policy:

It is the It is the National Policy of Palestine to

- *Define the priorities for allocating the available water resources between different types of users, e.g. domestic, agricultural, environmental, industrial, recreational, touristic, etc. and to ensure that domestic and residential uses shall enjoy absolute priority over all other uses.*
- *Allocate water rights for economic benefit (agriculture, industry, tourism…) between different users according to economic benefits to Palestine (in terms of revenue, job creation and food security) and in agreement with national development plans.*
- *Have a national organization to fix and review the water rights allocation at national level (defining the principles for allocation and quantities devoted to each activity).*
- *Ensure that the allocation of limited water supplies within specific user type is fair and equitable and that distribution among the regions is fair; where necessary, transfers from basin to basin and region to region will be organized, under the responsibility of bulk supply utility.*
- *Allocate water abstraction rights through a dedicated national administration; these rights will be limited in volume, limited in time and they*

will be for well-specified purposes; to this end, all well drilling, water production and supply will be allowed only by permit or a license.

- *Organize the settlement of any disputes that would arise from allocation of water rights by arbitration and, if necessary, by the court.*

The on-going reform of the water sector will define the rules for implementation of this policy, altogether the institutions in charge of water rights allocations and the mechanisms for settlement of disputes.

23.5. The very low level of cost recovery and Collection Rate

The service providers in Palestine are still very far from cost recovery. Almost investments are supported by outsiders (PA, backed by donors) and the water tariff, as calculated by now, covers only the operational costs.

Moreover, bill collection rate is among the lowest in the region, especially in the Gaza Strip.

TPAT calculations - Data source – IB Net

Figure 25. Collection rate in Palestine and some Middle East countries

The implementation of the Strategy will require:

- a tariff increase, in order to cover opex (operational expenditures) and capex (capital expenditure); a new tariff structure for water , wastewater and water reuse in Plaestine needs to be prepared; if the government decides not to raise the tariff to this level, he will implement alternative and reliable funding mechanisms, to guarantee water utilities financial viability, according to the National water Policy[13];
- coping mechanisms, to make water and sanitation services affordable for the Poor (including cross-subsidy among water users, direct subsidies to poor house-holds,

[13] Policy Statement : *"It is the National Policy of Palestine to ensure that the proposed financing and funding requirements of service reflect the approved financial objectives and cost profiles of each service provider, and that, where these tariffs do not provide full cost recovery, all sources of funding required to meet this gap are clearly identified and secured".*

24. Enhancing capacities to implement the Strategy

24.1. The role of bulk water utilities

Transporting bulk water from region to region is the core role of the National Water Utility (NWU). It aims to provide each region (each governorate, each municipality and each cluster of municipalities) with enough water to service customers.

To this end, the NWU manages the main water carriers, booster stations and storage tanks. These facilities include many connection points with the Mekorot water systems and, consequently, the NWU manages all commercial and technical relations with Mekorot.

24.2. Improving services inside demand areas

Customer water services are currently provided by 300 water service operators across the whole country. Most of them (> 90%) are not independent water companies, but rather small technical branches of municipalities. Many of these municipal branches have very low levels of financial autonomy and suffer from both a lack of technical skills and political interference.

In order to improve efficiency and achieve economies of scale, the National Water Policy is promoting the development of regional utilities that would provide water and wastewater services to more than one municipality. Ultimately, the Policy aims to support the development of 11 water service utilities whose concession areas will include one or several governorates.

Part 5 Appendices

Appendix 1. Acronyms

BWU:	bulk water utility
CMWU:	Coastal Municipal Water Utility
CoM:	Cabinet of Ministers
CoMSC:	Cabinet of Ministers Steering Committee
EQA:	Environmental Quality Authority
EU:	European Union
GOI:	Government of Israel
ICA:	Israeli Civil Administration
ILS:	Israeli Shekel
IWRM:	integrated water resources management
JMP:	Joint Monitoring Program (WHO/UNICEF)
JSC:	Joint Service Council
JWC:	Joint Water Committee
JWU:	Jerusalem Water Undertaking
MCM:	millions of cubic meters
MDG:	Millenium Development Goal
MoA:	Ministry of Agriculture
MoF:	Ministry of Finance
MoH:	Ministry of Health
MoLG:	Ministry of Local Government
MoPAD:	Ministry of Planning and Administrative Development
NGO:	non-governmental organization
NIS:	New Israeli Shekel (symbol ILS)
NRW:	non revenue water
NWC:	National Water Council
OPS:	Occupied Palestinian State
PA:	Palestinian Authority
PCBS:	Palestinian Central Bureau of Statistics
PECDAR:	Palestinian Economic Council for Development and Reconstruction
PHG:	Palestinian Hydrology Group
PIPA:	
PM:	Prime Minister
PMU:	Project Management Unit
PNA:	Palestinian National Authority
PSI:	Palestinian Standard Institute
PWA:	Palestinian Water Authority
TPAT:	technical, planning and advisory team
S/m3:	Shekel per m^3 (1 $ = 3.7 S)
USP:	Union of Service providers
WBWD:	West Bank Water Department (to become BWU)

WR:	water resources
WRM:	water resources management
WS:	water supply
WSS:	water supply and sanitation
WSSA:	Water Supply and Sewerage Authority
WW:	waste water

Appendix 2. Definitions

The following words and expressions shall have the meaning stated below unless the context indicates otherwise:

Artificial Recharge of Aquifers - The act of directing water, including flood waters or treated wastewater, under the ground, either directly by recharging the wells or reservoirs or by drilling recharge wells, or indirectly by permitting water to seep underground from the surface of the soil.

Minimum environmental flows - Minimum environmental flows of watercourses are the minimum flow levels required to maintain and support the aquatic-dependent ecosystems and fish life.

Palestine - The Palestinian State and the areas over which the Palestinian State has effective control. Option: Palestine is the territory defined by 1967 borders, consisting of two parts: the Gaza Strip and the West Bank, including East Jerusalem.

Permits and Licenses - The required permits and/or licenses to be issued by the competent authorities for the relevant tasks and activities.

Pollution - Any change that occurs to the quality and constituents of water that harms the health of humans and the environment.

Regulation - Any sub-normative regulation, law, ordinance, bylaw, etc. enacted for the implementation of the relevant Law, either where specifically so-mentioned or where otherwise inevitably required.

Water Resources - All water resources that lie within the territorial land of Palestine, including conventional surface or groundwater, such as water from springs, including hot springs, wells, ravines, rivers, lakes, and water collection areas, or unconventional water sources, such as sewage water, desalinated water and brackish water.

Water Facility - Any facilities or constructions intended and necessary for the abstraction, treatment and supply of water or for the collection and treatment and disposal of wastewater, and water storage structures.

Wastewater - The liquid that results from the use of water resources and which is unfit for further use other than for re-use purposes after treatment.

Water Services - The provision of piped water supplies, including treatment to the standards required for the intended use, and the conveyance, treatment and eventual collection, treatment and disposal of wastewater, or the conveyance of treated wastewater to the entities responsible for the equitable and fair distribution of treated wastewater for agricultural and industrial uses.

Well - Any facility intended for the exploration and extraction of groundwater.

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Appendix 4. Other strategies

Some specific and more technical policies and strategies are expected to be produced by TPAT and PWA as follows:

- Mitigation Measures for Climate Change: Action Plan and Budget (January 2012, produced)
- Water Sector Emergency Preparedness Strategy (January 2012, draft produced)
- Sustainable Financing Strategy for the Water Sector (April 2012, draft produced)
- Non-Revenue Water Strategy (July 2012)
- Priority WS/WW Investment Plan (August 2012)
- National Sludge Disposal Strategy (July 2013)

Other technical strategies to be developed may be done so e.g. on:

- Irrigation by the Ministry of Agriculture
- Water and Gender

In the Water Sector Strategy document, the contents of these technical strategies is not repeated in detail.

Appendix 5. Surface water resources assessment

No.	Flow Direction	Catchment	Average Runoff (Mm^3/y)	2011 Estimated Runoff (MCM)
1	Western Wadis Flowing towards Mediterranean Sea	Al Moqatta'a	3.60	3.32
2		Al Khodeira-Abu Nar	8.30	7.30
3		Al Khodeira-Massin	11.70	9.70
4		Alexander- Zeimar	8.70	7.34
5		Alexander-Abraq	8.10	6.78
6		Qana	12.80	9.88
7		Sarida	22.80	19.39
8		Al-Dilb	16.40	12.59
9		Salman	6.50	3.39
10		Soreq	2.10	1.36
11		Soreq Al-sarar	1.70	1.05
12		Lakhish-Saint	5.00	3.19
13		Lakhish	5.40	3.14
14		Shiqma	2.60	2.01
15		Besor-Nar	4.90	2.94
16		Besor	2.10	1.27
Total			**122.70**	94.66
17	Eastern Wadis Flowing towards Jordan River	Malih-Shubash	0.90	0.90
18		Malih	1.20	1.13
19		Abu Sidra	0.80	0.75
20		Faria	6.40	6.17
21		Al'Ahmar	0.40	0.33
22		Auja	4.60	3.25
23		Nueima	1.70	1.42
24		Qilt	4.20	2.34
25		Marar	0.40	0.30
Total			**20.60**	16.59
26	Eatern Wadis Flowing towards The Dead Sea	Mukallak	3.50	2.60
27		Qumran	0.40	0.37
28		Nar	2.40	2.31
29		Daraja	5.30	5.13
30		Hasasa	0.50	0.32
31		Ghar	6.50	6.37
32		Abu El-hayyat	2.40	2.40
33		Abu Muradin	0.50	0.38
Total			**21.50**	19.89
Total Runoff			**164.80**	131.14

Source: PWA. 2012c

Appendix 6. Rain harvesting list of projects

Water Harvesting system	Governorate	Dam capacity (m^3)	Actual additional resource (m3/year)	Use	Status
Auja Dam	Jericho	700,000	1,000,000	Storage	existing
Faria Dam	Nablus	10,400,000	17,300,000	Detention -Storage	proposed
Faria retention Dam	Nablus	40,000	50,000	Recharge/ storage	ongoing
Al Malih Dam	Tubas	UA		Storage	proposed
Al Qilt Retention Dam	Jericho	4,000,000		Recharge/ storage	proposed
Dyouk check Dam	Jericho			Flood control	ongoing
Jenin Agricultural ponds	Jenin	300,000	300,000	Storage	proposed
Nwiemeh	Jericho	2,500,000			proposed
Marj Sanour ponds	Jenin				
Agricultural pond	Nablus, Jericho, Tubas	450,000		Storage	ongoing
Cisterns	All the country	32,500	32,500	Storage	
		Total	**18,682,500**		

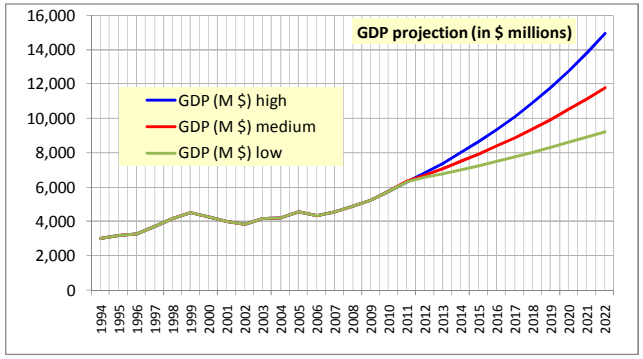
Appendix 7. GDP evolution trends and projections

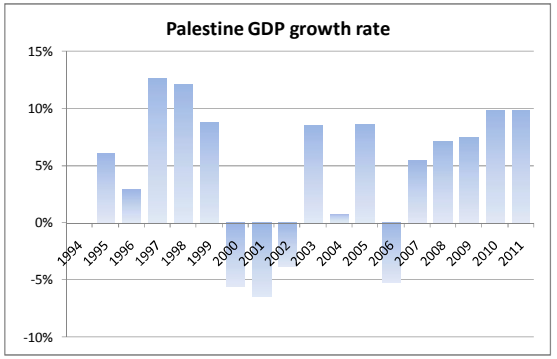
GDP trends

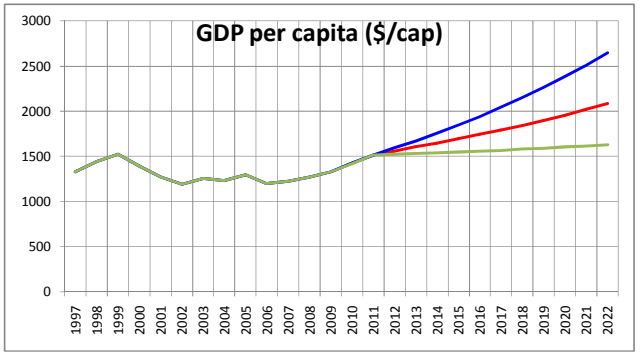
	PIPA and PCBS data																		TPAT extrapolation based on a % of 2003/2011 average growth rate									
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	
GDP (M $) high	3,012	3,193	3,286	3,701	4,148	4,511	4,261	3,989	3,839	4,165	4,198	4,560	4,322	4,554	4,878	5,241	5,757	6,323	6,837	7,393	7,995	8,645	9,348	10,108	10,931	11,820	12,781	13,820	14,944	140%
GDP (M $) medium	3,012	3,193	3,286	3,701	4,148	4,511	4,261	3,989	3,839	4,165	4,198	4,560	4,322	4,554	4,878	5,241	5,757	6,323	6,690	7,079	7,490	7,925	8,386	8,873	9,389	9,934	10,511	11,122	11,768	100%
GDP (M $) low	3,012	3,193	3,286	3,701	4,148	4,511	4,261	3,989	3,839	4,165	4,198	4,560	4,322	4,554	4,878	5,241	5,757	6,323	6,543	6,771	7,008	7,252	7,505	7,766	8,037	8,317	8,607	8,907	9,217	60%

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2003-2011 average	Projection hypotheses	low	medium	high
GDP growth rate		6.01%	2.91%	12.63%	12.08%	8.75%	-5.54%	-6.38%	-3.76%	8.49%	0.80%	8.60%	-5.20%	5.36%	7.12%	7.44%	9.84%	9.83%	5.81%		3.5%	5.8%	8.1%

GDP per capita ($/cap)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
GDP / capita ($/cap) medium	1329.82	1444.51	1522.84	1395.52	1271	1190.31	1256.6	1232.14	1299.7	1196.65	1224.49	1275.2	1331.89	1422.12	1516.72	1558.32	1601.39	1646.08	1692.57	1741.07	1791.55	1844.37	1899.66	1957.54	2018.16	2081.65
GDP / capita ($/cap) high	1329.82	1444.51	1522.84	1395.52	1271	1190.31	1256.6	1232.14	1299.7	1196.65	1224.49	1275.2	1331.89	1422.12	1516.72	1592.54	1672.5	1756.93	1846.24	1940.84	2040.97	2147.3	2260.24	2380.26	2507.86	2643.57
GDP / capita ($/cap) low	1329.82	1444.51	1522.84	1395.52	1271	1190.31	1256.6	1232.14	1299.7	1196.65	1224.49	1275.2	1331.89	1422.12	1516.72	1524.09	1531.82	1539.99	1548.71	1558.09	1568.06	1578.84	1590.45	1602.92	1616.26	1630.5
Populatio	2,783,084	2,871,568	2,962,226	3,053,335	3,138,471	3,225,214	3,314,509	3,407,417	3,508,126	3,611,998	3,719,189	3,825,512	3,935,249	4,048,403	4,168,860	4,293,313	4,420,549	4,550,368	4,682,467	4,816,503	4,952,722	5,090,365	5,229,333	5,369,521	5,510,822	5,653,121







Appendix 8. Recorded water production in Palestine

Water production in Palestine

All figures expressed in Mm3/year

196.1 PWA, 2012 **26.1** other source *80.0* TPAT estimation

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Water made available (wells, springs + purchase from Mekorot)						**290.4**	**309.5**	**316.7**	**335.6**	**303.6**	**311.2**	**326.8**	
Palestine	wells					196.1	214.7	223.5	241.2	225.7	227.2	244.0	
	springs					52.7	53.6	51.7	44.8	25.2	30.6	26.8	
	Mekhorot					41.6	41.2	41.5	49.6	52.7	53.4	56.0	
West Bank	wells					50.6	70.2	70.5	77.7	69.7	68.2	71.5	
	springs					52.7	53.6	51.7	44.8	25.2	30.6	26.8	
	Mekhorot					37.6	37.2	37.5	45.0	47.9	48.7	51.1	
Gaza	wells					145.5	144.5	153.0	163.5	156.0	159.0	177.4	
	springs					0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Mekhorot					*4.0*	*4.0*	4.0	4.6	4.8	4.7	4.9	

		2004	2005	2006	2007	2008	2009	2010	2011
Water made available (wells, springs + purchase from Mekorot)		**278.2**	**278.1**	**284.7**	**293.8**	**277.8**	**276.1**	**304.4**	
Palestine	domestic	148.0	151.0	153.0	163.5	178.6	172.5	181.4	
	agriculture	130.2	127.1	131.7	130.3	99.2	103.6	123.0	
West Bank	domestic	*80.0*	*80.0*	*80.0*	85.5	96.6	86.5	85.0	
	agriculture	52.7	53.6	51.7	44.8	25.2	30.6	42.0	
Gaza	domestic	68.0	71.0	73.0	78.0	82.0	86.0	96.4	
	agriculture	77.5	73.5	80.0	85.5	74.0	73.0	81.0	

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Gaza	water consumption	*36.0*	*38.0*	*39.0*	*40.0*	*42.0*	*43.0*	*44.0*	*45.0*	*48.0*	*50.0*	*54.0*	
	UFW	*35%*	*33%*	*36%*	*38%*	*38%*	*39%*	*40%*	*42%*	*41%*	*42%*	*44%*	

Appendix 9. Unit costs for investments

Boreholes							
500,000 $ +		**1,500 $/meter**	*Mac Donald et al - 2009 - Mapping groundwater development costs for the 2 transboundary Western Aquifer Basin, Palestine/Israel*				
		2,000 $/meter	JWU - 2012				
with a production capacity of 1,000,000 m3/year (Western Aquifer)							
for a 500 m well		**4,625,000 Sh/well**					
		0.23 Sh/m3 if amortized on 20 years of production					
Power							
20 US cent/kWh			*Abu-Madi - 2010 - Impact of energy price changes on the financial…*				
0.90 Sh/kWh			for Jerusalem electricity company				
0.6 to 0.7 Sh/kWh			for other				
Mekhorot							
2.50 Sh/m3			WB	*JWU - 2011*			
3.00 Sh/m3			Gaza	because water is coming from a desalination plant			
WWTP							
Gauff - 2010 - Feasibility study of Ramallah WWTP + sewer extension							
capex		230 MS (p.111)	**1,065 Sh/capita**	for Ramallah service area = 215,900 inhab by 2030 (p. 74)			
		108 MSh for WWTP	**5,334 Sh/m3/day**	20246 m3/day			
		connection cost	**600 Sh/capita for connection**	Gauff - p.104			
			3,600 Sh/hh				
		116 km networ	**491,379 Sh/km**	57 MSh			
opex	15 to 17	MSh/year	**74.1 Sh/capita per year**	all O&M costs including staff (pp. 196-197), for a WW flow of 20,246 m3/day by 2030 (p. 82)			
			2.2 Sh/m3				
PWA - 2010 - North Gaza Emergency Sewage Treatment Project							
capex		60 MSh for sewer	**631 Sh/capita**	for Gaza city = 370,000 inhab ????			
		174 MSh for WWTP	**4,885 Sh/m3/day**	35600 m3/day			
Rain harvesting							
A 10 m3 HDPE tank costing 5000 S			**500 Sh/m3 of storage capacity**				
			25 Sh/m3 of water for a 20 years depreciation				
UFW reduction							
Nablus implemented a comprehensive investment program (reshuffling, pressure zones, bulk meters…)							
had cost 20,000,000 $ for a 232,000 inhabitants city				**86.2 $/capita**	*Nablus WU 2012*		
JWU has invested 16,5 M$ from 2005 to 2012 to rehabilitate the network							
for 340,000 inhabitants				**48.5 $/capita**	*JWU 2012*		
System expansion		*JWU 2012*					
Network expansion with 4" pipelines			**70**	**$/ml**		**259**	**Sh/m**
average cost per customer			**4440**	**Sh/customer**		**814**	**Sh/capita**
Desalination		*Poch and Partners - 2012*					
A total investment of 455 MS							
for a 55 Mm3/ year facility							
if amortized on a 20-years period			**1.53 Sh/m3**	depreciation			
and O&M costys estimated at			**1.77 Sh/m3**	running costs			

Appendix 10. Investment needs

West Bank Water supply			short term	long-term strategy			
			2017	2022	2027	2032	
Production	deep wells	production capacity (Mm^3/year)	45	80	144	217	
		number of production wells	90	160	288	434	based on 500,000 m3/year per well
		additionnal wells to be build	50	70	128	146	starting from 63 deep wells in 2012
		pumps installment and replacement	64	114	205	310	based on 7-years lifespan
	desalination plants	production capacity (Mm^3/year)	0.0	22.0	22.0	22.0	Fashka Springs projects operational in 2020
		additionnal production capacity (Mm3/year)	0.0	22.0	0.0	0.0	
Storage	storage tanks	needed capacity (Mm^3/year)	61,000	137,000	251,000	409,000	for 8-hours of storage at the national level
		additionnal storage capacity (Mm3/year)	38,000	76,000	114,000	158,000	starting from 23,000 in 2012
Distribution	connections	number of connections	514,000	754,000	1,005,000	1,309,000	
		addtionnal connections	144,000	240000	251000	304000	
		customer connections (in ml)	1,440,000	2,400,000	2,510,000	3,040,000	based on 10 ml/connection
	network	main network extension (ml)	720,000	149,000	263,000	409,000	based on 5 ml/connection
		UFW reduction					

West Bank - Water supply			unit costs ($)		short term	long-term strategy		
					2017	2022	2027	2032
Production	deep wells							
			$1,200,000	$/well	$60,000,000	$84,000,000	$153,600,000	$175,200,000
			$200,000	$/pump	$12,800,000	$22,800,000	$41,000,000	$62,000,000
	desalination plants							
			$6,000,000	$/Mm3/y.	$0	$132,000,000	$0	$0
Storage	storage tanks							
			$1,000	$/$m^3$	$38,000,000	$76,000,000	$114,000,000	$158,000,000
Distribution	connections							
			$200	$/conn.	$28,800,000	$48,000,000	$50,200,000	$60,800,000
			$25	$/ml	$36,000,000	$60,000,000	$62,750,000	$76,000,000
	network		$100	$/ml	$72,000,000	$14,900,000	$26,300,000	$40,900,000
Total (in M$)			1,706		248	438	448	573
Total (in MSh)			6,312		916	1,619	1,657	2,120

Gaza Strip Water supply			short term	long-term strategy			
			2017	2022	2027	2032	
Production	deep wells	production capacity (Mm^3/year)	118	89	68	51	
		number of production wells	235	177	135	101	based on 500,000 m3/year per well
		additionnal wells to be build	56				starting from 63 deep wells in 2012
		pumps installment and replacement	167	126	96	72	based on 7-years lifespan
	desalination plants	production capacity (Mm^3/year)	2.0	55.0	100.0	143.0	Fashka Springs projects operational in 2020
		additionnal production capacity (Mm3/year)	0.0	53.0	45.0	43.0	
Storage	storage tanks	needed capacity (Mm^3/year)	48,000	84,000	129,000	187,000	for 8-hours of storage at the national level
		additionnal storage capacity (Mm3/year)	25,000	36,000	45,000	58,000	starting from 23,000 in 2012
Distribution	connections	number of connections	295,000	371,000	465,000	600,000	
		addtionnal connections	65,000	76000	94000	135000	
		customer connections (in ml)	650,000	760,000	940,000	1,350,000	based on 10 ml/connection
	network	main network extension (ml)	325,000	149,000	263,000	409,000	based on 5 ml/connection
		UFW reduction					

Gaza Strip - Water supply			unit costs ($)		short term	long-term strategy		
					2017	2022	2027	2032
Production	deep wells							
			$1,200,000	$/well	$67,200,000	$0	$0	$0
			$200,000	$/pump	$33,400,000	$25,200,000	$19,200,000	$14,400,000
	desalination plants							
			$6,000,000	$/Mm3/y.	$0	$318,000,000	$270,000,000	$258,000,000
Storage	storage tanks							
			$1,000	$/$m^3$	$25,000,000	$36,000,000	$45,000,000	$58,000,000
Distribution	connections							
			$200	$/conn.	$13,000,000	$15,200,000	$18,800,000	$27,000,000
			$25	$/ml	$16,250,000	$19,000,000	$23,500,000	$33,750,000
	network		$100	$/ml	$32,500,000	$14,900,000	$26,300,000	$40,900,000
Total (in M$)			1,451		187	428	403	432
Total (in MSh)			5,367		693	1,585	1,490	1,599

West Bank Sanitation			short term	long-term strategy			
			2017	2022	2027	2032	
Sanitation (plot level)	connection to sewers	sewered population	1,314,380	2,022,374	2,710,459	3,420,859	
		number of connections	131,438	202,237	271,046	342,086	*1 conn per 10 inhabitants*
		additionnal connections to be installed	43,938	114,737	183,546	254,586	*based on 500,000 m3/year per well*
	septic tanks	non sewered population	2,158,887	2,720,222	3,002,654	3,127,147	*private investment*
		on-site facilities	215,889	272,022	300,265	312,715	*private investment*
Severage	sewer	additionnal length of sewer (ml)	439,380	1,147,374	1,835,459	2,545,859	*based on 10 m per connection*
		additionnal lifting pump	220	574	918	1,273	*based on 1 per 2 km*
Treatment	WWTPs	treatment capacity	32,210	61,860	80,110	98,360	
		addtionnal treatment capacity	26,460	29,650	18,250	18,250	

West Bank - Sanitation		unit costs ($)		short term	long-term strategy		
				2017	2022	2027	2032
Sanitation (plot level)	connection to sewers						
		$1,200	$/conn.	$52,725,642	$137,684,903	$220,255,057	$305,503,098
	septic tanks						
Severage	sewer	$100	$/m	$43,938,035	$114,737,419	$183,545,881	$254,585,915
		$5,000	$/unit	$1,098,451	$2,868,435	$4,588,647	$6,364,648
Treatment	WWTPs						
		$1,500	$/m3/day	$39,690,000	$44,475,000	$27,375,000	$27,375,000
Total (in M$)		1,467		137	300	436	594
Total (in MSh)		5,427		509	1,109	1,612	2,197

Gaza Strip Sanitation			short term	long-term strategy			
			2017	2022	2027	2032	
Sanitation (plot level)	connection to sewers	sewered population	1,482,514	1,757,371	2,008,594	2,303,633	
		number of connections	148,251	175,737	200,859	230,363	*1 conn per 10 inhabitants*
		additionnal connections to be installed	27,251	88,237	113,359	142,863	*based on 500,000 m3/year per well*
	septic tanks	non sewered population	512,167	581,942	636,960	698,885	*private investment*
		on-site facilities	51,217	58,194	63,696	69,888	*private investment*
Sewerage	sewer	additionnal length of sewer (ml)	272,514	882,371	1,133,594	1,428,633	*based on 10 m per connection*
		additionnal lifting pump	136	441	567	714	*based on 1 per 2 km*
Treatment	WWTPs	treatment capacity	113,000	264,000	323,000	382,000	
		addtionnal treatment capacity	35,000	151,000	59,000	59,000	

Gaza Strip - Sanitation				short term	long-term strategy		
		unit costs ($)		2017	2022	2027	2032
Sanitation (plot level)	connection to sewers						
		$1,200	$/conn.	$32,701,651	$105,884,510	$136,031,263	$171,435,940
	septic tanks						
Sewerage	sewer	$100	$/m	$27,251,376	$88,237,092	$113,359,386	$142,863,283
		$5,000	$/unit	$681,284	$2,205,927	$2,833,985	$3,571,582
Treatment	WWTPs						
		$1,500	$/m3/day	$52,500,000	$226,500,000	$88,500,000	$88,500,000
Total (in M$)		1,283		113	423	341	406
Total (in MSh)		4,747		419	1,564	1,261	1,504