



## **The Water, Sanitation and Energy Crises in Gaza**

### **Humanitarian, Environmental and Geopolitical Implications**

#### **With Recommendations for Immediate Measures**

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#### **Foreword: Recommendations for Immediate Measures, Post-Hostilities**

This report was completed days before the outbreak of the latest round of Hamas – Israel hostilities and was shared in draft form with Israeli, Palestinian, and international stakeholders. The report is now updated with this foreword to include ramifications and recommendations for immediate measures needed post hostilities, should the ceasefire indeed continue to hold and negotiations for a more permanent agreement advance.

There is a serious humanitarian crisis in Gaza and water is at its center. Holding water issues hostage to the conflict will have dire consequences for Palestinians in Gaza, Israelis and Egyptians. Directly due to the hostilities, an estimated 1.2 million Palestinians in Gaza have no running water. There exists insufficient electricity in Gaza to treat or pump out sewage. This will no doubt result in even higher than present levels of drinking water contamination that risk the outbreak of pandemic disease, such as cholera and typhoid. The health risk is compounded by the present inability to even chlorinate drinking water.

This situation requires an urgent response if the outbreak of pandemic disease is to be avoided. Pandemics risk Palestinian, Israeli and Egyptian populations. But here lies the dilemma. Tackling the urgent water, environment, economic and energy problems all have to go through a central government and in Gaza that means Hamas. How can Israel and the international community therefore deal with the crisis?

The fact is that Israel presently sells an average of 4.7 million cubic meters (MCM) of potable water to Gaza, delivered through two grid connections: 2.8 MCM via the Bani Suhaila connection east of Khan-Younis, and 1.9 MCM via the Ben Said connection east of Deir el-Balah. Infrastructure constraints permitting, Israel could double this water supply for the immediate period.

Following political delays of nearly 20 years, a third Israeli pipeline connection, at Nahal Oz in Israel, to northern Gaza, was completed several months ago but no water has yet flowed into Gaza. An urgent agreement should be reached between Israel and the Palestinian Water Authority, an arm of the Palestinian Government in Ramallah, to open the lever in Israel and provide up to 10 MCM of potable water flow into Gaza.

In addition fuel and more generators need to be urgently delivered to Gaza to help operate what exists of Gaza's inadequate sanitation system, with direct supply from Israel of an additional 3MW of electricity needed to operate the newly completed World Bank coordinated waste water treatment plant in Beit Lahia.

These examples of two types of measures, water supply and sanitation, require the urgent agreement of the Palestinian and Israeli governments. If promptly implemented, they would go a long way to help prevent an additional humanitarian health crisis from developing due to lack of drinking water. They would also serve as a model for other longer term projects that are required for the reconstruction of Gaza. No less important, they would represent concrete evidence to the Palestinian and Israeli public that a relationship of mutual interest is capable of being advanced. In this way Palestinian, Israeli and international mutual interests are served in a manner that strengthens the Palestinian Government of Abu Mazen.

## **Executive Summary**

1.8 million Palestinian residents of the Gaza Strip face an imminent humanitarian crisis. Their natural water supply is no longer potable, but is heavily saline and polluted. They are increasingly dependent on desalination, yet they have insufficient electricity to produce new water or to treat sewage to prevent further spread of disease. While the water, sanitation and energy crises are well known to both Palestinians and the international community, the issue is off the radar of the Israeli public and Israeli decision makers.

Considering that over 12,500 rockets and mortar bombs have been shot into Israeli homes for over seven years from the Hamas-controlled Gaza Strip, some would ask, why should Israelis care? Israel's policy of unilateral disengagement indeed reflects a belief that Israel can leave Gaza, lock the gate and avoid any responsibility for the consequences. This report, co-authored by the Israeli Office of EcoPeace Middle East and the Institute for National Security Studies, aims specifically to inform the Israeli public and Israeli decision makers, that ignoring the water and environment crises in Gaza is contrary to Israeli interests. Israeli decision makers have not only the moral responsibility to prevent the seeping time bomb of salinity and pollution deepening the humanitarian crisis in Gaza, but also should display a much needed self-interest to urgently intervene for the sake of Israel's environment, public health and national security interests. A key purpose of this report is thus to inform the Israeli public of the extent of the crisis, its broader implications for Israel and the interim measures recommended that the Israeli Government take to stabilize the deteriorating conditions before they reach a point of no return.

Gaza's major water resource, the underlying Coastal Aquifer, is in a state of extreme overuse with water extraction rates three times renewable supply (UN, 2012). As a result, seawater from the Mediterranean is infiltrating into the groundwater, making 75% of the wells in the Gaza Strip more saline than health standards would permit for drinking water (Survey by PWA, 2012). Contamination of drinking water by sewage, due to sewage treatment plants having no electricity for their operation, makes the humanitarian crises even worse.

The impacts on Israel are direct. Over 90,000 cubic meters (CM) of raw or partially treated sewage from Gaza flow into the Mediterranean Sea every day (UN, 2012).

Millions of cubic meters of sewage flow only a few kilometers from the Ashkelon beaches where Israel also desalinates water for domestic use. As contaminated water and lack of sanitation solutions are responsible for 26% of all disease in Gaza (a yet to be published report by the World Health Organization – WHO), the possibility of pandemic diseases, such as cholera, poses a direct threat to communities on both sides of the Gaza fence.

From a national security perspective, 1.8 million thirsty people living in Gaza will not stay put as they run out of potable water to provide for their families. The water and pollution crisis could be the tipping point, as it adds to the animosity of an extremely crowded area, with rampant unemployment and poverty, as well as with restricted movement for people and goods.

While Israel is not solely responsible for many of the challenges facing the development of water and sanitation solutions in Gaza today, it does hold the key for interim measures that are urgently needed now. Increase in both water and energy imports from Israel are the most viable interim options favored by both Palestinian and the international community dealing with the water sector in Gaza. Israel is presently selling the Gaza Strip 5 million cubic meters (MCM) of water each year. A commitment for an additional 5MCM a year was made under the Oslo Accords but was never fulfilled. In a Memorandum of Understanding signed in Washington DC in late 2013 Israel agreed to the sale of up to an additional 30MCM annually to the Palestinian Water Authority (PWA). This could be used to supply more water to Gaza. Israel was considering supplying more electricity to Gaza, for the operation of sewage treatments plants but discussions are on hold since the establishment of the Palestinian Unity Government.



Figure 1: Map of the Gaza Strip

## **Introduction and Rationale**

Over the last several years many reports from the international community have highlighted that the situation in relation to water and sanitation for Palestinians in Gaza is reaching a critical point of no return. The Israeli public and many of Israel's decisions makers remain largely oblivious to the water and sanitation crisis in Gaza, particularly to the impact of this crisis on the region's stability and on Israel's own environment, public health and national security interests.

This report thus aims to inform the Israeli public of the urgency of dealing with the current crisis of water supply and sanitation in Gaza, using the most updated information available from the various aid agencies and donor community, including reports yet to be published.

Gaza is one of the most densely populated areas in the world. According to the UN (2012), there were 1.6 million people living in this area of 360 km<sup>2</sup> in 2012, today the estimated population is 1.8 million persons. Due to high birth rates, the population is expected to increase to 2.1 million by 2020. The population is already suffering high poverty rates (39% according to UNICEF, PWA & CMWU, 2014), high unemployment rates (29% in 2011 according to the UN, 2012), and food insecurity (around 44% of households in 2012 according to the UN). Half the population are children under 18 years of age.

The water situation in Gaza has been studied over the past decade by both the Palestinian Water Authority (PWA) and the international community to develop a strategy to mitigate the impact of the collapse of the Coastal Aquifer – almost Gaza's only source of water. The strategy developed is based on a combination of short- and long-term measures, including the increase of water and energy imports from Israel, wastewater treatment and reuse, and seawater desalination.

In principle, the Palestinian Authority should be able to augment needed water supplies in Gaza, at least in the short term, with any surplus water from their fair share of Mountain Aquifer and Jordan River waters. Until an agreement is reached, however, between the Palestinian Authority (PA) and Israel to replace article 40 of the Oslo II Accord (1995), (an interim agreement covering water issues that was supposed to be replaced within five years), internal Palestinian import of water from the West Bank into Gaza is not an option. Given the need to respond to an emergency

situation, broader Palestinian water management issues and fair share of cross-border water resources remain outside the scope of this report.

This report details the collapse of the Gaza Aquifer and the resulting lack of potable water for domestic use, as well as the lack of sanitation solutions that would prevent large scale pollution of the aquifer and the Mediterranean Sea. It then describes the current energy deficit and the projected energy needs of the water sector in Gaza, taking into consideration the water and sanitation infrastructure projects presently advanced by the donor community in cooperation with the PWA. A summary of the health impacts associated with the chemically and microbiologically contaminated water in Gaza follows. The next section deals with the longer term solutions of desalination and wastewater treatment and the inability to move forward due to lack of sufficient electricity in Gaza. The last section details with the geopolitical implications of inaction and the interim measures necessary to respond to the emergency situation – mainly an increase in water and energy imports to Gaza from Israel.

### **The Collapse of the Coastal Aquifer and Lack of Potable Water in Gaza**

Gaza draws up to 95% of its water from the underlying Coastal Aquifer. The aquifer extends from Binyamina (South of Haifa) in Israel, in the north, to the Sinai Desert of Egypt in the south. Palestinians regard Israeli pumping from wells just east of the Gaza Strip and rain harvesting projects along the Hebron – Besor Valley as contributing to the collapse of the coastal aquifer underneath the Gaza Strip. Israelis refer to the thousands of illegal shallow agricultural wells dug by Palestinian farmers as the main reason for the aquifer's collapse.

However, given the population size, the aquifer alone cannot possibly meet even the domestic needs of the Gaza population today, let alone needs for agriculture and industry or any future needs. Already water is being drawn from the aquifer at over three times its recharge rate (see Appendix). As groundwater levels decline due to such high levels of over-extraction, seawater from the Mediterranean and brines from deeper layers are infiltrating into the aquifer. Salinity levels have thus risen well beyond WHO guidelines for safe drinking water. This situation is compounded by contamination of the aquifer by nitrates from untreated and poorly treated sewage and

fertilizers from irrigation of farmlands. Today over 90% of water from the aquifer is not safe for drinking without treatment (UN, 2012).

Most Gaza residents today must cope by using water of different quality for different purposes. The saline ground water that run in the taps, when available, is used for cleaning and personal hygiene. Every Gaza resident who can afford it will seek to buy desalinated water for drinking and cooking purposes from one of several sources depending on their ability to pay. They may obtain some of their water for domestic use from the 20 brackish water desalination plants (BWDP) operated by the Coastal Municipalities Water using various water containers to carry the water themselves into their homes. More than four fifths of Gazans purchase water through 120 distributors that deliver water from the 40 private, mostly unregulated desalination plants (UNICEF 2014). Four-fifths of the water sold by private vendors is thought to be bacteriologically contaminated. WHO estimates the cost of this water at NIS 35/m<sup>3</sup>, a heavy burden on already impoverished families. In Israel there was public outrage two years ago when water prices were raised to 11 NIS m<sup>3</sup> including the cost of sewage treatment. Some families in Gaza are paying as much as one third of their household income for water. The UN benchmark for affordable water recommends the cost of water not exceed 5% of household income.

An estimated 20,000 wealthier homes have purchased private desalination units that store the desalinated water directly on rooftop tanks. With the continued rise in the salinity of aquifer water every year due to continuous over-extraction from the aquifer, the small desalination facilities will start to fail and will be unable to provide the needed drinking water.

In total, according to WHO, the domestic networks supplying untreated groundwater are used by more than 85% of the Gaza population for domestic purposes, the public desalination facilities are used by 87% for drinking water and the most expensive, privately supplied desalinated water is used by 73% of the public for drinking water to supplement the shortfalls from the public facilities.

The only additional source of fresh water in Gaza today is a relic of the Israeli military rule established following the capture of the Strip in 1967. In 1980 Israel started selling Gaza 5MCM of water annually through its National Water Company *Mekorot*. Following the establishment of the PA, a memorandum of understanding

was signed to confirm the continuation of this arrangement. Today the amount is 4.7 MCM on average, delivered through two grid connections: 2.8 MCM via the BaniSuhaila connection east of Khan-Younis, and 1.9 MCM via the Ben Said connection east of Deir el-Balah. The volume of water varies seasonally, often rising above average in the winter and declining in summertime. Israel sells this water to the PWA at 2.9 NIS per cubic meter.

### **Lack of Sanitation Solutions**

The overuse and salinity of the Gaza Aquifer is compounded by massive pollution due to lack of sanitation solutions, mainly lack of sewage networks and large-scale wastewater treatment plants (WWTP). In 2011, the sewage network covered only two thirds (66.7%) of Gaza's population and was then in a state of disrepair. The remaining third (33.3%) use cesspits and open drains to dispose of their wastewater (UNICEF, 2011). Since 2012 only 25% of wastewater collected has been treated and reused for irrigation (UN 2012).

Maintenance of WWTPs, as well as other water and sanitation infrastructure such as municipal water wells and pumps and the public desalination plants, are impeded by delayed entry and restricted imports of required materials (UNICEF, PWA, CMWU, 2014). All of these water supply or treatment facilities are impacted by the shortage of electricity, resulting in insufficient supply of water and a constant risk of back-flow and the flooding of sewage onto adjacent streets. Thus, most of the raw sewage, as well as the partially treated wastewater produced in the Gaza Strip, flow into the Mediterranean while also infiltrating groundwater on its way.

### **Energy for the Water Sector in Gaza**

Gaza receives electricity from three sources: the Israel Electricity Company (IEC) provides approximately 120MW; the diesel-based Gaza Power Plant (GPP) has a generating capacity of 140MW, but since the Israeli bombings of 2006 and due to limited diesel supply, it has been generating only 40-60MW (according to World Bank estimates); Egypt provides up to 30MW (usually between 23-25MW).

This supply currently meets only 46% of the estimated total demand – 452MW (2014). Electricity rationing is therefore implemented, with scheduled power cuts

ranging between 8-16 hours a day affecting hundreds of thousands of people all over Gaza at any given moment.

To meet the high energy demands, anticipated particularly for the water and sanitation sector, Gaza in the longer term could develop the Gaza Marine Field to provide offshore gas and increase its own large scale generation capacity through power plants converted from diesel to gas. However, even were Israel to permit the needed exploration and verification of the economic viability of the Gaza gas finds, the development of these fields for commercial production would constitute only a mid- to long-term solution for Gaza's energy needs. The only short-term option that is technically feasible is increasing electricity imports from Israel or Egypt to power water facilities.

### **Health Impacts of Low Quality Water and Lack of Sanitation Solutions in Gaza**

The population of Gaza is highly susceptible to both the chemical and microbiological contamination of the water used for domestic purposes, due to the high percentage of children: children aged 0-17 made up 51% of the total population in 2012, (UN, 2012).

One of the most pressing health issues related to the Coastal Aquifer's water is the rising salinity levels, while high nitrate levels may pose another urgent concern. The WHO standard for chloride in drinking water is 0.25 grams of chloride per liter of water. Nearly all of Gaza's groundwater is now brackish with chloride per liter ranging from 0.5 to sea water concentrations (20 grams per liter). Salinity levels alone render the Gaza Coastal Aquifer's water not potable for drinking

Nitrate levels are presently up to 10 times recommended health standards for drinking water. Although research on the full health effects of high nitrate levels on the Gaza population is lacking, these are known to cause of methaemoglobinaemia or the "Blue Baby Syndrome" in infants under 6 months and a threat to pregnant women (UNICEF, 2011).

Microbiological contamination of the aquifer by fecal coliforms and fecal streptococcus increases at each point of the water handling cycle. Water provided by private vendors is usually supplied at distribution points through tanker cars in non-hygienic condition. The resulting contamination leads to significant diarrheal and

other water-related disease, not only in Gaza's infants (children under five) but also in the general population.

Water-related diseases account for approximately 26% of disease in Gaza and are the primary cause of child morbidity. Such diseases also have an indirect effect on the nutritional status of children. In addition, intestinal parasites infect children throughout Gaza, reaching high levels in agricultural communities and near sewage ponds. The young children who are most vulnerable to infection by parasites and to development of pathogens are not reached by de-worming treatments administered to schoolchildren (UNICEF, 2011).

The health impacts of drinking heavily saline and contaminated water can be summarized as follows: 50 per cent of Gaza's children have a parasitic infection; children and adults suffer from diarrhea; consumption of saline water leads to high salt levels in humans that causes kidney dysfunction, heart failure, neurological symptoms, lethargy, and high blood pressure; excessive levels of fluoride are toxic, causing gastritis, ulcers, kidney failure, bone fluorosis (bone fractures and crippling), and teeth fluorosis (black lines around gums and tooth decay); and high nitrate levels cause "blue baby" syndrome, also known as methaemoglobinaemia and gastric cancer.

The sanitation setting in Gaza is so poor that it is conducive to the outbreak of pandemics such as cholera.

### **Investments in Desalination and Wastewater Treatment**

Desalination and wastewater treatment and reuse must ultimately be the foundations of Gaza's long-term resilience to water scarcity (along with a certain volume of the Mountain Aquifer's water and Jordan River waters, to be determined in a final water accord between Israel and Palestine). However, as presented earlier in this report, extreme energy shortage, as well as restrictions on entry of materials for construction and maintenance, impede the development of such long-term, large scale solutions.

The CMWU operates the only seawater desalination plant in the Strip. With an original capacity of 600CM per day, this plant was upgraded by the World Bank to produce 2,600 CM/d and another upgrade is now proposed that will result in a capacity of 5,000 CM/d. To make future desalination in Gaza sustainable, the World Bank in cooperation with the PWA has launched the Gaza Sustainable Water Supply

Program (GSWSP): Associated Works for the Gaza Desalination Project. This project includes infrastructure for distribution and blending of desalinated water with groundwater to reach WHO's water quality standards. The main components of the GSWSP are the construction of an extensive domestic water supply network and the North-South Carrier project (PWA, 2014).

Desalination in Gaza is to be coupled by extensive wastewater treatment to prevent pollution of the aquifer and to supply an additional source of water for irrigation. The international community has invested in the building of three large regional sewage treatments facilities in recent years: The North Gaza Emergency Sewage Treatment Project (NGEST), the Middle Area WWTP, and Khan Younis WWTP.

The NGEST project, initiated in 2004 and coordinated by the World Bank, included reconstruction at the old Beit Lahia WWTP site and its first phase is near completion. However following completion it is likely to remain inoperable due to power shortage of 3 MW that were requested from Israel. It remains unclear whether Israel will deliver the missing 3MW. The future needs of the project, estimated at a total of 11MW, must be met through the general energy supply of the Strip.

The realization of both the Gaza Middle Area Plant, initiated by the German Development Bank (KFW), and the Khan Younis Plant, funded primarily by the Government of Japan and implemented by UNDP-PAPP, has experienced extensive delays. The Gaza Middle Area Plant was initiated in 2003, work on design has now been resumed, but even with an optimistic scenario, the plant will be operative no earlier than 2018. Its full capacity will be 120,000 CM/d (the first phase will produce 60,000CM/d). The Khan Younis plant has been delayed since early 2000 partly due to funding issues. Recently an agreement bridging the deficit was reached between the Islamic Development Bank (IsDB) and UNDP, to complement the available Japanese funds. However, a funding source for the reuse component of the plant has not yet been found. This plant too will not be operative before 2017-2018 under the most optimistic scenario.

In addition, the CMWU, supported by the Red Cross, has initiated 3 emergency projects, in Khan Younis, Rafah, and Wadi Gaza, mainly refurbishing existing treatment facilities (except in Wadi Gaza) with the aim that these facilities will

operate until the major wastewater treatment plants in the Middle Area and Khan Younis reach full capacity.

### **Assessment of Environment, Health and Geopolitical Interests as Related to Israel**

The international community is willing to provide the funds for large scale desalination and sanitation operations in Gaza and they are already investing the required funds in sewage treatment. Yet, the sewage treatment plants being built will be unable to function without the necessary electricity. Raising the capital for the large desalination plants will not progress as funders are fearful of advancing white elephants, such as the NGEST plant of northern Gaza.

Despite the enmity towards Hamas, it is within Israel's interests to intervene and support the efforts of the international community to advance water issues in Gaza. Such intervention would not be a favor to the international community but would serve Israel's environmental, health and national security interests.

The natural north-easterly marine circulation of the Eastern Mediterranean means that sea water currents carry the 33 MCM of untreated wastewater from Gaza along the Gaza coast towards Israeli beaches. Israel has built one of its largest desalination plants off the beaches of Ashkelon, the Israeli city closest to Gaza. This plant produces 150 MCM of desalinated seawater for domestic purposes serving the Israeli population. The Israeli Ministry of Health has not yet closed the Ashkelon beaches or even beaches closer to Gaza due to Gaza sewage. However, common sense combined with sound science suggests that, despite dispersion and dilution, the release of Gaza's untreated sewage year after year so close to Israeli shores must have cumulative impacts on Israel's coastal waters. Moreover, Israel's Oceanographic and Limnological Research Centre (a government institution) has found an increase in bio-indicators pointing to an increase in organic matter in the shallow waters of Ashkelon. The report suggests that sewage flowing from Gaza is as a potential source (Herut B. et.al., 2014). The precautionary principal dictates that Israel has a direct interest in seeing sewage treatment plants preventing the pollution of Gaza and Israeli beaches.

If a pandemic, such as cholera, were to break out in Gaza, the sewage flowing along the coast would easily spread the disease into Israel. Polio was found in sewage

within Israel earlier this year, supporting sewage as the path by which disease can spread into Israel. The fence above ground will not stop the sewage polluting the groundwater in Gaza from spreading into groundwater in Israel. That the environment knows no borders is not just a cliché but, in this case, a real warning that should be heeded. The Israeli Water Authority itself recognized (2009) that with no substantial attention to pollution from Gaza, other parts of the Coastal Aquifer may become severely polluted.

The developing humanitarian crisis within Gaza, where desperation to find available and affordable potable water may be coupled with the outbreak of pandemic diseases, should alarm the Israeli public and Israeli decision makers. Regardless of the political-legal aspects of Israel's responsibility concerning Gaza, it is clearly in Israel's interest and a long-term strategic objective to prevent the spread of pandemic diseases across the security fence separating the two. In addition, while from an Israeli perspective a desperate and thirsty population in Gaza may turn against the Hamas Government to overthrow it, Hamas will not necessarily be their sole potential target. Israel is more likely to be seen as responsible. Thus, taking no action on water and sanitation in Gaza should not be considered an option by Israel. Moreover, the international community may not take a favorable view of Israel's inaction concerning the humanitarian crisis for 1.8 million persons next door to Israel.

Working together with the PWA on the relevant issues will serve several purposes, among which is assisting Israel to pursue its political and security objectives. Additional potable water and additional energy needed for sanitation solutions and desalination achieved through cooperation with the PWA, will strengthen the authority of the PA in Gaza and prevent public anger in the area from reaching undesirable levels.

### **Recommended Interim Measures**

Much could be achieved by fulfilling previously made commitments. Israel is already selling an annual average of 4.7 MCM of water to Gaza and is committed to supply an additional 5 MCM yearly under article 40 of Oslo II. It has taken nearly 20 years for a third pipe connection, at Nahal Oz in northern Gaza, to be completed for this purpose. While the connection is now complete and a transitional price set at 3.44 NIS/m<sup>3</sup> before VAT, no water has yet flowed into Gaza.

Israel also recently agreed to sell up to an additional 30 million cubic meters to the PA in the Memorandum of Understanding signed late last year between the Water Ministers of Israel, Jordan and the PA. If this is advanced and an agreement on the price is obtained, the PWA could request to supply this additional amount for Gaza.

Fulfilling the previous commitment made in Oslo II, increasing the amount of water delivered through the existing pipelines to match their maximum capacity, and moving forward with selling an additional 30 MCM to the PWA are three significant steps that could result in a much needed volume of 43.5 MCM a year. This alone will satisfy half the annual domestic water needs of the present population, at a time when Israel has excess water of its own due to large scale investments in seawater desalination.

For all these reasons, the issue of increased energy imports for water and sanitation projects should also be considered favorably by Israel as the wastewater treatment projects progress. A first step in this direction would be for the Israel Electricity Company (IEC) to supply an additional 3MW required for the Northern Gaza Emergency Sewage Treatment Plant.

Longer-term water and energy independence and sustainable water and energy supplies for Gaza can advance in parallel, depending on broader regional geopolitical developments. In the interim, however, Palestinians, Israelis and the world community have a common interest in avoiding another humanitarian crises developing in the Levant.

## **Appendix: Fact Sheet**

### **The Collapse of the Coastal Aquifer and Lack of Potable Water in Gaza:**

Scientists in Israel tend to describe the Coastal Aquifer as somewhat separate layers of water lenses flowing, if at all, from east to west towards the Mediterranean. The aquifer recharges from several sources, predominantly from rainfall. This recharge is estimated at 50 to 60MCM annually. Current Palestinian extraction of water from the aquifer below the Gaza Strip is an estimated 160MCM per year, triple the recharge rates (UN, 2012). The PWA reports that 91MCM are currently needed to meet domestic supply, this alone being almost double the recharge rate of the aquifer (PWA, 2014).

The WHO has determined that nitrate and chloride levels in many of Gaza's wells, dramatically exceed both its own guidelines and even the less stringent guidelines of the PWA (report yet to be published). 75% of the wells in the Gaza Strip are more saline than health standards would permit for drinking water: a survey by the PWA in 2012 revealed that one quarter of the wells contained 250 to 600 mg/liter of chloride; one quarter 600-1,000 mg/liter; and one quarter over 1,000 mg/liter. Only one quarter of the wells contained fewer than 250 milligrams of chloride per liter, the standard level of salinity set by the WHO. Only 21% of the wells in the Gaza Strip met the WHO standard for nitrates of less than 50 mg/ liter. 31% of wells contained 50-100 mg/liter; 38% contained 100-200 mg/liter, and the remaining 9% –located in Gaza's large cities – contain more than 200 mg/liter. Combining the data on chloride and nitrates levels reveals that only 14 wells (some 6.5% of all wells in Gaza) provide water meeting WHO standards. That is, in terms of chemical content this water is simply not potable.

Latest UN reports (2012) warn that, if current water extraction rates continue, the aquifer could become completely unusable as a fresh water source as early as 2016, with the damage irreversible by 2020.

### **Lack of Sanitation Solutions**

The Coastal Municipalities Water Utility (CMWU) produces a total of 6,000-8,000 m<sup>3</sup>/day of desalinated ground water and 2,600 m<sup>3</sup>/day of desalinated sea water. Four

wastewater treatment plants (WWTP's) with a total capacity of 11 MCM per year currently operate in the Gaza Strip (PWA, 2012). These are Jabalia in the north, built in 1976; Sheik Ashlin in Gaza City, built in 1977 and rehabilitated by the German Development Bank (KFW); Khan Younis, built in 2007; and Rafah in the south, built in 1983. A total of around 44MCM of wastewater is generated annually in the Gaza Strip and this figure is expected to rise to 57MCM by 2020. As of 2012, 90,000cm per day (almost 33MCM a year) of raw or partially treated sewage is dumped, infiltrating groundwater or flowing into the Mediterranean (UN, 2012).

### **Energy for the Water Sector in Gaza**

According to most estimates the total electricity supply to Gaza ranges between 183-210MW (for example, OQR, 2014). UN estimates are a little higher – the Gaza Power Plant's capacity is estimated at 100MW, resulting in an electricity supply of a total capacity of 242MW. According to UNICEF, PWA & CMWU, the forecast total demand for 2020 is 550MW (UN, 2012) but according to other estimates approximately 855MW (OQR, 2014).

Plans of the international community and the PWA for the development of the water sector require significant amounts of energy that are currently unavailable in Gaza. According to the World Bank, the total incremental power requirements for Gaza's water sector alone will amount to 65MW once the planned major international projects are completed. These include a 55 MCM desalination plant requiring an estimated 35MW, 3 regional waste water treatment plants together requiring a total of about 25MW, and in addition four low volume desalination plants to come on-line before the main desalination plant and requiring about 5MW together.

For the case that Gaza can develop off-shore natural gas, the planned 55MCM desalination plant includes an optional component of a dedicated gas-fired power plant of approximately 35MW as the facility's primary source of power. Similarly, the Gaza power plant could be converted from diesel to gas to render the plant more efficient and to expand it to a capacity of 240MW.

Further steps to improve the energy situation in Gaza would be to improve the power distribution systems to avoid loss, increase collection rates for electricity fees, and invest in solar PV generation.

## **Investment in Desalination and Wastewater Treatment**

Desalination targets of 55MCM/y for the Gaza Strip were set by the PWA for 2017 (increasing to 130MCM/y in 2035). Three short-term low volume desalination (STLV) plant projects are currently under construction for mitigating the existing deficit and the World Bank has taken the lead in coordinating the establishment of the planned large scale, longer term 55MCM desalination plant. In addition, plans exist for building two further plants: one by EU and UNICEF, to produce 10,000CM/d (3.65MCM/y) and another by the Islamic Development Bank with the same capacity.

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