

2014 Water Resources Status Summary Report /Gaza Strip

Water Resources Directorate

(2015)

Introduction:

The aim of this water resources summary report is throwing lights on the water resources situation in Gaza Strip in terms of quantity and quality for the year 2014, based on: the results of the groundwater level records and its fluctuation with time, groundwater quality of representative water wells covering Gaza Strip, and the total groundwater production as well as consumption per capita of the different Gaza Strip Governorates. This report is a summary of the detailed assessment, which PWA issued in the 2nd quarter of 2015; in particular studies for the 5-Governorate in Gaza Strip in general and each municipality (25-municipalities).

Domestic Water Supply:

The total water supplied for domestic use in Gaza Strip was about 88.466 mcm in 2014. Where, 96 % (84.9 mcm) of that water is supplied from groundwater through 247 water wells. While the remaining 4 % (3.54 mcm) is supplied from Mekorot (table.1). It is worthy to mention that the Private sector desalination plants abstract about 6 MCM/y additional water from the same aquifer.

Taking in consideration the network distribution system efficiency (58.9% as mean value), the total water consumption was 52.1 mcm in 2014. This means that the daily average per capita water consumption is 79.8 l/c/d. In general, the distribution system efficiency varies from area to another, where it is about 63% in Gaza Governorate and about 50% in Northern Governorate. Based on that, the per capita consumption ranged between 90 l/c/d in the Northern Governorate in spite of its low system efficiency (50%) as indication of high groundwater production quantities and 73 l/c/d in Khan Younis Governorate. The maximum production was recorded in the Northern Governorate of 180 l/c/d while the lowest is 120 l/c/d in the Khan Younis and Rafah Governorates (table.1).

Table.1. Domestic water supply in Gaza Strip / 2014

Governorate	Total Production	Total Consumption	System Efficiency	L/C/D Production	L/C/D Consumption
North	23,389,963	11,664,340	50%	180	90
Gaza	27,024,755	17,024,755	63%	123	78
Middle	13,636,819	8,287,506	61%	137	83
KhanYounis	14,702,700	8,997,143	61%	120	73
Rafah	9,712,729	6,089,174	63%	120	75
Total	88,466,966	52,062,918	58.9%	135.4	79.8

Groundwater Level

That high groundwater production affected negatively the water level decline in terms of attitude and magnitude as a result of un-equilibrium between the total groundwater aquifer renewable amount of about 55-60 mcm/y and the total groundwater abstraction of about 200 mcm/yr for both domestic and agriculture use.

As a result of that, two cone of depressions had occurred in northern and southern parts of Gaza Strip with water level depths of -5 m and -19 m below sea level respectively as shown in the water level contour map (fig. 1), based on the water level records of 88 monitoring wells distributed all over Gaza Strip.

The attitude and magnitude of water level decline trend is varying from well to another. They are controlled by its location, the hydrogeological characteristics of the water bearing aquifer formation, aquifer potential and its vicinity production water wells as well as the water abstraction around.

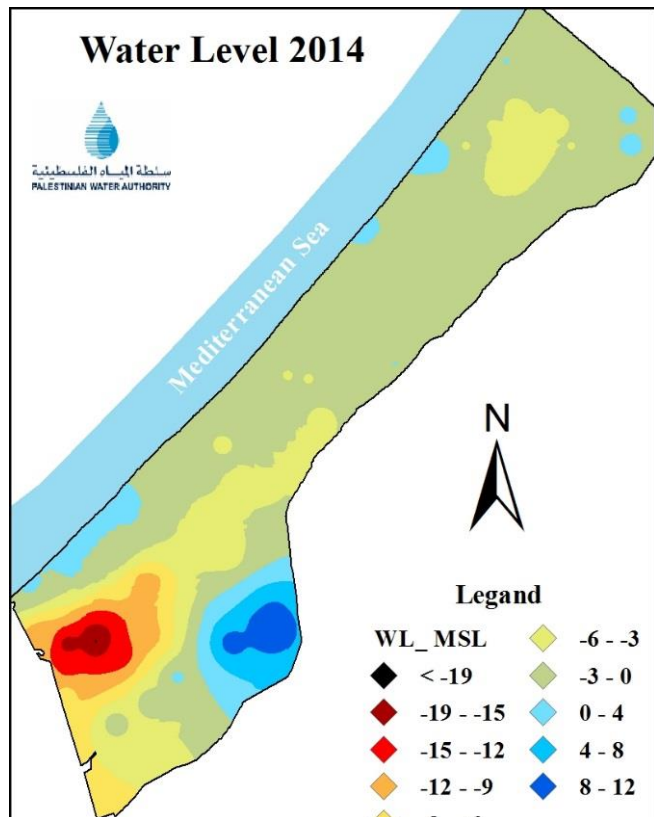


Figure.1. Water Level Contour Map, 2014

Groundwater Level Trend

Generally, most of the monitoring wells were characterized by continuous water level decline with different magnitude and attitude as reflected in fig.2, which shows that the significant water level decline has occurred in southern part of Gaza Strip (well no.P-48) with water level depth of about -19 m below sea level. Generally, the magnitude of water level decreases gradually towards the northern area of about -5m below sea level (well no.A-53).

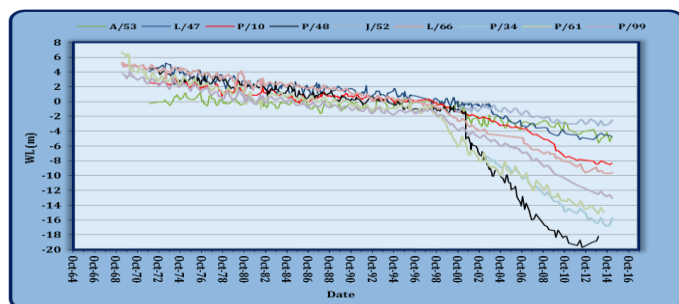


Figure.2. Groundwater Level Trend

With continuous intensive pumping, it is expected that the water level will continue declining.

Groundwater Quality

Depending on the results of the groundwater chemical analyses carried out twice a year by both Ministry of Health Lab (MOH) and Coastal Municipal Water Utility (CMWU) for about 200 domestic water wells in Gaza Strip, PWA has evaluated these results through preparing contour maps as well as graphs for the main ions such as Chloride as salinity indicator and Nitrate as pollution reference.

As reflected in the chloride contour map (fig. 3), the fresh groundwater of chloride concentration of less than 250 mg/l exists in limited part of the aquifer located in the north of Gaza and west of Khan Younis (Mawasy).

The major parts of the aquifer have a Cl concentration of 500 -1500 mg/l, while along the coastal line exceeds 2000 mg/l of Cl concentration because of seawater intrusion influence. The map shows also that the Cl concentration in the southeastern part of the Gaza Strip is more than 1500 mg/l reflecting the upward leakage of the high saline water from the underneath water horizons.

That limited fresh groundwater part shrinkages with time compared to previous years and it is expected to demolish during the next few years in case of continuing depending on the coastal aquifer as the only water resource for fulfilling the water needs of Gaza Strip. On the other hand, the seawater will continue invading the land and covering more inland areas.

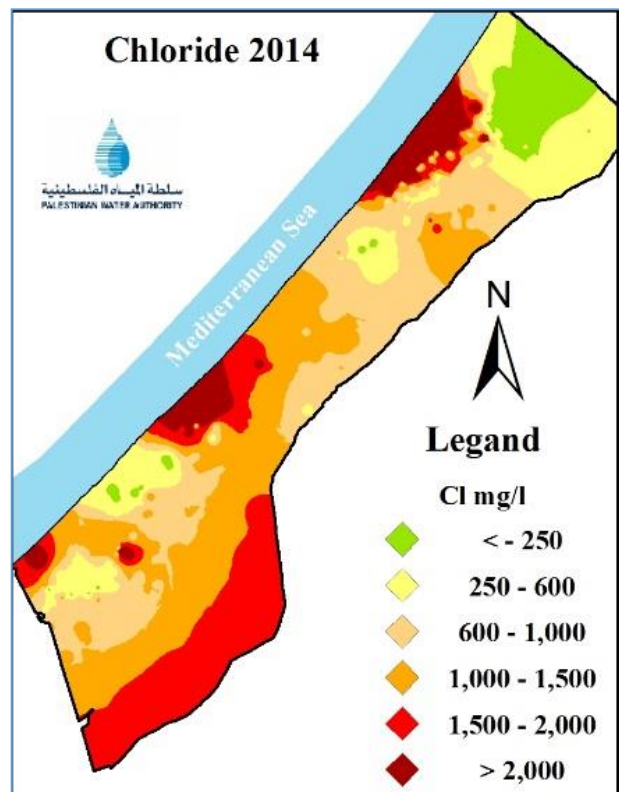


Figure .3. Chloride Contour Map, 2014

Chloride Ion concentration

The magnitude and attitude of Cl ion trend with time changes from area to another and is generally controlled by many factors such as; well location, pumping rate in the well itself and the vicinity wells and the hydrogeological characteristics of the yielding zone. As reflected in the representative graphs for Cl trends (fig.4), it can be concluded that there is a general increase trend in most of the water wells with time reaching to about 7000 mg/l in some wells reflecting the seawater intrusion effect (well no. R-162LA)

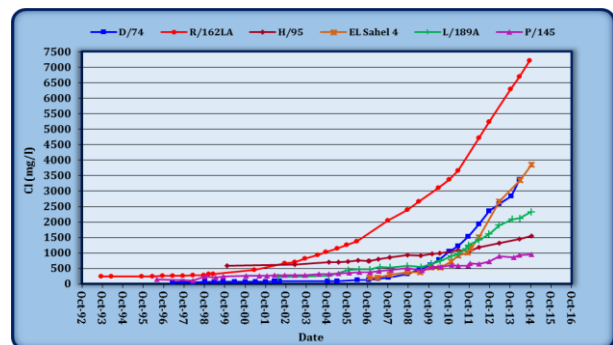


Figure .4. Chloride Concentration Trend

while others reflect the upward leakage of the saline groundwater from the underneath water bearing horizons.

Nitrate Ions concentration

Nitrate (NO_3) is generally a reference and / or an indicator for the water pollution because of wastewater and/or organic fertilizers leakage through the unsaturated zone. Its concentration is controlled by the availability of wastewater/pollutants, thickness of the unsaturated zone, and its hydrogeological characteristics in terms of hydraulic conductivity. As indicated in the NO_3 contour map for the year 2014 (fig.5), it is clear that the NO_3 concentration in the pumped domestic water is ranging between 50 mg/l and > 300 mg/l. Where the high NO_3 concentration mainly occurred in the different residential areas of Gaza Strip reflecting the percolation of the wastewater to the underneath aquifer through the networks or cesspits and septic tanks. Khan Younis has the highest concentration since most of the residential area is not served by sewerage system and many areas are still served by cesspits facilities. On the other hand, the low NO_3 concentration occurred in the area that is not occupied by residents (southeast part of Rafah) or characterized by low transitivity of thick unsaturated characterized (Al Nusairat area).

There is no general trend for NO_3 concentration as shown in fig.6, since it on spot effect, but generally, it is high in Khan Younis area and northern part of Gaza area. .

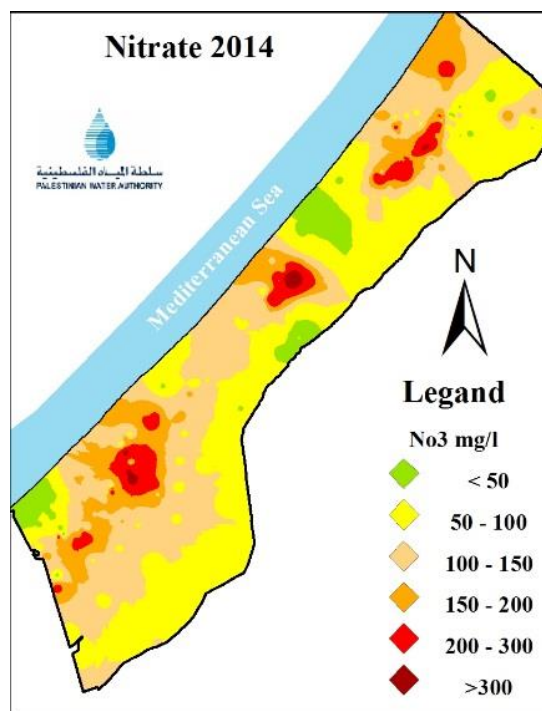


Figure .5. Nitrate Contour Map, 2014

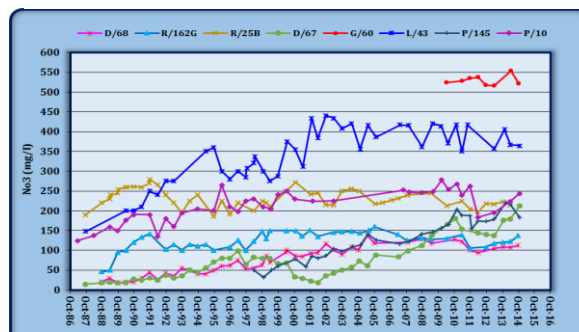


Figure. 6. Nitrate Concentration Trend

Water Supply Quality

Chloride concentration of the groundwater that supplied for Gaza people from the municipal wells in 2014 was ranging from 250 to more than 5000 mg/l. 19.8 % of that has chloride concentration of less than 250 (WHO allowable limit), while the remaining (80.2%) exceeds the WHO chloride level (fig.7). By comparing this percentage with that of 2013 it is clear that, Cl in 2014 has degraded by about 5 % where water with acceptable Cl level was 24.6 % in 2013 compared to 19.8 % in 2014.

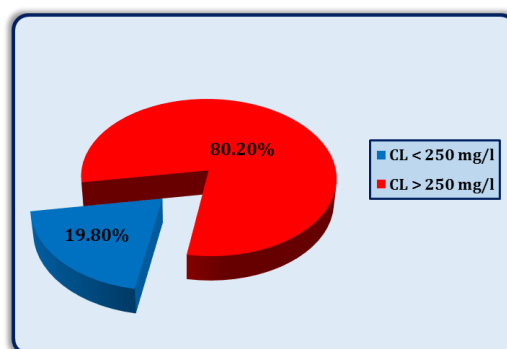


Figure .7. Cl in the Supplied Water

Nitrate (NO₃) concentration of the supplied groundwater in the municipal wells ranges from 50 to more than 300 mg/l. 14.1 % of that had Nitrate concentration of less than 50 mg/l (WHO allowable limit) while the remaining (85.9 %) exceeds the WHO nitrate level which is more or less close the year 2013 (fig.8).

Taking in consideration the combined concentrations of both chloride and nitrate ions, it is clear that 4% of the supplied domestic water in 2014 is only matching with WHO drinking limit (50 mg/l), while the remaining 96 % (fig.9) is out of limit and that is more or less similar the year 2013, which was 96.2%. This minor difference is mainly due to several new wells during 2014 with acceptable NO₃ level.

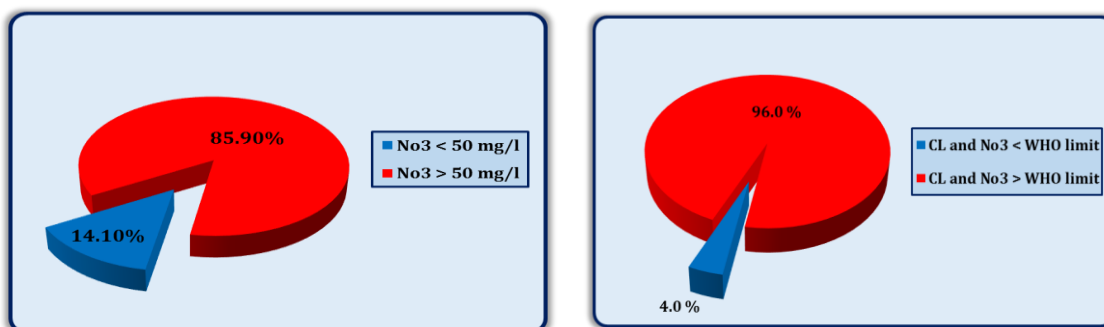


Figure .8. NO₃ in the Supplied Water

Figure.9. Cl & NO₃ in the Supplied Water

Planned Actions

The report has concluded the following Actions:

I- Northern Governorate:

- Closing 3-wells that is affected by the influence of seawater intrusion
- Reducing the pumping rate of 7-wells
- Not allowing during any new water wells till 2025
- Compensate the groundwater quantities required through drilling new wells in selected areas with minimum pumping rates
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II- Gaza Governorate:

- Closing all the wells (20 –wells) affected by seawater intrusion that located mainly along the shoreline

- Reducing the pumping rate of 23-wells that located in that area that expected to be affected by seawater intrusion influence
- Prohibiting drilling any new wells in the western area of Gaza Governorate
- Compensate the groundwater quantities required through drilling new wells in selected areas with minimum pumping rates

III- Middle Governorate:

- Closing a total of 7 water wells that were affected significantly by seawater intrusion
- Closing 1-well that is characterized by high NO₃
- Reducing the pumping rate of 9-wells that located in that area that expected to be affected by seawater intrusion influence
- Prohibiting drilling any new wells in the western and southwestern areas of the Middle Governorate and the new wells to be drilled in the central and eastern areas of the Governorate
- Compensate the groundwater quantities required through drilling new in the central and eastern areas with minimum pumping rates

IV- Khan Younis Governorate

- Closing 4-wells of more than 1200mg/l of Cl as a result of seawater intrusion effect.
- Reducing the pumping rate of 14-wells that located in that area that expected to be affected by seawater intrusion influence
- Prohibiting drilling any new wells in the western and southwestern areas
- Compensate the groundwater quantities required through drilling new wells in selected areas with minimum pumping rates

V- Rafah Governorate:

- Closing 3-wells that were significantly affected by seawater intrusion and that of more than 1200mg/l of Cl.
- Reducing the pumping rate of 5-wells that located in that area that expected to be affected by seawater intrusion influence
- Prohibiting drilling any new wells in the western areas
- Compensate the groundwater quantities required through drilling new wells in selected areas with minimum pumping rates

Note: An action plan regarding executing the above mentioned recommendations were prepared by PWA as reference for managing the water demand