Desequilibrium of the Groundwater in Argentina

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Prologue

The geosciences, when applied to environmental problems have, of course, a wide range of possibilities, especially regarding topics of territorial studies (for instance, basic geology and geomorphology) and soil and water resources. However, the concretion of such applications depends on factors which are not inherent to the activity itself, but related to different aspects of the governmental management of the environment amongst others. Indeed, the lack of specific legislation in many cases (or its inexistent application), its poor technical regulation the deficit of adequate scientific and thecnical institutes, the lack of a proper comptroller and users intervention and the lack of diffusion, are some of the non-geological aspects responsible for the delayed intervention of the dis ciplines that concern to.

Summary

A particular case is presented here, in which the lack of specific studies –such as prediction of rising of piezometric heads in a given aquifer-causes sequels in the economy and welfare of the people.
It is remarkable the lack of planning and of a suitable and efficient governmental intervention, particularly in the anderstanding of the water resources and its environmental esence.

Introduction

Buenos Aires City and nineteen (19) districts of the Great Buenos Aires conform one of the most numerous and most densely populated areas in the world, currently reaching a population of 11 500 000 inhabitants. Its area is about 3 880 km^2.
This territory is inserted in the wet Pampa region, more precisely in the so-called ¨Undulating Pampa¨, having the De La Plata River as its most conspicuous boundary.
Its geological characteristics are defined by pampean sediments loess and silts from the Quaternarian age, and partly by the post-pampean sediments in some valleys and along the coastal area. The existing aquifers are located in the mentioned pampean sediment layer. Deeper (40 - 50 meters), the Puelches semiconfined aquifer is located, having a very high quality water.
The groundwater in this area is of major importance since it has been the main source for supplying water for all uses (except for Buenos Aires City and some other minor areas).
The access to the aquifers is made through domiciliary connections, by manual or electrical pumping, through connections for public services, for bottling, for industries, for recreational purposes and others.
Where public network is inexistent, sewage is eliminated by means of shallow wells or blind drainSs
This region has been characterized by the existence of huge depression cones, due to over-exploitation of the groundwater. They have reached extensions of about 100 km^2 and depths up to 45 m below ground level.
In addition, the water table has been subjected to a continuous chemical and biological deterioration, suffering lateral saline water intrusion and contamination by nitrates, bacteria and several industrial products.

Background

Between 1947 and 1991, the population increased from 4.7 to 11.5 million inhabitants. Between 1950 and 1975, almost all basic industries were developed, giving place to unplanned settlements in the Great Buenos Aires, and worse, without basic sanitary services (drinking water and sewerage). This lead to intensive exploitations of groundwater, mainly for human and industrial consumption, either by domiciliary wells or by wells connected to the drinking water public network and to contamination of the aquifers due to lacking of sewerage and to disposal of untreated industrial effluents into the streams.

In Great Buenos Aires, drinking water networks were expanded from 1980 to 1991 (12 years) in a way that the percentage of the population supplied increased from 49.5 to 54.9. Similarly, the sewerage served a percentage of the population that increased from 27.9 to 30.4, during the same period.
From 1993 on, the public drinking water network has been observing an active increment in extension, in several districts of the Great Buenos Aires.

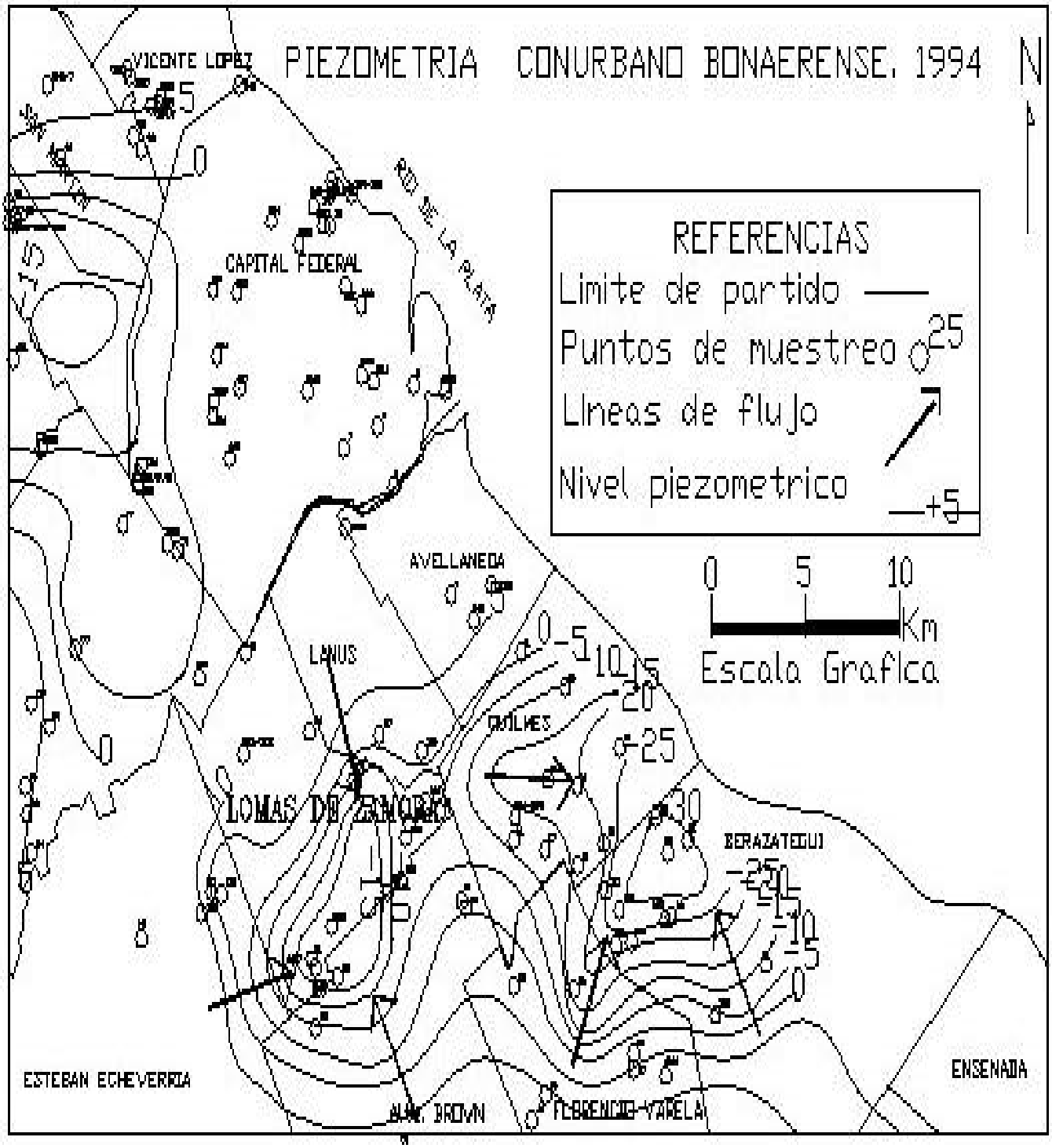
A typical example in the Great Buenos Aires

Lomas de Zamora

Area:	89 km^2
Population:	505 509 (1980 Census)
	572 769 (1991 Census)
Density:	6 453 inhabitants/km^2 (1991 Census)
Percentage of population supplied by public drinking water network:	61 % (1980 Census)
	68 % (1991 Census)
Estimated unit supply:	0.5 m^3/inh./day

Percentage of population served with public sewerage : 23 % (1980 Census)
19 % (1991 Census)

(Fig 1) shows an example of the piezometric surface and macro-depression cones configuration, in 1994 (Santa Cruz et al., 1996).



(Fig. 1)

It should be noticed that currently, and since about 1996, the water table (piezometric surface) has been recovering, being today very close to the ground surface (up to 0.50 m, below, in some places). This means an almost full recovery of the water levels and the vanishing of the macro-depression cone in the area.
To determine the main factor in this recovery, the following computation has been made (Fig 2):

I) *Area of macro-cone (1994):* 50 km^2
Average depth : 17 m
Effective porosity (pampean sediment): 10 %
Lacking volume of water in the cone: 85 000 000 m^3

II) *Balance (1980 database, INDEC)*
- Population: 505 510 inhabitants
- Maximum unit supply: 0.5 m^3/inh./day

- Percentage of population supplied by public drinking water network: 61 %
- Percentage of population served with public sewerage: 23 %
- Domestic wells : 120 000
- Volume of distributed drinking water: 56 276 000m3/year
- Volume of water non-returning to the aquifer: 12 943 458 m^3/year
- Volume of water returning to the aquifer, through shallow wells (60 %): 26 000 000 m^3/year

Estimated exploitation of domestic wells
- Quantity: 120 000
- Discharge: 2m^3/day
- Total extraction: 87 600 000 m^3/year
- Volume of water returning to the aquifer, through shallow wells (60%): 52 560 000 m^3/year

Balance: Returned to aquifer -Extractions

(52 560 000 + 26 000 000) – 87 600 000 m^3/year =

- 9 040 000 m^3/year
of deficit (expanding cones)

III) *Balance (1991 database, INDEC)*
- Population: 572 509 inhabitants
- Maximum unit supply: 0.5 m^3/inh./day
- Percentage of population supplied by public drinking water network: 68%
- Percentage of population served with public sewerage: 19%
- Domestic wells: 120.000
- Volume of distributed drinking water: 71 048 367 m^3/year
- Volume of water non-returning to the aquifer: 13 499 189 m^3/year
- Volume of water returning to the aquifer, through shallow wells (60 %): 34 592 000 m^3/year

Estimated explotaition of domestic wells
- Quantity: 120 000
- Discharge: 2m^3/day
- Total extraction: 87 600 000 m^3/year
- Volume of water non-returning to the aquifer: 35 040 000 m^3/year
- Volume of water returning to the aquifer, through shallow wells (60%): 52 560 000 m^3/year

Balance: Returned to aquifer -Extractions

87 089 500 m^3/year – 87 600 000 m^3/year =

zero balance m^3/year

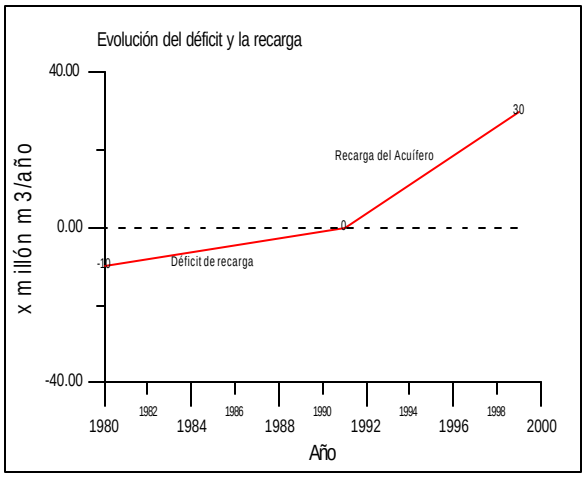
IV) *Estimated current balance (1998 and 1999)*
- Population: 572 509 inhabitants
- Maximum unit supply: 0.5 m^3/inh./day
- Percentage of population supplied by public drinking water network: 80%
- Percentage of population served with public sewerage: 19%
- Domestic wells: 30 000
- Volume of distributed drinking water : 83 586 000 m^3/year
- Volume of water non-returning to the aquifer: 15 881 400 m^3/year
- Volume of water returning to the aquifer, through shallow wells (60 %): 40 623 000 m^3/year

Estimated exploitation of domestic wells
- Quantity: 30 000
- Discharge: 2m^3/day
- Total extraction: 21 900 000 m^3/year
- Volume of water returning to the aquifer, through shallow wells (60%): 13 140 000 m^3/year

Balance: *Returned to aquifer -Extractions*

(40 623 000 + 13 140 000) – 21 900 000 m^3/year =

31 863 000 m^3/year



(Fig 2)

Conclusions

The increaseing supply of drinking water through public network, the lack of a public sewerage and the dismounting of domiciliary wells are the main factors responsible for the recovery of the aquifers in the area.
Today situation responds to actions which are effective regarding the increase in public dotation of drinking water. However, they are not efficient since they created inconvenience to the people, not suffered before. Being the water table located very closely to the ground level, it produces leaking from the shallow wells, causing harm to the health and economical prejudice.

Epilogue

The chronogram for building the sewerage is currently under discussion throughout the whole affected region in the Great Buenos Aires. However, given the urgency in solving the depicted situation, in Lomas de Zamora, it was decided by the Province of Buenos Aires, to carry out the digging of a network of wells, 100 m apart, to deplete the water table again.

Comments

This is a clear example of the absence of the State in an area where it has to have a strong influence, especially regarding the planning of the use of water resources and its consecuences.
In addition, it is noticeable the lack of basic information and of monitoring of the groundwater. It should be remembered that, according to the Agenda 21 (Rio de Janeiro, 1992), it is an inherent function of the State to increase the scientific and technological knowledge, as well as to obtain the environmental information, having it available for all the citizens.

Bibliography

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