# *DETERMINATION OF SENSITIVITY TO POLLUTION IN THE REGION OF BOUTELDJA (NE ALGERIAN)*

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## ABSTRACT

The determination of groundwater pollution is a delicate step, which scientists confront; including exploring the vulnerability of groundwater .The objective of this work is to assess not only the vulnerability but also the sensitivity of the water of the massive dune of Bouteldja highly sought by man. The sensitivity index is calculated from the product of the DRASTIC vulnerability index (IV) and the index of chemical quality (IQ) of water in the country in April 2012 (during high water). The IQ is calculated on the basis proposed by Neubert et al (2008) for water intended for drinking water supply classification. The obtained sensitivity map shows areas which coincide with those heavy agglomerations.

**Keywords:** Sensitivity, Vulnerability, Dune Massif Bouteldja, Algeria

## 1 INTRODUCTION

The index of sensitivity to water pollution (IS) is the product of the DRASTIC vulnerability index (IV) and the index of water quality (IQ) (Pusalti et al. 2009). IS = (IV) * (IQ) (1)
The risk of deterioration of the groundwater quality is measured by the IV, obtained by the DRASTIC method. However, assumptions are made: (i) the DRASTIC method is applicable to the regional level, (ii) the initial source of pollution spreads in the medium from the surface, (iii) the quality of the contaminant occurs not on the degree of vulnerability. It should be noted that the estimate of the final index (IV) needs to first assess the partial DRASTIC index for each of the seven parameters (D, R, A, S, T, I and C). This partial index is assigned a weight and a coast ranging respectively from 1 to 5, and 1 to 10, defining the degree of vulnerability (Go et al. 1987). The DRASTIC index (IV) is the weighted sum of the weights for the coasts of the seven region-specific hydrogeological parameters.
The index of the sensitivity of the water quality reflects the classification of waters into five groups according to each concentration of ions taken into account: I: very good water, II: good, III: usable IV: used with caution and V: harmful. The boundaries of each class used for the parameters concerned are listed in Tables 89 and 90. The quality point index is calculated using the formulation (7): IQ = $\sum_{i}^{n}(C_i)^2$ (2)

The summation is widely regarded as a quality parameter (ions). Class is the parameter i (ion) having an integer value between 1 and 5 at a given location. The use of the square of the concentration Ci of each ion can strengthen the effect of poor quality classes.

**Table1: Classification of drinking water (Neubert et al, 2008, in Saidi et al, 2009).**

| Parameters | Class I (very good) | Class II (good) | Class III (usable) | Class IV (use with caution) | Class V (harmful) |
|---|---|---|---|---|---|
| **EC (µS/cm) (à 25°C)** | 0 - 180 | 180 - 400 | 400 - 2000 | 2000 - 3000 | > 3000 |
| **Cl (mg/l)** | 0 - 25 | 25 - 200 | | | > 200 |
| **$NO_3^-$ (mg/l)** | 0 - 10 | 10 - 25 | 25 - 50 | | > 50 |
| **$SO_4^{2-}$ (mg/l)** | 0 - 25 | 25 - 250 | | | > 250 |
| **$Na^+$ (mg/l)** | 0 - 20 | 20 - 200 | | | > 200 |

The Massif of Dune Bouteldja locates at the east end of the great alluvial plain of Annaba (fig 1), it is one of the great watershed Mafragh. The dune of Bouteldja with an area of about 150 km2 is limited the north by the Mediterranean Sea, the south by the plain Bouteldja, the west by Mafragh, and to the east by the massive Cap Rosa.

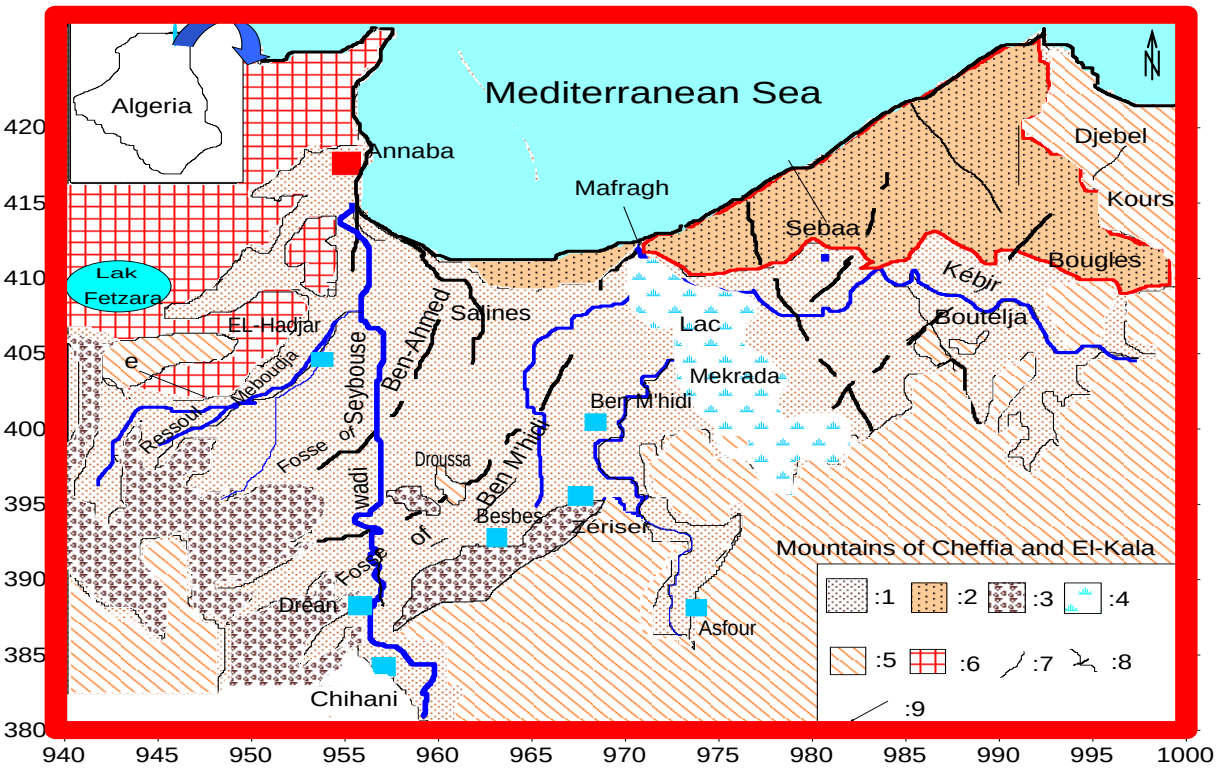


Figure 1: Geological map of the plains region of Annaba Bouteldja (after Strojexport, 1975 changed Attoui B, 2010.).

Legend: 1: current and recent alluvium, 2: Dunes, 3 old alluvium, 4: Swamp or lake, 5: Sandstone and Numidian clay 6: Training metamorphic 7: Fault; 8: Axis pits.

According Joleaud, 1936; Hilly, 1962; Vila, 1980; Lahondère 1987; Gleizes, 1988; Hammor, 1992, there are two types of terrain : one metamorphic (cristallophylien) Primary age presented by the Massif of the Edough in the West, and the other sedimentary age (Tertiary to Quaternary) occupying almost the totality of the plain. This last one is the seat of permeable formations aquifers that constitute important water reservoirs **(Fig. 1)**, forming the aquifer of Annaba (deep and shallow aquifer) and the aquifers El-Tarf (dunes of El-Chatt, massive dune of Bouteldja).

The climatic point of view, the region of study counts among regions the most watered in Algeria. It is subject to a Mediterranean climate -- mild and wet winters and hot, dry summer. The average annual rainfall varies between 817 mm and 594 mm, with an average temperature of about 18 ° C and the values of evapotranspiration range from 581. mm / yr and 485 mm / year.

## 2 RESULTS AND DISCUSSIONS

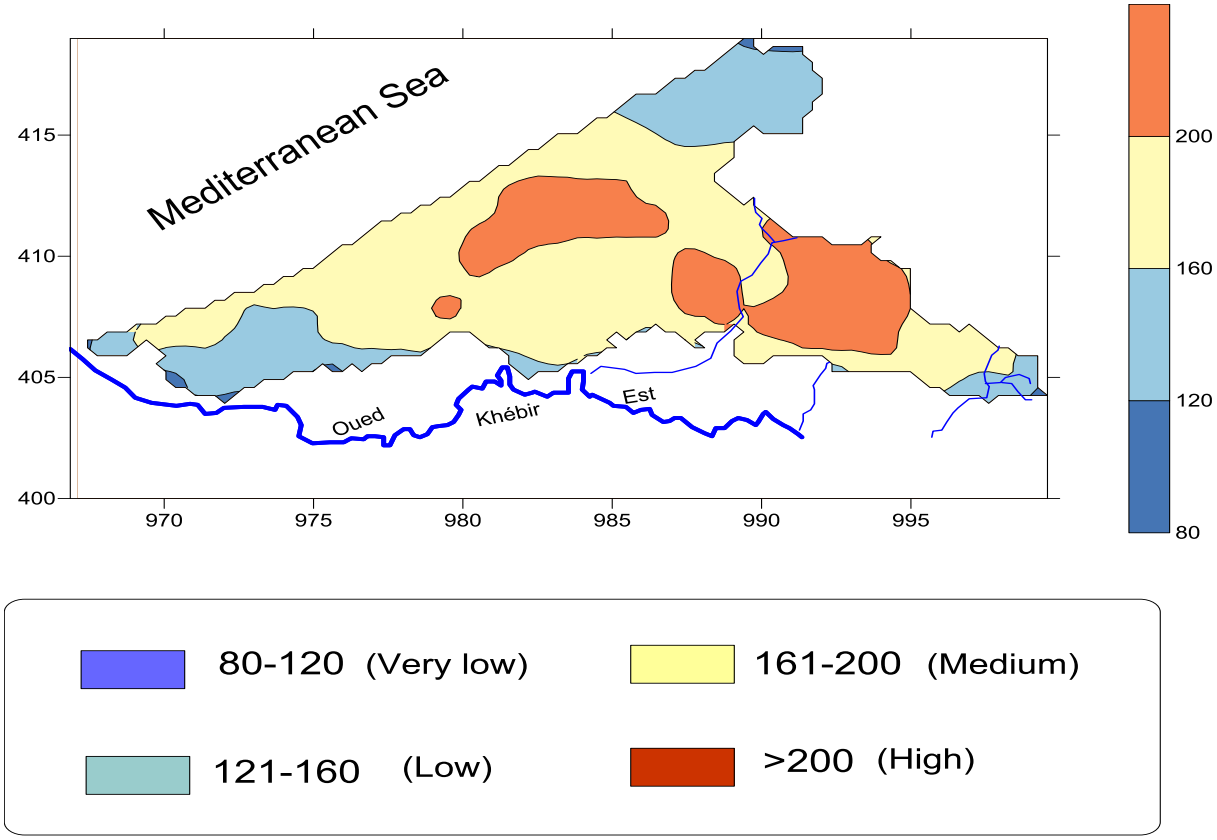


**Figure 02: Map of water vulnerability of groundwater Massif Bouteldja of Dune (DRASTIC) (Khadraoui, S, 2011)**

Identification of hydrogeological units and comment of the vulnerability map

The different hydrogeological units are illustrated in the map of final vulnerability (Fig.03) which reflects the outcome of main work carried:

The vulnerability map, allows to distinguish four hydrogeological units of different scales of vulnerability:

• 3-17A hydrogeological Unit (90à130).

This unit is characterized by low vulnerability and by the presence of a limono-sandy

coverage has clayey, resting on clays, the predominance clays in overburden (soil and the unsaturated zone) limits the risk of l ' infiltration of pollutants towards the groundwater.

This unit which occupies the entire plain of Bouteldja, presents depths of water between 25 and 75m from the soil surface.

• 3-17B hydrogeological Unit (130-170)

It corresponds an area has average vulnerability with a limono-sandy coverage, clayey, resting on argillaceous formations, limono-clayey and clayey sands. The depth of the web is variable. It reaches the 65m in the West party for study area. This second unit occupies the central part of the study area

• 3-17C hydrogeological Unit (170-210)

It presents a has vulnerability area high with a sandy aquifer, clayey and gravelly, with a sandblaster coverage.

The predominance of sandy fractions in these overburden facilitates recharging the tablecloth which is equal to 34%. All these parameters promote infiltration of pollutants to groundwater of the massif dune, where the roof of the tablecloth lies between 10 and 60m in the western part and she does not exceed the 15m in the Eastern part of the massif dune.

• 3-17D hydrogeological Unit (+210)

This unit occupies almost North-East part of dune massif presenting a sandblaster coverage, sandy loam with an aquifer formed by gravel, sand and clay and a non saturated clay type sand area. The depth of the web is weak, she does not exceed the 5m. The predominance of with high terrain proportion sands and a Shallow depth of the tablecloth define a zone of very high vulnerability.

The index of the quality of irrigation water (irrigation IQ) and the index of the quality of water for AEP (AEP IQ) are calculated using the data of chemical analyzes of the season dry (High Water, April 2012), the period of flooding affecting the region dropped after the dams (and Bounamoussa Mexa).

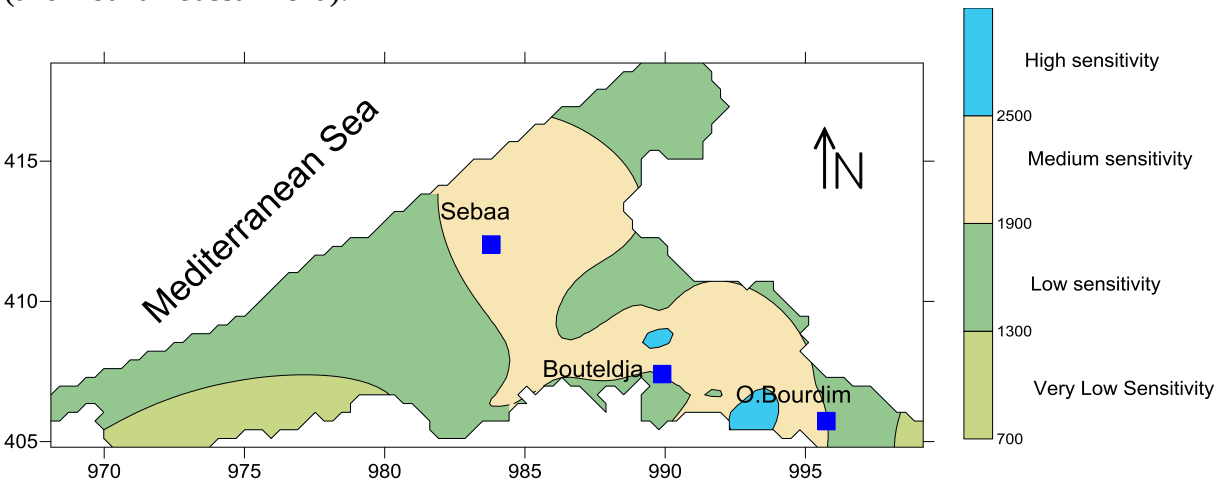


**Fig.03: Map of the sensitivity index of water for AEP groundwater Massif Dune**

From Figure 3, the water for the AEP are characterized, in most of the study area, with a very high sensitivity. Areas indicating high sensitivity are summarized in a small area in northwestern to O.Bourdim, because of intense agricultural activities and domesticated against regions characterized by low sensitivity are located far from urban

## 3 CONCLUSIONS

The combination of the DRASTIC model and indexing water quality method helped compile the hydrogeological and hydrochemical data based on a numerical rating, integrating GIS. A sensitivity map is developed, the result of crossing two methods, the sensitivity map of water intended for potable water. The comparison of the results leads to the conclusion that not only the indexing method identifies the existence of water pollution but is also a valuable aid to decision-making in the fields of hydraulics and the environment

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