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Hydrogeological Study for Mulussa Aquifer Between Rutba and Dhabaa-West of Iraq

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Abstract

The study area is located at Al Rutba city, in Al-Anbar Governorate, western Iraq. It is located between 3653442.86 m and 3659709.33 m to the north and 617632.76 m and 643771.85 m to the east. The total area is expanded over about 174.87 Km^2 with an elevation of (585–645 m a.s.l.). According to metrological data the total annual rainfall was 113.3 mm and relative humidity was 47.1 %, while monthly average temperature was 20.1 °C, evaporation was 3074.3 mm, wind speed was 2.6 m/s and sunshine duration was 9.2 h/day. Climate of the study area is described as an arid and relatively hot in summer, and cold with low rain in winter. During the 36 years' comparison period, water surplus was recorded in the study area was 19.849 % of the total rainfall. The value of groundwater recharge was 22.489 mm with a rate of 19.849% which represents the percentage of groundwater recharge from the total rainfall.

The groundwater moves in directions of (NE, E and SE) influenced by depletion process in the amount of hydraulic gradient ranged between (0.0000416 - 0.008036). The groundwater flux and groundwater pore velocity are reached (0.00451) m/day and (25.02) m/day, respectively. Mulussa aquifer is carbonate beds, where represents confined aquifer conditions. The values of transmissivity, permeability and storage coefficient are ranged between (0.507 – 250) m^2/day, (0.00547 - 3.05) m/day and (9.65×10^{-5} - 2.64×10^{-4}) respectively. While the estimated of transmissivities which are obtained from specific capacity ranged (208.041 – 862.166) m^2/day. This variation in the values revealing the great variations in the aquifer lithology, which was affected by intensity and the number of fractures and joints.

The concentration of ions of groundwater samples for the wet period are lower than the dry period due to the dilution process, according to the TDS

values the groundwater in the study area has classified as fresh to slightly water and the hardness of water is hard to very hard. The results show that the groundwater of the study area is unpolluted with trace elements such as (Fe, Mn, Pb, Cd and Zn).

The most prevalent water type is calcium bicarbonate $Ca(HCO_3)_2$ and the second prevailing type is calcium sulfate $CaSO_4$ while the calcium chloride $CaCl_2$ is a lower rate in the study area. The groundwater in the study area is suitable for drinking water, livestock, building and agricultural purposes, but it's unsuitable for industrial purposes.

The HWQI for all groundwater samples in two periods are (<50) and indicate that all groundwater samples are excellent water for human drinking, except (W-17, W-18 and W-20) in dry period and (W-17) in wet period have a raise very little about class I, which mean that the wells are good water for human drinking

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List of Symbols and Abbreviations

Abbreviation	Description
3D	Three-dimensional
A	Area
A %	Accuracy or Certainty
AI	Aridity index
APE	Actual Potential Evapotranspiration
BDL	Below Detection Level
CN	Curve Number
E	Evaporation
EC	Electrical Conductivity
epm	Equivalent per million
FAO	Food and Agriculture Organization
Fig.	Figure
GEOSURV	The State Company for Geological Survey and Mining
GIS	Geographic Information System
GPS	Geographic positioning system
H.I	Humidity index
HWQI	Human drinking Water Quality Index
I	Hydraulic gradient
IMO	Iraqi Meteorological Organization
IQS	Iraqi standards

K	Hydraulic Conductivity
KH	Key Hole
KI	Kelly Index
km	Kilometer
m	Meter
m a.s.l.	Meter above sea level
meq/l	milli-equivalents per liter
Na%	Soluble sodium percentage
NRCS	Natural Resources Conservation Service
O.S.W.	Ordinary sea water
Ob.	Observation well
P	Rainfall
P.L.	Piezometric levels
PE	Potential evapotranspiration
PEc	Correct evapotranspiration
pH	Hydrogen Number
PI	Permeability Index
ppm	part per million
Q	Discharge
qi	quality rating
Re	Groundwater recharge
RH%	Relative Humidity
Rs	Runoff
RSC	Residual Sodium Carbonate
S	Storage coefficient
SAR	Sodium Adsorption Ratio
Sc	Specific capacity
SCS	Soil Conservation Service Method

SIi	Index of the parameter
SL	Sea Level
Sw	Drawdown
T	Transmissivity
T ^{0}C	Temperature in centigrade degree
TCS	Total Calculated Solids
TDS	Total Dissolved Solids
TDSc	Calculated total dissolve solids
TH	Total Hardness
TSc	Transmissivity from specific capacity
U	Groundwater pore velocity
USDA	United States Department of Agriculture
USSL	United States Salinity Laboratory
V	Groundwater flux
W-1,W-2 ...etc.	Well number one, two … etc.
WD	Water Deficit
WHO	World Health organization
Wi	Parameter's relative weight
WQI	Water Quality Index
Wr	Relative weight
WS	Water Surplus