

Possible effects of changing groundwater level and chemistry on building foundation of Al Shuiaba residential district Al-Ain city UAE (case study)

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... Towards Efficient
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Oman

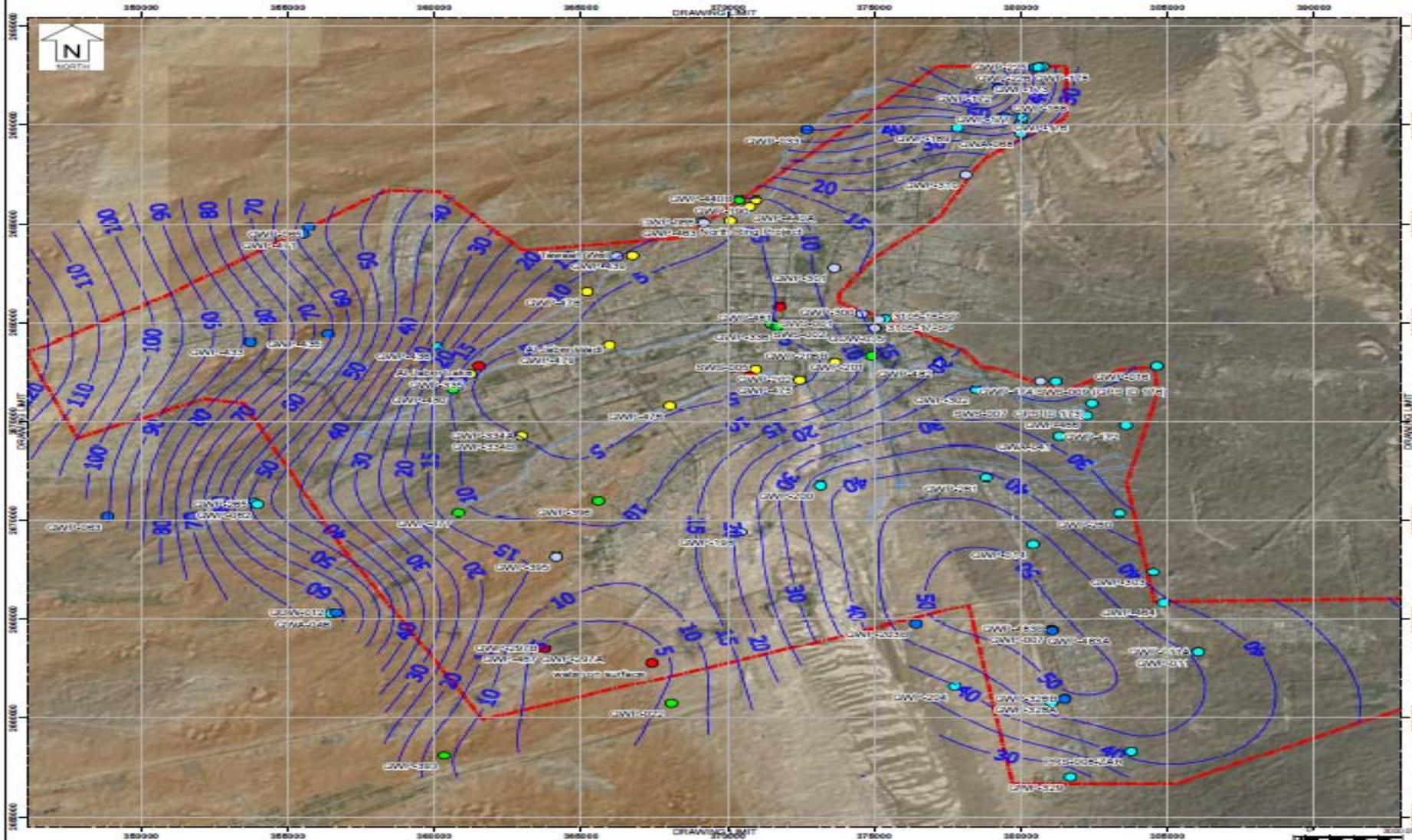
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Presentation outline

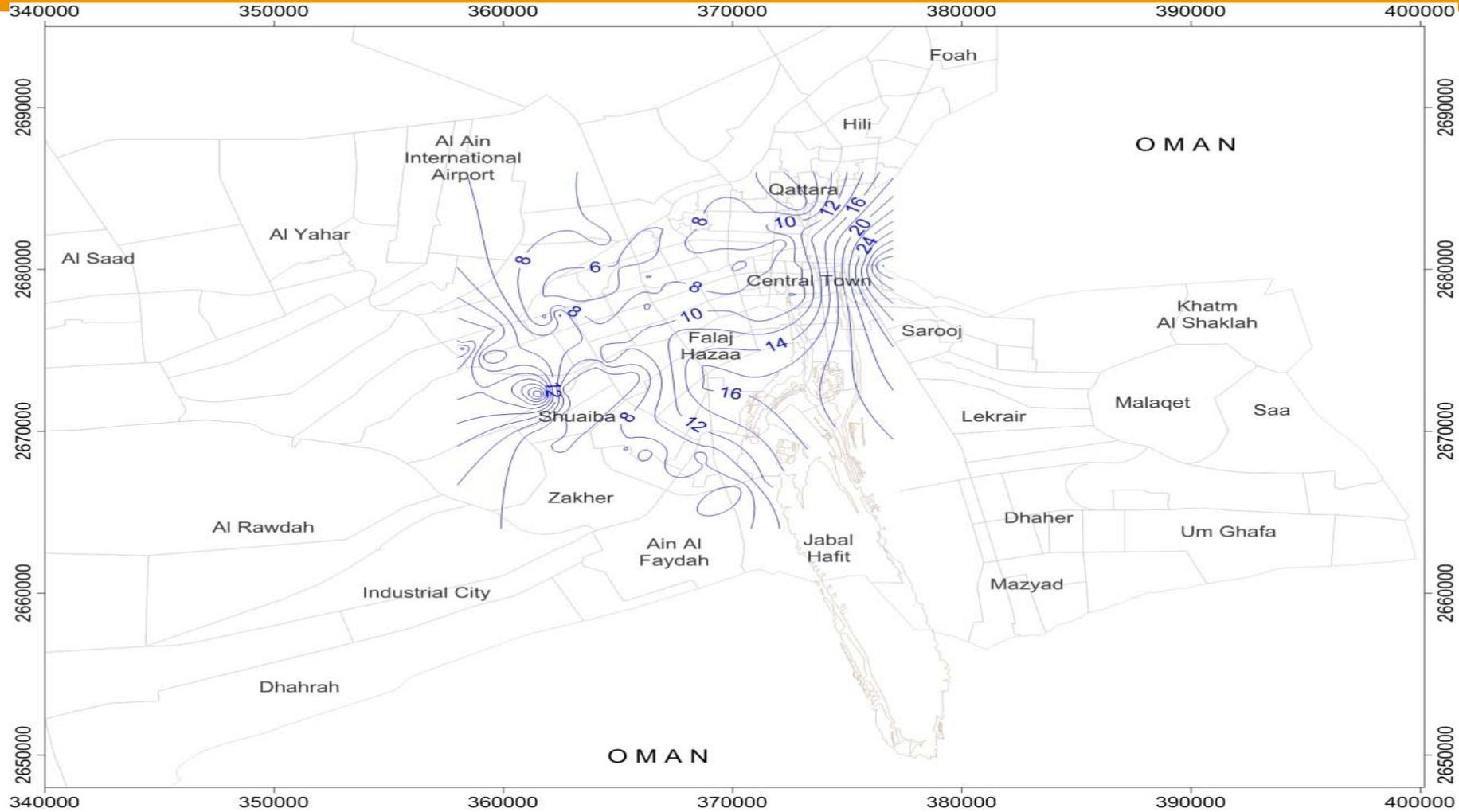
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Introduction:

- Al Ain City is rapidly expanding which is accompanied by *enormous water consumption* part of it *ends into the groundwater*.
- Accordingly, groundwater regime (Level and quality) in al Ain City was changing through time. *as shown in figs schluberger.*
- In some specific areas such as the one studied here the effects were sever leading to flooding of basements in many houses associated with damage of the buildings.
- In order to investigate the sources and causes of the problem a study of hydrogeological conditions of the area was conducted and is presented herein.



Depth to water level; after Schlumberger 2010



Al-Ain City is currently a site of intensive urbanization and expansion among the surrounding cities.



The urbanization is happening in infrastructure residential, tourism, cultivation, industry, environment and landscaping.



Thermal dumped water from Al Mubazara groundwater wells.



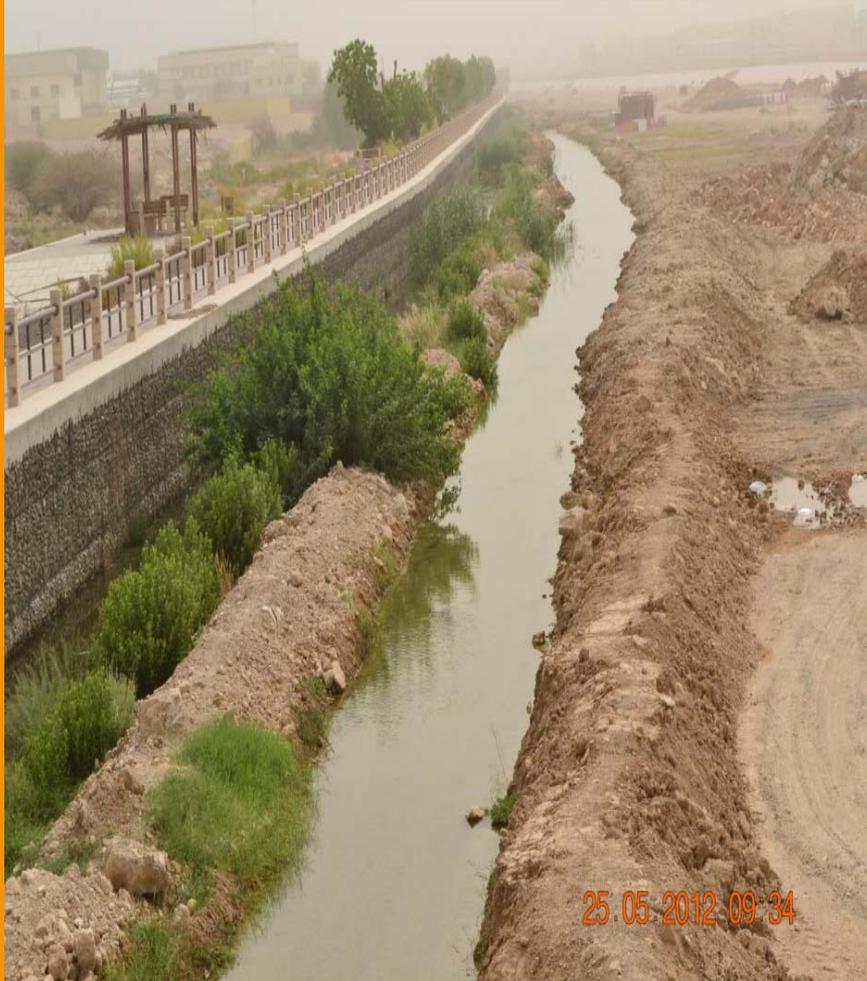
Seasonal surface Water



Ain Al Fydah thermal springs



Water dumping along a surface canal



Dewatering for infrastructure projects



Landscaping



Irrigation

Addition of domestic water ,gardening, sewerage will change groundwater quality and even groundwater level.



Problem statement:

- **Differential effect of rising water level in a residential area where adjacent houses within *50-100m* apart were flooded.**

Expected causes :

- **Existence of restricted permeable paleowadi channels substrata below the influenced buildings associated with extensive water use.**

Changing GWL & quality will impact foundations



Perched GWL

SOIL sampling site where groundwater is just a few meters from the surface



Uplift of water level and salinization problem in the adjacent building

Evaporation of near surface groundwater and precipitation of gypsum and calcite



Flooding of groundwater in a basement

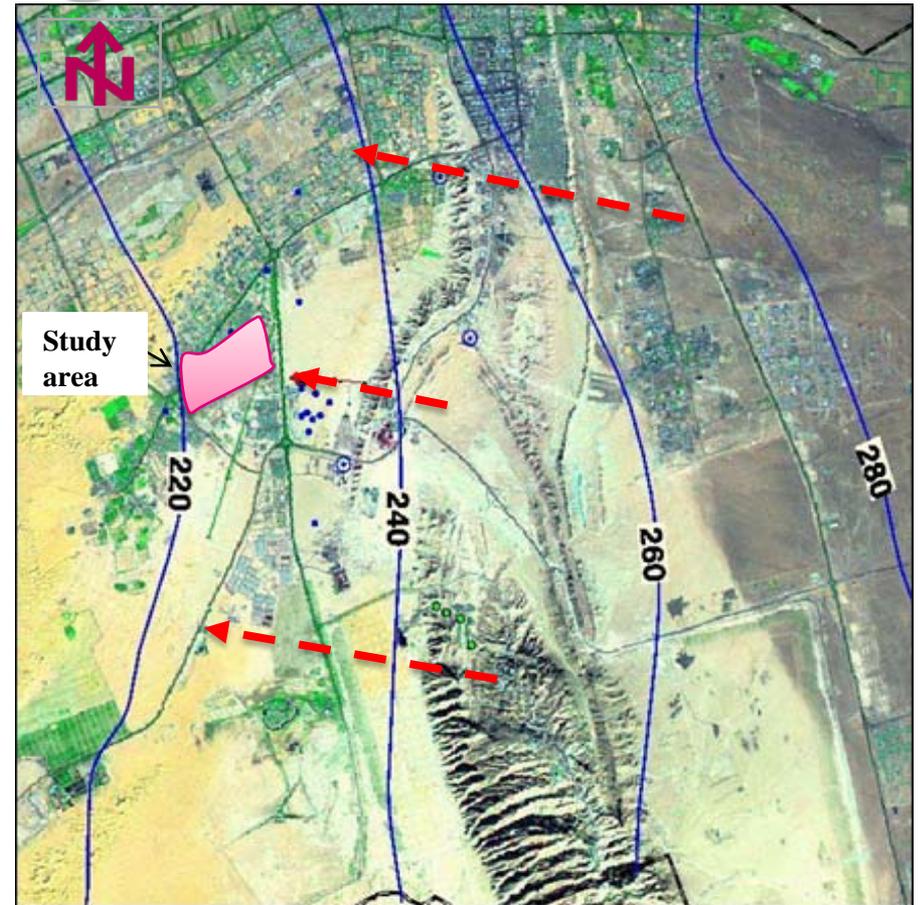


Study Objectives:

- **Construct accurate depth to water level contour map**
- **Linking water flow to the structure of the paleowadi channels**
- **Evaluation of groundwater physiochemical conditions with respect to impact on the houses structure and possible solution of the problems.**

Hydrogeological Setting:

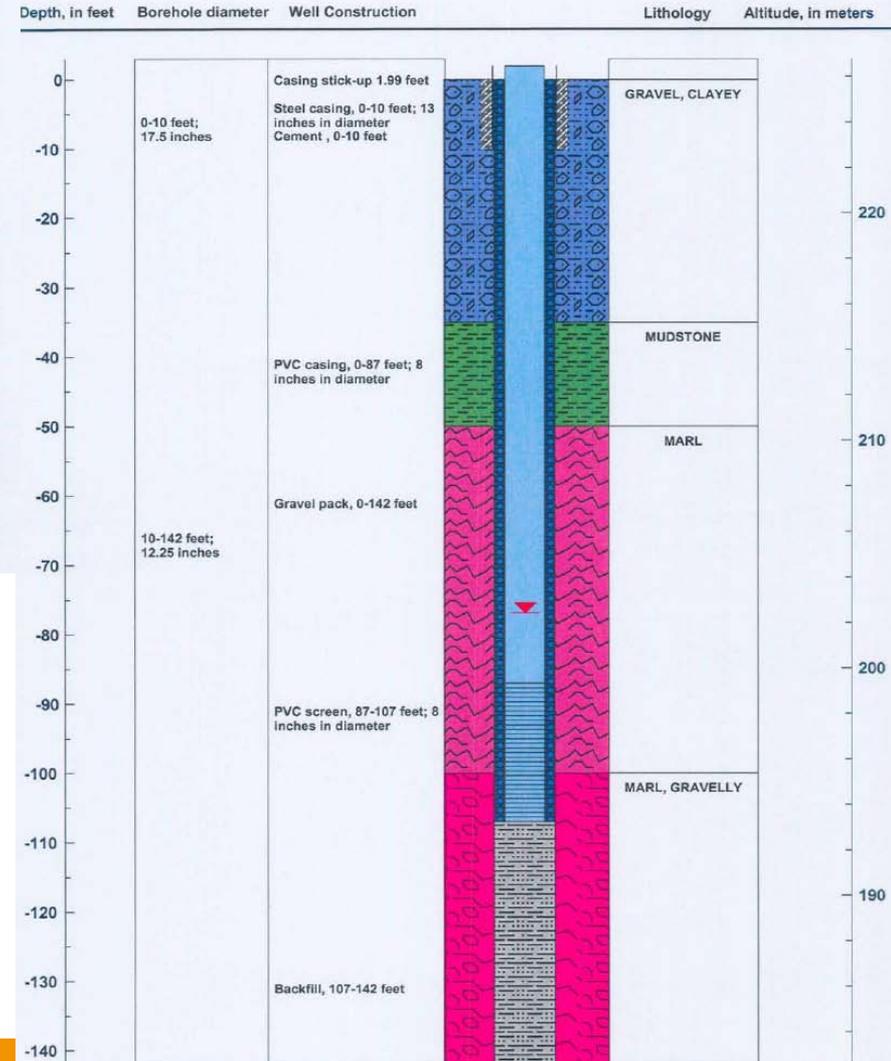
- Arid climate and rainfall about *64 mm/year*.
- Aquifers are Quaternary fluvial deposits, carbonates and argillaceous rocks with transmissivity and hydraulic conductivity as low as *100 m²/d* and *5 meter/day* respectively.
- This path can affect the Groundwater level in the study area.

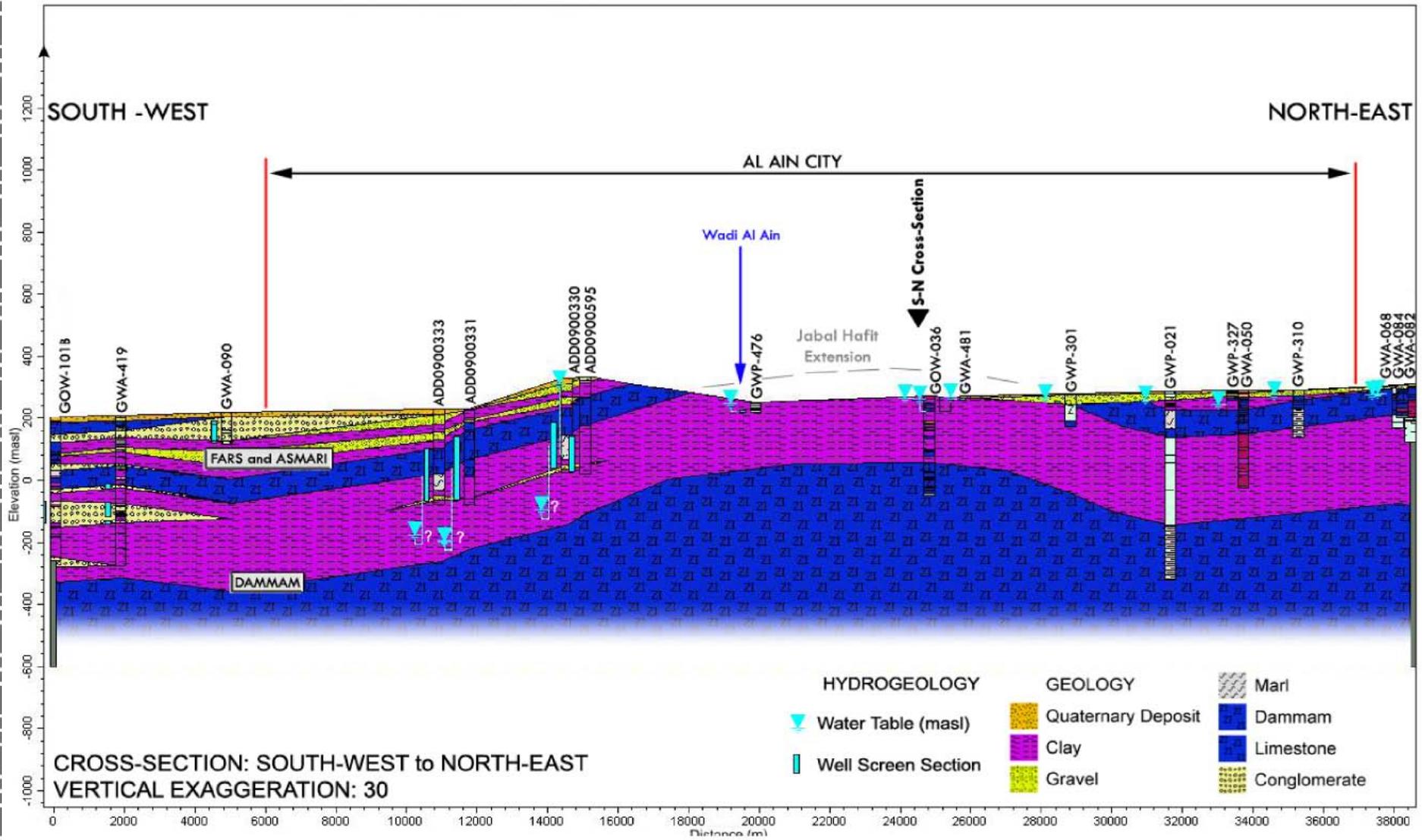




Depth to Base (feet)	Description of Lithology
30	Gravel, clayey
50	Mudstone, reddish brown
100	Marl
142	Marl, gravelly

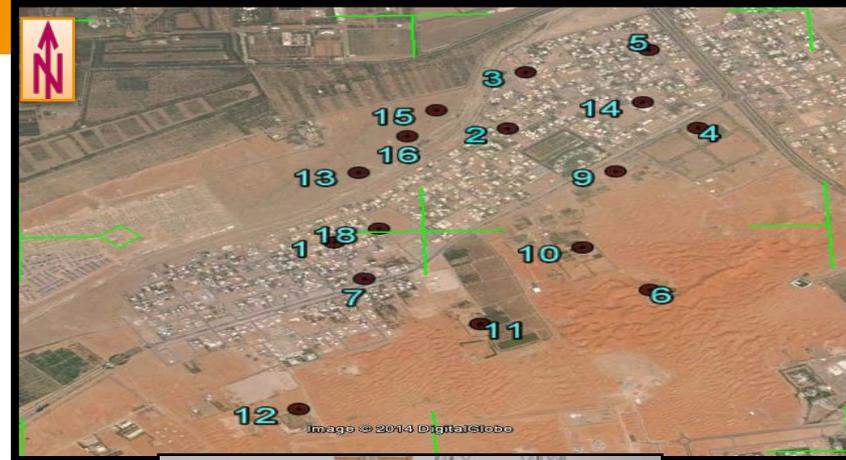
GWP-477
WELL LOG AND CONSTRUCTION





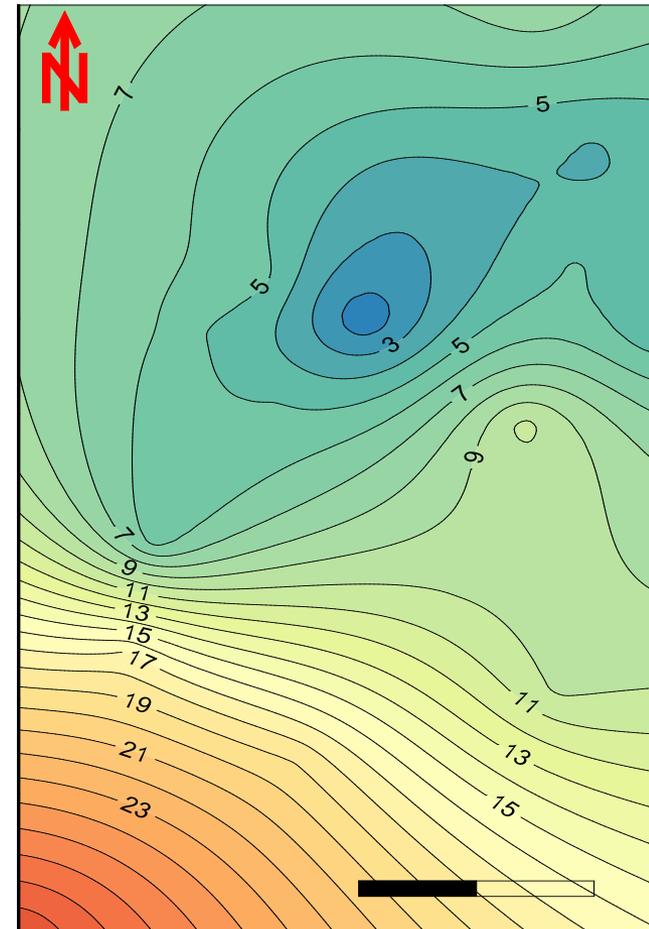
Methodology:

- Sixteen wells were accessible for measuring groundwater level as well as twelve wells were valid for collecting water samples for chemical analyses.
- In-situ field measurements of pH, temperature, EC and TDS were performed.

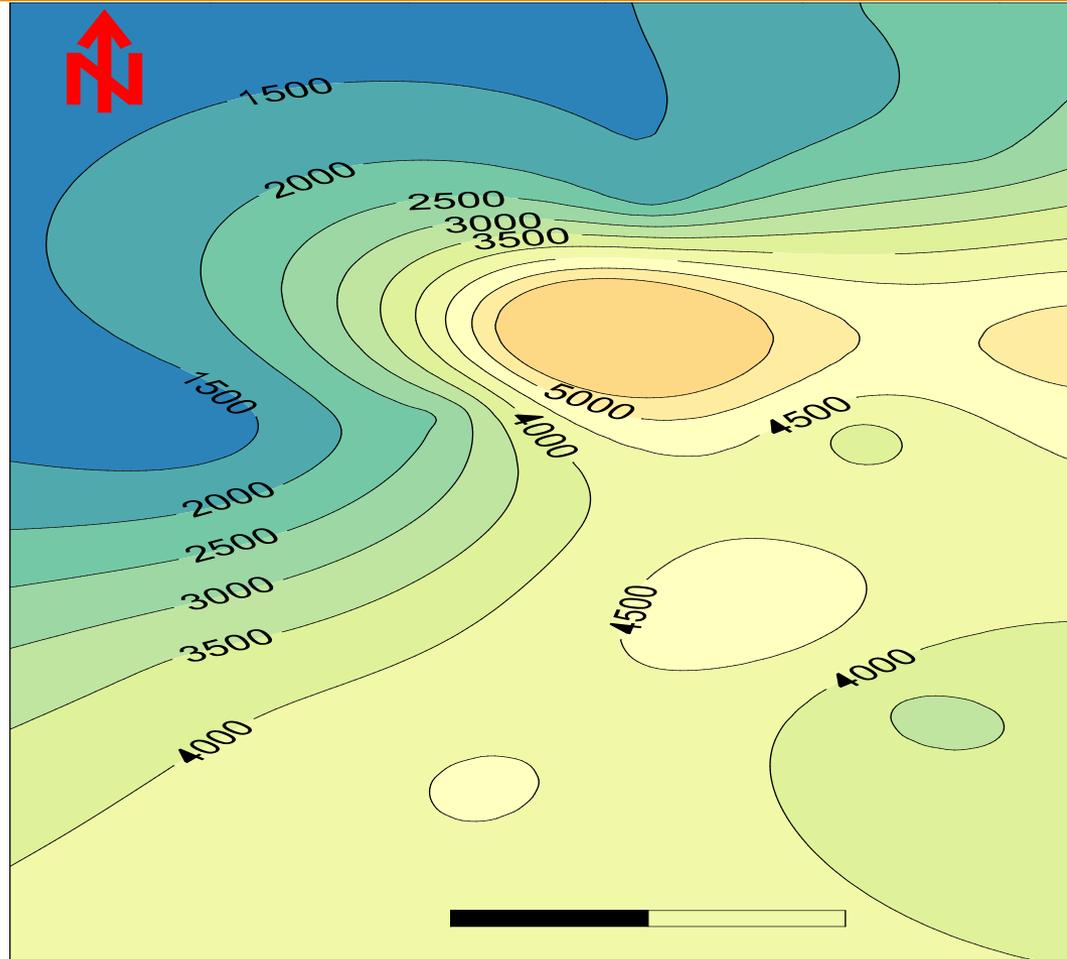


Results and Discussions:

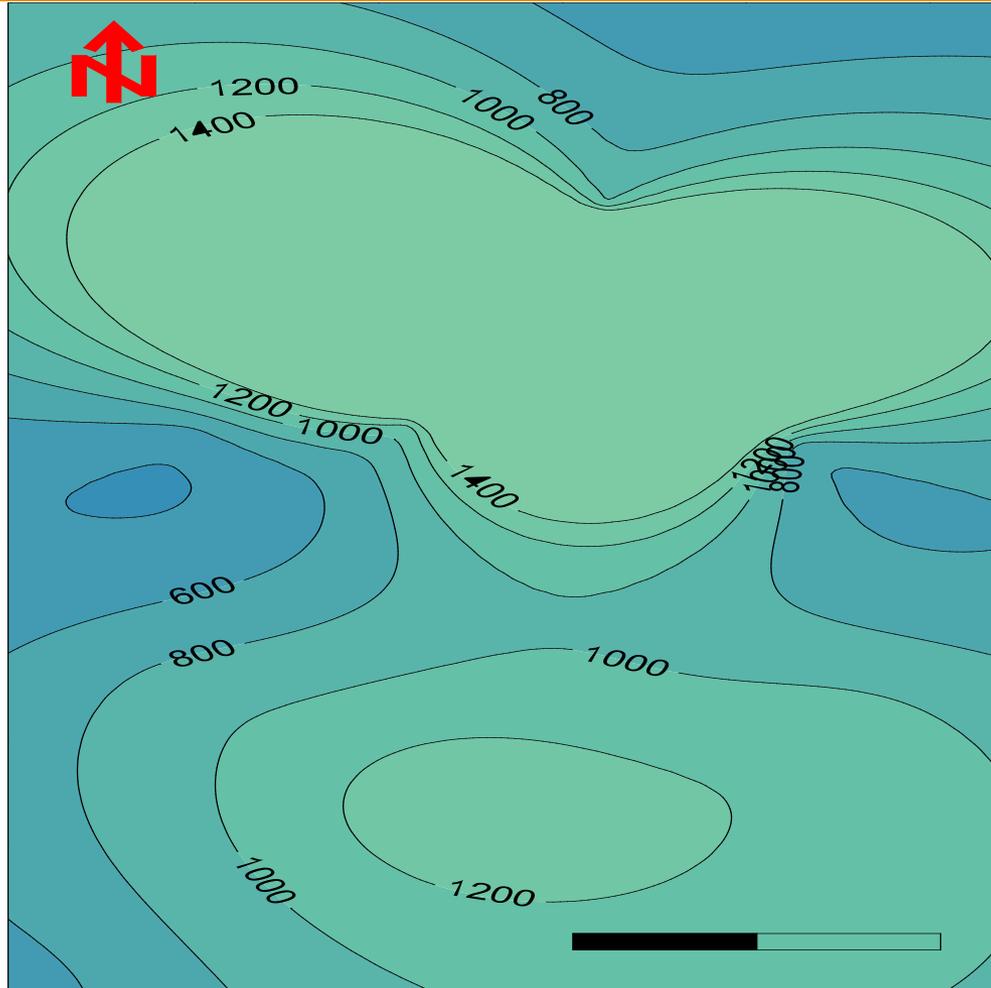
- **WL varies from <10m to > 25 m.**
- **As a result of water level decreases there was increase in the ionic concentration at the same zone.**



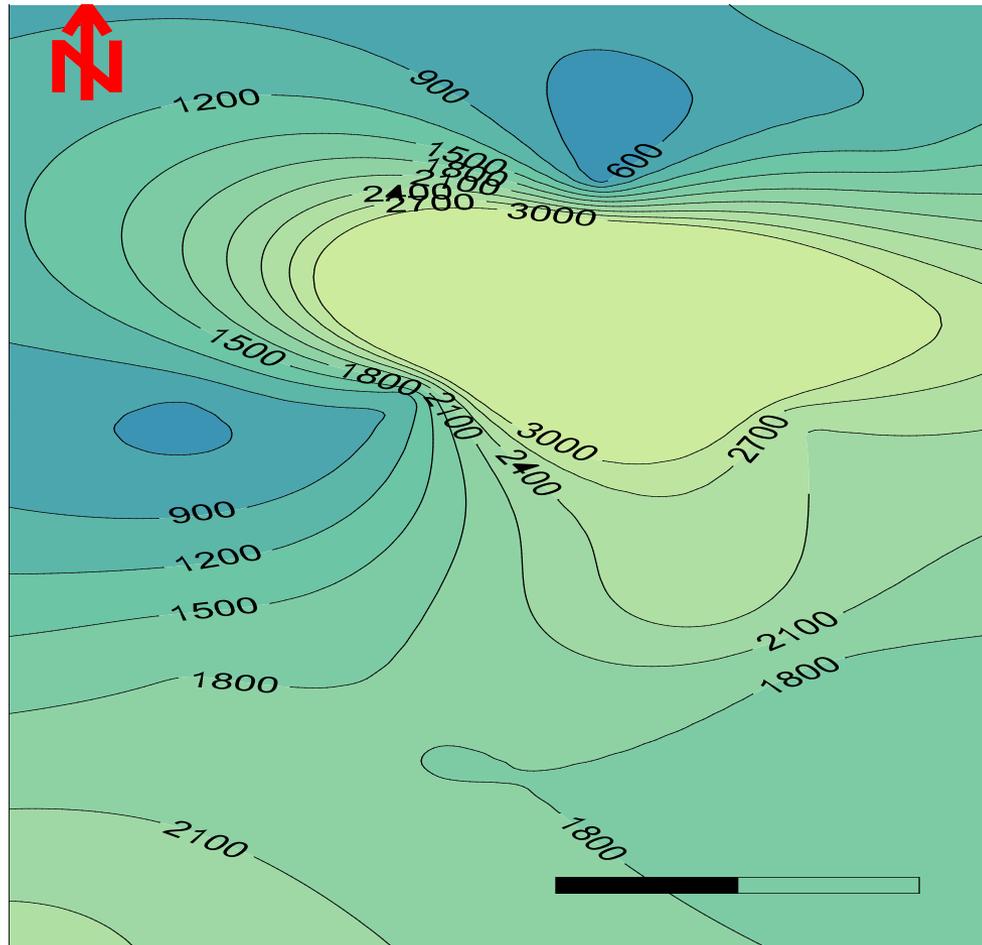
Water level depth contour map



TDS distribution contour map

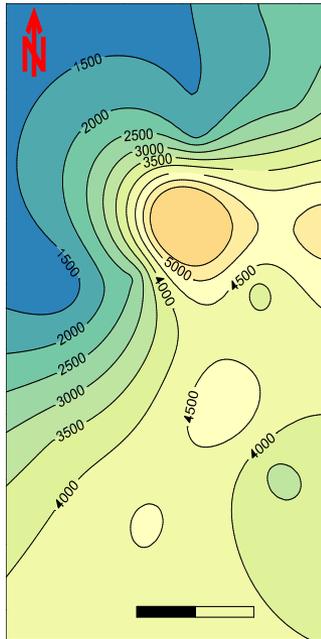


SO_4 distribution contour map

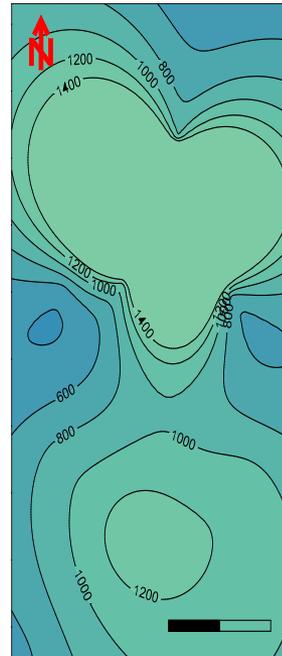


Cl distribution contour map

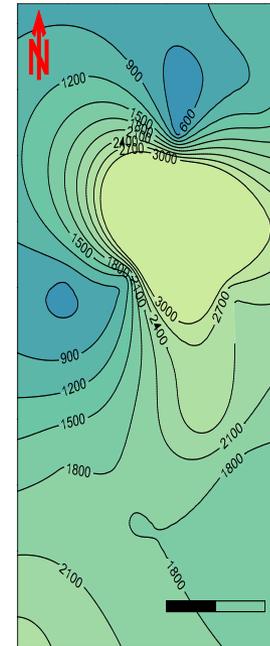
TDS, SO₄ and Cl reveal a relative consistency with water level lift.



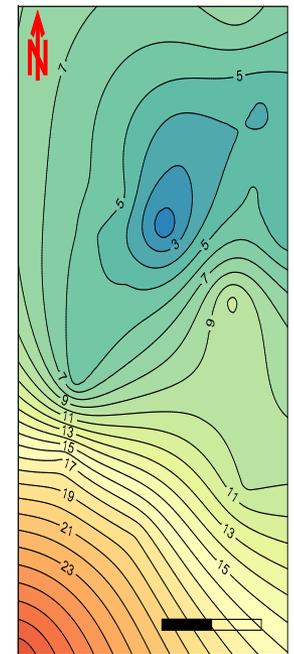
TDS distribution contour map



SO₄-2 distribution contour map



Cl- distribution contour map



Water level depth contour map

Reasons for coincidence of water level and chemical parameters are:

- **Salt enrichment due to slow drainage and retention of groundwater at shallow level.**
- **Confining in the groundwater flow pattern to restricted gravel (Paleowadi channels).**
- **Extensive landscaping and farm irrigation enhance the recharge to the area.**

Conclusions

- **Differential flooding of houses was caused by rising groundwater level at specific geologic conduits.**
- **Slow rate of infiltration through the substrata contributed the water level rise.**
- **Serious problems to the foundation of the buildings within the area due to high salinity associated with water level decrease .**
- **Concentrations Na, SO₄ and Cl ions are within the moderate to severe attack limits on concrete set by the American Concrete Institute (ACI).**

Recommendations:

- **Periodic monitoring of groundwater level and chemistry .**
- **Detailed investigation of mechanical, textural and mineralogical properties of the soil package and relationship to the engineering aspects.**

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Hafit Fountain

Thank You