Potential Danger for Northeast Oklahoma Aquifers?

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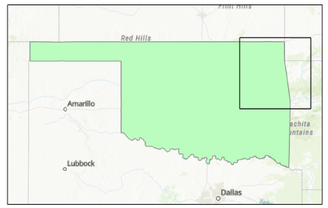
Abstract

Currently, over 1,400 households use the Roubidoux Aquifer in Northeastern Oklahoma as their main source of drinking water. Additionally, the total water demand is projected to increase 56% from 2010 to 2060. This increase in water demand is concerning due to the Boone and Roubidoux aquifers being highly susceptible to surface contamination, containing elements such as lead and zinc, from the Tar Creek superfund site located (TCSS) in Picher, OK. This study seeks to determine, using spatial analysis tools in GIS, the contamination susceptibility of the Boone and Roubidoux aquifer recharge zones as a result of direct surface contaminants and processes that facilitate their propagation.

Background

The Tar Creek Superfund Site (TCSS), located in Picher, OK., was a former mining site within the greater Tri-State Mining District (Kansas, Missouri, Oklahoma) that extracted lead and zinc from 1850-1970. Once the mines ceased production and pumping of the mineshafts, groundwater from the Boone aquifer filled the mineshafts which chemically reacted with the residual ore to form acid mine drainage that ultimately reached the surface and eliminated most of the local biota with Tar Creek.

The Boone aquifer is a minor unconfined karst aquifer located above the Roubidoux aquifer, a confined major aquifer, in Northeastern OK. These two aquifers are important sources of water for domestic use, as well as industrial and agricultural for the Roubidoux aquifer. Thus, it is imperative to protect both aquifers from continued contamination, from areas such as TCSS, as the Boone aquifer is highly susceptible and can then transfer the hazardous chemicals to the larger Roubidoux aquifer.



Objective

To determine potential areas with a high likelihood to contaminate the Roubidoux and Boone aquifers from the Tar Creek Superfund site via the aquifers' recharge zones in Northeastern Oklahoma.

Data

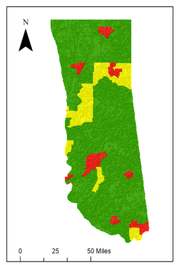
File	Source
U.S. Population	U.S. Census Bureau
Geology	USGS
Land Use	USGS
Aquifer Area	www.databasin.org
Tar Creek Superfund Site Area	EPA

Method

TCSS Layer
Aquifer Shape Layers (AQ)
Population Density Layer (POP)
Land Use Layer (LU)
Geology Layer (GE)

→ Layers GE, LU, and POP were reclassified to have three categories from 1-3 (low to high possibility for contamination)

Land Suitability Index was generated from combining layers GE, LU, and POP via the raster calculator function. The weighted percentages were 40% for GE, 40% for LU and 20% for POP.

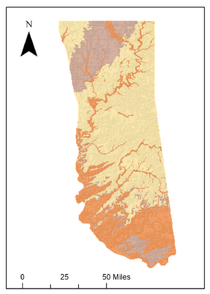


Population Density in Oklahoma, USA in Terms of Contamination Potential

Contamination Possibility
3
2
1

Land Use in Oklahoma, USA in Terms of Contamination Potential

Contamination Possibility
3
2
1



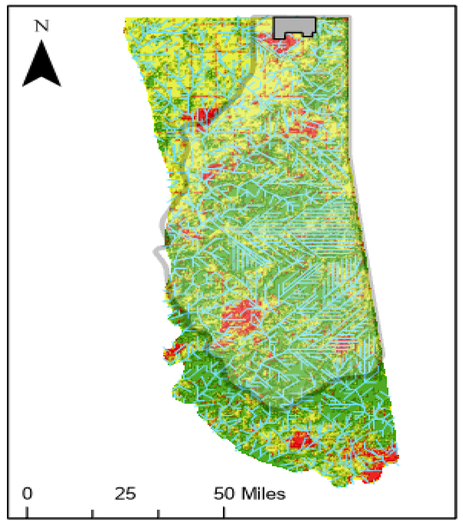
Geology in Oklahoma, USA in Terms of Contamination Potential

Contamination Possibility
3
2
1

A stream network was formed from combined DEM data that was masked to the Roubidoux aquifer shape file. Then six functions were performed sequentially to form the stream network. The functions were Fill, Flow Direction, Flow Accumulation, Stream Link, Stream Order, then Stream to Feature.

Result

Level of Contamination Possibility	Area (mi^2)	Percentage
3	464	10%
2	2087	45%
1	2087	45%



The results show that 464 sq. miles of the Boone-Roubidoux aquifer complex has a high possibility for contamination, which accounts for 10% of the total area. The majority of the aquifers' area, 90%, however falls within the medium to low contamination possibility categories. The stream network visually tells us that all the high contamination possibility areas are connected to some source of flowing water that can transfer from TCSS or other sources of contamination right to them overtime.

Conclusion

Based on the results gathered, contamination is a real possibility for the Boone and Roubidoux aquifers due to the current land use, population density, and geology. High contamination potential is low across the aquifer area, but combined with the medium potential category and the stream network a clearer picture forms. A picture of contamination to public, industrial and agricultural water supplies if more is not done to mitigate and or prevent future damages via stronger regulations, better education of the public and private sectors, as well as more funding for prevention or cleanup efforts.