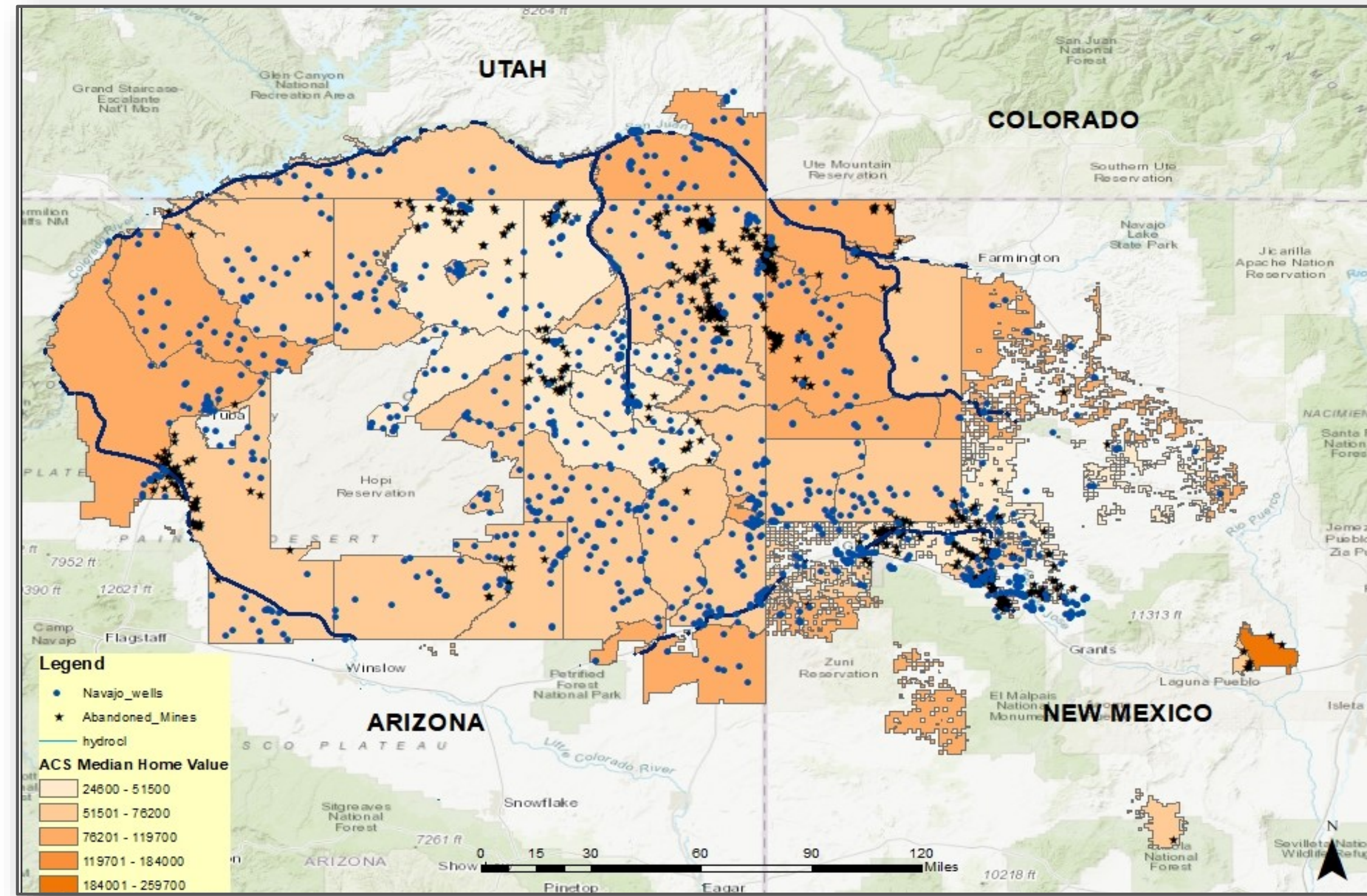


# SHOULD YOU DIG IT?

## Threats of Uranium Mining on the Navajo Nation's Water Resources

### INTRODUCTION

For years, tribal lands have been disproportionately impacted by uranium mining activity. Uranium mining has been an essential economic activity on the Navajo Nation since 1941, when manufacturing of weapons and the production of nuclear energy during the Cold War heightened (Linda, 2007). Tribal lands account for 87% of uranium mining and over 160,000 abandoned hard rock mines in western United States are located on tribal lands (Linda, 2007; Hoover, Gonzales, Shuey, Barney, & Lewis, 2007). Although most uranium mining ended in 1986, the abandoned uranium sites continue to impact communities and their water supplies.



Map 1: Abandoned Uranium Mines and Water Wells

In 1979, an earthen dam at United Nuclear Corporation at Church Rock New Mexico broke, releasing 94 million gallons of acidic and radioactive water. An estimated 1,100 tons of uranium mill spread over the reservation, contaminating Rio Puerco (Linda, 2007). Mining particularly in situ mining and nuclear waste dumping has since been banned on indigenous lands due to the threat it poses to the Navajo water resources (Linda, 2007). Approximately 30% of Navajo households lack access to a public water system thereby increasing their reliance on unregulated water sources, which are less frequently tested for chemicals such as uranium or arsenic (Hoover et al., 2007). A study by Hoover et al. (2007) on 463 unregulated water sources on the Navajo Nation found uranium in half of the water sources tested. Of the 463 samples, 3.9% of the sources exceeded uranium maximum contaminant levels (MCL). The highest amounts, where 7% of the samples exceeded uranium MCLs, were located on western section of Navajo Nation (Hoover et al., 2007). If consumed or inhaled, uranium poses health risks such as including silicosis, pneumonia, emphysema, impaired kidney function, bone cancer, and lung cancer (Brugge & Goble, 2002; EPA, 2018).

### STUDY SITE

This project is focused on the Navajo Nation which expands over 27,000 squared miles in Utah, New Mexico, and Arizona (EPA, 2014). There are over 500 abandoned uranium mines found on the Navajo Nation (EPA, 2014). Moreover, a large proportion of the population relies on unregulated water wells.

### RESEARCH QUESTIONS

The goal of this paper is to assess possible exposure of water sources to uranium contamination and map the vulnerability of populations living in close proximity to abandoned uranium mines. Using spatial analysis, I aim to answer the following questions: Which water sources and populations on the Navajo Nation are at highest risk of uranium contamination? Does risk vary across median housing value and median household income?

### DATA DESCRIPTION

Data (both raster and vector) were retrieved from:

- Environmental Protection Agency (EPA)'s compiled database of abandoned uranium mines from Colorado, New Mexico, Utah, and Arizona.
- GIS online data on wells on the Navajo Nation,
- USGS Data on Elevation and Land Use Cover, and
- U.S. Census Data and Tribal Census Tracts Data

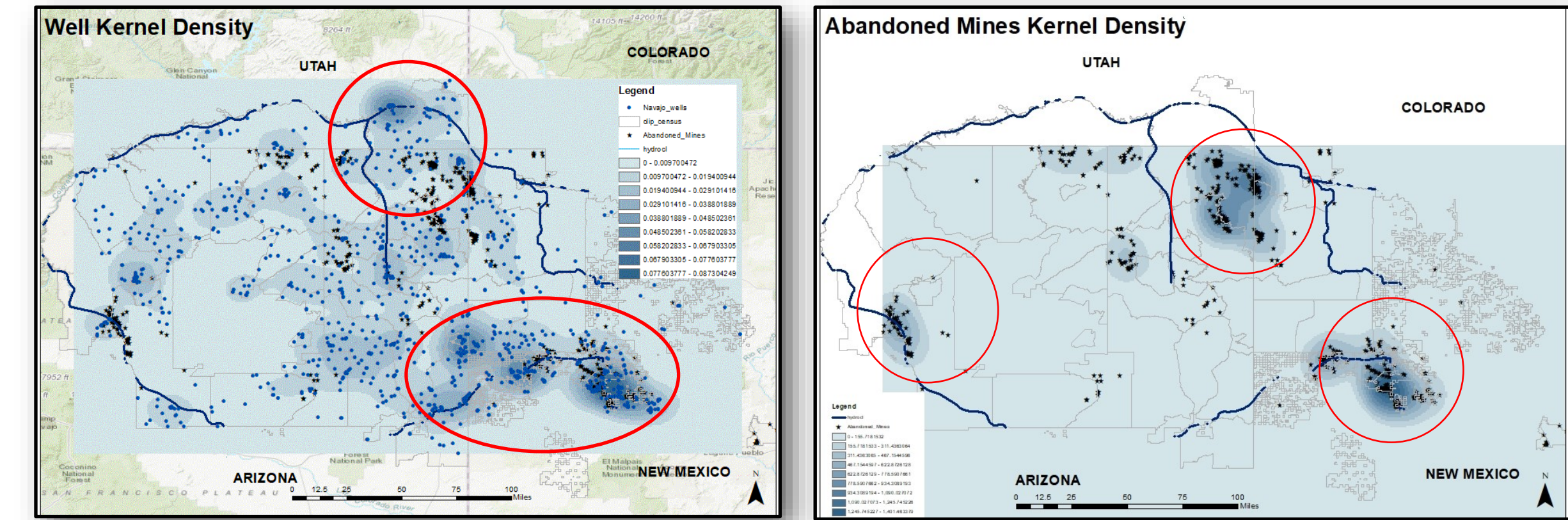
Map 1 shows abandoned uranium mines and wells used for domestic and municipal purposes. Wells used for agriculture and other purposes were excluded in the analysis. Additionally, data sources were all converted to shapefiles in GCS NA 1983 coordinate system to ensure ease of spatial analysis.

### METHODOLOGY

- I used the Extract by mask tool and carried out a hydrology analysis to determine flow direction of water from mines. Rainfall and runoff from mines located at a higher elevation would be more harmful to wells and water sources at lower elevations.
- I performed proximity analysis using the buffer tool to investigate how many wells are located within a 3-mile radius from uranium mines, and what water sources, using the near tool, are within a 3-mile distance from uranium mines.
- I attempted a vulnerability assessment of locations that could be impacted by uranium contamination. The vulnerability index consisted of land use cover (1-important use to 3; east important), mine density (1-least dense to 9-most dense), and elevation (1-lowest point to 9-highest point). Lower scores represented areas that are at less risk of uranium contamination, while higher scores depicted areas at higher contamination risk.

### RESULTS

Three locations in particular (indicated on maps 2 to 7) have high density of abandoned uranium mines, indicated on density map. Mines were primarily concentrated in areas with shrub, evergreen forests, and grassland/herbaceous land cover. These areas are also watersheds to



Maps 6 and 7 above in order: Well kernel density map and abandoned mine kernel map

rivers and creeks including Rio San Jose in the southwest corner of the Nation. Interestingly, there was a high density of wells in locations with a high density of abandoned mines. This suggests municipal and domestic water wells are at risk of uranium contamination. Mines were also located in areas of lower median household income and lower median home values, suggesting disparity of economic class and mine location.

### DISCUSSION

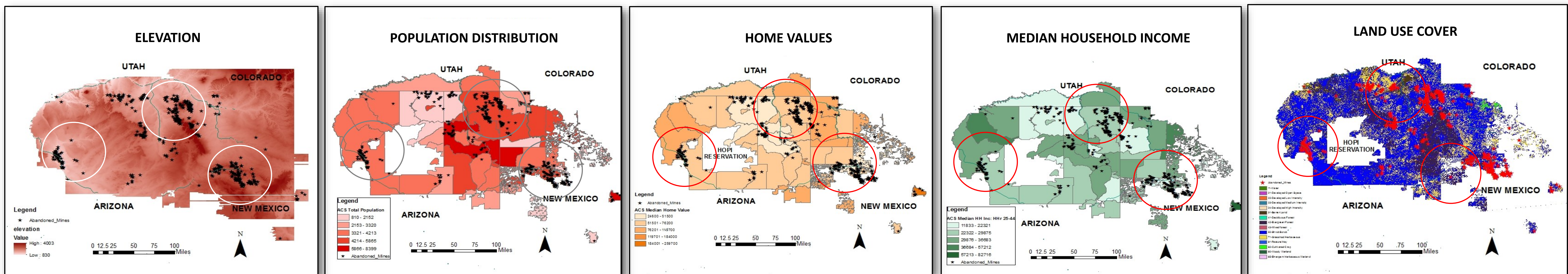
Navajo lands have long suffered health risks due to the extensive mining of radioactive material and limited water infrastructure coverage, which encourages dependence on unregulated water sources. The abundance of abandoned uranium mines and spread of water wells across the Navajo Nation illustrate environmental injustice in access to safe water. While this paper highlights possible uranium contamination, it is important to note that uranium mines also have high concentrations of arsenic. Therefore, Navajo populations and surrounding communities are at risk of multiple metal contaminants.

### CONCLUSION

This paper postulates that uranium is a threat to health on the Navajo Nation. It also pushes for stronger policy and government involvement in ensuring access to safe water through increasing water infrastructure expense and education outreach. Communities that are well informed of the risks of their water sources will be better equipped with what steps to take to ensure their water is safe. The main limitation to this study was the dearth of data, particularly contamination data. Moreover, multiple parties are collecting data without coordination and collaboration; therefore, data access is taxing. Regardless, this paper commends the increased efforts in mapping risk and reclaiming mines to ensure safer communities on the Navajo Nation.

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- NR: Data on abandoned uranium mines was retrieved from the EPA database constituting information from the Colorado Abandoned Mine Inventory, Colorado Abandoned Mine Land Database, BRASSCAP, Utah Abandoned Mine Land Inventory, Utah Abandoned Mine Reclamation Database, Navajo Lands Project, State of Arizona, New Mexico Mines Database, and the Bureau of Land Management.



Maps 2-5 below in order: Elevation Map, Population distribution (count not density), Median home values (2010 data), Median household income (in US\$), Land Use Cover