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Drinking Water Equity in New Mexico: Access, Quality and Affordability

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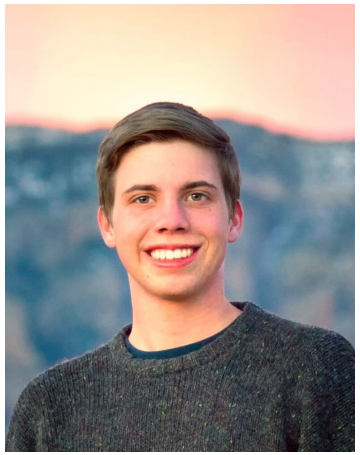
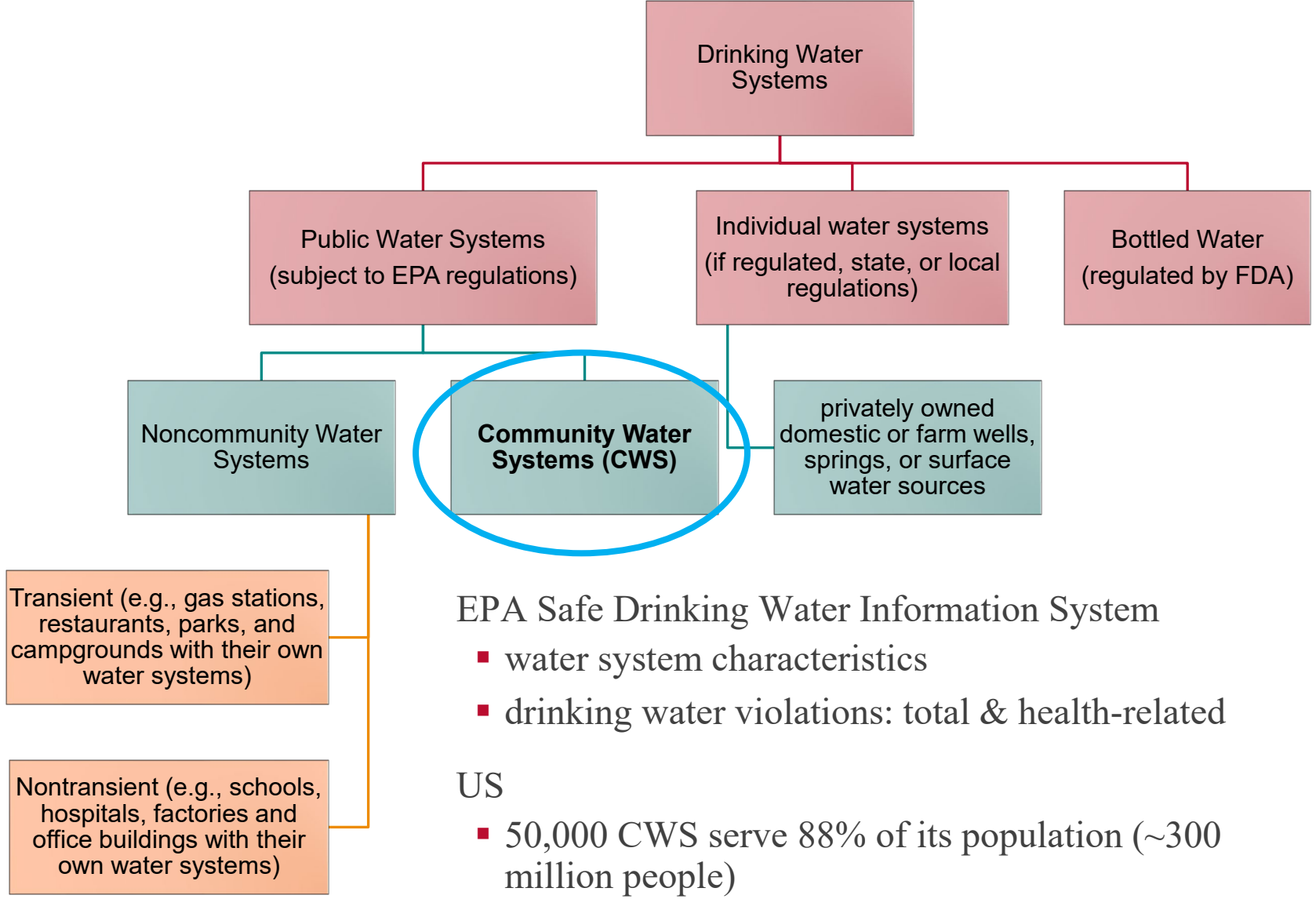


Introduction

Drinking Water Systems in the US & NM



EPA Safe Drinking Water Information System

- water system characteristics
- drinking water violations: total & health-related

US

- 50,000 CWS serve 88% of its population (~300 million people)

NM

- 563 active CWS serve 95% of New Mexicans (~2.02 million people)

Reference: https://archive.cdc.gov/www_cdc_gov/healthywater/surveillance/drinking-water-reg-history.html

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Study Overview

Three Sub-Studies

- Part I: Public Drinking Water Access and Violations in New Mexico
  - Statewide public water systems on non-Tribal lands
- Part II: Public Drinking Water Violations on Tribal Lands in New Mexico
- Part III: Urban Drinking Water Equity: A Case Study of Albuquerque

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Study Overview

Objectives, data, and methods

- **Part I: Public Drinking Water Access and Violations in New Mexico**
  - To identify spatial areas of concern & explore correlated factors with total and health-based drinking water violations
  - 2013-2023 annual data at the CWS level: CWS violation reports, CWS service areas, community characteristics
  - Geographic hotspot analysis and econometric analysis
- **Part II: Public Drinking Water Violations on Tribal Lands in New Mexico**
  - To explore the correlation between proportions of Tribal land and rates of drinking water violations
  - 2022 data at the census block group level: drinking water violation data on both tribal & non-tribal lands, community characteristics, environmental conditions
  - Econometric analysis
- **Part III: Urban Drinking Water Equity: A Case Study of Albuquerque**
  - To assess "water poverty" at the urban neighborhood level using the largest CWS in NM as a case study
  - 2019 data at the census block group level: water consumption, community characteristics, weather
  - Integrated assessment: develop a localized Water Poverty Index (WPI) and assess spatial variation in water-related hardship

Part I

Data

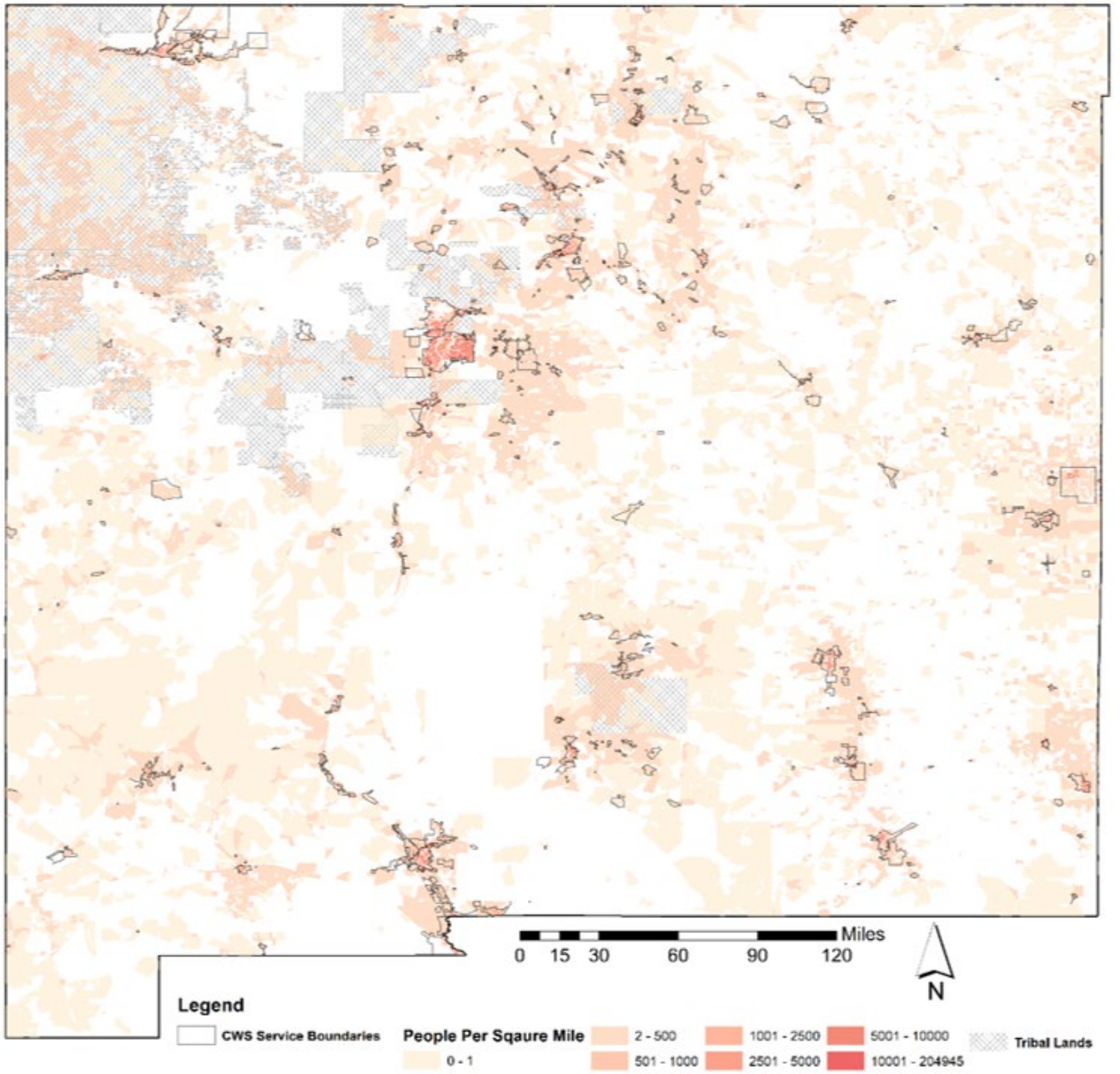

Figure 1. Community water systems and population density measured by people per square mile in New Mexico.
Note: Tribal lands are included in the map to identify potential access disparity.

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Part I

Data

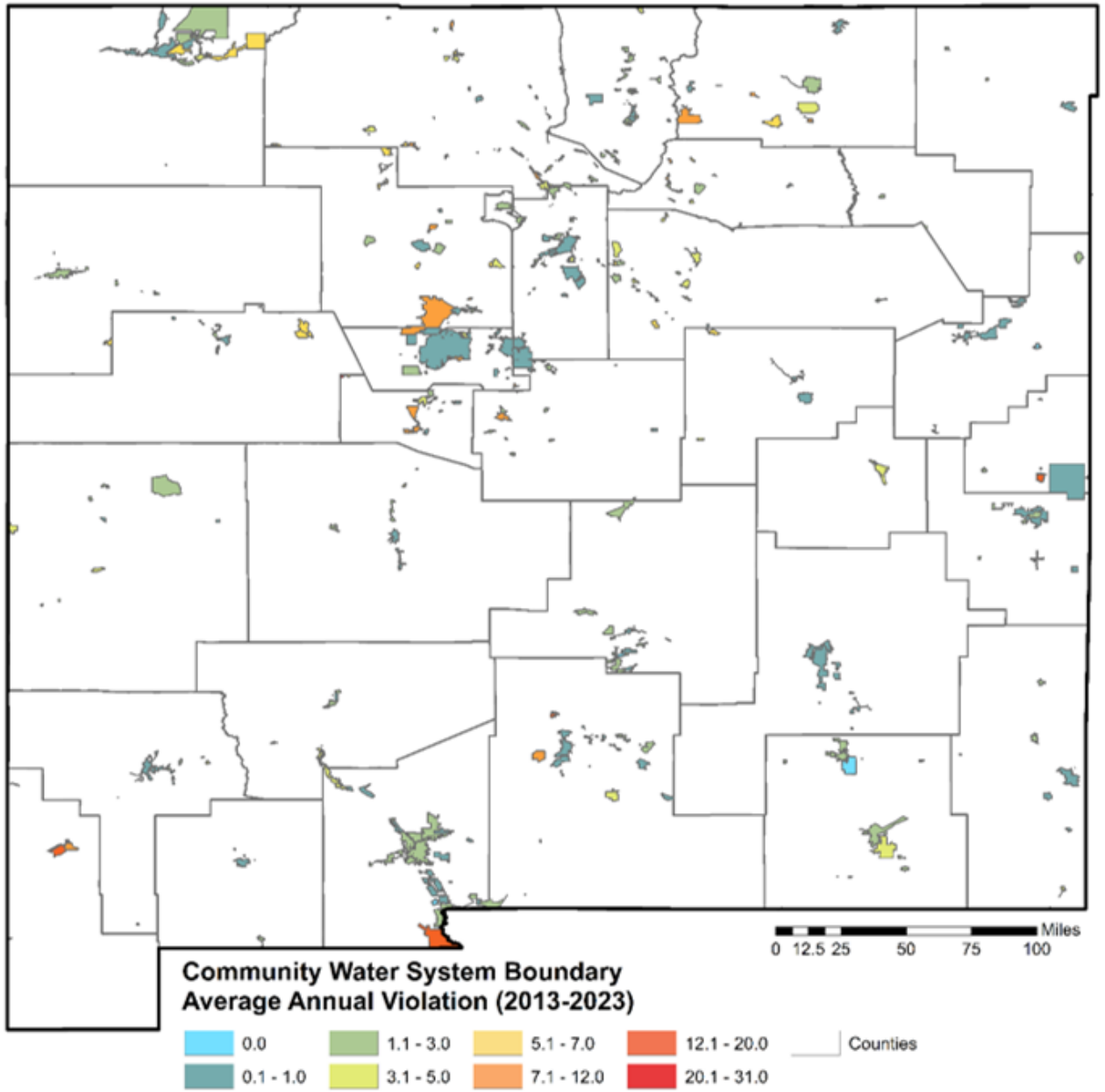

Figure 2. Community water systems in New Mexico and the average annual number of drinking water violations from 2013 to 2023.
Data source: U.S. Environmental Protection Agency (EPA) Safe Drinking Water Information System (SDWIS).

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Part I

Data

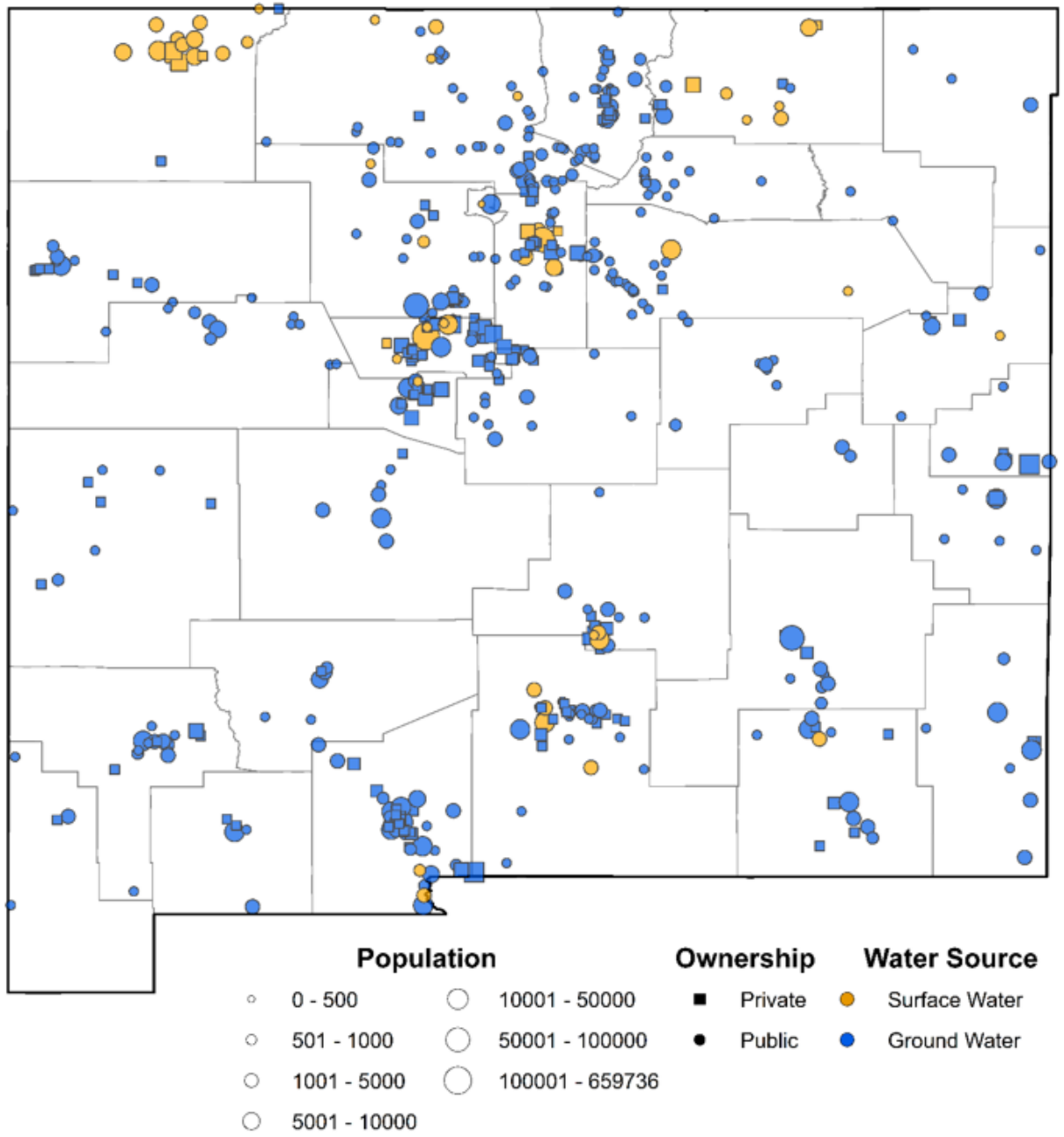

Figure 3. Community water systems in New Mexico by system characteristics.
Data source: U.S. Environmental Protection Agency (EPA) Safe Drinking Water Information System (SDWIS).

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Part I

Findings

Table 5. Results for all New Mexico community water systems.

	Total Violations		Health Related Violations	
Population	-0.004*	-0.004***	-0.002**	-0.002***
	(0.002)	(0.001)	(0.001)	(0.000)
Surface Water	1.526***	1.444***	0.561***	0.546***
	(0.248)	(0.174)	(0.092)	(0.092)
Privately Owned	-0.008	-0.015	-0.045	-0.045
	(0.148)	(0.129)	(0.055)	(0.049)
State Owned	1.075	1.010**	-0.377	-0.384***
	(0.778)	(0.450)	(0.288)	(0.117)
Percent Rural	0.883***	0.953***	0.144**	0.157***
	(0.195)	(0.227)	(0.072)	(0.048)
Median Income	-0.018***	-0.011***	-0.004***	-0.003***
	(0.003)	(0.002)	(0.001)	(0.000)
Percent White	-0.043	-1.310***	-0.100	-0.339**
	(0.339)	(0.391)	(0.125)	(0.150)
Year Fix Effect	N	Y	N	Y
# Observations	6050	6050	6050	6050
Adj. R^2	0.016	0.049	0.010	0.021

Note: * $p < 0.1$, * *$p < 0.05$, *** $p < 0.01$

Higher rates of drinking water violations are associated with

- Surface water sources
- Rural, low-income, or predominantly non-white communities
  - ➢These inequities are most pronounced in the smallest CWS (serving 500 or fewer people)

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Part II

Data

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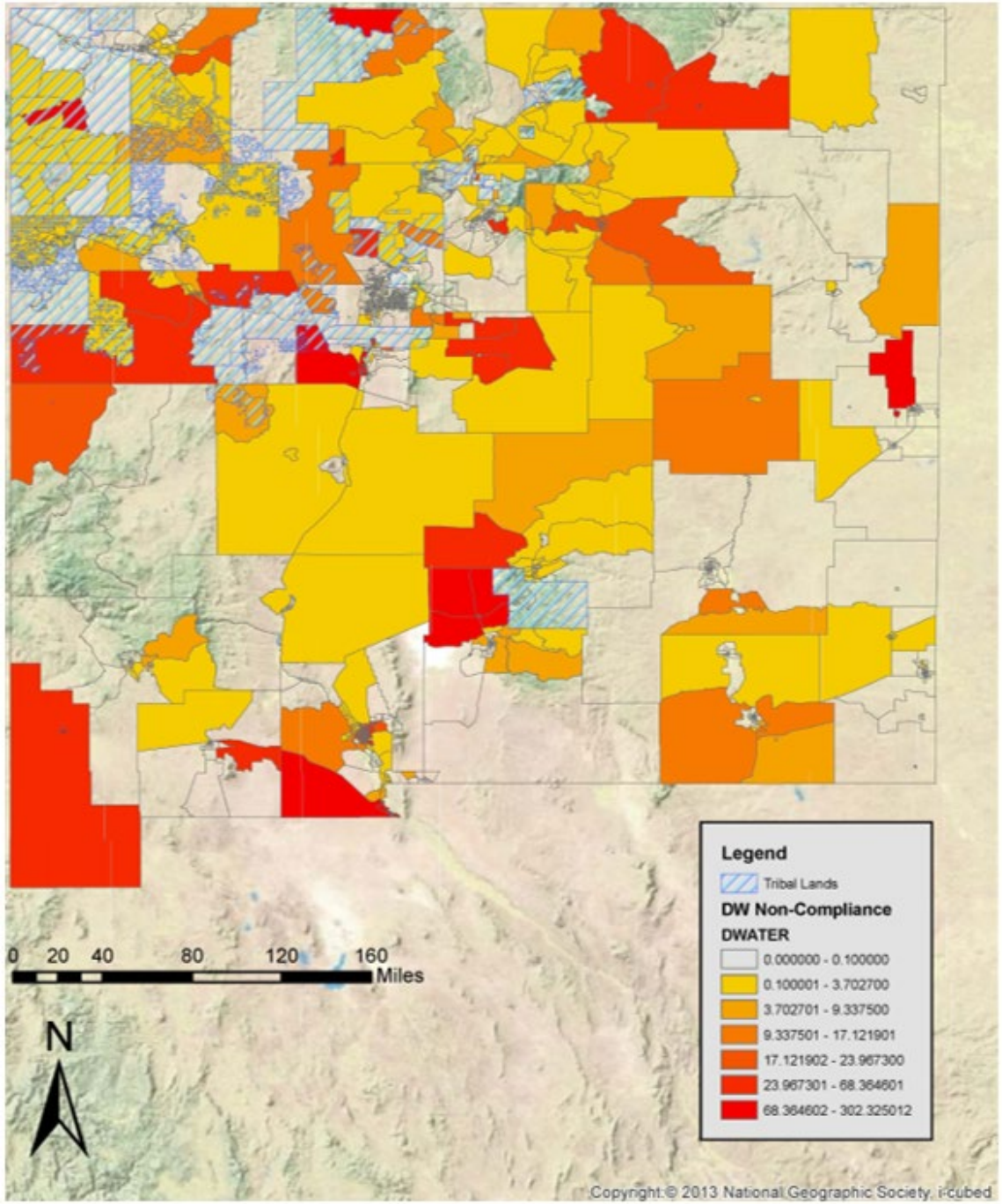

Figure 7. Tribal lands and drinking water violations in New Mexico by block groups (2022).

Part II

Findings

Table 9. Main model results for block group drinking water violations in New Mexico.

	Drinking Water Violations	
	(1)	(2)
Tribal Percent	-0.043***	-0.461***
	(0.01539)	(0.01562)
Total Population	0.2551	0.4428
	(0.9901)	(0.99643)
Household Median Income	-0.066***	-
	(0.01353)	
Household Median Income Centered	-	-0.0890**
		(0.02279)
Household Median Income Squared	-	0.0005***
		(0.0002)
NPL Dummy	-1.6225	-1.9504
	(1.6105)	(1.6586)
TSDF Dummy	-0.7360	-0.6706
	(2.9513)	(2.9508)
# Observations	1401	1401
Adj. R^2	0.0123	0.0143

Note: * $p < 0.1$, **$p < 0.05$, *** $p < 0.01$

Lower rates of drinking water violations are associated with

- Higher proportions of Tribal land within census block groups

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Part III

Data

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Water Poverty Index (WPI)

- **Underuse**: if average daily per capita consumption falls below 50 gallon per capita per day
- **Unaffordability**: unaffordable if household expenditure associated with essential water and sewer services exceeds 4.5% of monthly household income
- **Climate Vulnerability**: water use declines during hot days (≥90°F) compared to non-hot days

Part III

Findings

Table 14. Distribution of Water Poverty Index (WPI) by block group

WPI Score	Description	Number of Block Groups
0	No vulnerability	403
1	One vulnerability (Underuse, Afford., or Climate)	8
2	Two vulnerabilities	0
3	All three vulnerabilities	0
Total		411

Widespread water poverty is not prevalent in Albuquerque

- Individual water vulnerabilities are detected in underuse (2 block groups), affordability (1 block group), and climate vulnerability (5 block groups), revealing localized disparities
  - ➢ signals early warning signs of stress
- About 2% of 411 census block groups in Albuquerque show signs of water-related vulnerability, with no areas experiencing multiple overlapping stressors
  - ➢ May reflect the strength of local water management practices that other areas can learn from

Policy Implications

- Targeted investment should prioritize CWS that rely on surface water and serve at-risk populations to reduce health risks associated with unsafe drinking water.
- Small CWS face persistent regulatory and operational challenges; regional consolidation or shared services among neighboring systems may enhance compliance.
- Federal, state, and local agencies should strengthen support for Tribal nations as sovereign water managers, recognizing the importance of Tribal governance in ensuring safe and equitable water access.
- The adoption of equity-oriented tools, such as the Water Poverty Index, can help water utilities and policymakers identify specific dimensions of vulnerability and allocate resources more effectively.
- Additional research and targeted policy action are urgently needed to address the needs of communities lacking access to public drinking water infrastructure.

Thanks!

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Appendix

Table 1. Community water systems in New Mexico.

Category (Population Served)	Number of CWS	Population served	% of CWS	% of New Mexicans
Very small (25-500)	379	67,765	67.32	3.18
Small (501-3,300)	119	163,774	21.14	7.69
Medium (3,301-10,000)	33	208,339	5.86	9.78
Large (10,000-100,000)	30	805,018	5.33	37.79
Very Large (>100,000)	2	767,086	0.36	36.01
Total	563	2,011,982	100.00	94.45

Appendix

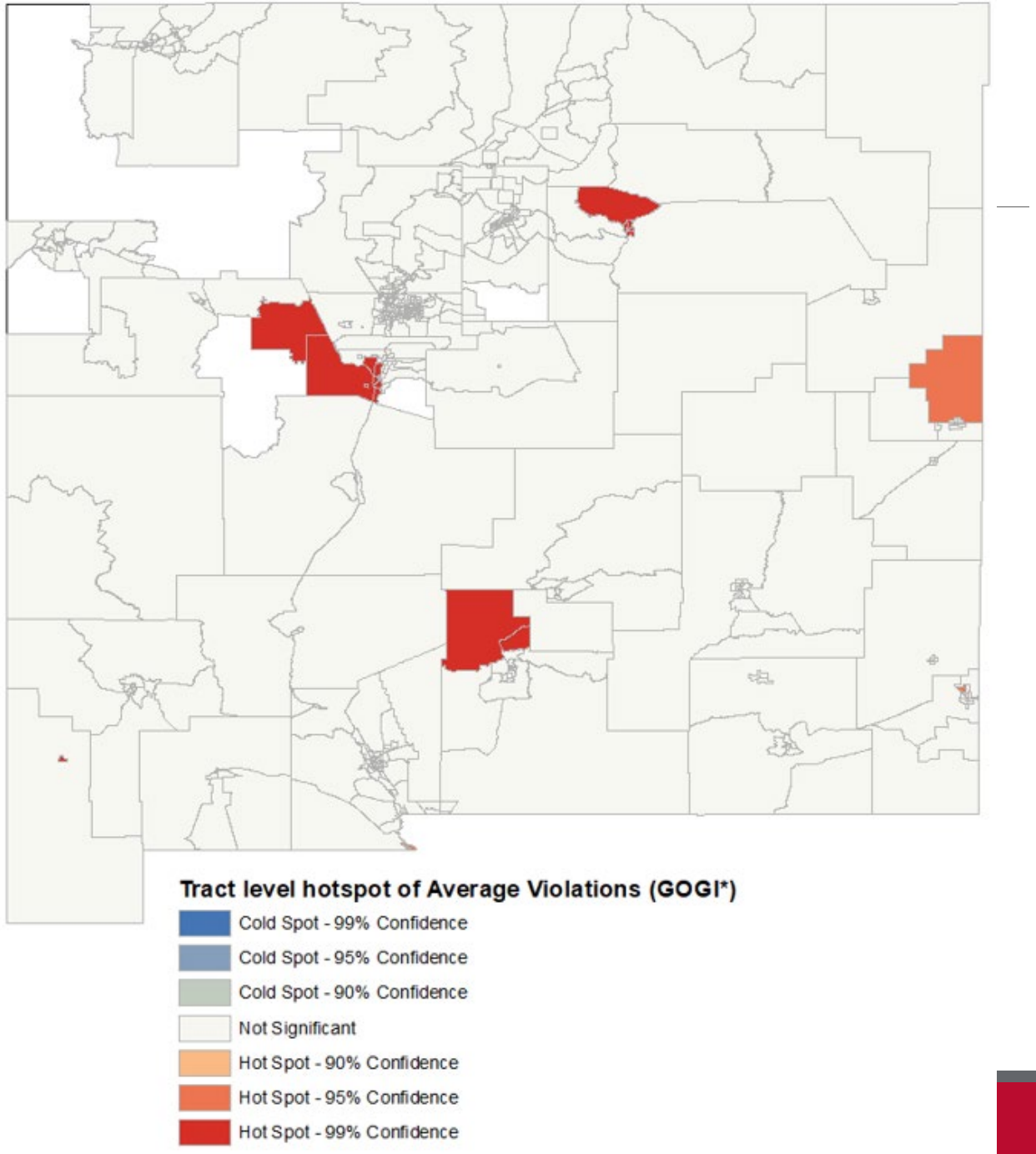

Figure 5. Hotspots of average total drinking water violations for New Mexico census tracts.

Appendix

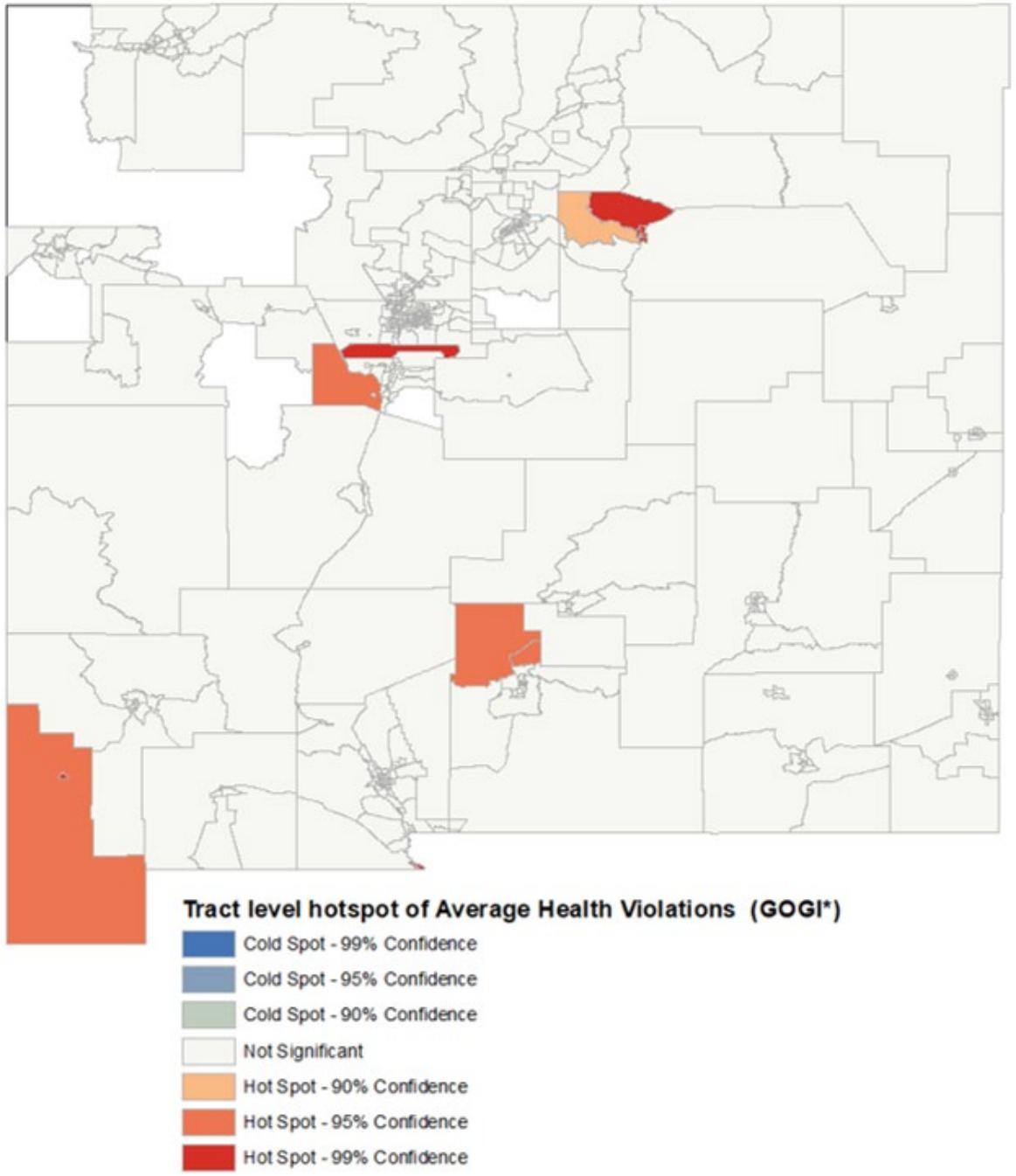

Figure 6. Hotspots of average health related drinking water violations for New Mexico census tracts.

Appendix

Table 6. Results for New Mexico community water systems serving over 500 people.

	Total Violations		Health Related Violations	
Population	-0.003	-0.003***	-0.001*	-0.001***
	(0.002)	(0.000)	(0.001)	(0.000)
Surface Water	1.392***	1.306***	0.453***	0.442***
	(0.265)	(0.250)	(0.118)	(0.104)
Privately Owned	-1.078***	-1.114***	-0.233**	-0.238***
	(0.241)	(0.122)	(0.107)	(0.064)
State Owned	0.423	0.229	-0.205	-0.235*
	(0.977)	(0.460)	(0.436)	(0.115)
Percent Rural	0.743***	0.814**	0.114	0.123
	(0.283)	(0.263)	(0.127)	(0.073)
Median Income	-0.014***	-0.009***	-0.007***	-0.006***
	(0.005)	(0.003)	(0.002)	(0.001)
Percent White	0.315	-0.914*	0.168	0.018
	(0.527)	(0.456)	(0.235)	(0.198)
Year Fix Effect	N	Y	N	Y
# Observations	1980	1980	1980	1980
Adj. R^2	0.032	0.048	0.014	0.016

Note: * $p < 0.1$, * *$p < 0.05$, *** $p < 0.01$

Appendix

Table 7. Results for New Mexico community water systems serving 500 or less people

	Total Violations		Health Related Violations	
Population	-1.487**	-1.412*	0.048	0.061
	(0.699)	(0.658)	(0.241)	(0.175)
Surface Water	2.434***	2.353***	0.932***	0.915***
	(0.462)	(0.562)	(0.159)	(0.142)
Privately Owned	0.095	0.115	-0.011	-0.004
	(0.203)	(0.205)	(0.070)	(0.065)
State Owned	1.574	1.745**	-0.289	-0.251
	(1.159)	(0.708)	(0.400)	(0.217)
Percent Rural	0.846***	0.941***	0.140	0.159**
	(0.275)	(0.277)	(0.095)	(0.066)
Median Income	-0.019***	-0.011***	-0.002*	-0.001
	(0.004)	(0.002)	(0.001)	(0.001)
Percent White	-0.065	-1.290***	-0.200	-0.465**
	(0.433)	(0.389)	(0.149)	(0.164)
Year Fix Effect	N	Y	N	Y
# Observations	4070	4070	4070	4070
Adj. R^2	0.017	0.055	0.010	0.026

Note: * $p < 0.1$, * *$p < 0.05$, *** $p < 0.01$

Appendix

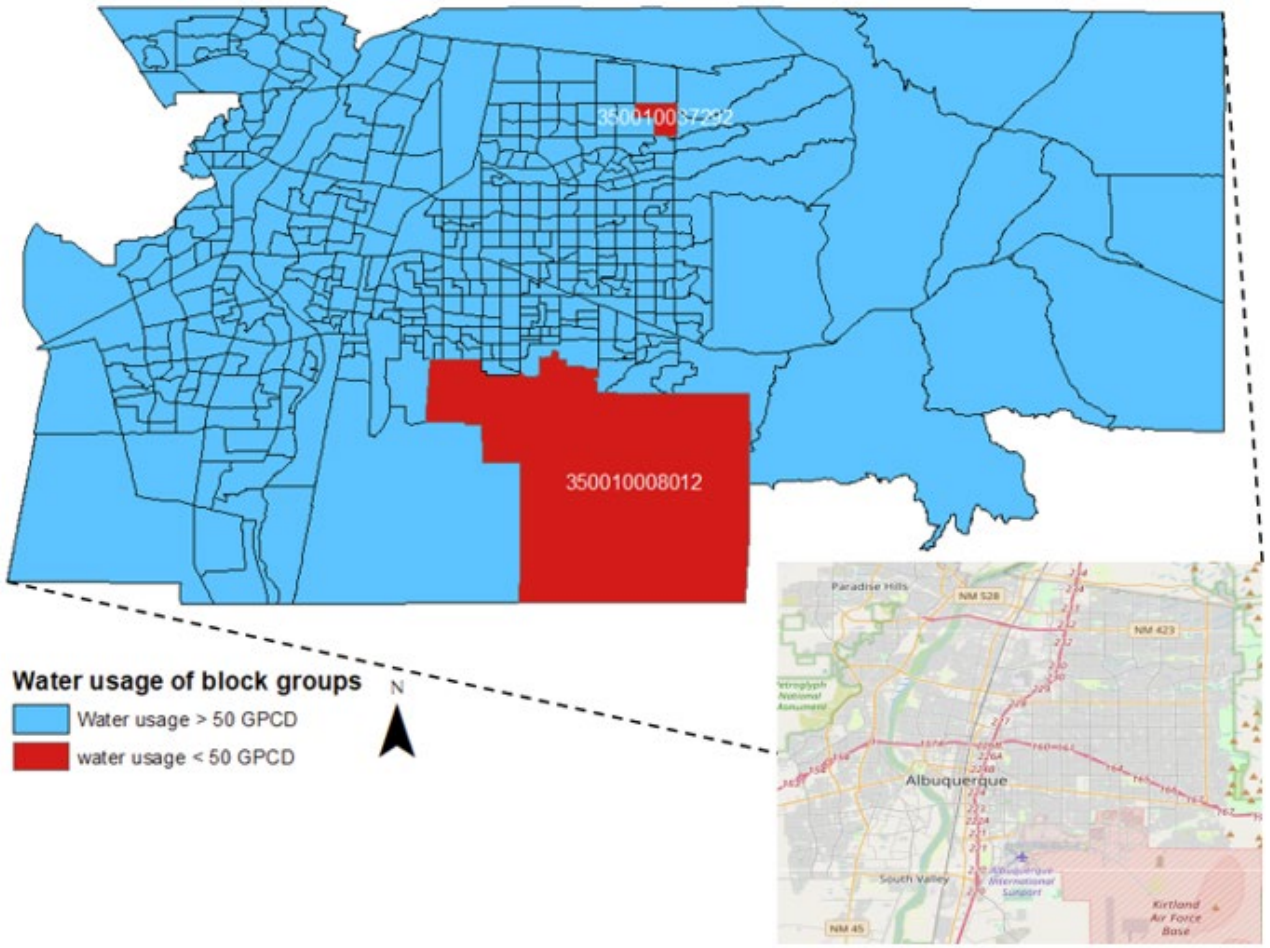

Figure A.1. Map of water usage of block groups in Albuquerque, New Mexico (2019)

Appendix

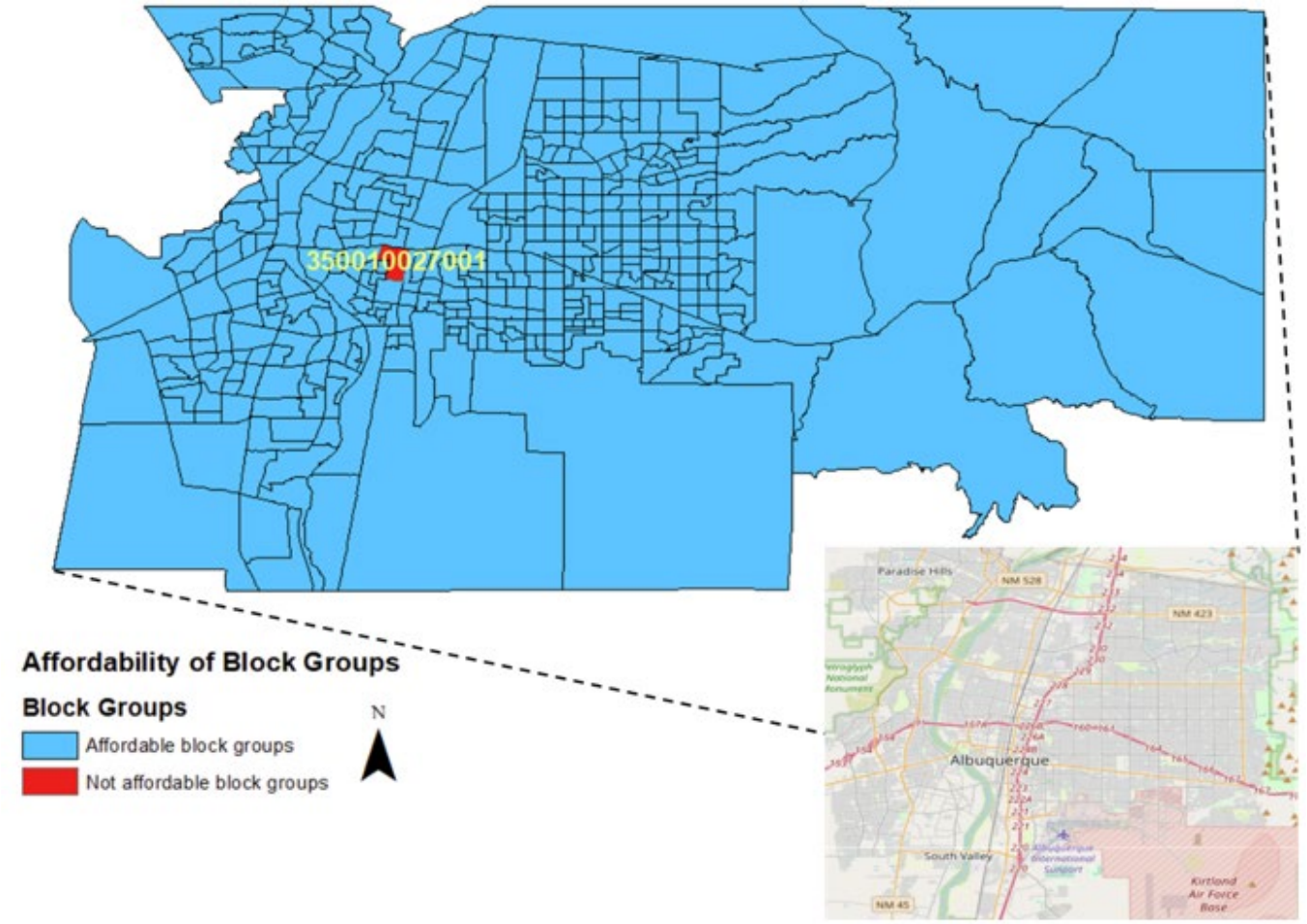

Figure A.2. Map of water affordability of block groups in Albuquerque, New Mexico (2019)

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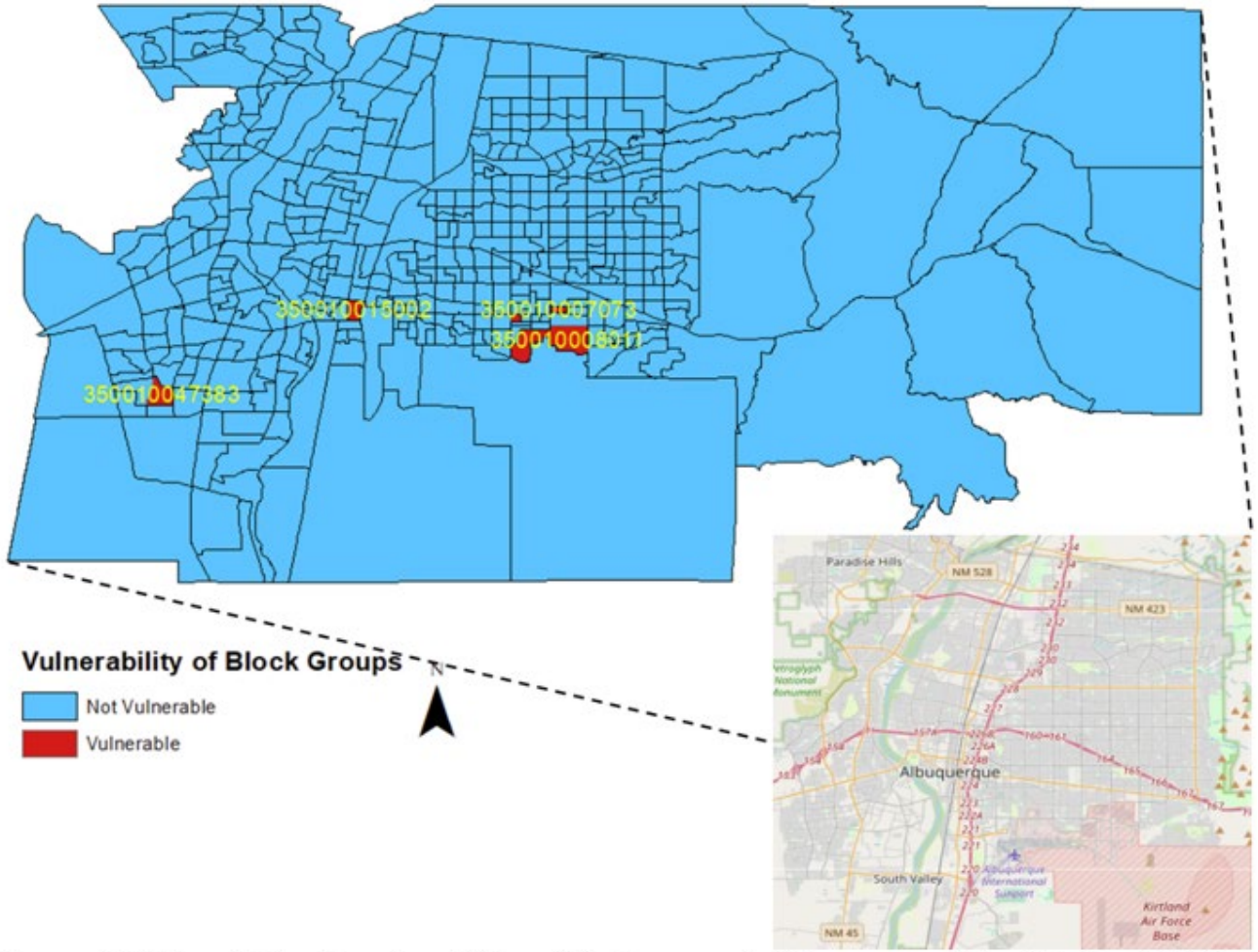

Figure A.3. Map of climate vulnerability of block groups in Albuquerque, New Mexico (2019)