

PGIS (Participatory Geographic Information System) : A Tool for Community-led Hazard Mapping- A Case Study On Beaumont-Port Arthur, Southeast Texas

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INTRODUCTION

This study explores the importance of Participatory Geographic Information Systems (PGIS) in enhancing hazard resilience and equity in communities along the US Gulf Coast.

In hazard mitigation and climate adaptation, a comprehensive approach encompassing both robust physical infrastructure and social support mechanisms is crucial (Peek et al., 2021). Environmental justice research underscores the disproportionate burden of environmental hazards on marginalized populations (Bullard, 1999), necessitating equitable solutions that prioritize community resilience and participation (Agyeman et al., 2016). Social vulnerability to disasters, as Morrow (1999) notes, is socially constructed and influenced by factors such as socioeconomic status, age, race, and gender, highlighting the need for inclusive emergency management strategies.

- Social vulnerability indices are used to understand inequalities in exposure to hazards and capacity to recover from disasters.
- There are several different indices with different variables and measurement techniques.
- Participatory and local data may be useful to validate these indices.

Beaumont-Port Arthur, with its coastal location and proximity to major petrochemical industrial complexes, is at a high risk of climate-related disasters and chronic exposure to flood and air pollutants (Figure 1). The area has marginalized populations that are disproportionately exposed to natural and industrial hazards.

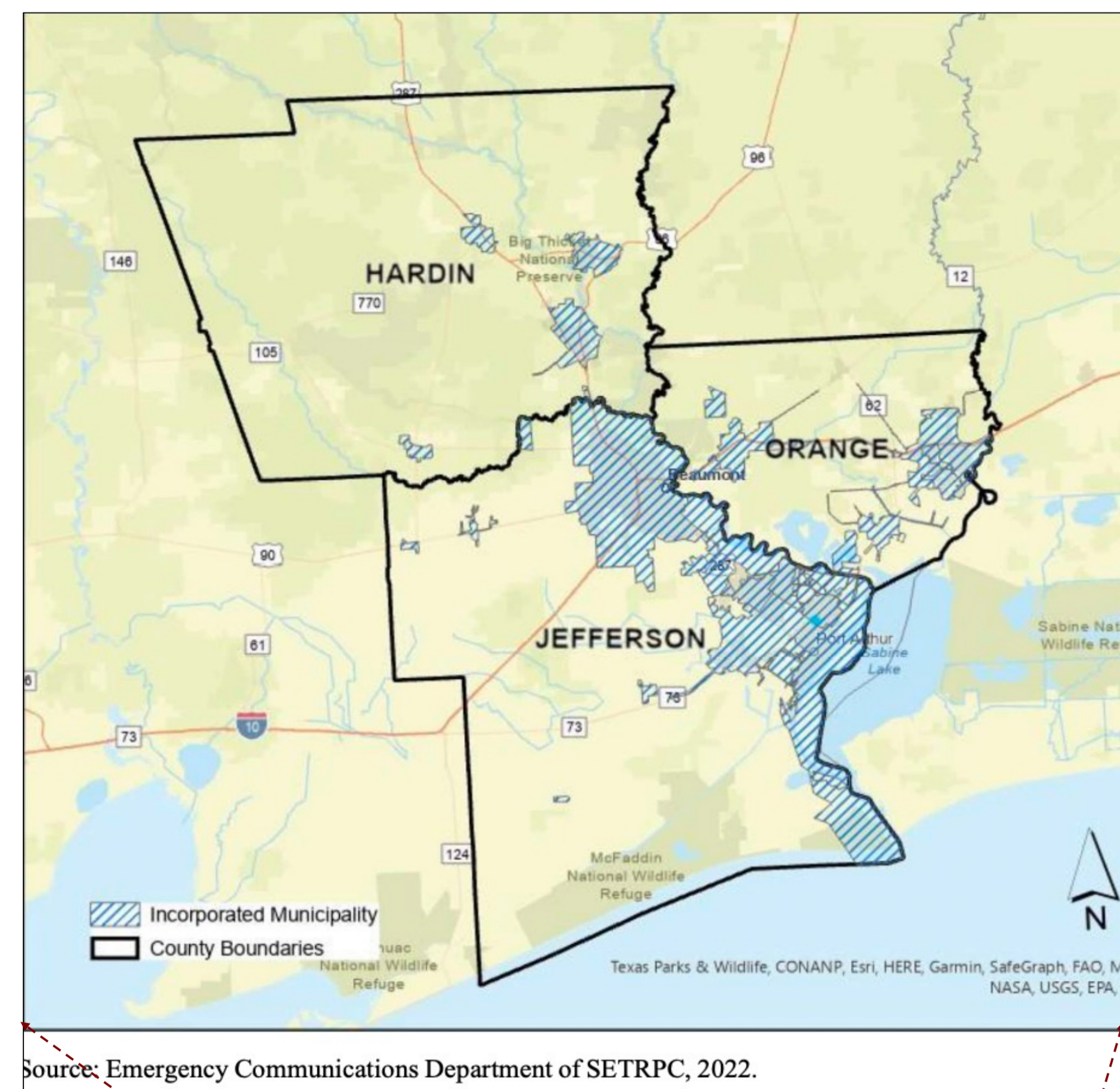


Figure 1: Map of Beaumont-Port Arthur and socioeconomic statistics

Social Vulnerability Variables	Beaumont-Port Arthur MSA	Texas
Households	148,489	10796247
Per Capita Income	\$31712	\$34717
Housing Units	171,716	11,867,820
Poverty	380,327	28,260,264
Unemployed	5.4%	5.4%
% Below the Poverty Line	14.8%	14.3%
% have attained bachelor Degree and Higher	18.3%	33.1%
Median Age	37.2	35.0
Pop Under 5 and over 65	86,186	55,80,021
Minority	36.7%	40.7%
Pop with disability	15.9%	11.4%
Households with limited English proficiency	3.4%	7.1 %
No Vehicle by household size	6.5%	5.21%
Mobile Homes	9.9%	6.5%
Female Householder with Children	7%	5.6%
Access to Internet	87.9%	91.5%

Source: US Census 2021 ACS-5 year estimates

METHODS AND DATA ANALYSIS

We compared 2 social vulnerability indices – from the Center for Disaster Control (CDC) and the Hazard Reduction and Recovery Center (HRRC). Both show similar trends: Social vulnerability is quite high in the Beaumont-Port Arthur MSA (Figures 2.1, 2.2), especially near the port, central Beaumont, and Port Arthur.

The Social Vulnerability Index for census tracts in Beaumont-Port Arthur, 2020.

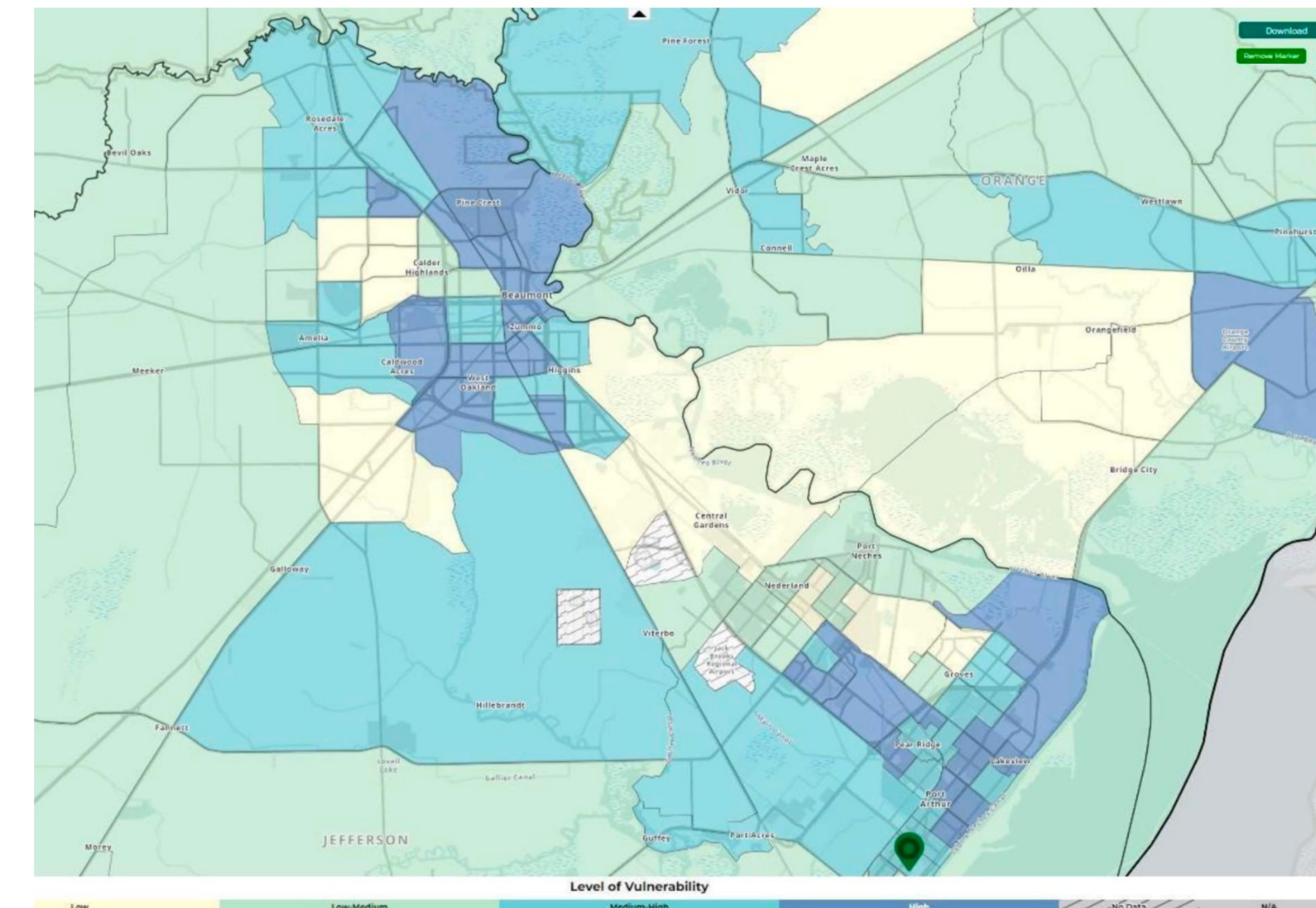


Figure 2.1: CDC social vulnerability analysis, Beaumont-Port Arthur

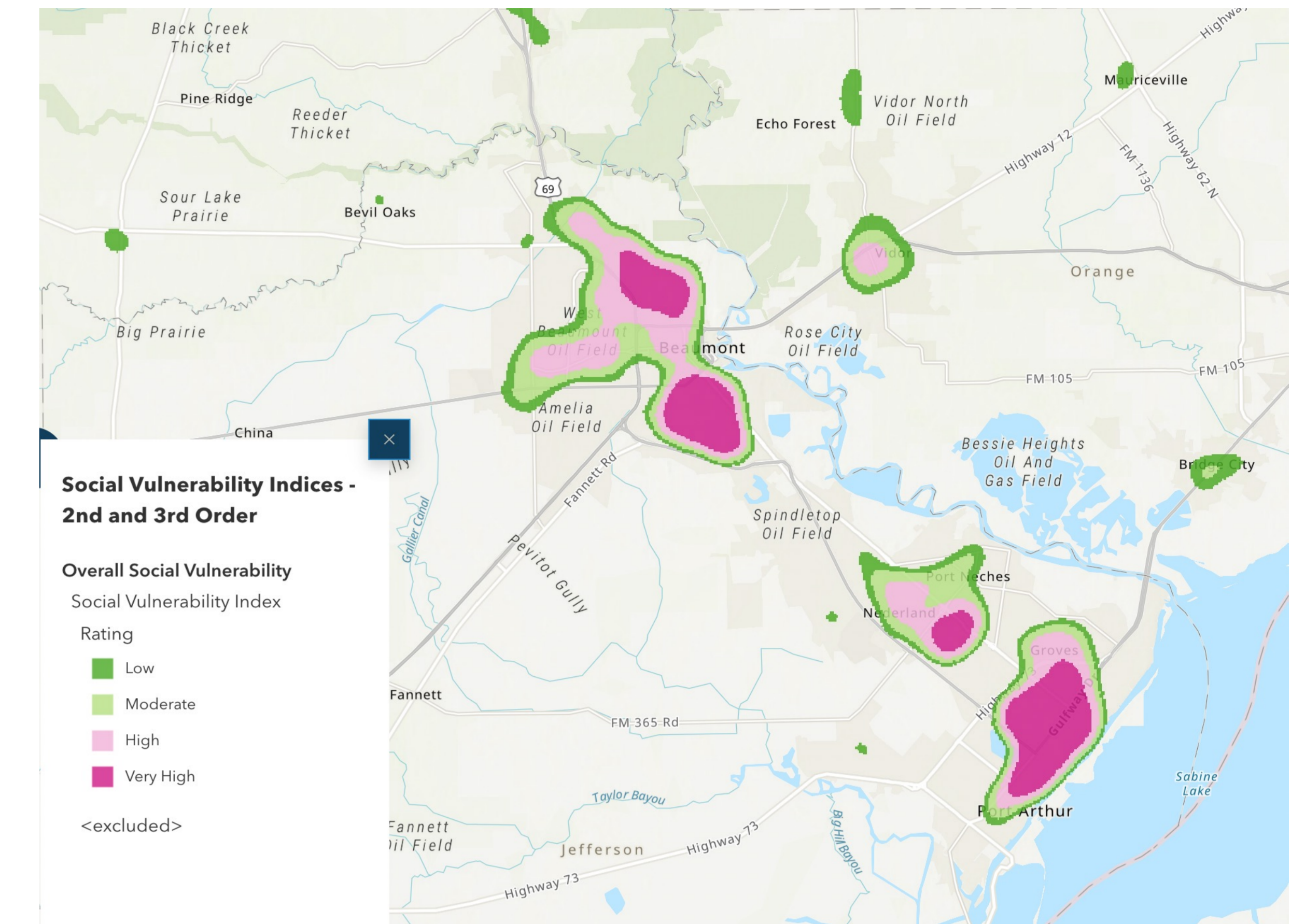


Figure 2.2: HRRC social vulnerability analysis, Beaumont-Port Arthur

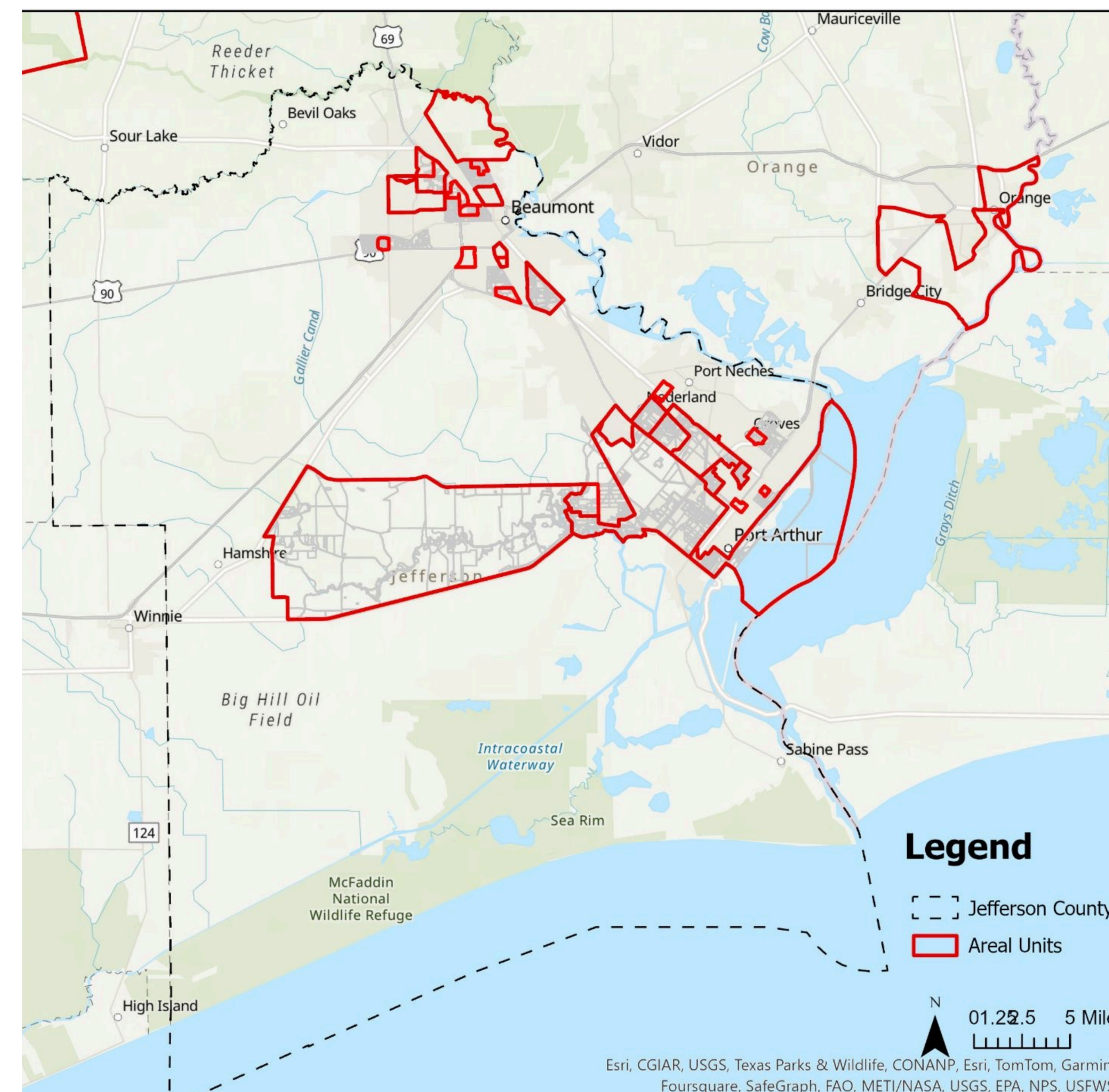


Figure 3: 37 Areal Units in Beaumont-Port Arthur with different social vulnerability scores

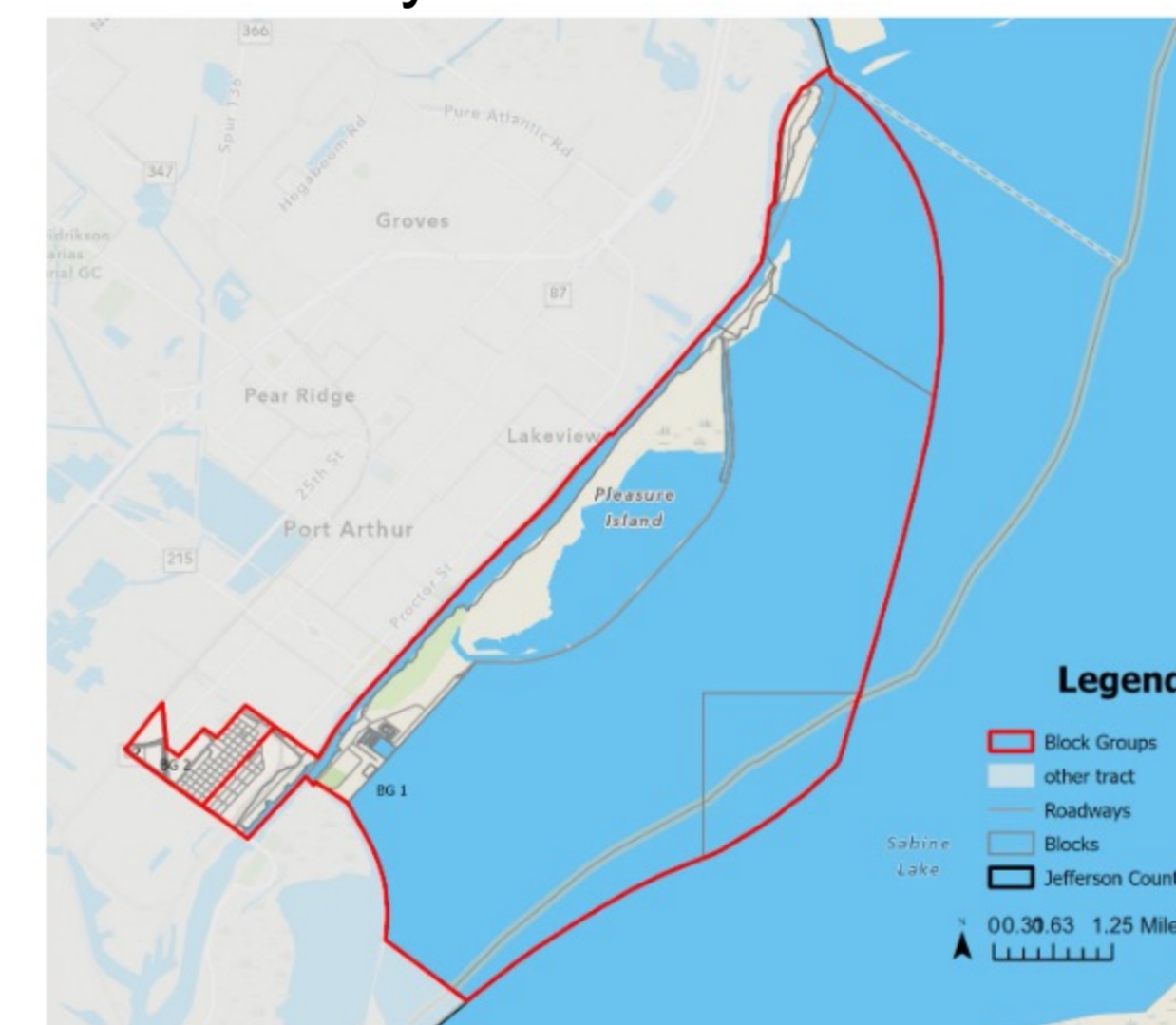


Figure 4: Example: Tract 51 in Port-Arthur

- Identified 37 areal units with different social vulnerability scores (Figure 3).
- An example is Tract 51 (Figure 4) comprising two blocks. Both CDC and HRRC indices indicate low social vulnerability. Assessments from ground truthing reveal a contrasting perspective, highlighting high vulnerability within the tract.
- The study used Zillow's public database to extract relevant socio-economic indicators such as housing affordability, property value trends, and neighborhood demographics. Cross-referenced Zillow data with existing vulnerability indices to identify correlations and discrepancies, contributing to a comprehensive understanding of social vulnerability within each areal unit.
- Utilized Google Street View imagery for visual neighborhood assessments, developed a systematic approach for evaluating street-level vulnerability indicators and used geospatial analysis techniques to improve social vulnerability evaluations.
- Results indicate an urgent need for innovative tools to improve data accuracy and understand vulnerability dynamics.

NEXT STEPS: Implement PGIS to include local people in mapping and analyzing social vulnerability indicators. Integrate indigenous knowledge and community perspectives to improve understanding of hazard resilience and equity. Developing a vulnerability analysis framework that is replicable across different socioeconomic conditions.

DISCUSSION

PGIS may play a crucial role in resolving discrepancies in vulnerability assessments like the one observed in Beaumont-Port Arthur. Such as:

- **Community Engagement:** PGIS facilitates active participation and engagement of local communities in the vulnerability assessment process.
- **Collaborative Mapping:** PGIS allows for collaborative mapping exercises where community members can identify and prioritize vulnerable areas based on their lived experiences.
- **Data Accuracy:** By supplementing official data with local insights, PGIS helps improve the accuracy and reliability of vulnerability assessments.
- **Empowerment:** PGIS empowers communities to take ownership of their resilience-building efforts by giving them a platform to voice their concerns and priorities.
- **Equitable Solutions:** Through PGIS, vulnerable communities can advocate for more equitable solutions and resource allocation to address their needs and challenges.

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- Acknowledgments: This material is based upon work support by the U.S. Department of Energy, Office of Science, Biological and Environmental Research Program under Award Number DE-SC0023216.