

Geospatial Resilient Economic Development (GeoRED)

Final Report

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Abstract

Texas OneGulf Center of Excellence, administered through the Texas Commission on Environmental Quality (TCEQ), supported the development of a GIS (geographic information systems) platform, called Geospatial Resilient Economic Development (GeoRED). With geographic focus on the Coastal Bend of Texas, GeoRED provides hyperlocal data to assist communities in economic development, hazard planning, and resilience building. The platform is designed to integrate new data and tools as needed over time. Adhering to the principles of co-production, the project team collected feedback regarding data and information needs, as well as potential uses of the mapping tool through extensive outreach efforts with city and county representatives throughout the Coastal Bend, before and during development. Flooding, especially compound flooding, is an issue for many communities across the Coastal Bend and was the primary natural hazard of concern expressed by local partners that provided input. Another important request was that the platform include resources that provide guidance on how to use the tool, especially for those that are inexperienced or not trained in viewing or using GIS -based tools. Given this input, the team developed a GeoRED website that houses multiple data viewers as well as informational resources for 1) the Hazard Impact and Response Tool (currently available); 2) Social Vulnerability Tool (currently available); 3) Economic Development Tool (in development); and 4) Environmental Resilience Tool (in development). GeoRED was “soft launched” in May 2023 at the local Coastal Bend Hurricane Conference and will continue to be refined with user input and feedback.

Introduction

Texas OneGulf Center of Excellence, administered through the Texas Commission on Environmental Quality (TCEQ), supported the development of a GIS (geographic information systems) platform, called Geospatial Resilient Economic Development (GeoRED). GeoRED is a geospatial tool co-produced with end-users to assist local officials, business owners, community planners, emergency responders, natural resource managers and practitioners, and anyone interested in visualizing the spatial relationships between natural hazards, the landscape, and the human environment within the Coastal Bend region of South Texas. The project is an extension of work funded by the U.S. Department of Commerce Economic Development Administration, where the Regional Resilience Partnership (RRP) – a partnership between the Coastal Bend Council of Governments and Texas A&M University Corpus Christi – initially developed the GeoRED concept for four Coastal Bend counties: Aransas, Bee, Refugio, and San Patricio. Texas OneGulf RESTORE Center of Excellence expanded this effort to Nueces, Kenedy, and Kleberg counties, and has led the development of an open-source online interface accessible by stakeholders and the public. This mapping tool and associated web-based resources can be used to identify local vulnerabilities and to plan for future conditions to limit impacts to our communities, thereby bolstering local economic, social and environmental resilience.

GeoRED may be viewed at: <https://geored.org/>

The following is the final report from the Harte Research Institute for Gulf of Mexico Studies (HRI) at Texas A&M University Corpus Christi (TAMUCC), which is leading the project on behalf of Texas OneGulf, on objectives achieved through May 31, 2023 for Nueces, Kleberg and Kenedy Counties.

GeoRED website development

Through extensive outreach efforts with city and county representatives throughout the Coastal Bend, the project team collected feedback regarding data and information needs, as well as potential uses of the mapping tool.

One important request was that the tool include resources that provide guidance on how to use the tool, especially for those that are not experienced or trained in viewing or using GIS -based tools. Given this input, the team developed a concept model for the GeoRED website (see Figure 1). The mapping tool itself would exist as a portal on the GeoRed home page, where users could click through directly to the mapping tool/data viewers or choose to explore the website to learn more before heading to the linked interactive maps.

As such, the website platform currently includes space for Story Maps, User Instructions, and a Links page for local and regional Mitigation Plans, Comprehensive Plans, and Master Plans relevant to the Coastal Bend. The project team aims to include additional guidance such as video tutorials, and testimonials from users themselves. Additionally, as GeoRED is increasingly used in various decision-making processes and projects, the project team will create more Story Maps that will live on the site. These Story Maps are helpful to new users, where they can browse real-world examples of where, how, and why GeoRED has been applied.

Overview of GeoRED Data Viewers

Geospatial data is critical for all aspects of resilience planning, including but not limited to emergency response and recovery, economic development, environmental planning, green and gray infrastructure design, and identification of vulnerable human communities. Flooding, especially compound flooding, is an issue for many communities across the Coastal Bend and was the primary natural hazard of concern expressed by local partners that provided input for development of GeoRED. Thus, GeoRED offers visualization of both the 1% and 0.2% FEMA Annual Flood Risk Hazard. Areas in the 1% flood risk hazard zone, also known as the Base Flood, indicate that there is a 1% chance of a flooding event occurring there in any given year. Statistically, a 1% flood has a 26% chance of occurring during a 30-year period. A 0.2% flood is a flooding event that has a 0.2% chance of occurring in any given year at any given location. Statistically, a 0.2% flood has a 6% chance of occurring during a 30-year time-period.

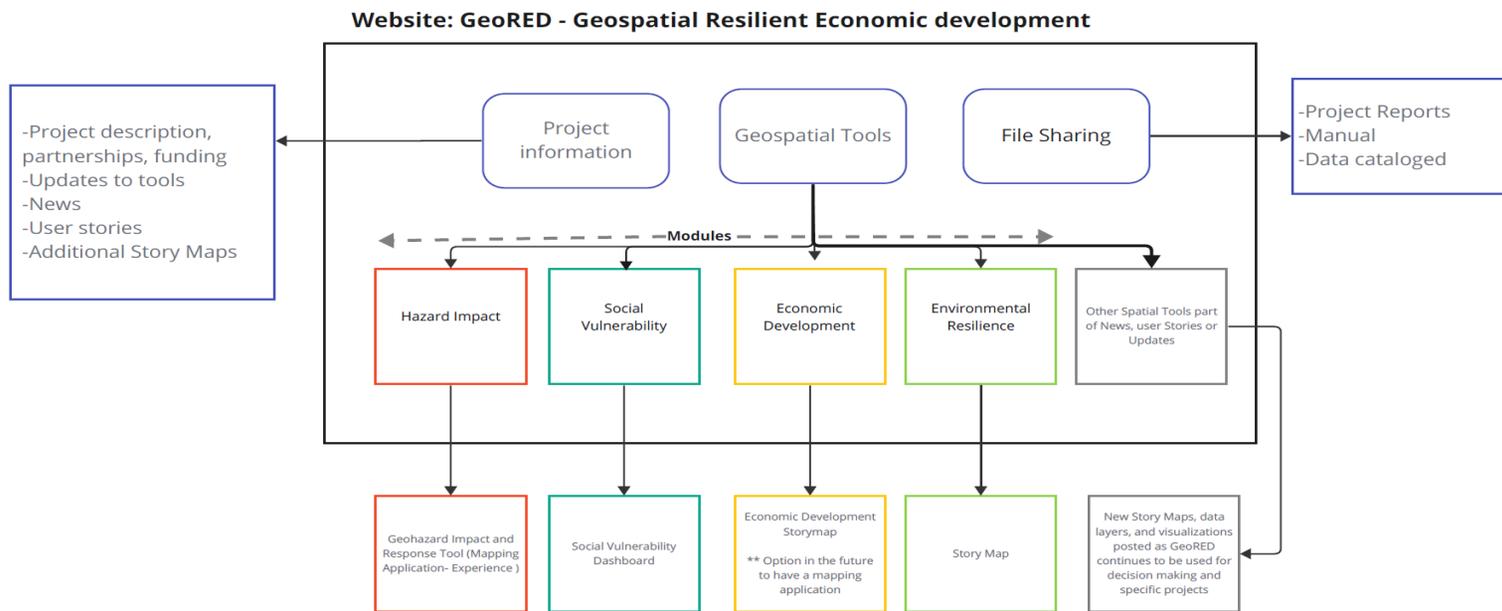
GeoRED integrates both environmental and manmade hazard layers with data such as critical facilities, transportation routes, and building footprints, so that planners, managers, local leaders, and other decision makers can assess the risk for given locations or facilities regarding hazards such as storm surge and flood events. Importantly, GeoRED enables sharing of this data across county and municipal lines which strengthens regional development goals as well as response efforts, allowing jurisdictions to proactively plan for collaborative efforts and know the risks and needs of not only their own communities but also those nearby. As such, GeoRED data is categorized into 4 main data viewers:

- 1) the Hazard Impact and Response Tool (currently available);
- 2) Social Vulnerability Tool (currently available);
- 3) Economic Development Tool (in development); and
- 4) Environmental Resilience Tool (in development).

The Hazard Impact and Response Tool can be accessed from the home page of the www.geored.org website (Figure 2). After the user clicks on the access link, the user is taken to the mapping portal. After the page loads the viewer is presented with an interactive map of the Coastal Bend of Texas, and on the right side of the screen is a panel of introductory information. In the upper right hand corner the viewer can navigate to their preferred basemap, and can toggle on or off the relevant hazard, flood, and critical infrastructure layers that they are interested in viewing. The viewer can also receive a summary of Nearby Critical Facilities located in proximity to various hazard and flood areas depending on where they zoom in on the map. For example (Figure 3), when the viewer zooms in on the Nueces County area, the list of Nearby Critical Facilities indicates that within the 1% Annual Flood Risk zone, they can quickly see that there are 57 Petroleum Storage Tanks, 28 Wastewater Treatment Facilities, 26 School Facilities, 19 Child Care Facilities, 21 Mobile Home Parks, as well as 6 police Stations, 5 Fire Stations, and 1 Emergency Care Facility in that area of concern. Zooming in further will automatically update a refined list of Critical Facilities relative to the location of floods and hazards. At the bottom of the screen the viewer can access attributes in tabular format, such as Name, Address, City, State Zip, Phone, Building Type, etc.

Likewise, the Social Vulnerability Tool can be accessed from the home page of the website. When clicking through to this Tool (data viewer), the user is greeted by an interactive map of the seven Coastal Bend counties currently available, with the option to zoom in or out. On the left panel of the screen, the user can access data layers organized into categories of social vulnerability “Indicators”: Population, Community, Health, Indices, and Other. The user can select which factor within each Indicator that they want to visualize on the map. For example (figure 4), if the user selects the Health Indicator tab, the list of factors that contribute to health in terms of social vulnerability are viewable, such as Low Life Expectancy, Asthma, Heart Disease, Lack of Health Insurance, etc. The viewer can click “show map” to visualize the data for each of these factors, such as “lack of health insurance” (Figure 4). On the right panel of the screen, the user can view the map Legend and determine the value of each factor in the preferred location. Additionally, the viewer can navigate to the Infographics tab on the right-side panel, where summaries are available as infographics for each County (see [County Profiles](#), below). Again, the user is able to zoom in on the Social Vulnerability map to receive a more refined visualization, and the data will automatically update for the viewer, as depicted in the following examples in the County Profiles section of this report.

The Economic Development and Environmental Resilience tools are in development with a launch date of September 2023. However, a GeoRED user can currently access relevant Story Maps for each of these viewers, which are linked as place holders for the viewers on the website. The Economic Development Tool will portray data layers and infographics that depict the intersection of environmental and manmade hazards with data layers important to resilient economic planning, such as broadband access, supply chains, business demographics, housing, energy, and more. The Environmental Resilience Tool will feature data layers such as land cover, flood hazards, habitat types, conservation easements, environmentally sensitive areas, and other data important to natural infrastructure planning, which is critical for holistic resilience.



GeoRED Tool Definitions and Conceptual Model

- **Tool-** Any application that offers multifunctionality for viewing data or maps
- **Module-** A grouping of geospatial data into a theme [Resilience pillars in this case]
- **Application/App-** Using ESRI tools to build mapcentric, geospatial, and location intelligent web & mobile applications (survey123, dashboards, online maps are all apps)
- **Dashboard-** An ESRI Dashboard is a application to present location-based analytics using interactive and easy-to-read data visualization. The dashboard allows for a robust suite of tools, including maps, lists, charts, and gauges.
- **Storymaps-** An ESRI StoryMap is an application which can weave in text, photos, and videos to your maps and web scenes to create contextual narratives that are easy to publish and share.
- **Experience-** in ESRI's experience builder one can build an interactive web experiences that look great on any screen size. The experience can include widgets for navigation, bookmarks, charts, dividers, images, legends etc

Figure 1. This concept model depicts basic components of the GeoRED website and tool and was used to bring the project team to a shared understanding of tool definitions and options as the team developed the website. Credit for image: Dr. Diana Del Angel

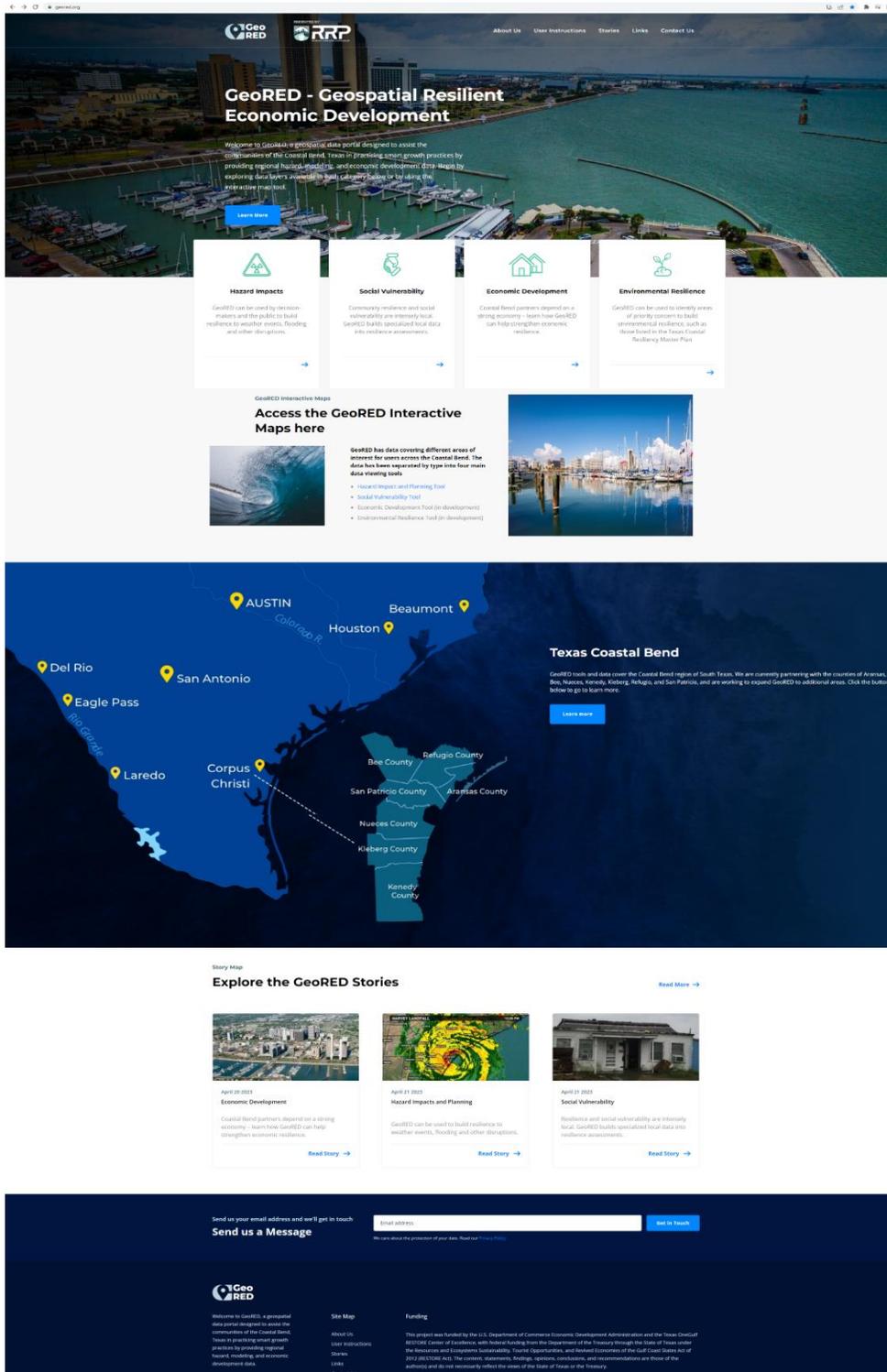


Figure 2. The home page for GeoRED/ www.geored.org.

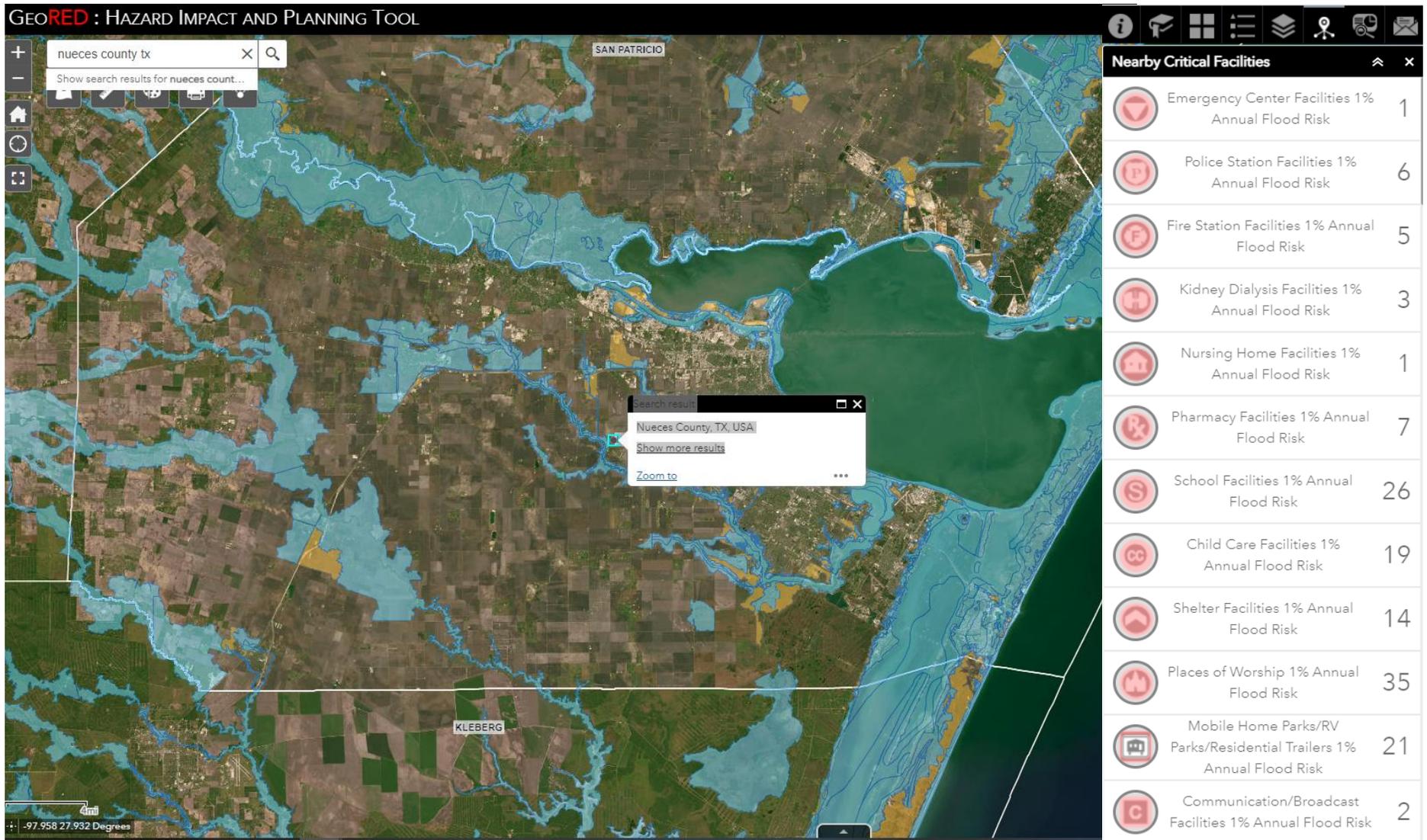


Figure 3. Screenshot taken from GeoRED.org of Nueces County and list of number of Nearby Critical Facilities, as well as 1% and 0.2% Annual Flood Risk.

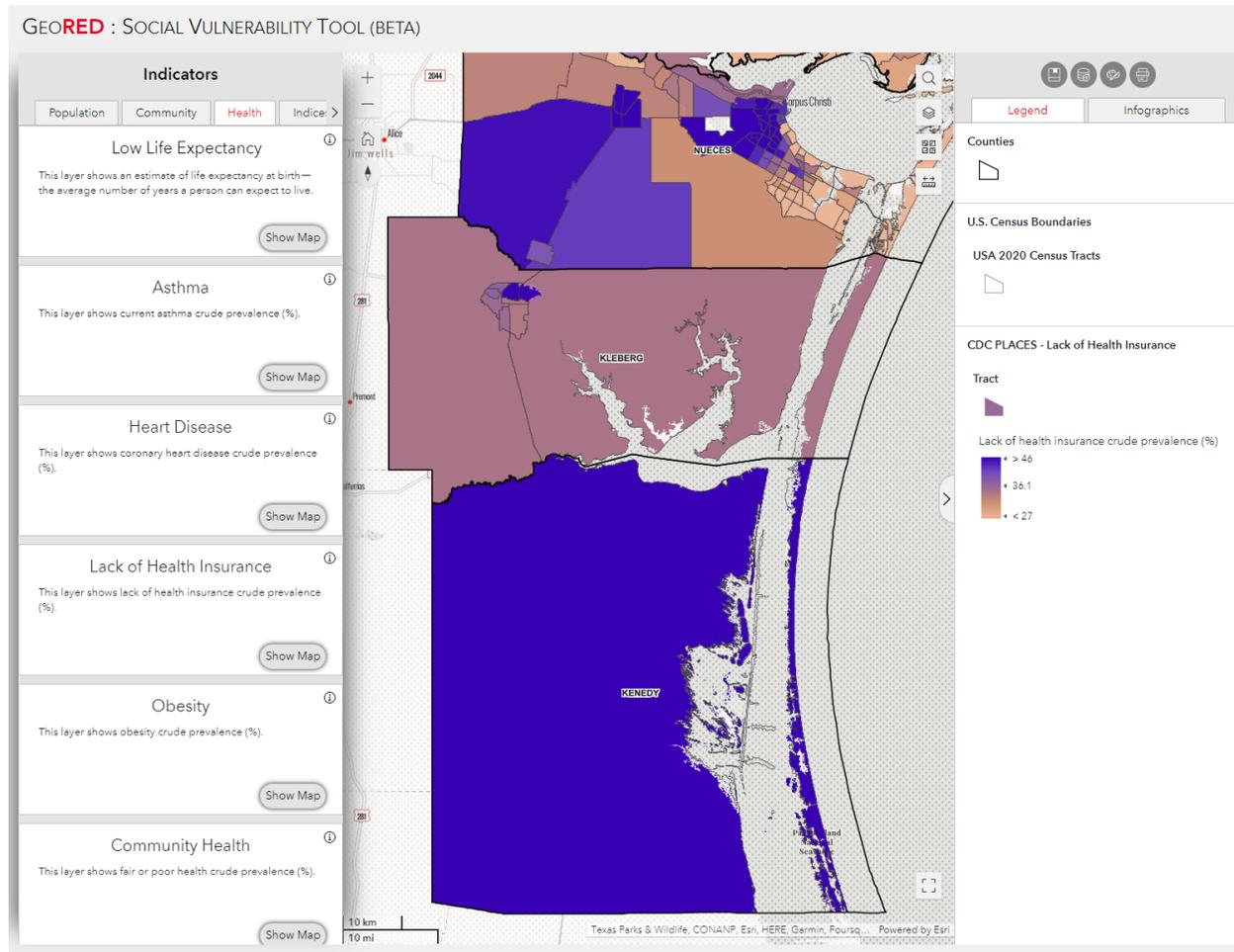


Figure 4. Screenshot of the Social Vulnerability Tool on GeoRED.org, of the Coastal Bend region of South Texas. Displayed on the left are the datasets available for visualization with regard to Social Vulnerability Indicators related to Health. Additional indicators are available in the topics of: Population, Community, Indices and “Other”, which includes data for Colonias, Low-to-Moderate Income (LMI) communities, and those using Supplemental Nutrition Assistance (SNAP) benefits.

County Profiles

To demonstrate how GeoRED can be used for local level assessments within the context of local flooding hazards and socially vulnerable communities, the following Profiles include simplified and hypothetical scenarios along with screenshots of the tool for select cities in Nueces, Kleberg, and Kenedy Counties.

Nueces County

The area depicted in Figure 6a is the northern segment of Corpus Christi, located in Nueces County, Texas. The blue shade represents the FEMA 1% Annual Flood Risk Areas, and the yellow shaded areas represent the FEMA 0.2% Annual Flood Risk Areas. The thick yellow lines are major evacuation routes, dotted black lines are railways, and the green dashed lines are potential contraflow. The side panel displays the number of Critical Facilities in this area. At this level of zoom, an emergency manager tasked with planning ahead for major and minor flooding and storm surge events can easily ascertain where problem areas are likely to be, locations for routing traffic, and how many emergency facilities there are. Importantly, an emergency manager will likely need to know where socially vulnerable communities are in proximity to hazards so that plans can be made to address the needs of these communities. Therefore, an emergency manager can navigate to GeoRED's Social Vulnerability Tool to consider those most at risk in this location. Looking at this same location (northern Corpus Christi) Figure 6b visualizes "Vehicle Availability", which is one of many factors when considering Indicators of social vulnerability. Through the lens of an emergency manager, agencies need to be aware of and prepare for rescue operations in areas where flooding is likely to occur and where there are communities of people without a method of evacuation. Zooming in a little bit closer on this location, in the Social Vulnerability Tool under the "Community" tab, and selecting for Emergency Shelters, an emergency manager can determine that there are 6 National Shelter System shelters located within this vulnerable community, and it is within the 1% annual Flood Risk Zone. Taking these and other data layers into consideration, an emergency manager can create multiple contingency plans with their staff and community partners.

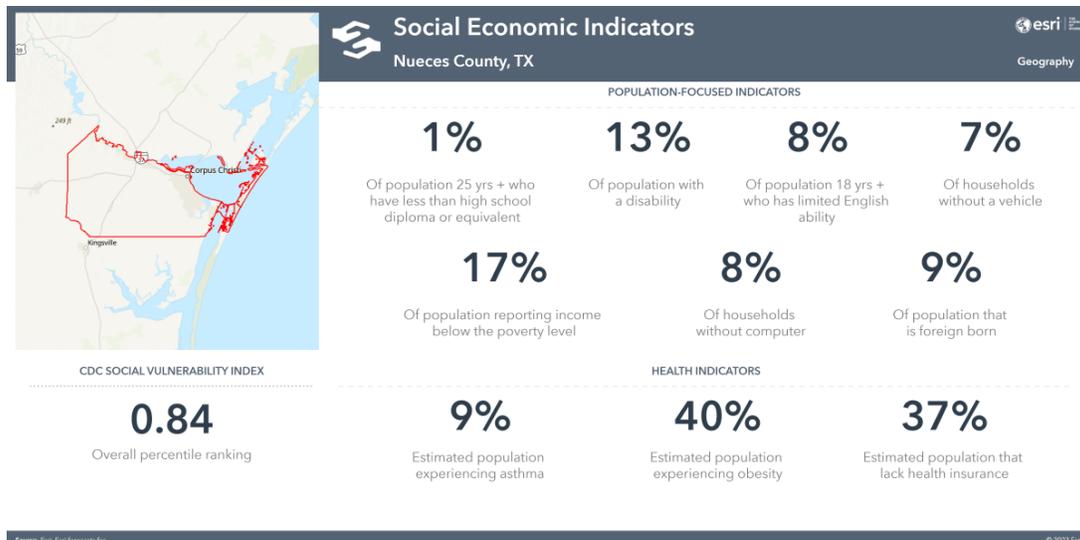


Figure 5a. Social Vulnerability "Infographics" tab from GeoRED.org. Depicted is a summary of Social Economic Indicators for Kleberg County, TX based on the CDC's Social Vulnerability Index.

Kleberg County

Kingsville, in Kleberg County, TX, is depicted in Figure 7a, with the “Human Geography” basemap turned on. Both the 1% and 0.2% Flood Risk Zones appear as a risk in northwest Kingsville, not far from the Campus of Texas A&M University-Kingsville. Considering economic development, some layers of interest here are the building footprints visualized as gray shapes, with the red shaded-shapes indicative of those located within the flood zone. Future development interests – hypothetically, if college housing needed to expand – may want to avoid building within these flood zones. Additionally, a railroad (dotted line) which is important to supply chains, is put at risk because it is also located within this flood zone. Likewise, using the Social Vulnerability Tool, Figure 7b shows Percent of Population 18 to 64 Years in Households with No Computer in this same area of Kingsville. The brown shade indicates that more than 7.8% of this community does not have access to a computer or computing device. This has implications for economic development as much of today’s economy is dependent on the internet for daily operations and management; moreover, this community also sits within the Flood Risk area, so planners will need to consider this risk when planning for improved internet (broadband) infrastructure. Furthermore, as shown in Figure 7c, a large portion of this community is unemployed, as indicated by the red shade; unemployment is one of several factors to consider when assessing social vulnerability. Utilizing both the Hazard Impact Planning and Social Vulnerability Tools can provide community leaders and planners with hyperlocal data they need to improve economic resilience.

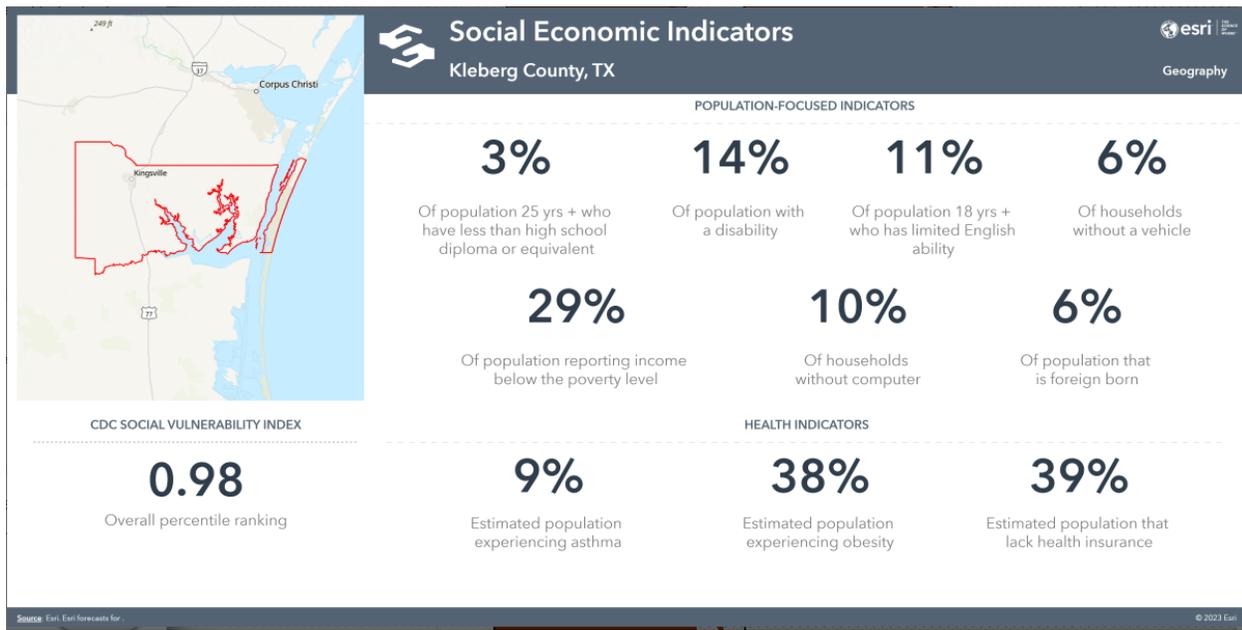


Figure 5b. Social Vulnerability “Infographics” tab from GeoRED.org. Depicted is a summary of Social Economic Indicators for Kleberg County, TX based on the CDC’s Social Vulnerability Index.

Kenedy County

Kenedy County, Texas is very sparsely populated; the US Census Bureau estimates the population to be 358, one of the least populated Counties in the United States. Much of the land is privately owned by

ranchers and the median household income for the County is below the national median is less than \$32,000 (below the national average of \$69,000; Figure 8a). Regardless of population numbers, humans have influenced the landscape here over the years, and land management decisions will continue to impact resilience locally and regionally. During early input sessions, Kenedy County leaders expressed interest in knowing what data layers they would have access to in GeoRED so that they could knowledgably collaborate with private landowners, as well as with neighboring Counties and cities. The most populate area of the County is the town of Sarita, which is located close to the Kenedy-Kleberg County line not far from Baffin Bay. Baffin Bay draws recreational fishers and associated tourism opportunities. For example, if Sarita leadership, local private landowners, and nearby Kleberg/Baffin Bay communities such as Riviera were interested in economic development opportunities to boost local income levels in their region, they would use GeoRED to explore the Flood Risk, transportation routes, nearby critical facilities, and other development considerations. Sarita is not in the 1% or 0.2% FEMA Flood Risk areas, and has access to the railway that connects their town to more developed counties to the north and south (Figure 8b).

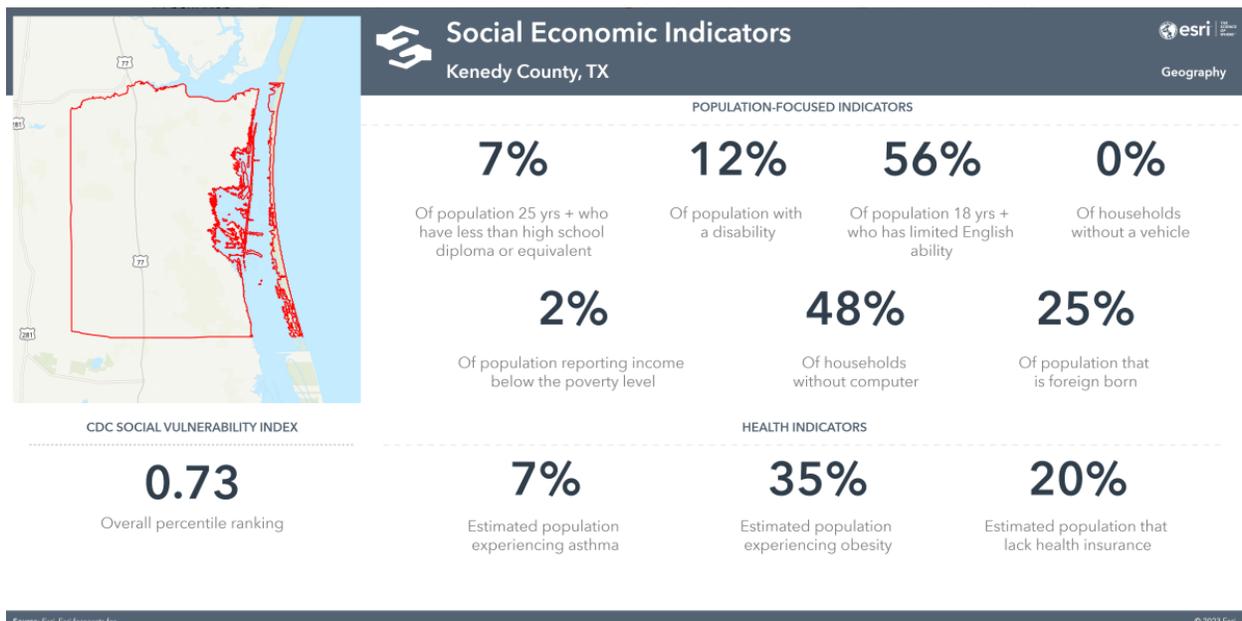


Figure 5c. Social Vulnerability “Infographics” tab from GeoRED.org. Depicted is a summary of Social Economic Indicators for Kleberg County, TX based on the CDC’s Social Vulnerability Index.

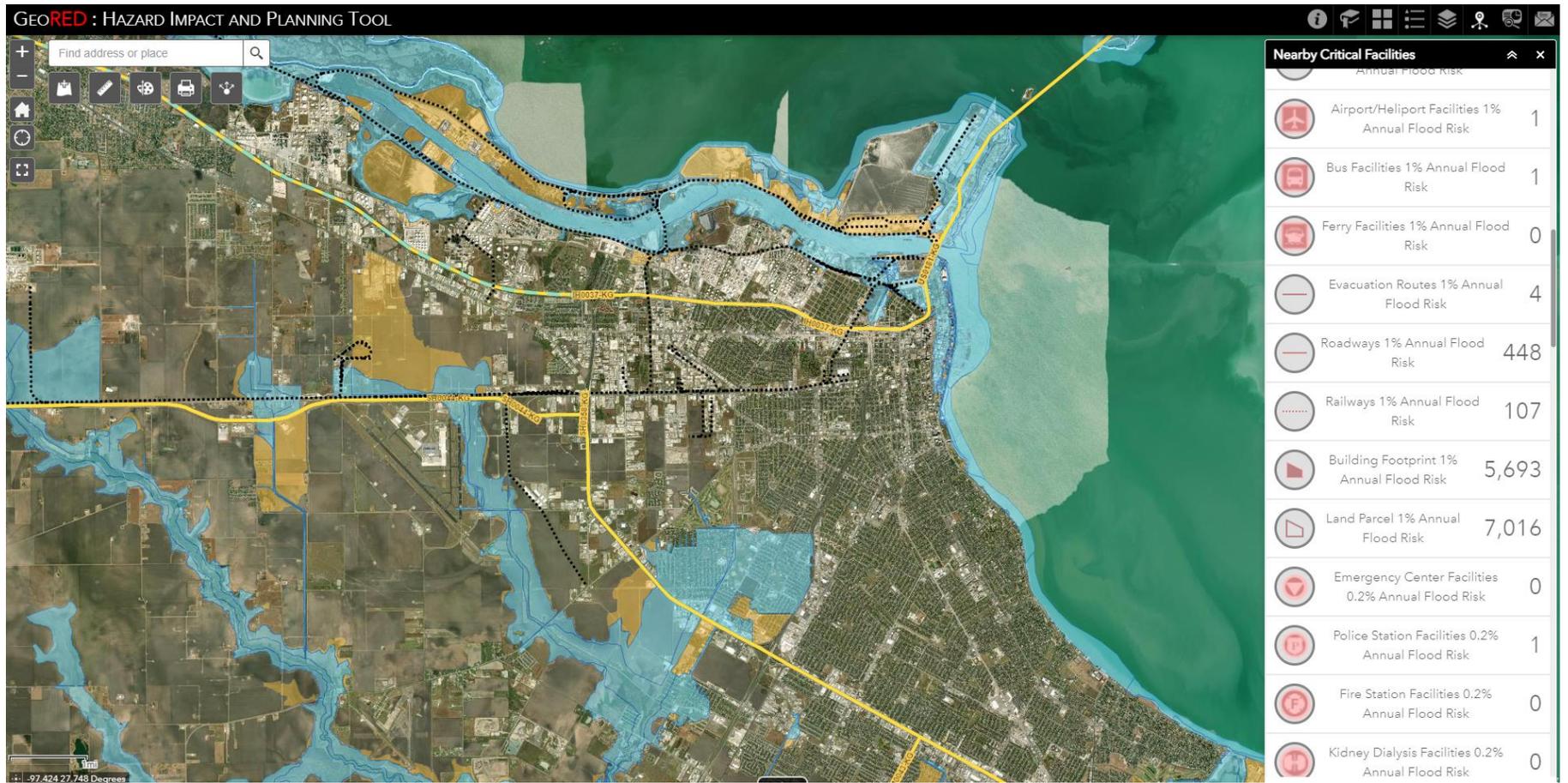


Figure 6a. A screen shot of GeoRED’s Hazard Impact and Planning Tool. The area depicted is the northern segment of Corpus Christi, located in Nueces County, Texas. The blue shade represents the FEMA 1% Annual Flood Risk Areas, and the yellow shaded areas represent the FEMA 0.2% Annual Flood Risk Areas. The thick yellow lines are major evacuation routes, dotted black lines are railways, and the green dashed lines are potential contraflow. The side panel displays the number of Critical Facilities in this area.

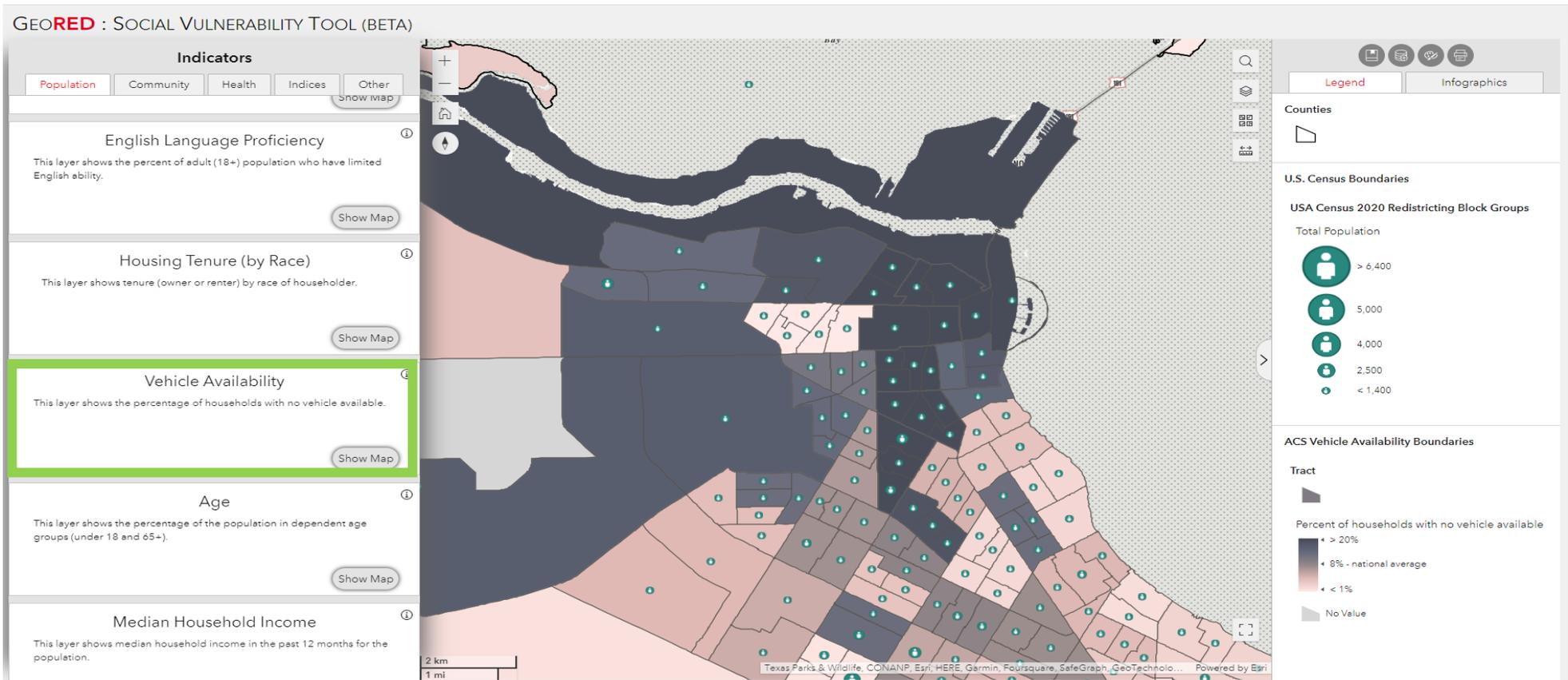


Figure 6b. A screen shot of GeoRED’s Social Vulnerability Tool. The area depicted is the northern segment of Corpus Christi, located in Nueces County, Texas. This map visualizes the percent of households with no vehicle available, where darker shading indicates a higher percentage. Total population is also shown by US 2020 Census Block Group.

GeoRED : SOCIAL VULNERABILITY TOOL (BETA)

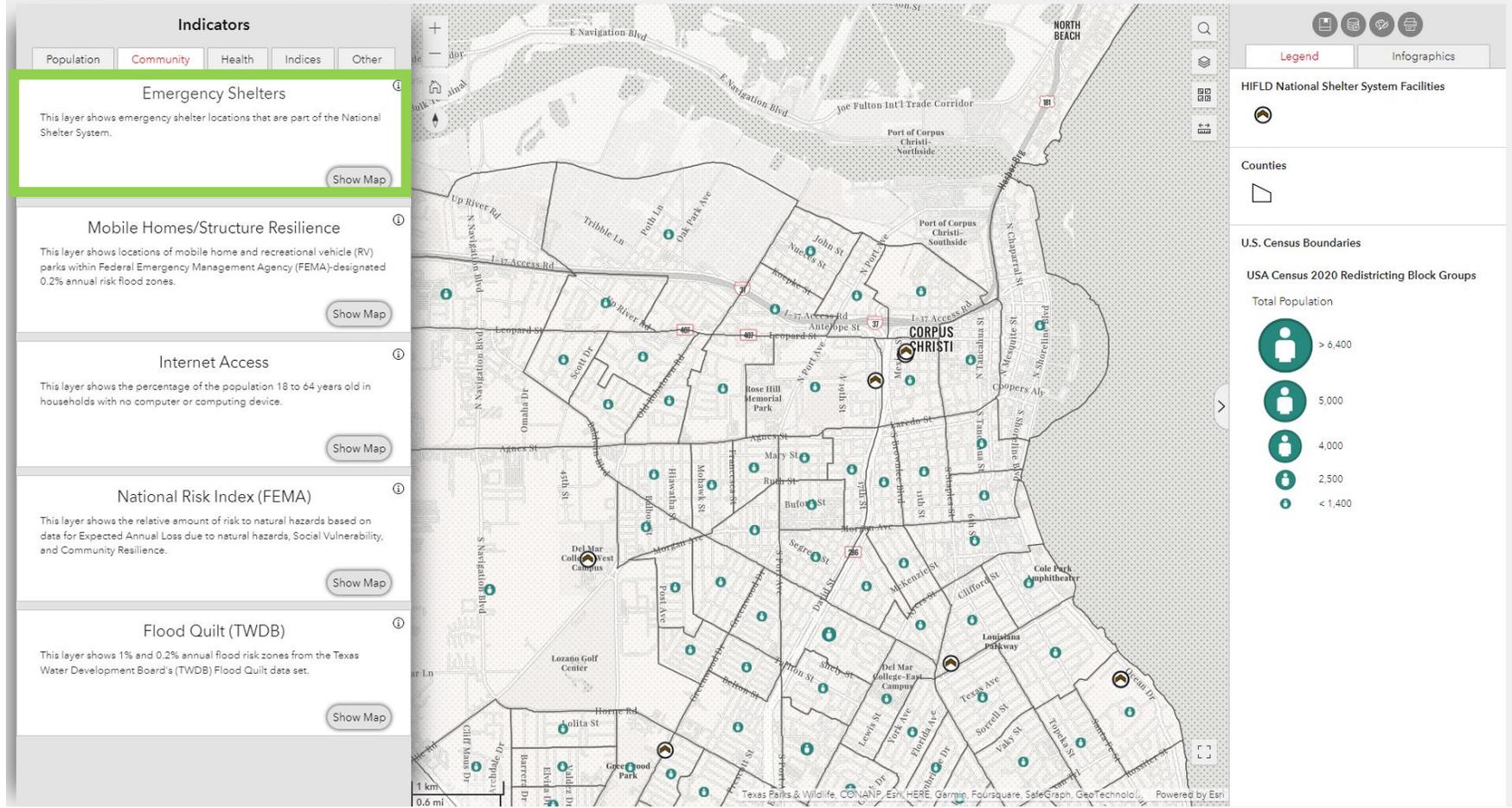


Figure 6c. A screen shot of GeoRED’s Social Vulnerability Tool. The area depicted is the northern segment of Corpus Christi, located in Nueces County, Texas. Depicted are locations of shelters associated with the National Shelter System at the street level. Total population is also shown by US 2020 Census Block Group.

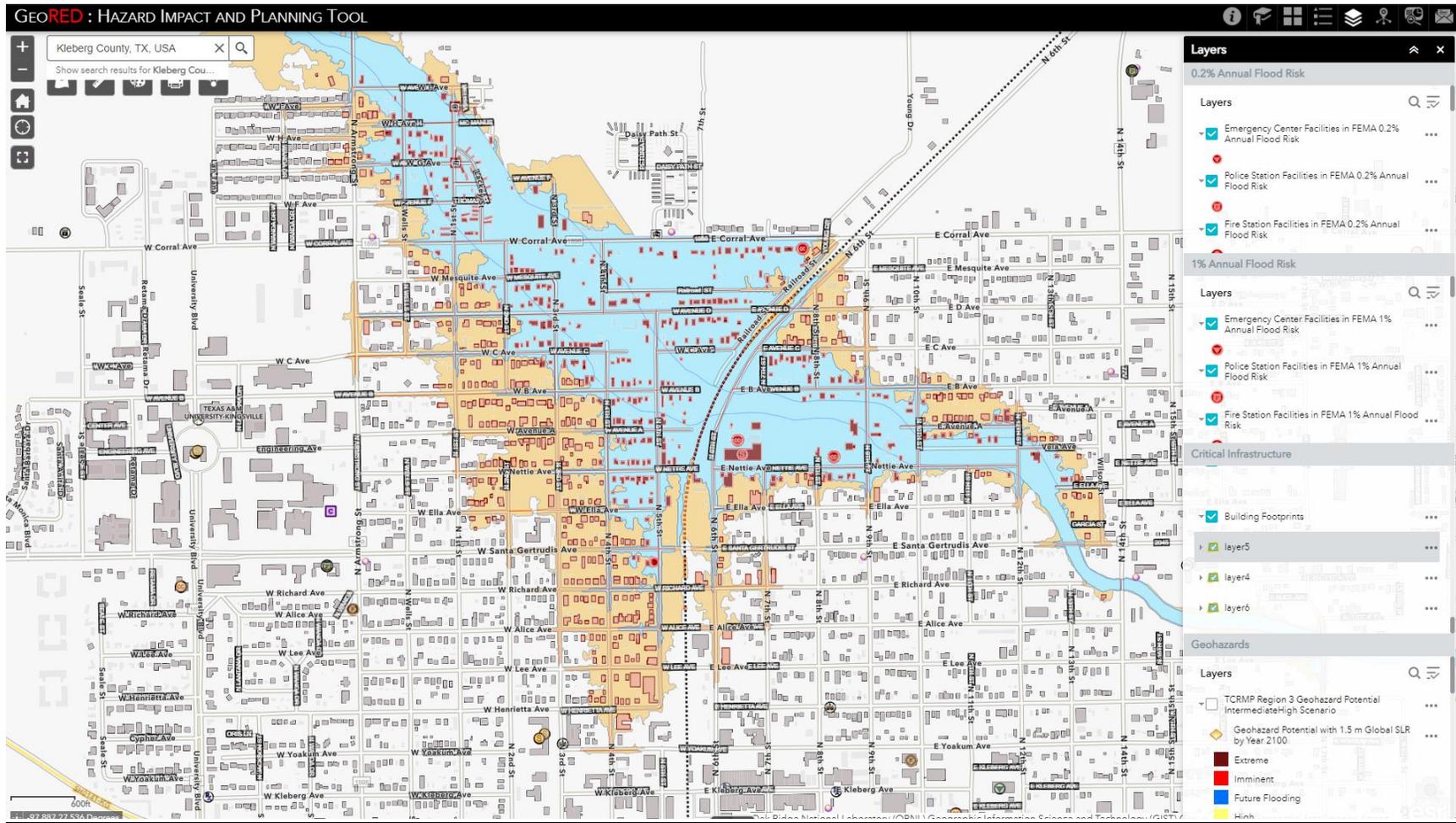
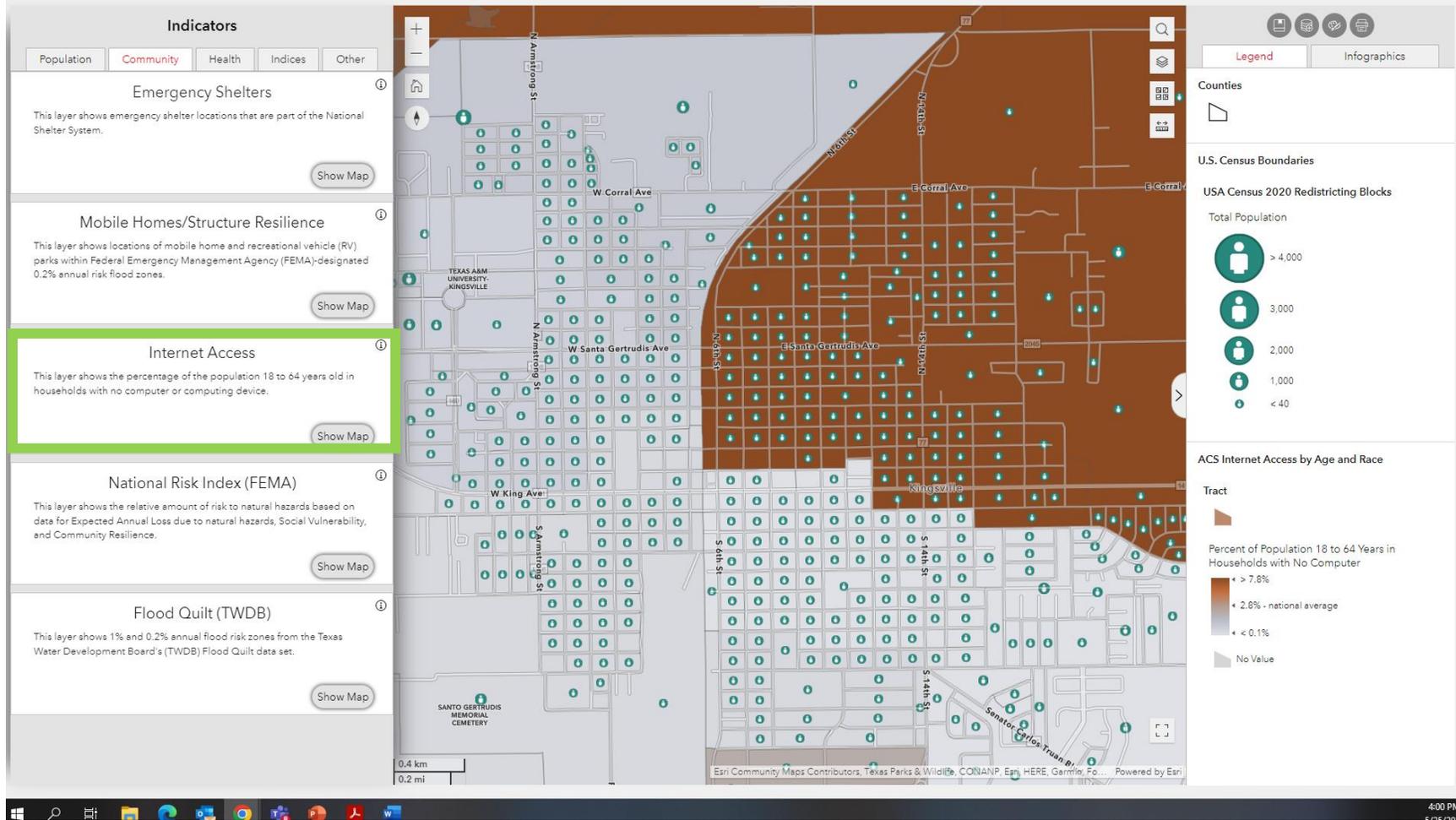


Figure 7a. A screen shot of the GeoRED Hazard Impact and Planning Tool. Depicted is northwest Kingsville, Texas, located in Kleberg County. The blue shaded area indicated the 1% FEMA Annual Flood Risk Area, and the yellow indicates the 0.2% FEMA Flood Risk Area. The right-side panel displays available data layers that can be toggled on or off.

GeoRED : SOCIAL VULNERABILITY TOOL (BETA)



7b. A screen shot of GeoRed’s Social Vulnerability Tool, zoomed in on northwest Kingsville in Kleberg County, Texas. Depicted is the Internet Access (see green box on right panel) data layer. Brown shaded areas show Percent of Population 18 to 64 Years Old in Households with No Computer or Computing Device. Total population is also shown by US 2020 Census Block Group.

GeoRED : SOCIAL VULNERABILITY TOOL (BETA)

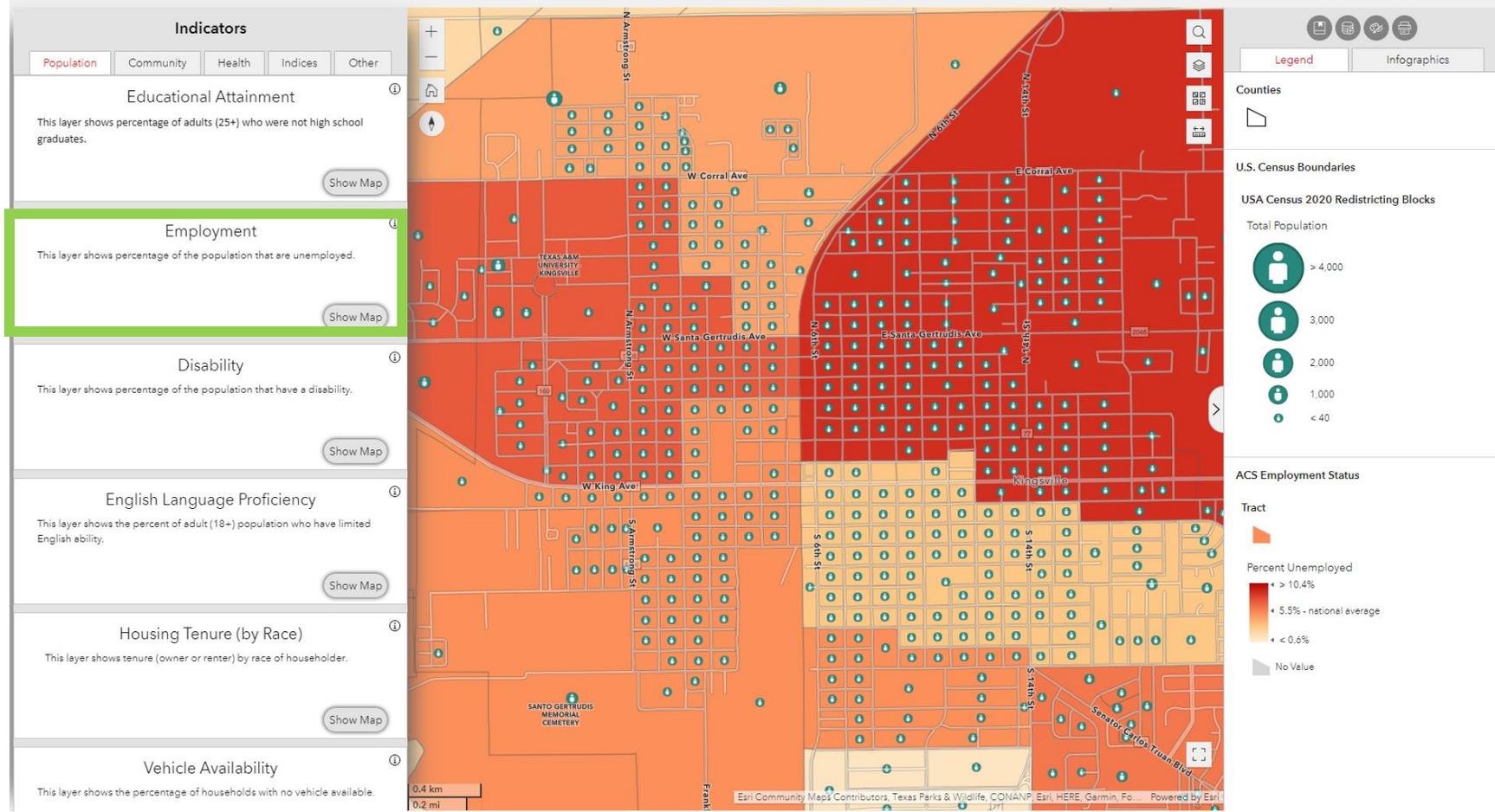


Figure 7c. A screen shot of GeoRED’s Social Vulnerability Tool, zoomed in on northwest Kingsville in Kleberg County, Texas. Depicted is Employment (see green box on right panel), where the red shows where more than 10.4 % of the population is unemployed, a key factor in determining vulnerability. Total population is also shown by US 2020 Census Block Group.

GeoRED : SOCIAL VULNERABILITY TOOL (BETA)

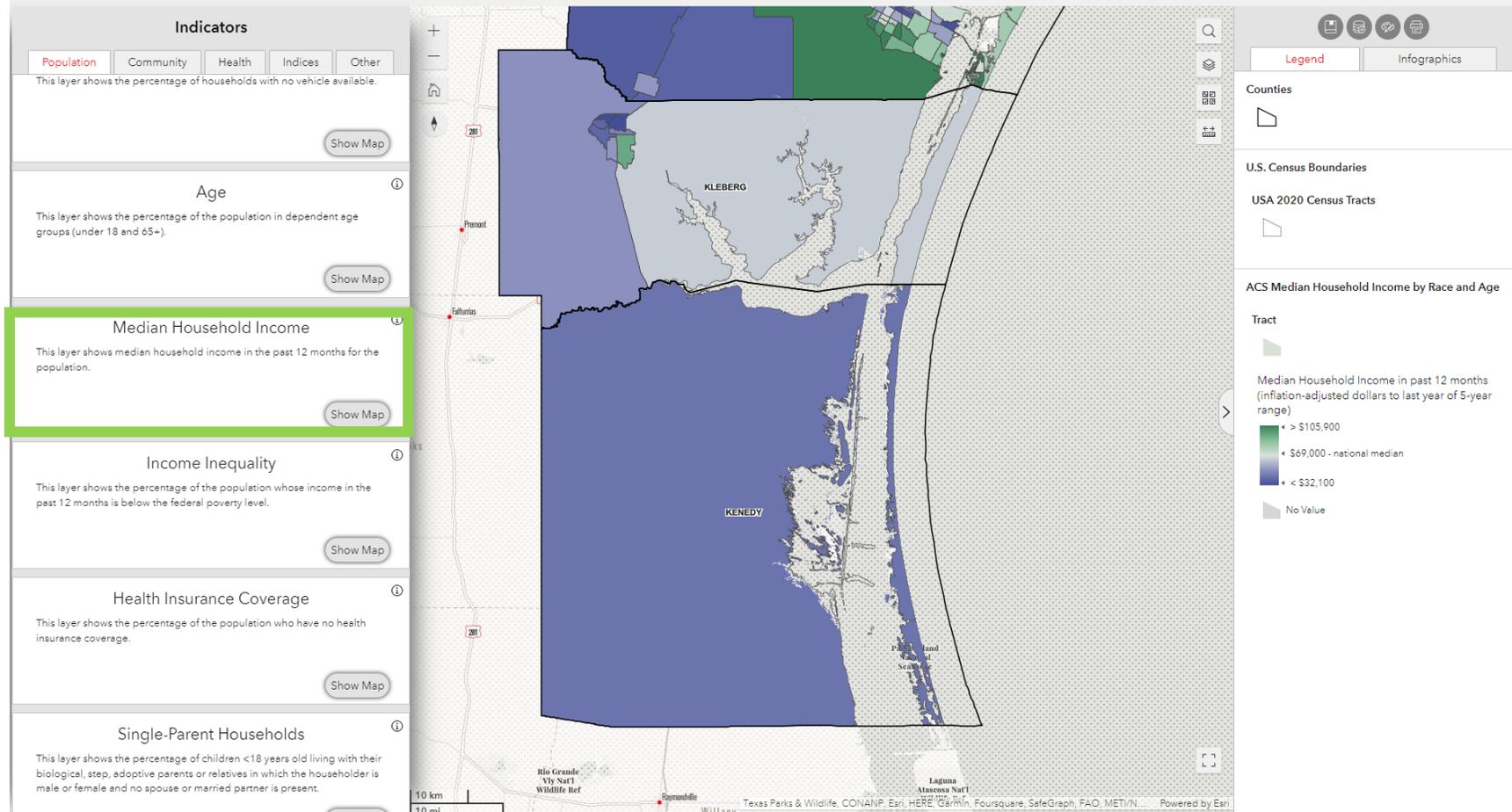


Figure 8a. A screen shot of GeoRED’s Social Vulnerability Tool, depicting Kenedy County, Texas’s Median Household Income in past 12 months. The darker purple shade indicates that the County’s median income is less than \$32,000. The national median is \$69,000. Data from American Community Survey, US 2020 Census.



Figure 8b. A screen shot of GeoRED’s Hazard Impact and Planning Tool, zoomed in on the town of Sarita in Kenedy County, Texas. While there are some FEMA 1% Flood Risk areas nearby, the town and its critical facilities do not sit within the risk areas (blue shade). The Railway is the black dotted line running north-south through the center of town.

Summary

The GeoRED platform is designed to be iterative, such that with continual engagement with Coastal Bend communities, the project team can adapt the tool and its accompanying resources to the evolving needs and interests of its users. While the tool will be officially launched later this year (soft launch was in May 2023 at the Annual Coastal Bend Hurricane Conference), there are several objectives the project team is actively working on. First, the Economic Development and Environmental Resilience data viewers will be finalized. Secondly, the team will create brief video tutorials for viewers that need guidance on how to explore the tools many data layers, with example scenarios. The team will explore options for producing these videos in both English and Spanish; if there are not enough resources to support Spanish translation this will be a priority in future funding opportunities for GeoRED. Also, the team plans to host in-person scenario training sessions based on “real-life” decisions, targeting those most likely to use the tool, such as county and city planners and emergency managers. Finally, the team is actively pursuing funding opportunities to continue development and long-term maintenance of the tool.

Going forward, the project team recommends that with additional funding, the geospatial coverage should be expanded to include additional Coastal Bend counties, as well as adjacent counties. This is important to our local partners, as many of them work with their neighbors across County lines, and expansion would improve planning and problem-solving. Expansion would also be more informative with regard to environmental decisions, for example, inland watersheds that impact drainage issues in the Coastal Bend.

Additionally, many Federal hazard mitigation funding opportunities require that a portion of awarded funds be used to support socially vulnerable or low to moderate income communities. GeoRED can aid in the identification of these communities and where they are in proximity to hazards at the local level (e.g. Community Development Block Grant). The team recommends going forward, that the social vulnerability data layers be merged with hazard layers within the tool. To reduce “load time” this may require that the team creates a separate module/data viewer for this that lives on the website, like the other four data viewers.

Finally, as restoration projects continue to be a priority for local, state, and federal agencies and institutions, and especially local decision-makers, the team recommends that the tool be used to plan for Nature-based restoration projects. For example, as many Coastal Bend communities continue to deal with erosion, flooding, and storm surge, while population continues to expand, they are faced with how to maintain their economy in step with the changing environment. Among many types of Nature-based restoration projects are gray and green-gray infrastructure projects, and communities could potentially benefit from utilizing GeoRED for site selection, project planning, and development.