

A close-up photograph of several bright green, serrated leaves on a thin brown branch, set against a blurred background of more green foliage and a bright sky. The leaves are the primary visual element, occupying the upper and middle portions of the frame.

Development of a Municipal Vulnerability Index

Final Tool Presentation
February 20, 2024



Welcome

MVI Task Group Membership

- Science & Data Subcommittee
 - Dr. Lesley-Ann Dupigny-Giroux
 - Dr. Jay Shafer
- Just Transitions Subcommittee
 - Sue Minter
 - Carey Hengstenberg
 - Paula Melton (also a member of the Rural Resilience & Adaptation Subcommittee)
- Rural Resilience & Adaptation Subcommittee
 - David Snedeker
 - Stephanie Smith
 - Ben Rose
 - Caroline Paske
 - Anne Margolis
 - David Grass
 - Bronwyn Cooke
 - Andrea Wright

Agenda

- Welcome (12:00pm - 12:10pm)
- Current Project Status and Timeline (12:10pm - 12:15pm)
- Update on Tool Development (12:15pm - 12:35pm)
- Tool Walk-Through and Use Cases (12:35pm -1:10pm)
- Questions and Comments (1:10pm - 1:30pm)

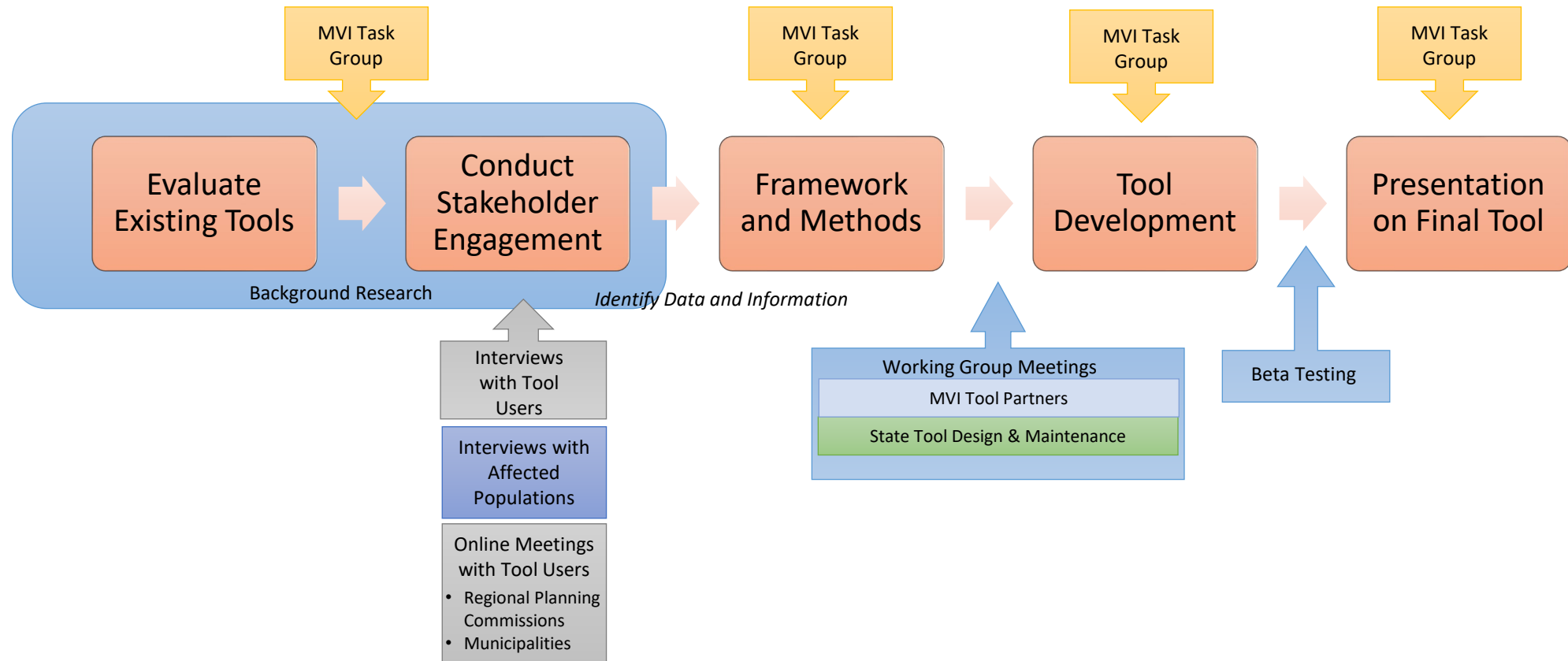
Current Project Status and Timeline

Current Project Status and Timeline

- Wrapping up first iteration of MVI (end of February)
 - Conducting presentations on final tool
 - Making final tool edits
 - To be transferred to Vermont ArcGIS profile when finalized
- Currently developing (by mid-April):
 - MVI user guide
 - Final project report
- MVI released for use: Anticipated mid-April 2024
- Tool training for regional planning commissions: April-May 2024

Update on Tool Development

Tool Development Process



Methods and Framework

- Flexible user-guided approach
- Geospatial data layers represent factors
- Outputs layered geospatial information rather than single vulnerability metric or score
- Users can select a location and conduct their own assessment of vulnerability for each hazard
- Indicates where a municipality is above the State threshold for non-geospatial factors

Methods and Framework (2)

- Integrates existing datasets
- Underlying data for each of the factors and hazards is accessible to provide more details
- Tool designed to be updateable

Tool Development

- Working sessions with developers of BioFinder, TRPT, and Community Resilience Index to ensure alignment
- Collaborative effort with Agency of Digital Services
- Developed in ArcGIS Experience Builder
- Using out-of-the box functionality
- Designed to align with Vermont systems, software, and related tools
- To be transferred to Vermont ArcGIS profile when finalized

Developing the MVI in ArcGIS Experience Builder

- First iteration of tool uses an off the shelf version that allows:
 - Foundational elements of tool to be built in an efficient manner
 - Opportunity to identify where customization most beneficial in future iterations of tool
- Considerations
 - “Out-of-the box” functions dictate what’s possible, including:
 - Options for customization of aesthetics
 - Customization around integrating certain types of web services
 - Customization of Experience Builder functions (layers, legend, print, controller)

Tool Testing

- Questionnaire implemented using Qualtrics online survey software platform
- 11 of 29 invited individuals participated (38%)
- Participants were given two written scenario exercises to practice using the tool
- Asked a series of 9 core questions to elicit feedback on tool:
 - Aesthetics
 - Functions/Features
 - Ease of Use
 - Suggested Improvements
- Feedback incorporated or captured in final report for future iterations

Tool Testing: Summary of Findings

- Overall, testers generally felt the tool was visually appealing and had a lot of potentially useful information
- Themes for suggested improvement include:
 - Update/Revise color schemes
 - Control/Selection of layers is not intuitive
 - Overlay of layers and need for transparency feature can be frustrating
 - Desire for more help interpreting data and providing data references
 - A detailed user guide with clear instructions and examples could be helpful

Tool Testing: Addressing Feedback

- Comments were addressed by:
 - Adding new boundary layers for Counties, Regional Planning Commissions boundaries, and Distribution Utility Service Territories boundaries
 - Adding data sources to the layer name, legend, and/or pop-ups on the map
 - Modifying colors schemes across different layers to make distinguishing them easier
 - Adjusting spatial extents and text contrast
 - Incorporating feedback into the user guide

Tool Testing: Addressing Feedback

- Feedback not possible to address in this iteration of the tool pertains to:
 - Methodological decisions
 - Data limitations
 - Standard features in Experience Builder
- Feedback not incorporated captured in final report for future iterations

Tool Walk-Through and Use Cases



Vermont Municipal Vulnerability Index

Find address or place

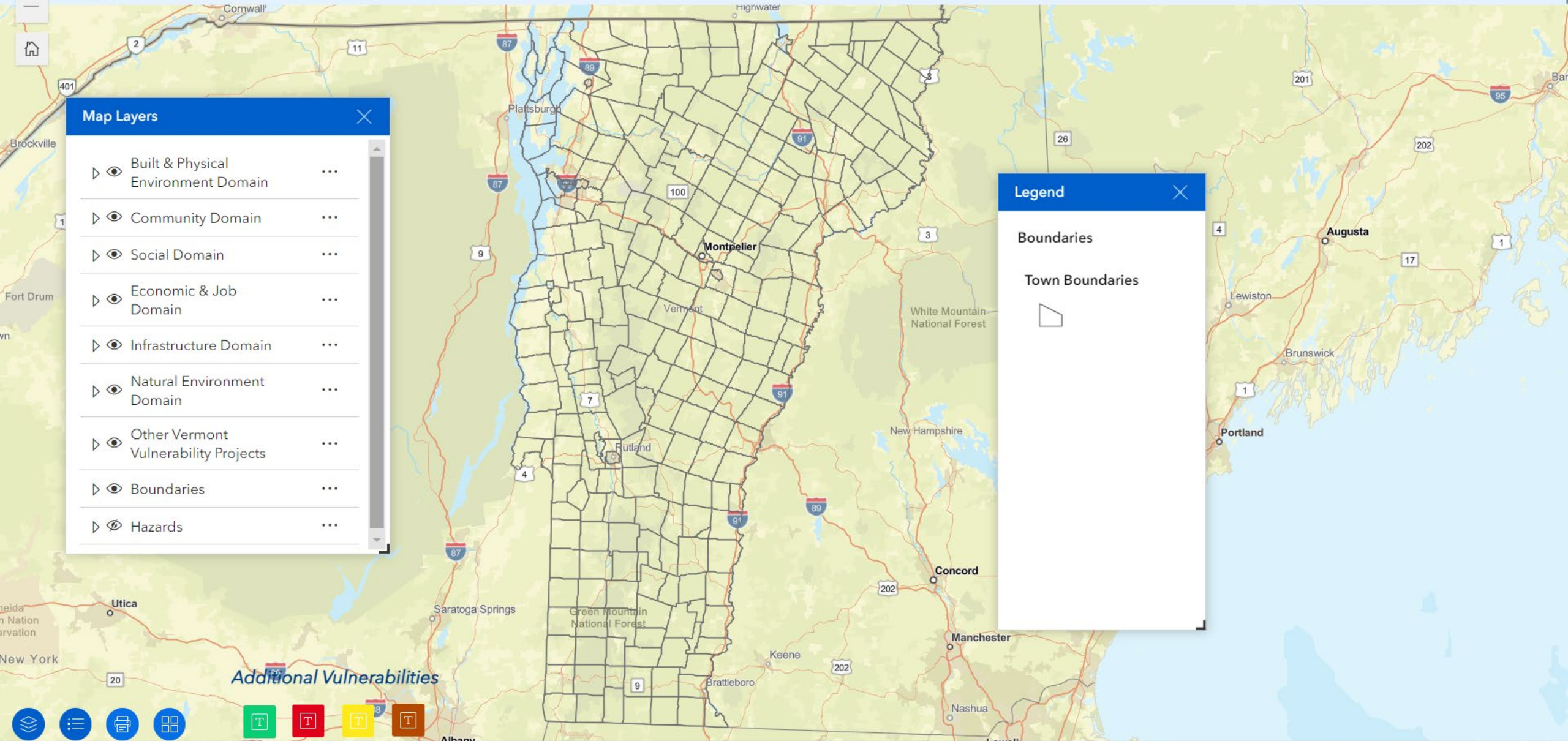
Map Layers

- Built & Physical Environment Domain
- Community Domain
- Social Domain
- Economic & Job Domain
- Infrastructure Domain
- Natural Environment Domain
- Other Vermont Vulnerability Projects
- Boundaries
- Hazards

Legend

Boundaries

Town Boundaries



Additional Vulnerabilities





Vermont Municipal Vulnerability Index

Find address or place

Map Layers

- ▶ Built & Physical Environment Domain ...
- ▶ Community Domain ...
- ▶ Social Domain ...
- ▶ Economic & Job Domain ...
- ▶ Infrastructure Domain ...
- ▶ Natural Environment Domain ...
- ▶ Other Vermont Vulnerability Projects ...
- ▶ Boundaries ...
- ▶ Hazards ...

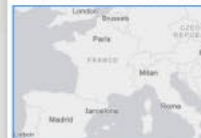
Legend

Boundaries

Town Boundaries



Basemap Gallery



Light Gray Canvas



Mid-Century Map



Modern Antique Map

Additional Vulnerabilities





Vermont Municipal Vulnerability Index

Find address or place



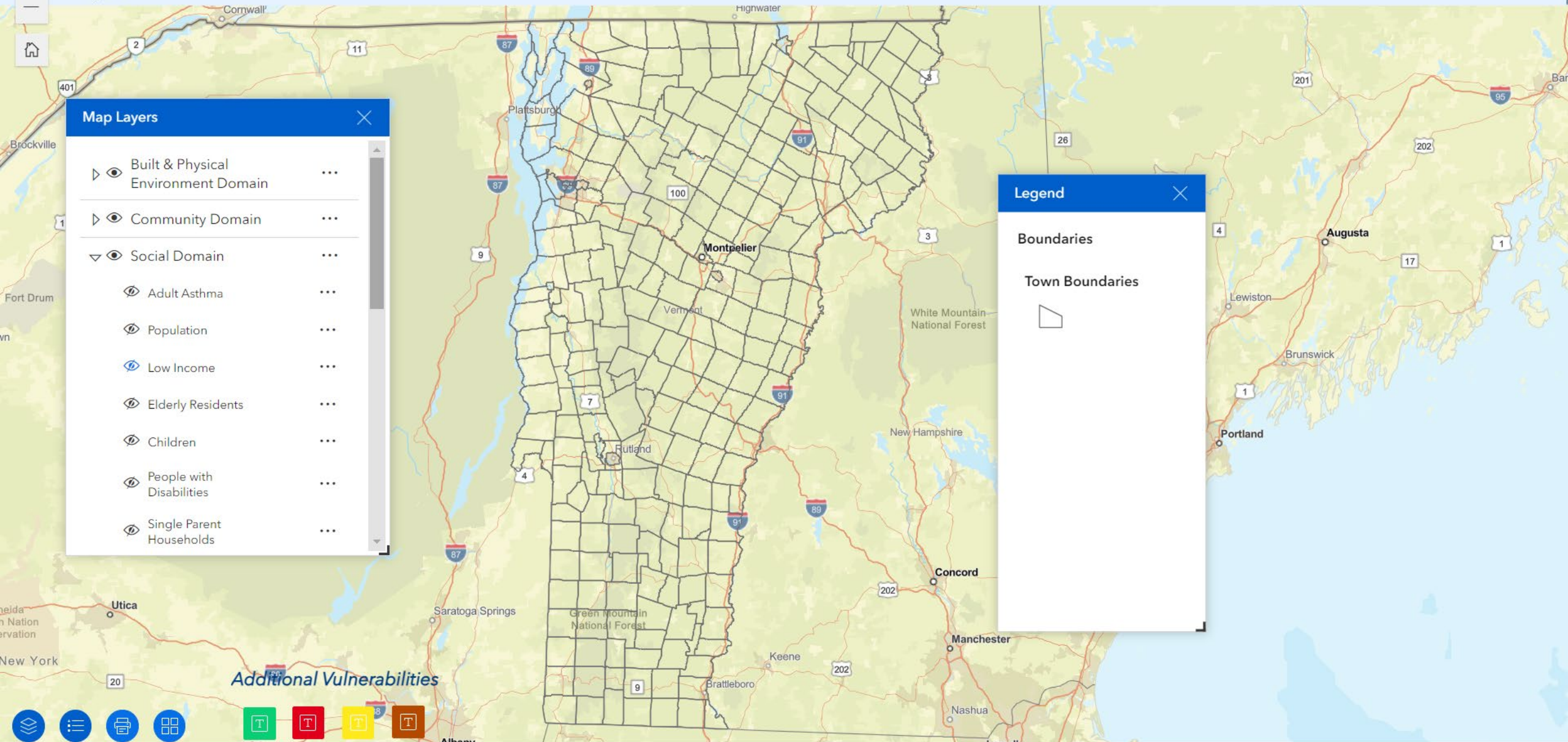
Map Layers

- Built & Physical Environment Domain
- Community Domain
- Social Domain
 - Adult Asthma
 - Population
 - Low Income
 - Elderly Residents
 - Children
 - People with Disabilities
 - Single Parent Households

Legend

Boundaries

Town Boundaries



Additional Vulnerabilities



Vermont Municipal Vulnerability Index

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Map Layers

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Legend

Social Domain

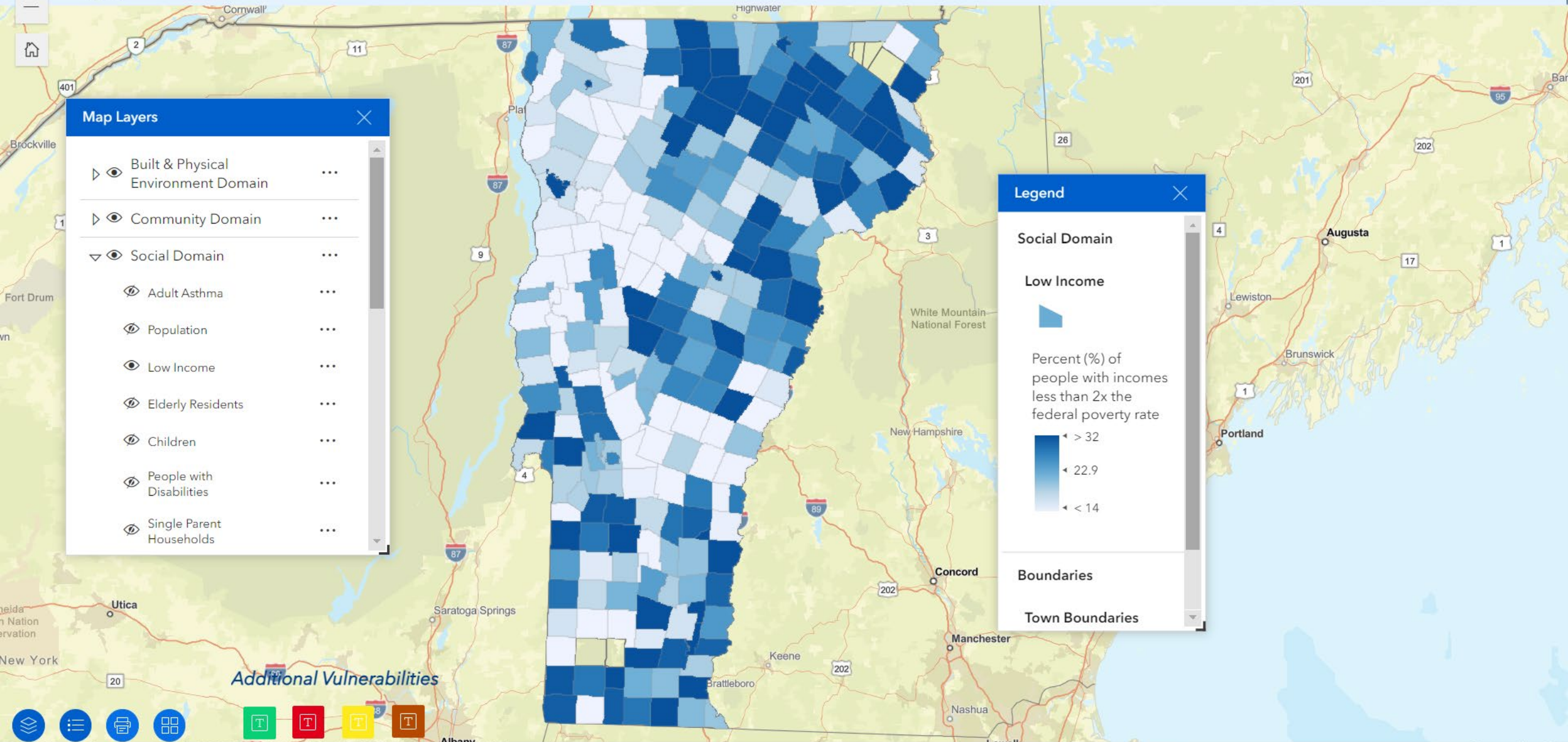
Low Income

Percent (%) of people with incomes less than 2x the federal poverty rate

- < 32
- < 22.9
- < 14

Boundaries

Town Boundaries



Additional Vulnerabilities



Vermont Municipal Vulnerability Index

Find address or place

Map Layers

- ▶ Built & Physical Environment Domain ...
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 - ▶ Elderly Residents ...
 - ▶ Children ...
 - ▶ People with Disabilities ...
 - ▶ Single Parent Households ...

Warren town, Washington County, Vermont

Zoom to

Low income percentage	32.46%
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Data Source: American Community Survey, U.S. Census Bureau

1 of 2

Legend

Social Domain

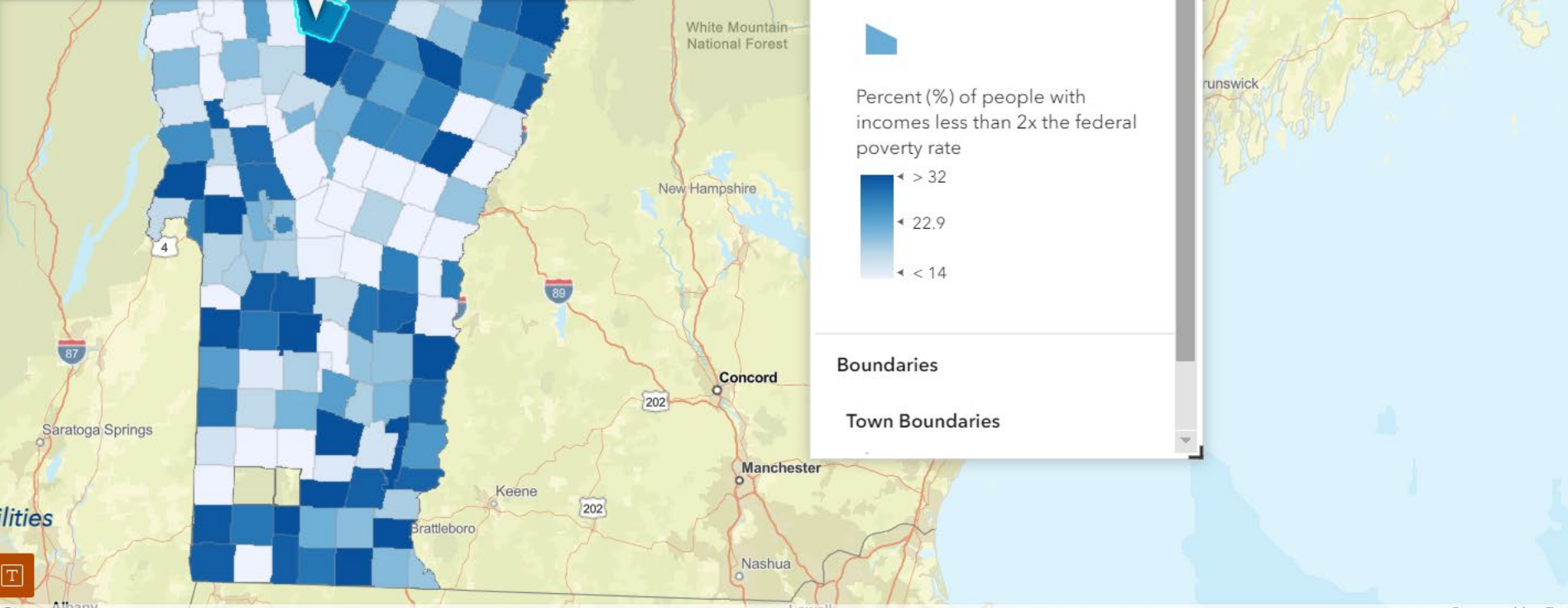
Low Income

Percent (%) of people with incomes less than 2x the federal poverty rate

- > 32
- 22.9
- < 14

Boundaries

Town Boundaries



Additional Vulnerabilities



Vermont Municipal Vulnerability Index

Find address or place



Map Layers

- ▶ Built & Physical Environment Domain
- ▶ Community Domain
- ▼ Social Domain
 - ▶ Adult Asthma
 - ▶ Population
 - ▶ Low Income
- ▲ Increase transparency
- ▼ Decrease transparency
- ⓘ Details
- ↑ Export
 - Export to JSON
 - Export to CSV**
 - Export to GeoJSON
- ▶ Elderly Residents

Legend

Social Domain

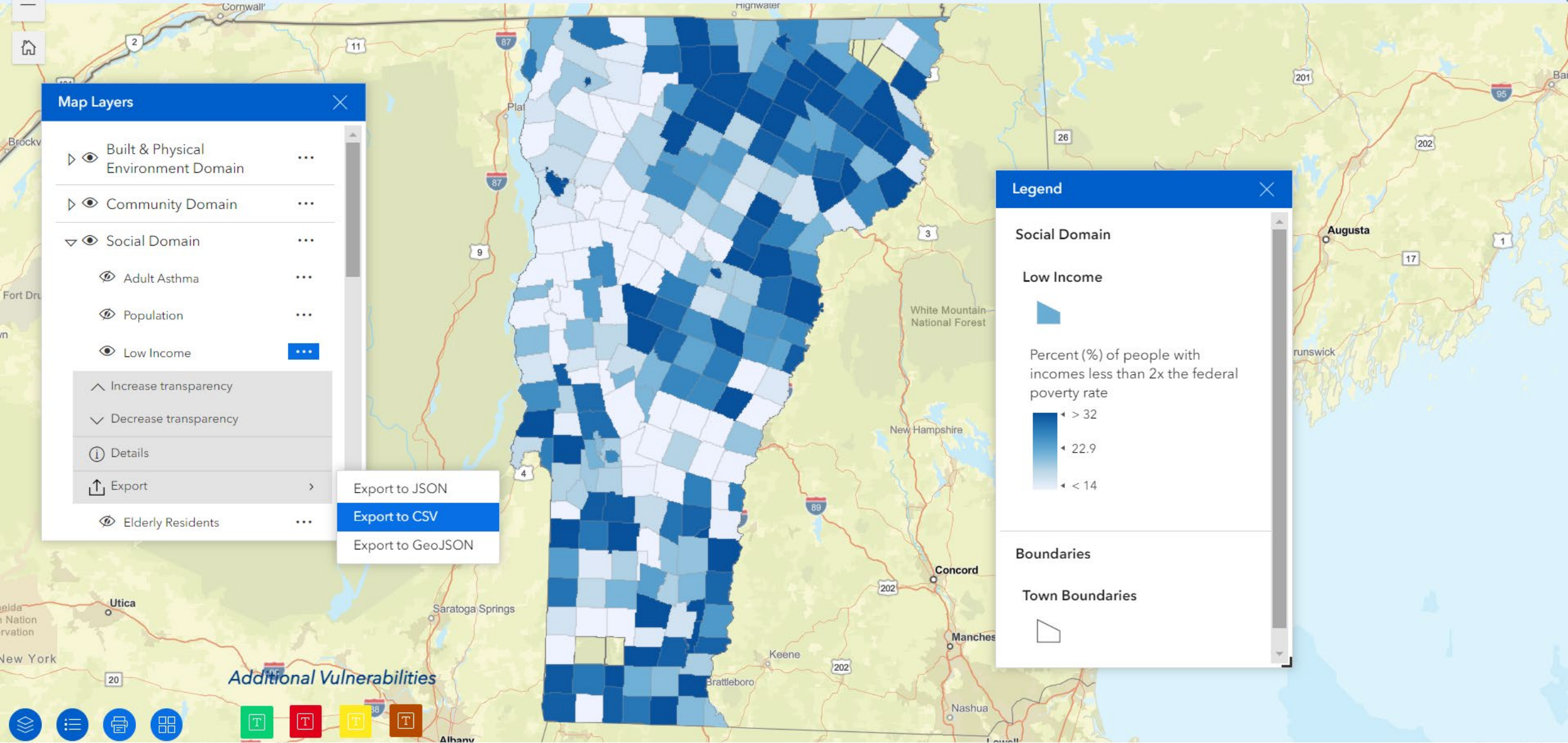
Low Income

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- ▶ > 32
- ◀ 22.9
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Boundaries

Town Boundaries



Additional Vulnerabilities



Vermont Municipal Vulnerability Index

Find address or place



Map Layers

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- ▶ Community Domain ...
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- ▶ Infrastructure Domain ...
- ▶ Natural Environment Domain ...
- ▶ Other Vermont Vulnerability Projects ...
- ▶ Boundaries ...
- ▶ Hazards ...

Granville town, Addison County, Vermont

Zoom to

Climate Vulnerabilities:

- Percentage of income is below the state average.
- Percentage of young residents is above the state average.
- Percentage of internet access is below the state average.
- Percentage of energy and transportation burden is above the state average.
- Percentage of outdoor workers is above the state average.
- Percentage of housing cost burden is above the state average.
- Limited municipal financial capacity.
- Limited municipal staff capacity.

Legend

Boundaries

Town Boundaries



Additional Vulnerabilities





Vermont Municipal Vulnerability Index

Find address or place

Map Layers

- Infrastructure Domain
- Natural Environment Domain
- Other Vermont Vulnerability Projects
 - Manufactured Homes in Flood Areas
 - Transportation Resilience Planning
 - Tactical Basins
- Rivers
- Bridges
- Culverts
- Roads

Legend

Other Vermont Vulnerability Projects

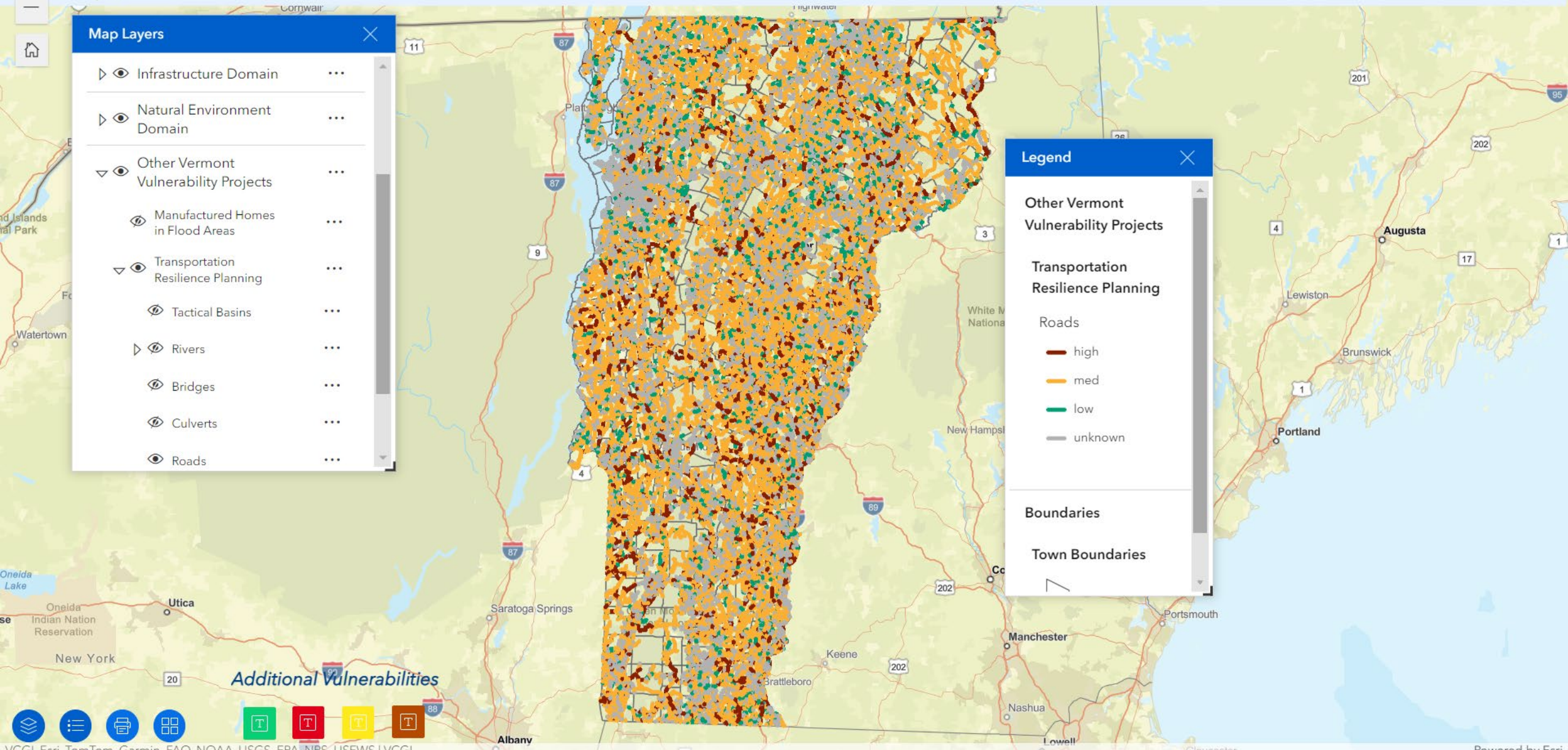
Transportation Resilience Planning

Roads

- high
- med
- low
- unknown

Boundaries

Town Boundaries



Additional Vulnerabilities



Vermont Municipal Vulnerability Index

Find address or place

Map Layers

- Vulnerability Projects
- Boundaries
- Hazards
 - Drought
 - Extreme Precipitation Projections (Days with precipitation greater than 2 inches). Data Source: UC San Diego
 - Fluvial Erosion - River Corridors. Data Source: VT DEC
 - Hail
 - Ice Storms

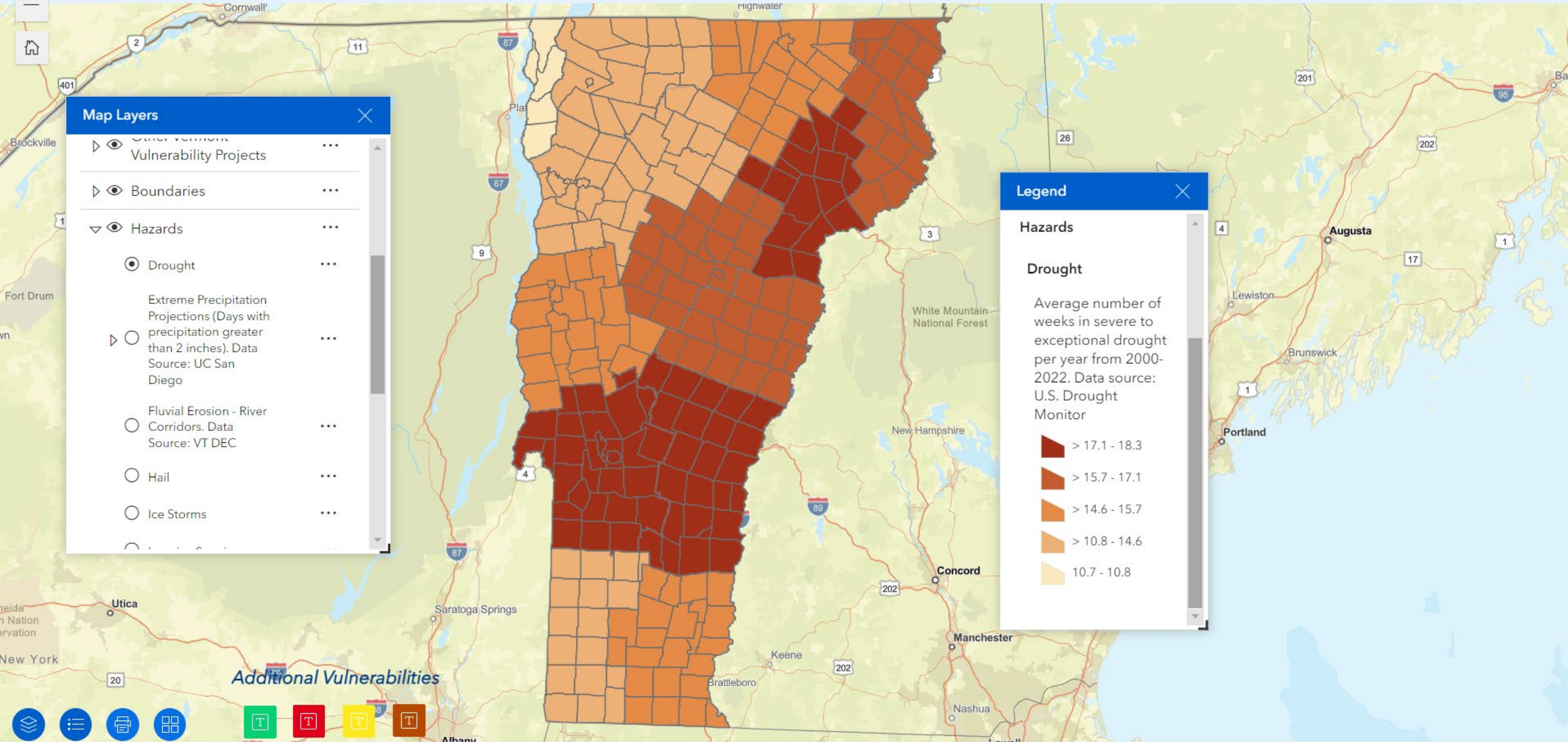
Legend

Hazards

Drought

Average number of weeks in severe to exceptional drought per year from 2000-2022. Data source: U.S. Drought Monitor

- > 17.1 - 18.3
- > 15.7 - 17.1
- > 14.6 - 15.7
- > 10.8 - 14.6
- 10.7 - 10.8



Additional Vulnerabilities

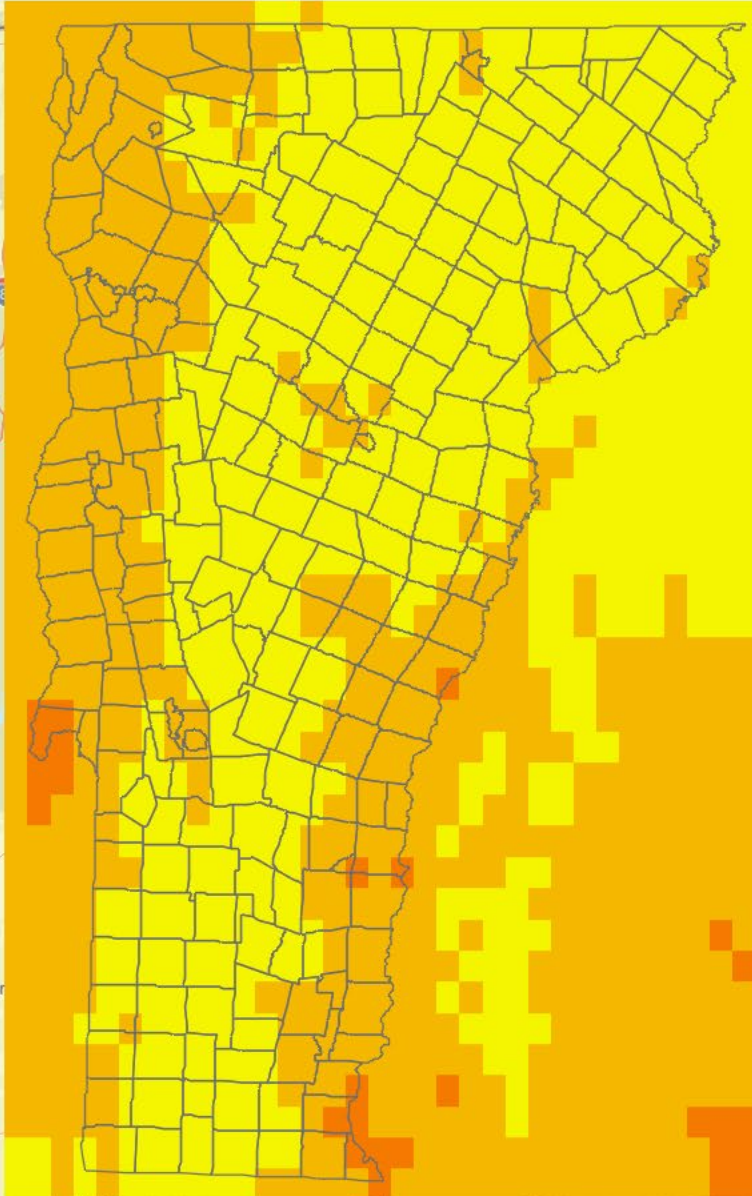


Vermont Municipal Vulnerability Index

Find address or place

Map Layers

- Snow Storms
- High Temperature Projections (Days above 90°F per year). Data Source: UC San Diego
- Middle of the Road (SSP2-4.5): 2015 - 2044
- Middle of the Road (SSP2-4.5): 2045 - 2074
- Middle of the Road (SSP2-4.5): 2075 - 2100
- Fossil-fueled Development (SSP5-8.5): 2015 - 2044



Legend

High Temperature Projections (Days above 90°F per year). Data Source: UC San Diego

Middle of the Road (SSP2-4.5): 2045 - 2074

- 0 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 100
- 100 - 120

Additional Vulnerabilities

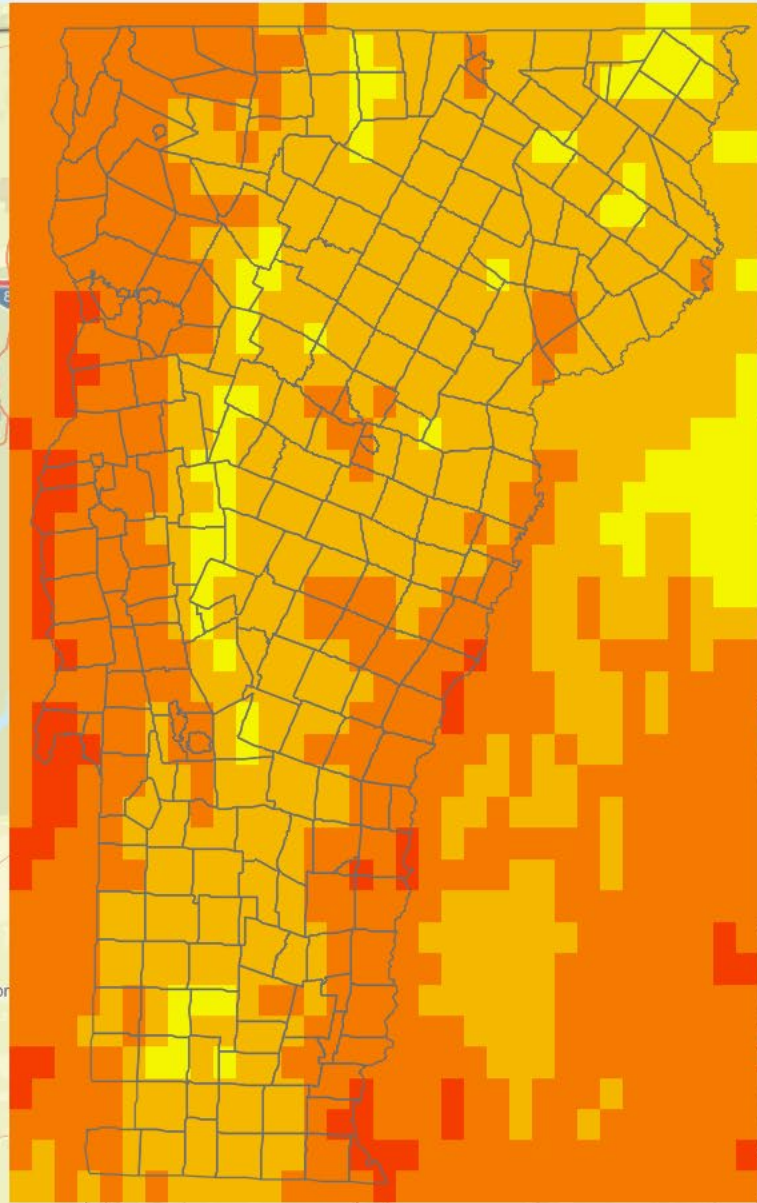


Vermont Municipal Vulnerability Index

Find address or place

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Legend

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- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 100
- 100 - 120

Additional Vulnerabilities



Vermont Municipal Vulnerability Index

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Built & Physical Environment Domain

have a widespread impact across the state. [Vermont Climate Assessment](#)

Heating and Cooling Centers: The presence of accessible and well-advertised heating and cooling centers in a community reduces life safety and health risks from extreme heat and extreme cold. It is important to consider location, accessibility, familiarity, and hours of operation when determining the value of heating and cooling centers to a community. Locating them in areas that are familiar to the community, having longer hours of operation, and including other benefits such as internet connections, games, clean water, and other necessities will increase their value and use. [The Role of Cooling Centers in Protecting Vulnerable Individuals from Extreme Heat](#)

Legend

High Temperature Projections (Days above 90°F per year). Data Source: UC San Diego

Middle of the Road (SSP2-4.5): 2045 - 2074

- 0 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 100
- 100 - 120

Additional Vulnerabilities





Vermont Municipal Vulnerability Index

Burlington, VT, USA



Search result



Burlington, Vermont

Map Layers

- Boundaries
- Hazards
 - Drought
 - Extreme Precipitation Projections (Days with precipitation greater than 2 inches). Data Source: UC San Diego
 - Fluvial Erosion - River Corridors. Data Source: VT DEC
 - Hail
 - Ice Storms
 - Invasive Species
 - Inundation Flooding
 - FEMA National Flood Hazard. Data Source: FEMA
 - Lake Champlain Basin Flood. Data Source: VT Center for GIS.
 - Landslides

Additional Vulnerabilities



Legend

Boundaries

Town Boundaries



Hazards

Inundation Flooding

FEMA National Flood Hazard. Data Source: FEMA

- AE (1-percent annual chance floodplains with elevations)
- A (1-percent annual chance floodplains without elevations)
- AO (1-percent annual chance zone of shallow flooding 1-3 feet)
- 0.2-percent annual chance flood hazard zone





Vermont Municipal Vulnerability Index

Find address or place

Map Layers

- Fluvial Erosion - River Corridors. Data Source: VT DEC
- Hail
- Ice Storms
- Invasive Species
- Inundation Flooding
 - FEMA National Flood Hazard. Data Source: FEMA
 - Increase transparency
 - Decrease transparency
 - Details
 - Export
- Lake Champlain Basin Flood. Data Source: VT Center for GIS.
- Landslides
- Snow Storms
- High Temperature

Additional Vulnerabilities



Legend

Boundaries





Town Boundaries



Hazards

Inundation Flooding

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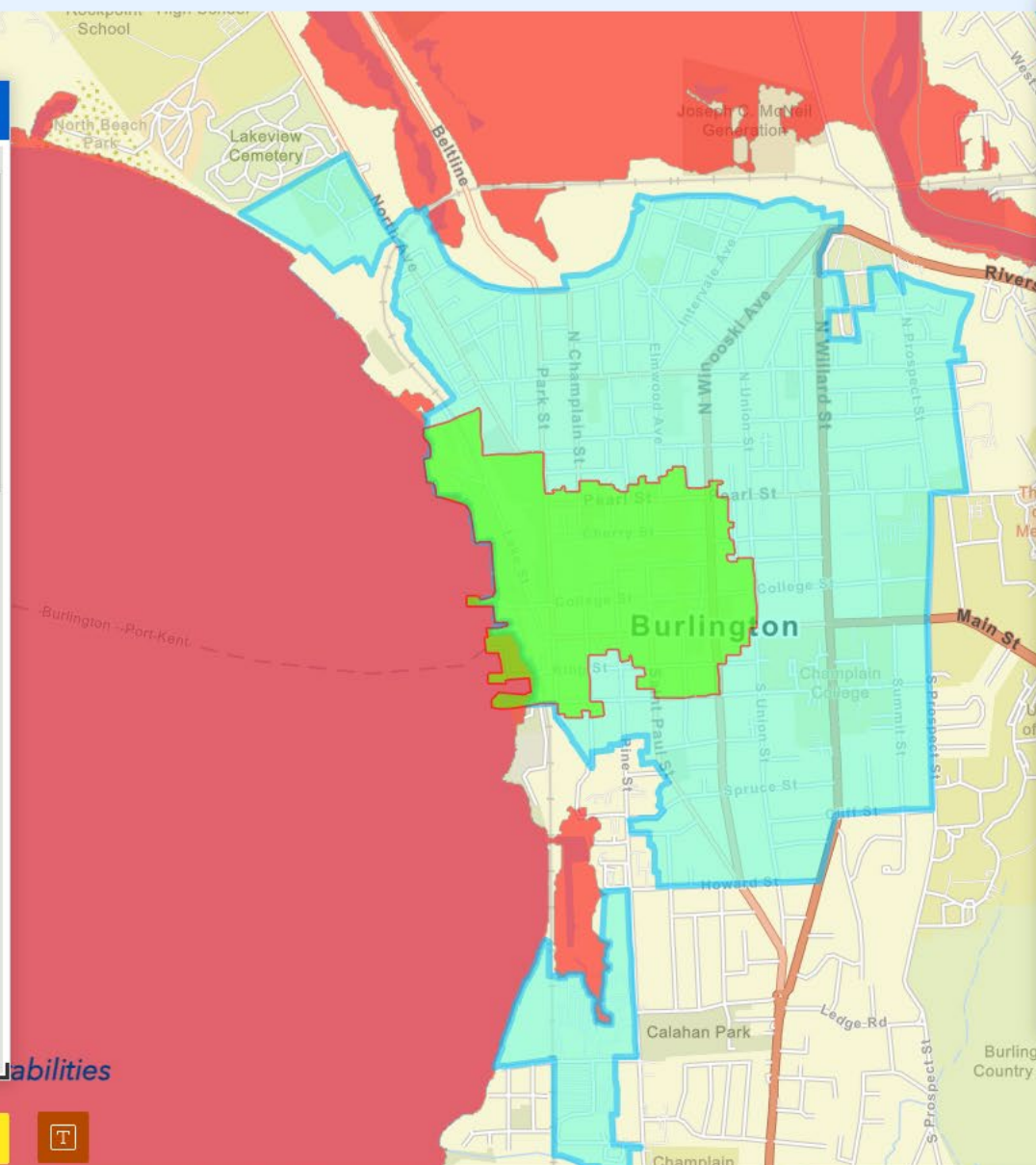


Vermont Municipal Vulnerability Index

Find address or place

Map Layers

- ▶ Built & Physical Environment Domain
- ▼ Community Domain
 - Designated Growth Center
 - Downtown District Boundaries
 - Municipal Financial Capacity
 - Municipal Staff Capacity
 - Neighborhood Development Area
 - New Town Center Boundaries
 - Plan + Regulation Status
 - State Register of Historic Districts
 - Village Boundaries
 - Emergency Relief & Assistance Funds
- ▶ Social Domain
- ▶ Economic & Job Domain



Legend

- Community Domain
 - Downtown District Boundaries
 - Neighborhood Development Area
- Hazards
 - Inundation Flooding
 - FEMA National Flood Hazard. Data Source: FEMA
 - AE (1-percent annual chance floodplains with elevations)
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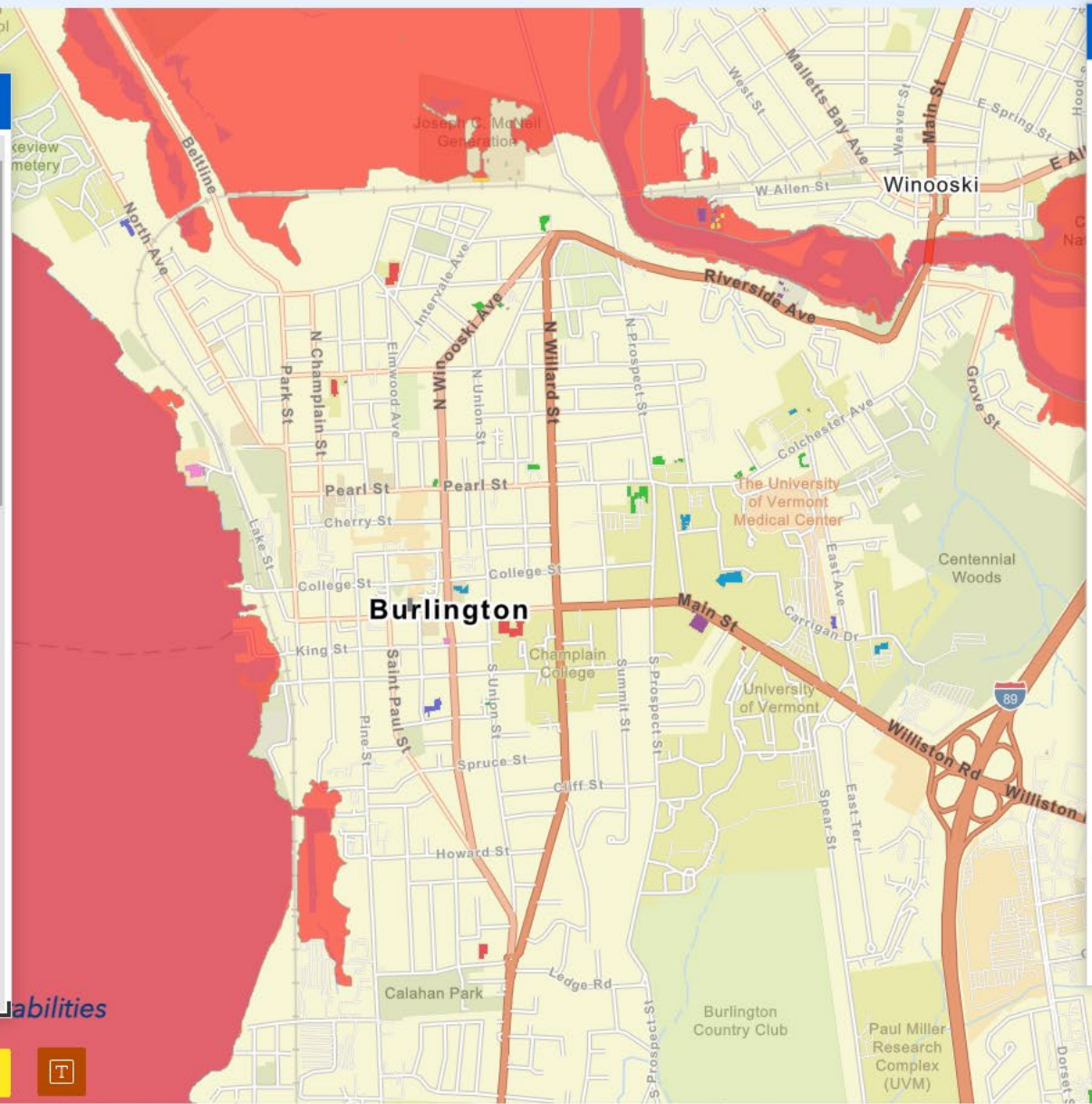


Vermont Municipal Vulnerability Index

Find address or place

Map Layers

- ▼ Built & Physical Environment Domain
- ▼ Critical Assets
- ▼ Emergency Services
- ▼ Mobile Homes
- ▼ Other Site Types
- ▼ Residential Dwellings
- ▼ Housing Age
- ▼ Community Domain
- ▼ Social Domain
- ▼ Economic & Job Domain
- ▼ Infrastructure Domain
- ▼ Natural Environment Domain
- ▼ Other Vermont Vulnerability Projects
- ▼ Boundaries



Legend

Built & Physical Environment Domain

Critical Assets

- SCHOOL K / 12
- LIBRARY
- HEALTH CLINIC
- TOWN GARAGE
- WASTEWATER TREATMENT PLANT
- COMMUNICATION TOWER
- SUBSTATION
- TOWN OFFICE
- UTILITY
- NURSING HOME / LONG TERM CARE
- HYDROELECTRIC FACILITY
- CITY / TOWN HALL
- PUBLIC WATER SUPPLY WELL

Hazards

Inundation Flooding



Vermont Municipal Vulnerability Index

Find address or place



Map Layers

- ▼ Built & Physical Environment Domain ...
- 👁 Critical Assets ...
- 👁 Emergency Services ...
- 👁 Mobile Homes ...
- 👁 Other Site Types ...
- 👁 Residential Dwellings ...
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- ▶ 👁 Infrastructure Domain ...
- ▶ 👁 Natural Environment Domain ...
- ▶ 👁 Other Vermont Vulnerability Projects ...
- ▶ 👁 Boundaries ...

Abilities

1 of 2

Critical Assets

Zoom to

Type of Site	WASTEWATER TREATMENT PLANT
Address	250 W ALLEN ST
Town	WINOOSKI
County	CHITTENDEN
Source Origin	E911
Update Date	3/4/2022, 5:33 AM

Legend

Built & Physical Environment Domain

Critical Assets

- SCHOOL K / 12
- LIBRARY
- HEALTH CLINIC
- TOWN GARAGE
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Hazards

Inundation Flooding





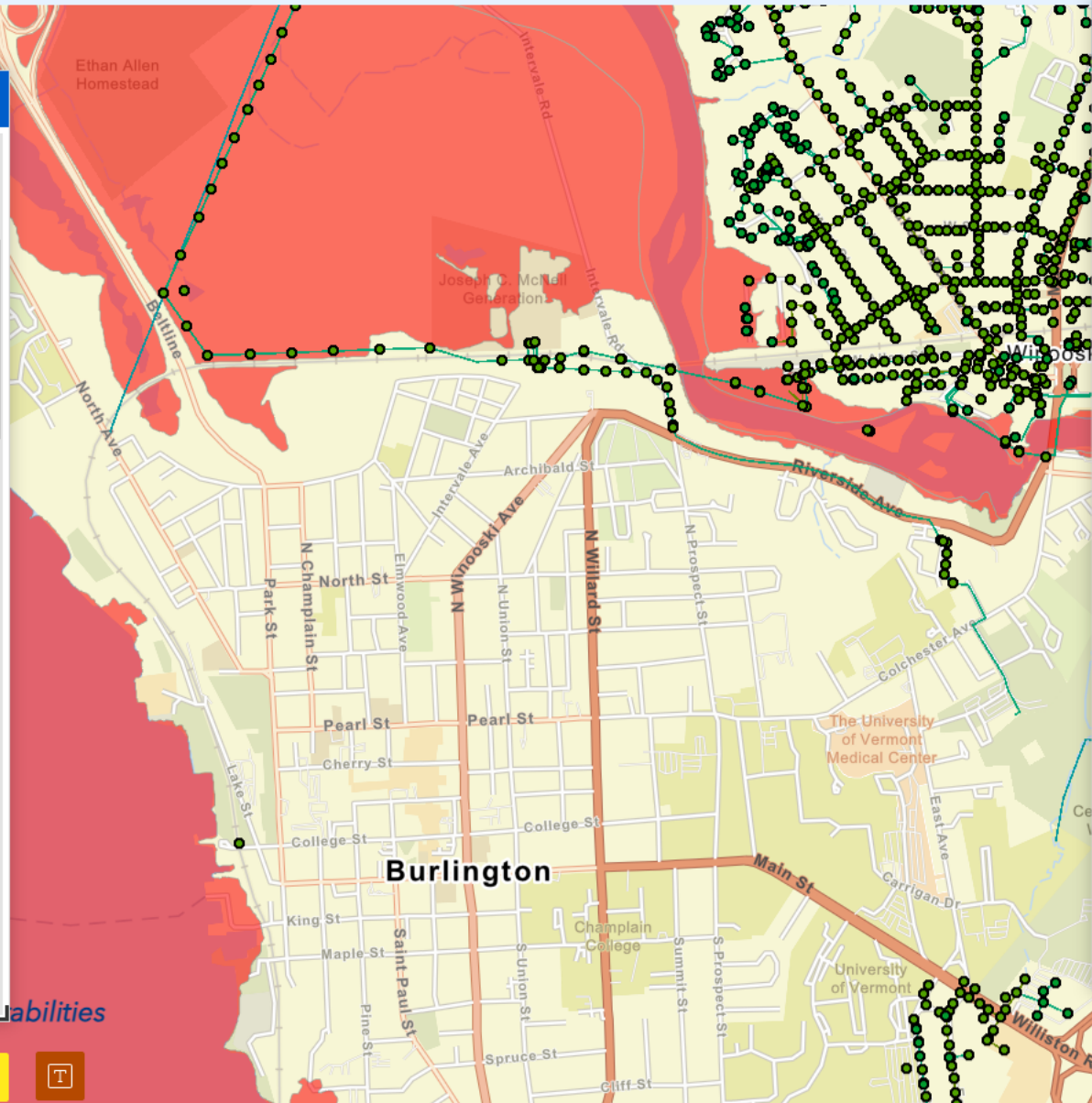
Vermont Municipal Vulnerability Index

Burlington, VT, USA

Search result

Map Layers

- Infrastructure Domain
 - Airports
 - Roads
 - Bridges
 - Culverts
 - Drinking Water Infrastructure
 - Electric Substations
- Impervious Surfaces (Vermont Open Geodata Portal)
- Power Lines (Green Mountain Power Lines)
 - VT Green Mountain Power Underground Structure Data
 - VT VEC Poles - Points
 - VT Telecommunication Facilities
 - VT Electric Transmission Line Corridors - substation points



Legend

Infrastructure Domain

Power Lines (Green Mountain Power Lines)

- VT Green Mountain Power Underground Structure Data
- VT VEC Poles - Points
- VT Green Mountain Power Pole Data
- VT 3-Phase-Power (Generalized) for Planning
- VT Green Mountain Power Line Data
- VT Electric Transmission Line Corridors - corridor lines
- VT VEC Primary Overhead and Underground Distribution Lines

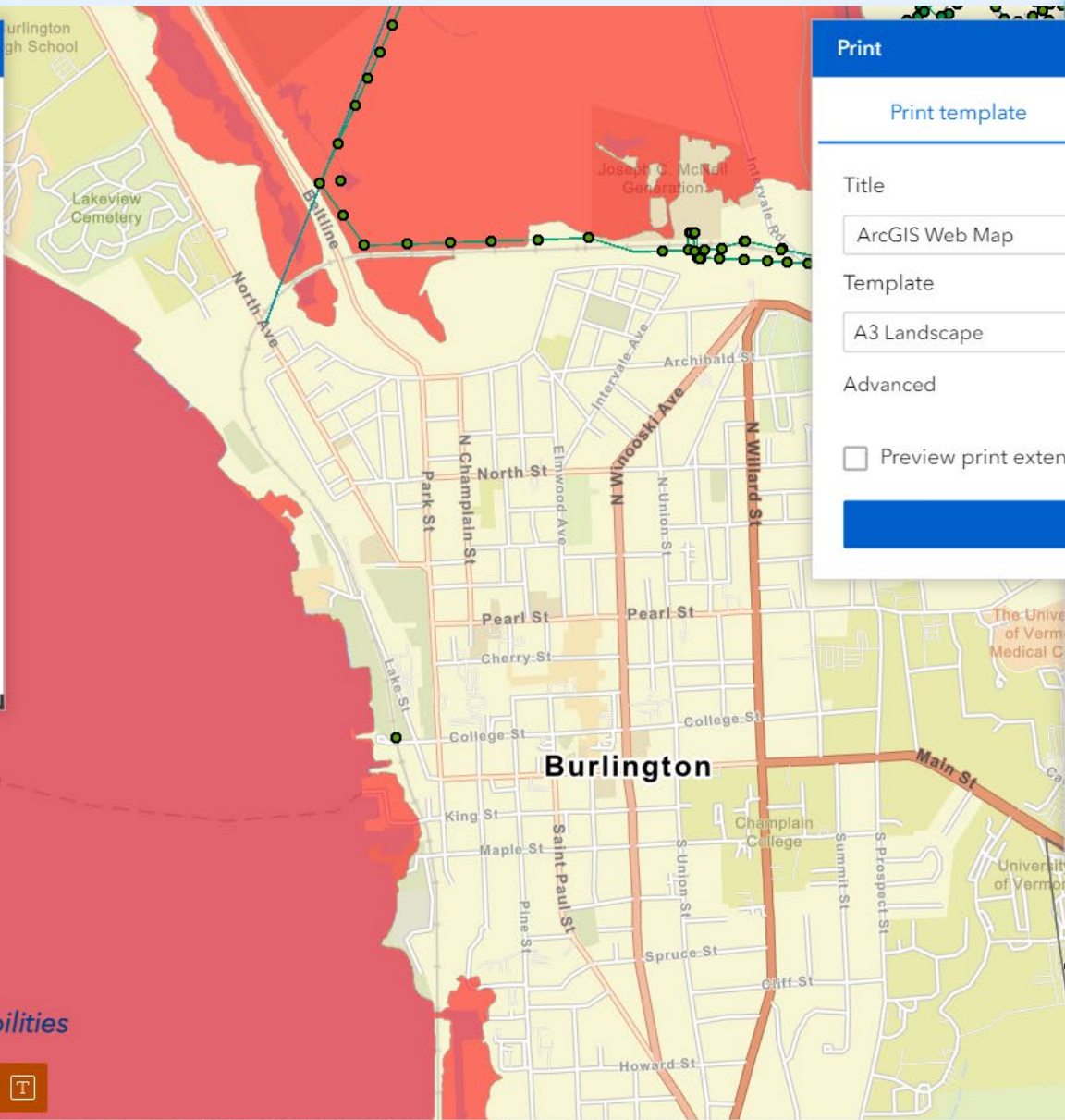


Vermont Municipal Vulnerability Index

Find address or place

Map Layers

- Line Data
 - VT Electric Transmission Line Corridors - corridor lines
 - VT VEC Primary Overhead and Underground Distribution Lines
 - VT Sewer Service Areas
 - VT Telephone Exchange Boundaries
 - Powerlines (VEC "spans" data)
 - Power Lines (WEC Utility Lines)
 - Power Plants and



Print

Print template | Print result

Title: ArcGIS Web Map

Template: A3 Landscape

Advanced

Preview print extents

Print

Legend

- VT Green Mountain Power Line Data
- VT Electric Transmission Line Corridors - corridor lines

Additional Vulnerabilities



Next Steps

- Finalizing MVI (end of February)
 - Making final tool edits
 - To be transferred to Vermont ArcGIS profile when finalized
- Development of project materials (by mid-April):
 - MVI user guide
 - Final project report
- MVI released for use: Anticipated mid-April 2024
- Tool training for regional planning commissions: April-May 2024

Questions?