GMP Resiliency Zone Screening

We've created a 12-point scale to evaluate which towns in GMP's service territory are the best candidates to be Resiliency Zones. This multivariate score is based on 3 categories worth 4 points each: reliability, social vulnerability, and connectivity. **A higher score indicates greater need for resilience work.**

We are very grateful to the Vermont Department of Public Service (DPS) for their feedback in developing this evaluation framework.

Reliability

Outage Frequency: Three points of the reliability score were determined by the number of outages a town experienced between 2014 and 2018. Town outage frequency was calculated as the average of customer outage counts in a 2000 foot grid between 2014 and 2018. Within each 2000 foot square, the total number of outages was divided by the total number of customers to give an outage per customer value within that square.Towns with 19-28 outages scored a 1, towns with 29-39 outages scored a 2, and towns with 40-64 outages scored a 3. Each town received the highest score within its bounds, so even if only a small portion of a town had 40-64 outages, the town scored a 3. **Not every town in our service area is included on our list-**-only those with a non-zero reliability score were ranked, as towns that experience infrequent outages do not require the same type of additional resilience investment.

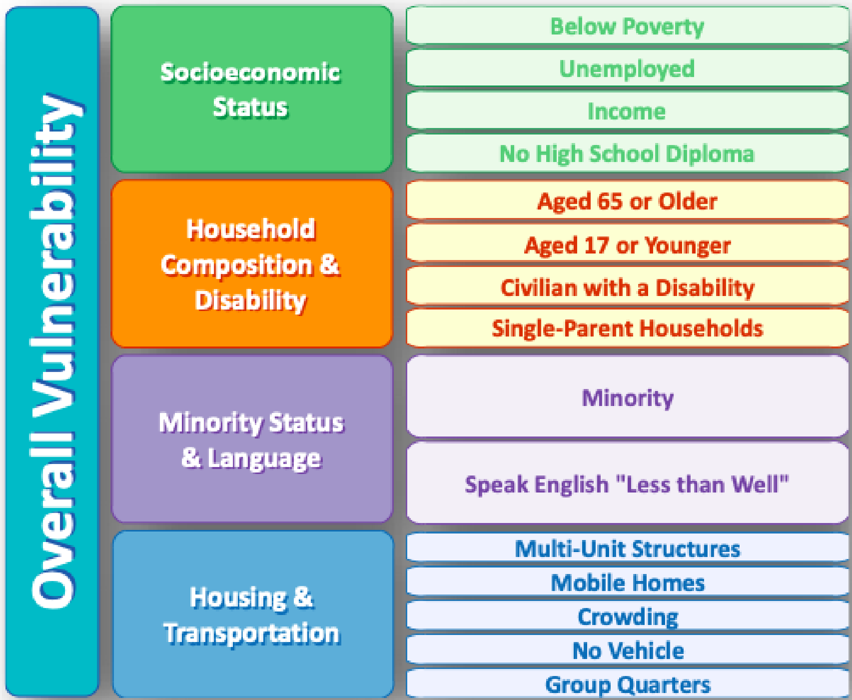
Outage Duration: The fourth point is based on long-duration outages. The data used for this is from 2017, 2018, and 2019 and was provided by Corey Chase (corey.chase@vermont.gov) at DPS. The number of 24+ hour outages for a given town was divided by the number of buildings in that town to determine an "outages per building" metric. The town with the most 24+ hr outages per building is Buel's Gore (0.18750) while the town with the least is Hartford (.00539). Based on these limits, we created an artificial floor of .00539, artificial ceiling of .18750 to adjust each town value to a percentile rank between 0 and 1. The calculation for this score was:

((#24+ hr outages/# buildings)-.00539)/(0.18750-.00539).

Social Vulnerability

CDC Index: For 2 points of the social vulnerability score, we've used the CDC's Social Vulnerability Index (SVI) which provides a composite score based on 15 census variables across 4 categories: socioeconomic status, household composition & disability, minority status & language, and housing & transportation. This measure was developed by the CDC to identify communities that "may need support before, during and after disasters." Possible scores range from 0 (lowest vulnerability) to 1 (highest vulnerability). For towns that contain portions of **two or**

more census tracts within their boundaries, the **highest CDC SVI score** was used. Raw SVI scores were scaled up by a factor of 2.



Note: Our map shows slightly different tract level SVI values than those shown in the CDC's map because we are using state-level data, which is scaled differently. From my email exchange with CDC SVI Coordinator:
"You are correct in that the **RPL_THEMES** variable represents overall social vulnerability. Second, the discrepancy you find is due to your use of two different databases – our U.S.-specific CDC SVI database and the Vermont-specific CDC SVI database. The U.S.-specific CDC SVI database compares the social vulnerability of a census tract (or county) to all tracts (or counties) in the U.S. The state-specific CDC SVI databases only compare the social vulnerability of a census tract (or county) to all tracts (or counties) within a particular state of interest. Within the CDC SVI Interactive Map, we show the U.S.-specific CDC SVI database. For your download, you likely obtained the CDC SVI database for Vermont. If you are only interested in how areas in Vermont compare to other areas in Vermont in terms of social vulnerability, then the state-specific database is sufficient."

Energy Burden: The other 2 points for social vulnerability were determined by town energy burden data from Efficiency Vermont's 2019 report. The lowest energy burden is 5.6396% (Norwich) while the highest energy burden is 15.2734% (Lunenburg) were used to create an artificial floor and artificial ceiling to adjust town values to a 0-1 percentile score. This was then scaled to a 0-1 percentile using the formula (Energy Burden-5.6396)/(15.2734-5.6396) which was then scaled up by a factor of 2 to determine the energy burden score.

> Note: Buel's Gore did not have any data as it is a small, unincorporated town. I determined a placeholder score of 0.63 by averaging the scores of 4 neighboring towns (Fayston, 0.49; Starksboro, 0.74; Huntington, 0.56; Warren, 0.73). While this is an imperfect proxy, even with an energy burden score of 2 (the highest possible), Buel's Gore would not be in the top 15 towns.

Connectivity

Connectivity is a combination of fiber infrastructure, cable infrastructure, and cell service. Fiber/cable are based on the DPS building connection data. The cell service score is a scaled measure based on DPS drive test data. Each of these sub-categories is worth 2 points.

Fiber/Cable: For this section, we assumed that buildings with fiber or cable connections are more vulnerable during outages because these systems rely on electricity. Buildings without fiber or cable are connected by copper and are able to make calls even without power. The percent of buildings in a given town with (# buildings with fiber or cable/ total # buildings) was scaled up by a factor of 2 to determine the fiber/cable score. The data used for this is from 2017, 2018, and 2019 and was provided by Corey Chase at DPS.

Cell: DPS drive test cellular data measurements were used to calculate average town signal values. Signal strength is measured in RSRP in dBm (Reference Signals Received Power in decibel-milliwatts), where a more negative measurement is a worse signal. The worst average signal is -113 (Granville, Ferdinand, Averill) while the best average signal is -76.42 (Mount Tabor). Based on these limits, we created an artificial floor of 76, artificial ceiling of 113 to adjust average town values to a scale of 37. This was then scaled to a 0-1 percentile and then scaled up by a factor of 2 to determine the cell score. The actual town value was made positive before these adjustments were made so that the score was derived using the calculation ((|signal|-76)/37)*2.

Towns with no drive test data were pinned at the ceiling level (i.e. worst signal) and given a score of 2. This choice was based on the assumption that if a town is so remote there's not even a major road through it, then it probably doesn't have great cell service!

<u>Top 15 Towns</u>

The table below shows the top 15 towns using the 3-category, 12-point scoring methodology explained above.

Adjacent towns are highlighted in the same color, showing three primary clusters.

Town	Connectivity Score	Reliability score	Vulnerability score	Total score
Rochester	3.73	3.48	2.28	9.49
Grafton	4.00	3.26	1.92	9.18
Vershire	3.50	3.26	1.92	8.68
Danby	3.20	3.09	2.34	8.63
Athens	3.99	2.14	2.45	8.58
Brookline	3.89	3.04	1.55	8.49
Rockingham	2.97	2.02	3.37	8.36
Bethel	2.80	3.28	2.26	8.34
Brattleboro	3.18	2.01	3.11	8.29
Townshend	3.10	3.27	1.84	8.20
Strafford	3.62	3.14	1.39	8.15
Plymouth	3.52	3.16	1.43	8.11
Granville	3.79	2.42	1.86	8.07
West Fairlee	2.82	3.14	2.12	8.07
Putney	2.22	3.13	2.69	8.05