



Climate Vulnerability Assessment — Seasonal Drought

New Lebanon, NY

December 29, 2020

Prepared by Marc Anthonisen

Volunteer Task Force Advisor

New Lebanon Climate Smart Communities Task Force

MPA Candidate May '21

Cornell Institute of Public Affairs

mja45@cornell.edu

High-level Summary

Seasonal drought is expected to increase over the coming years and decades in New Lebanon, NY as greenhouse gases drive continual temperature increases. Along with other hazards, including storms and floods, drought should be anticipated to increase gradually. Impacts could include more dry wells in late summer and early fall, crop damage, increased wildfire risk, and changes to our local ecosystem. Mitigation actions could include increased drought monitoring, watershed protection, reducing water use, and planning for emergency water supplies.

Outline

Introduction.....	1
Regional Climate Projections.....	3
Assessing Seasonal Drought Risk.....	5
ClimAID and Mitigate NY.....	7
Climate Explorer.....	7
Richmond, MA Climate Vulnerability Analysis.....	8
Drought Risk Summary.....	9
Sensitivity.....	10
Mitigation and Resilience.....	10
Conclusion.....	11
References.....	11

Tables

Table 1: Ranking of hazards in Columbia County.....	2
Table 2: Projected temperature increases for New Lebanon.....	3
Table 3: New York State projections for extreme weather in New Lebanon.....	4
Table 4: Possible climate hazards for New Lebanon.....	5

Figures

Figure 1: Location of New Lebanon in New York State.....	2
Figure 2: Projected evolution in climate of update New York.....	4
Figure 3: Terrain and streams in New Lebanon.....	6
Figure 4: September solar radiation across Columbia County.....	6
Figure 5: NOAA Climate Explorer - Dry day projections.....	8
Figure 6: Location of Richmond, MA.....	9
Figure 7: Top climate hazards faced by Richmond, MA.....	9

Introduction

One of the key activities of the New York State Climate Smart Communities program is for municipalities to assess their vulnerability to climate change and to develop mitigation and resilience strategies. These activities are listed under the seventh "Pledge Element" category, or "PE7" ("Climate Smart," n.d.). The first step is to create a Climate Vulnerability Assessment that looks at the possible stresses climate change could bring to a community. This is a priority action for both Bronze and Silver certification.

This report looks at the risk of increasing seasonal drought in New Lebanon, NY. Future work by our task force will assess the risks posed by other climate stresses for the town. These assessments may help inform the town's own mitigation planning as well as its participation in the next Hazard Mitigation Plan with Columbia County. In general, early mitigation of natural hazards tends to be much more cost effective than responding to events after the fact, according to a report by the National Institute of Building Sciences ("Natural Hazard Mitigation Saves," 2019).

New Lebanon is a town in Columbia County with just over 2,300 residents (Figure 1). The town has participated in the county's Hazard Mitigation Planning exercise every five years. During this process, all the participating towns rank hazards for the entire county. The current ranking lists severe storms, hurricanes, and tornados as "moderately high" risks, followed by flood, earthquake, and severe winter storms as "moderately low". Drought is currently ranked at the county level as the 10th risk (Table 1).

Figure 1

Location of New Lebanon, NY.

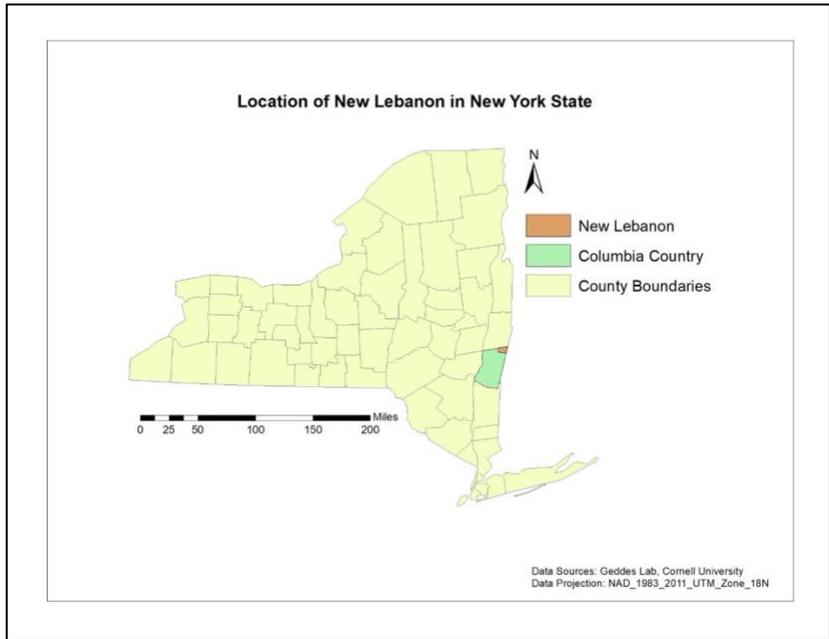


Table 1

Combined hazard ranking in Columbia County Hazard Mitigation Plan (2018).

Hazard	Score	Rating
Severe Storm	280	Moderately High
Hurricane	254	Moderately High
Tornado	246	Moderately High
Flood	232	Moderately Low
Earthquake	188	Moderately Low
Winter Storm (Severe)	179	Moderately Low
Dam Failure	143	Low
Ice Storm	126	Low
Ice Jams	124	Low
Drought	117	Low
Wildfire	112	Low
Landslide	110	Low
Infestation	108	Low
Extreme Temps	96	Low
Coastal Storm	N/A	N/A
Hailstorm	N/A	N/A
Expansive Soils	N/A	N/A
Windstorm	N/A	N/A

Regional Climate Projections

State and government agencies, academic researchers, and nonprofit organizations provide a number of reports and tools to estimate future climate changes. These are used to extrapolate trends down to the community level. Overall, mountain towns in the northeast U.S. like New Lebanon may be better situated than many other parts of the country to adapt to climate change (Horton et al., 2014; Fernandez & Zegre, 2019). In many ways, the northern Appalachian range could become an ecological stronghold for natural species migrating northward and upslope as temperatures rise (Anderson et al., 2016). Nevertheless, we can anticipate some climate impacts here as well.

The New York State Energy Research and Development Authority (NYSERDA) provides projections on climate change for the state in a report known as "ClimAID." The latest full report was published in 2011 with updated model projections added in 2014 ("Responding to Climate Change—ClimAID," 2011 & 2014). New Lebanon is in New York State's "Region 5" for the state's climate projections. The projections for our region are for an average temperature increase of 3.5°F to 7.1°F by the 2050s depending on the severity of the climate change scenario (Table 2). This will move our climate closer to that of Pennsylvania, Virginia, or the Carolinas, depending on the emissions scenario (Fig. 2) (Fromhoff et al., 2007).

Table 2

Projected temperature increases for New Lebanon, NY ("Responding to Climate Change—ClimAID," 2014).

Region 5 (Saratoga) – Temperature			
Baseline (1971-2000) 47.6 °F	Low Estimate (10th Percentile)	Middle Range (25th to 75th Percentile)	High Estimate (90th Percentile)
2020s	+ 1.7 °F	+ 2.3 to 3.2 °F	+ 3.7 °F
2050s	+ 3.5 °F	+ 4.5 to 6.2 °F	+ 7.1 °F
2080s	+ 4.1 °F	+ 5.6 to 9.7 °F	+ 11.4 °F
2100	+ 4.4 °F	+ 6.1 to 11.4 °F	+ 13.6 °F

Intense precipitation and heat waves are also likely to increase (Table 3). Overall, the likely climate risks that may impact New Lebanon are storms (both summer and winter), flooding, heat stress, drought, wildfire, and invasive species (Table 4).

Figure 2

Projected changes in climate for upstate New York (Frumhoff et al., 2007)

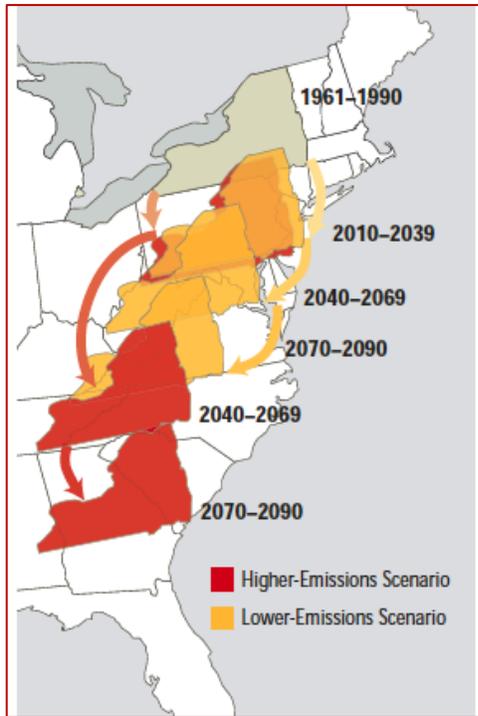


Table 3

Projections for extreme weather in New Lebanon, NY ("Responding to Climate Change—ClimAID," 2014).

Saratoga Springs (Region 5): Full range of changes in extreme events: minimum, (central range*), and maximum				
Extreme event	Baseline	2020s	2050s	2080s
Number of days per year with maximum temperature exceeding				
90°F	10	11 (14 to 20) 28	17 (20 to 35) 49	18 (26 to 60) 75
95°F	1	1 (2 to 4) 7	3 (3 to 10) 18	3 (6 to 25) 42
Heat Waves & Cold Events	Number of heat waves per year ²	2 (2 to 3) 4	3 (3 to 5) 7	3 (4 to 8) 9
	average duration	4 (4 to 5) 5	4 (4 to 5) 6	4 (5 to 6) 9
	Number of days per year with min. temp. at or below 32°F	134	121 (128 to 139) 147	92 (111 to 127) 135
	Number of days per year with rainfall exceeding:			
Intense Precipitation	1 inch	10	8 (10 to 11) 12	9 (10 to 11) 12
	2 inches	1	1 (1 to 2) 2	1 (1 to 2) 2

We are already experiencing some of these hazards to a certain degree today, while others may start to emerge over time. These risks may seem contradictory, such as increased

flooding and drought. However, as weather patterns become more variable, we may see weather events start to alternate between extremes.

Looking at potential demographic impacts, as climate change continues, we may also see an influx of new residents from coastal communities and from southern states. Especially as the pandemic has encouraged a move to work from home, we may see more people moving to New Lebanon to escape climate impacts while working remotely.

Table 4

Possible hazards driven by climate change that may impact New Lebanon in coming years (based on ClimAID ("Responding to Climate Change," 2011 & 2014).

<p>Possible climate hazards impacting New Lebanon in coming years (not ranked in order of severity):</p> <ul style="list-style-type: none">• Severe storms, including hurricanes• Severe winter storms• Flooding• Heat stress• Drought• Wildfire• Invasive species

Assessing Seasonal Drought Risk

This report looks at drought risk to help inform future mitigation planning. Drought today is ranked as a fairly low risk. However, there is a possibility that it will increase in severity in the coming years and decades. In the past year, nearby Petersburg, NY and Pittsfield, MA experienced water emergencies (La Rocque, 2020; Sheridan, 2020). New Lebanon also experienced at least three dry residential wells in September 2020. The town may also be more vulnerable than other Columbia County towns that are closer to the Hudson River given its steep terrain (Fig. 3), which accelerates stormwater runoff (Rossman & Bernagros, 2019). As a

ridgeline town, it also has higher area solar absorption than other towns in lowland areas (Fig. 4). Higher solar radiation results in greater evaporation (Rossman & Bernagros, 2019).

Figure 3

Steep terrain of New Lebanon accelerates stormwater runoff.

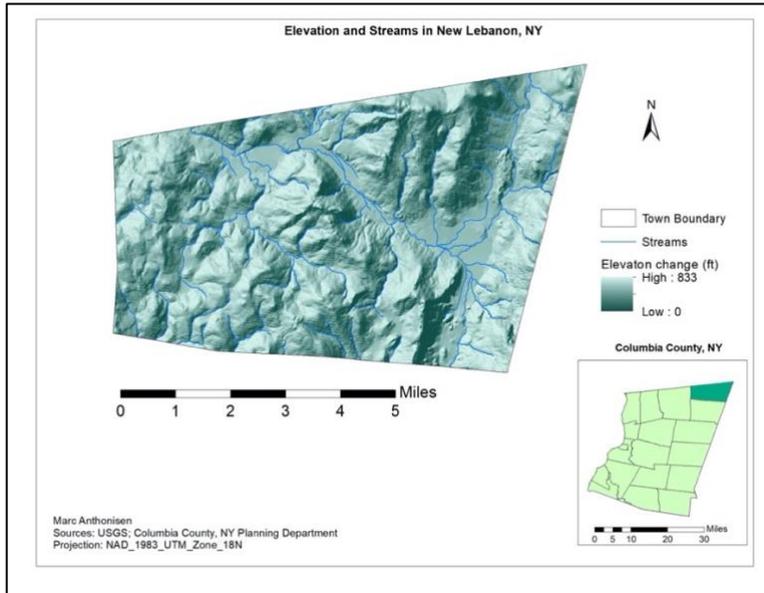
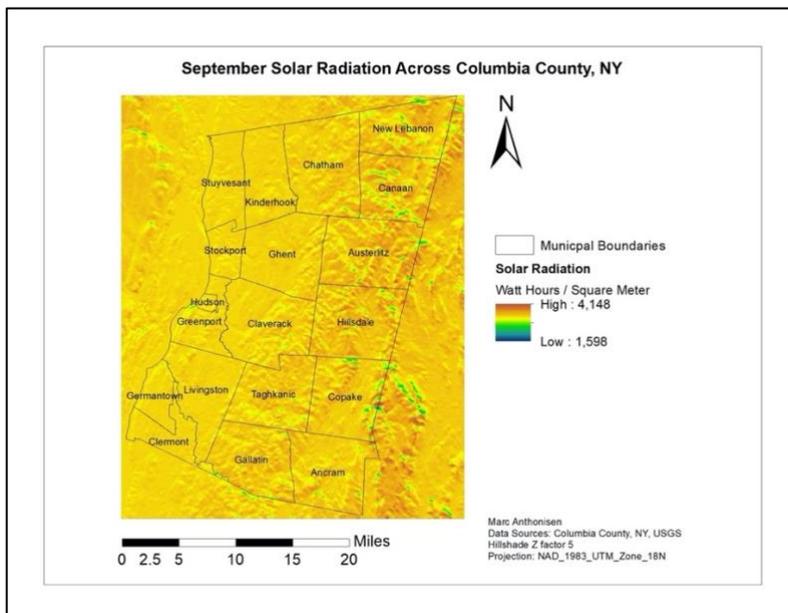


Figure 4

Area solar radiation across Columbia County in September. Towns along the Taconic Mountain Range absorb more solar radiation, leading to higher drought risk.



ClimAID and Mitigate NY

The ClimAID reports project an overall increase in precipitation in New York State in coming years, but with longer dry spells in between. As a result, we are likely to see an increase in both flooding and seasonal drought. It is important to note that the NYSERDA models are not able to project if we may also see multi-year drought and are only relevant for seasonal drought. The report also highlights the risk of smaller "exurb" communities that have an influx of new residents experiencing water shortage as demand for water increases ("Responding to Climate Change—ClimAID," 2011 & 2014).

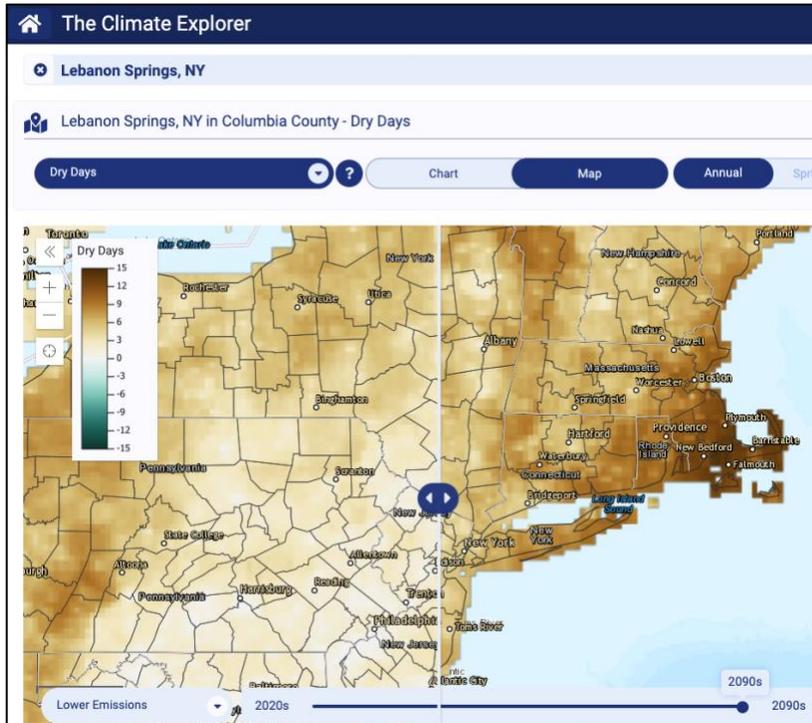
An additional resource provided by the state is "Mitigate NY," a website that hosts the state's Hazard Mitigation Plan ("Mitigate NY," 2019). This provides projections that are based on the same models as the ClimAID reports, but has a user friendly interface for exploring various hazards, risks, and vulnerabilities across the state, including drought.

Climate Explorer

Another tool to assess drought risk is the *Climate Explorer* website provided by National Oceanic and Atmospheric Association (NOAA) as part of its *US Climate Resilience Toolkit* ("Climate Explorer," n.d.). The tool includes a slider that allows the user to compare different scenarios for their region. Looking at Columbia County, the tool shows a gradual increase in number of consecutive dry days over time. Depending on the emissions scenario for greenhouse gases, the model shows an increase of up to 15 consecutive dry days by 2090.

Figure 5

Screen Shot of the "Climate Explorer" tool provided by NOAA, showing the projection for dry days under a high greenhouse gas emissions scenario (Climate Explorer, n.d.).



Richmond, MA Climate Vulnerability Analysis

The nearby town of Richmond, MA (Fig. 6) is also conducting a Climate Vulnerability Assessment with grants provided by the Commonwealth. Richmond has kindly invited our climate task force to sit in on their planning sessions. Given the proximity to New Lebanon, it is informative to compare notes with their approach. The project is being led by planning consultants Weston & Sampson, who have also highlighted drought as one of the possible hazards (Fig. 7). Citing the "Massachusetts Climate Change Adaptation Report" (2011), the team forecasts an 18% increase in consecutive dry days for Richmond by the end of the century. They also forecast that occurrences of drought lasting one to three months could go up 75% within the same time period ("Town of Richmond Community Resilience Building," 2020).

Figure 6

Location of Richmond, MA relative to New Lebanon, NY.

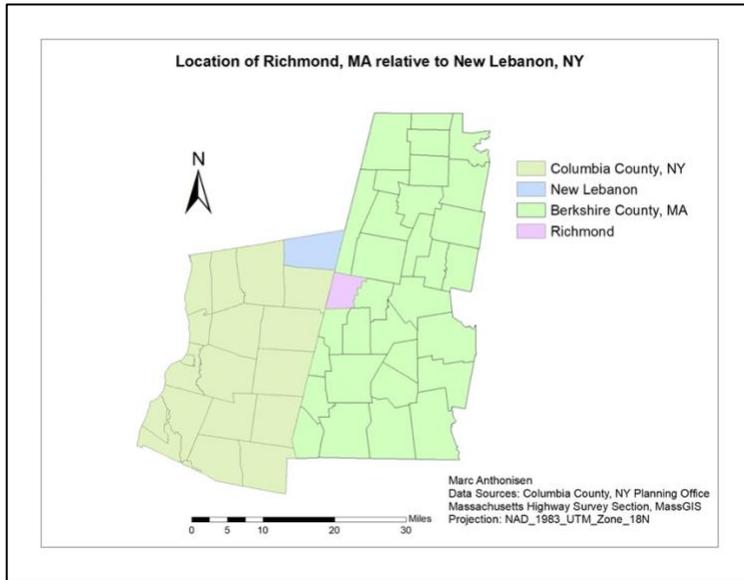


Figure 7

Screenshot of Climate Vulnerability mapping exercise presented to town of Richmond, MA in December, 2020 ("Town of Richmond Community Resilience Building," 2020).



Drought Risk Summary

In summary, drought risk seems likely to increase over the coming years and decades in New Lebanon. The exact time frame and severity is hard to gauge precisely. It is also difficult to

predict exactly which wells or areas may be most affected. Nevertheless, we can expect seasonal drought to become a more constant reality over time in New Lebanon, along with other climate driven changes including storms and increased precipitation. Using the NY ClimAID projection, the Massachusetts report, or the *Climate Explorer* model, the number of dry days gradually increases.

Sensitivity

New Lebanon's sensitivity to drought comes primarily from four areas: drying wells for residences and business, damage to crops, increased risk of wildfire, and impact on ecosystems. As New Lebanon does not have a municipal water system, residents rely on wells for water supply. To the extent repeated drought forces residents to dig deeper wells, there may be a financial cost to individual residents. For lower-income residents, this could create a significant financial burden. There is also the risk that as more residents move here, it will set off a race to drill deeper and deeper wells. Similarly for New Lebanon farmers, drought could have a financial impact (Downen, 2017). Mitigation actions could help reduce our community sensitivity.

Mitigation and Resilience

The town can take a number of steps to mitigate the impact of increasing drought. First of all, simply monitoring drought risk can help give the town an early warning of changing conditions. The NY State Department of Environmental Conservation provides a drought monitoring website ("Current Drought Conditions," n.d.). Similarly, the National Integrated Drought Information System provides early warning indicators ("US Drought Portal," n.d.).

Other possible mitigation strategies could include protecting watersheds to slow down stormwater runoff. This involves improving landcover, soil quality, and other land management

strategies, many of which are included in the Climate Smart Communities PE7 list of pledge elements ("Climate Smart," n.d.). Farmers may look at additional crop insurance to protect from drought losses. Additional mitigation strategies could include reducing water usage or sourcing emergency water supplies. Some communities also draft drought emergency plans.

Conclusion

This is a preliminary assessment meant to foster engagement and discussion with the community to further refine our assumptions and improve future planning. Drought is only one of a number of hazards that are likely to increase as climate change progresses. Currently, it is a fairly limited risk, but given its direct correlation with temperature rise, we can expect it to gradually and continually increase. In comparison with lowland towns in the county, New Lebanon may be at higher risk for drought given its steeper terrain. Finally, there is a need as we continue our discussions to identify our more vulnerable residents so that our mitigation plans can focus on the higher risk community members.

References

- Anderson, M. G., Barnett, A., Clark, M., Ferree, C., Sheldon, A. O., & Prince, J. (2016). Resilient Sites for Terrestrial Conservation in Eastern North America 2016 Edition. *The Nature Conservancy*. 202. https://climatechange.lta.org/wp-content/uploads/cct/2016/07/Resilient_Sites_for_Terrestrial_Conservation.pdf
- ArcGIS [GIS software]. Version 10.7.1 Redlands, CA: Environmental Systems Research Institute, Inc., 2019.
- Climate Explorer* (n.d.). National Oceanic and Atmospheric Administration (NOAA). Retrieved December 17, 2020, from <https://toolkit.climate.gov/>

Climate Smart Communities - Actions (n.d.). New York State Department of Environmental Conservation. <https://climatesmart.ny.gov/actions-certification/actions/>

Columbia County, NY (2020). Columbia County Geo-Data. Retrieved December 17, 2020, from <https://geodata-cc-ny.opendata.arcgis.com/>

Columbia County Hazard Mitigation Plan, 2018. (2018, April). Columbia County, NY.

<https://docs.google.com/a/columbiacountyny.com/viewer?a=v&pid=sites&srcid=Y29sdW1iaWFjb3VudHlueS5jb218Y29sdW1iaWEtY291bnR5LXNoZXJpZmYtcy1vZmZpY2V8Z3g6NDNmYzY3YWZhZTk5ZGY2Mg>

Current Drought Conditions (n.d.). NYS Dept. Of Environmental Conservation. Retrieved December 24, 2020, from <https://www.dec.ny.gov/lands/5017.html>

Downen, R. (2017, April 29). Devastation of 2016 drought looms in farmers' minds, plans, wallets.

Times Union. <https://www.timesunion.com/tuplus-business/article/Devastation-of-2016-drought-looms-in-farmers-11109159.php>

Fernandez, R., & Zegre, N. (2019). Seasonal Changes in Water and Energy Balances over the Appalachian Region and Beyond throughout the Twenty-First Century. *Journal of Applied Meteorology & Climatology*, 58(5), 1079–1102. <https://doi.org/10.1175/JAMC-D-18-0093.1>

Frumhoff, Peter C., James J. McCarthy, Jerry M. Melillo, Susanne C. Moser, and Donald J.

Wuebbles. *Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions*. Cambridge, MA: Union of Concerned Scientists (UCS), 2007.

<https://www.ucsusa.org/sites/default/files/2019-09/confronting-climate-change-in-the-u-s-northeast.pdf>

Horton, R., Yohe, G., Easterling, W., Kates, R., Ruth, M., Sussman, E., Whelchel, A., Wolfe, D., & Lipschultz, F. (2014). Ch. 16: Northeast. *Climate Change Impacts in the United States: The*

Third National Climate Assessment. U.S. Global Change Research Program.

<https://doi.org/10.7930/JOSF2T3P>

La Roque, D. (2020, August 8). Water Woes Impact Municipal Supplies. *The Eastwick Press*.

<https://eastwickpress.com/news/2020/08/51887/>

Massachusetts Climate Change Adaptation Report (2011). Massachusetts Executive Office of Energy

and Environmental Affairs.. Retrieved December 24, 2020, from [https://www.mass.gov/service-](https://www.mass.gov/service-details/2011-massachusetts-climate-change-adaptation-report)

[details/2011-massachusetts-climate-change-adaptation-report](https://www.mass.gov/service-details/2011-massachusetts-climate-change-adaptation-report)

Massachusetts Highway Survey Section (2020, September). *Community Boundaries (Towns) from*

Survey Points. [https://docs.digital.mass.gov/dataset/massgis-data-community-boundaries-towns-](https://docs.digital.mass.gov/dataset/massgis-data-community-boundaries-towns-survey-points)

[survey-points](https://docs.digital.mass.gov/dataset/massgis-data-community-boundaries-towns-survey-points)

Mitigate NY (n.d.). New York State Division of Homeland Security and Emergency Services

(DHSES) - Mitigation Planning. Retrieved December 17, 2020, from

<https://mitigateny.availabs.org/local>

Natural Hazard Mitigation Saves (2019). National Institute of Building Sciences. (n.d.). Retrieved

December 24, 2020, from <https://www.nibs.org/page/mitigationsaves>

Responding to Climate Change in New York State (ClimAID) (2011 & 2014). New York State Energy

Research and Development Authority (NYSERDA). Retrieved December 17, 2020, from

[https://www.nysERDA.ny.gov/About/Publications/Research%20and%20Development%20Technic](https://www.nysERDA.ny.gov/About/Publications/Research%20and%20Development%20Technical%20Reports/Environmental%20Research%20and%20Development%20Technical%20Reports/Response%20to%20Climate%20Change%20in%20New%20York)

[al%20Reports/Environmental%20Research%20and%20Development%20Technical%20Reports/](https://www.nysERDA.ny.gov/About/Publications/Research%20and%20Development%20Technical%20Reports/Environmental%20Research%20and%20Development%20Technical%20Reports/Response%20to%20Climate%20Change%20in%20New%20York)

[Response%20to%20Climate%20Change%20in%20New%20York](https://www.nysERDA.ny.gov/About/Publications/Research%20and%20Development%20Technical%20Reports/Environmental%20Research%20and%20Development%20Technical%20Reports/Response%20to%20Climate%20Change%20in%20New%20York)

Rossman, L. A., & Bernagros, J. T. (2019). National Stormwater Calculator User's Guide—Version

2.0.0.1. 99. U.S. Environmental Protection Agency.

https://www.epa.gov/sites/production/files/2019-04/documents/swc_users_guide_desktop_v1.2.0.3_april_2019.pdf

Sheridan, J. (2020, September 7). Pittsfield steps up drought prevention measures, mandates water conservation. *ABC News Albany*. <https://www.news10.com/news/pittsfield-steps-up-drought-prevention-measures-mandates-water-conservation/>

Town of Richmond Community Resilience Building (CRB) Workshop Series (2020, December 15).

Weston & Sampson, Inc. Retrieved December 24, 2020, from <https://sharefile.wseinc.com/message/m5hzglbONihGipKSuQdyDb>

US Drought Portal (n.d.) National Integrated Drought Information System. Retrieved December 24, 2020, from <https://www.drought.gov/drought/>

USGS (2018). *National Hydrography Database*. Retrieved December 23, 2020. <https://geodata-catalog.ny.opendata.arcgis.com/datasets/streams-nhd?geometry=-84.382%2C40.606%2C-63.289%2C43.461&showData=true>

USGS (2020). *National Elevation Dataset, North America*. Retrieved December 17, 2020 <https://cugir.library.cornell.edu/catalog/cugir-008186>