Climate Resilience Assessment and Planning: Durham, NH

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Introduction

Continued collaboration between the Town of Durham, New Hampshire and the University of New Hampshire (UNH) is critical for building a climate resilient community. UNH faculty staff, and students collaborate with the Town of Durham on many projects, including the water supply and wastewater treatment, policing and fire services, special event management.[1] Another recent example of this collaboration is the living shoreline project at Wagon Hill Farm, in which UNH faculty and students collaborated with the NH Coastal Program and the Durham Department of Public Works to research, test, and eventually rebuild a section of rapidly eroding shoreline.[2]

This report builds upon those "town – gown" collaborations in response to UNH's participation in the Climate Commitment, signed on to by hundreds of U.S. colleges and universities and supported by Boston-based nonprofit Second Nature. As part of this initiative, The Town of Durham and UNH are collaborating on a joint campus-community resilience plan. While initially focused on the issue of building resilience to our changing climate, this resilience plan also touches on broader issues including diversity, public safety, the health of local ecosystems, food insecurity and access, and healthy town budgets.

This resilience assessment uses a framework recommended by Second Nature, in which resilience is defined as: "the ability of a system or community to survive disruption and to anticipate, adapt, and flourish in the face of change."[3] The framework calls for splitting the resilience plan into four steps: 1) initial resilience assessment; 2) identification of future climate scenarios; 3) vulnerability assessment to anticipated climate impacts; and 4) initial resilience plan. The first and second steps were completed, in cooperation with UNH, between 2016-2019; this report, and a soon-to-be published supporting spreadsheet, summarize the preliminary results of the third and fourth steps. These were undertaken during the summer of 2019, during which members of the Town of Durham and UNH Sustainability Institute worked to assess community vulnerabilities and opportunities for improvement by first identifying indicators and metrics of resilience across categories, called the "five capitals" in the Second Nature framework. Once this list of indicators and metrics was compiled, baseline data was collected for each metric, and recommendations for future actions were developed.

The five capitals are: natural, physical, human, social, and financial.[4] *Natural capital* is represented by the natural resources and processes that provide critical life sustaining services (e.g., fiber, energy, water, climate regulation, oxygen, soil, recreation, and cultural). Physical capital includes buildings and other infrastructure (e.g., transportation networks, waters supply and treatment systems, communications, water disposal). *Human capital* incorporates health, knowledge, skills relationships, empathy and spirituality of the individual. *Social capital* refers to local systems of governance and other collaborative entities, including those that support and engagement between the campus and community. And finally, *financial capital* refers to a form of currency that enables other types of capital to be owned and traded.

Indicators of resilience have been identified within each capital, along with one or more metrics associated with that indicator. The Second Nature framework is limited to 10 indicators per capital. Indicators are generally qualitative (i.e., "Building Energy Efficiency"); metrics are quantitative, and, wherever possible, relatively straightforward to measure (i.e. "MMBTU/gross square foot/degree day"). The idea is to have metrics that are collected at regular intervals

(commonly monthly or annually), and then used to evaluate progress over time towards a common goal. For example, "Progress Toward Emissions Reduction" is generally considered a key indicator of climate leadership and resilience for municipalities and universities, and annual GHG emissions (measured in Metric Tons of Carbon Dioxide Equivalent) are the associated metric. An energy and greenhouse gas emissions inventory can be conducted annually to provide this metric; UNH supports many local governments and campuses across the New England and the US in completing such inventories.[5]

Climate Change

Since the industrial revolution, the Earth's climate system has experienced an unprecedented level of change, primarily the result of human activities.[6] While the earth's climate has always changed for a variety of reasons, the change that has occurred over the last five decades has been driven primarily by human activities. Humans are responsible for the changing climate through the burning of fossil fuels (coal, oil and natural gas), and land use and agricultural practices.

Durham and other areas of NH have experienced a changing climate over the past few decades and these effects are expected to continue over the next several decades.[7] This includes increases in temperature (especially in winter), increases in overall annual precipitation and in the number of extreme precipitation events, decrease in snow cover, and increase in the rate of sea level rise. While the extent of climate change is clearly dependent on future global GHG emission scenarios, it can be expected that NH will become hotter, there will be more extreme precipitation events, more severe storms, less snow, and a longer growing season and more invasive pests and plants. A warmer earth will cause sea ice and glaciers to melt which will lead to sea level rise. As Durham, NH is a coastal community the sea level rise is expected to lead to some areas of flooding, particularly when accompanied by a storm surge.

The two most important step societies can take to reduce the impacts associated with climate change are to reduce GHG emissions (mitigation) and become more resilient to our changing climate (adaptation). Since emissions know no boundaries and climate change will affect the entire world, particularly the global south, it is imperative that the entire world works together to reduce emissions. The landmark 2015 Paris Agreement was a non-binding agreement signed by almost every country in the world to reduce GHG emissions. Three strategies that countries and communities can employ to reduce emissions are replacing fossil fuels with renewable energy for electricity production; increasing fuel efficiency in vehicles and promoting alternative modes of transportation (such as electric vehicles [EV's], walking, and biking); and promoting energy efficiency in the building sector.

While they work to reduce emissions, local governments, institutions, and residents can also take steps to build resilience to the changing climate. For example, municipalities can work with residents to protect their communities from inland and coastal flooding by ensuring buildings, roads and other infrastructure is built in locations that are not susceptible to current or future flooding; protecting existing critical infrastructure from flooding; installing larger culverts to deal with increased rainfall and runoff; and protecting and expanding wetlands and salt marshes.

Because the US federal government has been unwilling to take action regarding climate change mitigation and resilience, it is important that state and local governments take action through mitigation and resilience. There are several coalitions that local governments, state governments, businesses, and others can join in order take actions to mitigate climate change and become more resilient. A prominent coalition is the Global Covenant of Mayors, with thousands of member municipalities that have committed to setting targets, creating action plans, and reporting regularly and publicly on progress.

Durham's Resilience Efforts to Date

Durham has already taken actions to increase its climate resilience, working to protect critical physical and natural ecosystems, engaging and communicating with residents, and collaborating with others in the region. Some highlights of these efforts are outlined in this section.

Durham municipal buildings are resilient during power outages because backup generators have been installed in every municipal building. Because of the generators, the town buildings can act as a cooling or heating station during times of power outages. (There are also several UNH buildings that can function in this capacity.)

Durham has developed an energy checklist that is given to developers and building permit applicants to consider the energy efficiency at the site. This is an optional checklist that outlines several ways that builders and home-owners can work to make the building more energy efficient and go beyond the existing energy code. The Town has also adopted the 2018 International Energy Conservation Code (IECC); Section 38-5 of the Durham town code mandates that Durham automatically adopts the strictest IECC energy code when it is updated every three years.[8]

In 2018, the Durham town council adopted town ordinance #2018-01. This recommends that new buildings located in climate change risk areas are constructed with a 2ft freeboard (two feet about FEMA defined base flood elevation associated with the 1 percent annul change flood). This means that "all new construction or substantial improvements of residential structures" and nonresidential structures "be elevated to at least two feet above the base flood elevation".[9] A freeboard height of 2ft rather than 1ft, which is more common, better protects the property against flooding.

Wagon Hill Farm is a town owned recreation area in Durham, NH that is popular with residents seeking a beautiful place to walk and recreate. Part of the property is on Great Bay and has been eroding at a pace of about 1 foot per year. Durham Department of Public Works (DPW) has worked with UNH, and the NH Coastal Program to develop a living shoreline at Wagon Hill Farm. A living shoreline is a stabilization technique that uses structural and organic material, such as stones and wetland plants to minimize erosion and adapt to sea level rise. The living shoreline is expected to restore the eroded shore, act as a natural water filtration system, and improve water quality.[10]

Durham is currently collaborating on an art project with Northeastern University, Strafford Regional Planning Commission (SRPC), and the UNH Cooperative Extension. Plaques will be placed at locations around Durham that will be affected by climate change. These

plaques are written as if the year is 2100 and readers look back on how climate change affected Durham. An example of what one of the plaques say is: "Twelve houses near Great Bay converted to open space after sustaining repeated flood damage- July, 2060". The benefit of this project is to educate the community, specifically about how that location will be affected by climate change.

Durham also has four core "Physical capital" systems that are already highly resilient. They are the water supply, water treatment, transportation system, and emergency services. Durham's public water supply system is resilient because there are four sources of water that, collectively, are capable of supplying more than 300 million gallons of water annually: the Lamprey River and Lee Well are the two largest producers, but water is also sourced from Spruce Hole and the Oyster River. In the spring when the Oyster and Lamprey Rivers have high water levels due to snow melt and spring rains, water is pumped into Spruce Hole for use during drought.[11] The Durham Waste Water Treatment Plant (WWTP) is also resilient, because it can treat twice as much water as Durham and UNH currently use. In 2017, UNH and the Town of Durham use 263 million gallons of water which equates to a daily use of 0.7 million gallons per day.[12]

Water and wastewater are an area where there is considerable collaboration between UNH and Durham. The two parties entered into a new agreement in 2016 that recognizes cost sharing, capital improvement, and operation and maintenance of facilities. Durham operates the wastewater treatment plant and UNH operates the water treatment plant. There is also a joint water committee that has two members from each Durham and UNH who are appointed by the town administrator and UNH president.[13]

The transportation system in Durham is resilient in that there are multiple ways to access Durham. Two major state roads, Rt 4 and Rt 108, cross through Durham and are close (under a mile) from the downtown area. Durham is also relatively accessible from Interstate 95 by way of the Spaulding turnpike and Rt 4. Another popular way to get to Durham is by way of the Spaulding turnpike to Rt 108, through Dover. There is a train station in Durham, which provides easy access to Boston and north to Portland Maine. UNH also operates a bus transportation system (Wildcat Transit) which provides service from neighboring towns (Dover, Newmarket, and Portsmouth). This service is free to UNH students, faculty, and staff. It is open to the public, but anyone without a UNH ID is charged a small fee. Wildcat Transit also connects the UNH campus with popular off-campus housing, such as the Gables and Lodges which are about a mile or less from campus.

If one option of getting to Durham such as by way of Rt 4 is closed due to flooding or other issues, there are multiple other options to get to Durham. This means that it is unlikely that the community would be completely closed off from the outside world. In addition, the bridge that is most vulnerable to flooding on Route 4 in Durham is currently being replaced and will be several feet higher than the previous bridge.

The emergency services in Durham are resilient because of how many first responders there are and how well they work together. Durham is unique among similar sized towns because there are two highly qualified, full-service police agencies: UNH police and the Durham police department. The Durham police department is CALEA certified, which means that it is nationally recognized for excellence in policing. The Durham fire department is also a full

service, professional fire department. This is unique among other neighboring towns, such as Lee and Madbury, who largely rely on volunteers.

There are mutual aid agreements between UNH and Durham and neighboring towns, so that the emergency service departments will help each other when needed. NH law, RSA Chapter 53-A, stipulates that municipalities can enter into mutual aid agreements with one another.[14] The most common type of mutual aid agreement is for the fire department. The mutual aid agreements will cover specifics, such as reimbursing costs and compensating the firefighters. The Durham fire department is half funded by UNH and Durham. McGregor EMS is a non-profit organization that provides EMT services and ambulance rides to the members of Durham, UNH, Madbury, and Lee communities.

The benefit of having a resilient emergency response system is that the public feels safer and the emergency response may be quicker and more attentive than they may be in other towns. The Durham Police and Fire departments are meagerly staffed but incredibly efficient. For a population of 16,523; there are 21 full-time police officers and 21 full-time firefighters (not including UNH police). For comparison, the town of Laconia, NH has a similar population and has 40 full time fire fighters and 41 full time police officers.[15]

The town communicates to the residents in a variety of ways. This includes Friday updates, updating the website with important information, social media, and the DCAT 22 cable channel. Friday updates is a weekly publication that is sent by email to Durham residents who have signed up. In the event of an emergency, information will be sent out to this email list. Information on the Friday updates includes important and new information that the various departments and committees wish to share with the public. The town will update the website as necessary with important information. According to Luke Vincent, the Durham IT director, this was done during the Mother's Day flood in 2006. Information about how residents could stay safe was added to the website. The town also administers social media pages on Facebook, Instagram, and Twitter. Information can be passed to the residents very quickly through these platforms. Durham also administers a public access cable channel (DCAT channel 22). Public meetings are taped and shown on this channel along with other information that serves the greater community.

Recommended Resilience Indicators and Metrics Across the Five Capitals

In spite of these and other important efforts, Durham and UNH still have work to do. Locally, we are already experiencing the impacts of climate change, and the effects are very likely to get worse in the future. That's why it is imperative that the UNH-Durham community continue to strive to understand the risks posed by a changing climate and prepare for them and minimize loss of life, property, financial resources, and disruption in daily life as possible. If the resilience plan is successful, the odds of the UNH-Durham community continuing to flourish will likely increase, despite the impacts of climate change on the community.

The effort to identify indicators and metrics of resilience is intended to provide a foundation for planning and for assessing progress for community resilience efforts. This section offers a snapshot and discussion of a handful of the indicators and metrics that were developed for this project. The complete list of the draft indicators and metrics selected for

each of the five capitals is provided for review in Appendix A. Data collection for each of the metrics was begun over the summer and should be published in a forthcoming document in Fall 2019.

One resilience indicator for physical capital is a multi-modal transportation system. Multi-modal transportation is important because thousands of people commute daily to and from Durham and because multi-modal transportation systems provide reduced dependence on single fuel sources, reduced fossil fuel use, and lower community greenhouse gas emissions. Without a multi-modal transportation system, the roadways would be more clogged than they already are, and it would take more time to get to work. A metric for this indicator is the number of people who travel to Durham by public transit each day. There is an average of 163 passengers per day to UNH's campus on the Downeaster train. There were 1,102,410 people who took the Wildcat transit in fiscal year 2018.[16] A goal should be to grow the number of people who commute to Durham and UNH by biking, walking, or public transit. Another important metric: for fiscal year (FY) 2018 there were 8,271 total parking permits issued by UNH.[17]

For social capital, an indicator of resilience is collaborative decision-making by the town of Durham and UNH that demonstrates a commitment to climate leadership and resilience. A metric for this indicator is: the existence and ambition of institution-wide sustainability goals adopted by UNH and Durham. Collecting data related to UNH-specific metrics was outside the scope of this project, but the goals related to Durham came from the relevant chapters of the town Master Plan. One such goal, from the energy chapter, is to update existing municipal facilities and critical assets to reduce energy use by 30% from 2015 to 2025.[18] As the chapters of the Master Plan are updated, so are the goals. The Master Plan chapters should be updated by 2025.

For natural capital, an indicator is structural integrity of local forest ecosystems. An associated metric is "impervious cover"—in other words, the area that rainwater falls and does not get absorbed, such as pavement and rooftops. In 1990, there was 523 acres of impervious cover in Durham; in 2000 there was 763 acres of impervious cover; in 2010, there was 1,061 acres of impervious cover in Durham.[19] This is an increase of 537 acres (more than a 100% increase!) in the 20-year time period from 1990-2010.[20] The town should consider adopting a goal of keeping impervious cover below 1,661 acres by 2030 (300 acres per decade). This would be about the same increase in impervious cover acreage as the preceding 20-year period. This metric is important because an aspect of Durham that residents like is the rural nature of the town. Keeping impervious cover as low as possible preserves the rural nature of town.

If the town and its resident choose to build up (higher) in the downtown rather than expanding out into undeveloped areas, the impervious cover should not expand current levels. This would mean that the population density in downtown Durham would increase. If the town believes that there is too much impervious cover, it can be offset with expanded greenspace or improved stormwater management. Less impervious cover provide means that there would be less flooding and improved water quality in Durham.

For human capital, an important indicator of the level of community resilience in Durham is the presence of public health threats. A metric for this indicator is the number of reported cases of Lyme disease in Strafford County. Strafford County was used for this metric rather than Durham because data isn't available from the state at the municipal level, only the

county level. In 2017 there were 150 cases of Lyme disease, or 116.6 cases per 100,000 residents, reported in Strafford County.[21] However, the number of people who actually get Lyme disease is higher, since only about 10% of cases of Lyme disease are actually reported. Durham should consider tracking how many residents get or have had Lyme disease.

For financial capital, this assessment identified on indicator as being "healthy budget, sustainable investments, and town assets." A related metric is the amount of money in undesignated fund balance (cash reserve). In 2018 Durham had $3,505,939 in their cash reserve.[22] Durham has a policy that the undesignated fund balance is at least 5% to 8% of the annual budget including town, school, and county. In 2018, the total budget was $31,788,000.[23] This means that the undesignated cash reserve is about 11% of the total budget. A goal should be to keep the undesignated cash reserve at this current percentage (11%) of the total budget.

Recommendations for Increasing Resilience

While our analysis suggest that Durham is more resilient than many communities across NH, more can and should be done to make the town more resilient in the face of a changing climate. In this endeavor, there is a great deal of opportunity and benefit in continuing to do so in collaboration with UNH. While the opportunities are numerous, the resilience assessment undertaken this summer suggest some immediate actions:

- Work with the UNH Sustainability Institute to complete municipal and community greenhouse gas emissions inventories;
- Adopt new procurement standards;
- Hire a sustainability coordinator;
- Consider additional strategies to raise money to address stormwater concerns; and
- Join the Global Covenant of Mayors, a coalition of cities that are working to cut GHG emissions and adapt to climate change.

1) Greenhouse Gas Inventory:

The town of Durham has not yet measured its municipal or community-wide greenhouse gas footprint. Yet many tools exist for doing so; it's become standard practice in many towns across NH and New England, and support is available from UNH to complete this analysis. Without knowing its carbon footprint, the Town isn't equipped to make an effective plan to reduce emissions ("you can't manage what you don't measure"). The GHG emission inventory could be used to estimate emissions from municipal buildings and vehicles, or could estimate all emissions in Durham including direct emissions (heating oil used in buildings), purchased electricity, and transportation emissions (people driving to work) for all Durham residents and businesses. Once Durham has this information, more accurate goals and strategies can be identified for emissions reductions. Completing a GHG emissions inventory can inform planning and resource allocation, inform effective policy development, create accountability, demonstrate leadership regarding mitigation, and increase engagement with residents. It can also help prioritize and show the impact of energy projects. The community GHG footprint is related to the "Reduced Greenhouse Gas Emissions" indicator under physical capital. It is also related to the challenge of improving

data collection to refine Durham's climate resilience plan. The GHG emission inventory could provide better data for the multi-modal transportation system, and building energy efficiency indicators as well.

2) Procurement standards:

As a sustainability leader among municipalities, it is important that Durham considers not only the up-front cost of new items but also their energy efficiency. Currently, only cost is being considered, so some new products, such as new lighting, appliances, windows, and more are not as energy efficient as they might be. In order to fix this problem and consider both the cost of an item and its energy efficiency when buying new products, Durham should consider adopting town-wide procurement standards, in which energy efficiency is a designated criterium. These procurement standards could cover everything from new vehicles to new lighting to new appliances to projects out to bid. Procurement standards are relevant to the indicator building energy efficiency (physical capital) and the indicator "healthy budget, sustainable investments, and town assets" (financial capital) as they would save energy efficient products would ultimately save the town both energy and money.

3) Sustainability Coordinator Position:

Town departments and employees actively try to make Durham a more sustainable community, but it is across several different departments and committees including DPW, planning, land stewardship, and more. Since sustainability initiatives are across several departments, there can be gaps in communication, and/or the best opportunities may not be realized. To address that need, Durham should consider joining the many municipalities who have dedicated part-time or full-time sustainability staff. Such communities have found that having a dedicated sustainability coordinator ensures that municipal efforts are better informed and coordinated, and projects can be planned and implemented efficiently and cost-effectively. This frees up time for other departments to focus more on their core responsibilities. In addition to streamlining sustainability initiatives with a sustainability coordinator, Durham should consider making grant writing for sustainability projects and evaluating project bids and products on the basis of energy efficiency and sustainability be a part of the sustainability coordinator's job. Current staff may not have the skills or knowledge to evaluate a project bid proposal or products on the basis of sustainability or how energy efficient it is; the sustainability coordinator could. A sustainability coordinator would encompass and work across all five capitals and could be involved in creating the final resilience plan, and help generate the resources need to implement it. Hiring a sustainability coordinator is related to the challenge of continuing to align UNH and Durham's goals.

4) Stormwater Utility or Other Funding Mechanisms:

Clean water is important, and the more impervious surface area there is the higher likelihood that the water quality will deteriorate. Moreover, in the event of an economic recession, it is important that Durham has sustainable revenue to complete necessary flood and erosion control projects, because grant money may not be available. For all of these reasons, Durham should consider additional strategies to raise money to address future

stormwater concerns: for example, through stormwater utility fees. RSA 149-I gives NH municipalities the ability to implement stormwater utility fees, which are user fees based on the amount of impervious surface on a property. Some benefits of stormwater utility fees are that they are a dedicated funding source, sustainable revenue, and address existing and future stormwater issues. Implementing stormwater utility fees can also help incentive best stormwater management practices.

Stormwater utility fees are either a flat rate for all residential property (and another flat rate for non-residential property) or a tiered approach based on equivalent residential unit (ERU). An ERU is the median amount of impervious area on all single-family parcels in the municipality. By assessing a fee based on square footage (sq ft) of impervious surfaces rather than a flat fee for all residential units, the fee becomes more equitable. If Durham deicides to go for the tiered approach based on ERU's and decides on a rate of $4 per ERU (the state allows fees ranging from $2-$20 per month) a medium-sized residential property of 2,800 sq ft of impervious surface would pay $4 per month or $48.00 per year. All properties with between 1,801-3,201 sq ft of impervious surfaces would pay this amount. Credits can be offered to incentivize best stormwater practices, such as rain gardens.[24] If Durham decides to implement stormwater utility fees or another type of additional funding source, it can use the money for flood and erosion control, water quality management, ecological preservation, or managing pollutant loads from stormwater discharges. Durham will likely do some of these projects in the future.

Before implementation, municipalities typically do a Does it Make Sense study and then a feasibility study. Several NH municipalities, including Dover and Portsmouth, have done feasibility studies but none have implemented stormwater utility fees.[25] These communities decided against stormwater utility fees because many residents consider it another tax and the residents were against another tax.

5) Global Covenant of Mayors:

Due to the absence of federal leadership regarding climate change, it is important that state and local governments take action to reduce GHG emissions and adapt to the changing climate. While Durham has done both, it should consider signing up for a coalition of local governments, such as the Global Covenant of Mayors.[26] The Global Covenant of Mayors is a coalition of 9,000 mayors and government representatives who want a low emission, resilient future. The local governments will set mitigation and adaptation goals and plans and upload self-reported data. It is impossible to search by state on the website, so it is unclear if any NH towns or cities have joined.

Durham should consider joining the Global Covenant of Mayors and setting mitigation and adaptation goals so that Durham can solidify its commitment to reducing GHG emissions and mitigation. Prospective residents may look at this as Durham's commitment to sustainability and realize that this is the community where they want to live, rather than a neighboring community that hasn't taken these steps and made commitments to sustainability. Joining the Global Covenant of Mayors or a related coalition of municipalities responding to climate change, is related to the challenge of furthering aligning Durham and UNH's goals since UNH has signed onto Second Nature, which is a coalition of Universities responding to climate change.

Conclusion

While all of the selected indicators and metrics are related to measuring how the Durham-UNH community becomes more resilient to climate change, some metrics are more urgent, and/or straightforward, than others. In some cases, the desired data is not yet consistently available. An important next step will be finding ways to refine some of these metrics, and implement or improve data collection

Likewise, the project's summer timeline did not allow for development of 5-year goals based on available data related to the metrics; this is also an important next step for completing a climate resilience plan for Durham.

In conclusion, climate change is a serious problem that will affect Durham, NH and the entire world. Local officials can take steps to ensure that Durham and its residents become more resilient to the changing climate. The town should consider these recommendations and continue to collaborate with UNH to make the community more resilient and a better place to live, work, and play. Durham and UNH should develop and implement a process for agreeing on a final list of Indicators and metrics, collecting data regularly, and updating plans based on what the data suggests about progress and opportunities.

Appendix A: List of indicators and metrics for each capital for the Town of Durham

(Note: A separate Excel spreadsheet is being finalized that details specific values for many of the metrics listed below. This should be available by Fall 2019).

Indicator **Metric**

Physical Capital

P1. Building Energy Efficiency

- BTU per square foot is EUI (Energy Use Intensity) adjusted floor area per degree day
- Adopted more stringent energy code that NH has adopted?
- Adopted most stringent IECC?

P2. Air Conditioning

- Percentage of municipal builidings that have central air conditioning or air source heat pumps.
- Percentage of municipal builidings that have window air conditioning units

P3. Multi-Modal transportation system

- Transportation sector greenhouse gas emissions
- Energy Intensity (by vehicle type)
- Carbon Intensity (by vehicle type)
- Fuel makeup (gasoline, nat gas, diesel, electric) of fleet (transit and UNH fleet)
- Overall bus ridership (total, by route, miles/passenger)
- Campus connector vs wildcat transit ridership
- Parking permits (faculty/staff, student)
- Visitor parking spaces
- Non-automobile parking spaces
- Number of EV chargers

P4. Access to Durham

- Daily Downeaster capacity to Durham
- Number of people who get on and off the Downeaster train at the Durham station annually
- Disruption in Downeaster service
- Bus (C&J) passenger trip capacity to Boston from Portsmouth
- Disruption in bus passenger trips to Boston
- Flights from Logan airport
- Disruption in flights per day
- Flights from Manchester airport
- Disruption in flights per day
- Hours Rte 108 closed from natural disasters
- Hours Rte 4 closed (Ports - Lee) from natural disasters
- Average travel time to work of Durham residents
- Cars per day on Rte 108, 4, & 155

P5. Reduced Greenhouse gas emissions

- Total GHG emissions (buildings, transportation, waste, travel)

P6. Energy supply reliability

- Hours with at least portion of area without electricity
- Municipal owned renewable energy capacity in Durham
- Privately owned renewable energy capacity in Durham
- Number of natural gas customers in Durham
- Is there a microgrid connecting UNH and Durham?

P7. Water, Storm Water and Sewage Treatment Management Systems

- Average daily water supply per year when UNH is in session
- During drought, ratio of actual water supply to long-term average demand
- Ratio of UNH water demand to Durham water demand
- Number of inadequate culverts
- Effective impervious cover
- Average daily sewage treatment per year when UNH is in session
- Violations above permitted level for discharge of pollutants from WWTP
- Ratio of UNH verus Durham sewage treated
- Average nitrogen levels in Oyster River

P8. Emergency Shelters

- Square feet of Emergency Shelter space with electricity, water, and waste facilities

P9. Information Technology

- Cell phone system disruption

Social Capital

S1. Structural Connections for Coordination and Planning

- Collaborative groups that work to plan and set policy for UNH and Durham community
- Number of dedicated FTE working directly on sustainability

S2. Commitment to Fairness, Inclusion, Equity and Diversity

- Percentage of job solicitations that say that the organization is committed to diversity (Equal Opportunity Employer)
- Training for fairness, inclusion, equity and diversity
- Percent of individuals from under-represented groups that live in Durham
- Percent of residents who are below the federal poverty line
- Percent of ORCSD students who receive free or reduced lunch

S3. Citizen engagement in civic life

- Levels of volunteerism and community service
- Voting participation
- Number of residents who serve on at least one town committee or commission

S4: Ability to experiment, monitor, and adapt (as indicatd by last year plan was updated)

- Durham Master Plan
- Durham Multi-Hazard Mitigation Plan

S5. Town Communication to residents

Number of Durham residents that subscribe to Friday Updates

Average number of Durham residents that stream DCAT public meetings online

Amount of followers/likes the town page have on Facebook, Twitter, and Instagram

S6. Policies for extreme weather events

Number of days a year, operations are cancelled or delayed because of weather

Are policies in place to cancel operations due to weather?

S7. Decision Making

Number of resiliency realted town ordinances have Durham passed?

Is there a adaptation chapter to the town master plan?

Is there a vulnerability assessment?

Last update of sustainability goals?

S8. Community Inclusion

Percent of Durham residents who have attained degrees from UNH

Number of UNH programs that specifically recruit students from neighboring communities (ex. Summer programs for local kids, allowing ORCSD students to take UNH classes)

# of residents who attend stop the bleed offered by McGreogor EMS annually

# of residents who attend first aid classes offered by McGregor EMS annually

Natural Capital

N1. Cultural Valuing of SocioEcological Systems

Awareness of public parks and public lands in Durham that the public can use, such as College Woods or Wagon Hill Farm

Percentage of land developed (in Durham)

Percentage of natural area/green space (in Durham)

Percentage of land conserved (in Durham)

Number of housing permits in Durham

Percentage of conserved land that has signage, maps, info on website

Annual maintenance budget for natural areas, plant, and animal life

N2. Structural Integrity of Local Forest Ecosystems

Percent of annual maintenance budget spent on terrestrial invasive species management

Acres of forest land developed each year

Acres of unfragemented land greater than 100 acres in Durham

Percentage of forest cover Durham

Acres of forest cover in Durham

Acres of effective impervious cover

N3. Diversity of Local Forest Ecosystems

Trend in bird species diversity derived from Audobon bird survey

Area of top 10 dominant tree speciea

N4. Structural Integrity of Local Freshwater Ecosystems

Enironmental DNA

River Herring Spawning Run counts
Number of acres of fresh water wetlands in Durham
Number of parcels in current 100 year floodplain
Number of town owned assets in 100 year flood plain

N5. Structural Integrity of Local Coastal Ecosystems

Number of miles of hardened tidal shoreline in Durham
Number of acres of salt marsh wetlands in Durham
undeveloped land vs. developed land in coastal watershed
Percent of annual maintenance budget spent on aquatic invasive species management
Number of fish species to Durham that have become extinct, endangered, or threatened
Acres of oyster reefs in Durham/Great Bay
Pounds of annual oyster productionfor food in Durham/Great Bay
Sea level rise
Number of salt water intrusions on wells and septic systems
Nitrogen levels in Great Bay
Area of salt marshes

N6. Structural Integrity of Local Agricultural Ecosystems

Pounds of food produced by farms
Acres of land in agriculture production (by type)
Percentage of of land in agriculture production (by type)

N7. Diversity of Local Agricultural Ecosystems

N8. Diversity of local Urban Ecosystems

Number of trees have been planted in downtown Durham
Amount of money Durham spends on tree care
Difference in temperature between downtown and rural sites on hottest days of year

Human Capital

2H. The robustness of a healthy, just, and sustainable food system

Percent of food insecure indivduals in Durham
Number of Seacoast harvest farmers markets in Durham and neighboring towns (TBD)
Number of days of food supply in grocery store(s)
Average percent of income spent on food annually
Percent of ORCSD students who receive free or reduced lunch

3H. Access to safe, affordable shelter

Percentage of people who are homeless
Percent of housing units that are considered affordable
Median gross rent
Average percent of income spent on rent
Percent of housing units that are owner occupied
Residential Unit vacancy rate

4H. Availability and utilization of quality health care services:

- Number of miles from Durham to the closest Medical provider
- Ratio of patients to primary care physicans in Strafford County
- Ratio of patients to dentists in Strafford County
- Percentage of residents who attempted suicide within last year

5H. Degree of physical activity and outdoor recreation

6H. Levels of substance use and abuse

- Number of alcohol or drug incidents where McGreogr EMS was dispatched
- Number of opiod related deaths

7H. Support for vulnerable populations

- Number of times emergency services are called to provide services to those who are mobility-challenged in the event of a power outage

8H. Level of safety and security

- Number of emergency responses by police
- Percent of residents who utilize police services
- Number of Arrests in Durham (by type?)
- Ratio of Durham resdients to first reponders (exlcude UNH police)

9H. Public Health threats

- Number of reported cases of Lyme Disease in Strafford County
- Percentage of people that have asthma in Strafford County
- Number of reported cases of mosquito borne diseaseein NH

Financial Capital

F1. Spending on energy

- Annual energy expenditures for energy for municipal buildigns and vehicles
- Amount of money spent per million BTU's
- Ratio money spent on renewable energy vs total energy used

F2. Spending on emergency events

- Amount of money budgeted and spent on snow removal

F3. Grants or investments on sustainability

- Amount of sustainability related state and federal grants received
- Amount of money recieved for disaster planning and related technical assistance

F4. Diversity of suppliers/flexible contracts

- Is there a flexible system to bypass regular biding protocols in event of an emergency
- Can union contracts be renegotiated if both sides agree?

F5. Wages and compensation

- Highest paid full time employee vs. the lowest paid full time employee (plus to and bottom 1%)
- Percent of persons in poverty- including UNH students

F6. Employee recruitment and retention

Ratio of county unemployment rate to national unemployment rate

ratio of county unemployment rate to state unemployment rate

Employee Turnover rate

Percent of open positions that are filled within 60-90 days

F7. Enrollment and cost of education

Percentage of ORCSD students from Durham vs. total ORCSD students

Amount of money spent per student

F8. Financial performance relative to peers

Ratio of Durham total tax rate vs. Hanover total tax rate (per $1000 of value)

Ratio of Durham budget vs. Hanover budget (appropiations)

Ratio of Durham median family income vs. Dover/Hanover median family income

F9. Healthy Budget, Sustainable Investments, and Town Assets

Annual maintenance budget

annual maintenance budget vs. total asset value

deferred maintenance vs. annual maintenance budget

Amount of budget spent on energy efficiency, purchasing renewable energy, or installing or upgrading renewable energy systems

Sustainable sources of revenue (money from munipcal budget or stormwater utility fees) vs. applying for grants

Percent of matching retirement plan funds- pension

Credit rating

Bond ratio

Amount of money in Undesignated Fund Balance (Cash Reserve)

F10. Fees Charged

Amount of money Durham residents are charged to dump items at the town landfill.

Endnotes

[1] Dean, P and D Kurz (2017) Town vs. Gown: From Conflict to Collaboration. Campus Law Enforcement Journal 47 (2), 44-46. https://www.unh.edu/sites/default/files/departments/police_department/dean_kurz_townvsgown.pdf

[2] Howard, K and RW Stephenson (2017) Meeting local needs for guidance on future coastal hazards at the New Hampshire shoreline. Shore & Beach 85 (2) 24-29. https://www.nhcrhc.org/journal-featured-articles/

[3] Climate Resilience. *Second Nature* https://secondnature.org/climate-resilience/

[4] Guidance for Resilience Planning" *Second Nature* https://secondnature.org/climate-action-guidance/resilience-guidance/

The five capitals: https://www.forumforthefuture.org/the-five-capitals

[5] UNH Greenhouse Gas Emissions Inventory: https://sustainableunh.unh.edu/ghginventory

[6] IPCC (2019) IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Prtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, M. Nicolai, A. Okem, J. Petzold, B. Rama, N. Weyer (eds.)]. In press. https://www.ipcc.ch/srocc/home/

IPCC (2019) IPCC Special Report on Climate Chage, Desertification, Land Degradation, Sustainable Land Development, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems. https://www.ipcc.ch/report/srccl/

IPCC (2018) Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [V. Masson-Delmotte, P. Zhai, H. O. P.rtner, D. Roberts, J. Skea, P. R. Shukla, A. Pirani, W. Moufouma-Okia, C. P.an, R. Pidcock, S. Connors, J. B. R. Matthews, Y. Chen, X. Zhou, M. I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp. https://www.ipcc.ch/sr15/

[7] Wake, CP.; Burakowski, EA.; Wilkinson, P; Hayhoe, K; Stoner, A; Keeley, C.; and LaBranche, J (2014) Climate Change in Southern New Hampshire: Past, Present and Future (2014).UNH Sustainability Institute. https://scholars.unh.edu/sustainability/2

Wake, C., Knott, J., Lippmann, T., Stampone, M., Ballestero, T., Bjerklie, D., Burakowski, E., Glidden, S., Hosseini-Shakib, I., Jacobs, J. (2019). New Hampshire Coastal Flood Risk Summary – Part I: Science. Prepared for the New Hampshire Coastal Flood Risk Science and Technical Advisory Panel. Report published by the University of New Hampshire, Durham, NH. https://scholars.unh.edu/ersc/210/ https://dx.doi.org/10.34051/p/2019.1

[8] Information from Todd Selig- Durham Administrator

[9] Ordinance #2018-01 of Durham, NH https://www.ci.durham.nh.us/sites/default/files/fileattachments/town_council/page/54386/2018-01_-_zo_amendment_to_flood_hazard.pdf

[10] "What Could a Living Shoreline at Wagon Hill Farm Look Like" https://www.ci.durham.nh.us/sites/default/files/fileattachments/town_administration/page/53921/whf_shoreline_restoration_project.pdf

[11] Data provided by Mike Lynch- Director, Durham DPW

[12] Data provided by Adam Kohler, UNH Energy Office

[13] Water and Wastewater System Agreement between Town of Durham and the University System of New Hampshire, 2016

[14] Connell, "Laws Governing Inter-Municipal Regional Cooperation" *New Hampshire Municipal Association* https://www.nhmunicipal.org/town-city-article/laws-governing-inter-municipal-regional-cooperation

[15] Laconia, NH City government https://www.laconianh.gov/Directory.aspx?DID=12

[16] Bennet, Bentley, Curtis, Puntin, Yacco, "You Can't Manage What you Don't Measure: Baseline Resilience at the University of New Hampshire"

[17] Bennet, Bentley, Curtis, Puntin, Yacco, "You Can't Manage What you Don't Measure: Baseline Resilience at the University of New Hampshire"

[18] Energy Chapter, Durham Master Plan pg. 23-30. https://www.ci.durham.nh.us/sites/default/files/fileattachments/planning_and_zoning/page/18691/energy_12312015.pdf

[19] UNH Stormwater Center, "Modeling the Effect of Local Stormwater Regulations on Future Pollutant Loads in the Oyster River Watershed", p.3 https://www.unh.edu/unhsc/sites/default/files/media/p2_final_report_modeling.pdf

[20] UNH Stormwater Center, "Modeling the Effect of Local Stormwater Regulations on Future Pollutant Loads in the Oyster River Watershed", p.3 https://www.unh.edu/unhsc/sites/default/files/media/p2_final_report_modeling.pdf

[21] Reported Cases of Lyme Disease in NH, 2013-2017, NH Department of Health and Human Services https://www.dhhs.nh.gov/dphs/cdcs/lyme/documents/county2017.pdf

[22] Data provided by Gail Jablonski- Durham Business Manager

[23] Data provided by Gail Jablonski- Durham Business Manager

[24] Stormwater Utilities, NH DES https://www.des.nh.gov/organization/divisions/water/stormwater/utilities.htm

[25] Stormwater Utilities, NH DES https://www.des.nh.gov/organization/divisions/water/stormwater/utilities.htm

[26] Global Covenant of Mayors for Climate and Energy: https://www.globalcovenantofmayors.org