

Delaware's Climate Change Programming: Evaluating Its Effectiveness and Impact on Local Resiliency

August 2020

Prepared by

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University of Delaware

In coordination with

Delaware Coastal Programs

Delaware Department of Natural Resources
and Environmental Control



UNIVERSITY OF DELAWARE

**BIDEN SCHOOL OF PUBLIC
POLICY & ADMINISTRATION**

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Preface

As the director of the Institute for Public Administration (IPA) at the University of Delaware, I am pleased to provide *Delaware's Climate Change Programming: Evaluating Its Effectiveness and Impact on Local Resiliency*. This important research sponsored by Delaware Coastal Programs and the Department of Natural Resources and Environmental Control takes a timely look at the efficacy of the various local government assistance programs and services offered by the state of Delaware and its partners that focus on climate change impacts.

This report continues IPA's tradition of research and service at the intersection of local municipal governance and climate change, and it complements prior work that developed and piloted a climate-conscious comprehensive planning process in Milford, Delaware. As a public service research organization that works closely with state and local authorities on a range of relevant topics—from flooding to water quality to comprehensive planning—IPA is committed to seeing communities across Delaware become more resilient to the impacts of climate change.

I want to thank Delaware Coastal Programs and the Department of Natural Resources and Environmental Control for supporting this research effort and for their longstanding partnership with IPA. Their tireless dedication to advancing coastal resiliency in Delaware testifies to their commitment to the residents, businesses, and visitors of the state. I also want to thank Philip Barnes who developed the research design, performed the analysis, and authored this report. Kohei Akiba, an undergraduate Public Administration Fellow, is due a debt of gratitude for the countless hours he spent transcribing interview audio. Additional thanks go to IPA staff members Lisa Moreland Allred for editing support and Sarah Pragg for designing and formatting this document. Finally, I would like to thank the local officials who graciously offered their time to be interviewed for this research even though they were simultaneously responsible for shepherding their communities through the anxious and uncertain beginning of the coronavirus pandemic. Nothing will stop Delaware's tremendous and dedicated public servants. Thank you.

Jerome R. Lewis, Ph.D.

Director, Institute for Public Administration

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Acronyms

ACT – Alliance of Coastal Towns

DCP – Delaware Coastal Programs

DNREC – Department of Natural Resources and Environmental Control

FEMA – Federal Emergency Management Agency

GIS – Geographic Information Systems

IPA – Institute for Public Administration

NFIP – National Flood Insurance Program

OSPC – Office of State Planning Coordination

RASCL – Resilient and Sustainable Communities League

SLR – Sea Level Rise

Executive Summary

There is a wide breadth of programs and services offered in Delaware that aim to inform jurisdictions about their climate change vulnerabilities and encourage them to advance resilience measures and practices. The ultimate effectiveness of this climate programming, however, is unknown. This report presents the results of a research effort to understand the efficacy of climate programming in Delaware and whether it is being translated into decisions at the local government level that ultimately enhance community resiliency.

Two questions motivated this effort: (1) How do local decision-makers learn about and acquire knowledge of the impact that climate change will have on their communities?, and (2) When officials acquire knowledge of local climate impacts, how do they use it, if at all, to make decisions that enhance their communities' resiliency? Interviews were conducted with 25 local officials in various jurisdictions—both large and small—to help answer these questions. Interviews were recorded, transcribed, and coded for further analysis.

The results indicate the local officials receive their climate information through a variety of means, the most common of which are direct observation of impacts and engagement with a public planning process (resiliency planning, comprehensive planning, etc.). Attendance at events sponsored by DNREC was well represented, as were events put on by the Resilient and Sustainable Communities League. When asked how the current range of climate trainings and educational events could be more effective, interviewees suggested that the content could be more relevant and targeted (e.g., inland versus coastal flooding, large versus small municipalities) and that online trainings would be useful. Forms of technical assistance were well received, especially for planning and vulnerability assessments. The technical assistance services were also found to have an important public education effect because they typically engage the wider community (citizens, businesses, elected officials) in the planning or assessment process.

The impact of climate programming and its effect on local resiliency is limited, and a direct linkage could not be conclusively established. This is not to suggest that the state's climate programming has no appreciable impact on municipal resiliency, only that a causal relationship is difficult to determine. Although there are a range of implemented climate adaptation measures undertaken at the local level, interviewees frequently discussed planning efforts and fulfilling statutory requirements (like updating floodplain ordinances) when asked to describe their resiliency measures. These actions, while important and useful, address current environmental conditions and do not typically anticipate more severe extremes in flooding or temperatures. Furthermore, an analysis of comprehensive development plans revealed that while jurisdictions are identifying climate change and sea level rise as threats, they are not

producing actionable recommendations to move forward and address these challenges. Implementation is, therefore, a significant obstacle for local climate resiliency.

A series of factors combine to diminish the effectiveness of climate programming in Delaware. First, there is a significant demand on municipal resources to manage an increasing workload of day-to-day operations and public administration. Second, there is a deficit of technical capacity to deal with the expectation of proactive climate adaptation. Third, there is uncertainty on the types of enforceable mechanisms that are available to advance local resiliency and how those mechanisms would operate within the limits of jurisdictional authority.

To effectively address this situation and advance more resilient practices and decisions at the local level, several recommendations are offered. The state should create and support a technical assistance program for implementation that would include collaboration with willing communities on a publicly engaged deep dive into enforceable mechanisms for local climate adaptation, with the objective of legislating a change in local codes and/or ordinances. If this program is created, existing technical assistance programs for planning and vulnerability assessments should continue their work but elevate the quality and the ambition of their recommendations because there would be an expectation of follow-on implementation assistance. Moreover, the state and its partners could leverage individuals' personal exposure to and observation of climate impacts by marketing the existing Coastal Observer app for Delaware, or perhaps develop a complementary platform that allows residents, businesses, and visitors to share their narratives and images of climate change. In terms of training and education, events could be transitioned to a remote platform such as webinars or virtual classrooms that would facilitate attendance, especially now that people are becoming familiar and comfortable with digital meetings. Finally, these training and educational events should be directly marketed to private-sector consultants who provide technical services to Delaware's cities and towns as well as local officials (e.g., councilmembers) who are ultimately responsible for taking legislative action on matters of local concern.

Introduction

Delaware is highly vulnerable to the impacts of a warming world. Delaware's population is increasing, and commercial and residential development are expanding in coastal areas. Two of the state's economic engines are agriculture and coastal activities, both of which are susceptible to rising temperatures, heat waves, and droughts (Hayhoe et al., 2013). Combined with a mid-Atlantic location that bears the brunt of tropical storms and nor'easters, flooding is a persistent problem (NOAA, 2016; Tiner et al., 2011). Delaware is also a hotspot for sea level rise (SLR) and experiences rates of SLR twice the global mean with an exponential increase in the frequency and severity of flood events (W. V. Sweet et al., 2018). SLR exacerbates the impact of waves and surge from coastal storms, erodes beaches and wetlands, negatively impacts tourism, damages critical infrastructure, and threatens the state's \$7 billion coastal economy (Latham & Lewis, 2012; Wakefield & Falk, 2017).

The state's municipalities are on the front line of the climate challenge, and they maintain significant authority to make local development decisions, many of which have implications for climate adaptation and mitigation (land use, zoning, public works, etc.). Toward that end, agencies within the state government, as well as partners in academia and the nonprofit sector, provide municipal decision-makers with climate-related services including financial assistance, technical assistance, online tools and data portals, and training and education. These services are intended to inform local decision-makers about the impact that climate change will have on their communities. Decision-makers can then utilize this climate information to chart an alternative development course, thus helping their municipalities become resilient to climate change.

However, the ultimate value and impact of climate change programming in Delaware is unknown. For instance, it is unclear whether or not the (1) trainings and education services are reaching the intended audience, (2) content is relevant and useful to decision-makers, (3) delivery methods are effective, and (4) decision-makers are leveraging new knowledge of climate impacts to pursue a more resilient development course in their communities. To help clarify those unknowns, the Institute for Public Administration (IPA) at the University of Delaware, at the request of Delaware Coastal Programs (DCP) and the Department of Natural Resources and Environmental Control (DNREC), conducted research to assess the effectiveness of the state's local climate programming. This report offers the results of that research effort.

Research Context

Local governments across Delaware engage in a variety of practices and exercises that have relevance for climate change adaptation. Likewise, state agencies provide guidance and frameworks for climate action. For instance, the Office of State Planning Coordination (OSPC, 2015) recommends that municipalities address climate change and SLR (if applicable) when they update their local comprehensive development plans. The Delaware Emergency Management Agency and the Division of Watershed Stewardship provide assistance to municipalities that participate in the National Flood Insurance Program (NFIP), for example by drafting model floodplain ordinance language (DNREC, 2014). The Division of Watershed Stewardship also provides technical support to ensure that municipalities comply with the state's sediment and stormwater management regulations (DNREC, 2020b).

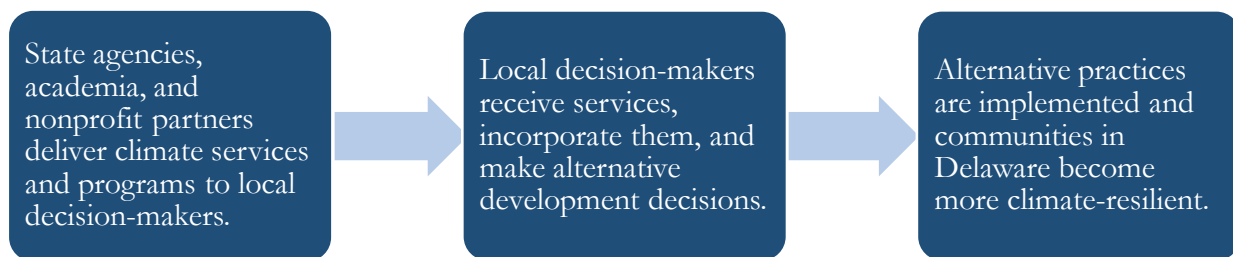
There are also many programs offered by state agencies, academic institutions, and nonprofit organizations that help municipalities voluntarily practice community development and decision-making in ways that are resilient to climate impacts. The Coastal Training Program, housed within the Delaware National Estuarine Research Reserve, offers education programs and trainings. Examples include training events for climate adaptation planning, green infrastructure, and climate communication (DNREC, 2020a). IPA provides online resources such as the Complete Communities Planning Toolbox and the Delaware Database for Funding Resilient Communities and offers a training program to help municipalities become flood-ready. Delaware Sea Grant and Delaware Coastal Programs provide direct technical assistance to cities and towns that are looking to plan for and adopt more resilient development practices. Online data portals are also available for local decision-makers. DNREC and the State Climatologist created the Delaware Climate Projections Portal that provides localized climate projections to the year 2100 across a range of climate indicators such as annual precipitation and number of days per year with temperatures above 90 degrees (DNREC, 2015). Similarly, DNREC and the Delaware Geological Survey collaborated to update the state's SLR inundation maps and subsequently made the map layers publicly available through an online viewer/portal (Delaware Geological Survey, 2017).

For their part, local decision-makers on the receiving end of climate programming in Delaware are expected to incorporate the information provided to chart a more resilient development course. There are community planning opportunities to become more climate resilient. Comprehensive development plans, emergency management and hazard mitigation plans, master plans, and municipal sustainability plans could leverage the state's climate programming. In terms of implementation, local land use is impacted by various ordinances with opportunities to enhance zoning, subdivision, and floodplain ordinances. Public managers must also make administrative decisions that have consequences for climate adaptation and

mitigation, for example by allocating resources to design, build, operate, and maintain local public works and infrastructure.

The creation and delivery of climate programs to local officials is based on a logic model. That model, which is presented graphically in Figure 1 below, is based on the idea that it is necessary to inform local decision-makers on potential climate impacts and assist with technical capacity so they can act accordingly and practice resilient climate adaptation and mitigation in their communities.

Figure 1. The Implied Logic Model for Climate Programming in Delaware



Given that the state and its partners spend some of their limited resources to provide climate services and local decision-makers must spend their limited time and energy to receive and implement these services, it makes sense to evaluate this model to determine whether it operates as intended under real-world conditions. If it does not function as intended—if the end goal of more climate resilient development is not being realized at the local level—then there may be inefficiencies or barriers to the service delivery or implementation.

Research Questions

There are two overarching questions that guided this research: (1) **How do local decision-makers learn about and acquire knowledge of the impact that climate change will have on their communities?**, and (2) **When officials acquire knowledge of local climate impacts, how do they use it, if at all, to make decisions that enhance their communities' resiliency?** These research questions embed certain assumptions about local decision-makers. First, the questions assume that decision-makers have agency to independently learn about local climate impacts and that state-sponsored climate programming is one possible learning pathway among many. Second, the questions assume that decision-makers must balance competing demands and expectations, and that local climate impacts are one factor among many within any decision-making calculus.

Second-order questions follow from the main overarching questions. Does the content of climate programming in Delaware meet the needs of local decision-makers and, if so, is it delivered or presented in the proper format? If not, how could it be improved? What are the main mechanisms by which resilient development practices are leveraged and implemented at the local level (comprehensive plans, zoning, subdivision approval, etc.)? What forms of assistance are most needed by local decision-makers? How do needs and practices vary by size of the municipality, geography, or other independent variables?

Research Design

The research scope involved interviews with local leaders who engage with the many state programs designed to enhance knowledge of climate change impacts. As noted above, the objective of these interviews is twofold: (1) to understand if decision-makers acquired useful and usable knowledge of climate impacts, and (2) to determine if they applied that knowledge as a criterion when making decisions and climate-related choices.

A sample population for the interviews was defined through consultation with DCP and DNREC's Division of Climate, Coastal & Energy. The geography for the sample population was initially selected as the cities, towns, and counties in Delaware that will experience one foot of SLR. This was achieved by using Geographic Information Systems (GIS) software to superimpose a one-foot SLR inundation layer (based on the most recent 2017 SLR projections) on top of municipal administrative boundaries to determine the jurisdictions that will be impacted by SLR (Delaware Geological Survey, 2017). One foot of inundation was chosen because it represents a moderate to high probability of occurrence over a 30-year timeframe and should therefore be taken seriously, even by the risk-tolerant (Callahan et al., 2017, fig. ES-2). Concomitantly, 30 years was chosen as the timeframe because it is the length of a typical mortgage and, therefore, a reasonable (though not extreme) planning horizon. The GIS model indicated that

the following jurisdictions will be affected by one foot of SLR: Bethel, Bethany Beach, Blades, Bowers Beach, Dagsboro, Delaware City, Dewey Beach, Dover, Fenwick Island, Frederica, Henlopen Acres, Kent County, Laurel, Leipsic, Lewes, Little Creek, Middletown, Milford, Millsboro, Millville, Milton, New Castle, New Castle County, Newport, Ocean View, Odessa, Rehoboth Beach, Seaford, Slaughter Beach, Smyrna, South Bethany, Sussex County, and Wilmington. In addition to these 33 jurisdictions, the municipalities of Newark, Elsmere, and Georgetown were included in the sample at the request of DCP and DNREC because of their larger population size or history of local flooding issues. A map of the jurisdictions in the sample population is shown in Appendix A.

With the sample population defined, potential interviewees needed to be identified within each jurisdiction. It was determined that one interview should be conducted with a local decision-maker in each of the affected jurisdictions. Given the varying sizes of the jurisdictions, a municipal staff priority list was generated based on who would (1) be accessible for an interview and (2) have knowledge of local climate impacts. Through further consultation with DCP and DNREC, the list was prioritized as follows: (1) director or head of planning department, (2) staff planner, (3) city/town manager, (4) chair of the local planning commission, (5) mayor. In other words, if a municipality has a planning department with multiple staff planners, the best person to interview would be the director or head of the department. If the municipality does not have a planning department, but has a paid staff planner, the staff planner would be the best person to interview in that city or town. If the municipality does not have a paid staff planner, the next best person to interview would be the city/town manager, and so on down to the mayor. Given these criteria, a list was generated that included email addresses and phone numbers for all the priority interviewees in each of the jurisdictions in the sample population.

Next, an interview questionnaire was developed and shared with the project sponsors at DCP and DNREC for their review. Interview questions were designed to solicit responses that could be analyzed and help answer the main research questions. After several amendments and revisions to the questionnaire, it was finalized and submitted to the University of Delaware Institutional Review Board for its approval of human subject research (see Appendices B and C for the final questionnaire and approval letter, respectively). It was determined that interviewee identity should be protected to elicit more honest and open answers to the questionnaire.

To solicit and schedule the interviews, an email was sent to the priority interviewee in each jurisdiction requesting their participation in the research. If the interviewee did not respond within ten days, a follow-up email was sent. If no response was received after the second email, a third email was sent after another ten days. If there was still no response, an email was sent to the next person on the priority list for that jurisdiction. In most instances, the priority interviewee responded and agreed to participate in the research, but in several instances they

suggested that a different local official would be better suited to answer questions. In those cases, an email solicitation was sent to those individuals. After the interviewees agreed to participate and dates and times for the interviews were established, the interviews were conducted over the phone. The interview period for this research—March and April of 2020—unfortunately coincided with the steep rise in coronavirus transmission in Delaware and Governor Carney’s Executive Orders to shelter in place. Consequently, many local officials were occupied with health and safety priorities in their communities in addition to carrying out their normal public administration duties. Several local officials noted that they were not able to participate in the research due to these conditions.

Twenty-five interviews were conducted with a range of local officials including planning directors, planning staff, town managers, assistant town managers, planning commission chairs, mayors, and building officials (see Table 1 below). Interviews ranged in duration from 12 to 30 minutes, and they were recorded with a digital voice recorder and later transcribed for further analysis. Hand-written notes were also taken during the interviews to capture important statements or feedback.

Table 1. Job/Position Titles for Interviewees

Job/Position Titles for Interviewees	Count
Planner	5
Town Manager	5
Building Official	4
Planning Director	2
Senior Planner	2
Assistant Town Manager	2
Mayor	1
Planning Commission Chair	1
Code Enforcement Officer	1
Councilmember	1
Site Manager	1

Interview Analysis and Presentation

The analysis of the transcripts proceeded through several phases. In the first phase, the transcripts were read twice and answers to the individual questions were qualitatively open coded into common responses. The objectives of this phase were to create a comprehensive picture of substantively unique answers and establish a categorization system for succinctly communicating results with descriptive statistics. The open coding process was not strictly

superficial, and interviewee responses were interpreted to help with categorization. The second phase of the analysis involved reading the transcripts a third time and applying a thematic axial coding system to aid in interpreting the interview data (Guest et al., 2012). This thematic analysis helped to tease out deeper meaning from the interviewees, with the goal of informing changes to policy, administrative, and programmatic practices that would enhance community resiliency to climate impacts.

At the request of DCP, this report presents a full and comprehensive catalog of all the responses given by interviewees. For example, if one interviewee answered a question in a substantively different way from all other interviewees, that substantively different answer is still presented in this report. The open coding process was used to create this catalog and counts of substantively unique responses to each question.

In the remainder of the report, direct quotations from interviewees are reproduced with the intention of supporting the findings and recommendations. The quotations that are used may be modified to remove personally identifiable information but will still retain the meaning and the essence of the interviewees' statements. Selection of a quotation was based on two criteria: (1) it is well-reasoned and articulated, and (2) it succinctly encapsulates the finding or recommendation.

Findings

Most interviewees self-reported that they were either very knowledgeable or fairly knowledgeable about the impact that climate change would have on their communities, with a smaller number expressing only limited knowledge. No interviewees reported having no knowledge of local climate impacts (Table 2).

Table 2. Interviewees' Local Climate Knowledge

Self-Reported Knowledge of Local Climate Impacts	Count
Very knowledgeable	11
Fairly knowledgeable	9
Limited knowledge	5
No knowledge	0

Acquisition of Local Climate Knowledge

With interviewees reporting knowledge of local climate impacts, a prerequisite is established to answer the first overarching research question: **How do local decision-makers learn about and acquire knowledge of the impact that climate change will have on their communities?** Eight interviewees reported that they primarily learned about local climate impacts by directly observing more intense and frequent flood events. The following quote is representative of the personal observations that interviewees made regarding local flooding:

I know from just discussions and I know from my own experiences that we have had more back-bay flooding... Some of that is not just on rainy days but it's also on our sunny days when wind blows water into the bay and it doesn't let it out.

Eight interviewees noted that they learned about local climate impacts through engagement with a planning process (comprehensive planning, resiliency planning, master planning, etc.). Involvement with planning processes was valuable for a range of local officials and not just for those who are professional planners. Several managers and building officials, the mayor, the councilmember, and the site manager (Table 1) all reported that a planning project afforded them the opportunity to assess local climate risk, particularly flooding and SLR. For example, with comprehensive plans:

[We] just completed [our] comprehensive plan...Climate change crept into a number of the chapters because we did reach out to DNREC staff in those areas as kind of one of our resources for some of the information that we were looking to gather and then be able to develop.

Several interviewees noted the value of working with DCP and the Resilient Community Partnership program to assess local flooding and SLR vulnerability. Working through that planning process, which involves engagement with localized climate data such as the SLR inundation layers, was reported to be a valuable learning experience:

[We were] selected...to participate in the sustainability and resiliency program that the Coastal Programs office runs. We worked very closely with the Coastal Programs office in assessing our vulnerability...Working with the state has helped. Some of the online tools that the state has put together on sea level rise has helped make me more aware on how it will impact [us] specifically.

Less commonly reported methods of acquiring local climate knowledge include self-education (five mentions), interactions with DNREC staff (four mentions), exploration of the SLR inundation layers online (three mentions), and updates of the local floodplain ordinance to comply with the requirements of the NFIP (two mentions). Three interviewees mentioned Susan Love, DNREC Climate and Sustainability Section Administrator, by name as their main source of local climate knowledge. When one interviewee was asked how she acquired an understanding of climate change, she replied, "I've been to enough meetings with Susan Love that you can't not know."

Engagement with Climate Programming

Interviewees were asked about their experiences with the range of climate programs offered by the state and its partners. The types of programs that received the most engagement were events, online tools, and technical assistance.

Events

Twenty out of 25 interviewees reported that they attended a training, workshop, meeting, or event on climate change. DNREC was the most commonly cited sponsor of these events. Fifteen of the 20 interviewees who attended at least one event noted that DNREC was the main sponsor. Unfortunately, memory recall with interviewees was imprecise, and they struggled to remember specific details of these events, especially shorter, half-day trainings. For instance, when asked who sponsored the event, interviewees would commonly reply DNREC, but could not identify the section or division within DNREC that sponsored the event when asked. There were exceptions however. One exception was the four-day Managing Floodplain Development training led by either Greg Williams or Dave Warga from DNREC. Seven interviewees specifically mentioned that they attended this training.¹ The Resilient Community Partnership program, which is a competitive grant program that pairs DNREC resources with a jurisdiction to

¹ It is logical that an intense four-day training session or a months-long collaborative partnership is more memorable than the common half-day events.

collaborate on a year-long local resiliency-building effort, was another exception that received five mentions. Receiving three mentions was DNREC's Sustainable Communities Planning Grant program, another competitive funding program that paired municipalities with financial and technical resources to develop a local sustainability plan.

The Resilient and Sustainable Communities League (RASCL) was cited by eight interviewees. RASCL is a collaborative partnership among state agencies, nonprofit organizations, and academic units that offer climate-related services to municipalities and local stakeholders. The partnership organizes an annual summit in Dover (eight mentions) and has, for several years, been hosting periodic "Coffee Hours" at various locations across Delaware where state employees and climate experts make themselves available to attendees (four mentions).

Event sponsors with three or fewer mentions include IPA, Delaware Emergency Management Agency, Wilmington Area Planning Council, American Planning Association, the Federal Emergency Management Agency (FEMA), International City/County Management Association, and the Alliance of Coastal Towns (ACT).²

Online Tools

With eight mentions, the most frequently discussed online tool was the Delaware Flood Planning Tool. The SLR inundation layers were identified by three interviewees, and FirstMap was mentioned by two. The Delaware Coastal Flood Monitoring System, the Delaware Database for Funding Resilient Communities, the FEMA flood claims portal, and the Delaware Flood Risk Adaptation Map (FRAM) all received a single mention.

Technical Assistance

Eight interviewees noted they received project-specific technical assistance from DNREC or another partner such as DeIDOT or Sea Grant. All of these projects were specific to a particular site that was susceptible to flooding or SLR. More generally, interviewees also mentioned that climate-relevant technical assistance from DNREC was received for various planning processes such as comprehensive development plans, resiliency plans, sustainability plans. Interviewees from municipalities in ACT also recognized DNREC's assistance with the recent assessment of impervious surface coverage.

Feedback on Climate Programming

As noted earlier, interviewees' recall of specific events was poor. When asked whether the events were useful, or for recommendations on how the events could be improved, interviewees had difficulty articulating detailed responses. Still, some valuable feedback was

² The Alliance of Coastal Towns is a partnership among Lewes, Henlopen Acres, Rehoboth Beach, Dewey Beach, Bethany Beach, South Bethany, and Fenwick Island.

elicited. When asked if the in-person events were useful, interviewees overwhelmingly responded in the affirmative, with one person saying no and another expressing modest enthusiasm. When interviewees did respond with clarity to the question about the value of the events, several noted that they appreciated hearing about other jurisdictions' experiences and learning about best practices in climate adaptation. In addition, several interviewees also spoke about the valuable networking opportunities that events provide. The following quote captures this sentiment:

I use these meetings mainly for networking. I'll ask a couple questions. I might whine and complain that we don't have this, that, or the other. And all of the more knowledgeable people and more well-connected people will want to take pride in answering the question...and they'll say, "you know, we can do this, and we can do that." Well now I got something to work with, or someone I can work with. So I use these meetings when I go really for that, for the networking component of it, not for the meeting itself.

When asked for recommendations on how to improve events, the most common response was that events needed to be contextualized and made relevant for the diversity of Delaware's cities and towns. For example, several interviewees from inland communities stated that event topics that were relevant for beach towns that might be vulnerable to storm surge, did not apply to their own major challenge of riverine flooding. Interviewees from very small towns noted that their lack of financial and technical capacity meant that implementing the types of projects presented at events was difficult if not impossible, and they would prefer to receive guidance on administratively feasible adaptation options given their resource limitations. Other suggestions for improvement include offering content on actionable strategies instead of focusing on vulnerability assessment techniques, making trainings shorter and easier to attend (geographically), and targeting trainings to those who possess decision-making authority (like councilmembers) instead of training individuals who play supportive roles (like planners and floodplain managers).

Feedback was also received on the climate-related online tools. For instance, beyond mentioning that the SLR maps exist, few interviewees commented on their utility or ease of access. Conversely, the Delaware Flood Planning Tool received overwhelmingly positive reviews. Interviewees noted it was extremely easy to use, and they appreciate the level of detail, particularly with respect to parcel-level boundaries:

I absolutely adore, I guess it's DNREC's floodplain tool, mapping? Oh my God, that is like, a lifesaver. I absolutely love it...and you can zoom in on a parcel. I use it a lot. It's an absolute dream.

Interviewees were asked for feedback on effective ways to learn about local climate impacts. Ten noted that in-person trainings were effective, while six indicated that webinars would also be effective:

I think given what's happening in the world [with COVID-19], people are going to be more interested or more receptive—I know I am—more receptive now to kind of the webinar training, and Zoom meeting stuff, and Google Team meeting stuff like that. I was not very involved in it before, and I'm being forced into it. While I think it's going to take me a little while to get fully comfortable with it, I do think it's a great way to get some of these—you know a 15- to 20-minute or even a half hour to an hour—training sessions out there on various subject matters that are important.

Five interviewees suggested a more passive method, stating that DNREC should continue to share information with local stakeholders and officials, for example by emailing new reports or datasets as they become available. Strategies that received two or fewer mentions included holding conferences, sharing best practices, developing mapping products, developing climate risk communication products for the public, and offering direct technical assistance.

Impact of Climate Programming

The second overarching research question seeks to understand how Delaware's climate programming influences decisions at the local level: **When officials acquire knowledge of local climate impacts, how do they use it, if at all, to make decisions that enhance their communities' resiliency?** Answering this question proved to be extremely difficult for several practical reasons.

First, some interviewees are new arrivals in their communities and do not have institutional memory of the factors or reasoning that went into certain administrative or policy decisions. Second, in some locations, particularly the larger municipalities where the local government is more fragmented and siloed, interviewees could not comment on decisions that were made in other municipal departments. For example, an interviewee from a planning department would not have intimate knowledge of decision-making in the public works department. Third, and perhaps most importantly, it is challenging to draw a direct connection between a particular experience with climate programming and a later decision that was clearly influenced by that experience.

An example will better illustrate the third condition. When interviewees were asked if any local ordinances were changed because of information they heard or learned through Delaware's climate programs, a number of individuals responded that they had a freeboard requirement within their floodplain ordinance, but were unable to clearly link the insertion of that requirement to any training, workshop, or event they attended. Indeed, several noted that the

freeboard requirement arose from a process in 2014–2015 where their municipality was obligated to revise and update their floodplain ordinance to remain compliant with the NFIP. Thus, the freeboard requirement was a product of regulation and not a voluntary action on the part of local government.

This is not to suggest that climate programming is ineffective and does not lead to enhanced community resiliency. Indeed, there are many local adaptation actions that interviewees identified and that were likely influenced by the range of climate programming offered in Delaware. These actions range from regulating the width of driveways, acquiring property parcels that are vulnerable to SLR, widening riparian buffers, prohibiting floodplain subdivision, limiting floodplain development, updating building codes, adding hinges to manhole covers, installing green infrastructure, upgrading floodgates, incorporating SLR projections into capital improvement and land development projects, using permeable paving, and restoring wetlands with dredged materials. Unfortunately, it is not possible to directly tie these actions to climate programs due to the complications highlighted above.

On the other hand, some of the technical assistance services could be directly connected to local climate adaptation actions. To continue with the case of freeboard requirements, one municipality received technical assistance to update its comprehensive development plan and, through that direct engagement with DNREC resources, decided it was prudent to make a recommendation in the plan to upgrade its floodplain ordinance. After the local council approved the comprehensive plan, the municipality followed through and subsequently modified its floodplain ordinance with a more conservative freeboard requirement.

Direct technical assistance was also responsible for helping to produce many of the local plans and assessments that identify climate impacts, examine vulnerabilities, and propose adaptation options. As noted previously, climate change is integrated into project- or site-specific plans, comprehensive development plans, resiliency plans, sustainability plans, and impervious surface assessments. These climate-aware plans and assessments are being developed more frequently in part because DCP and DNREC are directly financing and supporting these efforts through various grant and technical assistance programs.

Limitations and Barriers to Action

Interviewees were asked about the factors that limit their ability to make climate-aware decisions that ultimately enhance community resiliency. The most common response, with eight mentions, was technical capacity.

Yeah, I mean with the small town...we just had a very steady volume of large development applications that really took the focus of the staff and the planning commission. And there's only so many balls you can keep in the air at once. All of that kind of policy development stuff had to be pushed to the side while we cleared the queue on development applications.

Interestingly, four interviewees stated that their communities were largely built out with no additional room for growth, suggesting that they were already locked-in to a static development situation with little room to maneuver for change.

I think the biggest [limitation is that we are] totally built out. There really is no open space left. So there's no place to put retention ponds or bigger projects that would handle sea level rise. Everything we have is built on.

Four interviewees mentioned that there was not enough public support for action on climate adaptation, with four others noting that the political environment within local government did not prioritize the issue. Indeed, three interviewees said that climate change was nowhere to be found on the local policy agenda. Two stated that climate change impacts were not a concern because the community was not vulnerable.³

A number of limitations received a single mention. These include high rates of staff turnover, the presence of red tape when making impactful changes, lack of local leadership, low-quality data, strong private property rights, permissive ordinances, permissive state regulations, and permissive development practices in Sussex County.

When asked what would help communities become more climate-resilient, the most common answer—with eight responses—was technical assistance. This finding is not surprising given that the most frequently cited barrier was technical capacity. In terms of the types of technical assistance needed, interviewees mentioned technical analyses (for instance understanding marsh dynamics) and project-specific or ad-hoc assistance. Another common suggestion was offering more education on climate impacts and adaptation actions. Sub-categories contained within the education response include educating the public (four responses), educating elected leaders (four responses), and providing more general training (three responses). Three

³ Looking at the extent of the Flood Insurance Rate Map and the Flood Risk Adaptation Map with these two municipalities, one interviewee can reasonably claim that their community has low vulnerability to flooding, but the other is in fact vulnerable to current and future flooding.

interviewees stated that they needed public support from DNREC and the state when making difficult decisions that were likely to be controversial or unpopular. Four also stated that it would be helpful to have clear guidance on the types of enforceable resiliency mechanisms available to municipalities.

Two interviewees noted that they would like to receive assistance and support for cost-benefit analyses that could demonstrate the cost effectiveness of implementing climate resiliency measures. Suggestions receiving a single mention included receiving GIS services, sharing best practices and examples from other communities, establishing partnerships with existing coalitions like the Delaware League of Local Governments or ACT, improving state-level leadership and support, strengthening state regulations, and creating a buyout program to help with property acquisition.

Greenhouse Gas Mitigation

At DNREC's request, a question about local greenhouse gas mitigation actions was added at the end of the interview questionnaire. This element of the research was an initial attempt to inventory the variety of greenhouse gas reduction efforts happening at the local level in Delaware. Unfortunately, 12 interviewees could not identify a single greenhouse gas mitigation project or strategy in their communities. Of those who could, the most common response from interviewees, with six mentions, was investments in municipal solar projects (both ground and roof mounted). Three interviewees noted that they were steering development near public transit routes, that their municipality had purchased hybrid vehicles, and that their municipality installed electric vehicle charging stations at municipal buildings. Receiving one or two mentions were actions such as upgrading bicycle and pedestrian infrastructure, creating off-road trails, encouraging compact development, signing a power purchase agreement, rapid permitting of rooftop solar, urban greening and tree planting, installing green roofs, and purchasing electric vehicles for the municipal fleet.

Discussion

The research literature on local climate action identifies a series of local conditions that influence efforts to adapt to climate impacts. Commonly cited conditions include local technical capacity, availability of funding and financial resources, local leadership and champions for action, political values, and the availability and usability of climate information (Birchall, 2020; Hamin et al., 2014; Jones et al., 2017; Moser & Ekstrom, 2010; Sarzynski, 2015). The state and its partners offer climate programs that directly address some of these conditions (technical assistance, funding, information, and education), but they are also limited in how much they can or should intervene (political values).

Usefulness of Climate Programming

It is notable that among interviewees, the most frequently cited sources of climate information are direct experience and personal observation and not services offered by state agencies and their partners. This should not be interpreted to mean that climate services are ineffective or that interviewees did not find them useful. Rather, it highlights the power of independent discovery and self-learning about climate change.

While an individual's observation of climate change can help a single person recognize climate vulnerability, personal and anecdotal evidence is not useful for making critical policy decisions that will affect an entire community.⁴ More comprehensive, detailed, and objective data are required for planning and analysis of local climate adaptation strategies. Therefore, despite receiving a low number of mentions during the interview process, the Climate Projections Portal and SLR inundation scenarios are essential services that serve an important planning and policy function in Delaware.⁵

DNREC's training and technical assistance programs also help communities understand their climate vulnerabilities. Certain forms of direct technical assistance, for example resiliency planning or comprehensive planning, can bring a community together and can be more impactful because the information reaches a wider audience. One interviewee discussed the value of cooperating with DNREC on a resiliency plan and noted:

I also found it very helpful in stakeholder awareness. Stakeholder being resident awareness. I found that it was very helpful in doing that, [DNREC] were really great in their public outreach and in making everyone else in town aware of it, the concerns. And the fact that the state and the town officials are looking at this, and we're working on it as much as we can.

⁴ Although emerging research on Climate Risk Narratives indicates this view may be changing (Jack et al., 2020).

⁵ The Climate Projections Portal did not receive a single mention.

This is a particularly salient point, as several interviewees noted that educating the public (to build broad political support) and elected officials (to increase capacity and leadership among those with decision-making authority) were prerequisites to moving forward with substantive climate resiliency measures. Direct technical assistance that engages local stakeholders accomplishes multiple objectives. It fills the sizeable technical capacity gap that is present in nearly all jurisdictions, enhances awareness of climate vulnerability in a community, amasses political will, and provides knowledge to those who wield decision-making power.

The usefulness of training and education programs was difficult to assess for two reasons noted earlier: interviewees had poor memory recall of these events and could not directly link the information received to decisions made in their communities. Some useful feedback was elicited however. Interviewees did suggest that trainings were an effective way to learn about climate change and expressed a willingness to attend remote sessions, such as webinars. Interviewees also suggested that the training and education events could be tailored to specific contexts. For example, rather than having a single statewide flood-ready community training that treats all communities similarly even though they might experience different types of flood risk, it would be beneficial to target coastal communities with coastal flood training and inland communities with riverine flood training. Another specialized training could be developed for very small towns to include content that is both actionable and feasible for less-populated municipalities that have limited capacity and resources. Yet another division in training could be created for towns that are fully built out and deal almost exclusively with redevelopment applications in contrast to towns and cities that are growing and process greenfield and subdivision applications. The policy and administrative tools used to oversee development and consider climate change in these two types of communities is different, and training content and materials could reflect that reality.

Trainings also serve a valuable role in educating individuals who are new to their communities or to the issues of flooding and climate change. Previous research conducted for DCP found that staff turnover was a major issue for towns in Sussex County, and newly arrived municipal employees may not have the same level of expertise on Delaware flooding dynamics as their predecessors (Barnes, 2017). Trainings provide a valuable opportunity for these less-experienced individuals to quickly ascend the learning curve.

The primary audience for the climate training and education programs is local administrators (planners, floodplain managers, etc.), and interviewees mentioned that the audience should be expanded. Some suggested that it would be useful to educate the public and build understanding and support for action on climate adaptation. However, direct training and education of the public that was conducted independently of an engaged planning process would be a heavy lift with no guarantee of results. A potentially more beneficial and feasible option would be to conduct trainings for local officials, such as councilmembers.

Councilmembers have decision-making authority over climate-relevant choices such as development applications and budgets.

Another audience that could receive training and play a more prominent role in municipal climate resiliency is the consultant industry. Towns and cities in Delaware frequently contract with engineering, surveying, and planning consultants who provide technical support and services. None of the interview questions asked about consultants, but they were mentioned by 12 interviewees. Climate-conscious consultants could provide support and services that enhance community resiliency, and they could also elevate the conversation within municipal governments about the opportunities and advantages of taking action on climate adaptation.

Climate Programs and Their Effect on Community Resiliency

The interviews revealed that cities and towns are taking climate actions that are required by statute (comprehensive development plan updates, floodplain ordinance updates, stormwater regulations). But these non-voluntary actions have limited effect on community resiliency because they address current environment conditions and not a future with increased temperatures and more frequently flooding. For example, an analysis of comprehensive development plans shows that of the 17 SLR-vulnerable municipalities that have updated their plans since 2016, all 17 mentioned SLR in their plans.⁶ But that encouraging quantitative statistic masks a qualitative deficiency because the plans themselves typically lack actionable language or strategies for dealing with SLR. SLR is often identified as a future problem requiring further analysis, not as a present problem that necessitates action. A similar assessment can be conducted with floodplain ordinances. SLR-vulnerable municipalities are flood-prone and need to periodically update their flood ordinances to remain compliant with the NFIP, most recently in 2014. While many floodplain ordinances in Delaware include freeboard, several highly vulnerable jurisdictions established their freeboard at zero inches above base flood elevation (Sussex County, South Bethany, Fenwick Island, and Blades).

It is not prudent to view these non-voluntary actions as climate-adaptation strategies because they do not effectively advance local resiliency. Naming SLR in a comprehensive development plan is ineffective compared to taking and implementing legislative or administrative action. Updating a floodplain ordinance with zero inches of freeboard, just to remain in standing with the NFIP, is not effective compared to proactively and explicitly preparing for SLR.

Furthermore, while many interviewees identified some adaptation and resiliency-enhancing measures taken in their communities—actions such as regulating impervious surface coverage, acquiring vulnerable property, increasing freeboard, widening riparian buffers, prohibiting or

⁶ OSPC added climate change and SLR to its comprehensive plan checklist in March 2015. Sixteen SLR-vulnerable municipalities last updated their comprehensive development plans in 2015 or earlier. Of those 16, only six mentioned SLR.

limiting floodplain development, updating building codes, installing green infrastructure, and upgrading greywater infrastructure—these can be interpreted as strategies to address current flood risk. Certainly, these laudable actions enhance community resiliency and help to minimize vulnerability to climate impacts such as SLR, but the interviews could not establish whether the motivation and rationale for these actions is SLR adaptation. In fact, given several interviewee comments, it is reasonable to conclude that these positive actions were the product of a commendable effort at the local level to advance current flood mitigation measures. These efforts arise from a dual set of compounding pressures faced by jurisdictions. The first set includes limited staff resources, technical capacity, and financial resources. The second is the accelerating pace of development in Delaware. As one interviewee stated:

I know in the planning office we do a little bit of everything. So what tends to fall by the wayside is more of the long-range planning initiatives versus what I would call current planning which is dealing with the permits that are walking in the door, the applications for development that need to go to a broader commission for a regular approval process.

A second noted:

And we're a decent-sized town, and I imagine like your largest cities and counties probably have more staff time to commit to analyzing some of this stuff, but you know smaller towns and people our size I mean they're so busy trying to keep up with the day-to-day operation that some of the stuff gets...I don't want to say ignored but it's just not a priority.

And a third testified that:

I don't think you can imagine the body of work that comes through this town on a daily basis. You know, my office handles all the licensing, the rental licensing, the business licensing, the code enforcement, the developments, the transportation projects, the capital improvement projects, everything. We just don't have enough heads... It's not there's not enough will or desire to do anything, it just all comes down to resources.

Local governments in Delaware are caught in the middle of a struggle, a struggle that manifests because there is a significant imbalance between the demands placed on local administrative resources (both from the state and from resident/business/development interests) and the supply of local resources to meet those demands (human, technical, financial, etc.). Given this mismatch between supply and demand, local governments work diligently to keep pace with day-to-day administrative tasks and challenges, but proactive climate adaptation and implementation remains sidelined.

This is compounded by the lack of ideas and mechanisms available to local governments that wish to become proactive on climate change. One interviewee, an experienced and climate-aware professional, stated:

I think where we find ourselves, because we're practitioners of a very different kind of planning than the folks at DNREC are, is what are we supposed to do about it? Other than discouraging development in certain places.... what do you want us to do? I don't know what you want us to do.

Even this quote belies the difficulties faced by local governments. "Discouraging development in certain places" is a general statement that does not reveal the implementation process for achieving such an outcome. The crucial question of *how* development is discouraged is not stated. What enforceable mechanisms, using what legal authorities, need to be exercised to "discourage development in certain places?" Local officials are unclear on their implementation options, including those who seek to advance climate resiliency:

One thing I think would be helpful is, how do you incorporate aspects of these into the code in a practical way? But I think that's the area where we're starting to try to figure out. How do we adjust our codes to address these issues?

This analysis reveals that the transformative effect of climate programming in Delaware is muted. Local officials and citizens are indeed becoming more climate-aware, in part due to the training and education programs offered by the state and its partners. But considering the lack of on-the-ground climate adaptation measures that are implemented in Delaware and the maladaptive practices that repeatedly occur in certain jurisdictions (subdividing the floodplain, filling the floodplain, expanding impervious surface coverage, etc.), one can conclude that climate programming is having a limited impact on community resiliency. Revisiting Figure 1, we see that the logic model for climate programming partially breaks down between boxes one and two and essentially fails to move from box two to box three. The failure results from a confluence of factors and have already been identified: a short supply of technical expertise, the day-to-day demands of public administration that absorb scarce resources, a dearth of legal and enforceable mechanisms to implement that go beyond the non-voluntary minimums, and the low to moderate levels of political will and public support to legislate and move forward with adaptation measures.

It is important to recognize that the state administers several programs that are extremely effective at building resiliency toward climate change and flooding, although the programs were not created for this purpose. Established in the early 1990s, Delaware's Open Space and Aglands Preservation Programs have combined to protect over 200,000 acres of undeveloped

land in the state, much of it in flood-prone and SLR-vulnerable locations.⁷ The Aglands Preservation Program secures easements on farm and forestland and was created to promote local food production and farming as an occupation. The Open Space Program likewise secures conservation easements, but it also contains a property acquisition element that is intended to protect ecologically sensitive natural resource areas. Climate resiliency is not a criterion in the selection process for either of these programs, yet it could be argued that they are the most impactful state programs in that respect.⁸

Greenhouse Gas Emissions Reduction

The research design for this project focused primarily on climate adaptation, but it is relevant for greenhouse gas mitigation as well. A DNREC-led effort currently underway to develop a Climate Action Plan for the state will propose emission reduction recommendations for the transportation, electricity, agricultural, industrial, and building sectors. The objective of the Climate Action Plan is to set and meet carbon emission reduction targets for the state, and local governments will have a role to play in helping to meet these targets.

For the interviewees that identified emissions reduction actions in their communities, the range of strategies is consistent with sectors targeted for the Climate Action Plan. Compact development, trail networks, and hybrid and electric vehicles lower emissions in the transportation sector. Solar installations reduce emissions from the electricity sector. Upgrading energy efficiency codes lower emissions in the building sector.

Unfortunately, approximately half of the interviewees did not identify a carbon emission reduction effort or program in their communities. Within this subgroup of responses, interviewees from larger jurisdictions provided this answer, suggesting that inaction on greenhouse gas mitigation is not concentrated among small towns with limited resources. This indicates that there is a significant opportunity to advance emission mitigation efforts at the local level across the state.

⁷ The Open Space Program has protected over 62,000 acres from development, while the Aglands Preservation Program has protected over 140,000 acres (Delaware Department of Agriculture, 2020; DNREC, 2019).

⁸ The success of these programs is certainly a function of the hundreds of millions of dollars that have been used to preserve participating lands.

Recommendations

The analysis leads to a series of recommendations that DNREC and the state should consider as they seek to advance local climate resiliency in Delaware. Ultimately, the decision to move forward with the following recommendations will depend on a range of criteria such as cost effectiveness, administrative feasibility, equity, and political will, among others.

Offer Technical Assistance for Implementation

The most significant need at the local level, besides funding, is technical capacity. More specifically, jurisdictions need assistance to identify and implement enforceable mechanisms that advance proactive climate adaptation practices. Such a technical assistance program should not be tasked with helping communities to produce resiliency, sustainability, or comprehensive development plans. Its objective should be to work directly with local jurisdictions—their residents, businesses, and officials—to create, adopt, or amend local codes and ordinances. The program should seek partnerships with communities that are committed to going above and beyond basic requirements for stormwater and floodplain management. Partnering communities should be willing to lead in the climate adaptation space by exploring development controls in SLR-vulnerable areas.

Educating the public and officials was identified by interviewees as a pressing need. A technical assistance program that works closely with communities and brings together stakeholders, including local officials, could leverage the engagement process as an avenue to increase awareness and knowledge of local climate impacts. Furthermore, it is critical to involve local officials, such as councilmembers, and those with decision-making authority so they have a stake in the outcome and are willing to expend political capital to shepherd recommendations through the legislative process.

Elevate Existing Technical Assistance Offerings

Much of the climate-conscious planning and vulnerability assessments and studies that occur in the state are a product of DNREC's direct involvement with communities. The current forms of technical assistance offered by the state and its partners should continue for a number of reasons. As noted previously, a publicly engaged assistance process helps from education and political will standpoints. Also, the technical assistance that is being offered sets up communities to take the next step and implement climate adaptation strategies. In other words, it is a prerequisite to the technical assistance for implementation discussed above. Importantly, if an implementation assistance program is established, plans and vulnerability assessments should be completed with the expectation that their recommendations will be implemented because help will be provided for that phase of the climate adaptation process.

This could lead to bolder and more aggressive adaptation recommendations because stakeholders will be certain that follow-up support is available to translate those recommendations into actions.

Leverage Personal Experience of Climate Impacts

In the last ten years, the percentage of Delawareans who have reported personally observing and experiencing climate impacts, particularly SLR, has increased by more than 250 percent. The first climate perceptions survey sponsored by DNREC in 2009 found that 22 percent of Delawareans experienced SLR, while the same statistic for the 2019 survey stood at 56 percent (Brewer, 2020). The survey did not ask respondents to detail the form of their SLR experience, but it is logical to attribute a portion of the increase to the higher prevalence of nuisance flooding in Delaware (Sweet et al., 2020). These findings are consistent with the results of this research that found interviewees' most common pathway to acquiring knowledge of climate impacts is through direct observation of SLR.

This situation presents an opportunity to educate and communicate climate vulnerability by leveraging Delawareans' personal experiences and observations of SLR. By developing creative methods for people to share stories, images, and videos of SLR, the power of statewide narratives can be harnessed to demonstrate the imperative to adapt. Indeed, one such platform already exists in Delaware, namely the Delaware Resiliency Awareness Project (DeIRAP) and its Coastal Observer app that allows users to upload photos and stories of their experiences with SLR (Hynson, 2020). DeIRAP is a project of the Coastal Resilience Design Studio, created by the University of Delaware and Delaware Sea Grant. A straightforward and low-cost approach for DNREC and DCP would be to use their network of contacts and events to market DeIRAP and the Coastal Observer app to residents, businesses, and local officials. RASCL could also market the app in their newsletter. A more hands-on strategy would be to develop a complementary crowdsourced platform or campaign for individuals to share their experiences with flooding and SLR (Le Coz et al., 2016; Paul et al., 2018). If enough crowdsourced and geolocated data are received, it may provide enough information to identify chronic areas and prioritize infrastructure investment.

Increase Remote Training Opportunities

Training and education programs are valuable, and they were identified by interviewees as the most effective way to learn about climate change. They undoubtedly serve to increase awareness of climate impacts, and for local officials that are new to the area or their roles, trainings help to bring them up to speed. Although the four-day flood training received numerous mentions from interviewees, smaller and more focused trainings should not seek to replicate or approximate that length. Time commitment to attend a training presented a

concern for many interviewees, and several indicated they prefer shorter sessions. Events sponsored by RASCL were very well received and should continue to be supported by affiliated organizations.

The coronavirus pandemic has forced local governments to transition their many in-person meetings into a virtual environment using a number of platforms (Zoom, GoToMeeting, Skype, etc.). This means that nearly all local officials are now familiar with virtual meetings and should be comfortable attending a remote training event. With this in mind, the state and its partners, which offer training and education programs, should look to create more remote training opportunities, such as webinars. Additional reasons to hold training sessions online are compelling. Due to travel times to and from event venues, interviewees noted that attending an in-person training session can occupy nearly an entire day's working hours—even if the event itself is only scheduled for a few hours.⁹ In a virtual learning environment, this disincentive would be eliminated and, therefore, attendance may increase.

Many interviewees commented on the networking value of in-person trainings, so one drawback of virtual events is that they do not offer the same quality of networking opportunities. This shortcoming could be minimized, however, by adding a dedicated virtual networking component to a remote training event, perhaps by using a platform that allows breakout rooms or a peer-to-peer messaging system.

Expand Audience for Trainings and Deliver Targeted Content

The private-sector consulting industry is a significant player within municipal affairs and public administration. Representatives work with jurisdictions on a wide range of projects that are relevant for climate adaptation and resiliency. Yet the consultant industry has not been a major focus for climate programming in Delaware, which tends to focus on the state's local officials and citizens. The consultant industry should, therefore, become a priority audience when designing and marketing trainings and events. In this way, their participation can be leveraged to provide climate-conscious and progressive adaptation services to their clients. Doing so would also help to alleviate the technical services burden faced by municipalities.

Likewise, another untapped audience for trainings and events are local decision-makers, specifically local councilmembers. While public administrators and municipal staff carry out the day-to-day operations and wield significant influence over community affairs, they are limited in what they can achieve because they must operate within the bounds of their authority. Councilmembers can expand that authority by passing new ordinances or amending existing ones. DNREC and its partners could seize the opportunity to engage councils by offering short

⁹ This finding is consistent with previous research for DCP (Barnes, 2017).

presentations at regularly scheduled council meetings, especially now that the meetings are being held virtually.

To make trainings and education opportunities more relevant to stakeholders, it is worth considering the development of modules with content that targets the particular flood and climate vulnerabilities experienced by the range of communities across Delaware. For instance, the Flood-Ready Communities training could have a module that focuses on inland flood risk for towns that are not exposed to coastal inundation as well as a coastal flood module for those that are. Another audience for targeted and context-specific training would be municipalities that are built out and mostly deal with parcel-level redevelopment activity. Their training would be different from that for cities and towns that are growing and experiencing new greenfield and larger-scale development.

Conclusion

With support from DCP and DNREC, this research effort investigated the effectiveness of Delaware's climate change programming. By conducting interviews with 25 local officials in jurisdictions that are vulnerable to SLR, data were collected on the efficacy of climate programs and their impact on local resiliency. The results indicate that the current suite of services offered by the state and its partners is valuable—from trainings to technical service to online tools and databases—but more needs to be done to transition these efforts into the implementation phase. Indeed, implementation is where most communities encounter barriers to further action.

The reasons for limited success with implementation vary, but the primary factor is due to the workload that local administrators experience on a day-to-day basis, coupled with the short supply of technical capacity. There is also uncertainty about the types of enforceable mechanisms that are available to advance resilient practices and how those mechanisms operate within the boundaries of jurisdictional authority. Furthermore, certain enforceable mechanisms will require legislative approval by local councilmembers, so public administrators are constrained by the kinds of changes they can make.

There are steps that the state and its partners can take to help advance local resiliency. The most pressing need is for technical assistance for implementation. Such a program could work closely with a willing jurisdiction to follow a planning or vulnerability assessment process with a deep-dive into local codes and ordinances. The objective would be to establish and legislate new authority to advance resiliency. If an implementation program is developed, the existing technical programs for planning and assessments should be encouraged to make more aggressive and actionable recommendations knowing that additional assistance is forthcoming.

The research found that many local officials learn about climate change through direct observation of its impacts, such as more frequent nuisance flooding. This is consistent with DNREC's most recent climate survey showing that 56 percent of Delawareans have personally experienced climate change. These experiences should be leveraged to help educate more people about the consequences of climate change. Marketing an existing app in Delaware—the Coastal Observer app that allows users to share stories and photos of climate change—or developing a complementary platform should be explored.

The climate training and educational events sponsored by DNREC and partners such as RASCL are valuable because they expand awareness of climate change and provide a useful networking opportunity. Improvements can be made, however. Short virtual trainings such as webinars should be considered and may increase attendance. New audiences can be engaged

as well, for example the private-sector consulting industry and local councilmembers. Content-wise, new modules could be created that provide context-specific information for the jurisdictions that vary by location, population, and climate vulnerability.

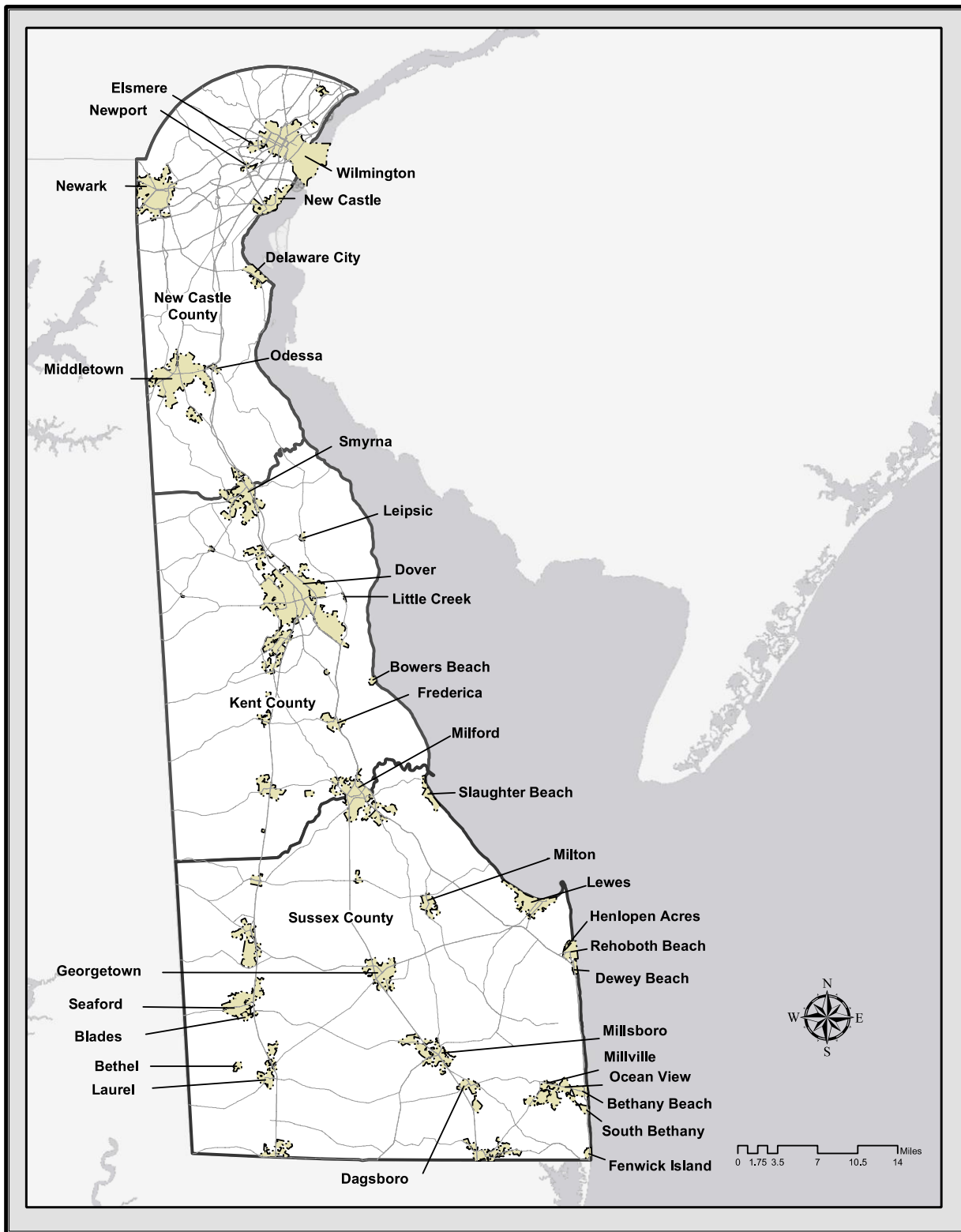
References

- Barnes, P. (2017). *Coastal resiliency needs assessment in Sussex County*. University of Delaware, Institute for Public Administration.
<http://udspace.udel.edu/bitstream/handle/19716/21590/resiliency-needs-assessment-2017.pdf?sequence=1&isAllowed=y>
- Birchall, J. S. (2020). Coastal climate adaptation planning and evolutionary governance: Insights from Homer, Alaska. *Marine Policy*, 112.
- Brewer, P. (2020). *Delaware residents' opinions on climate change and sea level rise: 2019 survey*. Center for Political Communication.
<http://www.dnrec.delaware.gov/energy/Documents/Climate/DNREC-Climate-Survey-Full-Report-20200323.pdf>
- Callahan, J. A., Horton, B. P., Nikitina, D. L., Sommerfield, C. K., McKenna, T. E., & Swallow, D. (2017). *Recommendation of sea-level rise planning scenarios for Delaware: Technical report*. Delaware Geological Survey.
https://www.dgs.udel.edu/sites/default/files/projects-docs/DE%202017%20SLR%20Technical%20Report_Mar2018.pdf
- Delaware Department of Agriculture. (2020). *Delaware agricultural lands preservation foundation: Current situation report for July 15, 2020* (p. 2). Delaware Department of Agriculture. <https://agriculture.delaware.gov/wp-content/uploads/sites/108/2020/07/Current-Situation-Report-071520.pdf>
- Delaware Geological Survey. (2017). *Delaware coastal inundation maps*.
<https://www.dgs.udel.edu/datasets/delaware-coastal-inundation-maps>
- DNREC. (2014). *Ordinance revision resources*. Ordinance Revision Resources.
<http://www.dnrec.delaware.gov/swc/Pages/Ordinance-Revision-Resources.aspx>
- DNREC. (2015). *Delaware climate projections portal*.
<http://climate.udel.edu/declimateprojections/>
- DNREC. (2019, August 14). *Open space program land inventory*. Delaware Open Data Portal.
<https://data.delaware.gov/Energy-and-Environment/Open-Space-Program-Land-Inventory/juuq-nkkk>
- DNREC. (2020a). *Coastal Training Program*. <https://dnrec.alpha.delaware.gov/coastal-programs/planning-training/coastal-training/>
- DNREC. (2020b). *Delaware's sediment and stormwater management program*.
<http://www.dnrec.delaware.gov/swc/Pages/SedimentStormwater.aspx>
- Guest, G., MacQueen, K. M., & Namey, E. E. (2012). *Applied thematic analysis*. Sage.
- Hamin, E. M., Gurrán, N., & Emlinger, A. M. (2014). Barriers to municipal climate adaptation: Examples from coastal Massachusetts' smaller cities and towns. *Journal of the American Planning Association*, 80(2), 110–122.

- Hayhoe, C. M., Stoner, A., & Gelca, R. (2013). *Climate change projections and indicators for Delaware*. ATMOS Research and Consulting.
- Hynson, J. (2020). *Coastal Observer App*. UDaily.
<https://www.udel.edu/udaily/2020/june/Delaware-Coastal-Communities-Sea-Level-Rise-App/>
- Jack, C. D., Jones, R., Burgin, L., & Daron, J. (2020). Climate risk narratives: An iterative reflective process for co-producing and integrating climate knowledge. *Climate Risk Management*, 29, 100239. <https://doi.org/10.1016/j.crm.2020.100239>
- Jones, L., Champalle, C., Chesterman, S., Cramer, L., & Crane, T. A. (2017). Constraining and enabling factors to using long-term climate information in decision-making. *Climate Policy*, 17(5), 551–572.
- Latham, W., & Lewis, K. (2012). *The contribution of the coastal economy to the state of Delaware*. Delaware Sea Grant. <https://repositories.tdl.org/tamug-ir/bitstream/handle/1969.3/29196/economicReport-2012lr.pdf?sequence=1>
- Le Coz, J., Patalano, A., Collins, D., Guillén, N. F., García, C. M., Smart, G. M., Bind, J., Chiaverini, A., Le Boursicaud, R., Dramais, G., & Braud, I. (2016). Crowdsourced data for flood hydrology: Feedback from recent citizen science projects in Argentina, France and New Zealand. *Journal of Hydrology*, 541, 766–777.
<https://doi.org/10.1016/j.jhydrol.2016.07.036>
- Moser, S. C., & Ekstrom, J. A. (2010). A framework to diagnose barriers to climate change adaptation. *Proceedings of the National Academy of Sciences*, 107(51), 22026–22031.
- NOAA. (2016). *NOAA shoreline website: A guide to national shoreline data and terms*.
<https://shoreline.noaa.gov/>
- OSPC. (2015). *State of Delaware comprehensive plan checklist*. Office of State Planning Coordination. <https://stateplanning.delaware.gov/lup/documents/comprehensive-plan-checklist-guide.pdf>
- Paul, J. D., Buytaert, W., Allen, S., Ballesteros-Cánovas, J. A., Bhusal, J., Cieslik, K., Clark, J., Dugar, S., Hannah, D. M., Stoffel, M., Dewulf, A., Dhital, M. R., Liu, W., Nayaval, J. L., Neupane, B., Schiller, A., Smith, P. J., & Supper, R. (2018). Citizen science for hydrological risk reduction and resilience building. *WIREs Water*, 5(1), e1262.
<https://doi.org/10.1002/wat2.1262>
- Sarzynski, A. (2015). Public participation, civic capacity, and climate change adaptation in cities. *Urban Science*, 14(1), 52–67.
- Sweet, W., Dusek, G., Carbin, G., Marra, J., Marcy, D., & Simon, S. (2020). *2019 state of U.S. high tide flooding with a 2020 outlook* (NOS CO-OPS 092). National Oceanic and Atmospheric Administration.
https://tidesandcurrents.noaa.gov/publications/Techrpt_092_2019_State_of_US_High_Tide_Flooding_with_a_2020_Outlook_30June2020.pdf

- Sweet, W. V., Dusek, G., Obeysekera, J., & Marra, J. J. (2018). *Patterns and projections of high tide flooding along the U.S. coastline using a common impact threshold*. NOAA.
- Tiner, R. W., Biddle, M. A., Jacobs, A. D., Rogerson, A. B., & McGuckin, K. G. (2011). *Delaware wetlands: Status and changes from 1992 to 2007*. Department of Natural Resources and Environmental Control.
- University of Delaware. (2019). *Delaware Resilience Awareness Project*.
<https://sites.udel.edu/resilience-awareness-project/>
- Wakefield, K., & Falk, J. (2017). *Coastal Delaware resiliency report*. Delaware Sea Grant.
<https://static1.squarespace.com/static/5a9eec779772aecca58eb94/t/5b1595a688251b408d36230a/1529932748267/Coastal+Delaware+Resiliency+Report.pdf>

Appendix A – Jurisdictions in the Sample Population



Appendix B – Interview Questionnaire

PART 1: Acquiring Knowledge

1. How knowledgeable are you about the impact that climate change will have on your community? Specifically on your community.
 - a. If knowledgeable: How did you learn that?
 - b. If not knowledgeable: Any particular reason why?
2. Have you attended any trainings, meetings, workshops, or other sessions on climate change?
 - a. Who sponsored it and what was the format?
 - b. Did it give you useful information and tools?
 - c. What was good about it, if you can remember?
 - d. How could it be improved, if you can remember?
3. In your view, what would be an effective way to learn about climate change and its impacts on your community?

PART 2: Applying Knowledge / Taking Action

1. Do climate change impacts on your community factor into decisions on (please give examples):
 - a. Zoning and land use?
 - b. Subdivision applications?
 - c. Comp plans and master plans?
 - d. Emergency plans and services?
 - e. Infrastructure needs?
 - f. Anything else?
2. Have the following types of assistance been useful and effective to help you make these decisions? If so, please give examples.
 - a. Workshops, trainings, events
 - b. Tools (mapping, data portal, websites, etc.)
 - c. Direct technical assistance
 - d. Feedback/comments on plans
 - e. Anything else?
3. Beyond funding, what limits your community's ability to consider climate change impacts and make informed decisions in these areas?
4. Beyond funding, what would help you make decisions that consider climate impacts?
5. Are you taking steps in your community to limit greenhouse gas emissions? Please give examples.

Appendix C – Institutional Review Board Exemption Letter



DATE: February 11, 2020

TO: Philip Barnes, Ph.D.
FROM: University of Delaware IRB

STUDY TITLE: [1547042-1] Research on the Effectiveness of Delaware's Local Climate Change Programming

SUBMISSION TYPE: New Project

ACTION: DETERMINATION OF EXEMPT STATUS

EFFECTIVE DATE: February 11, 2020

REVIEW CATEGORY: Exemption category # (2)

Thank you for your New Project submission to the University of Delaware Institutional Review Board (UD IRB). According to the pertinent regulations, the UD IRB has determined this project is EXEMPT from most federal policy requirements for the protection of human subjects. The privacy of subjects and the confidentiality of participants must be safeguarded as prescribed in the reviewed protocol form.

This exempt determination is valid for the research study as described by the documents in this submission. Proposed revisions to previously approved procedures and documents that may affect this exempt determination must be reviewed and approved by this office prior to initiation. The UD amendment form must be used to request the review of changes that may substantially change the study design or data collected.

Unanticipated problems and serious adverse events involving risk to participants must be reported to this office in a timely fashion according with the UD requirements for reportable events.

A copy of this correspondence will be kept on file by our office. If you have any questions, please contact the UD IRB Office at (302) 831-2137 or via email at hsrb-research@udel.edu. Please include the study title and reference number in all correspondence with this office.

INSTITUTIONAL REVIEW BOARD

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