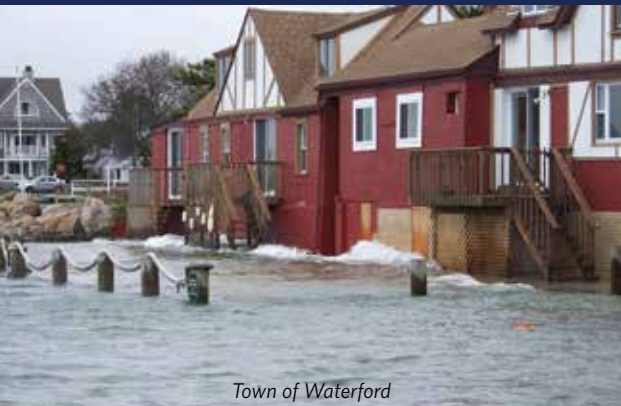


ADAPTING TO COASTAL STORMS AND FLOODING

Report on a 2014 Survey of Waterford Residents

*George Perkins Marsh Institute/Clark University
and The Nature Conservancy*



Town of Waterford

ADAPTING TO COASTAL STORMS AND FLOODING

REPORT ON A 2014 SURVEY OF WATERFORD RESIDENTS

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EXECUTIVE SUMMARY

This report summarizes the findings of the survey *Adapting to Coastal Storms and Flooding* conducted in Waterford, Connecticut, from June through August 2014. The survey evaluates the attitudes and preferences of Waterford residents toward the risks of coastal storms and flooding, along with potential adaptation actions that could be taken to address these risks. The survey was conducted through a collaboration of Clark University and The Nature Conservancy in Connecticut, and funded by a research grant from the Northeast Sea Grant Consortium.

The survey was developed and pretested over more than two years in a collaborative process involving economists and natural scientists; meetings with town officials and stakeholder groups; and 13 focus groups comprised of community residents. This development and pretesting ensured that information in the survey was accurate and that the survey could be easily understood and answered by the public. The survey was mailed to a sample of 1,152 randomly selected Waterford residents. Out of 1,024 deliverable surveys, 319 were returned for a response rate of 31.2%. This is a relatively high rate of return for a mail survey, and suggests the relevance of the topic to the public.

The survey included a wide range of attitudinal questions, along with referendum-style voting questions that enabled residents to vote for or against different types of hypothetical adaptation alternatives for the town. Results provide insight into the way that Waterford residents understand the risks facing their town, and their preferences for how those risks should be addressed.

Principal findings of the survey include:

- Waterford residents perceive coastal storms and flooding as a major problem. Those who own coastal waterfront homes view the problem as less severe than other residents. Residents have split opinions regarding the degree to which the town is well prepared for these reoccurring events.

- Residents have strong opinions about many methods and outcomes of coastal adaptation, and these opinions differ. However, on average, residents are more concerned with the protection of the town's natural/built resources and public services than with potential changes in taxes/fees, flood insurance rates, or development restrictions. Furthermore, residents are more concerned with the protection of public resources such as beaches, natural resources and public services than with the protection of private homes.
- When asked to vote for or against hypothetical but feasible adaptation plans for Waterford, residents' votes show strong support for coastal adaptation, even if this requires new taxes and fees. These votes reveal relatively: (a) high values for the protection of beaches and natural areas such as wetlands, (b) lower but still significant values for the protection of coastal homes, and (c) negligible values associated with the prevention of road flooding and the extent of coastal armoring.
- For example, based on the pattern of observed votes, an adaptation plan would have to prevent the expected flooding of approximately 312 private homes (per Category 3 storm) to have the same value as preserving one acre of beach in perpetuity.

Survey results suggest that taking action to adapt is important to Waterford residents, and that residents are willing to pay for effective adaptation strategies. However, some effects of coastal adaptation are more important—and more highly valued—than others. Although protection of waterfront homes from flooding is important to the residents living in those homes, it does not appear to be a top priority of the public at large. A coastal adaptation strategy prioritizing the protection of natural habitats and public resources will gain more support from the broader community than one emphasizing only engineered defenses and the protection of private homes.

Questions/comments for further information should be directed to Robert Johnston, rjohnston@clarku.edu

SECTION 1

Introduction

Hazards related to a variable and changing climate are a challenge facing coastal communities in Connecticut and elsewhere. Strategies to address these challenges involve tradeoffs among development, ecosystem viability, capital costs and community needs. Hazard mitigation requires tradeoffs. Many different actions are possible, yet available funds are rarely sufficient to protect all sites and resources. Thus, difficult choices must be made.

As described by the 2005 Hazard Mitigation Plan Annex for Waterford, Connecticut, the Town includes approximately 33.4 square miles of land area and 7.3 miles of shoreline along Long Island Sound, with most of this shoreline privately owned. The town's total tidal shoreline is approximately 22 miles, including tidal riverfront. According to data in Coastal Resilience (<http://coastalresilience.org/>), approximately 50% of this shoreline has some form of hard armoring. The 2010 U.S. Census lists a total town population of 19,517, many of whom reside in areas subject to flood risk or other coastal hazards. Although northern portions of the town are largely at elevations that resist coastal flooding and storm surge, many southern portions are relatively flat and at low elevation with increased risk. Every storm is unique, with damage depending on storm intensity, timing, path, wind direction/speed and many other factors. Nonetheless, the experience of Hurricane Sandy in 2012, together with coastal storm scenarios for the town, suggest that a considerable portion of Waterford's homes, roads, infrastructure and natural capital (e.g., beaches, wetlands) have exposure.

When designing hazard mitigation plans and strategies, coastal communities frequently rely on extensive input from community officials, experts and stakeholder groups. The values and preferences of community residents are also important; these are the individuals who both experience losses and pay the taxes and fees necessary to support many types of hazard mitigation actions. The survey *Adapting to Coastal Storms and Flooding*, implemented from June through August 2014, evaluated the attitudes and preferences of the town's residents toward the risk of coastal storms and flooding and potential adaptation actions that could be taken to address these risks. One of the goals of the survey was to identify the types of hazard mitigation actions that would provide the greatest value to—and would be most supported by—Waterford residents.

The survey was conducted through a collaboration of Clark University and The Nature Conservancy in Connecticut and was supported by the Northeast Sea Grant Consortium. Survey development engaged a diverse set of Waterford residents and public officials over two years of design and pretesting, including 13 focus groups¹ with community residents. This development and pretesting ensured that information in the survey was accurate and that the survey could be easily understood and answered by the public. The survey was designed using economic choice experiment methods. These quantify the economic benefits of different types of policy actions and predict public support for them. The survey included attitudinal questions, along with referendum-style voting questions that enabled residents to vote for or against different types of hypothetical but feasible adaptation alternatives for the town.

The results provide insight into the way that Waterford residents understand the risks facing their town, their preferences for how those risks should be addressed, and their willingness to pay additional taxes and fees for different types of adaptation programs. They suggest that Waterford residents perceive a growing sense of urgency regarding coastal hazard mitigation and are willing to support actions to reduce the associated risks. Residents are particularly concerned with—and willing to pay for—programs that protect public natural resources such as beaches and coastal marshes. There was less concern, however, with effects such as road flooding. Contrasting these results to the priorities in the 2005 Hazard Mitigation Plan Annex suggests that there is at least some difference between the top priorities of the plan (focusing primarily on residential, commercial/industrial and transportation effects) and the top priorities of average town residents (emphasizing community character and natural resources).

¹ Groups of randomly selected Waterford residents met with a moderator to freely discuss their perceptions, opinions, beliefs and attitudes towards coastal storms and flooding, and the types of resources whose protection they felt should be emphasized by coastal adaptation efforts.

SECTION 2

Survey Design

The goal was to understand Waterford residents' (a) attitudes concerning coastal storms and flooding, (b) priorities for protecting built infrastructure and natural resources, and (c) preferences and values related to the protection of built infrastructure and natural resources. Particular emphasis was given to attitudes and preferences for hard (engineered) versus soft (natural) adaptation actions. The survey included a wide range of attitudinal questions, along with referendum-style voting questions that enabled residents to vote for or against different types of hypothetical adaptation alternatives for the town. The results provide insight into the way that Waterford residents understand the risks facing their town and their preferences for how those risks should be addressed.

SECTION 3Survey
Implementation

The survey was implemented by mail from June through August, 2014. It was mailed to a sample of 1,152 randomly selected Waterford residents, with systematic follow-up mailings to increase response rates. Out of 1,024 deliverable surveys, 319 were returned for a response rate of 31.2%. This is a high rate of return for a mail survey, and suggests the relevance of the topic to the public in Waterford.

SECTION 4

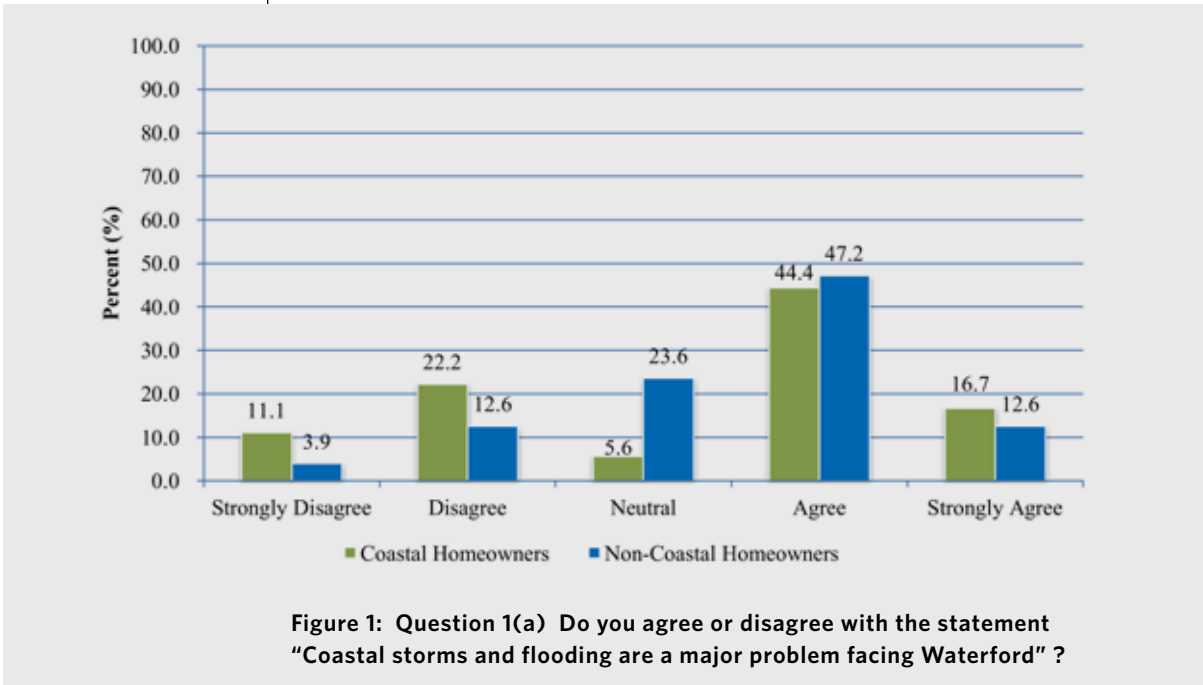
Key Findings

4.1 RESIDENTS' ATTITUDES TOWARD COASTAL STORMS AND FLOODING

The first sections of the survey asked respondents to agree or disagree with a variety of statements related to the future risk of coastal storms and flooding in Waterford, and the degree to which the town is prepared for these hazards. These statements were evaluated on a 1 to 5 scale, where 1 = strongly disagree and 5 = strongly agree.

In most cases, responses to these questions were similar, on average, across all types of Waterford residents. However, in some cases, residents who live on coastal waterfront property (“coastal homeowners”)² answered these questions differently than other residents (“non-coastal homeowners”). The survey sample includes 301 responses from non-coastal homeowners and 18 responses from coastal homeowners. For these questions, separate results are presented for the two groups.

The much smaller sample of coastal waterfront homeowners is expected, and reflects the fact that a relatively small proportion of Waterford residents owns coastal waterfront property. Thus it is important to recognize that results for coastal homeowners are drawn from a relatively small sample, and to interpret these results accordingly.



The majority of both “coastal” and “non-coastal” homeowners agree that coastal storms and flooding are a major problem facing Waterford (Figure 1). Relatively few people, about 17% of non-coastal

² Coastal homeowners are identified as those who answered “yes” to the survey question, “Is your home located on coastal waterfront property?”

homeowners and 33% of coastal homeowners, disagree or strongly disagree. However, the level of agreement with this statement is higher among non-coastal homeowners, suggesting that coastal homeowners in Waterford, on average, tend to view coastal storms and flooding as less of a problem.

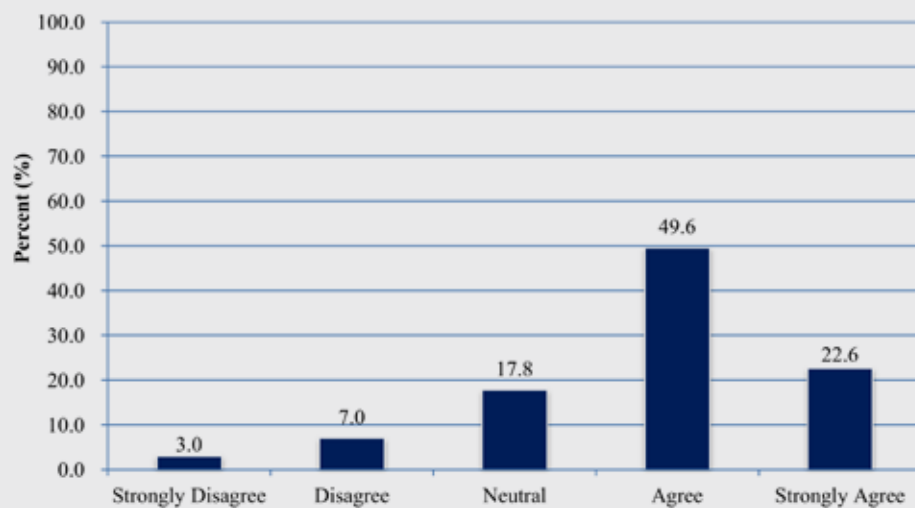


Figure 2: Question 1(b) Do you agree or disagree with the statement “In the future, coastal storms and flooding are likely to increase”?

Most residents agree or strongly agree that coastal storms and flooding are likely to increase in Waterford over time (Figure 2); very few residents disagree or strongly disagree. Coastal and non-coastal residents answered this question similarly.

A minority of residents, about 24% of non-coastal homeowners and 35% of coastal homeowners, either agree or strongly agree that Waterford is well-prepared for future storms and flooding (Figure 3). The plurality of coastal homeowners and majority of non-coastal homeowners are neutral concerning this statement. Compared to non-coastal homeowners, a larger proportion of coastal homeowners agree that Waterford is well prepared.

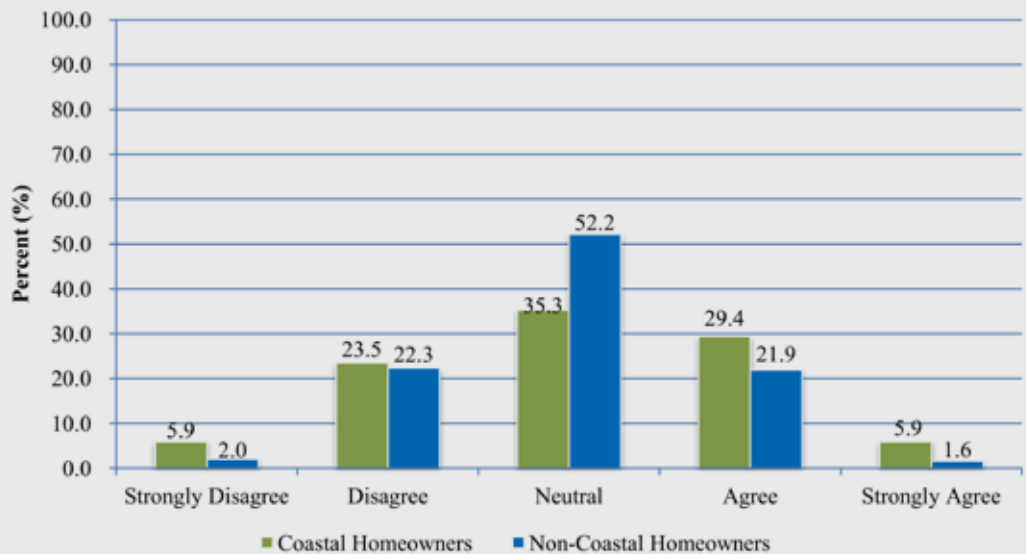


Figure 3: Question 1(c) Do you agree or disagree with the statement “Waterford is well prepared for future coastal storms and flooding”?

4.2 RESIDENTS’ PRIORITIES FOR PROTECTING BUILT INFRASTRUCTURE AND NATURAL RESOURCES

Other questions in the survey evaluated the general importance that residents place on protecting different types of community resources. These questions ask about the importance of each resource independent of others, so the answers cannot be used to calculate tradeoffs or relative values. Tradeoffs between different types of adaptation outcomes are discussed in Section 5.

4.2.1 Protecting Built Infrastructure

Statements related to protecting built infrastructure were rated on a scale of 1 to 5, where 1 = Not at all important and 5 = Very important. As in the previous section, coastal and non-coastal homeowners sometimes answered these questions differently. For such cases, separate results are presented for these two groups. The plurality of non-coastal homeowners (about 36%) and the majority of coastal homeowners

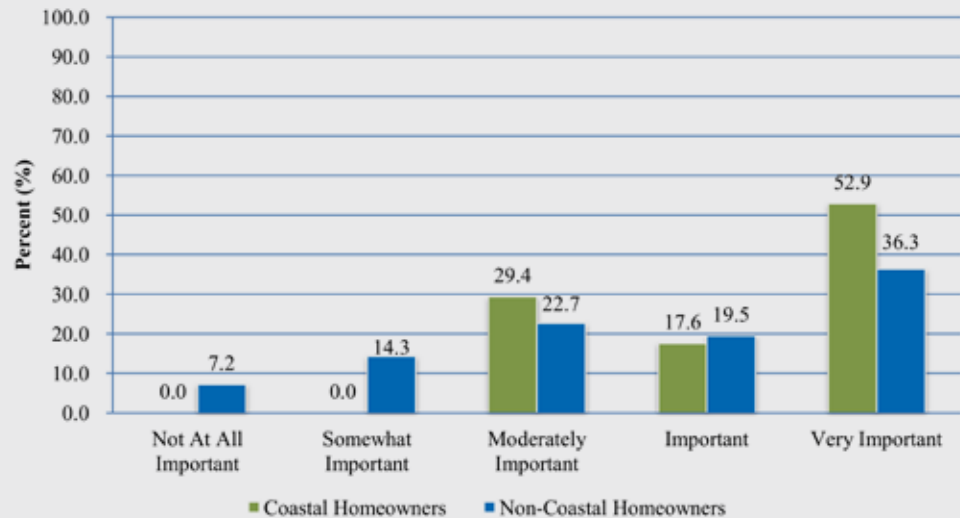


Figure 4: Question 2(a) How important do you think it is that “Private homes and property are protected” ?

(about 53%) indicated that protecting private homes and property is very important (Figure 4). No coastal residents and relatively few non-coastal residents (less than 22%) rated this statement as somewhat or not at all important. However, the level of importance of this statement is higher among coastal homeowners, suggesting that to the average coastal homeowner in Waterford, protecting private homes and property is more important than to the average non-coastal homeowner.

Relatively few non-coastal homeowners, about 18%, indicated that government’s respect of coastal landowners’ right to develop their land was very important (Figure 5). In contrast, nearly half (44.4%) of coastal homeowners rated this statement as very important. A minority of residents, about 23% of non-coastal homeowners and 17% of coastal homeowners, rated this statement as less than moderately important.

Coastal and non-coastal homeowners answered questions related to the protection of town infrastructure and services similarly (Figure 6). Few people, about 6%, indicated that the protection of facilities

such as police stations and schools was somewhat or not at all important, and a minority of respondents rated this statement as moderately important. The vast majority of Waterford residents, about 81%, rated this statement as important or very important.

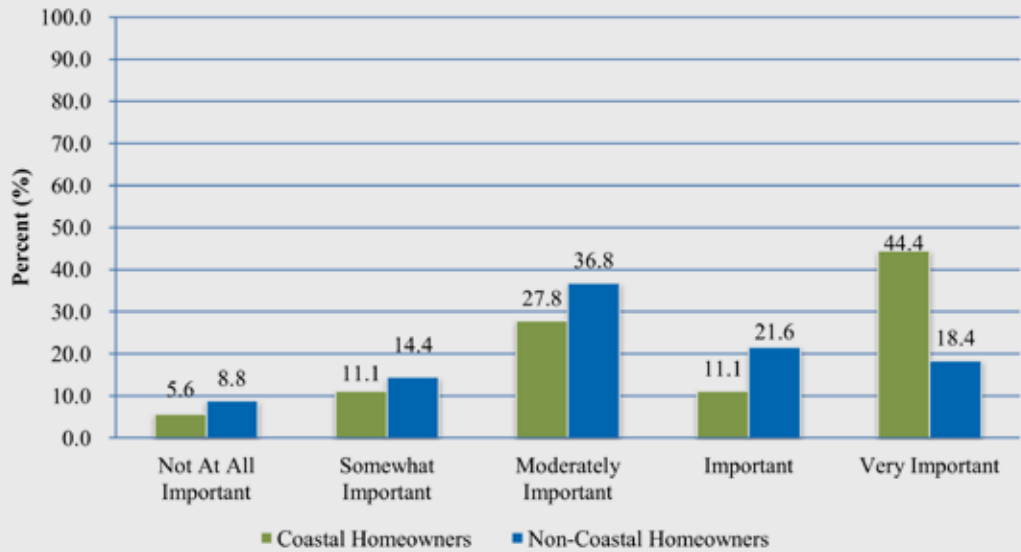


Figure 5: Question 2(b) How important do you think it is that “Government respects the right of coastal landowners to use and develop their land” ?

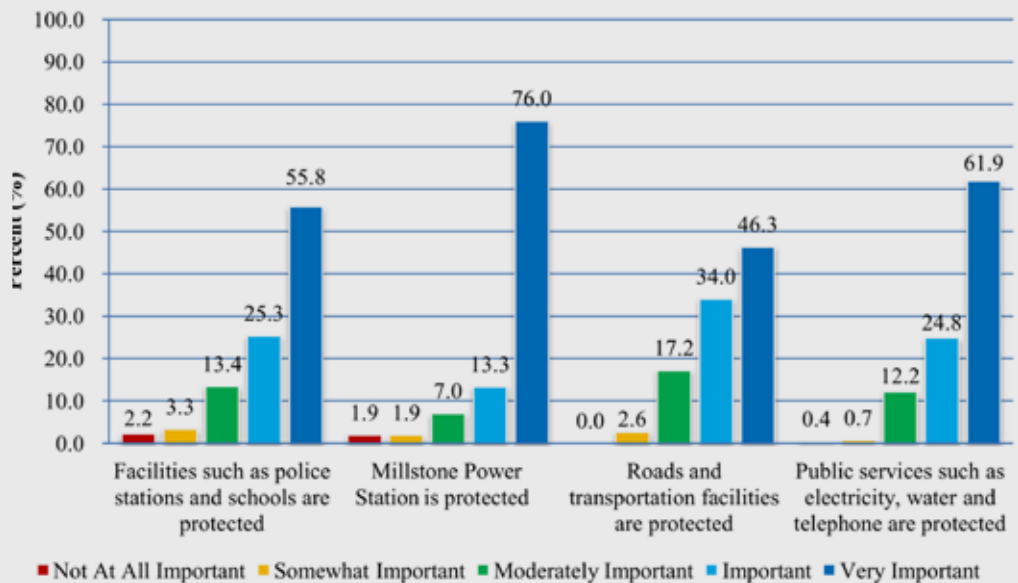


Figure 6: Questions 2(g) - 2(i) and 2(k)

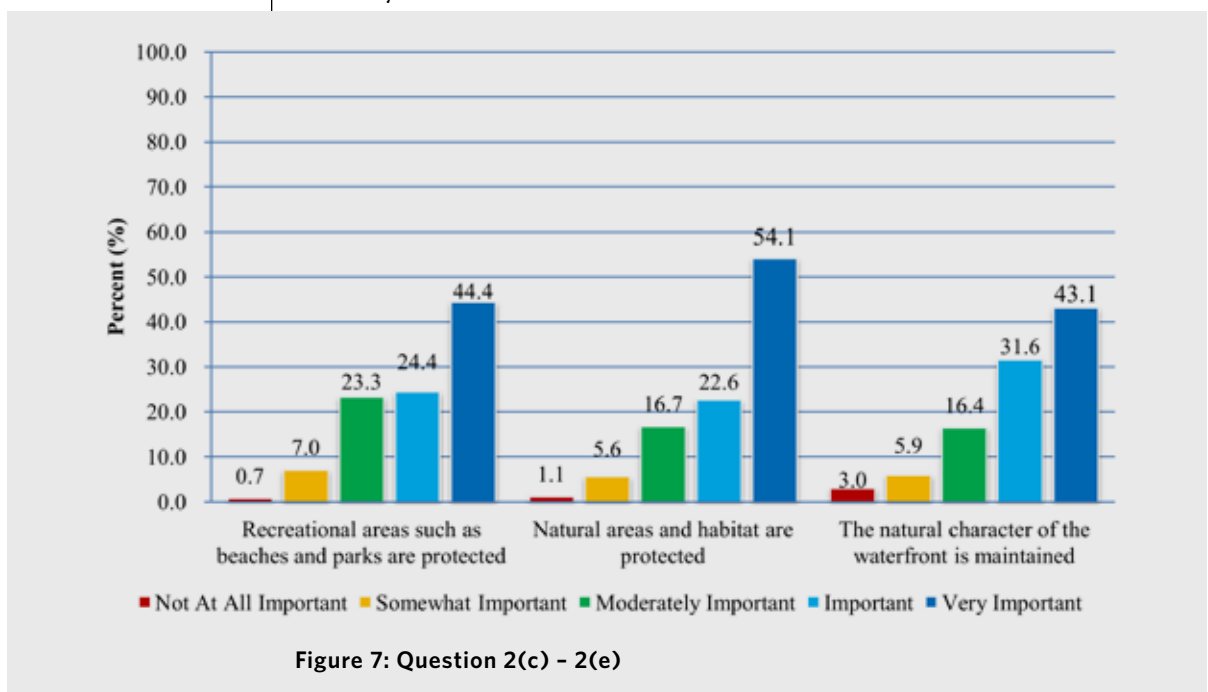
Very few residents, about 4%, indicated that protecting the Millstone Power Station is less than moderately important and a small minority of 7% rated protection of the power station as moderately important. The majority of respondents, about 89%, rated this statement as important or very important.

The majority of residents, about 80%, rated the protection of roads and transportation facilities as important or very important, and no residents rated this statement as not at all important. However, compared to other types of built infrastructure, the lowest percentage of residents rated this as very important (46%).

Only about 1% of respondents rated the protection of public services such as electricity and water and telephone less than moderately important and relatively few rated this statement as moderately important (about 12%). The majority of residents, about 87%, rated this statement as important or very important.

4.2.2 Protecting Natural Resources

Statements related to the protection of natural resources were also rated on a scale of 1 to 5, where 1 = Not at all important and 5 = Very important (Figure 7). Coastal and non-coastal homeowners rated these statements similarly.



Few residents rated the protection of recreational areas such as beaches and parks lower than moderately important (about 8%) and a minority of respondents rated this statement as moderately important (about 23%). The majority of residents, about 70%, rated the protection of recreational areas such as beaches and parks as important or very important.

When asked to rate how important it is that “Natural areas and habitat are protected,” about 77% of residents indicated that this was either important (22%) or very important (54%). Few people, about 7%, rated this statement as somewhat or not at all important. Maintaining the natural character of the waterfront is also important to the majority of Waterford residents: about 75% of respondents rated this statement as important or very important.

In summary, the vast majority of Waterford residents attach high importance to the protection of natural resources, particularly along the waterfront. Across these three questions, an average of about 73% of residents rated the protection of natural resources as important to very important. Few people, about 7.8%, rated these statements as somewhat to not at all important.

4.3 RESIDENTS’ ATTITUDES TOWARD TAXES AND FLOOD INSURANCE RATES

Statements related to changes in taxes and flood insurance rates were rated on a scale of 1 to 5, where 1 = Not at all important and 5 = Very important (Figures 8, 9). Separate results are presented for coastal and non-coastal homeowners.

When asked to rate how important it is that “Taxes and fees paid by my household do not increase,” about 71% of non-coastal homeowners and 72% of coastal residents rated this statement as important to very important. Very few residents, about 9% of non-coastal residents and less than 6% of coastal residents, rated this statement as somewhat important to not at all important.

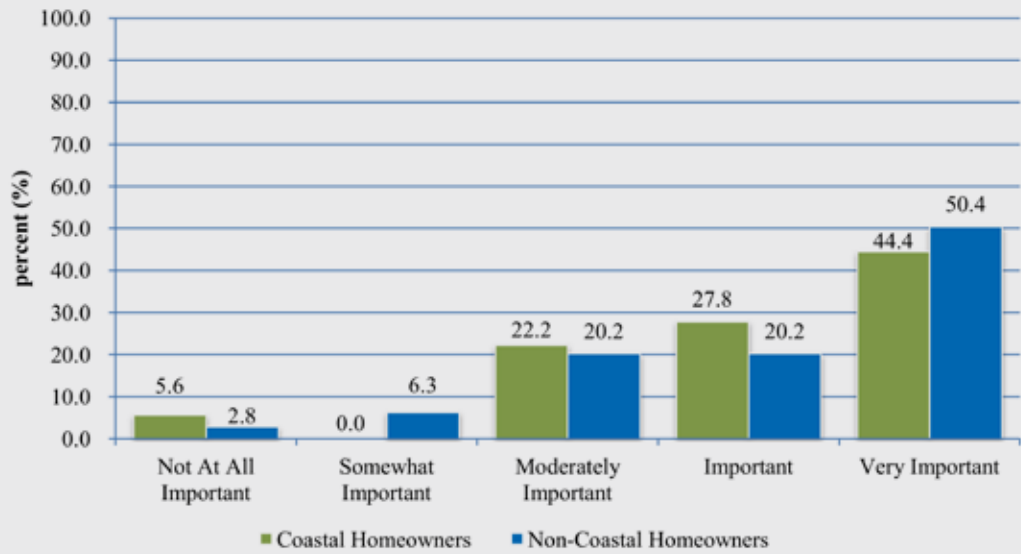


Figure 8: Question 2(f) How important do you think it is that “Taxes and fees paid by my household do not increase” ?

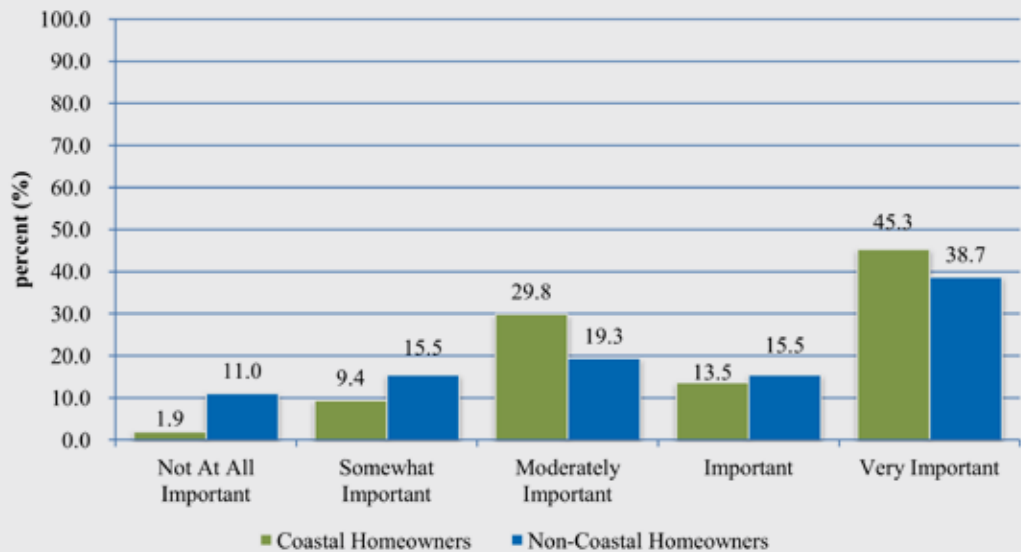


Figure 9: Question 2(l) How important do you think it is that “Flood insurance rates paid by homeowners do not increase” ?

Attitudes regarding potential changes in flood insurance rates were mixed. About 27% of non-coastal homeowners and 11% of coastal homeowners rated the statement “Flood insurance rates paid by homeowners do not increase” as somewhat or not at all important. The plurality of non-coastal homeowners, about 39%, and 45% of coastal homeowners rated this statement as very important. These results suggest flood insurance rates are less important to Waterford residents, in general, than other types of coastal adaptation outcomes.

SECTION 5

Support and Values for Coastal Adaptation

Adaptation to the risks of coastal storms and flooding is costly and requires tradeoffs. Within a given region, many different types of coastal adaptation may be possible, and available funds are rarely sufficient to protect all sites and resources equally. Thus, difficult choices must be made.

One of the primary goals of the survey was to evaluate the types of coastal adaptation tradeoffs that would be most supported by Waterford residents. This includes residents’ willingness to pay additional taxes and fees to support different types of community adaptation programs, with different effects.

To evaluate the tradeoffs supported by residents, surveyed households were asked to choose among different types of hypothetical coastal adaptation programs, within referendum-style voting questions (called choice experiments). Each adaptation program was described in terms of projected effects on coastal homes, natural resources such as beaches and wetlands, road flooding, coastal armoring and annual household costs. Each of these voting questions asked the respondent to choose between two adaptation programs with different effects and costs, and a “business as usual” alternative with no additional cost (i.e., Option A versus Option B versus Neither [N], or A-B-N). Seventy-two hypothetical A-B-N choices were developed, and divided randomly among surveys sent to different households. Each of these questions illustrated a different set of coastal adaptation programs. Each







household was asked to answer three of the 72 A-B-N choices. The combined votes of all households over all of these hypothetical A-B-N choices were used to calculate the tradeoffs households were willing to make, based on their observed votes.

The projected effects of each hypothetical program through the 2020s (“What it Means”— Figure 10) used as a basis for the A-B-N choices were derived from coastal flooding scenarios for Waterford available through the Coastal Resilience decision–support tool (see <http://coastalresilience.org/>). Figure 11 shows an example of the type of A-B-N choices included in the survey. The annual household costs presented in each A-B-N choice are hypothetical. Some programs include higher costs and others include lower costs, to evaluate how changes in these costs affect residents’ votes for or against different types of programs.

Prior to each choice, the survey presented information on the situation facing Waterford, as well as the different types of adaptation actions that could be used. Particular emphasis was given to differences between hard and soft defenses. Maps and graphics were also included to illustrate flooding scenarios and effects in Waterford (e.g., Figure 12). All materials were subjected to extensive pretesting and revision over a two-year process, during which 13 focus groups provided feedback on preliminary versions of the survey. This pretesting ensured that survey information and questions were clear and easily understood, and that questions addressed hazard mitigation effects that were potentially important to community residents.

COMPARING PROTECTION OPTIONS

Upcoming sections will ask you to compare different protection options for Waterford and vote for the ones you prefer. You may also vote to reject the proposed options and retain the status quo. **The methods and effects of each option include the following:**

Methods and Effects of Protection	What it Means
 Homes Flooded	The percentage of Waterford homes expected to flood in a high intensity (Category 3) storm in the mid-2020s. With no new action, 7% of homes (566 of the current 8,460 homes in Waterford) will be in this category by the mid-2020s. This is similar to current levels.
 Road Miles Flooded	The percentage of road miles in Waterford expected to flood in a high intensity (Category 3) storm in the mid-2020s. With no new action, 5% of roads (8 of the current 156 road miles in Waterford) are expected to flood.
 Wetlands Lost	The percentage of Waterford's coastal marshes expected to be lost by the mid-2020s due to flooding or erosion. With no new action, 12% of Waterford's coastal marshes (9 of 77 acres that exist today) are expected to be lost.
 Beaches and Dunes Lost	The percentage of Waterford's beaches and dunes expected to be lost by the mid-2020s due to flooding or erosion. With no new action, 10% of Waterford's beaches and dunes (about 4 of 36 acres that exist today) are expected to be lost.
 Seawalls and Coastal Armoring	The percentage of Waterford's coast shielded by hard defenses. With no new action, 50% of Waterford's coastline (13 of 26 miles) will have hard defenses by the mid-2020s. This is the same level as today.
 Cost to Your Household per Year	How much the option will cost your household per year, in unavoidable taxes and fees. Assume that these funds are legally guaranteed to be spent only on the coastal protection option that you vote for.







For homes, roads, wetlands and beaches, higher numbers mean greater losses.

Figure 10. Effects and Costs of Adaptation Included in Choice Questions

YOU WILL BE ASKED TO VOTE

After considering the current situation and possible protection effects and methods, which do you prefer? You will be given choices and asked to vote for the option you prefer by checking the appropriate box. **Questions will look similar to the example below.**

EXAMPLE QUESTION

Methods and Effects of Protection	Result in 2020s with NO NEW ACTION	Result in 2020s with PROTECTION OPTION A	Result in 2020s with PROTECTION OPTION B
	No Change in Existing Defenses	More Emphasis on HARD Defenses	SIMILAR Emphasis on Hard and Soft Defenses
 Homes Flooded	7% 566 of 8,460 homes expected to flood in a Category 3 storm	7% 566 of 8,460 homes expected to flood in a Category 3 storm	10% 846 of 8,460 homes expected to flood in a Category 3 storm
 Road Miles Flooded	5% 8 of 156 miles of roads expected to flood in a Category 3 storm	5% 8 of 156 miles of roads expected to flood in a Category 3 storm	8% 12 of 156 miles of roads expected to flood in a Category 3 storm
 Wetlands Lost	12% 9 of 77 wetland acres expected to be lost	5% 4 of 77 wetland acres expected to be lost	12% 9 of 77 wetland acres expected to be lost
 Beaches and Dunes Lost	10% 4 of 36 beach acres expected to be lost	10% 4 of 36 beach acres expected to be lost	4% 1 of 36 beach acres expected to be lost
 Seawalls and Coastal Armoring	50% 13 of 26 miles of coast armored	60% 16 of 26 miles of coast armored	60% 16 of 26 miles of coast armored
 Cost to Your Household per Year	\$0 Increase in annual taxes or fees	\$155 Increase in annual taxes or fees	\$95 Increase in annual taxes or fees
HOW WOULD YOU VOTE? (CHOOSE ONLY ONE) I vote for	<input checked="" type="checkbox"/> I vote for NO NEW ACTION	<input checked="" type="checkbox"/> I vote for PROTECTION OPTION A	<input checked="" type="checkbox"/> I vote for PROTECTION OPTION B

↑
If you prefer
No New Action
check here

↑
If you prefer
Protection Option A
check here

↑
If you prefer
Protection Option B
check here

Figure 11. Example Choice Question

PREDICTING THE FUTURE RISK

This survey asks you to consider different options that Waterford might use to protect against coastal storms and flooding, and choose the ones you prefer.

To help make choices such as these, scientists have developed forecasts of the type of flooding that would occur in the mid-2020s, under different scenarios.

For example, the map below shows the expected flooding in Waterford under a high-intensity (Category 3) hurricane in the mid-2020s. Conditions would approach this situation gradually. This is slightly more extensive than the flooding caused by Hurricane Sandy in 2012.

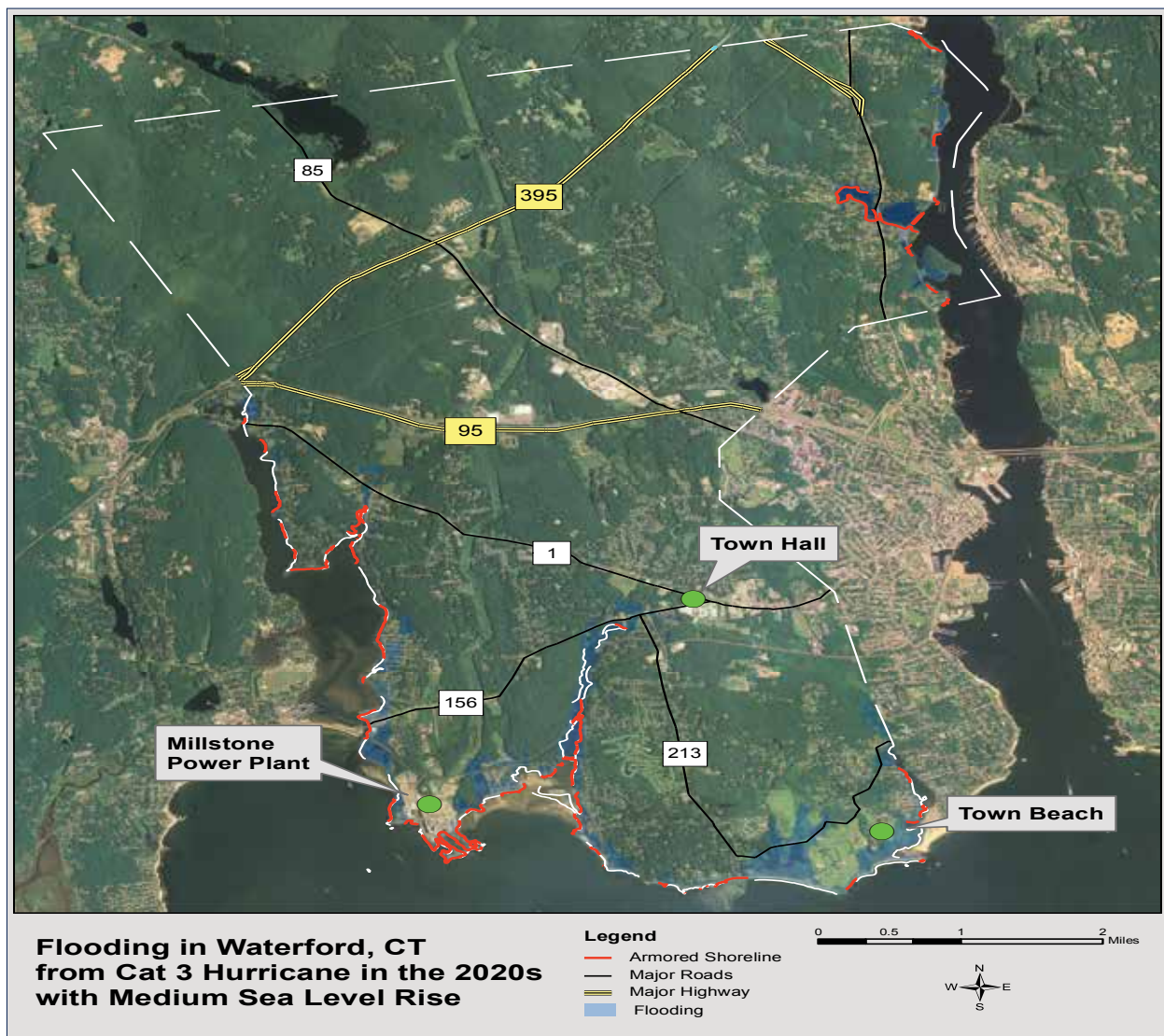


Figure 12. Storm Scenario Illustrated in Waterford Survey

5.1 COASTAL ADAPTATION TRADEOFFS AND VALUES

The A-B-N choices of Waterford households show strong support for coastal adaptation, even if it requires new taxes and fees. These choices reflect a strong desire for action that reduces risk for the town.

One way to illustrate these results is to calculate the economic values that are implied. Table 1 shows the economic value of each adaptation outcome (described in Figure 10) to an average Waterford household. These may be interpreted as the amount that an average household would be willing to pay per year, in additional and reoccurring town taxes and fees, to obtain these outcomes. Survey results show that the value placed on coastal adaptation by Waterford residents depends on what is protected.

Table 1. Value of Coastal Adaptation Outcomes to Waterford Households
(Revealed by Votes over Adaptation Alternatives³)

Coastal Adaptation Outcome	Additional Taxes/Fees that Each Household Would Be Willing to Pay (per year)
Fewer Waterford homes expected to flood during a typical Category 3 storm	\$0.07 per additional home not expected to flood ⁴
Fewer beach acres lost to flooding and erosion by the mid-2020s	\$21.86 per acre saved
Fewer wetland acres lost to flooding and erosion by the mid-2020s	\$9.43 per acre saved
Fewer Waterford road miles expected to flood during a typical Category 3 storm	\$0.005 per mile not expected to flood ⁵
Miles of sea walls <u>removed</u>	\$0.001 per mile removed ⁵
Taking action versus business-as-usual (no new action), in addition to all other specific values listed above	\$127.44 to take action

³ 80% of respondents indicated that they would vote the same way in a binding public referendum.

⁴ These are the values that Waterford households would be willing to pay to prevent the flooding of other people's homes in Waterford, not the value placed on protecting their own home. This can be interpreted as the amount that the average household would be willing to pay in annual bond payments for a hazard mitigation plan that would protect a certain number of additional homes. For example, for a plan that would protect 100 additional homes from flooding in a typical Category 3 storm, the average Waterford household would be willing to pay $100 \times \$0.07 = \7.00 per year in additional taxes and fees.

⁵ This number is not statistically different from zero.

For example, consider a hypothetical hazard mitigation plan that would change coastal protection in Waterford so that, by the year 2025: (a) 200 fewer homes are expected to flood in a typical Category 3 storm, (b) loss of two beach acres is prevented (c) loss of three coastal marsh acres is prevented, (d) four fewer road miles are expected to flood in a typical Category 3 storm, and (e) the number of miles of sea walls in Waterford is unchanged. Table 2 shows the estimated value of this plan.

Table 2. Illustrative Value of a Hypothetical Coastal Adaptation Plan

(A) Outcome of Hypothetical Adaptation Plan	(B) Additional Taxes/Fees that Each Household Would Be Willing to Pay—See Table 1	(C) Total Value per Household, Per Year (= A×B)
200 fewer homes are expected to flood in a typical Category 3 storm	\$0.07 per home	\$14.00
Loss of two beach acres is prevented	\$21.86 per acre	\$43.72
Loss of three coastal marsh acres is prevented	\$9.43 per acre	\$28.29
Four fewer road miles are expected to flood in a typical Category 3 storm	\$0.005 per mile	\$0.02
Sea walls are unchanged	\$0.001 per mile	\$0.00
Taking action versus business-as-usual	\$127.44 to take action	\$127.46
Total Plan Value per Household Per Year The amount that an average household would be willing to pay in additional taxes and fees, per year and in perpetuity, to obtain these combined outcomes		\$213.47 per household, per year (Equivalent to a total of \$1.61 million per year, in perpetuity, multiplied by all 7,542 Waterford households.) ⁶

As shown by Table 2, average residents strongly value action to mitigate coastal hazards, but only a small portion of total value is related to the protection of private homes, and almost none is related to reductions in expected road flooding. Although protection of waterfront homes from flooding is important to the residents living in those homes, it does not appear to be a top priority of the public at large. Similar illustrations are possible for many different types of coastal adaptation plans.

⁶For example, over 20 years, this would imply \$32.2 million in additional taxes and fees.

In summary, the votes of Waterford residents reveal: (a) high values for the protection of beaches and natural areas such as wetlands, (b) lower but still significant values for the protection of coastal homes, and (c) negligible values associated with reductions in expected road flooding or changes in the extent of hard shoreline armoring (sea walls). Residents also strongly support taking action above and beyond the values associated with specific adaptation results.

These values also imply tradeoffs that Waterford residents are willing to make. For example, the average Waterford household values the preservation of beach acres about twice as much as the preservation of wetland acres ($2.3 = \$21.86 / \9.43). An adaptation plan would have to prevent the expected flooding of approximately 135 homes (per Category 3 storm) to have the same value as preserving one acre of wetland ($134.7 = \$9.43 / \0.07). Similarly, an adaptation plan would have to prevent the expected flooding of approximately 312 private homes to have the same value as preserving one acre of beach in perpetuity.

These results imply that protecting homes from flooding is important to Waterford residents, but is not necessarily their top priority. Public resources such as wetlands and beaches appear to be of greater value and will garner more financial support from residents. Nearly 80% of respondents indicated that they would vote the same way in a binding public vote or referendum.

The survey also included questions to evaluate the validity of these results, and how respondents felt about the survey. The vast majority of Waterford residents viewed the survey instrument favorably. Most indicated that the information and questions were easy to understand, that survey content was fair and balanced and that they were confident about their answers.

Results of the survey predict the type of coastal adaptation that would be supported by Waterford residents. An advantage of this analysis is its grounding in a random sample of Waterford residents—not merely those that choose to attend town meetings or speak out on town policies.

SECTION 6

Conclusion

Waterford residents are concerned about a broad range of hazard impacts, including effects on private property, public infrastructure and natural resources. Survey respondents recognize the risks of coastal storms and flooding in Waterford, and perceive a strong need to take actions to address these risks. When viewed from a comparative perspective, however, some priorities stand out. Some principal findings of this study include:

- Waterford residents perceive coastal storms and flooding as a major problem. Those who own coastal waterfront homes view the problem as less severe than other residents. Residents have split opinions regarding the degree to which the town is well prepared for these reoccurring events.
- Residents have strong opinions about many methods and outcomes of coastal adaptation, and these opinions differ. However, on average, residents are more concerned with the protection of the town's natural and built resources than with potential changes in taxes and fees, flood insurance rates, or development restrictions. Furthermore, residents are more concerned with the protection of public resources such as beaches, natural resources and public services than with the protection of private homes.
- When asked to vote for or against hypothetical but feasible adaptation plans for Waterford, residents' votes show strong support for coastal adaptation, even if this requires new taxes and fees. These votes reveal relatively: (a) high values for the protection of beaches and natural areas such as wetlands, (b) lower but still significant values for the protection of coastal homes, and (c) negligible values associated with the prevention of road flooding and the extent of coastal armoring.

Study results quantify the value that Waterford residents place on hazard mitigation, and their willingness to support programs that protect important community resources. While these values might appear modest on a per household basis (e.g., \$213.47 per year for the illustrative adaptation plan in Table 2), it is important to recognize that these are average values for each Waterford household, and that

these values reflect a willingness to pay per year, in perpetuity. When considered in aggregate over all Waterford Households, these values can become large.

The value of mitigation also depends on the type of resources that are protected. Some values of Waterford residents appear to diverge from the priorities highlighted in recent community hazard mitigation plans. For example, despite an emphasis on protecting roads and transportation corridors, survey respondents do not appear to value road protection as a top priority. Results also show a high value placed on the protection of natural resources such as coastal wetlands and beaches, compared to values for the protection of private homes and roads. For example, an adaptation plan would have to prevent the expected flooding of approximately 135 homes (per Category 3 storm) to have the same value as preserving one acre of wetland. These findings highlight the importance of open dialogues concerning town priorities and values for coastal adaptation and resilience.

When interpreting results such as these, it is also important to distinguish the private value that a homeowner might have for the protection of her own home, from values that residents have for public actions to protect the town resources. Both study results and focus group findings suggest that most residents view the protection of homes as the responsibility of private homeowners, not the responsibility of the town. This at least partially explains the relatively low value placed on town actions that would prevent the flooding of private homes, compared to town actions that would protect resources such as beaches and wetlands.

The results of this study do not indicate what types of coastal hazard adaptation are right or wrong, only those that are predicted to generate the greatest social value to town residents, and would hence be supported most strongly by these residents. These estimates are based on current information and projections regarding coastal hazards, and the importance that residents place on different hazard mitigation outcomes. When combined with information on the cost of different adaptation alternatives, results such as these can help identify adaptation strategies that best support the goals and values of town residents.

APPENDIX I

DEMOGRAPHIC PROFILE OF THE SURVEY SAMPLE

The survey was mailed to a random sample of Waterford residents. The following summarizes the characteristics of those who responded.

HOME CHARACTERISTICS OF THE WATERFORD SURVEY SAMPLE

Question 9: Is your home located north or south of Route I-95?		
North	South	Unsure
13.0%	80.4%	6.7%

Question 10: Is your home located within a federally designated flood zone?		
Yes	No	Unsure
10.8%	69.5%	19.7%

Question 11: Is your home located on coastal waterfront property?		
Yes	No	Unsure
6.6%	91.9%	1.5%

Question 12: Is your home covered by any federal or private flood insurance?		
Yes	No	Unsure
11.0%	83.1%	5.9%

Question 13: Has your home suffered coastal flood damage in the past five years?		
Yes	No	Unsure
2.6%	93.8%	3.7%

APPENDIX I (continued)

SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE WATERFORD SURVEY SAMPLE

Question 16: What is your gender?

Male 55.0%	Female 45.0%						
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Question 17: What is your age?

19-29 3.8%	30-39 7.2%	40-49 17.9%	50-59 27.0%	60-69 21.3%	70-80 13.7%	Over 80 9.1%	
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Question 18: What is the highest level of education you have completed?

Less than high school 0.8%	High School/GED 13.7%	Some college 17.9%	2-Year college 10.6%	4-Year college 29.3%	Graduate Degree (MS, PHD, etc.) 27.8%		
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Question 19: How many years have you been a Waterford resident?

Less than 5 10.4%	5-19 29.6%	20-34 26.3%	35-49 18.1%	50-65 11.9%	More than 65 3.7%		
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Question 20: Are you currently employed?

Yes 61.3%	No 38.7%						
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Question 21: What category best describes your total household annual income?

Less than \$10,000 1.2%	\$10,000 \$19,999 2.8%	\$20,000~ \$39,999 11.6%	\$40,000~ \$59,999 16.5%	\$60,000~ \$79,999 17.7%	\$80,000~ \$99,999 13.7%	\$100,000~ \$249,999 32.9%	\$250,000~ or more 1.2%
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Question 22: Are you a seasonal or year-round resident of Waterford?

Seasonal 3.3%	Year-round 96.7%						
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APPENDIX II

CHOICE MODEL RESULTS

Table A.1 shows the statistical results underlying the value estimates provided in Table 1. These results are calculated using a mixed logit model. The model predicts the choices (or votes) that were made by each survey respondent, as a function of the particular attributes (or characteristics) of the adaptation plans they considered. The model is statistically significant at $p < 0.0001$, with 8 out of 10 coefficient estimates statistically significant at $p < 0.10$.

Table A1. Random Parameters Logit Model Results

ATTRIBUTE (OR RESOURCE)	COEFFICIENT	STANDARD ERROR
Random parameters in utility functions		
NNA (No New Action)	-1.61***	0.509
Beaches	-0.098***	0.030
Cost	-0.018***	0.004
Nonrandom parameters in utility functions		
Homes	-0.070*	0.041
Roads	-0.005	0.041
Wetlands	-0.090***	0.022
Seawalls	-0.001	0.013
Standard deviation of random parameters (for Cost, limit of triangular bounds)		
NNA (No New Action)	3.737***	0.661
Beaches	0.131**	0.053
Cost	0.018***	0.004
Model fit		
No. of Observations (N)	388	
X ² / Significance Level	172.978 (9 d.f.) / 0.0001	
AIC	697.5	
LL Function	-339.77253	
Pseudo - R ²	0.20290	

Note: ***, ** and * imply statistical significance respectively at the 1%, 5% and 10% levels



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