

EXECUTIVE SUMMARY

INTRODUCTION AND METHODOLOGY

This study was conducted for the Delaware Department of Natural Resources and Environmental Control (DNREC) to determine Delaware residents' opinions on climate change and sea level rise. The study entailed a telephone survey of Delaware residents ages 18 years and older.

For the survey, telephones were selected as the preferred sampling medium (both landlines and cell phones) because of the almost universal ownership of telephones: 98.8% of Delaware residents own telephones—93.1% own landlines and 5.7% own cell phones only. Additionally, telephone surveys, relative to mail or Internet surveys, allow for more scientific sampling and data collection, provide higher quality data, obtain higher response rates, are more timely, and are more cost-effective. Telephone surveys also have fewer negative effects on the environment than do mail surveys because of reduced use of paper and reduced energy consumption for delivering and returning the questionnaires.

The sampling methodology entailed Random Digit Dialing (RDD), which ensures that all households with telephones (in Delaware, 98.8% of households) have an equal chance of being called to participate in the survey. RDD is the best methodology for maintaining a representative random sample of households, taking into account such issues as those without landlines, those unlisted by choice, new numbers, and those numbers that have been disconnected due to a move or change in residence. In this sense, RDD sampling helps to produce representative, scientifically defensible survey data, unlike samples drawn from telephone directories or other “lists,” which tend to under-represent unlisted households. The sample was purchased from Survey Sampling International (www.surveysampling.com), a company specializing in providing scientific telephone samples.

A central polling site at the Responsive Management office allowed for rigorous quality control over the interviews and data collection. Responsive Management maintains its own in-house telephone interviewing facilities. These facilities are staffed by interviewers with experience conducting computer-assisted telephone interviews on the subjects of natural resources and outdoor recreation. The telephone survey questionnaire was developed cooperatively by

Responsive Management and DNREC. Responsive Management conducted a pre-test of the questionnaire to ensure proper wording, flow, and logic in the survey.

Interviews were conducted Monday through Friday from 9:00 a.m. to 9:00 p.m., Saturday from noon to 5:00 p.m., and Sunday from 5:00 p.m. to 9:00 p.m., local time. The survey was conducted in December 2009. Responsive Management obtained a total of 1,505 completed interviews (from landlines and cell phones).

For the entire sample of Delaware residents ages 18 years and older, the sampling error is at most plus or minus 2.52 percentage points, based on a sample size of 1,505 and a population of 685,085 Delaware residents ages 18 years and older.

PERCEPTIONS OF IMPORTANT ENVIRONMENTAL ISSUES

- Delaware residents were asked to rate their concern about 10 issues that the country faces, listed in Text Box 1 on the following page.
 - The economy (75% are *very* concerned) and health care (72%) top the list, as ranked by the percentage saying that they are *very* concerned about the issues.
 - A middle tier consists of public education (65%), national security (60%), energy resources (59%), social security (57%), the environment (55%), and crime rates (52%).
 - At the bottom of the ranking are climate change (36%) and sea level rise (30%), in the ranking by the percentage saying that they are *very* concerned.
 - Women, compared to men, are more likely to be *very* concerned about each of the issues listed below; the lone exception is the economy, where men and women have similar opinions.
 - Older people (65 years or older), compared to the two other age groups (ages 18 to 34 and ages 35 to 64), are more likely to be *very* concerned about health care, crime rates, and national security.

Text Box 1
Concern About Issues That the Country Faces
(Ranked by the Percentage Who Are Very Concerned
About the Following Issues)

The economy
Health care
Public education
National security
Energy resources
Social security
The environment
Crime rates
Climate change
Sea level rise

- Another series of questions asked residents to rate their concern about nine *environmental* issues in Delaware, listed in Text Box 2 below.
- At the top of the ranking by the percentage being *very* concerned (as well as the ranking by *very* or *somewhat* concerned) are three issues related to pollution: water pollution (76% are *very* concerned), toxic waste (72%), and air quality (65%).
 - A middle tier consists of habitat and wildlife-related issues: loss of forest habitat (58%), declining fish and wildlife populations (54%), and loss of marsh or wetlands (45%).
 - At the bottom are flooding (42%), climate change (36%), and sea level rise (32%).
 - Women, compared to men, are more likely to be *very* concerned about water pollution, climate change, sea level rise, and flooding.

Text Box 2
Concern About Environmental Issues That Delaware Faces
(Ranked by the Percentage Who Are Very Concerned About the Following Issues)

Water pollution
Toxic waste
Air quality
Loss of forest habitat
Declining fish and wildlife populations
Loss of marsh or wetlands
Flooding
Climate change
Sea level rise

- In a direct question, residents are split regarding worry about climate change: a slight majority of residents (53%) say they personally worry about climate change *a great deal* or *a moderate amount*, but just under a majority (46%) worry *only a little* or *not at all*.
 - Women, compared to men, are more likely to worry about climate change *a great deal*.

- Less than a majority of residents (39%) say that they personally worry about sea level rise *a great deal* or *a moderate amount*, while a large majority (60%) worry *only a little* or *not at all*.
 - Kent County residents, compared to residents of Sussex County and New Castle County, are the least likely to personally worry *a great deal* or *a moderate amount* about sea level rise ($p < 0.05$).

- The survey also asked about residents' level of worry about the impacts of climate change on Delaware's environment, with slightly more concern than in either of the above questions: 60% worry *a great deal* or *a moderate amount*, while 39% worry *only a little* or *not at all*.

KNOWLEDGE AND AWARENESS OF CLIMATE CHANGE

- The survey examined self-professed knowledge about climate change: 70% say that they know *a great deal* or *a moderate amount*, while 30% say that they know *a little* or *nothing*. The most common answer is *a moderate amount* (54%).
 - Men are more likely than are women to claim to know *a great deal* about climate change, and more educated people (i.e., those with at least a bachelor's degree) claim to know more about climate change compared to those with less education.
 - Those who say they know *a great deal* or *moderate amount* about climate change, compared to those who say they know *a little* or *nothing*, are more likely to worry about climate change *a great deal* or *moderate amount*.

- Self-professed knowledge about sea level rise is lower than about climate change: 40% say that they know *a great deal* or a *moderate amount*, while 59% say that they know *a little* or *nothing*. The most common answer is *a little* (40%).
 - As before, those who say they know *a great deal* or *moderate amount* about sea level rise, compared to those who say they know *a little* or *nothing*, are more likely to worry about sea level rise *a great deal* or *moderate amount* ($p < 0.001$).

- The newspaper is the leading source of information about environmental issues in Delaware (52% get their information about the environment that way), followed by television (44%), the Internet (excluding the DNREC site) (30%), and magazines (14%). (In total, 32% use the Internet, including the DNREC site.)
 - Younger residents appear more likely to get information from the Internet and older residents appear more likely to get information from newspapers.

- Residents are split regarding whether there is enough available information about sea level rise: 39% say that there is enough available information, but 51% say that there is not enough available information.

- Residents were asked to name information topics related to sea level rise that they might want. Six topics were most commonly named, listed below.
 - Sea level rise in general (33% want more information on this).
 - Actions that can be taken to reduce impacts of sea level rise (26%).
 - Current or potential impacts of sea level rise (24%).
 - How sea level rise relates to climate change/global warming (23%).
 - How to protect property from sea level rise (19%).
 - Funding needs to address sea level rise in Delaware (18%).

OPINION ON CLIMATE CHANGE AND WHETHER CLIMATE CHANGE IS HAPPENING

- A direct question asked residents to indicate how convinced they are that climate change is happening. The large majority (70%) are *completely* or *mostly* convinced that climate change is happening. At the other end, 27% are *not so* convinced or are *not at all* convinced. Similarly, 63% are *completely* or *mostly* convinced that sea levels are rising, and 33% are *not so* convinced or are *not at all* convinced that sea levels are rising.
 - Women, compared to men, are more likely to be either completely or mostly convinced that climate change is happening.
 - Residents in the higher education group (has at least a bachelor's degree), relative to those with less education, are more likely to be completely convinced that climate change is happening.

- When told that some scientists predict that sea levels will rise at least 1 to 3 feet in the next 100 years, the large majority of residents (62%) agree that this is a reasonable prediction; at the other end, 21% disagree.

- The survey also touched on perceptions of what most *scientists* think regarding climate change. Residents are split, with 42% thinking that most scientists think climate change is happening, and 42% thinking that there is a lot of disagreement among scientists about whether climate change is happening. Only 5% think that most scientists think that climate change is *not* happening.

- A series of six questions further explored residents' perceptions regarding whether climate change and sea level rise are happening, listed in Text Box 3 on the following page.
 - Large majorities *strongly* or *moderately* agree with the following: that scientists are right that climate change is occurring (79%), that climate change is contributing to the rise in sea levels (75%), that the state of Delaware needs to conduct more research to identify the impacts of sea level rise in Delaware (73%), and that the state of Delaware needs to conduct more research to identify the impacts of climate change in Delaware (71%).

- Less than a majority (40%) *strongly* or *moderately* agree that the impacts of climate change are greatly exaggerated.
- Interestingly, although the majority of residents agree that scientists are right that climate change is occurring and that climate change is contributing to the rise in sea levels, a small percentage of residents (22%) think that they have *personally experienced* the impacts of sea level rise.
 - Sussex County residents are the most likely to *strongly* agree that they have personally experienced the impacts of sea level rise
 - Non-coastal residents are more likely to *strongly* agree that climate change is contributing to the rise in sea levels, compared to coastal residents.
 - Coastal residents, relative to non-coastal residents, are more likely to *strongly* agree that they have experienced the impacts of sea level rise.

Text Box 3**Perceptions Regarding Whether Climate Change and Sea Level Rise Are Happening (Ranked by the Percentage Who Strongly or Moderately Agree With the Following Statements)**

Scientists are right that climate change is occurring.

Climate change is contributing to the rise in sea levels.

The state of Delaware needs to conduct more research to identify the impacts of sea level rise in Delaware.

The state of Delaware needs to conduct more research to identify the impacts of climate change in Delaware.

The impacts of climate change are greatly exaggerated.

You (the respondent) have personally experienced the impacts of sea level rise.

- A question explored perceptions of *causes* of climate change. More residents think that climate change, if it is happening, is caused mostly by human activities (43%) than think it is caused mostly by natural changes in the environment (26%). In the middle, 27% think it is caused about equally by human activities and by natural changes in the environment.
 - New Castle County residents are the least likely to attribute climate change to mostly natural changes in the environment.

- A question about the terms “climate change” and “global warming” asked residents whether the terms are the same thing, whether they are different but related things, or whether they are unrelated things (DNREC considers them to be different but related). The most common answer (66%) is that they are different but related things.

PERCEPTIONS OF CLIMATE CHANGE AS A THREAT

- Most residents (77%) consider climate change to be a threat, saying it is a *very* serious threat (38%) or a *somewhat* serious threat (39%). At the other end, 21% consider it to be a *not very serious* or *not at all serious threat*.
 - Women are more likely than are men to think that climate change is a *very* or *somewhat* serious threat.

- Six questions explored how much residents worry about various aspects of climate change, shown in Text Box 4 on the following page.
 - The most concern, in the ranking by the percentage worrying *a great deal* or *a moderate amount*, is regarding the impact of climate change on Delaware’s environment (61%). Four items follow, grouped together: worry about the impact on the respondent’s own quality of life in Delaware (54%), worry about climate change personally (53%), worry about the impacts of climate change on Delaware’s economy (52%), and worry about the problems sea level rise may cause (52%).
 - At the bottom, 39% said that they worry *a great deal* or *a moderate amount* about sea level rise personally.
 - Kent County residents, compared to residents of the other two counties, are the least likely to personally worry *a great deal* or *a moderate amount* about sea level rise.
 - Sussex County residents, compared to residents of the other two counties, are the most likely to worry *a great deal* or *moderate amount* about the problems that sea level rise may cause in Delaware.
 - Coastal residents are more likely than are non-coastal residents to worry *a great deal* or *moderate amount* about the problems sea level rise may cause in Delaware.

Text Box 4**Amount of Worry About Specific Aspects of Climate Change
(Ranked by the Percentage Who Worry a Great Deal or a Moderate Amount About
the Following Issues)**

How much do you worry about the impacts of climate change on Delaware's environment?
How much do you worry about the impacts of climate change on your quality of life in Delaware?
How much do you personally worry about climate change?
How much do you worry about the impacts of climate change on Delaware's economy?
How much do you worry about the problems sea level rise may cause in Delaware?
How much do you personally worry about sea level rise?

- Fifteen questions asked residents to indicate how much sea level rise is a threat to various locations (e.g., beaches, ocean-front towns, the state as a whole) or various other things (e.g., wildlife, the economy, public works systems), shown in Text Box 5 on the following page.
 - In looking at the ranking by the percentage saying that sea level rise is a *very serious threat*, three items stand out at the top: Delaware's beaches (53% say sea level rise is a *very serious* threat to this), ocean-front cities and towns in Delaware (48%), and marshes and wetlands in Delaware (42%).
 - A middle tier consists of seven items, each with from 30% to 34% saying sea level rise is a *very serious* threat: river-front cities and towns in Delaware (34%), the state of Delaware as a whole (33%), Delaware's wildlife populations (32%), Delaware's economy (32%), the United States as a whole (31%), the Mid-Atlantic states (30%), and Delaware's public works (30%).
 - There are five items in a bottom tier of items not considered by many to be greatly threatened by sea level rise: outdoor recreation in Delaware (24%), the respondent's local community (19%), the respondent personally (18%), the respondent's family (14%), and the respondent's property (13%).
 - Kent County residents, relative to residents of the other two counties, are the most likely to consider sea level rise to be *not at all a serious* threat to Delaware's economy, Delaware's public works systems, their local community, and their property.

- On the other hand, coastal residents, compared to non-coastal residents, are more likely to think that sea level rise is a *very serious* threat to river-front cities and towns in Delaware, outdoor recreation in Delaware, their local community, their property, their family, and them personally.

Text Box 5

**Items to Which Sea Level Rise May Be a Threat
(Ranked by the Percentage Who Think Sea Level Rise is a Very Serious Threat to the Following)**

Delaware beaches
 Ocean-front cities and towns in Delaware
 Marsh and wetlands in Delaware
 River-front cities and towns in Delaware
 The State of Delaware
 Delaware's wildlife populations
 Delaware's economy
 The United States
 The Mid-Atlantic U.S.
 Delaware's public works systems, such as public buildings, roads, and sewer systems
 Outdoor recreation in Delaware
 Your local community
 You personally
 Your family
 Your property

- Delaware residents overwhelmingly think that Sussex County is the most threatened by sea level rise (78% named Sussex County); only 5% named either New Castle County or Kent County.
- Residents were asked to indicate when they think sea level rise will start to have impacts on the area in which they live in Delaware: 5 years, 10 years, 25 years, 50 years, or 100 years, or if they think that sea levels are not rising. Answers are spread fairly evenly among the possible responses. For instance, 14% think sea level rise is having an impact now, and 11% think it will have an impact in 100 years. The most common response is 25 years (17%).
 - Coastal residents, relative to non-coastal residents, are more likely to say that sea level rise is having impacts now. On the other hand, non-coastal residents are more

- likely to pick a date in the future when saying when they think that sea level rise will start to have impacts on the area in which they live.
- Men, compared to women, are more likely to think that sea level rise will start to have impacts in the distant future (rather than the near future or now) or to never have impacts.

PERCEPTIONS OF EFFICACY OF TAKING ACTION TO MITIGATE CLIMATE CHANGE

- Thirteen questions explored whether residents think that human action can affect climate change or mitigate the effects of climate change, shown in Text Box 6 on page xii.
 - The top tier in the ranking shows conflicting opinion. The results suggest that residents believe that human actions can affect climate change, as large majorities *strongly* or *moderately* agree that the U.S. can take actions that will help reduce climate change (79%), that the impacts of climate change can be reduced by human efforts (76%), that there are many actions that can be taken to reduce climate change (72%), and that an individual can personally take actions that will help reduce climate change (70%). However, despite thinking that human actions can affect climate change, large majorities think that we (our society) should conduct more research before taking any action to address sea level rise (71%) and that we (our society) should conduct more research before taking any action to address climate change (68%).
 - Four statements are in the middle tier, showing that a slight majority, despite other opinions, think that action should be taken now and that action would be efficacious in addressing climate change. From 56% to 61% think that we (our society) should take immediate and drastic action to reduce the impacts of climate change (61%), that sea level rise can be reduced by human efforts (59%), that we (our society) should take immediate and drastic action to reduce the impacts of sea level rise (58%), and that climate change is something people can control (56%).
 - The bottom tier has three items, which support the above findings by showing that less than a majority are pessimistic about the efficacy of taking action to mitigate climate change. Less than a majority think that there is limited action that can be taken to reduce

climate change (46%), that the actions of a single person will not make any difference in reducing climate change (32%), and that the actions of a single country like the U.S. will not make any difference in reducing climate change (31%).

- Taken as a whole, the results suggest that people think that human action can mitigate the effects of climate change, but opinion is split regarding whether society should take *immediate* action or whether society should *conduct more research before* taking action.
 - Sussex County residents are the least likely, relative to residents of the other two counties, to *strongly* agree that climate change is something people can control.
 - New Castle County residents are the most likely, compared to residents of the other two counties, to *strongly* agree that the impacts of climate change can be reduced by human efforts, and to *strongly* or *moderately* agree that sea level rise can be reduced by human efforts.
 - Kent County residents, relative to residents of the other two counties, are the least likely to *strongly* agree that there are many actions that can be taken to reduce climate change.
 - Coastal residents, compared to non-coastal residents, are more likely to *strongly* agree that there are many actions that can be taken to reduce climate change.
 - Women, compared to men, are more likely to *strongly* agree that the impacts of climate change can be reduced by human efforts.

Text Box 6

Statements Regarding Taking Action to Mitigate Climate Change

(Ranked by the Percentage Who Strongly or Moderately Agree With the Following Statements)

The U.S. can take actions that will help reduce climate change.
 The impacts of climate change can be reduced by human efforts.
 There are many actions that can be taken to reduce climate change.
 We should conduct more research before taking any action to address sea level rise.
 You can personally take actions that will help reduce climate change.
 We should conduct more research before taking any action to address climate change.
 We should take immediate and drastic action to reduce the impacts of climate change.
 Sea level rise can be reduced by human efforts.
 We should take immediate and drastic action to reduce the impacts of sea level rise.
 Climate change is something people can control.
 There is limited action that can be taken to reduce climate change.
 The actions of a single person like you will not make any difference in reducing climate change.
 The actions of a single country like the U.S. will not make any difference in reducing climate change.

- Regardless of how many years residents believe it will take for sea level rise to affect their area, residents overwhelmingly think action should be taken to address or reduce the impacts of sea level rise *before impacts occur* (80%) rather than *as impacts begin* (8%) or *after impacts cause problems* (3%).

MANAGEMENT STRATEGIES PERTAINING TO CLIMATE CHANGE

- The survey had a series of 11 questions regarding actions that could be taken and management strategies to address sea level rise, as shown in Text Box 7 on the following page.
 - In looking at the percentage who *strongly* support the actions/management strategies, two stand out at the top, both relating to building codes: avoiding building new structures in areas at risk from sea level rise (67%), and changing building codes and regulations to reduce risk in flood prone areas (63%).
 - A second tier includes funding research (44%), using dredged material to build up marsh areas at risk (40%), and elevating buildings using *private* funding (40%).
 - A third tier, at about a third each, includes two that require large capital outlays: building dikes, seawalls, and bulkheads (33%), and elevating land surfaces in areas at risk of sea level rise (30%). A third is the natural option: allowing beaches and wetlands to naturally migrate inland (29%).
 - At the bottom, with little support, are the three potential actions that each include using “government funds” to purchase land at risk of sea level rise (21%), to elevate buildings (18%), and to purchase frequently flooded properties (16%).

Text Box 7**Support for Actions/Management Strategies to Mitigate the Effects of Sea Level Rise (Ranked by the Percentage Who Strongly Support the Following Actions/Management Strategies)**

Avoiding building new structures in areas at risk from sea level rise
 Changing building codes and regulations to reduce risk in flood prone areas
 Increasing funding for research
 Using clean dredged material from waterways to build up marsh areas that are at risk from sea level rise
 Elevating buildings in areas at risk from sea level rise using private funding
 Building dikes, seawalls, and bulkheads to keep water back
 Elevating the land surface in areas at risk from sea level rise
 Allowing beaches and wetlands to naturally migrate inland
 Purchasing or acquiring land and open space at risk from sea level rise from willing land sellers using government funds
 Elevating buildings in areas at risk from sea level rise using government funds
 Purchasing or buying out frequently flooded properties using government funds

- The survey asked residents whether they support or oppose having their local and state governments spend more money on public construction projects if it means that the structures can withstand or accommodate sea level rise in Delaware. They were informed before the question that such construction is more *expensive* than is construction that cannot withstand or accommodate sea level rise. The results suggest that residents are willing to pay the expense now so that construction will withstand sea level rise: 64% support, and 25% oppose.
 - In follow-up to the above question, those who opposed were further informed of the following: “What if you knew that it would save money and be less costly *long-term* for Delaware to construct structures to withstand or accommodate sea level rise?” Of those who opposed previously, 58% still oppose (most of them now *strongly* opposing), but just under a third (32%) now support.

RESPONSIBILITY FOR TAKING ACTION

- The survey asked nine questions about entities that should be doing more or doing less to address or reduce the impacts of sea level rise in Delaware. For each entity (shown in Text

Box 8 below), the survey asked respondents if they thought the entity should be doing more, about the same, or less than it is currently doing.

- Among the results of this series of questions as a whole, it is notable that, for each entity, the percentage of residents who say that the entity should be doing more (ranging from 45% up to 66%) far exceeds the percentage who say that the entity should be doing the same or less (ranging from 22% to 29%).
- At the top of the ranking by the percentage who say the entity should be doing *more* are corporations and industry (66%) and Delaware citizens (64%)—both at nearly two-thirds. Five entities are in the middle, all with from 56% to 59% giving the “doing more” response: state government officials, city/town government officials, county government officials, Delaware’s state legislators, and the U.S. Congress.

Text Box 8

**Entities That Should Be Doing More or Less to Address Sea Level Rise
(Ranked by Percentage Who Think the Following Should be Doing More to Address
Sea Level Rise)**

Corporations and industry
 Delaware citizens
 State government officials
 The respondent’s city or town government officials
 The respondent’s county government officials
 Delaware’s state legislators
 The U.S. Congress
 Delaware’s governor
 Delaware’s state agencies

- Most residents (55%) indicate that they would *not* be likely to attend a public meeting, informational session, or “webinar” in the next 12 months on sea level rise in Delaware. On the other end, 10% indicate being *very* likely. A similar question asked residents about their likelihood to write letters, send emails, or call elected officials in the next 12 months about sea level rise: 62% would be *not at all* likely, while only 9% indicate being *very* likely.

DEMOGRAPHIC OVERVIEW

- Overall, several patterns emerged from the data regarding opinions and attitudinal tendencies among certain groups of Delaware residents. A few general observations follow (note that specific aspects of disparities in knowledge or concern have also been discussed above under various topic headings).
- In large part, women show more concern than do men about climate change and sea level rise, and they are generally more likely to consider climate change and sea level rise as threats. At the same time, men are more likely to say that they know *a great deal* or *moderate amount* about climate change and sea level rise than are women.
 - In general, men (as compared to women) are more likely to think that sea levels are not rising or that sea level rise will not begin to have impacts on Delaware until 50 or 100 years from now; on the other hand, women are more likely to think that sea level rise will have impacts in 25 years or less.
 - Delaware residents in a broad middle age group comprising 35- to 64-year-olds tend to show more concern about climate change, sea level rise, and the impacts associated with these than do those in the younger age group (18- to 34-year-olds) and older age group (65 years or older).
 - Coastal residents are more likely than are non-coastal residents to worry about the problems and impacts associated with sea level rise. One notable difference is that people who live in coastal areas tend to be more likely to consider sea level rise a threat to them personally, whereas those in non-coastal areas are more likely to consider sea level rise a threat to the state of Delaware but not to them personally.
 - Coastal residents are more likely to think that sea level rise is having an impact on Delaware now, whereas non-coastal residents are more likely to think that any impact from sea level rise will be in years to come. Coastal residents are also more likely to think that various government and non-government entities and agencies should be doing more to reduce the impacts of sea level rise.
 - More educated residents (i.e., those with at least a Bachelor's degree) are more likely, compared to those with less education, to claim to know a great deal or moderate amount about climate change and to be completely convinced that climate change is happening.