



# FLOODING AND CLIMATE CHANGE RISKS IN NORTHAM

## General Instructions

Northam, a 30,000-person city **on a tidal bay in New England**, has a reputation for being a great place to live. It boasts low unemployment, a strong working middle-class, and an educated population. In recent years, residents have been startled by the increasing number of “**freak storms**” that have hit their area. Heavy rainstorms and snowstorms are particularly hard on Northam because **flooding comes from two sources**: runoff from buildings, roads, and other impermeable surfaces (*i.e.*, **stormwater runoff**), and the **overflow from two tidal rivers** that run through the heart of the city. In the past few years, flooding from both sources has led to costly damage and loss of business. Luckily, no one has been physically harmed.

Now, however, the City of Northam is in the hot seat. Over the last five years, Northam was hit by two “100-year storms” – huge rainstorms that should only have a 1% chance of occurring in any given year. When the last big storm blasted the region a few months ago, the local news happened to be running a story on a **climate change research project** at nearby Sharpton College. The story captured images of Northam’s rivers overrunning their banks and water pooling on roads and in parking lots as the city’s aging stormwater infrastructure was overwhelmed. Northam became the poster child for a Sharpton professor’s provocative statement, “Climate change may be caused by millions of irresponsible decisions around the globe, but it’s up to local folks to figure out how to deal with the impacts.”

Northam’s Conservation Commission saw this as an opportunity to put pressure on the city to start considering climate change impacts in its long-term planning. Coincidentally, when the newscast aired, Northam was just a little more than half a year away from starting its formal review of the city’s Master Plan – a process that generally happens every five years and takes about six months. The Conservation Commission made a formal request to Northam’s Planning Department to commission researchers at Sharpton College to create a preliminary **climate change risk assessment** specifically for Northam.

The Planning Department complied with the Conservation Commission’s request and Sharpton produced the assessment. The assessment warned that climate change could have significant impacts on Northam in the next 100 years due to the effects of greenhouse gases (GHG) in the atmosphere. These effects include higher temperatures, increased precipitation, and rising sea

levels, which in turn could cause **severe flooding, heat waves, drought**, and a handful of other problems in the city.

With this assessment in hand, the Planning Board decided to approach its Master Plan review process differently than it has in the past. The Planning Director appointed four advisory committees to discuss some of the city's regulations and services that, based on Sharpton's assessment, could be impacted by climate change, and to make recommendations about what Northam should do going forward. The four Climate Change Advisory Committees (CCACs) are dedicated to:

- **Subdivision Regulations** (specifically, stormwater management)
- **Emergency Services**
- **Zoning in the Floodplain**
- **Drinking Water**

The Planning Board has asked each of these groups to meet weekly for three consecutive weeks to produce recommendations for changes to existing city policies. **The Planning Board has agreed to implement any recommendations put forth by each CCAC, as long as the group reaches consensus on the decision—meaning no one in the CCAC opposes the recommendation.**

The CCAC on Subdivision Regulations, which is the first of the four groups to convene, is meeting today.

### **Today's Meeting**

This is the last meeting of the CCAC on Subdivision Regulations (hereafter referred to as the Advisory Committee). In the Advisory Committee's first meeting, the group members reviewed the risk assessment prepared by Sharpton's climate scientists and the city's subdivision regulations for stormwater management (see Appendix A). In the second meeting, the Advisory Committee developed a few potential options for changes to the regulations, based on the precipitation projections in Sharpton's risk assessment. The Advisory Committee must finalize its recommendations to the Planning Board by the end of the meeting today or the other three CCACs will be delayed and the Master Plan review process may be compromised. A lot of people are watching what this Committee does, since its decisions today will set the precedent for the remaining three CCACs (Emergency Services, Zoning in the Floodplain, and Drinking Water).

If the Advisory Committee recommends any changes to the regulations, and the Planning Board accepts those changes, the cost of construction for new stormwater infrastructure will almost certainly rise. This will directly affect developers and indirectly impact homebuyers and business owners when they purchase property. Also, the public will pay more through tax dollars for any future city upgrades to the existing stormwater infrastructure. Regulation changes could significantly affect a large bridge reconstruction project—a major public expenditure coming up in the Capital Improvements Plan—in the near-term.

## The Issues

The Advisory Committee is seeking agreement on three issues:

- 1) *Which climate projections should the city require engineers to use when designing stormwater infrastructure?*
- 2) *How much stormwater should developers be required to manage on-site?*
- 3) *If there are any changes to the regulations, when should they go into effect?*

### Issue 1: Precipitation data and projections: *Which climate change projections should engineers be required to use when designing stormwater infrastructure?*

The first issue is deciding what information should be used to design future stormwater infrastructure. Currently, when project owners (private developers or the city's Public Works Department) plan to build or upgrade stormwater infrastructure, they hire engineers to design the underground pipes and culverts to meet the specifications in the city's subdivision regulation (see Appendix A). In order to determine the correct sizes for the pipes and culverts, the engineers have to estimate how much water the pipes will have to carry. To make these estimates, the engineers consult a precipitation database that is managed by the state, which includes recorded storm information for the past 50 years (1960 – 2010). Standard engineering practice assumes this data is a good proxy for the amount of precipitation expected for Northam in the next 50 years. Consequently, engineers design the pipes and culverts to accommodate the amount of water expected based on past data.

The problem is that the Sharpton climate change risk assessment shows that the precipitation expected over the next 50 years is very different than what occurred in the last 50 years (see below). Sharpton's estimates build on historical data, but they also incorporate climate science that accounts for increases in global temperature due to greenhouse gas emissions from burning fossil fuels. The Sharpton researchers developed the projections below for "better" and "worse" case future scenarios. The "better case" scenario assumes that greenhouse gas emissions over the next 50 years stay at the same levels they are now, or go down. The "worse case" scenario assumes that emissions continue to rise. Most people who study climate policy think emissions will continue to rise for the foreseeable future, but this is an issue of debate around the globe. Sharpton also stresses that while the science is improving all the time, there is still some uncertainty about exactly how rising temperatures will affect precipitation. They say there is no doubt that precipitation will change, but the actual numbers could be better or worse than the models predict.

The numbers on the next page show the difference between the historical data and Sharpton's projections. The different storm categories (10-year, 15-year, 50-year) are indications of probability. A 10-year storm has a 10% chance of occurring in any given year. A 15-year storm has a nearly 7% chance of occurring, and there is a 2% chance that a 50-year storm will happen in any given year. The expected inches of precipitation for these storms are shown below. The storm that was captured in the news report dropped 7.5 inches of rain in 24 hours and caused approximately \$500,000 in damage to public and private property.

<b>The State's Precipitation Data from 1960-2010</b>			
	<b>10-Year Storm</b>	<b>15-Year Storm</b>	<b>50-Year Storm</b>
<b>Rainfall in 24 hrs (in inches)</b>	4.55"	4.76"	6.84"

<b>Sharpton's Precipitation Estimates Using "Better Case" Scenario Climate Change Projections for the next 50 years</b>			
	<b>10-Year Storm</b>	<b>15-Year Storm</b>	<b>50-Year Storm</b>
<b>Rainfall in 24 hrs (in inches)</b>	5.12"	5.34"	8.45"

<b>Sharpton's Precipitation Estimates Using "Worse Case" Scenario Climate Change Projections for the next 50 years</b>			
	<b>10-Year Storm</b>	<b>15-Year Storm</b>	<b>50-Year Storm</b>
<b>Rainfall in 24 hrs (in inches)</b>	6.02"	6.32"	9.61"

The question before the Advisory Committee tonight is: Should Northam allow engineers to continue to design stormwater infrastructure using the State's data, or should they be required to use climate projections that take climate change into account? If they are required to use the projections, should they use the better case or worse case scenario? Everyone understands that requiring engineers to design for more precipitation in the future will mean bigger pipes and more money in construction up front. Those costs would, of course, vary project by project. In theory, spending more money up front will also save money down the road by avoiding flood damage. No one has yet done the calculations for these scenarios, so the Advisory Committee has to make the best decision it can without specific numbers.

Issue 2: Stormwater management—*How much stormwater should developers be required to manage on-site?*

Most new developments create new stormwater flows because they increase the amount of hard surface, such as new buildings, sidewalks, streets, and driveways that cannot soak up water. Northam currently requires all new development plans to calculate the "pre-development" and "post-development" runoff based on their designs, and then to create a plan to detain and manage the difference on-site. In other words, developers must find ways to keep the new stormwater they are responsible for creating out of the city's stormwater collection system. These objectives can be achieved by increasing the amount of landscaping, building detention ponds, installing "green roofs" or roof gardens, and employing many other techniques commonly referred to as "low-impact development."

Tonight the Advisory Committee is debating whether that regulation should be stronger. There are cities in the country that require all new development to do stormwater infrastructure calculations as if the site were starting in its perfectly natural state, but that is not currently the case in Northam. Today, if a developer wants to tear down an old department store with a large parking lot, for example, and build condos and a small park in its place, the volume of runoff the developer would be responsible for is the difference between the existing store and the future condos. If Northam's regulation were strengthened, the developer would have to compare the expected runoff from his or her future development to the ground before it was developed at all.

The rationale behind requiring developers to manage all the stormwater on-site is two-fold. First, when water has time to soak back into the ground, it recharges the groundwater and the underground aquifers, from which Northam gets all of its drinking water. Second, keeping water out of the stormwater system in the first place reduces the risk that the pipes and rivers will become overwhelmed with water and cause flooding. In the past, asking developers to manage only the difference between pre- and post-development stormwater on-site has worked well enough. Tonight, the Advisory Committee has to decide whether expected increases in precipitation due to climate change warrant a more stringent regulation.

Issue 3: Timing: *If there are any changes to the regulations, when should they go into effect?*

Although the Advisory Committee is meeting as part of a longer Master Plan review process, the Planning Board has the authority to approve a change to the subdivision regulations at any time. The next Planning Board meeting is in two weeks, so technically any changes submitted to the Board could be considered almost immediately. Otherwise, the changes are more likely to be considered along with the other CCACs' recommendations in several months, or when the Master Plan is officially updated in one year. Today, the Advisory Committee has to decide when its suggested regulations will go into affect.

## **Summary of the issues the Advisory Committee is considering today**

Issue 1: Precipitation data and projections: *Which climate change projections should engineers be required to use when designing stormwater infrastructure?*

- 1A.** No new requirement. Engineers continue to use the state’s data from 1960 – 2010.
- 1B.** Change the regulation to require all new stormwater infrastructure designs to use Sharpton College’s “better case” scenario climate change projections.
- 1C.** Change the regulation to require all new stormwater infrastructure designs to use Sharpton College’s “worse case” scenario climate change projections.

Issue 2: Stormwater management: *How much stormwater should developers be required to manage on-site?*

- 2A.** No change to the regulation. Developers continue to be responsible *only* for the difference between the amount of stormwater the site currently generates and what it will generate after their project is complete.
- 2B.** Require developers to calculate the total amount of stormwater their design will produce in comparison to the amount of stormwater the site could manage if it were land in its natural state. Require low-impact development to manage the difference on-site.

Issue 3: Timing: *If there are any changes to the regulations, when should they go into effect?*

- 3A.** Immediately, except all development applications that have already been approved
- 3B.** Sometime in the next six months
- 3C.** At the same time the Master Plan update is complete (in one year)

## **Members of the Advisory Committee**

### City Engineer

All subdivision plans have to be reviewed by the City Engineer before they can be approved. He or she also approves all city-led construction projects. The Engineer is highly pragmatic and wants to be sure the city is prepared to implement any changes it approves.

### Planning Director

Northam's Planning Director has been eager to incorporate climate change into the city's planning for a long time, but there has not been enough political will to do so until now. The Planning Director played a strong role in determining which Advisory Committees would meet, and in what order.

### Public Works Director

The Public Works Director oversees all of the city's infrastructure construction and maintenance. He or she has been complaining for years that the city's stormwater system is failing and underfunded. His or her biggest concern about climate change is the potential impact on the aquifer and drinking water.

### Resident

The Resident has lived in Northam for 45 years and has been active in civic affairs most of that time, particularly in the last decade. He or she is a fiscal conservative and skeptical about concerns related to climate change. The Planning Director asked the Resident to participate to represent taxpayers and private citizens in the process.

### Chamber of Commerce President and Developer

The Chamber President is a long-time resident and developer in Northam. He or she is known for being an amiable but unyielding negotiator. Some of Northam's oldest and most respected businesses are members of the Chamber and count on the President to represent their interests.

### Conservation Commission Chair

The Conservation Commission is responsible for developing, protecting, and supporting the natural resources of Northam and for promoting awareness of conservation practices and policies throughout the city. The Conservation Commission Chair was the person who demanded that Northam request the climate change impacts study from Sharpton College, and has been the most vocal supporter of the Planning Department's effort to incorporate climate change into its Master Planning.

### Facilitator

The Planning Board invited a trained, neutral facilitator to help move the discussion along and keep the parties engaged. Everyone has agreed to work with this facilitator.

## APPENDIX A: Northam City Subdivision Regulation

Relevant excerpt:

### *122-35. Stormwater Drainage Appurtenances*

The plans and specifications for the disposing of stormwater and the construction thereof shall be approved by the City Engineer.

#### A) Design.

- a. Proper sizing of culverts, pipes, etc., shall be by acceptable established engineering practice.
- b. Design storm frequency requirements shall be as follows:
  - i. Major streams, rivers, bridges, culverts: fifty (50) year storm or flood of record.
  - ii. Minor brook culverts: fifteen (15) year storm.
  - iii. Storm sewers: ten (10) year storm.
- c. A sample set of the calculations used in sizing the various pipes and a list of the variables used must be submitted to the City Engineer's office.

### *122-36. Stormwater Management, Erosion Control, and Flood Hazards*

A written engineering report describing the impacted watershed area, projected runoff and any projected downstream impacts shall be required upon request. Unless the planning board grants a waiver, the post-development surface water runoff rate(s) shall not exceed the pre-development runoff rate(s). All required drainage improvements and/or facilities shall be sized and constructed as required in Chapter 122-35.

•••••

*This case was prepared with funding from the University of New Hampshire under Cooperative Agreement No. NA09NOS4190153 (CFDA No. 11.419) from the National Oceanic and Atmospheric Administration. The opinions and recommendations in this case are those of the authors and do not necessarily reflect those of the University of New Hampshire or the National Oceanic and Atmospheric Administration.*