

City of North Myrtle Beach South Carolina



Drainage Problems – Hugo

December 2004



Hazel 1954

Hazard Mitigation Plan



Hazel 1954

"A natural disaster resistant community is one that can tolerate – and overcome – damage, diminished productivity, and reduced quality of life from a natural hazard event within a shortened time frame and with less outside public and private assistance."

Dennis S. Mileti

City of North Myrtle Beach, South Carolina

Hazard Mitigation Plan

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City of North Myrtle Beach, South Carolina

Hazard Mitigation Plan

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Chapter 1. Introduction

“Mitigation:” The Department of Homeland Security - FEMA defines mitigation as “sustained action taken to reduce or eliminate long-term risk to people and their property from hazards and their effects.” Mitigation does not mean controlling or stopping natural disasters. It means doing all that can be done to minimize their impacts. There are a variety of mitigation strategies and measures. Some will work while others won’t, depending on the hazard and the resources available to implement the measures.

In sum, mitigation planning is a careful, systematic review of what is possible and what is appropriate for a community. It is the opposite of making quick decisions on dealing with a problem or putting all of a community’s hopes into one single project.

1.1 Why Plan?

Through the application of mitigation policies and practices the City of North Myrtle Beach is working to ensure that fewer citizens and local businesses become victims of disasters that may occur in the area.

This mitigation plan provides guidance and recommendations on how the City can mitigate losses from natural hazards. The *Plan* uses six strategies as a “checklist” to ensure that all possible measures are considered.

Mitigation Strategies

- Preventive Measures
- Property Protection
- Natural Resource Protection
- Structural Projects
- Emergency Management
- Public Information

Determining what mitigation strategies and measures are best for an area is done through a planning process. During this process, the various hazards are inventoried, the full range of possible measures are reviewed, and the most appropriate and affordable ones are recommended for implementation.

Hazard mitigation is an ongoing effort to lessen the impact that disasters have on people and property. In practice, mitigation can take many forms and include many actions, which happen locally.

Planning is the key to making mitigation a proactive process and pre-disaster planning is an essential element in building an effective mitigation program. Mitigation plans emphasize actions taken before a disaster happens to reduce or prevent future damages. Preparing a plan to reduce the impact of a disaster before it occurs can provide a community with a number of benefits:

- *Saves lives and property:* In light of the fact that every community exists in a distinct natural, economic and social environment, hazard mitigation plans must fit within the specific needs of individual communities. A plan must consider the geography, demography, community size, economy, land uses, current community goals, and the hazards that define a community. Mitigation plans are designed to correspond with other community goals in order to provide a plan those best suits the overall needs of the community.
- *Achieves Multiple Objectives:* Mitigation plans can cover numerous hazards. By conducting a concurrent assessment of community vulnerability and capability to deal with various hazards, communities are able to prioritize needs and develop appropriate solutions to current and potential problems. This evaluation provides a comprehensive strategy to contend with the multiple facets of hazard preparation, response and recovery.
- *Saves Money:* The community will experience cost savings by not having to provide emergency services, rescue operations, or recovery measures to areas that are dangerous to people in the event of a hazard. They will also avoid costly repairs or replacement of buildings and infrastructure that would have been preventive mitigation measures not been taken.
- *Facilitates post-disaster funding:* Many disaster assistance agencies and programs, including FEMA, require pre-disaster mitigation plans as a condition for both mitigation funding and for disaster relief funding. Such plans must include a thorough evaluation of potential hazards and community readiness for potential disasters. Programs that require such a plan include the Hazard Mitigation Grant Program (HMGP), which is authorized by Section 404 of the Stafford Act, the Flood Mitigation Assistance Program (FMA) and the Community Rating System (CRS).

The Stafford Act, which authorizes HMGP funding, requires that communities include the following components in their mitigation plan:

44 CFR 206.405

- (a) *General. In order to fulfill the requirement to evaluate natural hazards within the designated area and to take appropriate action to mitigate such hazards, the State shall prepare and implement a hazard mitigation plan or plan update. At a minimum the plan shall contain the following:*
- *An evaluation of the natural hazards in the designated area;*
 - *A description and analysis of the state and local hazard mitigation policies, programs and capabilities to mitigate the hazards in the area;*

- *Hazard mitigation goals and objectives and proposed strategies, programs and actions to reduce or avoid long-term vulnerability to hazards;*
- *A method of implementing, monitoring, evaluating and updating the mitigation plan. Such evaluation is to occur at least a 5-year basis to ensure that implementation occurs as planned, and to ensure that the plan remains current*

1.2 North Myrtle Beach Mitigation Planning Process

Step 1. Organize to Prepare the Plan.

Mitigation Planning Committee Appointed

This *Mitigation Plan* was developed under the guidance of a Mitigation Planning Committee. A resolution was passed on March 15, 2004, by the City Council that formally recognized the planning process and created the Committee. The resolution specified that at least half of the members represent the general public, including floodplain residents (see box).

<p style="text-align: center;">City of North Myrtle Beach <i>Mitigation Planning Committee</i></p>	
<ul style="list-style-type: none"> – Ed Prince, Chair, floodplain resident and Chamber of Commerce Board Member – Clinton Norris, floodplain resident and property manager – DeWayne Bates, floodplain resident, developer, member of the Construction Board of Adjustments and Appeals – Hank Thomas, floodplain resident, Realtor, member of the NMB Planning Commission – Russell Burgess, Real Estate Appraiser and Chamber of Commerce Board Member – Myron Cox, Chief Building Official – Butch Coster, CFM – Tripp Morton, Assistant Zoning Administrator, floodplain resident 	

In the March 15 resolution the Committee was charged to:

- a. Collect data on natural hazards and the vulnerability of buildings and critical facilities.

- b. Assess the impact natural hazards could have on the City's people, property, and economy.
- c. Recommend hazard mitigation goals.
- d. Review potential activities that will accomplish the proposed mitigation goals.
- e. Prepare a mitigation plan that recommends actions the City should take to achieve the recommended mitigation goals. The plan should meet the planning requirements of the Disaster Mitigation Act of 2000 and the National Flood Insurance Program's Community Rating System.
- f. Solicit public input on natural hazard problems and solutions during the preparation of the plan and keep the public informed of your deliberations and recommendations.
- g. Recommend procedures to evaluate the impact of the proposed actions.

Mitigation Planning Consultant

The Planning Committee set the directions and policies for this planning effort. The Building Department provided overall coordination and logistical support for the committee. Other City staff, particularly the Planning and Development Department, the Public Utilities Department and the Public Safety Department provided assistance and information for the plan.

The team of Berry A. Williams & Associates did the legwork of data collection, research, analysis and draft findings. This team also drafted public information materials, handouts, and this *Hazard Mitigation Plan*.

Mitigation Planning Committee Meetings

At its first meeting, the members elected their own chair. Meetings were held on April 1 and 14, May 12 and 26, June 16 and 30, July 7, August 11, and September 8 and 27. Committee members also conducted public meetings on May 12 and June 16 and work sessions with the City Council on September 27 and October 25.

**City of North Myrtle Beach
Mitigation Planning Committee Schedule**

April	1	Organize, Orientation to Planning Process, Public Involvement Options
April	14	Planning Process, Hazard Assessment, Public Survey
May	12	Public Meeting held by the Committee
May	26	Review Public Comments, Hazard Problems Evaluation, Identification of Potential Mitigation Measures including Higher Regulatory Standards
June	16	Public Meeting on Potential Mitigation Measures
June	30	Review Draft Plan – Property Protection, Preventive Measures
July	7	Update on Survey Results and Review Draft Plan – Emergency Services, Structural Projects
August	11	Review Draft Plan – Natural Resource Protection and Action Plan
Sept.	8	Final Overall Plan Review Before Sending Plan to City Council
Sept.	27	City Council Workshop with Mitigation Planning Committee
Oct.	25	City Council Workshop with Mitigation Planning Committee

Step 2. Involve the Public

Public Meetings

Two public meetings were held. The first was held on May 12. The Committee and the consultant walked through the regulatory requirements and the planning process using a power point presentation. Copies of the questionnaire that had been mailed with the water bill were reviewed and comments received from the public. Most comments were related to drainage system maintenance and stormwater management problems.

The second meeting was held on June 16. Again using a power point presentation, the committee and consultant reviewed findings from the

questionnaire mailed to water bill customers, discussed hazard mitigation problems identified during the study, and described mitigation options the committee was considering for recommendation to the City Council.

The public meetings gave all of the participants plenty of opportunities to learn about the floodplain regulations and the mitigation activities being considered by the Planning Committee. They also gave people a forum to state their concerns.

Questionnaire

The public meetings were only one approach to keeping the public informed and obtaining public input into the planning process. To provide a more confidential and statistically based sense of the public's interests, a questionnaire was mailed to water bill customers and distributed at the first public meeting.

Nine hundred eighty-nine (989) questionnaires were returned. As expected, those responding to the survey did not respond to every question. Survey responses are discussed below. Generally speaking, the survey shows a high level of public support for City efforts to reduce the potential for losses from the effects of hurricanes, floods and other natural hazards.

Best Ways to Get Mitigation Information

Responses from 940 people were recorded for this question. The question allowed more than one response and most people used this option. 73 percent indicated that the best way to provide mitigation information is through the mail. This was closely followed by 60 percent who said articles in newspapers and programs on television and radio are also effective methods for providing information on ways to make a home safer from natural disasters.

Best Ways to Get Mitigation Information

1. What is the most effective way for you to receive information about how to make your household and home safer from natural disasters? (Please check all that apply)

562	Newspapers, Television or Radio.	683	Mail
108	Visit from the Building Inspection Department	213	Internet

Comments on Other Information Methods Added By Several Respondents:

Workshops	Public Meetings
Newsletters	Pamphlets
Reports from Neighbors	Email

Community Mitigation Priorities

Ninety-eight (98) percent of the respondents say it is important for the City to plan and take actions that protect private property, critical facilities and utilities. But as seen in question 5, there is some division on how this mission should be implemented.

Community Mitigation Priorities				
2. Natural hazards can have a significant impact on a community, but planning for these events can help lessen the impacts. The following statements will help determine citizen priorities for planning for natural hazards. Please tell us how important each one is to you.				
	<u>Very Important</u>	<u>Somewhat Important</u>	<u>Neutral</u>	<u>Not Very Important</u>
A. Protecting private property:	804	104	10	2
B. Protecting critical facilities (e.g. hospitals, schools, fire stations, etc.):	863	63	11	2
C. Protecting and reducing damage to utilities:	798	120	15	4

Two hundred fifty-five (255) provided written responses when asked to list specific things they thought the City should do to reduce losses from natural hazards. Twenty-one (21) percent of those responding to the question said Improve and maintain the drainage system. Drainage system responses led the list with fifty-three (53) written comments. Bury power, phone and cable lines came in second with forty-one (41) comments representing sixteen(16) percent of those responding.

Thirty-four (34) provided comments about the evacuation plan. Most of these comments addressed evacuation routes and suggested that traffic bottlenecks should be eliminated, better traffic control provided, and security for evacuated areas enhanced. An additional sixteen (16) comments addressed the City's warning system and procedures. Some think evacuation warnings should be issued earlier, especially for tourist. Others would like more advanced notice when flooding is expected for rainfall events not associated with a hurricane. This seemed to be a particular concern of those who live in areas with drainage system problems.

Thirty (30) would like to see the Comprehensive Plan strengthen policies that restrict development in hazard areas through such measures as limiting high rise ocean front development, protecting natural areas such as marsh lands, and providing more open space. In a related item, ten (10) suggested the City establish larger setbacks from the oceanfront shoreline.

Citizen Views of Specific Things North Myrtle Beach Could Do

3. Other things I think the city could do to reduce loss from natural disasters. (The following items were recorded in the comments section by at least five survey respondents.)

- 53 Improve and maintain the drainage system.
- 41 Bury power, phone and cable lines.
- 34 Improve the evacuation plan.
- 30 Strengthen mitigation provisions in the Comprehensive Plan
- 20 Require and enforce stronger building codes.
- 17 Provide public information and education on loss reduction measures.
- 16 Improve the warning system to address rainfall and drainage problems.
- 10 Require larger setbacks from the ocean.
- 10 Maintain trees so they don't block evacuation routes.

Twenty (20) suggested the City require and enforce stronger building codes to deal with floods and high winds. Some suggested that shutters should be required for new buildings.

People might be will to do more to protect their property if they knew what to do. Seventeen (17) comments suggested the City provide mitigation information to property owners. This could be through brochures and newsletters mailed to property owners and renters, workshops and articles in the newspaper.

Things Citizens Have Done to Protect Their Property

Seventy-four (74) percent of the respondents indicated they have taken one or more actions to protect their property from natural hazards. It appears that many of these actions were taken during the construction of their home and were required by the building code or the City's flood damage prevention ordinance. As reported by respondents these measures include, elevating the building and equipment above the base flood elevation, anchoring the structure to the foundation, and installing flood vents in enclosed areas below the base flood elevation. These are all minimum code requirements for new construction.

Property owners have also completed voluntary mitigation measures for buildings constructed before the code requirements were enacted. These measures include removing enclosures below the base flood elevation, elevating buildings and equipment above the base flood elevation, and installing flood vents in enclosed areas below the base flood elevation.

Things Citizens Have Done to Protect Their Property

4. What modifications have you made to your home to make it safer for hurricanes and floods?

- 426 Elevated equipment (water heater, air conditioner, etc.) above the flood level.
- 351 Secured home to foundation,
- 238 Elevated the building,
- 147 Installed flood vents in enclosed area,
- 30 Removed enclosure below my elevated house,
- 245 No action taken.

Additionally, some property owners constructed their homes to higher standards than required by Federal and local regulations. For example, most have had their home elevated higher than required by the regulations.

Thirty (30) indicated they have reduced their potential flood losses by eliminating the enclosure below their elevated flood.

Support For Mitigation Actions The City Might Take

When asked if they would support a regulatory approach to reduce the City's risk from natural hazards twenty-four (24) percent said no, twenty-seven (27) percent said they were not sure and forty-eight (48) percent said yes. When asked about a specific regulation, that would prohibit enclosures below the base flood elevation fifty-eight (58) percent said yes and the percentage opposed to the regulation dropped to sixteen (16) percent.

Survey responses indicate there is less out-right objection to non-regulatory approaches, but a higher percentage of respondents are in the "not sure" category. On-the-other hand sixty-five (65) percent indicated their willingness to use tax dollars to reduce the City's risk and losses from natural disasters. The support for mitigation measures increases to eighty-two (82) percent if the actions are viewed as protecting the local economy.

Support For Mitigation Actions The City Might Take

5. A number of activities can reduce your community's risk from natural hazards. These activities can be both regulatory and non-regulatory. Please check the item that best represents your opinion of the following strategies to reduce the risk and loss associated with natural disasters.

	<u>Strongly Agree</u>	<u>Agree</u>	<u>Neutral</u>	<u>Disagree</u>	<u>Strongly Disagree</u>	<u>Not Sure</u>
A. I support a regulatory approach to reducing risk:	174	244	157	138	71	78
B. I support a non-regulatory approach to reducing risk:	187	245	166	95	29	80
C. I support policies to prohibit enclosures in areas subject to damage from floods:	211	293	156	91	49	72
D. I support the use of local tax dollars to reduce risks and losses from natural disasters:	200	382	139	78	50	50
E. I support steps to safeguard the local economy following a disaster event:	312	425	91	17	14	38

Pay More For A Disaster Resistant Home?

Sixty (60) percent of those responding to this question said they would pay more for a home with disaster resistant features. An additional twenty-two (22) percent said they were not sure. They might if they had more information about the mitigation methods to be used, their cost and the expected benefits. Only eighteen (18) percent said they would not be willing to pay more for a disaster resistant home. Several indicated they were on a fixed income and could not afford to pay more for housing.

Pay More For A Disaster Resistant Home?

6. Would you be willing to spend more money on a new home with features that made it more disaster resistant from hurricanes, floods or other natural hazards?

544 Yes. **161** No. **204** Don't Know.

Seventy-five (75) percent of those participating in the survey said they are willing to undertake tasks to make their home more resistant to natural disasters. In this question and others some respondents indicated that will they are willing to make their homes stronger, but they are not sure what they should do or who to contact.

Willing to Make Home More Disaster Resistant?

7. Would you be willing to make your existing home more resistant to natural disasters?

665 Yes. **178** No. **42** Don't Know

How Much Would You Spend To Add Protection To Your Home?

Most survey respondents are willing to spend money to increase the protection of their home from natural disasters. The majority just don't know what to do or how to evaluate the benefits. Several have indicated this is where the City could be of assistance to property owners.

How Much Would You Spend To Add Protection To Your Home?

8. How much are you willing to spend to better protect your home from natural disasters?

103 \$500 - \$999
114 \$1000 - \$2499
66 \$2500 - \$4999
42 \$5000 or more
475 Don't know.

Incentives

It appears from the following responses that incentives could be a major motivator to encourage mitigation actions by property owners. Property owners with flood insurance policies already receive a flood insurance premium adjustment of up to 15 percent because of the City's participation in the National Flood Insurance Program's Community Rating System. Respondents would like to see the City's flood insurance rating improved and for the area to be eligible for discounts with other insurance programs. Considerable interest was also expressed in tax breaks for completing mitigation measures.

Incentives

9. Which of the following incentives, if any, would motivate you to take additional steps to protect your home from a natural disaster? (Check all that apply.)

808	Insurance discount
220	Low interest rate loan
194	Mortgage discount
748	Tax break or incentive

Step 3. Coordination With Other Agencies

During the planning process, many agencies were contacted for information and to determine how their programs affect or could support the City's activities.

Local agencies

- Horry County Division of Emergency Preparedness
- Chamber of Commerce (non-profit)
- North Myrtle Beach Rescue Squad (non-profit)

State agencies

- Department of Natural Resources, Flood Mitigation Office
- Department of Natural Resources, State Hydrologist
- Office of the Adjutant General, Emergency Preparedness Division
- Department of Health & Environmental Control (DHEC)
- South Carolina Sea Grant
- S. C. University, Hazards Research Lab, Department of Geography

Federal agencies

- U. S. Army Corps of Engineers
- National Weather Service
- Department of Homeland Security - FEMA

Step 4. Assess the Hazards

This step was conducted by gathering data on the natural hazards that might occur in the City. This information was gathered from local, state, and federal agencies and organizations, as well as, from newspaper and other media accounts, and from state and local weather records. Mitigation planning meetings were held during this process to review the information on previous hazards. These meetings also provided a forum for discussing the relative importance of the hazards. This information is included in the Vulnerability Analysis in Chapter 2.

Step 5. Assess the Problems Associated With the Hazards

This step was conducted through a review of a local base map, topography maps, flood-prone areas map, as well as, others. A more detailed analysis was conducted through field surveys, and a review of documents such as the Comprehensive Plan, tax records, the 1991 Floodplain Management Plan, the Beach Management Plan, and the Stormwater Master Plan. Mitigation meetings were held to review areas of vulnerability associated with specific hazards. Attendees provided comments and changes were made to the plan. This information is included in the Vulnerability Analysis in Chapter 2.

Step 6. Set Mitigation Goals

Mitigation goals are included in a number of City plans including the Comprehensive Plan, the 1991 Floodplain Management Plan, the Beach Management Plan, the City Budget and the Stormwater Master Plan. These documents were reviewed along with the hazard problems identified in Chapter 2, Vulnerability Assessment, to identify a comprehensive set of hazard mitigation goals for the City. These goals and their associated objectives are described in Chapter 3.

Step 7. Review Possible Mitigation Activities

This mitigation plan provides guidance and recommendations on how the City can mitigate losses from natural hazards. The *Plan* uses six strategies as a “checklist” to ensure that all possible measures are considered.

Mitigation Strategies

- Preventive Measures
- Property Protection
- Natural Resource Protection
- Structural Projects
- Emergency Management
- Public Information

A series of brainstorming sessions were used to develop mitigation alternatives and formulate policy statements. The committee analyzed a wide range of possible policies, exploring a combination of different types and scales of projects. Some of the ideas involve new initiatives, programs, and activities. Others involve enhancing or continuing efforts that are

already in place and have proven effective in reducing damage losses in previous hazard events. Still other recommendations involve changes to existing policies and practices that were identified during the capability assessment. The mitigation strategies and recommendations are discussed in Chapters 4 – 9.

Step 8. Draft a Mitigation Action Plan

In this step the committee identified mitigation policies and activities to carry out the strategies selected for implementation. Each mitigation action is linked to one or more mitigation goals and objectives. The Action Plan identifies the office or agency responsible for implementation, identifies a target date for completing the action and the source(s) of funding. The Mitigation Action Plan is found in Chapter 10.

While developing the Action Plan the committee considered the following:

- Will the policy or action solve the problem it is intended to solve?
- Does the policy or activity meet at least one community mitigation goal?
- Will the policy or activity achieve other community objectives?
- Does the policy or activity comply with all federal, state and local regulations?
- Will there be a beneficial or neutral impact on the environment?
- Will the benefits outweigh the costs (for example, the cost of the activity is less than the cost of repetitive repairs that would be necessary if the activity was not implemented)?
- Is funding available or potentially available?
- Does sufficient management capability exist to implement and administer the policy?
- In sum, are the proposed policies and mitigation measures cost effective, environmentally sound, and technically feasible?

Step 9. Adopt the Plan

Because official adoption by the local governing body is so critical to the plan's success, this step asks local governments to document the adoption process, and include an adoption or signature page in the plan itself. On November 15 the City Council held a public hearing to offer citizens an additional opportunity to comment on the plan. A record of this meeting is included as Appendix . The plan was adopted according to the community's enabling legislation and established legal procedures with at least a two-week public notice of the public hearing.

The City Council's resolution adopting the Hazard Mitigation Plan is included in Chapter 12.

Step 10. Implement, Evaluate and Revise the Plan

An effective plan is dynamic and evolving. A community must periodically monitor its implementation, evaluate its effectiveness, and report on the progress of the plan. This step involves a series of tasks that help the City set procedures for ongoing monitoring and evaluation after the plan has been written and put in motion. The tasks include establishing benchmarks or indicators to measure progress, assigning responsibility for updating the vulnerability and capability assessments, and preparing an evaluation report (or plan maintenance report).

FEMA requires an annual evaluation report (or plan maintenance report) to be prepared and for appropriate revisions and updates of the plan to be submitted for approval. Note that FEMA also requires that a formal review occur every five years (when the community must submit the updated plan to South Carolina and FEMA for approval).

To ensure these tasks are completed in a timely manner Chapter 12 includes a resolution that maintains the Mitigation Committee and assigns it new responsibilities.

1.3 The Community Rating System

The Community Rating System (CRS) provides a flood insurance premium reduction for all policyholders in communities that implement activities above and beyond the minimum requirements of the National Flood Insurance Program. The CRS provides credits for a variety of community flood protection activities, organized under four general series:

- 300 Public information
- 400 Mapping and regulatory activities
- 500 Flood damage reduction
- 600 Flood preparedness

The objective of the CRS is to reward communities that are doing more than meeting the minimum NFIP requirements to help their citizens prevent or reduce flood losses. The CRS also provides an incentive for communities to initiate new flood protection activities. The goal of the CRS is to encourage, by the use of flood insurance premium adjustments, community and state activities beyond those required by the National Flood Insurance Program to:

- Reduce flood losses, i.e.,
 - protect public health and safety,
 - reduce damage to buildings and contents,
 - prevent increases in flood damage from new construction,

- reduce the risk of erosion damage, and
 - protect natural and beneficial floodplain functions.
- Facilitate accurate insurance rating, and
 - Promote the awareness of flood insurance.

Benefits: It is important to note that reduced flood insurance rates are only one of the rewards a community receives from participating in the CRS. There are several other benefits.

- The CRS flood hazard mitigation activities provide enhanced public safety, a reduction in damage to property and public infrastructure, avoidance of disruption and losses, reduction of human suffering, and protection of the environment.
- A community can evaluate the effectiveness of its flood program against a nationally recognized benchmark.
- Implementing some CRS activities, such as flood hazard mitigation planning, can help a community qualify for certain federal assistance programs.

Plan Credit: This *Hazard Mitigation Plan* is also intended to qualify for CRS credit. It has been prepared in accordance with CRS guidelines. In order to keep the credit, an evaluation report on the City's progress must be submitted to FEMA by October 1 of each year. This requirement acts as additional assurance that this *Hazard Mitigation Plan* will be implemented.

Community Classification Points: There are 10 community classes in the community rating system. Class 1 communities have the largest premium credit; residents of class 10 communities receive no premium credit. Communities that do not apply for CRS classification are class 10 communities.

The insurance premium credit is based on whether a property is in or out of the Special Flood Hazard Area (SFHA), i.e., the A and V Zones as shown on the City's Flood Insurance Rate Map (FIRM). The premium credit for properties in the SFHA increases according to the City's CRS class.

A City's classification is based on the total points (cT) as calculated on activity worksheet AW-720. The qualifying community total points, CRS classes, and flood insurance premium credits are shown below:

CRS CLASSIFICATION POINTS AND INSURANCE DISCOUNTS

Credit Points (cT)	CRS Class	Premium Discount
4,500+	1	45%
4,000–4,499	2	40%
3,500–3,999	3	35%
3,000–3,499	4	30%
2,500–2,999	5	25%
2,000–2,499	6	20%
1,500–1,999	7	15%
1,000–1,499	8	10%
500–999	9	5%
0–499	10	0

The City of North Myrtle Beach has qualified for a Class 7 CRS designation. There are 9,371 flood insurance policies in force in the City. The annual flood insurance premium for City policies is \$2,840,118. Flood insurance policy holders say more than \$426,000 each year due to the City's participation in the National Flood Insurance Program's Community Rating System.

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Chapter 2. Hazard Vulnerability Analysis

2.1 North Myrtle Beach Background Data

Historical Background

The City of North Myrtle Beach was established on May 7, 1968, when a new charter was adopted consolidating Ocean Drive Beach, Crescent Beach, Cherry Grove Beach and Windy Hill Beach. Before U. S. Highway 17 was completed access to the area was limited and the population remained small. Of the four original beach communities consolidated to create North Myrtle Beach only Ocean Drive Beach was incorporated before 1950.¹

Year-round Population

According to the US Census Bureau, the total population as of the 2000 Census was 10,974 residents. The City grew by 27% in population and 36% in housing units between 1990 and 2000. The decrease in density during this period is a result of the 2,300-acre Barefoot Resort annexation in 1999. When completed, it is anticipated that the Barefoot Resort will contain 6,500 housing units, many of which will be permanent residences. This annexation marks the beginning of the City's expansion west of the Intracoastal Waterway.²

Table 2.1 Change in Population and Housing over Time

Year	Population	Housing Units	Area (sq. mi.)	Density (persons/sq. mi.)
1970	1,957	4,348	9.3	210.4
1980	3,960	7,588	9.3	425.8
1990	8,636	13,336	9.3	928.6
2000	10,974	18,091	13.5	812.9

Source: Adapted from *Draft Comprehensive Plan Update*, 2004

Seasonal Population

With the completion of Highway 17 access to the "Grand Strand" brought thousands of tourist and tourism became the economic foundation of the area. According to a recent Coastal Carolina Tourism Study, North Myrtle Beach has over 3.7 million visitors a year. The City has approximately 8,000 overnight rental units with a capacity for 38,000 overnight guest.

Additionally, there are 3,005 properties that are considered second homes. In a survey of these property owners, 1196 indicated they do not rent their property, and use it strictly as a second home.³

Housing Stock

Most of the housing units are either single-family detached or multi-family with 20 or more units per structure. 41% of the occupied housing units were built between 1980 –1989. 31% were built between 1990 and 2000.⁴ Between January 2000 and December 2003, 4,209 dwelling units were constructed. As indicated in the Table below most of these units are in multi-family buildings.⁵

Table 2.2 Residential Construction Trends

Year	1&2 Family	Multi-family	Hotel/Motel	Total
2000	213	837	0	1050
2001	186	798	0	984
2002	268	278	324	870
2003	386	624	295	1305
Total	1053	2537	619	4209

Source: NMB Building Department files.

The Census also includes information on the value of 5,466 occupied year-round homes. Slightly over one-half are owner-occupied. The median value was \$142,600. 61% of the units were mortgaged, with a median monthly mortgage payment of \$962. Renters paid a median monthly rent of \$628, with about one-third of the renters paying more than 30% of their household income in rent.⁶

Development Trends

According to the Draft Comprehensive Plan Update, the year-round population is expected to grow at a 37% growth rate. Projections provided by the Waccamaw Regional Council of Governments range from 13,609 in 2010 to 15,047 in 2015. The seasonal population is expected to grow even faster.⁷

While the market may not continue to support construction of 1,000 units per year, it is likely that the predominant style of units will continue to be mid- to high rise buildings with 3- to 4-bedrooms. Most of this development is expected to be located along the first and second rows of the oceanfront.

2.2 Hazard Vulnerability Analysis Tasks

In this section the past hazard events of North Myrtle Beach are recorded and analyzed. This information is identified by using both primary and secondary research materials which will include but is not limited to reports from local, state, and national agencies, as well as, media accounts, state and local weather

records, and conversations with key personnel and residents in the City of North Myrtle Beach.

This analysis will include the possible severity and magnitude as well as the potential impact of damage within the City from future hazards. To rank the hazards in order of the importance for mitigating their effects, the committee used the hazard index shown in Table 2.3. This method takes into account the anticipated Frequency of Occurrence (see Table 2.4) and the expected Hazard Consequences or Impact (see Table 2.16).

Table 2.3 Hazard Index Ranking

Impact → Frequency of Occurrence ↓	Catastrophic	Critical	Limited	Negligible
Highly Likely	5 (Highest)	4 (High)	4 (High)	3 (Medium)
Likely	5 (Highest)	4 (High)	3 (Medium)	2 (Low)
Possible	4 (High)	3 (Medium)	2 (Low)	2 (Low)
Unlikely	3 (Medium)	2 (Low)	1 (Lowest)	1 (Lowest)
Highly Unlikely	2 (Low)	1 (Lowest)	1 (Lowest)	1 (Lowest)

Hazard Index Scale: 1-5, with 5 indicating the highest priority for considering mitigation measures and 1 indicating the lowest priority. (Highest, High, Medium, Low and Lowest)

This is not meant to be a scientific process, but will serve as a way to prioritize mitigation measures based on the potential frequency and the likely extent of damage from hazards known to affect the community. This ranking will be considered when specific mitigation measures are prioritized for implementation, along with other factors, such as stated community goals, citizen concerns, on-going projects, and opportunities for funding.

The first step in preparing a hazard mitigation plan involves identifying and analyzing the hazards facing the community. To conduct this step, the mitigation Committee examined the:

- *types* of natural hazards that threaten the community
- *characteristics* (associated elements) of each hazard
- *likelihood* of occurrence (probability)
- likely *magnitude* of the potential hazards
- possible *impacts* on the community

2.2.1 Task 1.1: List the Types of Natural Hazards and their Associated Elements.

To complete these tasks the committee utilized a Hazard Identification and Analysis Worksheet (See Table 2-17, page 2-43). In the first column of the Worksheet, the committee listed the natural hazards that could occur in North Myrtle Beach. The list also includes some hazards not likely to occur in the area. These are included on the list because DHS FEMA planning guidance states they should be considered during the planning process. Some hazards are single-force events. Other hazards are made up of multiple elements; for instance, a hurricane can involve the combined threats of wind, storm surge, and flooding.

While some hazards are more likely than others to occur in North Myrtle Beach, the committee's approach at this point in the planning process was to consider *all* the hazards and their associated elements that threaten the City. Remember, just because a particular hazard has not occurred recently does not mean it won't occur in the future. Also, some hazards may be *chronic* (regularly occurring but not causing extensive damage each time). Such repetitive occurrences can lead to a *cumulative* impact over time, such as flooding that occurs as the result of rainfall over a period of time. Other hazards may be less frequent but can have more catastrophic impacts, such as earthquakes and major hurricanes.

2.2.2 Task 1.2 Indicate the Hazards' Intensity.

Any type of hazard can occur with varying severity. Intensity refers to the damage-generating attributes of a hazard. In Column 2 of Worksheet (See Table 2-17, page 2-43), the committee estimated the intensity (or range of intensities) North Myrtle Beach would likely experience for each hazard threat. These estimates are based on local historical evidence and regional data.

These varying levels of potential intensity were estimated using relative terms such as mild, moderate or severe, or the committee referred to standardized scales that describe the different levels of intensity for some types of hazards. These scales include the Saffir-Simpson scale that categorizes hurricanes, the Fujita rating scale for tornadoes, the Modified Mercalli scale that ranks earthquakes, and the Dolan-Davis nor'easter intensity scale. These intensity rating scales are defined in the charts below.

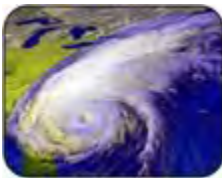
2.2.3 Task 1.3 Indicate the Hazards' Likelihood of Occurrence.

The third column of Worksheet (See Table 2-17, page 2-43) allows the City to estimate the probability that each of the hazards listed in Column 1 will happen. This is not an actual prediction, but based on regional data and local historical evidence. The planning committee indicated whether each hazard is likely or unlikely. The following chart helped the committee determine the likelihood, based on frequency of occurrence:

Table 2.4 Frequency of Occurrence

<i>Likelihood</i>	<i>Frequency of Occurrence</i>
<i>Highly Likely</i>	Probably will occur in the next 5-years
<i>Likely</i>	Probably will occur in the next 10-years
<i>Possible</i>	Probably will occur least once in the next 100-years
<i>Unlikely</i>	Less than 1% probability of occurring in the next 100-years
<i>Highly Unlikely</i>	Little to no probability of occurring in the next 100-years.

2.3.1 Hurricanes and Tropical Storms



South Carolina is one of the most vulnerable states in the nation to be impacted by hurricanes and tropical storms. North Myrtle Beach borders the Atlantic Ocean with over 9 miles of coastline and inland areas that may be directly affected by these storms.⁸ The City is densely populated, especially during the peak tourist seasons. That density coupled with the generally low coastal elevations, significantly increase the City's vulnerability. The greatest threat to life and property associated with a hurricane and tropical storm is storm surge. Other effects include high winds, tornadoes, and inland flooding associated with heavy rainfall that usually accompanies these storms.

What Is A Hurricane?

A hurricane is a category of tropical cyclone characterized by thunderstorms and defined surface wind circulation. Hurricanes develop over warm waters and are

caused by the atmospheric instability created by the collision of warm air with cooler air.

Hurricane winds blow in a large spiral around a calm center called the eye, which can be 20-30 miles wide. When a hurricane nears land, it may bring torrential rains, high winds, storm surges, coastal flooding, inland flooding, and sometimes tornadoes (see “Characteristics of Coastal Storms” below). A single hurricane can last for more than two weeks over water and can extend outward 400 miles. The hurricane season for the Atlantic Coast is June 1 to November 30, with a peak around mid-September.

Characteristics of Coastal Storms:

Storm Surge: The most dangerous and damaging feature of a coastal storm is storm surge. Storm surges are large waves of ocean water that sweep across coastlines where a storm makes landfall. The more intense the storm, the greater the height of the water. The higher the storm surge, the greater the damage to the coastline. Storm surges inundate coastal areas, wash out dunes, cause backwater flooding in rivers and streams, and can flood streets and buildings in coastal communities. Storm surge areas can be mapped by the probability of storm surge occurrences using Sea, Lake, and Overland Surges from Hurricanes modeling (SLOSH) (see discussion of SLOSH below).

The output of the SLOSH-model provides heights of storm surge for various combinations of hurricane strength, forward speed of storm, and direction of storm. Storm strength is modeled by use of the central pressure and storm eye size using the five categories of storm intensity.

Various storm events can cause abnormally high water levels along ocean coasts and interior shorelines. These higher than expected water levels, known as storm surges, are generally the result of a synoptic scale meteorological disturbance. Storm surges can affect a shoreline over distances of more than 100 miles; however, there may be significant spatial variations in the magnitude of the surge due to local bathymetric and topographic features.

Wind is the primary cause of storm surge. Wind blowing over the surface of the water exerts a horizontal force that induces a surface current in the general direction of the wind. The surface current, in turn, forms currents in subsurface water. In the case of a hurricane, the depth affected by this process of current creation depends upon the intensity and forward motion of the storm. For example, a fast-moving hurricane of moderate intensity may only induce currents to a depth of a hundred feet, whereas a slow moving hurricane of the same intensity might induce currents to several hundred feet. As the hurricane approaches the coastline, these horizontal currents are impeded by a sloping continental shelf, thereby causing the water level to rise. The amount of rise

increases shoreward to a maximum level that is often inland from the usual coastline.

Factors Affecting Surge Height

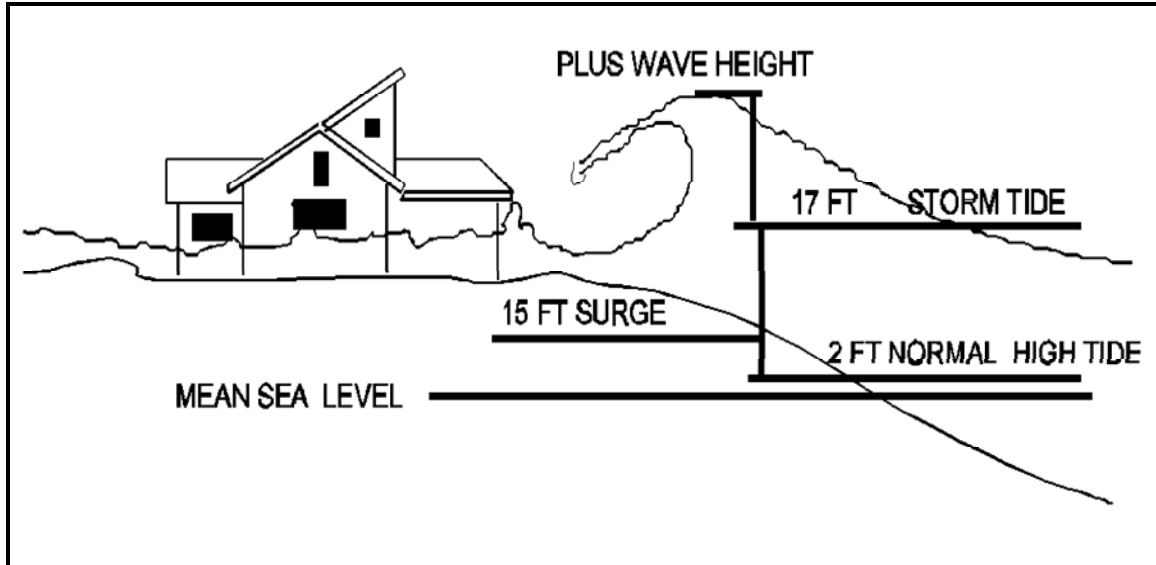
The elevation reached by the storm surge within a coastal basin depends upon the meteorological parameters of the hurricane and the physical characteristics existing within the basin. The meteorological parameters affecting the height of the storm surge include the intensity of the hurricane; measured by the storm-center sea-level pressure, track (path) of the storm, forward speed, and radius of maximum winds.

Due to the complementary effects of forward motion and the counterclockwise rotation of the wind field, highest surges from a hurricane usually occur on the northeast quadrant of the storm's track. This radius of maximum winds, which is measured from the center of the hurricane eye to the location of the highest wind speeds within the storm, can vary from as little as four miles to as much as 50 miles or greater. Peak storm surge may vary drastically within a relatively short distance along the coastline depending on the radius of maximum winds and the point of hurricane eye landfall. The physical characteristics of a basin that influence the surge heights include the basin bathymetry (water depths), roughness of the continental shelf, configuration of the coastline, and natural or man-made barriers. A wide, gentle sloping continental shelf or a large bay may produce particularly large storm surges.

Storm Tide: Other factors that contribute to the total water height are the initial water level within the basin at the time the hurricane strikes and wave effects. If a storm surge occurs at the same time as high tide, the water height will be even greater. Storm tide is the combination of the storm surge and the normal tide. For example, a 15-foot storm surge along with the normal 2-foot high tide creates a storm tide of 17 feet. The timing of the arrival of storm surge is important in that the difference in total flood elevation can be as much as 1 to 2 feet in the study area.

Waves breaking near the shore cause a transport of water shoreward. When there is an increase in wave height water cannot flow back to the sea as rapidly as it came in. This phenomenon, known as "wave setup", increases the water level along the beachfront. Waves will break and dissipate their energy in shallow water. Therefore, a relatively steep offshore beach slope allows large ocean waves to get closer to the shore before breaking and usually promotes larger waves.

Figure 2-1 Flood Elevation Includes Storm Tide and Wave Height



Source: National Oceanic and Atmospheric Administration, Tropical Prediction Center

Due to the presence of barriers such as structures, dunes, or vegetation, the waves break and dissipate a tremendous amount of energy within a few hundred yards of the coastline. Buildings within that zone that are not specifically designed to withstand the forces of wave action are often heavily damaged or destroyed.

Water Force: During hurricanes and other coastal storms, coastal areas will experience flooding with velocity or “wave action,” defined as areas subject to receiving waves on top of the rising water from coastal flooding. The velocity and the force of the water make flooding even more destructive. Water weighs approximately 1,700 pounds per cubic yard; extended pounding by frequent waves can demolish any structure not specifically designed to withstand such forces.

The currents created by the tide combine with the action of the waves to severely erode beaches and coastal highways. Many buildings withstand hurricane force winds until their foundations, undermined by erosion, are weakened and fail.

The velocity and wave action knock over buildings, move debris, erode dunes, scour the shoreline, and displace and redeposit sand. Areas subject to coastal flooding with velocity are designated as V or VE zones on FIRMs. Buildings in the coastal AE-Zone experience many of the same problems.

Wind Velocity: The higher the wind speed, the greater the damage. Hurricane force winds can travel hundreds of miles inland, creating substantial damage to buildings, vegetation, and infrastructure.

High winds are capable of imposing large lateral (horizontal) and uplift (vertical) forces on buildings. Residential buildings can suffer extensive wind damage when they are improperly designed and constructed and when wind speeds exceed design levels. The effects of high winds on a building will depend on several factors:

- wind speed (sustained and gusts) and duration of high winds
- height of building above ground
- exposure or shielding of the building (by topography, vegetation, or other buildings) relative to wind direction
- strength of the structural frame, connections, and envelope (walls and roof)
- shape of building and building components
- number, size, location, and strength of openings (e.g., windows, doors, vents)
- presence and strength of shutters or opening protection
- type, quantity, and velocity of windborne debris

Proper design and construction of residential structures, particularly those close to open water or near the coast, demand that every factor mentioned above be investigated and addressed carefully. Failure to do so may ultimately result in building damage or destruction by wind.

High Risk Factors:

The following conditions may exacerbate the effects of coastal storms:

Coastal shape: Concave shoreline sections sustain more damage because the water is driven into a confined area by the advancing storm, thus increasing storm surge height and storm surge flooding.

Storm center velocity: The slower the storm moves, the greater the damage. The worst possible situation is a storm that stalls along a coast, through several high tides.

Nature of coast: Damage is most severe on low-lying barrier island shorelines because they are easily overwashed by storm waves and storm surge.

Previous storm damage: A coast weakened by even a previous minor storm may be subject to proportionately greater damage in a subsequent storm.

Human activity: With increased development, property damage increases, multiplying the amount of floating debris available to damage or destroy other structures.

Hardened sand and flood control structures: Structures such as groins, jetties, or seawalls exacerbate localized scour and erosion and can be undermined, resulting in collapse (particularly seawalls).

Measurement:

Hurricane intensity is measured using the Saffir-Simpson Scale, ranging from 1 (minimal) to 5 (catastrophic). The scale categorizes hurricane intensity linearly based upon maximum sustained winds, minimum barometric pressure and storm surge potential, which are combined to estimate the potential flooding and damage to property given a hurricane's estimated intensity (see Saffir-Simpson Scale and Damage tables below).

Table 2.5 Saffir-Simpson Hurricane Scale

Saffir-Simpson Category	Maximum Sustained Wind Speed			Minimum Surface Pressure Millibars (mb)	Storm Surge	
	mph	meters/ sec	knots		feet	meters
1	74-96	33-42	64-83	Greater than 980	3-5	1.0-1.7
2	97-111	43-49	84-96	979-965	6-8	1.8-2.6
3	112-131	50-58	97-113	964-945	9-12	2.7-3.8
4	132-155	59-69	114-135	944-920	13-18	3.9-5.6
5	156+	70+	136+	Less than 920	19+	5.7+

Source: National Oceanic and Atmospheric Administration, Tropical Prediction Center

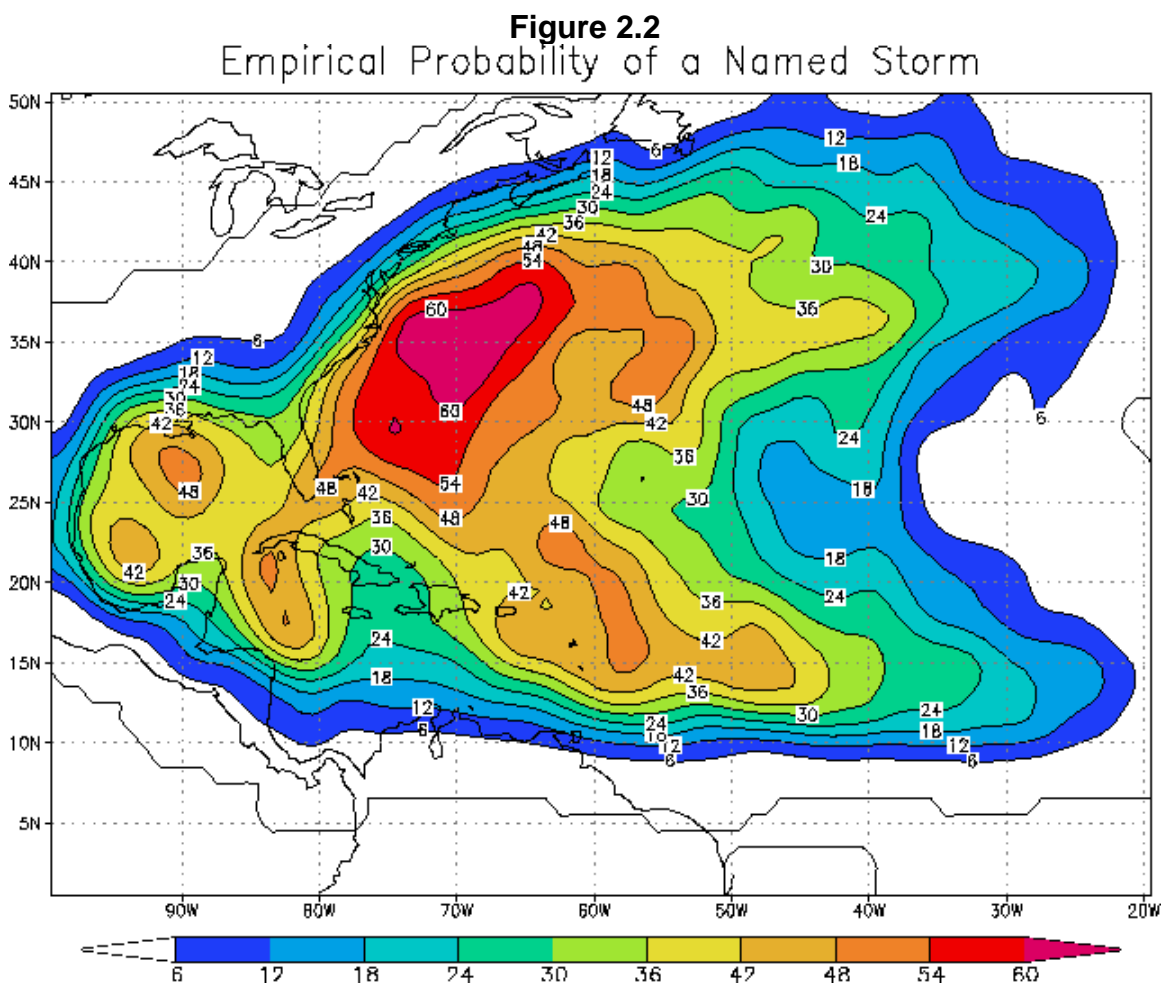
Table 2.6 Hurricane Damage By Category of Storm

Category	Level	Description	Example
1	Minimal	Damage primarily to shrubbery, trees, foliage, and unanchored homes. No real damage to other structures. Some damage to poorly constructed signs. Low-lying coastal roads inundated, minor pier damage, some small craft in exposed anchorage torn from moorings.	Hurricane Jerry (1989)
2	Moderate	Considerable damage to shrubbery and tree foliage; some trees blown down. Major damage to exposed mobile homes. Extensive damage to poorly constructed signs. Some damage to roofing materials of buildings; some window and door damage. No major damage to buildings. Coast roads and low-lying escape routes inland cut by rising water 2 to 4 hours before arrival of hurricane center. Considerable damage to piers. Marinas flooded. Small craft in unprotected anchorages torn from moorings. Evacuation of some shoreline residences and low-lying areas required.	Hurricane Bob (1991)
3	Extensive	Foliage torn from trees; large trees blown down. Practically all poorly constructed signs blown down. Some damage to roofing materials of buildings; some wind and door damage. Some structural damage to small buildings. Mobile homes destroyed. Serious flooding at coast and many smaller structures near coast destroyed; larger structures near coast damaged by battering waves and floating debris. Low-lying escape routes inland cut by rising water 3 to 5 hours before hurricane center arrives. Flat terrain 5 feet or less above sea level flooded inland 8 miles or more. Evacuation of low-lying residences within several blocks of shoreline possibly required.	Hurricane Gloria (1985) Hurricane Fran (1996)
4	Extreme	Shrubs and trees blown down; all signs down. Extensive damage to roofing materials, windows and doors. Complete failures of roofs on many small residences. Complete destruction of mobile homes. Flat terrain 10 feet or less above sea level flooded inland as far as 6 miles. Major damage to lower floors of structures near shore due to flooding and battering by waves and floating debris. Low-lying escape routes inland cut by rising water 3 to 5 hours before hurricane center arrives. Major erosion of beaches. Massive evacuation of all residences within 500 yards of shore possibly required, and of single-story residences within 2 miles of shore.	Hurricane Andrew (1992)
5	Catastrophic	Shrubs and trees blown down; considerable damage to roofs of buildings; all signs down. Very severe and extensive damage to windows and doors. Complete failure of roofs on many residences and industrial buildings. Extensive shattering of glass in windows and doors. Some complete building failures. Small buildings overturned or blown away. Complete destruction of mobile homes. Major damage to lower floors of all structures less than 15 feet above sea level within 500 yards of shore. Low-lying escape routes inland cut by rising water 3 to 5 hours before hurricane center arrives. Massive evacuation of residential areas on low ground within 5 to 10 miles of shore possibly required.	Hurricane Camille (1969)

Source: National Oceanic and Atmospheric Administration, Tropical Prediction Center

Figure 2.2 shows for any particular location what the chance is that a tropical storm or hurricane will affect the area sometime during the whole June to November hurricane season. The figure was created by Todd Kimberlain of the National Oceanic and Atmospheric Administration's Hurricane Research Division. In creating the graphic, he utilized the years 1944 to 1999 in the analysis and counted hits when a storm or hurricane was within about 100 miles(165 km) of each location.

The figure shows that North Myrtle Beach faces a **36-42% annual chance** that a tropical storm or hurricane will affect the area.



Source: National Oceanic and Atmospheric Administration, Hurricane Research Division

Table 2.7 Hurricane Tracks within 75 Miles of North Myrtle Beach 1950 - 1999

YEAR	MONTH	DAY	STORM ID	STORM NAME	WIND SPEED (KTS)	PRESSURE (MB)	WIND SPEED (MPH)	CATEGORY
1954	10	15	776	HAZEL	110	937	125	H3
1955	8	17	781	DIANE	75	0	85	H1
1958	9	27	814	HELENE	110	934	125	H3
1958	9	27	814	HELENE	115	938	135	H4
1984	9	11	1055	DIANA	100	960	115	H3
1984	9	11	1055	DIANA	110	952	125	H3
1984	9	13	1055	DIANA	85	972	100	H2
1984	9	13	1055	DIANA	80	978	90	H1
1984	9	13	1055	DIANA	65	990	75	H1
1996	7	12	1175	BERTHA	85	975	100	H2
1996	7	12	1175	BERTHA	90	974	105	H2
1996	9	5	1179	FRAN	100	952	115	H3
1996	9	6	1179	FRAN	100	954	115	H3
1998	8	26	1196	BONNIE	100	962	115	H3
1999	9	16	1214	FLOYD	90	950	105	H2
1999	9	16	1214	FLOYD	90	956	105	H2

Source: National Oceanic and Atmospheric Administration

October 1954: (Category 4) Hurricane Hazel – made landfall in the vicinity of the North Carolina/South Carolina line. Near Little River, S.C., wind speeds were reported at 106- mph and tides up to 16.9 feet. In South Carolina one person was killed and damage was estimated at \$27 million.

August 1955: (Category 1) Hurricane Diane – passed off the coast of North Myrtle Beach before moving into North Carolina. Fortunately there was no storm surge associated with this storm but it did cause tides to come in higher than normal. Damages in South Carolina were reported by the National Weather Service to be about \$100,000.

September 1958: (Category 3) Hurricane Helene – Approached North Myrtle Beach but curved Northeast and only caused minor damages from the fringe effects of the storm.

September 1984: (Category 2) Hurricane Diana – hit the North Carolina Coast twice near Wilmington with winds in excess of 110 mph and dropping more than 11 inches of rain. Heavy rains and high winds were felt in South Carolina but few damages were reported.

July 1996: (Category 2) Hurricane Bertha – ht the North Carolina coast between Wrightsville Beach and Topsail Island. Came close to the coastal counties of S.C., but did not cause any significant damage. The maximum sustained winds (36 kts) and peak gusts (50 kts) both occurred at the Charleston City office. Bertha's most significant impact was on tourism.

September 1996: (Category 3) Hurricane Fran – hit the North Carolina coast near Bald Head Island. Because North Myrtle Beach was on the weaker side of the storm the damage was not severe. The storm surge caused minor beach erosion.

August 1998: (Category 2) Hurricane Bonnie – made landfall near Bald Head Island. The Center came within 70 miles of the Horry County coast. As the storm tracked northward during the afternoon and early evening, highest wind reports were from the NNW, ranging as high 82 mph at the Cherry Grove pier, while at the Myrtle Beach Pavilion the highest gust was 76 mph. Rainfall ranged from 2 to 4 inches. Ocean levels rose 2 to 3 feet above normal with no overwash. Rainfall of about 7 inches caused extensive ponding of water.

September 1999: (Category 4 in Bahamas, Category 2 when made landfall in North Carolina) Hurricane Floyd – The center moved northeast about 60 miles off the coast of Georgetown, S.C., where wind gusts were recorded at 50 to 60 mph. Rainfall was heavy along coastal counties, a foot fell in Georgetown County; 18 inches fell in eastern Horry County. The heavy rains caused flooding to many roads, and buildings. Waves were reported to be 15 feet at Cherry Grove Pier where damage was the largest.

September 1989: (Category 4) Hurricane Hugo –made landfall as a Category 4 Hurricane near Sullivan's Island and immediately was downgraded to Category 3. It continued on a northwest track at 25-30 mph and maintained hurricane force winds as far inland as Sumter. Hugo exited the State southwest of Charlotte, N.C., before sunrise on September 22. The hurricane caused 13 directly related deaths and 22 indirectly related deaths, and it injured several hundred people in South Carolina. Damage in the State was estimated to exceed \$7 billion, including \$2 billion in crop damage. Though Hugo came ashore more than 75 miles from North Myrtle Beach; it still had a profound impact on the beach. The storm produced a 10-foot storm surge that caused major damage to hundreds of first and second row, oceanfront homes.

While no hurricane has ever made a direct hit on North Myrtle Beach, hurricanes have the potential to cause catastrophic damages to both public facilities and private property. For this reason hurricanes have been given an Index Ranking of 5 on the Hazard Identification and Analysis Worksheet (see Table 2.17).

2.3.2 Floods

What Is A Flood?

A flood is a natural event for rivers, streams and coastal areas. Excess water from rainfall, or storm surge accumulates and overflows onto the banks and adjacent floodplains. Floodplains are lowlands, adjacent to rivers, lakes and

oceans that are subject to recurring floods. Flooding is the most common hazard in South Carolina, and thousands of households are located within floodplains.

Floods can occur at any time of the year, and at any time of day or night. Most injuries and deaths occur when people are swept away by flood currents, often when attempting to traverse floodwaters in a vehicle.

Coastal flooding is typically a result of storm surge, wind-driven waves, and heavy rainfall. These conditions are produced by hurricanes during the summer and fall, and nor'easters and other large coastal storms during the winter and spring. Storm surges may overrun barrier islands and push seawater up coastal rivers and inlets, blocking the downstream flow of inland runoff. The surge associated with tropical storms and hurricanes propagates the Intracoastal Waterway and causes overbank flooding in North Myrtle Beach.

Urban flooding occurs where there has been development within stream floodplains. Urbanization increases the magnitude and frequency of floods by increasing impermeable surfaces, increasing the speed of drainage collection, reducing the carrying capacity of the land, and occasionally, overwhelming sanitary sewer systems.

High Risk Factors:

The following conditions may exacerbate the effects of floods: impermeable surfaces, steeply sloped watersheds, constrictions, obstructions, debris, contamination, soil saturation, and velocity.

Impermeable surfaces: Excessive amounts of paved areas or other surfaces upstream or in the community can increase the amount and rate of water runoff. Development affects the runoff of stormwater when buildings and parking lots replace the natural vegetation, which normally would absorb water. When rain falls in an undeveloped area, as much as 90 percent of it will infiltrate the ground; in a highly developed area, as much as 90 percent of rainfall will run off.

Constrictions: Re-grading or filling within or on the edge of floodplains obstructs flood flows, backing up floodwaters onto upstream and adjacent properties. It also reduces the floodplain's ability to store excess water, sending more water downstream and causing floods to rise to higher levels. This also increases floodwater's velocity downstream of the constriction.

Obstructions: Bridges, culverts and other obstructions can block flood flow and trap debris, causing increased flooding upstream and increased velocity downstream.

Debris: Debris from the watershed, such as trees, rocks, and parts of damaged buildings, increases the hazard posed by moving water. Moving water will float,

drag or roll objects, which then act as battering rams that can knock holes in walls and further exacerbate the effects of debris.

Contamination: Few floods have clear floodwater, and the water will pick up whatever was on the ground within the floodplain, such as soil, road oil, farm and lawn chemicals, and animal waste. In addition, if a wastewater treatment plant was inundated, the floodwaters will likely include untreated sewage. Contamination is also caused by the presence of hazardous material storage in the floodplain and in the community, as well as upstream from the community.

Velocity: Flood velocity is the speed of moving water, measured in feet per second. Velocity is determined by slope, waves, and several other factors. The damage potential of flood waters increases dramatically, sometimes exponentially, with velocity. High velocities (greater than 5 feet per second) can erode stream banks, lift buildings off their foundations, and scour away soils around bridge supports and buildings. Water velocity is a major cause of damage in the following areas:

- Areas subject to coastal wave action (velocity zones)
- Coastal inlets and overwash areas

Flood Frequency - 100-Year Flood

Floodplain managers use the term “100-year flood” to describe a flood that has a one-percent chance of occurring in any given year. Many people find it helpful to think of the 100-year flood risk as a bag of 100 marbles: 99 clear marbles and one black marble. Depending on weather conditions, a community may draw one or more marbles, or floods, from the bag. Most of these—the clear marbles—will be minor floods. It is possible, however, to draw the black marble, representing the 100-year flood, at any time. Because the marbles must be returned to the bag after they are drawn, it is even possible to draw the black marble several times in a row. Just because a community has suffered a 100-year flood *does not* mean that it won’t face a flood of similar magnitude for another 99 years.

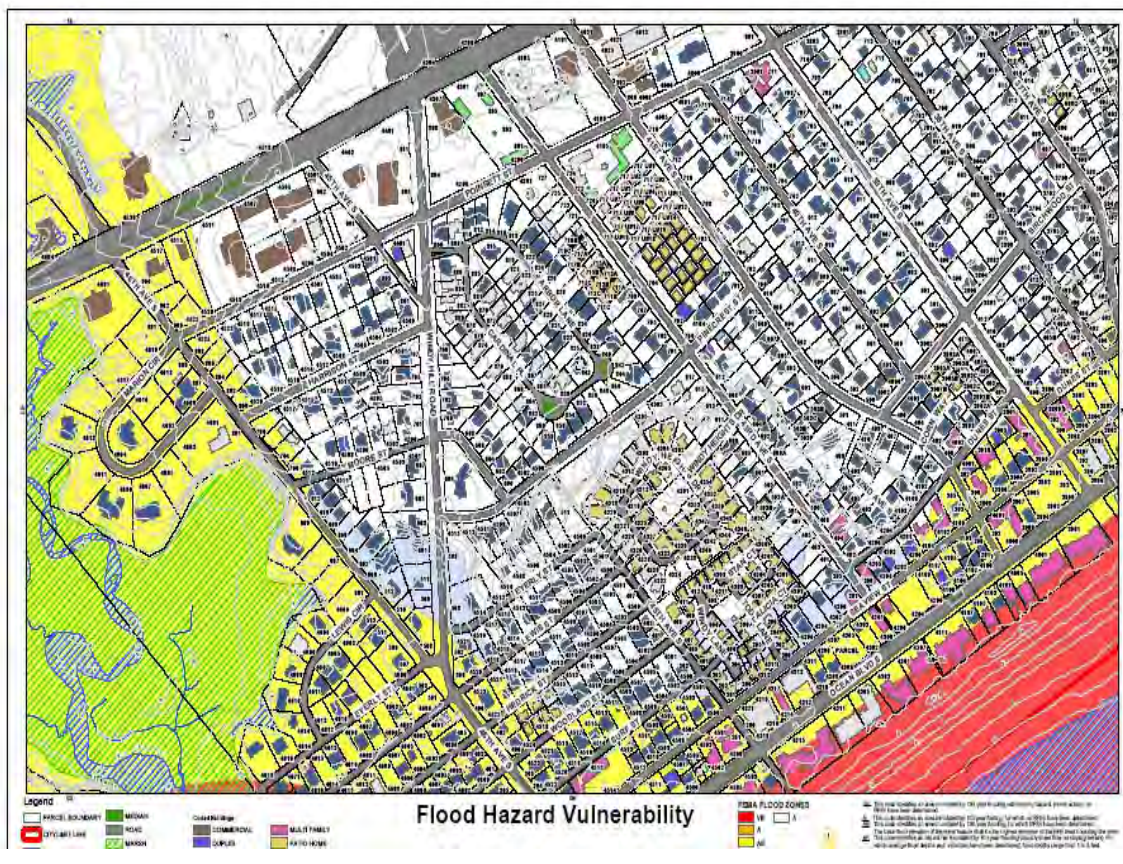
The location of the 100-year floodplain is often indicated on maps, such as the National Flood Insurance Program’s Flood Insurance Rate Maps (FIRMs). In practice, the location of the 100-year flood should be judged in part by community experience as well. Where the water goes in a flood depends on many changing variables, including land use, that may not be accurately reflected by a map in every instance.

Floods have the potential to cause major damages to both public facilities and private property. In fact, the City has more than 240 repetitive loss flood prone properties.⁹ For these reasons floods have been given an Index Ranking of 5 on the Hazard Identification and Analysis Worksheet (see Table 2.17).

North Myrtle Beach has included its flood hazard zones as overlays in its Geographic Information System (GIS). Since the GIS also includes buildings identified by land use, zoning districts and tax information the City is able to analyze its flood hazards by land use category and tax value. There are 71 map sheets in the GIS system with flood hazards zones and buildings by land use category. Figure 2.3 below is an example of these maps. The maps can be viewed at the Building Department during regular business hours.

Approximately 20% of the buildings in North Myrtle Beach are located in a special hazard area designated by FEMA. Most are located near the oceanfront and are subject to the impacts of waves during hurricanes. These flood prone properties are valued at over \$396 million. Their loss during a major storm would represent a significant loss to the City's tax base.¹⁰

Figure 2.3 GIS Map With Flood Hazards and Land Use



Source: NMB Planning and Community Development Department

Data showing the number of structures by flood hazard zone and type of land use are shown in Table 2.8. The value of these buildings by flood hazard zone and land use category is shown in Table 2.9.

Table 2.8 Number of Buildings by Flood Hazard Area

<u>Buildings by Type</u>	<u>V-Zone</u>	<u>AE-Zone</u>	<u>X-Zone (500-year)</u>	<u>City Total</u>
Amusement	0	5	0	5
Commercial	0	171	14	185
Common Open Space	0	4	0	4
Duplex	8	152	8	168
Golf Course	0	1	0	1
Hotel/Motel	6	33	0	39
Mobile Home	0	105	165	270
Multi-Family	28	262	14	304
Patio Home	27	76	39	142
Private Parking Lot	0	3	0	3
Public, Social, Cultural	0	10	0	10
RV/Campground	4	188	0	192
Single Family	74	1911	72	2057
Townhouse	0	7	0	7
No land-use assigned	17	637	95	749
TOTALS	164	3565	407	4136

Source: NMB Planning and Community Development Department

Table 2.9 Value of Buildings (Cost Improvements) by Flood Hazard Area

Buildings by Type	V-Zone	AE-Zone	X-Zone (500-year)	City Total
Amusement	0	946,900	0	946,900
Commercial	719,500	32,221,800	1,100,700	34,042,000
Common Open Space	0	4,095,600	872,000	4,967,600
Duplex	1,783,100	11,689,100	265,800	13,738,000
Golf Course	0	8,062,700	3,281,300	11,344,000
Hotel/Motel	18,865,200	24,322,400	0	43,187,600
Mobile Home	0	1,971,900	2,450,400	4,422,300
Multi-Family	9,702,700	21,028,900	1,346,600	32,078,200
Patio Home	4,173,300	8,784,800	3,850,500	16,808,600
Private Parking Lot	599,800	1,662,100	0	2,261,900
Public, Social, Cultural	0	63,200	339,100	402,300
RV/Campground	0	103,600	0	103,600
Single Family	17,343,200	96,571,750	8,785,100	122,700,050
Townhouse	0	1,204,600	47,500	1,252,100
No land-use Assigned and vacant	7,284,300	97,396,900	3,153,000	107,834,200
TOTALS	\$60,471,100	\$310,126,250	\$25,492,000	\$396,089,350

Source: NMB Planning and Community Development Department

As illustrated by Table 2.10 the City still has a significant amount of land east of the waterway that is vacant.

Table 2.10 Acreage of Vacant Land by Flood Hazard Area

Zoning District	V-Zone	AE-Zone	X-Zone (500-year)	City Total
CP	0.542742	39.81766	0	40.3604
R-1	0	92.8626	1.768342	94.63094
R-1A	0	0	0	0
R-2	3.674349	34.48486	0.27559	38.4348
R-2A	0	16.16767	0.699174	16.86684
R-3	0	1.040013	0	1.040013
R-4	2.643272	16.84389	0.984365	20.47153
NC	0	0	0	0
OC	0	0	0	0
BC	0	1.720464	0	1.720464
HC	0	13.22385	14.43371	27.65756
RC	0	0	0	0
LI	0	0	0	0
PUD	0	13.36045	4.36501	17.72546
W-1	1.447498	0	0	1.447498
No Zoning or Multiple Zoning Assigned	11.89072	425.9327	83.11885	520.9423
TOTALS	20.19858	655.4541	105.645	781.2978

Source: NMB Planning and Community Development Department

2.3.3 Nor'Easter

What is a Nor'Easter?

Nor'Easters are extra-tropical events that produce gale-force winds and precipitation in the form of heavy rain or snow. They can cause increases in tidal elevations (storm surge), wind speed, and erosion. These cyclonic storms, called Nor'Easters because of the direction of the storm winds, can last for several days and can be very large –1,000-mile wide storms are not uncommon.

Causes of Nor'Easters:

The presence of the Gulf Stream off the eastern seaboard in the winter season acts to dramatically enhance the surface horizontal temperature gradients within the coastal zone. During winter offshore cold periods, these horizontal

temperature gradients can result in rapid and intense destabilization of the atmosphere directly above and shoreward of the Gulf Stream. This air mass modification or conditioning period often precedes wintertime coastal extra-tropical cyclone development.

Table 2.11
The Dolan-Davis Nor'Easter Intensity Scale

Storm Class	Beach Erosion	Dune Erosion	Overwash	Property Damage
1 (Weak)	Minor changes	None	No	No
2 (Moderate)	Modest; mostly to lower beach	Minor	No	Modest
3 (Significant)	Erosion extends across beach	Can be significant	No	Loss of many structures at local level
4 (Severe)	Severe beach erosion and recession	Severe dune erosion or destruction	On low beaches	Loss of structures at community-scale
5 (Extreme)	Extreme beach erosion	Dunes destroyed over extensive areas	Massive in sheets and channels	Extensive at regional-scale; millions of dollars

Source: DHS - FEMA

It is the temperature structure of the continental air mass and the position of the temperature gradient along the Gulf Stream that drives this cyclone development. As a low pressure deepens, winds and waves can uninhibitedly increase and cause serious damage to coastal areas as the storm generally moves to the northeast.

Nor'Easters in South Carolina:

The coastal counties of South Carolina are most vulnerable to the impacts of Nor'Easters. Since the storms often occur at night, and typically make landfall with less warning than hurricanes (due to their rapid formation right along the coast), residents may be caught at home unprepared. On the other hand, Nor'Easters typically occur during the off-season when fewer non-residents are visiting the coast. As with hurricanes, vulnerability is proportional to structural strength, with mobile homes particularly vulnerable.

March 1962: (Category 5) The Ash Wednesday Storm of 1962” lasted more than 60 hours. The winds and raging surf caused the most damage for Horry County Beaches. According to the Army Corps of Engineers, the storm caused more erosion damage to oceanfront property than many hurricanes that preceded it. Along the Mid-Atlantic States more than 1,800 houses were completely destroyed causing an estimated \$234M in property damage.¹¹

Nor'Easters have the potential to cause severe erosion damage to the beach which can result in major damages to both public facilities and private property. Since these areas directly affected by Nor'Easters is limited, Nor'Easters have been given an Index Ranking of 4 on the Hazard Identification and Analysis Worksheet (see Table 2.17).

2.3.4 Coastal Erosion

Coastal erosion is the wearing away of coastal land. It is commonly used to describe the horizontal retreat of the shoreline along the ocean. Erosion is considered a function of larger processes of shoreline change, which includes erosion and accretion. Erosion results when more sediment is lost along a particular shoreline than is redeposited by the water body. Accretion results when more sediment is deposited along a particular shoreline than is lost. When these two processes are balanced, the shoreline is said to be stable.

In assessing the erosion hazard, it is important to realize that there is a temporal, or time aspect associated with the average rate at which a shoreline is either eroding or accreting. Over a long-term period (years), a shoreline is considered either eroding, accreting, or stable. When evaluating coastal erosion the focus is generally on the long-term erosion situation. However, in the short-term, it is important to understand that storms can erode a shoreline that is, over the long-term, classified as accreting.

Erosion is measured as a rate, with respect to either a linear retreat (i.e., feet of shoreline recession per year) or volumetric loss (i.e., cubic yards of eroded sediment per linear foot of shoreline frontage per year). Erosion rates are not uniform, and vary over time at any single location. Annual variations are the result of seasonal changes in wave action and water levels.

South Carolina Beach Management Planning Requirements

The City of North Myrtle Beach, South Carolina Beach Management Plan (June 1992) was prepared pursuant to South Carolina Code of Laws, Section 48-39-350, of the South Carolina Coastal Zone Management Act, as amended July 1, 1990.

The Beach Management Act required each coastal beachfront county and city to prepare a Local Comprehensive Beach-front Management Plan based on guidelines provided by the South Carolina Coastal Council (SCCC).

North Myrtle Beach's Experience

The City's shoreline development consists of a combination of single-family houses, condominiums, apartments, small motels, and large high-rise hotels along with the commercial establishments necessary to support a growing tourist trade. Few vacant lots remain along the shorefront and redevelopment has increased the density of dwelling units and hotels along the beach.

With limited land between Ocean Boulevard and the beach plus increased demand for beachfront living, high-density development has been moving closer to the shoreline, displacing much of the natural dune system. This development and periods of shoreline erosion led to the use of a variety of protection measures. The 1992 beach management study found as much as 25 percent of the oceanfront was armored with seawalls, bulkheads, or rock revetments.¹²

As these hard structures were built, the available high-tide beach diminished in some sections. Parts of Cherry Grove, for example, have virtually no "dry sand" beach during high tide. Vertical structures and, to a lesser extent, sloping rock revetments have tended to accelerate erosion of the high-tide beach and have slowed its recovery after storms.¹³

With only a small inlet to the northeast (Hog Inlet) and a swash south of Windy Hill, the shoreline forms a broad arc which is in general equilibrium with the principal wave approaches. A 1997 Sea Grant erosion inventory classified North Myrtle Beach as generally stable. A later 1986 study, *North Myrtle Beach Shorefront Management Plan* (SMP), provided a detailed accounting of linear shore movement and volumetric sand losses since the 1950's. The SMP estimated erosion rates at a low 0.4 feet per year over the 40-year period and volumetric losses along the recreational profile at around 0.2 cubic yards per foot per year between 1955-1985.¹⁴

Short-term erosion rates can greatly exceed the long-term erosion rates. This was illustrated just one year after completion of the SMP. Two northeasters occurred (December 2, 1986 and January 1, 1987). The latter storm took about 40 feet of dune throughout the Grand Strand and caused over \$2.5 million in property damage in North Myrtle Beach. Much of this damage involved seawalls and pools which collapsed from undermining and scour as storm waves penetrated further inland. Remedial action along the beach after the storms was largely confined to beach scraping and rebuilding seawalls.¹⁵

Beach surveys by the South Carolina Coastal Council estimated the erosion loss from the 1987 winter storms at -11.2 cy/ft in North Myrtle Beach. By April 1987,

7.0 cy/ft had been recovered, for a short-term loss averaging -4.2 cy/ft. The report stated the *Cherry Grove area continues to be critically short of sand...and the sections of North Myrtle Beach with armored shorelines continue to have a lower sand volume than natural sections as seawalls exacerbate the erosion problem.*¹⁶

In 1988 North Myrtle Beach adopted baselines and setback lines based on the 1986 SMP. Later, South Carolina's Beach Management Act (BMA) was adopted in 1990. This Act prescribes a methodology for establishing baselines and setback lines for the purpose of enforcing state law. In 1991 the South Carolina Coastal Council adopted a baseline for North Myrtle Beach.¹⁷

Hurricane Hugo and Beach Erosion

Hugo caused extensive damage and beach erosion along the North Myrtle Beach shoreline. Upwards of 75 feet of erosion occurred primarily in the recreational zone of the beach. However, with a volumetric loss in excess of 1.1 million cubic yards, much of the beach was left with little protection from a second storm.¹⁸

Responding to the city's request for assistance, the Federal Emergency Management Agency (FEMA) designated 7,200 ft of shoreline for emergency protection. Under the Public Assistance Grant, construction of dunes at an elevation of +9 ft NGVD was approved. This height corresponds to the five-year return period water level. The state approved a similar emergency measure for the remaining sections of the beach.¹⁹

The purpose of the emergency dune was to protect remaining structures from further damage. Emergency dunes were constructed by earthmovers and bulldozers moving sand from the intertidal beach to locations closer to ocean front buildings. The emergency work was completed by mid-October 1989. Some of the sand deposited offshore during the storm is gradually returned to the shore. By December 1989, about 225,000 cubic yards of sand had returned to the beach by this natural process.²⁰

This still left the beach with a large sand deficit that needed remediation before the next tourist season. An emergency nourishment plan was approved for the placement of 372,000 cubic yards of sand along 30,000 feet of the most critically eroded sections of the beach. The combination of emergency nourishment and natural recovery replaced almost 90 percent of the sand lost during Hugo. Emergency nourishment contributed about 40 percent of the restoration and natural recovery the remainder. Post-project surveys indicated that by October 1990 North Myrtle Beach had regained all but 124,000 cubic yards of sand.²¹

Severe erosion can be caused by hurricanes and Nor'Easters. These coastal storms have been ranked as 5 and 4 respectively on the community's hazard

index. Since severe erosion damage to the beach can result in major damages to both public facilities and private property, coastal erosion has been given an Index Ranking of 4 on the Hazard Identification and Analysis Worksheet (see Table 2.17).

2.3.5 Severe Thunderstorm/Lightening

What Is A Thunderstorm?

Thunderstorms are the result of convection in the atmosphere. They are typically the by-product of atmospheric instability, which promotes the vigorous rising of air parcels that form cumulus and, eventually, the cumulonimbus (thunderstorm) cloud. Instability can be caused either by surface heating or upper-tropospheric (~50,000 feet) divergence of air. Generally, the former “air mass” thunderstorms form on warm-season afternoons and are not severe. The latter “dynamically-driven” thunderstorms generally form in association with a cold front or other regional-scaled atmospheric disturbance. These storms can become severe, producing strong winds, frequent lightning, hail, downbursts and even tornadoes.

A typical thunderstorm may be three miles wide at its base, rise to between 40,000 to 60,000 feet in the troposphere, and contain half a million tons of condensed water. Conglomerations of thunderstorms along cold fronts (with squall lines) can extend for hundreds of miles. Thunderstorms contain tremendous amounts of energy derived from condensation of water.

According to the National Weather Service, a severe thunderstorm is one that produces tornadoes, hail 0.75 inches or more in diameter, or winds of 50 knots (58 mph) or more. Structural wind damage may imply the occurrence of a severe thunderstorm. Hail, formed by the accretion of supercooled liquid water on ice particles in a thunderstorm updraft, can pose a serious threat to agriculture and exposed objects. Likewise, strong winds can potentially wreak havoc on fragile or flimsy structures, or yield secondary damage through the downing of trees. Lightning associated with thunderstorms poses a threat to people and animals in unsheltered areas. The tornado, however, is by far the greatest natural hazard threat from a severe thunderstorm.

Thunderstorms in South Carolina:

Thunderstorms are common throughout South Carolina, and have occurred in all months of the year. Thunderstorm related deaths and injuries in South Carolina have peaked during July and August. Between 1994 and 2000 Horry County had 16 significant lightening events according to the South Carolina State Climatology Office. During this period 7 lightening-related injuries occurred within the county; however, no lightening-related deaths were reported. Property losses for these events totaled \$120,000.²²

Severe thunderstorms can result in floods have the potential to cause major damages to both public facilities and private property. In fact, the city has more than 240 repetitive loss flood prone properties caused in part from flooding that occurred as a result of thunderstorms. Additionally, lightening generally occurs during severe thunderstorms and have causes several injuries over the past ten years. However, since their overall impact on the community is generally negligible, severe thunderstorms have been given an Index Ranking of 3 on the Hazard Identification and Analysis Worksheet (see Table 2.17).

2.3.6 Wildfire

What Is A Wildfire?

A wildfire is an uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures. They often begin unnoticed and spread quickly and are usually signaled by dense smoke that fills the air for miles around.

Naturally occurring and non-native species of grasses, brush, and trees fuel wildfires. A wildland fire is a wildfire in an area in which development is essentially nonexistent, except for roads, railroads, power lines and similar facilities. An Urban-Wildland Interface fire is a wildfire in a geographical area where structures and other human development meets or intermingle with wildland or vegetative fuels.

Causes of Wildfires:

People start more than four out of every five wildfires, usually as debris burns, arson, or carelessness. Lightning strikes are the next leading cause of wildfires. Regardless of the cause, Wildfires can pose a significant risk to the human environment.

Wildfire behavior is based on three primary factors: fuel, topography and weather
Fuel: The type and amount of fuel, as well as its burning qualities and level of moisture affect wildfire potential and behavior. The continuity of fuels, expressed in both horizontal and vertical components is also a factor, in that it expresses the pattern of vegetative growth and open areas.

Weather affects the probability of wildfire and has a significant effect on its behavior. Temperature, humidity, and wind (both short and long term) affect the severity and duration of wildfires. Critical Fire Weather Frequency is a set of weather conditions, usually a combination of low relative humidity and wind, whose effects on fire behavior make control difficult and threaten firefighter safety.

Wildfire Measurement:

For wildfires, intensity can be expressed as fire line intensity (a measure of the rate at which a fire releases heat, or the unit length of the fire line); the rate of fire spread (feet per second); and flame length. To determine fire hazard severity, use the Fire Hazard Severity Table below. Remember, a community may have more than one classification depending on the degrees of the slope and fuel models.

Table 2.12

Fuel Classification	Critical Fire Weather Frequency								
	< 1 Day/Year			2 to 7 Days/Year			> 8 Days/Year		
	Slope (%)			Slope (%)			Slope (%)		
	< 40	41-60	>61	< 40	14-60	> 61	< 40	14-60	> 61
Light Fuel	M	M	M	M	M	M	M	M	H
Medium Fuel	M	M	H	H	H	H	E	E	E
Heavy Fuel	H	H	H	H	E	E	E	E	E

Source: Urban Wildland Interface Code: 2000

Heavy Fuel is vegetation consisting of round wood 3 to 8 inches in diameter

Medium Fuel is vegetation consisting of round wood 1/3 to 3 inches in diameter

Light Fuel is vegetation consisting of herbaceous plants and round wood less than ¼ inch in diameter

M = Moderate Hazard; **H** = High Hazard; **E** = Extreme Hazard

(Source: FEMA Report No. 386-2)

Due to normal human negligence, the history of severe thunderstorms producing lightening, and the potential for dry and hot conditions wildfires in North Myrtle Beach are highly likely in the future. In the past, impacts from fires have been negligible with damage being limited. Between 1975 – 1995 Horry County experienced 3,788 wildfires.²³ The most likely areas for wildfires in the City are along Little River Neck Road and the Barefoot Resort areas.

While future impacts will most likely continue to be negligible meaning minor injuries may occur; critical facilities may be shut down for 24 hours or less and few properties in the community would be damaged. These factors suggest a hazard index ranking of 2 for wildfires in North Myrtle Beach. This indicates that while wildfires are not one of the most important considerations in determining the City's mitigation strategies, its potential for disaster cannot be ignored (see Table 2.17).

2.3.7 Extreme Heat

Extreme heat/Heat Waves occur when there are high temperatures combined with high humidity persist over an extended period of time. According to FEMA (1997), extreme heat/heat waves can cause the following disorders:

1. *Heat Stroke*: The body is unable to control its temperature. It will rise rapidly. Sweating does not occur. This can cause permanent disability. Those at highest risk included outdoor laborers, elderly, children, and people in poor health.
2. *Heat Exhaustion*: occurs when there is an excessive loss of water and salt released in sweat. Those at highest risk include the elderly, people with high blood pressure, outdoor laborers, and those exercising outdoors.
3. *Heat Syncope*: results in a sudden loss of consciousness, which generally returns when the person lies down. There is little or no permanent harm as a result of heat syncope. This is associated with people who are not properly acclimated to the weather.
4. *Heat Cramps*: occur as a result of a mild fluid and electrolyte imbalance and generally ceases to be a problem after acclimatization. This occurs in people who exercise outdoors when they are unaccustomed to the activity.

The National Weather Service categorizes heat index in relation to heat disorders.

Table 2. 13 Heat Index in Relation to Heat Disorders		
Danger Category	Heat Disorder	Apparent Temperature °F
IV Extreme Danger	Heat Stroke or Sunstroke Imminent	>130
III Danger	Sunstroke, heat cramps, or heat exhaustion likely; heat stroke possible with prolonged exposure and physical activity	105-130
II Extreme Caution	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and physical activity	90-105
I Caution	Fatigue possible with prolonged exposure and physical activity	80-90

North Myrtle Beach Extreme Heat Vulnerability Summary

An examination of temperature records for the period 1948-2000 found the highest maximum temperature to be 107 F on August 18, 1954. The South Carolina State Climatology Office also provided data for the Myrtle Beach Area. The data results were compiled by reviewing 31 years of complete temperature, dew point and relative humidity data. The results showed that on average there were 2.06 days in June with a heat index over 104.5°F, 5.91 days in July with a heat index over 104.5°F, 4.55 days in August with a heat index over 104.5°F, and 2.17 days in September with a heat index over 104.5°F.

Historical records indicate that it is possible extreme heat/heat waves will affect North Myrtle Beach; however, future impacts will most likely be negligible. This suggests a hazard index ranking of 2 for extreme heat/heat waves in the North Myrtle Beach area. This indicates that extreme heat/heat waves are not one of the most important considerations in determining the City's mitigation strategies (see Table 2.17).

2.3.8 Tornadoes/Waterspouts

What Is A Tornado?

A tornado is a violently rotating column of air extending to the ground. Over water, a tornado is called a *waterspout*. The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of 1 mile wide and 50 miles long.

Tornadoes are among the most unpredictable of weather phenomena. Tornado season runs ordinarily from March through August; however, tornadoes can strike at any time of the year if the essential conditions are present.

Cause of Tornadoes:

Thunderstorms and hurricanes spawn tornadoes when cold air overrides a layer of warm air, causing the warm air to rise rapidly. The winds produced from hurricanes, earthquake-induced fires, and wildfires have also been known to produce tornadoes.

The nature of tornadoes is that they strike at random. While it is known that some areas of the country experience tornadoes more than others, predicting exactly what parts of your community have a greater chance of being struck by a tornado is difficult. In order to determine the likelihood and potential severity of tornado events in your community, you should ascertain the number and intensity of tornadoes that have affected the area in the past. Take note, however, that the

Tornadoes are characterized by damage pattern, F0 through F5 on the Fujita-Pearson Tornado Scale. The table below shows the tornado category, expected damages, and corresponding wind speed.

Table 2.14 Fujita-Pearson Tornado Scale

<i>F-Scale</i>	<i>Damage</i>	<i>Winds (mph)</i>	<i>Path Length (miles)</i>	<i>Mean Width (miles)</i>
<i>F0 (Weak)</i>	Light	40-72	<1	<0.01
<i>F1 (Weak)</i>	Moderate	73-112	1-3.1	0.01-0.03
<i>F2 (Strong)</i>	Considerable	113-157	3.2-9.9	0.04-0.09
<i>F3 (Strong)</i>	Severe	158-206	10-31	0.1-0.31
<i>F4 (Violent)</i>	Devastating	207-260	32-99	0.32-0.99
<i>F5 (Violent)</i>	Incredible	261-318	≥100	≥1.0

North Myrtle Beach Experience with Tornadoes

North Myrtle Beach is located within Zone III. The tornado hazard in Zone III, while not as great as in Zone IV, is still significant with winds potentially reaching 200 miles per hour. Between 1955 and September 2000, Horry County experienced 39 tornadoes. Damages from these events cost \$16.8 million and 65 people were injured.²⁵

Tornadoes in the North Myrtle Beach area included events on:

November 7, 1995 (F2) An estimated five tornado touchdowns ran a track in ten minutes from near the Conway Raceway northeast along US Highway 378 to the Little River area on SC Highway 90. Major damage was done to 50 residential and five commercial buildings. Minor damage was done to 85 residential and 20 commercial buildings. Hundreds of large trees were twisted and snapped.²⁶

July 10, 1996 (F0) A waterspout sighted off Cherry Grove beach moved ashore. No damage was reported.²⁷

July 6, 2001 (F2) During the late afternoon of July 6, 2001, two tornadoes occurred in portions of North Myrtle Beach and Myrtle Beach, South Carolina. Between 4:25 and 4:30 pm, several reports of tornadoes in Myrtle Beach were received at the National Weather Service. A Tornado Warning was issued for Horry County at 4:33 pm. At 4:34 pm, weather observations from the Myrtle

Beach airport included mention of a tornado moving southwest near the end of the runway. Tower personnel reported seeing the funnel surrounded by a debris cloud.

A preliminary damage assessment was performed during the evening of July 6th and revealed damage to many buildings, signs, utility poles, and vehicles. The magnitude of the damage suggests F2 strength for the tornado, which corresponds to peak wind speeds of 113 to 157 mph. Many automobiles and multi-story motels had their windows blown out. Several structures had damage to their roofs and stucco walls, and one wooden structure had its roof completely removed. Power lines were down and some large billboards were damaged. The power of the wind was very evident when several vehicles were actually flipped over by the tornadoes, including two tourist trolleys. The most concentrated damage occurred in the vicinity of the Myrtle Beach pavilion, although more spotty damage occurred for miles north along the coastline

Reports indicated up to thirty-six people were taken by ambulance to area hospitals for only minor injuries. Damage from this tornado is preliminarily estimated at \$8,000,000. Damage to automobiles accounts for over \$1,000,000 of that total. At the height of the storm, 4,000 Myrtle Beach residents were without power.



Paul Donovan of Springfield, Va., took this image at around 4:30 p.m. July 6, 2001, from the ninth floor of the Sandcastle Inn on Ocean Boulevard. It shows the funnel cloud as it moved south along the beach.[Photo provided by the National Weather Service]

While tornadoes/waterspouts are likely to occur in North Myrtle Beach their impact is expected to be limited to a small geographic area. Therefore, tornadoes have been given an Index Ranking of 2 on the Hazard Identification and Analysis Worksheet (see Table 2.17).

2.3.9 Severe Winter Storms

What Are Severe Winter Storms?

Severe winter storms can produce an array of hazardous weather conditions, including heavy snow, blizzards, freezing rain and ice pellets and extreme cold. Extreme snow events are the most potentially disruptive to society, for they can bring down power lines, trees and lead to roof collapses. All forms of severe winter weather can make traveling treacherous. Severe winter storms are extra-tropical cyclones fueled by strong temperature gradients and an active upper-level jet stream.

The winter storms that impact South Carolina generally form in the Gulf of Mexico or off the southeast Atlantic Coast. Few of these storms result in blizzard conditions, defined by the presence of winds in excess of 35 mph, falling and blowing snow, and a maximum temperature of 20 Fahrenheit.

Severe Winter Storms in South Carolina:

The entire state of South Carolina has a likelihood of experiencing severe winter weather. The threat varies by location and by type of storm. Coastal areas typically face their greatest threat from Nor'Easters and other severe winter coastal storms. These storms can contain strong waves and result in extensive beach erosion and flooding. Freezing rain and ice storms typically occur once every several years at coastal locations, and severe snowstorms have been recorded occasionally in coastal areas.

December 23-24, 1989: Winter storms caused 14 inches of snowfall in Myrtle Beach. Gale force winds, gusting up to 60 mph, produced waves up to 34 feet high off the coast of and whipped the snow into drifts up to 8 feet high. Ice and snow caused treacherous conditions on the streets. Power outages lasted several hours. There was no major property damage reported nor were there any deaths or injuries as a result of the storm.²⁸

Severe winter storms have the potential to cause major damages to both public facilities and private property; however, they do not occur very frequently and their impact is of a short duration. For these reasons severe winter storms have been given an Index Ranking of 2 on the Hazard Identification and Analysis Worksheet (see Table 2.17).

2.3.10 Drought

Drought is defined by FEMA (1997) as being a water shortage caused by a deficiency of rainfall. During severe droughts, agricultural crops do not mature, wildlife and livestock are undermined, land values decline, and unemployment increases. Droughts can cause a shortage of water for human and industrial consumption, hydroelectric power, recreation and navigation. Water quality may decline and the number of wildfires may increase.

There are four types of droughts (FEMA, 1997):

1. Meteorological Drought – This is a reduction of precipitation over time. This definition is regionally based. In the United States, this is indicated by less than 2.5 mm of rainfall in 48 hours, which is the first indication of drought.
2. Agricultural Drought – This happens when soil moisture cannot meet the demands of a crop. This type of drought happens after a meteorological drought but before a hydrological drought.
3. Hydrological Drought – This refers to reduction in surface and subsurface water supplies. This is measured through stream flow and lake, reservoir, and ground water levels.
4. Socioeconomic Drought – This occurs when water shortages affect people, either in terms of water supply or economic impacts (i.e. loss of crops so price increases).

South Carolina experienced one of its worst multiyear droughts on record during the period from June 1998 to August 2002. Average precipitation was 10-30 percent below normal during the drought. Stream flows were at historic lows throughout the State, threatening water-supply intakes and causing saltwater intrusion in coastal areas. Lakes were being drained to perilously low levels in order to sustain water demands, downstream flows and to prevent saltwater intrusion from contaminating supply intakes in the Grand Strand area. Ground-water levels in shallow and deep aquifers dropped to record lows. Pumps in municipal and domestic wells had to be lowered, wells had to be deepened and, in some cases, new wells had to be drilled to keep pace with declines. Ground water levels in some areas of the State declined to the point that streams were losing water to the ground, the reverse of what normally occurs.²⁹

Undoubtedly, the recent drought was one of the worst on record, but its effects were also compounded by population increases that have taken place during the past 50 years. South Carolina's population has nearly doubled during this period, growing from 2.1 million in 1950 to 4.0 million in 2000. The population will continue to grow and the demand for water will correspondingly increase, but the amount of water that is available will remain essentially the same.³⁰

Surface water and ground water are connected hydraulically, but their interaction is often overlooked in water-resource management considerations. During dry

periods, stream flows and lake levels are maintained by discharged ground water; at other times, aquifers are recharged when water seeps from lakes and streams into the ground. Because many natural processes and human actions affect this interaction, it is important for water managers to consider ground water and surface water as a single resource.

When water enters a watershed, it becomes part of the total water budget for that watershed, whether it flows on the surface or below it. In a typical year, about 56 inches of water (averaged over the State) comes into South Carolina from all sources. Precipitation is the source of about 48 inches, or 85 percent of the total, and stream flow from North Carolina accounts for the remaining 8 inches.³¹

Loss of water from the State occurs primarily through evapotranspiration (the conversion of liquid into vapor by the processes of evaporation and transpiration) and discharge from streams into the ocean. In an average year, 34 inches of water are evapotranspired, 21 inches are discharged into the ocean from streams, and less than 1 inch is discharged into the ocean from aquifers.

The availability of water, especially surface water, is strongly influenced by seasonal variations in precipitation and evapotranspiration. Ground-water supplies are also subject to seasonal variation and decline due to prolonged drought, but usually to a lesser degree than surface-water supplies. Ground-water levels lowered during the summer and fall, the result of both increased pumping and reduced recharge, usually recover during the winter and spring, owing to increased aquifer recharge and reduced pumping. Multiyear droughts lower aquifer water levels by limiting the recharge that normally occurs during the wet winter and spring months.

Although ground water is a renewable resource, pumping water from wells at rates that exceed natural replenishment will deplete the resource and cause ground water levels to decline. Consequences of over pumping include reductions in well yield, increased pumping costs, reduced flow rates in streams, altered ground water flow patterns, water-level declines in lakes and wetlands, land subsidence, sinkholes, and saltwater intrusion.

Cones of depression develop where aquifers are stressed by pumping. When water is pumped from a well, it is replaced with water from the aquifer. As pumping continues, water levels in the aquifer continue to decline and take on the shape of an inverted cone, the apex of which is centered at the well. Water levels are at their deepest near the well and gradually become shallower away from the well. Deep and aerially extensive cones of depression often develop where excessive, long-term pumping occurs.³²

Cones of depression can impact large areas, affect hundreds of well owners, and can take decades to recover. Although cones of depression are reversible and reduced pumping will result in a return to higher water levels, significant over

pumping of an aquifer can also cause permanent damage to the aquifer or the overlying land. The water level in a confined aquifer can decline to a point at which the increased stress on the aquifer system causes a rearrangement of the grains that form the aquifer skeleton, resulting in an irreversible reduction in the aquifer's water-storing capacity. Excessive pumping can also lead to the dewatering of clay layers within the aquifer system, which can cause land subsidence. This is of particular concern in South Carolina because of the large number of clay beds in the Coastal Plain aquifer systems.

North Myrtle Beach Area

Over pumping has caused significant regional water-level declines in nearly half (13) of the counties in the Coastal Plain, including Horry. However, future impacts will most likely be negligible since the City of North Myrtle Beach and neighboring communities are making changes in their water supply source. In 1991 the City received its first water from a new water treatment plant built by the City of Myrtle Beach. The water is then pumped to North Myrtle Beach through approximately six (6) miles of transmission mains.

These factors suggest a hazard index ranking of 2 for droughts in the North Myrtle Beach area. This indicates that, in the large scheme, droughts are not one of the most important considerations in determining the City's mitigation strategies (see Table 2.17).

2.3.11 Dam Failure

According to the FEMA (1997) publication, *Multiple Hazard Identification and Risk Assessment*, a dam is a "barrier constructed across a watercourse for the purpose of storage, control, or diversion of water." Dam failures can occur as a result of natural events, human actions or a combination of both. The most common cause of failure is rainfall. Collapsed or damaged dams can lead to downstream flooding and subsequent damages or loss of life.

North Myrtle Beach

There are no high hazard dams within or near North Myrtle Beach. Thus, dam failure is not a high mitigation priority and is given a rating of 1 on the Vulnerability Rating Chart (see Table 2.17).

2.3.12 Earthquake

What Is An Earthquake?

Earthquakes are geologic events that involve movement or shaking of the earth's crust. Earthquakes are usually caused by the release of stresses accumulated as a result of the rupture of rocks along opposing fault planes in the earth's outer crust. These fault planes are typically found along borders of the earth's 10 tectonic plates.

The areas of greatest tectonic instability occur at the perimeters of the slowly moving plates, as these locations are subjected to the greatest strains from plates traveling in opposite directions and at different speeds. Deformation along plate boundaries causes strain in the rock and the consequent buildup of stored energy. When the built-up stress exceeds the rocks' strength, a rupture occurs. The rock on both sides of the fracture is snapped, releasing the stored energy and producing seismic waves, generating an earthquake.

An earthquake is a sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of Earth's tectonic plates. The severity of these effects is dependent on the amount of energy released from the fault or epicenter. The effects of an earthquake can be felt far beyond the site of its occurrence. They usually occur without warning and after just a few seconds can cause massive damage and extensive casualties.

The variables that characterize earthquakes are ground motion, surface faulting, ground failure, and seismic activity. Ground motion is the vibration or shaking of the ground during an earthquake. When a fault ruptures, seismic waves radiate, causing the ground to vibrate. The severity of the vibration increases with the amount of energy released and decreases with distance from the causative fault or epicenter, but soft soils can further amplify ground motions.

Surface faulting is the differential movement of two sides of a fracture – in other words, the location where the ground breaks apart. The length, width, and displacement of the ground characterize surface faults.

Liquefaction is the phenomenon that occurs when ground shaking causes loose soils to lose strength and act like viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength. Lateral spreads develop on gentle slopes and entail the sidelong movement of large masses of soil as an underlying layer liquefies. Loss of bearing strength results when the soil supporting structures liquefies. This can cause structures to tip and topple.

Measurement:

Earthquakes are measured in terms of their magnitude and intensity. There are several different scales that are commonly used, including Richter Magnitude, Modified Mercalli Intensity (MMI), Moment Magnitude and Peak Ground Acceleration (PGA), among others.

Magnitude is measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude. Each unit increase in magnitude on the Richter Scale corresponds to a ten-fold increase in wave amplitude, or a 244-fold increase in energy.

Table 2.15 Modified Mercalli Scale of Earthquake Intensity

Scale	Intensity	Description of Effects	Maximum Acceleration (mm/sec)	Corresponding Richter Scale
I	Instrumental	Detected only on seismographs	<10	
II	Feeble	Some people feel it	<25	<4.2
III	Slight	Felt by people resting; like a truck rumbling by	<50	
IV	Moderate	Felt by people walking	<100	
V	Slightly Strong	Sleepers awake; church bells ring	<250	<4.8
VI	Strong	Trees sway; suspended objects swing, objects fall off shelves	<500	<5.4
VII	Very Strong	Mild walls crack; plaster falls	<1000	<6.1
VIII	Destructive	Moving cars uncontrollable; masonry fractures, poorly constructed buildings damaged	<2500	
IX	Ruinous	Some houses collapse; ground cracks; pipes break open	<5000	<6.9
X	Disastrous	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread	<7500	<7.3
XI	Very Disastrous	Most buildings and bridges collapse; roads, railways, pipes and cables destroyed; general triggering of other hazards	<9800	<8.1
XII	Catastrophic	Total destruction; trees fall; ground rises and falls in waves	>9800	>8.1

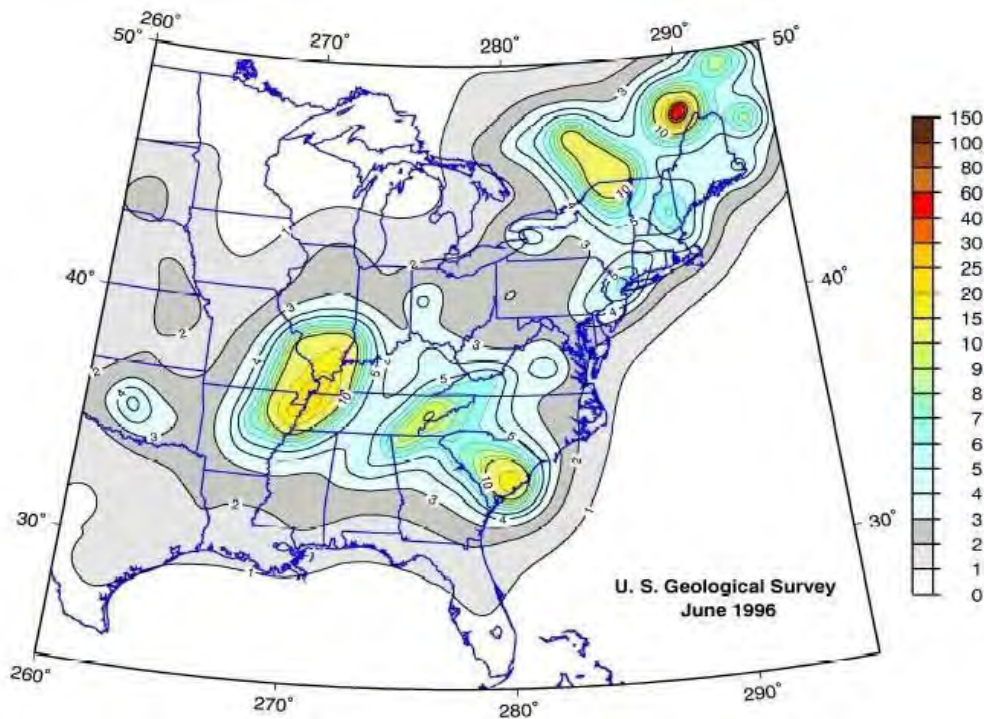
Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale. It is a twelve-level scale based on direct and indirect measurements of seismic effects. The scale levels are typically described using Roman numerals, with a I corresponding to imperceptible (instrumental) events, IV corresponding to moderate (felt by people awake), to XII for catastrophic (total destruction). A detailed description of the Modified Mercalli Scale of Earthquake Intensity (and its correspondence to the Richter Scale) is illustrated in Table 2.15 above.

Earthquakes in South Carolina:

Earthquakes are relatively infrequent but not uncommon in South Carolina. Epicenters of South Carolina earthquakes are generally concentrated in the active Eastern Tennessee Seismic Zone, which is second in activity in the eastern United States only to the New Madrid Fault. The Eastern Tennessee Seismic Zone is part of a crescent of moderate seismic activity risk extending from Charleston, South Carolina northwestward into eastern Tennessee and then curving northeastward into central Virginia. While there have not been any earthquakes with a MMI intensity greater than IV since 1928 in this area, it has the potential to produce an earthquake of significant intensity in the future.

FIGURE 2.4

Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years



Source: United States Geological Survey

August 31, 1886: Most violent earthquake (7.3 Richter) to affect Horry County and North Myrtle Beach. The earthquakes initial tremors occurred at 9:50 PM, with aftershocks at 10:00 PM, 10:12 PM, and 10:25 PM. The epicenter was in Charleston South Carolina. Though the MMI scale is an 11 and would list this event as a very disastrous event, the damage reported in North Myrtle Beach was minimal.³³

Earthquakes have the potential to cause major damages to both public facilities and private property; however, they do not occur very frequently. For these reasons earthquakes have been given an Index Ranking of 1 on the Hazard Identification and Analysis Worksheet (see Table 2.17).

2.3.13 Tsunami

A Tsunami is defined as a large seismic wave, impulsively generated by shallow-focus, underwater earthquakes. A Tsunami wave can travel unnoticed across the ocean at speeds of up to 500 mph and, upon connection with a coastline, can cause significant damage to shore protection structures, buildings, as well as, severe erosion, extensive inland flooding and loss of life (FEMA 1997).

Significant damage as a result of Tsunamis has been identified in the Western States of Alaska, Hawaii and American Samoa. In the Atlantic Ocean and Caribbean Sea, events have occurred in the vicinity of Puerto Rico and the U.S. Virgin Islands, but are much less frequent.

According to FEMA (1997), North Myrtle Beach does not lie in an area frequented by Tsunamis. Thus, Tsunamis are given a Hazard Index ranking of 1, as it is highly unlikely they will affect the area and are not the most important consideration when determining mitigation strategies.

2.3.14 Sinkholes

Collapse sinkholes form with little warning and leave behind a deep, steeply sided hole. They occur because of weakening of the rock of the aquifer by erosion and is often triggered by changes in water levels in the surficial aquifers. The development of collapse sinkholes can be triggered by natural conditions as well as human interference such as dredging, constructing reservoirs, diverting surface water, and pumping groundwater.

According to the USGS, the most damage in the United States from sinkholes tends to occur in Florida, Texas, Alabama, Missouri, Kentucky, Tennessee, and Pennsylvania. North Myrtle Beach has a low probability of having sinkholes. Thus, they are given a Hazard Index ranking of 1 and are not an important consideration in the City's mitigation efforts.

2.3.15 Volcanoes

Volcanic eruptions are classified as nonexplosive or explosive. Nonexplosive eruptions are caused by an iron- and magnesium-rich magma that is relatively fluid and allows gas to escape.

Explosive eruptions are violent and are derived from a silica-rich magma that is not fluid. However, both types of eruption can produce debris flows and surges, floods, lava flows and domes, ash falls and gases, and lateral blasts (FEMA 1997). All of which can lead to the destruction and endangerment of people, buildings, and infrastructure.

North Myrtle Beach does not lie in an area known for volcanic activity. As a result volcanoes are given a Hazard Index ranking of 1 and are not an important consideration to the Town's mitigation efforts.

2.3.16 Landslides

Landslides are described as the downward and outward movement of slope-forming materials reacting under the force of gravity (FEMA 1997). Landslides can be triggered by both human factors such as mining, construction of highways, railroads, and the like, as well as, natural factors such as topography, geology, and precipitation or a combination thereof. Often Landslides are triggered by other events such as floods, earthquakes, and volcanic eruptions.

Though landslides are a consideration for the mountainous areas of South Carolina, North Myrtle Beach lies in the coastal area. According to the United States Geological Survey, North Myrtle Beach has a low incidence and non-existent susceptibility to landslides (Rodbruch-Hall, et. al. 1982).

Due to the geology and practically flat topography of the area, landslides are given a Hazard Index ranking of 1 and are not an important consideration in the City's mitigation efforts.

2.4 Task 1.4: Estimate the Hazards' Level of Impact.

In column 4, the committee estimated the level of impact that could occur from the hazards listed. Impact is a combination of the magnitude of the event, how large an area within the community is affected, and the amount of human activity in that area. Later steps in the planning process will help determine the density of human development more precisely, but for now, estimate impact in fairly general terms. The following chart can help determine various levels of impact.

Table 2.16 Level of Disaster Impact

Level	Area Affected	Impact
Catastrophic	More than 50%	<ul style="list-style-type: none">• Multiple deaths.• Complete shutdown of facilities for 30 days or more.• More than 50 percent of property is severely damaged.
Critical	25 to 50%	<ul style="list-style-type: none">• Multiple severe injuries.• Complete shutdown of critical facilities for at least 2 weeks.• More than 25 percent of property is severely damaged.
Limited	10 to 25%	<ul style="list-style-type: none">• Some injuries.• Complete shutdown of critical facilities more than one week.• More than 10 percent of property is severely damaged.
Negligible	Less than 10%	<ul style="list-style-type: none">• Minor injuries.• Minimal quality-of-life impact.• Shutdown of critical facilities/services for 24 hours or less.• Less than 10 percent of property is severely damaged.

2.5 Task 1.5: Formulate Conclusions.

Some natural hazards have extraordinary impacts, but occur infrequently (for example, severe earthquakes). Other hazards may occur annually or several times a decade, but cause less extensive damage (for example, nuisance flooding). Use the last column of Worksheet to rank and prioritize so the City can focus on the hazards that need most attention. For example, the committee ranked high-likelihood, high-intensity hazards with severe impacts as the City's primary objective. The committee used a scale of 1 to 5, to synthesize the intensity, likelihood, and impact of each hazard identified.

Table 2.17 Hazard Identification and Analysis Worksheet

Type of Hazard	Magnitude	Frequency	Impact	Index
Hurricane & Tropical Storms	Tropical Storm Category 1 Category 2 Category 3 Category 4 Category 5	Highly Likely Highly Likely Likely Possible Unlikely Highly Unlikely	Limited Limited Critical Catastrophic Catastrophic Catastrophic	5
Flooding	10-49 year event 50-100 year event > 100 year event	High Moderate Low	Limited Critical Catastrophic	5
Nor'easter	Class 1 Weak Class 2 Moderate Class 3 Significant	Highly Likely Likely Possible	Negligible Limited Critical	4
Erosion	Moderate	Highly Likely	Limited	4
Severe Thunderstorms	Moderate	Highly Likely	Negligible	2
Wildfires	Moderate	Highly likely	Negligible	2
Extreme Heat	Danger Class 1 Danger Class 2	Highly Likely Highly Likely	Negligible Negligible	2
Tornadoes/Waterspouts	F0 Weak F1 Weak F2 Strong	Highly Likely Likely Likely	Limited Limited Critical	2
Winter Storms	Moderate	Possible	Limited	2
Drought	Mild	Possible	Limited	2
Dam Failure	Mild	Highly Unlikely	Negligible	1
Earthquake	Mild	Possible	Negligible	1
Tsunami	Mild	Highly Unlikely	Negligible	1
Sinkholes	Mild	Unlikely	Negligible	1

2.6 Summary of Hazard Mitigation Problems

High Winds (Hurricanes, Nor'Easters, and Tornadoes)

- Loss of roof shingles and sheathing.
- Wind borne debris damage to buildings.
- Trees blown on houses and utilities.
- Power, telephone and cable lines damaged.
- Evacuation routes must be closed early.

Storm Surge (Hurricanes)

- Destruction and major damages to buildings located in V-Zones and coastal AE-Zones.
- Destruction of roads and utilities.

Coastal Erosion (Hurricanes and Nor'Easters)

- Loss of the recreational beach.
- Building foundations fail due to being undermined by erosion and scour.

Flooding (Hurricanes and Severe Thunderstorms)

- Damage to buildings not elevated above the flood level.
- Damage to buildings with enclosures below the flood level.
- Damage to buildings and utilities from water borne debris.
- Flood Hazard Maps that do not adequately reflect the flood risk to buildings.
- Evacuation routes closed.

Wildfire

- Destruction of buildings and utilities.
- Destruction of natural resources, including wildlife habitat.

Severe Winter Storms

- Beach erosion.
- Destruction of power, telephone and cable lines damaged.

Earthquake

- Building failure from shaking and liquefaction.
- Damage to bridges, pipes and cables.
- Destruction of trees, some of which may block evacuation and emergency response teams.

Footnotes:

- ¹ *City of North Myrtle Beach Comprehensive Plan*, 1995. p.3.
- ² *City of North Myrtle Beach Draft Comprehensive Plan Update, 2004.* p. 1-2.
- ³ Ibid. p1-7.
- ⁴ Ibid. p1-8.
- ⁵ NMB Building Department memo, March 15, 2004
- ⁶ *City of North Myrtle Beach Draft Comprehensive Plan Update, 2004.* p. 1-8.
- ⁷ Ibid. p1-11.
- ⁸ Ibid. p5-17.
- ⁹ Department of Homeland Security – FEMA, National Flood Insurance Program Repetitive Loss file, 2004.
- ¹⁰ NMB Information Services Department, May 26, 2004 memo.
- ¹¹ National Weather Service, National Climatic Data Center, Extreme Weather and Climate Events Data Base (South Carolina files)
- ¹² *North Myrtle Beach, South Carolina Beach Management Plan*, 1991. p. 3.
- ¹³ Ibid. p.3.
- ¹⁴ Ibid. p.6.
- ¹⁵ Ibid. p.7.
- ¹⁶ Ibid. p.7.
- ¹⁷ Ibid. p.7.
- ¹⁸ Ibid. p.8.
- ¹⁹ Ibid. p.8.
- ²⁰ Ibid. p.8.
- ²¹ Ibid. p.9.

- ²² National Weather Service, National Climatic Data Center, Extreme Weather and Climate Events Data Base (South Carolina files)
- ²³ Ibid.
- ²⁴ South Carolina Hazard Mitigation Plan
- ²⁵ National Weather Service, National Climatic Data Center, Extreme Weather and Climate Events Data Base (South Carolina files)
- ²⁶ South Carolina Climatology Office, Significant Tornadoes in South Carolina 1990- 2001.
- ²⁷ Ibid.
- ²⁸ National Weather Service, National Climatic Data Center, Extreme Weather and Climate Events Data Base (South Carolina files)
- ²⁹ South Carolina Water Plan, Second Edition, 2004. South Carolina Department of Natural Resources, Land and Water Conservation Division. p. 29.
- ³⁰ Ibid. p. 30.
- ³¹ Ibid. p. 8.
- ³² Ibid. p. 55.
- ³³ National Weather Service, National Climatic Data Center, Extreme Weather and Climate Events Data Base (South Carolina files)

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Chapter 3. Goals, Strategies and Possible Mitigation Actions

This portion of the Mitigation Plan outlines North Myrtle Beach's overall basic mitigation goals and objectives from which the proposed hazard mitigation strategies, programs, and actions shall be drawn. The focus of these goals and objectives is to reduce the City's vulnerability to the effects of natural hazards. This Chapter will address:

- A. Mitigation Goals*
- B. Mitigation Objectives*
- C. Mitigation Strategies and Measures*
- D. Mitigation Actions*

3.1 Mitigation Goals and Objectives

Hazard mitigation goals are broad in scope and far-reaching in application. This part of the plan presents the vision of the government for mitigation in the community. The goals also serve to set the community's priorities.

The Mitigation Objectives are designed to support the goals. Each objective is numbered (i.e., "1.1"), with the first digit representing the corresponding Mitigation Goal.

Objectives are developed as a means of realizing a community's hazard mitigation goals. Objectives are more specific and tangible than goals. Rather than being long-term and general, objectives should be achievable in a finite period of time, and the results should be measurable against benchmarks and indicators. Since objectives need to be attainable, they should be soundly based on the background studies prepared earlier and documented in the plan.

Goal 1. Minimize future flood, wind and earthquake damage to buildings, critical facilities and infrastructure.

Objective 1.1 Reduce flood losses to buildings with enclosures.

Objective 1.2 Protect buildings in the coastal AE-Zone from damage due to wave action on the foundation and enclosures.

- Objective 1.3** Ensure that all new construction is completed using wind-resistant design techniques that will limit damage caused by high winds and reduce the amount of wind-borne debris.
- Objective 1.4** Ensure new and substantially improved buildings meet the applicable earthquake provision of the building code.
- Objective 1.5** Provide adequate staffing and training, complete building plan reviews, and ensure administrative and enforcement procedures meet the requirements for the City to maintain its 3/3 Classification under the Building Code Effectiveness Grading Schedule.
- Objective 1.6** Maintain the City's Class 3 Fire Insurance Rating through adequate staffing, training, equipment maintenance, facility distribution, and water supply.
- Objective 1.7** Ensure maintenance of the beach nourishment project in accordance with the City's agreement with the U. S. Army Corps of Engineers.
- Objective 1.8** Reduce property damage from stormwater runoff.
- Objective 1.9** Ensure the beach management setback regulations are applied to all new construction and redevelopment projects.

Goal 2. Protect the City's most vulnerable populations, buildings and critical facilities through the implementation of cost-effective and technically feasible mitigation projects.

- Objective 2.1** Maximize the use of available hazard mitigation grant programs to protect the City's most vulnerable populations and structures.
- Objective 2.2** Decrease the number of FEMA-identified "repetitive loss properties" located in North Myrtle Beach by 25% by the year 2010 (currently showing 240 properties).
- Objective 2.3** Ensure that all vital / critical facilities are protected from the effects of natural hazards to the maximum extent possible.
- Objective 2.4** Ensure that current emergency services are adequate to protect public health and safety.

Objective 2.5 Develop a system for recording flood damages as a result of inadequate drainage.

Objective 2.6 Develop a schedule for placing existing above ground utilities under ground where feasible, particularly along evacuation routes, major arteries, and highly congested areas.

Goal 3. Protect public health, safety and welfare by increasing the public awareness of existing hazards and by fostering both individual and public responsibility in mitigating risks due to those hazards.

Objective 3.1 Increase the level of knowledge and awareness for the City's residents on the hazards that routinely threaten the area.

Objective 3.2 Educate property owners on the affordable, individual mitigation and preparedness measures that can be taken before the next hazard event.

Objective 3.3 Increase the number of City residents that maintain an active NFIP flood insurance policy by 10% by the year 2008 (currently 9,371 policies in force).

Objective 3.4 Increase the City's NFIP/CRS Class Rating to a Class 5 by the year 2007 through enhanced floodplain management activities.

Goal 4. Preserve and protect the natural ecology and environment, including beaches, marshes and the waterway.

Objective 4.1 Preserve the natural and beneficial functions of the city's floodplain, wetlands, beaches and dunes through continued support of natural resource protection policies and by discouraging growth in environmentally sensitive areas.

Goal 5. To create a more disaster resistant community through cooperative efforts of the public, private and non-profit sectors.

Objective 5.1 Working with other organizations, develop educational materials to educate residents about hazard resistant

construction techniques and actions they can take to protect existing buildings from hazard-related damages.

Objective 5.2 Support demonstration projects where residents may learn how to protect their homes from hazards.

Objective 5.3 Enhance the City's capability to conduct hazard risk assessments, demonstrate funding needs, and track mitigation activities throughout the City.

3.2 Mitigation Strategies and Measures

In formulating this Mitigation Strategy, a wide range of mitigation measures were considered in order to help achieve the goals of the community and to lessen the vulnerability of the City to the effects of natural hazards. In general, all of these measures fall into one of the following broad categories of mitigation strategies. These Mitigation Strategies and Measures are described in Chapters 4 – 9.

1. Prevention

Preventative activities are intended to keep hazard problems from getting worse. They are particularly effective in reducing a community's future vulnerability, especially in areas where development has not occurred or capital improvements have not been substantial. Examples of preventative measures are described in Chapter 4 under the following topics:

Current Measures

- | | |
|---|--|
| 4.1 Comprehensive Plan | 4.7 Floodplain Open Space Preservation |
| 4.2 Beach Management Plan | 4.8 Low-density Zoning |
| 4.3 Zoning | 4.9 Planned Unit Development |
| 4.4 Building Codes | 4.10 Subdivision Regulations |
| 4.5 Floodplain Construction Standards | 4.11 Setback Regulations |
| 4.6 Floodplain Mapping/Data Maintenance | |

Proposed Measures

- | | |
|--|---|
| 4.12 Coastal AE-Zone Regulations | 4.16 Critical Facility Regulations |
| 4.13 Enclosure Regulations | 4.17 Advanced Acquisition |
| 4.14 Freeboard Regulations | 4.18 Wildfire Protection |
| 4.15 Cumulative Substantial Improvement And Substantial Damage Regulations | 4.19 Regulations for Additions to Buildings |

2. Property Protection

Property protection measures protect existing structures by modifying the building to withstand hazardous events, or removing structures from hazardous locations. Property protection measures are discussed in Chapter 5 under the following topics:

- | | |
|--------------------------------|-------------------------|
| 5.1 Acquisition and Demolition | 5.5 Lifeline protection |
| 5.2 Acquisition and Relocation | 5.6 Flood insurance |
| 5.3 Building Elevation | 5.7 Windproofing |
| 5.4 Floodproofing | 5.8 Safe Rooms |
| | 5.9 Seismic Retrofit |

3. Natural Resource Protection

Natural resource protection activities reduce the impact of natural hazards by preserving or restoring natural areas and their mitigative functions. Such areas include floodplains, wetlands and dunes. Parks, recreation or conservation agencies and organizations often implement these measures. Natural resources protection measures are discussed in Chapter 6 under the following topics:

- | | |
|----------------------------------|-------------------------------|
| 6.1 Wetland protection | 6.3 Best management practices |
| 6.2 Erosion and sediment control | 6.4 Dumping regulations |

4. Structural Projects

Structural mitigation projects are intended to lessen the impact of a hazard by modifying the environmental natural progression of the hazard event. They are usually designed by engineers and managed or maintained by public works staff. Structural protection measures are discussed in Chapter 7 under the following topics:

- | | |
|-----------------------|-----------------------------------|
| 7.1 Beach nourishment | 7.5 Swales |
| 7.2 Dune building | 7.6 Drainage Modifications |
| 7.3 Sand scraping | 7.7 Channel and basin maintenance |
| 7.4 Levees/floodwalls | 7.8 Retention Ponds |

5. Emergency Services

Although not typically considered a “mitigation technique,” emergency service measures do minimize the impact of a hazard event on people and property. Emergency service measures are discussed in Chapter 8 under the following topics:

- 8.1 Threat Recognition
- 8.2 Emergency Warning Dissemination
- 8.3 Response and Mitigation Operations
- 8.4 Post-disaster Recovery and Mitigation

6. Public Information and Awareness

Public Information and awareness activities are used to advise residents, business owners, potential property buyers, and visitors about hazards, hazardous areas, and mitigation techniques they can use to protect themselves and their property. Examples of measures to educate and inform the public are discussed in Chapter 9 under the following topics:

- | | |
|----------------------------|--------------------------|
| 9.1 Map information | 9.4 Library |
| 9.2 Outreach projects | 9.5 Technical assistance |
| 9.3 Real estate disclosure | 9.6 Educational programs |

3.3 Mitigation Actions

Based on the Mitigation Strategies and Measures described in Chapters 4 – 9, the City has identified several Mitigation Actions. The Mitigation Actions are short-term, specific measures to be undertaken by the City in order to achieve the identified objectives. Most of these actions are also hazard-specific. Each action identifies the objective(s) it is intended to achieve, includes some general background information to justify the proposed action, and provides measures to assure successful and timely implementation.

Also important to note is that each Mitigation Objective and Mitigation Action is designed to be performance-based, making it easier for the City to measure the Plan's progress over time and during the Plan's future evaluations. It is expected that while the Mitigation Goals may remain the same for an extended period of time, the objectives and actions included in this Mitigation Plan will be updated and/or revised through regular enhancements of the Plan.

A detailed list of Mitigation Actions is located in Chapter 11.

Chapter 4 Preventive Measures

Community officials recognize the importance of protecting their citizens from the devastation hurricanes, floods and other natural disasters can bring. For example, the City has recognized that meeting the minimum requirements for participation in the National Flood Insurance Program does not provide the level of protection its citizens need and deserve. Therefore, City Council has adopted enhancements to the City's floodplain management standards in order to decrease its vulnerability to floods.

To increase the level of protection from natural hazards the Mitigation Committee has examined additional approaches. These recommended safer standards are explained in detail in this section. The standards encourage prudent land use management and development, while promoting responsibility, fairness, community involvement, and planning.

Current Prevention Measures in North Myrtle Beach

- | | |
|---|--|
| 4.1 Comprehensive Plan | 4.7 Floodplain Open Space Preservation |
| 4.2 Beach Management Plan | 4.8 Low-density Zoning |
| 4.3 Zoning | 4.9 Planned Unit Development |
| 4.4 Building Codes | 4.10 Subdivision Regulations |
| 4.5 Floodplain Construction Standards | 4.11 Setback Regulations |
| 4.6 Floodplain Mapping/Data Maintenance | |

4.1 Comprehensive Plan

The Local Government Comprehensive Planning Enabling Act of 1994 requires all counties and cities to establish comprehensive plans as a precondition of enacting a zoning ordinance and other land use controls, such as subdivision, landscape and historic preservation regulations. Local plans must cover seven elements, including community facilities and natural resources. While the latter may include floodplain information, there are no requirements that a plan address natural hazards.

Comprehensive plans identify how a community should be developed and where development should not occur. They govern the rate, intensity, form and quality of physical development. A thorough comprehensive plan will also address economic development, environmental, social and hazard mitigation concerns.

Hazard mitigation is often addressed through separate, stand-alone plans created in the wake of a disaster. Some hazard experts believe integrating mitigation into comprehensive plans is preferable to developing independent hazard plans.

The typical elements of a comprehensive plan include land use, transportation, economic development, environmental protection, dedication of open space, provision of infrastructure and other municipal functions. Their main advantage as a hazard planning tool is that they guide other local measures, such as capital improvement programs, zoning ordinances, and subdivision ordinances.

Comprehensive plans are useful for creating a body of information about local hazard risks. They help identify hazard areas. The appropriate land uses and building (or retrofitting) standards can then be applied to those areas. They identify areas that are less vulnerable to hazards, where development should be directed.

Integrating mitigation into comprehensive planning can improve its effectiveness in four important ways. First, it institutionalizes the process of addressing hazards. This may help make mitigation a habit for community officials. Second, it can create a constituency for mitigation by making it a part of the public discussion of community goals that should be a part of any comprehensive planning process. Third, it allows communities to integrate mitigation with other community objectives. An example of this would be acquiring flood prone properties to achieve both mitigation and open space goals. Fourth, integrating mitigation planning makes it easier for communities to address multiple hazards at once, a process known as cross-mitigation.

Comprehensive planning requires local governments to collect and analyze information about land's suitability for development. This process helps policy makers and local residents understand the limitations to development in hazard-prone areas. In turn, land uses can be tailored to the hazard risk, typically by reserving dangerous areas for less intensive, hazard-compatible uses such as parks, golf courses, backyards, wildlife refuges or natural areas. Other elements of a plan can directly address hazard risk. For example, the capital improvements element should address the elevation or relocation of critical public facilities that could be incapacitated by natural hazards.

The objective of these plans is to preclude inefficient or hazardous land use by coordinating the development of adjacent properties. Developers have an incentive to submit proposals that meet the policies of the comprehensive plan since appropriate designs ensure a fast track for approval.

Current Practice in North Myrtle Beach:

The City's current Comprehensive Plan was adopted in 1995 and is under review by the Planning Commission and City Council at this time. The plan addresses several mitigation topics including plant and animal habitats, wetlands areas, shoreline erosion, beach renourishment, open space preservation, stormwater management and fire suppression.

Mitigation goals identified in the Comprehensive Plan:

1. To protect and maintain natural resources, including beaches, marshes, and the waterway.
2. To ensure continual visual and physical access to the City's natural resources, particularly the ocean and beaches.
3. To stabilize and protect established medium and low-density residential areas from higher intensity uses, and insure land use compatibility.
4. To encourage the best and most economical use of land, without compromising the City's assets and amenities.
5. To insure the preservation and protection of the natural ecology and environment.

4.2 Beach Management Plan

South Carolina Code of Laws, Section 48-39-350, the South Carolina Coastal Zone Management Act, as amended July 1, 1990 required each coastal beachfront county and city to prepare a Local Comprehensive Beach-front Management Plan based on guidelines provided by the South Carolina Coastal Council (SCCC).

The local comprehensive beach management plan, at a minimum, must contain all of the following:

- (1) an inventory of beach profile data and historic erosion rate data provided by the department for each standard erosion zone and inlet erosion zone under the local jurisdiction;
- (2) an inventory of public beach access and attendant parking along with a plan for enhancing public access and parking;
- (3) an inventory of all structures located in the area seaward of the setback line;
- (4) an inventory of turtle nesting and important habitats of the beach/dune system and a protection and restoration plan if necessary;
- (5) a conventional zoning and land use plan consistent with the purposes of this chapter for the area seaward of the setback line;
- (6) an analysis of beach erosion control alternatives, including renourishment for the beach under the local government's jurisdiction;
- (7) a drainage plan for the area seaward of the setback zone;

- (8) a post disaster plan including plans for cleanup, maintaining essential services, protecting public health, emergency building ordinances, and the establishment of priorities,
- (9) a detailed strategy for achieving the goals of the Coastal Zone Management Act by the end of the forty-year retreat period. Consideration must be given to relocating buildings, removal of erosion control structures, and relocation of utilities;
- (10) a detailed strategy for achieving the goals of preservation of existing public access and the enhancement of public access to assure full enjoyment of the beach by all residents of this State. The plan must be updated at least every five years.

Since the original legislation was passed, SCCC was dissolved, and beachfront management planning is now under the auspices of the Department of Health and Environmental Control (DHEC) Office of Ocean & Coastal Resource Management (OCRM).

Current Practice in North Myrtle Beach:

The City has developed a strategy for responding to beach erosion within the framework of the Beach Management Act. City policies call for:

- (1) Maintaining existing shore protection structures until other measures can be implemented to rebuild the beach dune system.
- (2) Maintain a dry sand beach for recreational use and storm surge protection through the beach nourishment project in accordance with the agreement with the U S Army Corps of Engineers.
- (3) Enforcing shoreline setback regulation in conformance with South Carolina State Law.
- (4) Ensuring full public access to the beach through the provision of safe, comfortable public access walkways to the beach with parking facilities.

Updates to the plan occur every five years with the next updated scheduled for 2006.

4.3 Zoning

A zoning ordinance regulates development and existing uses by dividing the community into zones or districts and setting development criteria for each district. The floodplain can be designated as one or more separate zoning districts that prohibit development or allow only development that is not susceptible to damage by flooding. For example, new commercial development can reasonably be precluded or dissuaded from hazardous areas in the interest of protecting these major contributors to the tax base.

Appropriate zoning districts include public use, conservation, and cluster or planned unit developments that keep buildings out of the floodplain, wetlands, and other areas that are not suitable for intensive development.

Current Practice in North Myrtle Beach:

Most of North Myrtle Beach's zoning districts are traditional residential and commercial zones. There is a "conservation/preservation" district. Two large marsh areas in the City are zoned Conservation Preservation (CP). The largest is located in the northern end of the City and is known as the Cherry Grove Marsh. The other is located in the Windy Hill section and is a large marsh that borders US 17 in the vicinity of 46th Avenue South. The CP zoning limits the potential use of these sites to recreational activities such as fishing piers and nature walks.

Elsewhere, the floodplains in the City are zoned as follows:

R-1	Single-family Residential, Low Density	W-1	Waterfront-Pleasure
R-2	Medium Density Residential	R-4	Resort Residential
CPO	Coastal Protection Overlay	RC	Resort Commercial
PUD	Planned Unit Development		

4.4 Building Codes

Building codes are laws, ordinances, or governmental regulations that set forth standards and requirements for the construction, maintenance, operation, occupancy, use or appearance of buildings, premises, and dwelling units. North Myrtle Beach has adopted the International Building and Residential Codes. These building codes regulate for seismic, flooding and high wind resilience in addition to fire resistance.

One way to require non-conforming structures to come up to code is to establish passive or active code triggers, such as a change in use. In order to qualify for a change in use, the building must meet or approach current code. A different kind of code trigger requires that buildings that have suffered a certain degree of damage be renovated to a higher level of natural hazards resilience. Another approach to code enforcement is to establish financial incentive or voluntary compliance programs.

Current Practices in North Myrtle Beach:

Enforcement at the local level extends beyond construction inspections to the advance review of plans. An applicant for a building permit must submit plans for approval. The local building department reviews the plans and elects to approve or reject them or to require revisions. Construction cannot begin until local officials confirm that the plans are in accordance with the code.

A building inspector must then visually monitor the construction of the building. The inspector's duty is make sure that the project follows the plans as approved. Inspectors are empowered to stop work on projects that fail to conform to the plans. Any observed errors must be fixed before work can continue. The inspector must perform a final review before an occupancy permit is issued.

Adherence to existing codes and standards is essential to maintaining public safety and promoting an effective local mitigation program—so much so that the insurance industry has moved to rate communities according to their ability to enforce the building code and by the qualifications and training of their staff. North Myrtle Beach currently has a 3/3 rating under the Building Code Effectiveness Grading Schedule.

4.5 Floodplain Construction Standards

Zoning and open space preservation work to keep damage-prone development *out* of the hazardous or sensitive areas. Building construction and special use regulations impose construction standards on what is allowed to be built *in* the floodplain.

The NFIP operates through a partnership between the Federal Government, the states, and individual communities. Participation in the NFIP is voluntary. In participating communities, affordable, federally backed flood insurance is made available to property owners and renters. In return, each community adopts and enforces a floodplain management ordinance or law, which it uses to define regulatory floodplains and control floodplain development, including new construction, substantial improvement of existing buildings, and repairs of substantially damaged buildings.

FEMA's National Flood Insurance Program (NFIP) sets minimum requirements for participating communities' building construction regulations. The NFIP minimum requirements are summarized in the box on the next page.

Current Practice in North Myrtle Beach

North Myrtle Beach's ordinance meets the minimum NFIP requirements spelled out in the box on the next page. It exceeds the minimum standards for elevation in that it requires new, substantially improved and substantially damaged buildings to be protected to a level one foot above the base flood elevation shown on the FIRM.

Floodplain regulation are enforced as part of the City's inspection program by the Building Department. The Department reviews permit applications and site plans, conducts field inspections, reviews elevation certificates, engineering

Minimum Regulatory Requirements Imposed by Communities Participating in the NFIP

Newly Constructed , Substantially Damaged, and Substantially Improved Buildings in the SFHA

- Building sites must be reasonably safe from flooding.
- Buildings must be:
 1. designed (or modified) and anchored to prevent flotation, collapse, and lateral movement of the building resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy,
 2. constructed with materials resistant to damage from immersion in flood waters,
 3. constructed with methods and practices that minimize flood damage, and
 4. constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent flood water from entering or accumulating within their components.

Subdivisions and Other New Development in the SFHA

- All proposals for subdivisions and other new development in the SFHA must be consistent with the need to minimize flood damage within the floodprone area.
- All public utilities and facilities must be located and constructed to minimize or eliminate flood damage.
- Adequate drainage must be provided for all such subdivisions and new developments in order to reduce exposure to flood hazards.

Additional Minimum Requirements for Buildings in A Zones

Building Elevation in Zones AE and A1-A30. The top of the lowest floor, including the basement floor, of all newly constructed, substantially damaged, and substantially improved buildings must be at or above the BFE.

Enclosures Below the Lowest Floor in Zones AE, A1-A30, AO, and A. Enclosed space below the lowest floors of newly constructed, substantially damaged, and substantially improved buildings may be used only for parking of vehicles, access to the building, or storage. The walls of such areas must be equipped with openings designed to allow the automatic entry and exit of flood waters.

Additional Minimum Requirements for Buildings in V Zones

The additional minimum requirements regarding newly constructed, substantially damaged, and substantially improved buildings in Zones VE, V1-V30, and V pertain to **Siting** : All newly constructed buildings must be located landward of the reach of mean high tide. **Building Elevation**: All newly constructed, substantially damaged, and substantially improved buildings must be elevated on pilings, posts, piers, or columns so that the bottom of the lowest horizontal structural member of the lowest floor is at or above the BFE. **Foundation Design**: A registered engineer or architect must develop or review the structural design, construction specifications, and plans for construction and must certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the building elevation and foundation design standards described above. **Use of Fill**: Fill may not be used for the structural support of any building within Zones VE, V1-V30, and V.

certifications and other documentation to determine compliance with federal, state and local regulations.

In 1990, to provide incentives for communities to adopt more stringent requirements, FEMA established the NFIP Community Rating System (CRS), a program through which FEMA encourages and recognizes community floodplain management activities that exceed the minimum NFIP requirements. Under the CRS, flood insurance premium rates within participating communities are adjusted to reflect the reduced flood risk resulting from community activities that meet the three goals of the CRS: (1) reducing flood losses, (2) facilitating accurate insurance rating, and (3) promoting the awareness of flood insurance.

North Myrtle Beach participates in the Community Rating System and is a Class 7 community. As a result, most property owners with a flood insurance policy receive a 15 percent adjustment in their annual flood insurance premium.

4.6 Floodplain Mapping/Data Maintenance

Identifying the floodplain is the first step in preventing flood problems. Most of the preventive and public information mitigation measures rely on a map to designate the areas affected and to help set appropriate protection standards.

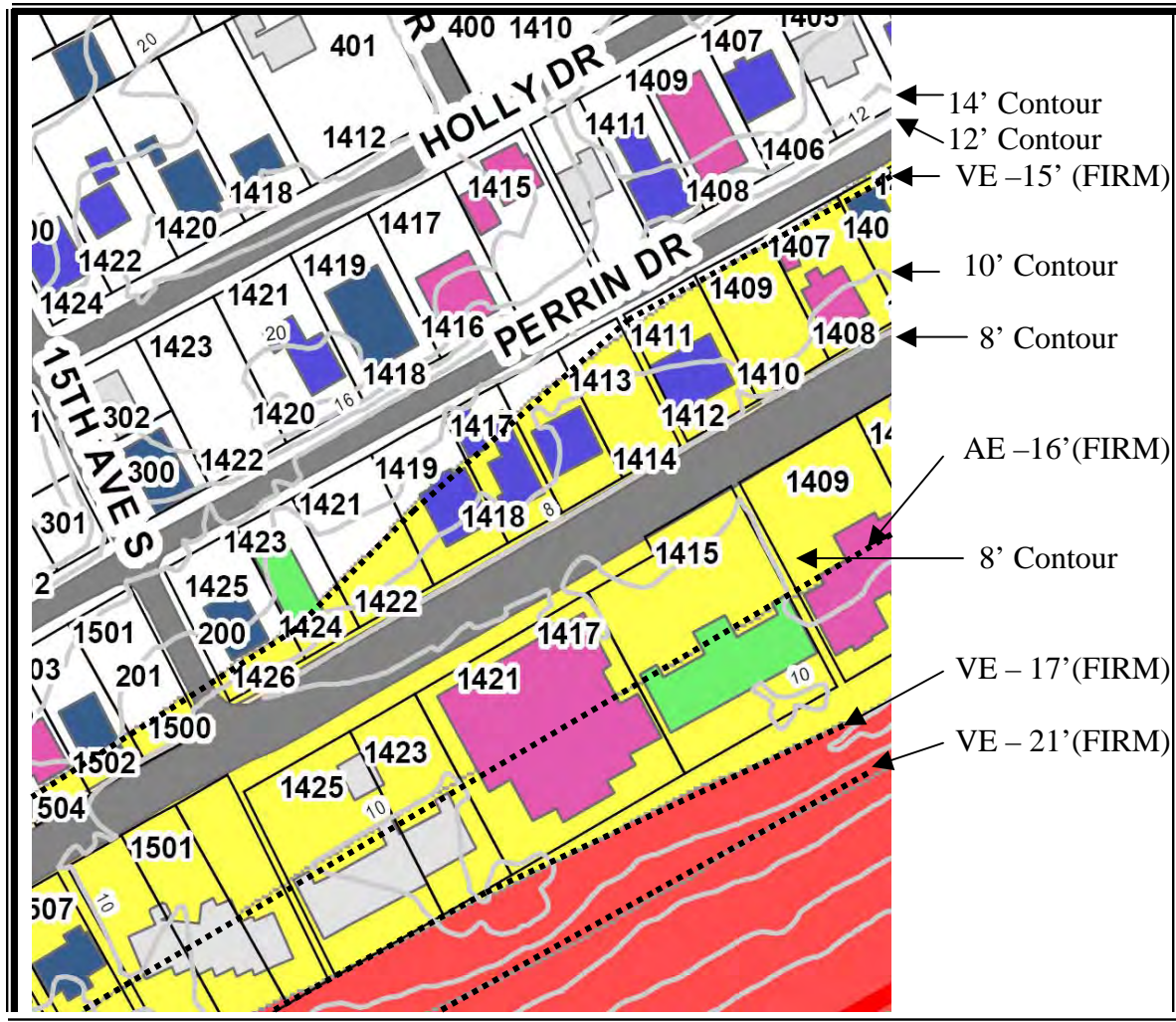
The term “mapping” include both a spatial display that shows the properties affected by flooding and the background data, such as discharges and flood elevations that are used as the basis for the map.

One important data source for riverine flooding is the flood profile. Because water runs downhill, the flood elevation is not constant. A profile is a graph that relates flood elevations to horizontal points along a channel as it flows downstream. Seventh Avenue Stream in North Myrtle Beach is mapped with a floodway.

The nation’s primary floodplain mapping program is conducted by the Department of Homeland Security - FEMA for the National Flood Insurance Program. Flood Insurance Rate Maps (FIRMs) and their accompanying Flood Insurance Studies provide data on the areas affected by the base or 100-year flood, the 500-year flood, and the regulatory floodway.

North Myrtle Beach was provided its first FIRM in 1977. This was last revised when a county-wide map was published in August 1999. The map comes in several panels that show the floodplain and the floodway. The Flood Insurance Study includes the background data, such as the study techniques, discharges and profiles. The City provided planimetric data based on 1990 aerial photography for the latest flood study.

Figure 4.1 Land Use, Topography and Flood Hazards Map



Current Practice in North Myrtle Beach:

The City maintains the flood insurance study data (100- and 500-year flood zones, V-zones and floodway boundaries) in its Geographic Information System (GIS) as overlay layers (See Figure 4.1 Example above). The flood hazard data can be combined with topographic contours, buildings with parcel boundaries and street address, building use classification and building footprint. The GIS also includes corporate limits and streets and is linked to tax parcel information and zoning designation. Repetitive flood loss properties identified by FEMA are included in the GIS as an overlay with restricted access. Finally, to aid surveyors, engineers and City staff, North Myrtle Beach maintains elevation reference marks, checking them at least every two years.

Data available from the system makes administration of the community's regulations more effective and efficient. Additionally, the City receives 153 CRS credit points towards its classification and increases the flood insurance premium adjustment for policy holders.

When FEMA prepared the 1999 Flood Insurance Study for North Myrtle Beach, the most recent USGS topographic data was used as a base for delineating the flood zone boundaries. The City has better topographic data based on a 2002 survey and is available at two-foot contour intervals.

As illustrated in the example in Figure 4.1, the accuracy of the flood risk on the current maps could be improved by using the latest topographic data. In this example the current flood zones have been overlaid on the City's Land Use Map. The red area is the current VE-Zones and the yellow represents the current AE-Zones. In both cases the current flood zone boundaries do not match the risks as depicted by the City's topographic maps.

Recommendation

The City should become a Cooperating Technical Partner for flood hazard mapping with the State and DHS – FEMA. Under this partnership the City should undertake a redelineation or restudy of its flood hazards.

4.7 Floodplain Open Space Preservation

Keeping the floodplain free from development is the best approach to preventing flood damage. Preserving vacant natural areas also has recreational benefits and preserves these areas' natural and beneficial functions. These functions include:

- storage of flood waters
- lowering peak flood flows by slowly releasing storm water over time
- absorbing overland flood flow through infiltration
- recharging aquifers through infiltration
- filtration of hazardous materials and excessive nutrients
- habitat for riparian species

Open space can be preserved through a variety of methods, including:

- establishing parks in the floodplain
- acquiring vacant floodprone land
- enacting restrictive zoning requirements to prevent construction of buildings
- requiring buffers or setbacks from a waterway
- purchasing or dedicating easements

The simplest method is to acquire lands and preserve them as parks. There are several alternatives to public acquisition and ownership of open space lands. One is a public-private partnership that shares the load of purchasing, developing and managing the property. Often the financial and legal responsibility can be easier to manage through a public entity and the management is conducted

by private non-profit or volunteer organizations.

Easements are another alternative to preserving open space. There are various types, including:

- conservation (the owner agrees to keep it in a natural state)
- public access (the owner agrees to allow public access across the land)
- drainage (the owner agrees to keep the area open for flood flows)
- maintenance (the owner agrees to allow maintenance crews on the property)

In all of these, the owner keeps possession of the land but benefits by a reduction in property taxes. The community benefits by increasing the amount of open space that can be preserved without paying for the full property value and being responsible for maintaining the land. Often a local land trust legally “holds” the easement and is responsible for the annual oversight.

Open space lands and easements do not always have to be purchased. Developers can be required to dedicate park land and flood flow, drainage, or maintenance easements. Maintenance easements also can be donated by existing streamside property owners in return for a community channel maintenance program.

Current Practice in North Myrtle Beach:

The City has three recreational areas in floodprone areas:

<u>Name</u>	<u>Location</u>	<u>Facilities</u>
City Park	1 st Avenue South on Oceanfront	Restrooms, Parking, Concessions, Benches
Hill Street Park	Hill Street and 24 th Avenue N.	Playground, Picnic Area and Tennis Court
Russell Burgess Coastal Preserve	Lake Drive in Cherry Grove	Access to Natural Resource Areas and Parking

None of these properties preserves much land from development, but they do provide facilities for visitors to the floodplain. There are a couple of other small publicly owned areas in the City’s mapped floodplains used for boat ramps.

4.8 Low-Density Zoning

Density ordinances can be applied within floodplains, in the surcharge area along the coast, or any other area that can be demonstrated as a high-risk zone. Local

governments lower the allowable intensity of development in hazardous areas to prevent intense private development within areas delineated as high-hazard.

There are two primary ways to regulate residential development density: set maximum housing density or set minimum lot size. In terms of floodplain development, both approaches are complemented by limits on the percentage of impervious surface within parcels.

Current Practice in North Myrtle Beach:

Most of North Myrtle Beach's zoning districts are traditional residential and commercial zones that do not require lots larger than 10,000 square feet for single-family residential use. There is a "conservation/preservation" district that has a minimum lot size requirement of 5 acres. Two large marsh areas in the City are zoned Conservation Preservation (CP). The largest is located in the northern end of the City and is known as the Cherry Grove Marsh. The other is located in the Windy Hill section and is a large marsh that borders US 17 in the vicinity of 46th Avenue South. The CP zoning limits the potential use of these sites to recreational activities such as fishing piers and nature walks.

4.9 Planned Unit Development

These types of regulations allow the flexible design of large- or small-scale developments that are constructed as a unit. While the actual design is a matter of negotiation, the basic premise is that some areas are developed more intensively than would normally be allowed and others are used less. The average density of the site remains at or near the allowable limit.

Planned unit development (PUD) places regulations on an area rather than on individual lots and allows for mixed use. Since PUDs are typically negotiated between the developer and city officials on a project-by-project basis, this approach allows for flexibility in meeting subdivision regulations. Clustering typically refers to the concentration of housing on a portion of a site. Clustering can be integrated into a zoning code instead of being negotiated.

Shifting density away from hazard-prone areas is a good way to limit development in these areas without instigating a 'taking.' In shorefront areas, PUDs are generally used to encourage property owners to cluster buildings on the inland portions of their parcels, while reserving areas adjacent to the beach for recreational open space and parking.

Current Practice in North Myrtle Beach:

The City's Zoning Ordinance includes a PUD District. One of the stated purposes of the district is "to preserve the natural and scenic features of open areas. The minimum lot size for a PUD designation is two (2) acres. At least fifteen (15)

percent of this area must be developed into common open space. Most of the land between the Intercostal Waterway and the ocean has already been developed or subdivided. Thus, in this area little floodplain land is expected to be preserved as open space as a result of the PUD regulations. As the City expands across the Waterway this situation is expected to change. Recently the City annexed an area west of the Waterway called Barefoot Resort. This 2,300 acre development is being developed under the City's PUD regulations. As a result, a significant number of acres will be developed as common open space; however, a detailed flood hazard analysis has not been completed in this area so it is not known how many acres are located in the floodplain.

4.10 Subdivision Regulations

Subdivision regulations govern the division of land for development or sale. In addition to controlling the configuration of parcels, they set standards for developer-built infrastructure. Many communities include developer exactions and impact fees/system development charges in their subdivision regulations.

Subdivision regulations can be used for mitigation purposes in several ways. They primarily prohibit the subdivision of land subject to flooding. When hazard zones can be identified on a map of the parcel, communities may require minimum distances between those zones and development. If land dedications are required as part of the subdivision regulation, they can be used to reserve hazard-prone land for non-intensive uses.

Subdivision regulations may also set a standard for public infrastructure that ensures it is adequate for the assessed risk. For example, the installation of adequate drainage and stormwater management facilities should be required in flood-prone areas. If local governments are responsible for managing of developer-built infrastructure, they should require that all improvements be built to hazard-resilient standards. This may help reduce the public cost of post-disaster reconstruction.

Subdivision regulations can require that developments be built in a hazard-resilient manner. In order to reduce fire risk, for example, subdivision ordinances may require wide building spacing, fire breaks, on-site water storage, and multiple access points. They should require "deep" lots in shorefront areas. These lots allow homes to be moved inland on the same parcel in the case of shoreline erosion.

The site plan review stage is another time at which it is possible to require developers to site buildings away from hazard-prone portions of the area. Local governments may require mitigation actions, such as the protection or creation of wetlands, dunes or natural vegetation, as a condition of subdivision approval.

Some experts recommend establishing land use restrictions for each property before it is subdivided. After a property is subdivided, the various owners may demand compensation for the loss of use of their property. As a result, the city might have to acquire land that it could have otherwise regulated without a purchase.

Subdivision regulations are not as broad as zoning and only indirectly affect the quality and type of development that occurs on subdivided land. Since these regulations apply only when land is subdivided and sold, they do not address development of small or undivided parcels of land.

Current Practice in North Myrtle Beach:

The North Myrtle Beach Subdivision Regulation establishes procedures and rules to provide for the timely provision of required streets, utilities and stormwater management facilities; and for the separation of buildings for fire safety and open space.

Section 20-23 (b) (13) requires the areas subject to inundation by a 100-year flood to be shown on the final plat. Subdivision regulations also require that wetland areas be delineated upon preliminary subdivision plats. However, use of wetland areas remains within the regulatory realm of the United States Army Corps of Engineers and the Office of Coastal Resource Management.

4.11 Setback Regulations

The borders of natural hazard areas are often “fuzzy,” or difficult to define. Setbacks provide a margin for error in assessing where damage is likely to occur. The length of the required setback varies with the type and degree of hazard, as well as the type of development.

Current Practice in North Myrtle Beach:

Along the oceanfront the building location is determined by a setback line, which is established by using a mathematical formula based on the 40-year erosion rate in that area. New habitable structures must be built as far landward as possible and are limited to a maximum of 5,000 square feet. Special permits must be obtained to build seaward of the baseline. To qualify, the structure (usually a house) must be built as far landward as possible and have no impact on the primary sand dune or active beach area. If the beach erodes and the permitted structure becomes situated on the active beach, the property owner, at his or her own expense, must agree to remove the structure if so ordered by Office of Ocean and Coastal Resource Management (OCRM).

Additions located wholly or partially in the setback area are allowed, provided that the addition and the existing structure together do not exceed 5,000 square

feet of heated space. The additions must also be located no farther seaward than the existing structure. The linear footage of the structure, parallel to the coast, cannot be increased. Additions made totally landward of the setback area do not require any notice to OCRM.

Proposed Prevention Measures in North Myrtle Beach

As indicated in Chapter 2 current programs and regulations do not address all of the issues that can cause property losses and business interruption. These additional measures address some of the remaining property loss issues.

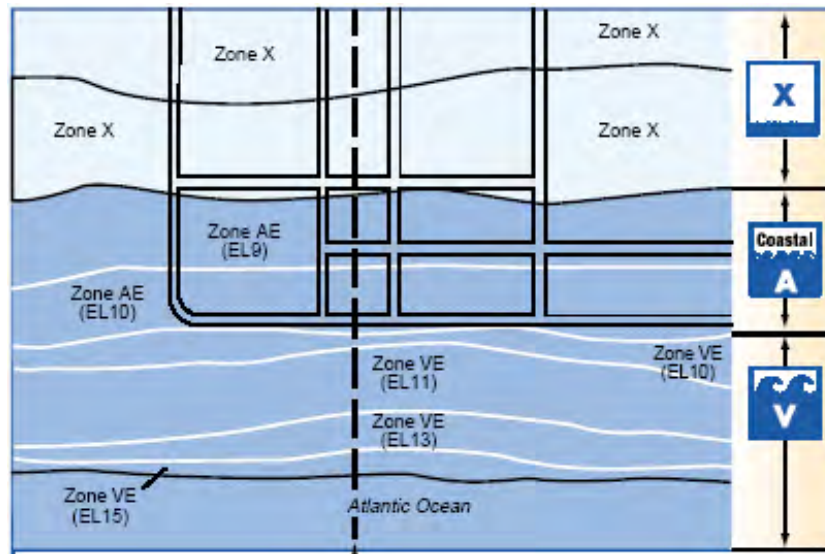
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|---|--|
| 4.12 Coastal AE-Zone Regulations | 4.16 Critical Facility Regulations |
| 4.13 Enclosure Regulations | 4.17 Advanced Acquisition |
| 4.14 Freeboard Regulations | 4.18 Wildfire Protection |
| 4.15 Cumulative Substantial Improvement
and Substantial Damage Regulations | 4.19 Regulations for Additions to
Buildings |

4.12 Coastal AE-Zone Regulations

The NFIP regulations do not differentiate between coastal and non-coastal A zones. Because coastal A zones may be subject to the types of hazards present in V zones, such as wave effects, velocity flows, erosion, scour, and high winds, **this proposal recommends that buildings in coastal A zones meet the NFIP regulatory requirements for V-zone buildings.**

The criteria for construction in A Zones do not provide adequate protection in coastal AE Zones subject to wave effects, velocity flows, erosion, scour, or combinations of these forces. Wave tank studies conducted by FEMA show that breaking waves less than the 3-foot criteria used to designate VE Zones can cause considerable damage. Post-disaster evaluations and insurance claims data also support this conclusion, particularly for those buildings with enclosures below the elevated floor. FEMA's current regulations do not adequately address this situation and contribute to communities like North Myrtle Beach having a high number of repetitive loss properties.

Typical Coastal FIRM



Section 431.p.2.(a) of the *CRS Coordinator's Manual* provides up to 500 points for local governments that adopt and enforce NFIP requirements for V Zones in areas it identifies as its coastal AE Zone. Up to 150 additional points are available under Section 431.p.2.(b) if the community adopts higher standards that prohibit or regulate the size of enclosures under elevated buildings in the coastal AE Zone.

The proposed regulations would apply to areas mapped as A-Zones seaward of US Highway 17. The current code would be amended to require new construction, substantially damaged and substantially improved structures within this area to meet the following standards:

a. Foundation Design

For buildings in the designated coastal AE-zone the piling or column foundations for all newly constructed, substantially damaged, and substantially improved buildings, as well as the buildings attached to the foundations, must be anchored to resist flotation, collapse, and lateral movement due to the effects of wind and water loads acting simultaneously on all components of the building. A registered engineer or architect must develop or review the structural design, construction specifications, and plans for construction and must certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the building elevation and foundation design standards described above.

In addition, erosion control structures and other structures such as bulkheads, seawalls, and retaining walls may not be attached to the building or its foundation.

Fill may not be used for the structural support of any building within the designated coastal AE-zone. Fill may be used in the designated coastal AE-zone for minor landscaping and site drainage purposes.

The NFIP's Community Rating System provides substantial insurance credits when local governments apply these standards within its coastal AE-zone. The following CRS credits, subject to the impact adjustment described in Chapter 1, are available to North Myrtle Beach upon adoption of the proposed regulations.

Foundation. (225 Points.)

Meets all of the following:

- A. New construction and substantial improvements are elevated on piles and columns (60.3(e)(4))
- B. The pile or column foundation and the structure attached are anchored to resist floatation, collapse, and lateral movement due to the effects of wind and water loads (60.3(e)(4)(ii)).
- C. New construction and substantial improvements have the space below the lowest floor free of obstruction or enclosed with non-supporting breakaway walls, open wood lattice work, or insect screening (60.3(e)(5)) and have openings (60.3(c)(5)).
- D. Use of fill for structural support is prohibited (60.3(6)).

[Note: If the requirements of paragraph C. are not met, foundation credit will be reduced.]

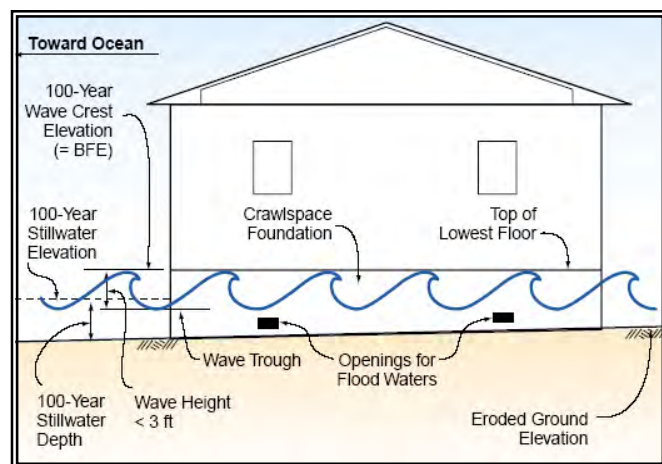
Structural Design, Specifications and Plans. (125 points.)

A registered professional engineer or architect shall develop or review the structural design, specifications, and plans and certify the designs and methods of construction to be used meet accepted standards of practice for meeting the provisions of (60.3(e)(4)(ii) and breakaway walls (60.3(e)(5)).

b. Reference Elevation

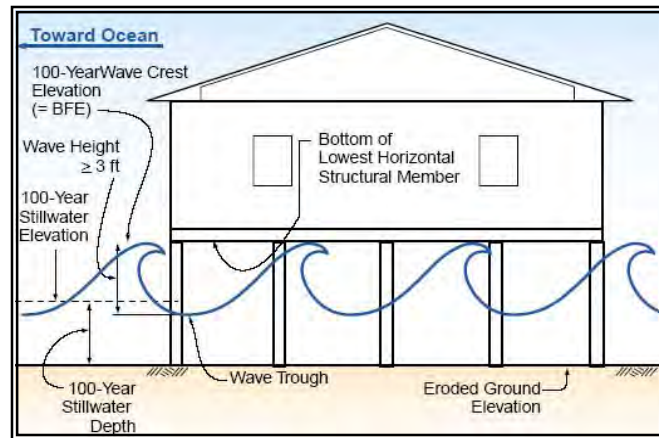
All newly constructed, substantially damaged, and substantially improved buildings must be elevated on pilings, posts, piers, or columns so that the bottom of the lowest horizontal structural member of the lowest floor (excluding the vertical foundation members) is at or above the BFE.

The NFIP's Community Rating System provides substantial insurance credits when local



Current A-Zone Elevation Reference Point

governments use the bottom of the lowest horizontal member as the reference point for elevation requirement within its coastal AE-zone. The following CRS credits, subject to the impact adjustment based on the percentage of the floodplain affected by the regulation, are available to North Myrtle Beach upon adoption of the proposed regulations.



Proposed Elevation Reference Point

Reference Elevation. (100 points.)

The bottom of the lowest horizontal structural member, and electrical and mechanical equipment servicing the building must be elevated to or above the BFE. (60.3(e)(4)(i).

[Note: These points can be approved when the community regulations require two or more feet of freeboard in the coastal A zone area, but use the top of the lowest floor as the reference point; however, a community cannot earn both Freeboard (FRB) and CAZ reference elevation credit for the same two feet of freeboard. To earn freeboard credit the community would need to prorate the credit for freeboard greater than two feet.]

c. Siting

Along the oceanfront all newly constructed buildings must be located landward of the reach of mean high tide (i.e., the mean high water line). In addition, manmade alterations of sand dunes are prohibited if those alterations would increase potential flood damage. Removing sand or vegetation from, or otherwise altering, a sand dune may increase potential flood damage; therefore, such actions must not be carried out without the prior approval of a local official.

When local governments regulate the siting of buildings in accordance with these standards within its coastal AE-zone the NFIP's Community Rating System provides insurance credits. Subject to the impact adjustment described earlier, CRS insurance credits (up to 25 points) are available to North Myrtle Beach for requiring all new construction to be located landward of the reach of mean high tide.

Along the oceanfront the building location is determined by a setback line, which is established by using a mathematical formula based on the 40-year erosion rate in that area. New habitable structures must be built as far landward as possible and are limited to a maximum of 5,000 square feet. Special permits must be obtained to build seaward of the baseline. To qualify, the structure (usually a house) must be built as far landward as possible and have no impact

on the primary sand dune or active beach area. To receive this credit the City should ensure that the Office of Ocean and Coastal Resource Management (OCRM) do not issue any variances to the setback regulation.

Recommendation

The City should adopt coastal AE-Zone regulation that require buildings to be elevated on pile or column foundations, with the structure attached are anchored to resist floatation, collapse, and lateral movement due to the effects of wind and water loads, and without the support of fill. The space below the lowest floor must be free of obstruction or enclosed with non-supporting breakaway walls, open wood lattice work, or insect screening and have openings.

The rule should require a registered professional engineer or architect to develop or review the structural design, specifications, and plans and certify the designs and methods of construction to be used meet accepted standards of practice for meeting the provisions of V-Zone construction including, if used, breakaway walls for enclosures. Additionally, the reference elevation in this zone should be measured at the bottom of the lowest horizontal structural member.

Current Building Practice

To determine how the change in regulations would affect current construction practices, 30 elevation certificates were reviewed. All of the buildings were constructed since the most recent Flood Insurance Rate Maps were adopted by the City in 1999.

- New Piling Foundation Requirement

22 buildings out of 30 meet the new requirement = 73.3%

- New Elevation Reference Point (Bottom of Lowest Horizontal Structural Member)

29 of 30 buildings meet the elevation requirement = 96.6%

- Engineer/Architect Design Certification

30 of 30 buildings meet this requirement. = 100%
(Already required by building code due to
wind zone requirement.)

- Ensure no variances granted for oceanfront
Setback regulations. = 100%

Benefits of new regulation

1. Reduced flood damage to buildings and contents.
2. Reduce cost of debris removal following hurricane and flood disasters.
3. CRS credit points 475 x impact adjustment (based on the percentage of the SFHA subject to the proposed Coastal A-Zone Regulation)

Building Survey on Current Construction Practices

Property	Date	Zone	Base Flood	Lowest Floor	Diagram	Foundation	Enclosure
1	9/29/2000	AE	17	31.0	6	Piling	Y
2	6/19/2001	AE	17	30.9	6	Piling	Y
3	3/8/2001	AE	14	29.6	6	Piling	Y
4	4/7/2000	AE	14	17.9	5	Piling	
5	12/7/1999	AE	15	19.0	5	Piling	
6	7/13/2001	AE	14	19.2	8	Crawl Space	
7	3/8/2001	AE	14	18	6	Piling	Y
8	2/2/2004	AE	12	18.9	1	Slab-on-grade	
9	1/27/2004	AE	12	15.5	1	Slab-on-grade	
10	6/7/2004	AE	16	18.7	6	Piling	Y
11	2/4/2004	AE	12	14	8	Crawl Space	
12	8/21/2004	AE	13	21.6	6	Piling	Y
13	7/13/2004	AE	15	19.5	5	Piling	
14	4/9/2004	VE	18	22.1	5	Piling	
15	1/20/2004	AE	13	15.8	1	Slab-on-grade	
16	6/26/2004	AE	12	20.3	6	Piling	Y
17	6/8/2004	AE	12	19.1	6	Piling	Y
18	1/10/2003	AE	15	17.7	8	Crawl Space	
19	2/28/2001	AE	15	16.1	1	Slab-on-grade	
20	6/20/2002	AE	15	28.4	5	Piling	
21	2/16/2004	AE	15	23.4	6	Piling	Y
22	6/26/1905	AE	15	17.3	6	Piling	Y
23	4/27/2004	VE	16	24.9	5	Piling	
24	6/20/2002	AE	15	17.7	8	Crawl Space	
25	11/5/2002	AE	16	21.6	6	Piling	Y
26	12/23/2003	AE	16	25	6	Piling	Y
27	5/13/2004	VE	17	19.8	6	Piling	Y
28	9/11/2003	VE	17	22.4	6	Piling	Y
29	6/2/2004	AE	16	19.2	6	Piling	Y
30	2004	AE	16	22.1	6	Piling	Y

4.13 Enclosure Regulations

There are no NFIP restrictions on the size of the area that may be enclosed. However, V-zone buildings with lower area enclosures (constructed with breakaway walls) of 300 square feet or greater may be subject to higher insurance premiums due to the potential for increased loadings on the foundation system caused by the enclosure.

The area beneath the elevated superstructure of a V-zone building may be enclosed only with non-load bearing breakaway walls. Open lattice and insect screening may also be used in lower areas.

Uses of the area beneath an elevated building are restricted to parking, access, and storage; lower areas must not be finished or used for recreational or habitable purposes. No mechanical, electrical, or plumbing equipment is to be installed below the BFE.



Damage to Enclosed Area

Public Opinion Survey

In the public opinion survey 504 or 58% of the respondents said the City should prohibit enclosures below the base flood elevation. 128 or 16% of the respondents opposed prohibiting enclosures. 228 or 26% were not sure or had no opinion about limiting enclosures.

Current building practice, based on the review of 30 buildings identified above, shows that 53% of new buildings have enclosures below the elevated floor.

Recommendation

The City should adopt regulations that limit the size of enclosures to no more than 299 square feet. The enclosures should be constructed with non-load bearing breakaway walls with appropriate openings. Open lattice and insect screening may also be used in lower areas.

Uses of the area beneath an elevated building should be restricted to parking, access, and storage; lower areas must not be finished or used for recreational or habitable purposes. No

mechanical, electrical, or plumbing equipment is to be installed below the BFE.

Additionally, the permit applicant should be required to sign a non-conversion agreement. The regulation should apply to all building in the mapped special flood hazard area identified on the City's Flood Insurance Rate Maps.

Benefits – Adoption of this higher standard will prevent loss of life and property during flood events. Property owners will be discouraged from converting enclosed areas to living space, thus disqualifying themselves from flood insurance coverage. This higher standard will also reduce potential damage to foundation walls and the superstructure from hydrostatic and hydrodynamic pressures.

In addition, adoption of the standard will provide CRS credits as a 430 Series activity as well as Federal flood insurance cost reduction for both below BFE enclosure sizes and a possible CRS discount. When local governments enforce enclosure limits within the coastal AE-zone they are eligible for flood insurance credits as described below.

Coastal AE-Zone Enclosure Limits. (Up to 150 points.)

- 150 Prohibit all Enclosures
- 50 Limit Enclosures to 299 Square feet or less.

The enclosure points were added because FEMA was concerned that encouraging elevated structures would also encourage enclosures below the elevated building. Communities are eligible for these additional enclosure points only if they receive CAZ foundation credit. These points are in addition to the 300 points provided for in Section 430h of the *CRS Coordinator's Manual*.

Section 430h Enclosure limits (ENL) (Maximum credit: 300 points)

ENL is EITHER:

1. 300, if regulations prohibit ANY building enclosures, including breakaway walls, below the base flood elevation; OR
2. The total of the following points:
 - a. 100, if regulations prohibit enclosures of areas greater than 300 square feet, including breakaway walls, below the base flood elevation. The area enclosed must still meet all NFIP requirements for openings, anchoring, and flood-resistant materials.
 - b. 50, if regulations require that the owner of a building sign a nonconversion agreement, promising not to improve, finish, or otherwise convert the area below the lowest floor and granting the community the right to inspect the enclosed area.

Based on the above recommendation 200 CRS credit points awarded would be awarded to North Myrtle Beach.

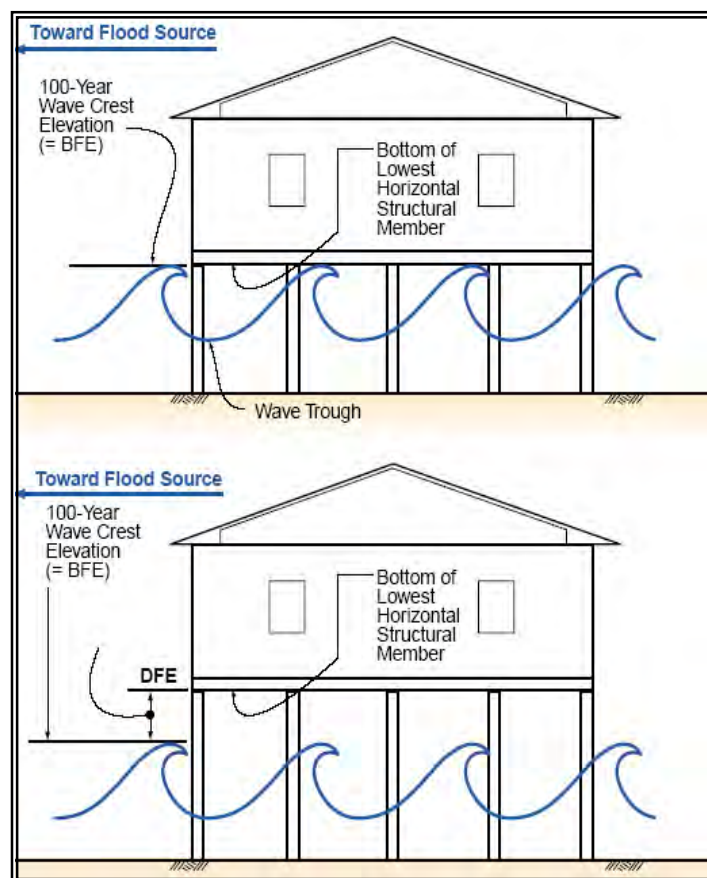
Cost Impacts – Adoption of this standard may cause a slight increase in the initial cost of construction of alternative foundation systems for structures in the floodplain, but it may give property owners a discount on their Federal flood insurance costs both for the limited size of below BFE enclosure as well as the community-wide CRS classification discount.

4.14 Design/Regulatory Flood Elevation (Freeboard)

The NFIP requires “all new construction and substantial improvements of residential structures within AE zones on the community’s FIRM, have the lowest floor (including the basement) elevated to or above the base (1% annual chance) flood level” (44 CFR 60.3I(2)). Within riverine special flood hazard areas, commercial structures may be floodproofed in lieu of elevation.

In coastal areas, the NFIP regulations require that “all new construction and substantial improvements in Zones V1-30 and VE on the community’s FIRM are elevated on pilings and columns so that (i) the bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to or above the base flood level” (44 CFR 60.3(e)(4)).

For CRS credit, freeboard must be applied not just to the elevation of the lowest



**Top Figure Illustrates NFIP Minimum V-Zone Standard
Lower Illustrates Additional Protection with Freeboard**

floor of the building or to the elevation to which a non-residential building is dry floodproofed, but also to the level of protection provided to all components of the

building. All building utilities, including ductwork, must be elevated or protected to the freeboard level and all portions of the building below the freeboard level must be constructed using materials resistant to flood damage.

North Myrtle Beach requires new construction and substantial improvement of all structures to have the reference floor elevation at least one foot above the 1% annual chance flood elevation. This vertical distance from the 1% annual chance water-surface elevation to the regulatory flood elevation is known as “freeboard.” This freeboard is a buffer zone to provide added protection for the structure to help prevent the entrance of floodwaters during a flood event.

The amount of freeboard a community adopts depends on local considerations. Factors that may contribute to the selection of freeboard include the desired level of additional protection, the potential rise due to future development, how sensitive the flood level is to changes in flow, the amount of insurance rate reduction that is available through the NFIP's CRS program, and economic impacts on development. Another major deciding factor may be development height limitations within a community.

Background of the Higher Standard – Some structures that are built to the minimum NFIP standards will be partially inundated during a 1% annual chance flood. With the reference floor elevated at the BFE, floodwater will be literally at door level under ideal conditions during a base flood. Any conditions that could increase flood levels such as debris accumulation at bridges and culverts, channel sedimentation, or wave action will cause further flood damage of the structure. Many communities discovered this in recent hurricanes, especially in areas that have shown high development since their current FIRM was actually published. The impervious surface areas added by these new developments increased runoff, possibly causing structures to be flooded even though they were constructed in compliance with minimum NFIP standards.

Guidance on Selecting the Higher Standard – The amount of freeboard a community should adopt may vary, even by flooding source. The flood profiles in the FIS Report may provide some guidance. If the difference between the 1% and 0.2% annual chance elevations is less than one foot, a community may choose to require only 1 or 2 feet of freeboard. For Stevens Avenue Stream, the differences in the elevations for the 1% and 0.2% annual chance floods is 3 feet and the city should consider a 3 foot freeboard in this area. Along the oceanfront the differences in the elevations for the 1% and 0.2% annual chance floods is between 1 and 2 feet and the city should consider a 2 foot freeboard in this area.

Recommendation

Assuming the City adopts the proposed coastal AE-Zone regulation the freeboard requirement should be increased to two feet. Even combining the elevation requirement on the proposed coastal AE-Zone with the current elevation requirement, 23 (76.6%) of the 30 buildings in the above survey would

meet the proposed requirements. Four more buildings, 13% are within four inches of meeting the new standard.

Benefits – Adoption of the standard may prevent loss of life and property because elevated construction is safer during flood events. The reference floor elevation has a direct impact on the Federal flood insurance rates. For a one-floor, no basement structure, for example, the annual flood insurance policy costs for \$100,000 coverage on a home with \$25,000 coverage on contents, are shown below in the Table below (May 1, 2002, rates):

Annual Flood Insurance Cost and Savings with Freeboard

Reference Elevation	AE Zone	Savings	VE Zone	Savings
One foot below the BFE*	\$2,055.00	N/A	1,915.00	N/A
Equal to the BFE	682.00	0	1,452.50	0
One foot above the BFE	431.00	251.00	1,117.50	335.00
Two feet above the BFE	284.00	398.00	832.50	620.00
Three feet above the BFE	254.00	428.00	667.50	785.00

*Reference floor elevation two feet or more below the BFE must be "Submit to Rate" in Washington, D.C.

The increased freeboard will result in safer construction as well as direct reduction in flood insurance costs as shown above. Also, if a community enforces freeboard, disaster recovery efforts and costs will be reduced and the community could receive recognition for this regulation as part of the 430 Series of the CRS, which in turn would further reduce the rates listed above. Each foot of freeboard provides up to 100 credits for a maximum of 300 points. As indicated in Chapter 1 the rate reductions under CRS are made in 5% increments related to 500-point credits.

Cost Impacts – Requiring freeboard will increase the initial construction costs for structures in the regulated floodplain. The floor level can be raised by increasing the height of the foundation. Raising the footprint of a 1,400 square foot house by 1 foot would cost approximately \$1,500 at the time of initial construction. Elevating the same house by 1 foot after initial construction would cost approximately \$30,000.

4.15 Cumulative Substantial Improvement and Substantial Damage Regulations

The NFIP allows improvements valued at up to 50% of the building's pre-improvement value to be permitted without meeting the flood protection requirements. Over the years, a community may issue a succession of permits for different repairs or improvements to the same structures. This can greatly increase the overall flood damage potential within a community as well as the insurance liability to the Federal Insurance Administration.

This proposed requirement has the effect of requiring more structures to come into compliance after a disaster because damage repair is included in "improvements" under the NFIP rules. Since the City participates in the NFIP it already has a substantial improvement threshold; therefore, it is only necessary to change the number of years specified in its ordinance that are to be used to calculate substantial improvements.

This Community Rating System provides credit to a community that ensures that the total value of all improvements or repairs permitted over the years does not exceed 50% of the value of the structure. When the total value does exceed 50%, the original building must be protected according to the ordinance requirements for new buildings.

Under some circumstances the NFIP flood insurance policy may pay part of the cost of bringing a substantially flood-damaged building into compliance with the community's floodplain management ordinance. This Increased Cost of Compliance coverage is described in the following Figure.

Increased Cost of Compliance

On June 1, 1997, the NFIP began offering "Increased Cost of Compliance" (ICC) coverage for buildings covered under the Standard Flood Insurance Policy (SFIP). ICC coverage provides for the payment of a claim to help pay for the cost to comply with community floodplain management ordinances after a flood event in which a building has been declared substantially damaged or repetitively damaged.

When an insured building is damaged by a flood and the community declares the building to be substantially or repetitively damaged, ICC will help pay for the cost to elevate, floodproof, demolish, or relocate the building up to a maximum of \$30,000. This coverage is in addition to the building coverage for the repair of actual physical damage from flood under the SFIP. An ICC claim can be filed whether or not a community has received a Presidential disaster declaration.

Increased Cost of Compliance (cont.)

The following conditions must be met for a substantially damaged building to be eligible for an ICC claim: A building is eligible for an ICC claim payment if it is in a Special Flood Hazard Area and if the community determines it has been damaged by a flood whereby the cost of restoring the building to its before-damaged condition would equal or exceed 50% of the market value of the building before the damage occurred, as determined by the community. All NFIP communities must have, at a minimum, a substantial damage provision in their floodplain management ordinance in accordance with the NFIP criteria.

***CRS NOTE:** By statute, an ICC claim can only be paid upon a substantial damage determination based on the NFIP's 50% damage criteria. An ICC claim will not be paid if the damage is less than 50% of the market value, even if the local ordinance declares the building substantially damaged. Communities receiving LSI credit for lower substantial improvement thresholds need to be aware that there may be times when their higher regulatory standard will not trigger an ICC claim payment for their residents.*

The following conditions must be met for a repetitively damaged building to be eligible for an ICC claim payment: A building is eligible for an ICC claim payment if it is in a Special Flood Hazard Area and is a repetitive loss structure and is subject to a community floodplain management ordinance. Two conditions must be met for an ICC claim to be paid under the SFIP for a repetitive loss structure:

1. The state or community must have adopted and be currently enforcing a repetitive loss provision or a cumulative substantial damage provision requiring action by the property owner to comply with the community's floodplain management ordinance, and
2. The building must have a history of NFIP claim payments that satisfies the statute's definition of "repetitive loss structure". A repetitive loss structure means "a building covered by a contract for flood insurance that has incurred flood-related damage on 2 occasions during a 10-year period ending on the date of the event for which a second claim is made, in which the cost of repairing the flood damage, on the average, equaled or exceeded 25% of the market value of the building at the time of each such flood event." *Note that this statutory ICC definition is not the same as the CRS definition of a repetitive loss property.*

The date on which the first loss occurred, even if the loss occurred before June 1, 1997, is immaterial to eligibility for an ICC claim payment, as long as the state or community enforced a repetitive loss or cumulative substantial damage requirement on the building and the insured building satisfies the definition of the "repetitive loss structure" defined above.

***CRS NOTE:** Communities receiving CSI credit for a cumulative substantial improvement regulation must be aware that there may be instances in which the community's criteria may require compliance with its floodplain management ordinance, but the building may not qualify for an ICC claim payment (e.g., if a building is damaged three times with each flood averaging 20% damage).*

Source: DHS – FEMA CRS Coordinator's Manual, 2002

4.16 Critical Facilities Regulations

Current Minimum Standard – The NFIP regulations only require elevation of structures located in SFHAs to the BFE, regardless of the function they serve. Facilities belonging to agencies of the Federal Government are subject to Executive Order 11988, which requires rigorous alternative site evaluations before funding, leasing, or building any facility in the 100-year floodplain. The guidelines for implementing Executive Order 11988 set the 500-year flood as the standard for protecting “critical actions.”

Background of the Higher Standard – Many public and commercial facilities serve vital functions for communities, which, if interrupted due to flooding, would severely impact citizens. Also, some facilities house large numbers of people who would experience difficulty if required to evacuate before or during a severe flood. Special consideration should be given to requiring a higher level of protection from flooding for such facilities.

Since flooding can prevent access to a critical facility even if the facility is elevated or floodproofed above the flood level, primary consideration should be given to locating critical facilities where the risk of flooding is minimal.

Statistically, a facility located in a SFHA stands a 26% chance of experiencing the 100-year flood in a 30-year period. On the other hand, a facility located outside a 500-year floodplain (i.e., in a C Zone or “unshaded X Zone” as shown on the FIRM) stands less than a 6% chance of being flooded over a 30-year period.

Recommendation

The City could prohibit siting of critical facilities in areas subject to flooding by the 1% annual chance flood (SFHAs) and should discourage siting of critical facilities in areas subject to flooding by the 0.2% annual chance (500-year recurrence interval) flood.

If no feasible alternative site is available for a newly constructed facility, or if an existing critical facility located in a SFHA or 500-year floodplain is substantially damaged or improved, it should be elevated to at least the 0.2% annual chance flood elevation and be accessible by road during a 0.2% annual chance flood event.

If a proposed critical facility site is in or near a SFHA for which the 0.2% annual chance flood elevation is not determined and the 500-year floodplain has not been delineated, a flood study should be performed to determine this information before the facility is sited.

If locating critical facilities outside of 500-year or even 100-year floodplains is not an option, elevation to the level of the 0.2% annual chance flood offers

almost the same level of protection from flooding for the facility and its contents. Requiring elevation above the 500-year flood level provides an additional level of protection if floodwaters rise higher than predicted 500-year levels due to debris accumulation or other factors.

For some facilities, floodproofing to the same elevation will provide a similar level of protection. However, since all-weather access is generally necessary either to maintain operations or to evacuate the occupants, it will be necessary to provide an elevated access road to facilities located inside the 100-year or 500-year floodplain. When evaluating where to locate a critical facility, the additional cost to elevate or floodproof and to provide all-weather access if the facility is located in a floodplain should be fully considered.

The City should consider requiring that the following categories of facilities be subject to these requirements:

- i Emergency response facilities, including rescue/emergency medical services, police departments, fire departments, hospitals, health clinics, emergency shelters, emergency management operations, and communication facilities.
- ii Facilities housing vulnerable occupants, such as nursing homes, prisons, jails, centers and group homes for the mentally and physically handicapped, and day-care centers.
- iii Public utilities, including power generating plants and transfer stations, public water supply plants, solid waste incinerators and waste transfer stations, and wastewater treatment plants.
- iv Facilities housing irreplaceable public documents, such as libraries, museums, courthouses, colleges, and schools.
- v Hazardous material facilities, such as liquid and gas fuel tanks, petrochemical facilities, chemical manufacturing and storage facilities, research laboratories testing infectious biological agents, explosive manufacturing and warehousing, toxic waste facilities, and landfills.

Benefits – Adoption of this higher standard may prevent loss of life and property during flood events by ensuring that services provided by critical facilities are not interrupted during and after major flood events. In addition, adoption of the standard will provide CRS credit points as a 430 Series activity. Communities that prohibit siting critical facilities in the 500-year floodplain receive 100 CRS credit points; communities that only require protection from damage (i.e., elevation or floodproofing) and loss of access as a result of the 500-year flood or the flood of record, whichever is higher, receive 50 CRS credit points.

Cost Impacts – Restricting critical facility sites to locations outside of SFHAs and 500-year floodplains may increase costs if land prices are higher in non-floodprone areas. Requiring elevation or floodproofing and all-weather access for new and substantially improved structures built in SFHAs and 500-year floodplains may significantly increase facility costs.

4.17 Advanced Acquisition

Advance site acquisition, also known as land banking, involves the purchase of land by the government for future public facilities or for resale to the private sector. The goal is to influence the character and/or timing of growth.

Implementation Policies

1. The power of acquisition can be a useful tool for pursuing mitigation goals. The City may find the most effective method for completely hazard-proofing a particular piece of property is to remove it from the private market, thereby eliminating or reducing the possibility of inappropriate development. Given its cost, this technique should be used only for property in the most hazardous areas, where property and life is subject to repeated damage or extreme risk.
2. Properties subject to repeated damage or extreme risk should not be returned to the marketplace.

Financial Approaches to Implementation

Municipalities may acquire sites in advance through the power of eminent domain, in conjunction with official maps or master plans. Acquisition through purchase is also possible.

Acquisition Disadvantages

Fee-simple purchase is usually the most expensive method of land acquisition. In addition to the cost of buying the property, a local government must delete the property from its property tax rolls and assume its maintenance costs.

Acquisition Advantages

By exercising control over the release of land for development, a local government can avoid the private development of hazardous parcels. It can also ensure that less hazard-prone property is available for siting public facilities, such as schools or emergency services departments.

Acquisition of vacant at-risk properties and shoreline is an alternative to acquisition and demolition that should be explored. If shoreline properties can be purchased prior to the development of erosion-prone lots, this technique may be less expensive than disaster assistance payments and acquisition in the long run; however, after development has occurred, acquisition may be prohibitively expensive unless Federal assistance is available.

Recommendation

The City should look for advanced acquisition opportunities.

4.18 Wildfire Regulations

High rates of construction along the edge of forests (known as the urban-wildland interface), combined with a century-long policy of fire suppression in these areas are creating an ever-growing risk of damaging fires. Wildfire mitigation techniques reduce this risk by limiting the number of structures in high-risk areas or by increasing their fire resistance.

Implementation

Most structures that are destroyed in a fire are lost in the first few hours. Many of these losses could be prevented or reduced through the use of fire-resistant landscaping and building practices. Flammable vegetation should be removed or relocated away from buildings and facilities. Where necessary, fire-resistant plant species can be planted as a replacement.

Building codes may require that roofs be finished with fire-resistant materials such as slate, tile or metal roofing. Clearing brush, creating fuel breaks and staging controlled burns are all excellent methods for reducing flammable material and limiting the area in which a fire could spread. Fuel break construction should be a part of any open space management program. However, it should be noted that fuel breaks alone will not stop a fire: the 1991 Oakland Fire jumped an eight-lane highway. Rather, fire breaks are designed to allow firefighters a chance to attack a fire.

The factors that determine adequate fire protection include: zoning regulations, fire and building codes, and basic fire protection infrastructure. Buildings that are close together, poorly constructed, or difficult to reach with firefighting equipment are most at risk for fire damage. Many effective fire mitigation efforts, such as planting and re-roofing, require the cooperation of individual homeowners. Other techniques, such as mandatory large-lot zoning, clearing vegetation or replacing native species may raise equity or environmental concerns.

The Fire Chief is currently studying the wildfire potential in North Myrtle Beach with plans to make recommendations on actions the City should take to protect its citizens.

Recommendations

1. The City should ensure adequate staffing, training, equipment, facilities and water supply to maintain the Class 3 standing in the Fire Insurance Rating Schedule.

2. Wildfire mitigation recommendation being developed by the Fire Chief should be considered for incorporation in this mitigation plan.

4.19 Regulations for Additions to Buildings

Additions are improvements that increase the square footage of a structure. Commonly, this includes the structural attachment of a bedroom, den, recreational room garage or other type of addition to an existing structure. All additions to a post-FIRM building must be elevated at least as high as the BFE in effect when the building was built. A compliant building must not be allowed to become noncompliant by allowing additions at grade. If a new, higher BFE has been adopted since the building was built, additions that are substantial improvements must be elevated to the new BFE.

There has been some confusion about how additions should be regulated. The current code should be examined for possible clarification.

Recommendation

Prepare regulations that govern the flood protection requirements for additions (other than enclosures described above) to existing buildings. Consideration should be given to the adoption of regulations that specify where the addition is within the footprint of the original building the addition must be to a floor at or above the regulatory flood elevation. And, where additions are outside the footprint of the original building they would be required to be elevated at or above the regulatory flood elevation.

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Chapter 5 Property Protection

Property protection measures are used to modify buildings or other facilities subject to flood damage rather than to keep floodwaters away. Often they are implemented by (or cost-shared with) property owners. There are a variety of flood protection measures that can be implemented to protect individual buildings from flooding: They include

- | | |
|--------------------------------|-------------------------|
| 5.1 Acquisition and Demolition | 5.5 Lifeline protection |
| 5.2 Acquisition and Relocation | 5.6 Flood insurance |
| 5.3 Building Elevation | 5.7 Windproofing |
| 5.4 Floodproofing | 5.8 Safe Rooms |
| | 5.9 Seismic Retrofit |

5.1 Acquisition and Demolition

Acquiring a property in fee simple means buying the land outright. It provides a local government with the greatest level of control over the use and disposition of a parcel.

Fee simple acquisition can be used to meet several community objectives at once. One example would be the purchase of beachfront properties to ensure recreational access and reduce hazard risk. Acquisition can also be used where general land-use regulations are not sufficient or where environmental objectives are sought. Acquiring properties in the floodplain and reverting them to open space can restore the natural function of the floodplain or wetlands. Similar gains can be made if parks and recreation areas replace flood-prone buildings. Acquisition policies could also target beachfront properties where redevelopment would be permitted under current regulations but would impact the beach and dune system.

Implementation Policies

1. The power of acquisition can be a useful tool for pursuing mitigation goals. The City may find the most effective method for completely hazard-proofing a particular piece of property is to remove it from the private market, thereby eliminating or reducing the possibility of inappropriate development. Given its cost, this technique should be used only for property in the most hazardous areas, where property and life is subject to repeated damage or extreme risk.
2. Acquisition, followed by demolition, is most appropriate for buildings that are too expensive to move -- such as larger, slab foundation, or masonry structures -- and for dilapidated structures that are not worth protecting.

3. Properties subject to repeated damage or extreme risk should not be returned to the marketplace.
4. The City should look for acquisition opportunities where it may not need to pay full price for damaged structures acquired in the wake of a disaster. Sometimes a property can be purchased for the difference in value between its full price and payments already made to the landowner, such as insurance settlements and Small Business Administration loans.
5. Checkerboard purchases should be avoided whenever possible since dispersed properties are more costly and difficult to maintain.

Financial Approaches to Implementation

1. The City should apply for funding to pay for 75% of the fair market value of the substantially damaged buildings and their lots. Funds may be available from the Flood Mitigation Assistance (FMA) and Hazard Mitigation Grant Programs (HMGP).
2. If the funding is received, a property appraiser would prepare a formal appraisal of the pre-flood value of each lot and building. Those without flood insurance would be offered 75% of this appraised amount. For example: if a property is appraised at \$100,000, the owner would be offered \$75,000. The owner in effect absorbs the difference which is credited to the project as the non-federal share.
3. Those who did have flood insurance will have the amount of the flood insurance claim payment subtracted from the property value. The offer would be 75% of the balance. For example: If the property is valued at \$100,000 and the owner received a claim payment for \$60,000, the offer would be 75% of \$40,000 or \$30,000. In the end, the owner would have received a total of \$90,000.
4. The property owners can decide if they need more than 75% of the appraised value. Whether they were insured or not, they can apply for an SBA loan. This can help pay the costs for a new property. For example: a property was appraised for \$100,000 and the owner receives \$75,000 for it. There is still a \$50,000 mortgage payment. The owner pays off the mortgage and uses the remaining \$25,000 plus a low interest SBA loan to purchase a new place. The loan can also help pay for new furniture, etc.

Acquisition Disadvantages

Fee-simple purchase is usually the most expensive method of land acquisition. In addition to the cost of buying the property, a local government must delete the property from its property tax rolls and assume its maintenance costs.

Acquisition Advantages

Acquisition ensures that buildings in a floodprone area will cease to be subject to damage. Acquisition is undertaken by a government agency, so the cost is generally not borne by the property owner, and the land is converted to public use, such as a park. Acquiring and clearing buildings from the floodplain is not only the best flood protection measure available, it is also a way to convert a problem area into a community asset and obtain environmental benefits.

Recommendation

The City should develop a post-disaster recovery program that establishes policies and procedures that will be used to administer acquisition and demolition grants. Priority for the allocation of these funds should go first to acquire and demolish the most severe repetitive loss buildings in the highest flood hazard areas. The second priority should be buildings that suffer substantial damage and are in high hazard areas. The policy should identify the criteria to be used to determine the remaining priority categories for the use of these funds.

Some grant programs require a reuse plan for the vacant land to be submitted with the grant application. Programs like FEMA's Hazard Mitigation Grant Program require floodprone land acquired through the grant program to remain as open space. The City should consider how these acquisitions can assist in achieving other City objectives such as additions to parks, expanding natural areas, developing walking trails, and providing parking and access to the beach.

5.2 Acquisition and Relocation

Moving a building to higher ground is the surest and safest way to protect it from flooding. While almost any building can be moved, the cost goes up for heavier or rigid structures, such as those made of brick, and for large or irregularly shaped buildings.

Mobile homes and manufactured housing have been shown to be highly vulnerable to floods and should not be located in the floodplain. Where such housing can be relocated, this step should be taken.

Implementation Policies

Issues that need to be addressed in the planning stage include: cost-benefit comparisons of relocating structures intact or rebuilding; and whether buildings can be relocated on the same property or if new property must be acquired.

While relocation and acquisition work against any type of flood hazard, it is more cost-effective in areas subject to storm surge, flash flooding, deep waters, or other severe flood hazards where other property protection measures are not feasible. They are also often justified for properties that repetitively flood, are substantially damaged and/or where the occupants are kept out of the building for extended periods.

Relocation is also preferred for large lots with portions outside the floodplain or where the owner has a new flood-free lot available.

Financial Approaches to Implementation

See the discussion under Acquisition and Demolition above.

Relocation and Acquisition Disadvantages

The costs of a new lot, a new foundation, new utility connections, landscaping, moving fees and mitigation of the former site (including the removal of foundations, utility connections, concrete and asphalt) may outweigh the value of the structure. Adding to these costs is the fact that prices for lots outside the floodplain are often more expensive.

In addition to the cost of buying the building lot, a local government must delete the property from its property tax rolls and assume its maintenance costs.

Relocation and Acquisition Advantages

Relocation allows the City to remove a building from a hazard area, place it on a safer site and keep the building on the property tax rolls. The vacant lot may be converted to public use, such as a park. Like acquisition and demolition projects, acquiring and relocating buildings from the floodplain or other hazard areas is one of the most effective protection measures available, it is also a way to convert a problem area into a community asset and obtain environmental benefits.

Recommendation

The City should develop a post-disaster recovery program that establishes policies and procedures that will be used to administer acquisition and relocation grants. Priority for the allocation of these funds should go first to acquire and demolish the most severe repetitive loss buildings in the highest flood hazard areas. The second priority should be buildings that suffer substantial damage and are in high hazard areas. The policy should identify the criteria to be used to determine the remaining priority categories for the use of these funds.

5.3 Building Elevation

Raising a house above the flood level is the best property protection method short of getting the building entirely out of the floodplain. Water flows under the building, causing little or no damage to the structure or its contents. Another alternative is to raise the building and place fill under it before the building is lowered back down, although sometimes buildings on fill look safe and people may feel encouraged to stay in them during a flood.

Elevating a structure will change its appearance. If the house is raised two feet, the front door would be three steps higher than before. If the house is raised eight feet, codes will usually allow the lower area to be wet floodproofed for use as a garage and for limited storage of items not subject to flood damage.

Raising a building above the flood level is cheaper than moving it and can be less disruptive to a neighborhood. This protection technique is required by law for new and substantially damaged residences located in a floodplain if the lowest floor is below the base flood elevation. Commonly practiced in flood-prone areas nationwide, house-moving contractors know the techniques to elevate a building.

Elevated buildings are not new to North Myrtle Beach. Construction practices in the area favor the “elevated look” especially near the shoreline. Therefore, the method is tried and true and appearance is not a major problem.

Inland from the oceanfront the standard practice has been to build single-family homes on crawlspace foundations with the first floor two to three feet above grade or in some cases slab-on-grade construction is used.

Implementation Policies

FEMA has developed a set of criteria that may be used to evaluate whether a building can be elevated. It must be accessible below the first floor for placement of jacks and beams, it must be light enough to be lifted, it must be small enough to be elevated in one piece, and it must be strong enough to survive the elevation process.

Elevation of a building increases its vulnerability to high winds and earthquakes. Thus there is a need to incorporate wind and seismic protection measures to ensure that the flood protection project does not increase the building’s vulnerability to other hazards.

Financial Approaches to Implementation

See the discussion under Acquisition and Demolition above.

Elevation Disadvantages

Some think regulatory restrictions, such as the Americans with Disabilities Act (ADA) pose a problem for elevating structures. However, the regulatory requirements of the Americans with Disabilities Act and historic preservation programs do not affect single-family homes, the type of buildings that comprise approximately 90% of North Myrtle Beach's floodprone structures. While the City's building code does require wind and seismic protection standards, they do not add significantly to the cost of elevation.

Elevation Advantages

Elevation is one of the best techniques for protecting buildings that are, or for some reason must be, located in areas prone to flooding. Elevation is cheaper than relocation and is less disruptive to the neighborhood.

Where funds are not available to elevate a building, one less expensive way to reduce flood damage is to elevate only a structure's heating, ventilating, and cooling (HVAC) equipment, such as furnaces and hot water heaters. This equipment can often be moved to an upper floor or attic. However, relocating HVAC systems is likely to involve plumbing and electrical changes. A less desirable method of floodproofing this equipment is to build a concrete or masonry block floodwall around it in its existing location. This kind of floodwall must be strong enough and high enough to protect the equipment.

Electrical system components, including service panels (fuse and circuit breaker boxes), meters, switches, and outlets should also be elevated at least 1 foot above the 100-year flood. These components suffer water damage easily and could short and cause fires. By elevating electrical and mechanical equipment, buildings should be able to recover more quickly and less expensively.

Financial Approaches to Implementation

Several of the financial assistance programs, including FEMA's Home Repair Program and SBA loans can help fund these measures. FEMA's program aims to get people back in their homes quickly rather than pay for housing elsewhere. It covers items deemed necessary for "habitability" of a residence. People who qualify can receive additional funds for mitigation items, such as

- relocating the main electrical panel to a higher floor
- elevating the furnace or water heater to 1 foot above the experienced flood elevation within the crawlspace or basement but not to another floor.

Recommendation

The City should develop a post-disaster recovery program that establishes policies and procedures that will be used to administer elevation grants. Priority for the allocation of these funds should go first to elevate the most severe repetitive loss buildings in the highest flood hazard areas. The second priority should be buildings that suffer substantial damage and are in high hazard areas. The policy should identify the criteria to be used to determine the remaining priority categories for the use of these funds.

Some of the flooded buildings in North Myrtle Beach are houses on crawlspaces. Most of these had water under the flooring and were not substantially damaged. However, their heating, air conditioning and duct systems were often a total loss. Electrical circuits that were underwater were also in need of replacement.

Residents and businesses should be encouraged to include retrofitting measures in their building repairs. These could include:

- Moving the electrical box to a level above the high water mark.
- Moving the furnace, air conditioner and ductwork to a higher level. If there's no more room in the crawlspace, the system could be replaced with one in the attic where it will be high and dry.

5.4 Floodproofing

If a building cannot be removed from harm's way, it can be protected on site. In areas of low flood threat, such as infrequent low velocity shallow flooding, barriers and dry and wet floodproofing can be efficient approaches. These approaches can also be less disruptive to a neighborhood. However, floodproofing a residential building does not qualify for an insurance premium reduction and is not allowed if the project is a substantial improvement or repair of substantial damage.

Barriers

Levees, floodwalls and berms keep floodwaters from reaching a building. They are useful only in areas subject to shallow flooding. They can surround the entire building, tie into high ground, or be as small as a low floodwall built around a stairwell to protect a basement or split-level home. Care must be taken in locating barriers. They must be placed so as not to create flooding or drainage problems on neighboring properties. All barriers must be kept out of the floodway.

Dry floodproofing

Through dry floodproofing, a building on a slab foundation is sealed against floodwaters. All areas below the flood protection level are made watertight. Walls are coated with waterproofing compounds or plastic sheeting. Openings, such as doors, windows, sewer lines and vents, are closed, either permanently with removable shields or with sandbags.

The flood protection level should be no more than 2 or 3 feet above the top of the slab because the building's walls and floors may not withstand the pressure of deeper water. If a nonresidential building is dry floodproofed to one foot above the base flood elevation, there is a flood insurance rate reduction.

Wet floodproofing

This term means intentionally letting floodwaters into an area, but modifying the area to eliminate or minimize water damage. Wet floodproofing techniques can be as simple as moving a few valuable items or as involved as rebuilding the floodable area.

This is the preferred approach for crawlspaces and garages. If damageable items, such as furnaces, air conditioning units and ductwork are removed or elevated above the flood level, a crawlspace can be flooded and be damage free.

For other areas, wet floodproofing is usually considered a measure of last resort, because the modifications needed severely limit use of an inhabited area.

Implementation Policies

Barriers or dry floodproofing are more appropriate for buildings on slab foundations subject to shallow flooding. There are several commercial buildings on Main Street that would benefit from these approaches. They could also be useful for the slab buildings and small enclosed areas subject to local drainage problems. However, for this approach to be effective the property owners must receive adequate warning.

Floodproofing Disadvantages

Floodproofed buildings in the flood zone are still subject to damage from floating debris and may not provide shelter during flood events. Floodproofing a residential building does not qualify for an insurance premium reduction.

Dry floodproofing cannot extend more than two or three feet above the foundation of the building because the pressure exerted by deeper water would collapse most walls and floors.

It must be remembered that during a flood, the building may be isolated and without utilities, and therefore unusable. The streets, utilities and other infrastructure that serve the property will still be exposed to flood damage. This is also a risk to the occupants who may try to get in and out of the building during a flood.

Floodproofing Advantages

Although floodproofing raises construction costs, it is an effective mitigation tool and provides a high level of protection from water damage. Simply moving utilities, contents and electrical appliances out of the floodprone area can prevent thousands of dollars in damage.

Recommendation

Due to its disadvantages, floodproofing should be used as a last resort.

5.5 Lifeline protection

“Lifelines” include roads, railroads, pipelines, power lines, and other utility systems that are used for transportation or communication. They are vital to an area’s economic base and, depending on the situation, can be vital for public health and safety.

In most cases, well-constructed lifelines can resist the effects of high winds, and flooding, especially shallow, slow moving floodwaters. Protection measures vary according to the facility and flood conditions. Well-known engineering practices, such as proper siting and deeper foundations, can protect a new or existing facility, provided there is recognition of the full potential of the natural hazards.

As discussed in Chapter 1, lifelines affected by previous hurricanes and floods included streets and sewers, power, and phone lines.

Sewers

Commonly situated at low elevations, sewage lift stations often fall victim to flooding. Simple telemetry equipment offers early detection of high water levels at the lift, and timely response can keep the station operational.

The electronics of the lift stations have been raised above base flood elevation to protect the vital and costly switchboard. If the lift becomes disconnected from the City’s electrical grid, yet the onsite electronics remain dry and functional, service personnel can safely use a “quick connect” hook-up installed in the station to access power from an emergency generator.

Sandbagging has been determined not to be a feasible option by the City. When a hurricane is expected to make landfall or approach the beach so that lift stations may be flooded, one pump in the station is taken off-line for protection purposes. All lift stations have been wired to accept standby generators. Standby generators are stationed in reserve for deployment as needed.

Recommendation

Additional emergency generators should be purchased as funding becomes available. This will help maintain operations of the sewer system, permit earlier return of residents and visitors to the beach following a hurricane, and protect the environment.

Traffic lights and other traffic controls

Protect traffic lights and other traffic controls, and/or install resilient street signs for navigation in an emergency to avoid traffic signal malfunction, which can produce backups and accidents at intersections and subsequently impede evacuation or emergency response.

Housing for electronics should be watertight, and traffic lights securely connected to suspension wires. Arching or “trunk-and-branch” metal poles used to suspend traffic lights are more expensive; however, they are also more durable than wooden poles in the face of strong wind and water forces. For earthquake hazards, traffic hardware should be resistant to malfunction associated with jarring.

Finally, signs with street names should be resilient: emergency service crews from neighboring towns might join the rescue effort; presuming that personnel from outside the locality are unfamiliar with the road network, the survival of street signs could promote a timely response.

Recommendation

Continue the policy of protecting traffic lights from high winds to prevent them from becoming airborne.

Electric, telephone, and cable lines

Nationwide, falling trees and swinging tree limbs are the greatest source of power outages. In addition, tree limbs entangled in a frayed and sparking electrical wire create the perfect conditions for an uncontrolled fire. The force of tornadoes and hurricane winds is strong enough to torque high-tension wires from their connections on utility poles. Even if the wind does not break the wires, objects lifted by the high winds can catch upon and tear utility wires.

Recommendation

Continue the program to bury electric, telephone, and cable lines, and/or reinforces the connections on existing utility lines to avoid line damage resulting from high winds. Routinely clear tree limbs hanging in the right-of-way to prevent trees from damaging utility wires during high wind events. Take care not to trim more than is necessary to avoid denying citizens the shade and beauty that a full tree offers.

When ground is broken to bury lines, there is an opportunity to install high-speed Internet lines that are attractive to both business and the current generation of homebuyers.

Strips of easement land above buried wires are available as pedestrian or cyclist pathways, and this may also be seen as an opportunity for streetscape beautification by eliminating industrial-looking poles and overhead lines.

5.6 Flood Insurance

Increased Cost of Compliance Coverage and Regulations

The requirement for non-compliant buildings to achieve compliance after substantial damage is sustained has been part of the NFIP regulations since 1974. Standard NFIP flood insurance policies issued or renewed since May 1997 include coverage called Increased Cost of Compliance. This coverage is intended to help bear at least a substantial part of the cost of bringing a flood damaged building into compliance with the flood resistant provisions of the community's codes and regulations.

Most buildings insured under the NFIP that are declared "substantially damaged" by the community will qualify for an additional insurance claim payment of up to an amount stated in the flood insurance policy. This additional claim payment may also be used as part of the non-federal cost-share for certain federally funded flood mitigation grants.

Increased Cost of Compliance claim payments may also be available for insured buildings that sustain "repetitive flood losses", but only if the community has adopted a specific cumulative substantial damage provision that either meets or exceeds the definition in the standard flood insurance policy.

If eligible, a flood insurance policy holder can collect up to \$30,000 to help cover the cost of bringing their home or business into compliance with floodplain ordinances. For a policy holder to be eligible to file for ICC the City's floodplain administrator must determine one of the following:

- The property is "substantially damaged." This means the cost to repair the flooded building is 50% or more of its pre-disaster market value.
- The property sustained "repetitive damage." This term applies to homes or businesses that were damaged by flooding twice in the past 10 years, where the cost of repairing the flood damage, on average, equaled or exceeded 25% of the property market value at the time of each flood. Also, there must have been flood insurance claim payments for each of the two flood losses. To access the ICC flood policy benefit using this provision the City's floodplain management ordinance must have a repetitive loss provision.

To help property owners comply with these provisions in the City's building codes and floodplain ordinances, ICC can be used to help pay for any of these mitigation solutions:

- Elevating above the flood protection level required by the City code.
- Relocating to a new site.
- Demolishing the building.
- Floodproofing (non-residential properties only).

Recommendation

The City should undertake a study to see how many property owners would potentially benefit from the addition of a repetitive loss provision in the ordinance.

5.7 Windproofing

Windproofing is the modification of the design and construction of buildings to withstand wind damage. It typically involves improvements to the aerodynamics of a structure, the materials used in its construction, or the addition of features such as storm shutters. Windproofing can also help protect a building's occupants and their possessions from broken glass and flying objects.

Implementation

Several structural measures can significantly increase a buildings' wind resistance without raising the cost of construction by more than a few percent.

These include:

- using larger than usual timbers;
- using bolts instead of nails;
- strengthening wood frames with braces;
- anchoring the structure to the foundation;
- make sure there is a continuous load path;
- secure roof sheathing with screws instead of nails; and
- make sure roof shingles meet the wind code standards for the area.

Property owners should properly prepare the exterior of their homes. Garage doors should be reinforced to prevent them from blowing open. Roof-mounted structures should be securely attached to buildings. Residents should reduce the number of potential airborne objects around their homes, since such items can puncture a home and render it vulnerable to the elements. Doors and windows should be strengthened to resist flying debris. In the case of a severe storm warning, home and business owners should cover their windows with plywood boards or storm shutters. Other techniques include securing fan and light fixtures to ceilings and strapping or bolting generators to walls.

Manufactured housing has also been shown to be very susceptible to wind damage. These structures should be securely anchored to their foundations. Mobile homes should be tied down to their pads to prevent them from being blown apart. Windblown debris from mobile or manufactured housing can be a hazard to structures located nearby.

5.8 “Safe Rooms”

Windproofing will not protect structures from tornadoes. As a result, tornado shelters should be provided in areas with high tornado likelihood, or where structures lack basements and underground protection (such as mobile home parks). Manufactured housing has proved to be especially vulnerable to damage from tornadoes.

The shelter has the potential to be an attractive building that functions as a community meeting room and gives a greater sense of permanence to the mobile home park. As a result, it may increase lot values.

Recommendation

Encourage construction of a “safe room” in new schools, daycares, and rest homes to provide a room, or adequate space, that is capable of withstanding extreme wind forces and the force of collapsing or propelled materials.

The room should be large enough to hold the anticipated number of daily occupants of the building. Existing schools, daycares, and rest homes could potentially receive government subsidy to reinforce a room or hallway to function as a safe room.

Encourage mobile home parks to build a storm shelter for their residents, whose housing is susceptible to destruction by relatively minor high-wind events.

5.9 Seismic retrofitting

Seismic retrofitting means preparing existing and new buildings to withstand the shaking force of an earthquake. Preparedness also includes non-structural improvements to reduce earthquake damage within a structure.

Structural improvements typically include adding braces and removing overhangs. Bridges, water towers and other non-occupied structures should also be retrofit with earthquake-resilient materials. Sources of secondary damage, such as sprinkler pipes, water and gas service lines should be secured or fitted with shutoff valves. Fuel tanks and their supply lines should be securely anchored so that they are not dislodged by earthquakes. Unanchored basement tanks can tear free of their supply lines. Fuel storage tanks need to be inspected and, if necessary, repaired or reconstructed following hazard events.

Recommendation

Nearly every structure, both public and private, is a candidate for seismic retrofitting of some sort. Public buildings, especially those that also serve as shelters, should be made earthquake resilient.

Homeowners should be encouraged to undertake relatively simple but effective non-structural mitigation actions. These might include: securing bookcases, light fixtures and computer monitors; covering high-hazard windows with shatter-resistant film; and locating hazardous materials where they are unlikely to be spilled in an earthquake.

Government and public buildings should be inspected for equivalent mitigation opportunities. Education and awareness programs can help raise public interest in mitigation activities. Brace generators, elevators and other vital equipment in critical facilities such as hospitals to ensure that the usual operations of hospitals are not disturbed by the jarring associated with an earthquake.

Chapter 6. Natural Resource Protection

Preserving or restoring natural areas or the natural functions of floodplain and watershed areas produce flood loss reduction benefits as well as improve water quality and habitats. These activities are usually implemented by parks, recreation, or conservation agencies or organizations. In addition to the four measures listed here, other measures, such as zoning and preservation of open space (covered in Chapter 5) can also protect natural resources.

The tidelands and coastal waters of the South Carolina coast are a very dynamic ecosystem and a valuable natural resource for the people of the State. The tides regularly ebb and flood through the coastal inlets, bays and marshes which constitute a fragile area, vulnerable to the impacts of many human activities. Tidelands and coastal waters are identified as "critical areas" over which the Department has direct permitting authority.

The saline marshes are highly productive components of the marine food web of coastal waters and estuaries. Decaying organic material, called detritus, serves as the basis of the food web and is the major biological contribution of the saline marshes. Many commercially and recreationally important fish and shellfish species depend on the marshlands and estuaries for all or part of their life cycle. In addition, many birds and other forms of wildlife utilize wetlands as habitat as well as a source of food. Tidelands and coastal waters also have become increasingly important in recent years for the purposes of aquaculture.

Among the important functions of the salt and brackish marshes is their role in protecting adjacent highlands from erosion and storm damage. Marsh vegetation absorbs and dissipates wave energy and establishes a root system, which stabilizes the soils. Its effectiveness as a buffer depends on the surface area available which, combined with the composition of the underlying substrate, allows tidelands to act as "sponges," absorbing and releasing waters during storms or times of heavy riverine discharge.

Marshes also perform a valuable waste treatment function since the dense vegetation acts as a filter, trapping sediments and pollutants, which enter as run-off from the upland areas. The trapping of sediments helps maintain water clarity, a factor important to clam, oyster, and phytoplankton productivity. The marshes also assimilate pollutants and recycle nutrients through various biochemical processes.

Coastal waters and the adjacent marshes are also significant as aesthetic, recreational and educational resources. Much of the expenditure for recreation and tourism in the South Carolina coastal zone is for purposes of enjoying outdoor activities and the aesthetic pleasures of undisturbed tideland areas. These natural areas lend themselves to important academic pursuits such as wildlife population and nutrient recycling studies.

These same unique natural resource areas face increasing land development pressure and negative impacts from human activities in and around them. The marshes constitute a fragile ecosystem; consequently, indiscriminate dredging and filling, degradation of water quality or unsound building and development practices can have long-term detrimental effects.

Natural resource protection measures include:

6.1 Wetland protection

6.2 Erosion and sediment control

6.3 Best management practices

6.4 Dumping regulations

6.1. Wetlands protection

Wetlands are often found in floodplains or depression areas in the watershed. Many can store large amounts of floodwaters, slowing and reducing downstream flows. They also filter water and provide habitats for fish and wildlife. Most development projects in wetlands are regulated by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act. Corps “404” permits are required for projects that will place fill or dredged materials in a wetland. Before a permit is issued, the plans are reviewed by several agencies, including the U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency.

Generally, these agencies want to protect wetlands by preventing development that will adversely affect them. However, sometimes the negative impact can be mitigated by preserving or developing an equivalent or larger wetland on another site, although it takes many years for a new wetland to approach the same quality as an existing one. Another drawback is that a new wetland in a different location (especially if it’s in a different drainage basin) will not have the same flood protection benefits as the original one did.

Implementation in North Myrtle Beach:

According to the South Carolina Land Resources Commission, approximately 45% of all land in Horry County is considered to be wetlands. This represents a tremendous resource that can provide flood protection as well as be inappropriate land for development.

In 1998, a court ruling limited the Corps of Engineers’ permit authority to wetlands that are within 800 feet of navigable streams, i.e., the Intracoastal Waterway. DHEC and DNR review and comment on development plans before the Corps issues a 404 permit. The state agencies have no authority to veto or alter a proposed permit. However, there are good relations and cooperation with the Corps’ program and state recommendations are often accepted.

In the coastal counties, development in the remaining wetlands is subject to review by DHEC's Office of Ocean and Coastal Resources Management (OCRM). As with the Corps' program, OCRM does not stop development. It can only minimize the adverse impact development has on a wetland.

An alternative wetland protection measure is to purchase the land or otherwise pay the owner to prevent development on it. Since 1996, over 10,000 acres of wetlands have been enrolled in the state-wide Wetland Reserve Program. In most of the successful projects, additional agencies and private partners are part of the cooperative effort. Examples of partners could be: State Department of Natural Resources, U.S. Fish and Wildlife Service, or the South Carolina Waterfowl Association.

6.2. Erosion and sediment control

Because construction sites are usually bare, stormwater runoff can erode soil, sending sediment into downstream waterways. Sediment tends to settle where a river or stream slows down, such as when it enters a lake. Sedimentation will gradually fill in channels and lakes, reducing their ability to carry or store floodwaters. Not only are the drainage channels less able to do their job, but also the sediment in the water reduces light, oxygen and water quality, which affects water supply treatment, habitat and fishing.

The Sediment and Erosion Control Act of 1991 sets erosion and sediment control requirements for all construction projects greater than two acres. It is administered by DHEC, but communities can implement their own regulations if their standards meet or exceed DHEC's. As it excludes agriculture and forestry, its primary impact is on new construction sites.

Implementation in North Myrtle Beach:

The City relies on the DHEC regulations and its regulatory standards for erosion and sediment control on construction projects. These are explained in *South Carolina Stormwater Management and Sediment Control Handbook for Land Disturbance Activities*, August 1998. The City does ensure that the proper DHEC permits are obtained.

6.3. Best management practices

Point source pollutants come from clearly identified locations such as the outfall of a municipal wastewater treatment plant. Nonpoint source pollutants come from non-specific locations. Examples of nonpoint source pollutants are lawn fertilizers, pesticides, and other farm chemicals, animal wastes, oils from street surfaces and industrial areas and sediment from agriculture, construction, mining and forestry.

Best management practices (“BMPs”) are measures that reduce nonpoint source pollutants that enter the waterways. Unlike erosion and sediment controls, which focus on problems created during construction, BMPs can also be implemented as part of a project’s design to permanently address nonpoint source pollutants. There are two general categories of BMPs:

1. Those that prevent runoff that conveys sediment and other water-borne pollutants, such as planting proper vegetation and conservation tillage, and
2. Those that stop pollutants after they are en route to a stream, such as grass drainage ways that filter the water and retention and detention basins that let pollutants settle to the bottom before they are drained.

6.4. Dumping regulations

Floodplain regulations and building codes control major development projects. However, debris can be accidentally or intentionally dumped into the channels or wetlands, obstructing even low flows and reducing their ability to retain or clean stormwater.

Dumping regulations are one approach to preventing intentional placement of trash or debris in channels and other water bodies. Many cities have nuisance ordinances that prohibit dumping garbage or other “objectionable waste” on public or private property. Some prohibit the discharge of polluted waters into natural outlets or storm sewers. Waterway dumping regulations need to also apply to “non-objectionable” materials, such as grass clippings or tree branches, which can kill ground cover or cause obstructions in channels.

Many people do not realize the consequences of their actions. They may, for example, fill in the ditch in their front yard not realizing that it is needed to drain street runoff. Similarly, they may not understand how regrading their yard, or discarding leaves or branches in a watercourse can cause a problem. Therefore, a dumping enforcement program should include public information materials that explain the reasons for the rules as well as the penalties.

Regular inspections to catch violations also should be scheduled. Finding dumped materials is easy; locating the source of the refuse is hard. Usually the owner of property adjacent to a stream is responsible for keeping the stream clean. This may not be fair for sites near bridges and other public access points.

Implementation in North Myrtle Beach:

The City's Code of Ordinances specifies the City's authority to prevent obstructions to drainage and the penalty for violations. The ordinance clearly regulates drainage in streets and makes the City responsible for maintaining open ditches. The ordinance is enforced by the Department of Public Works.

6.5. Recommendations

1. The City should review its regulatory requirements for new development in wetlands and other natural areas to see if best management practices should be included. Development regulations should promote and reward developments that protect natural areas.
2. The City should consider developing a walking trail system that links all parts of the City and incorporates natural areas in the corridor plan.
3. The City should incorporate preserving natural areas in its work to preserve open space (see Chapter 5's recommendations) and should utilize interest in and programs that protect natural areas to support the corridor plan.

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Chapter 7. Structural Projects

Structural flood control projects are used to prevent floodwaters from reaching properties. These measures are “structural” because they involve construction of man-made structures to control water flows. They can be grouped under five measures:

- | | |
|-----------------------|-----------------------------------|
| 7.1 Beach nourishment | 7.5 Swales |
| 7.2 Dune building | 7.6 Drainage Modifications |
| 7.3 Sand scraping | 7.7 Channel and basin maintenance |
| 7.4 Levees/floodwalls | 7.8 Retention Ponds |

The 1977 Coastal Zone Management Act, as amended, rejects construction of new erosion control devices and adopts retreat and renourishment as the basic state policy towards preserving and restoring the beaches of our state. The State is implementing the forty-year retreat policy described in the statute by designating a baseline and setback line on all oceanfront properties of the State, developing a long-range comprehensive State plan for management of the beach/dune resource, and supporting the efforts of local governments in developing local long-range beach management plans.

Based on this policy North Myrtle Beach has not considered the placement of any additional hardened structures along the ocean shoreline. Therefore, this plan does not include a discussion of seawalls, revetments or similar structures.

7.1 Beach Nourishment

Beach nourishment is the artificial replacement or addition of sand to beaches to widen the backshore and move the high-water line offshore. This technique is expensive, temporary, and requires maintenance at great cost.

The effectiveness and longevity of a beach nourishment project depends on the type of imported sand, the slope of the beach, the strength of cross-shore currents, and the frequency of storms. The slope of the nourished beach should match as closely as possible the beach’s original slope, and fill should resemble the original beach material, since finer fill will erode more quickly than the native beach.

Financial Approach to Implementation

The Beach Nourishment Fund was established in 1995 to account for the City’s share of the \$22.5 million Army Corps of Engineers Beach Nourishment Project. Funding for the project came from the issuance of General Obligation Bonds for a period of 10 years.

Additionally, each year the City appropriates \$50,000 for emergency repairs and replacement.

During FY 2006, a substantial beach renourishment project is scheduled to be undertaken. The City's share is estimated at \$3 million assuming the Corps pays 65% of the cost and the State of South Carolina funds 17.5%.

Beach Nourishment Disadvantages

Nourishment programs may spur shorefront development, putting even more structures at risk.

Beach Nourishment Advantages

Nourishment programs offer wider beaches for recreational use and they can provide a significant level of protection against building damage from severe storms and long-term shoreline erosion.

7.2 Dune Building

The North Myrtle Beach shore protection project includes a program to construct and maintain a healthy dune system in the upper reach of the beach. Dunes can provide a significant level of protection against building damage from severe storms and long-term shoreline erosion. They prevent overwash* flooding during storms and minimize the scouring that occurs when this water retreats to the sea. Dunes also shelter buildings from high winds. In the long-term, dunes help replenish beach sands and maintain beach width.

Dunes can be constructed artificially by trapping sand with fences or by piling sand into dunes with bulldozers. The most effective method of creating new dunes is to interrupt airflow with fences made of porous materials. This technique encourages sand to deposit where the airflow has been disrupted. It is important that the fences alter the airflow but do not halt it.

Dunes can also be built using vegetation. It is important to note the distinction between vegetation used for dune construction and for dune stabilization, as they are usually of different species. It is also important to note that such methods are less likely to work at restoring interior dunes, since buildings, lawns and roads cover much of the sand that would feed them. In these cases, it is necessary to create dunes by depositing sand manually. Sand used for this purpose should match the existing sand type. New dunes should resemble and be in line with existing dunes.

Dune stabilization can be achieved through grading or the rapid construction of new dunes with earth-moving equipment. It is also possible to anchor the surface

of the dune by adding chemicals or planting vegetation (such as grasses, shrubs and trees).

Dune fields can be difficult to integrate with existing beachfront residences. To provide any storm protection, dune fields must be wide. A study of dune fields in South Carolina following Hurricane Hugo discovered that the minimum effective field size was 100 feet wide, with dunes 10 feet high on average.

7.3 Sand Scraping

Sand scraping is a technique for reinforcing the beach without adding new sand. The top foot of sand is scraped from the beach with bulldozers and deposited above the high-tide line. This may result in new sand drifting onto those parts of the beach that are below the high-tide line.

Scraping should dig no deeper than one foot below the existing surface to prevent the beach from becoming too steep. If the slope of the beach is increased it will erode more quickly than it would have at its natural slope.

Critique

While sand scraping is less expensive than beach nourishment, it is also only a temporary solution to beach erosion. Scraped beaches continue to erode, and may erode more quickly than natural beaches in storms. If so, this technique would not be well suited for mitigation. Some research has shown that beach scraping may actually help beaches recover after a storm event. However, since no new sand is added to the system, gains on scraped beaches amount to a net sand loss on downdrift beaches.

Recommendation

The City should continue to maintain the beach nourishment and dune building projects. Sand scraping should only be used in a severe emergency.

7.4 Levees/floodwalls

Probably the best known structural flood control measure is a barrier of earth (*levee*) or steel or concrete (*floodwall*) erected between the watercourse and the property to be protected. Levees need considerable room to fit between the river and the area to be protected. If space is a constraint, more expensive floodwalls are used.

Levees and floodwalls should be set back out of the floodway so they will not push floodwater onto other properties. Their design also should compensate for the flood storage that they will displace and for access through or over the barrier.

Current Practice in North Myrtle Beach

There are no levees or floodwalls along the streams or Intracoastal Waterway in North Myrtle Beach.

Recommendation

Since local floodplain overbank areas are very wide and development close to the shoreline, levee encroachments would remove considerable flood conveyance and storage area. Levees are not recommended for North Myrtle Beach.

7.5 Swale

A grassy swale consists of grass beds or grassy expanses at the side of the road where a concrete ditch or other hard structure might have been placed; it filters or treats stormwater in addition to conveying it to the drainage system. Grassy swales along the roadside, and/or natural vegetative beds in stormwater channels, aid in decreasing the velocity of stormwater flow. Velocity is a major cause of erosion, and in the case of floods, structural damage.

Advantages

These “green” pieces of infrastructure are generally more visually appealing than their “gray” counterparts.

Disadvantages

Swales and vegetated channel beds may require insect management techniques (preferably all-natural) and occasional aeration.

Recommendation

Where swales are feasible to convey stormwater, the sidewalks should slant slightly away from the streets and toward the grassy swales. Grassy strips and linings also provide a modest degree of absorption and sediment filtration. Additions of vegetation to the environment should be indigenous for ecological soundness and ease of maintenance.

7.6 Drainage Modifications

Drainage modifications include man-made ditches and storm sewers that help drain areas where the surface drainage system is inadequate or where underground drainage ways may be safer or more attractive. Particularly appropriate for depressions and low spots that will not drain naturally, drainage and storm sewer projects usually carry the runoff from smaller, more frequent storms.

Storm sewer improvements include installing new sewers, enlarging small pipes, street improvements, and preventing back flow.

Recommendations

1. Increase dimensions of drainage culverts in the most troublesome areas to improve stormwater removal in repetitively flooded areas. Wider culverts enhance the ability of the neighborhood stormwater system to convey accumulated surface waters.
2. Prioritize culverts for upgrade according to their level of potential flood loss reduction or the number of property owners affected, and err on the side of overestimation when building culverts under new streets.
3. Seek mitigation funding to complete the Hillside Drive drainage improvements.

Properties in the Hillside Drainage Basin have flooded on several occasions over the past 20 years. When there is a significant rainfall Hillside Drive must be closed. Additionally, due to the inadequate drainage system, two oceanfront condominiums have had repeated washouts under the elevated structures. These washouts have damaged pilings, air conditioning units, electrical services, and the parking lots.

There are 103 special flood hazard properties in the basin. Since 1983 seventeen of these properties have had 42 flood insurance claims that total \$1,119,160. The average insurance payment for these claims is \$26,647. Nine of the properties are classified as repetitive loss properties. Two of the properties have had seven paid flood insurance claims, two have had four paid claims, and two have had three claims paid.

Some drainage improvements have already been made to the drainage system. Phase I improvements included the installation of a 60-inch drainage line from Perrin Drive to the beach and the replacement of the stormwater outfall near 6th Avenue South. The outfall was replaced with a 72-inch reinforced concrete pipe. The original outfall terminated on the beach. The new outfall extends 1,100 feet offshore.

Proposed Phase II improvements include:

- Construction of two stormwater retention ponds west of U. S. Highway 17.
- Construction of one retention pond east of U. S. Highway 17.
- Purchase of vacant lots where the retention ponds will be constructed.
- Raise the height of Hillside Drive between 6th Avenue South and 9th Avenue South from five to nine feet msl.

Benefits of the project:

- Increase the level of flood protection from the 10-year to the 25-year storm.
- Reduce flooding during the most frequent flood events to approximately 103 buildings, of which nine are repetitive loss structures.
- Improve water quality along the beach in the vicinity of the outfall discharge point.
- Reduce potential health risks.

4. Seek funding to complete the Main Street drainage area improvements.

Proposed improvements include:

- Construction of catch basin at each corner of the intersection of 2nd Avenue North and North Hillside Drive.
- Install a 24" RCP along 2nd Avenue from North Hillside Drive to a catch basin in the vicinity of 213 2nd Avenue North. From the catch basin install a 30" RCP to Ocean Blvd. North.
- Install a 36" RCP along Ocean Drive North from 2nd Avenue North to 1st Avenue North.
- Install an ocean outfall from the intersection of 1st Avenue North and Ocean Drive North to approximately 1300 feet in the ocean.

There are 60 buildings in the floodplain in this area. Twenty-five building have received flood damage since 1987 with 46 flood insurance claim payments totaling \$1,788,300 for an average claim payment of \$38,876. Ten buildings in the area have been classified as repetitive loss structures. Flood insurance claims paid on these repetitive loss structures total \$767,391 for an average payment of \$76,739 per structure.

5. *Conduct a study of drainage problems in the Cherry Grove area.*

1,350 flood insurance claims have been paid for losses in the Cherry Grove area. These payments total \$18,284,043 and are 50 percent of the flood claims paid within the City.

There are 156 repetitive loss properties in this area. They represent 78 percent of the City's repetitive loss properties. These properties have had 365 flood insurance claims with payments totaling \$5,684,480 for an average payment of \$15,574 per claim and \$36,207 per building.

The proposed study should examine dredging the cannels as one possible solution to reduce the flooding problem.

7.7 Channel and basin maintenance

Clogged or broken drainage systems can seriously impair stormwater management efforts. Flood channels, storm sewers, retaining ponds and erosion basins can become blocked by overgrowth, debris, sedimentation, or components that fail with age.

Channel and detention basin maintenance is an ongoing program to clean out blockages caused by overgrowth or debris. These activities normally do not affect the shape of the channel or basin, but they do affect how well they can perform.

Many people do not realize the consequences of their actions. They may, for example, fill in the ditch in their front yard not realizing that it is needed to drain street runoff. They may not understand how regrading their yard, filling a wetland, or discarding leaves or branches in a watercourse can cause a problem to themselves and others. Individual actions can add up to big problems. Therefore, the North Myrtle Beach drainage system maintenance program includes regulations that prevent dumping in or altering watercourses or storage basins.

Recommendation

Drainage systems require perpetual maintenance. The City should continue its program for the replacement or improvement of culverts, mains, stormwater lines, sewer pipes and backup valves as part of its general program of maintenance and improvement to reduce flooding hazards.

7.8 Retention ponds

Retaining or retention ponds (used here interchangeably with detention ponds) are basins designed to catch surface runoff and prevent its flow directly into a stream or river.

Current Practice in North Myrtle Beach

North Myrtle Beach encourages the use of “Best Management Practices” to maximize the amount of rainfall that infiltrates into the soils and the use of on site storage facilities to reduce runoff rates and volumes, and minimize erosion and sedimentation. The City requires that stormwater must not leave a parcel at a higher rate after the parcel has been developed than it did before.

Retention and detention basins must be designed with sufficient hydraulic capacity for the 25 year, 24-hour storm. Primary drainage systems must meet the same hydraulic capacity.

Advantages

Retention ponds are a relatively inexpensive way to prevent localized flooding, provided that ample undeveloped land is available, and have the added advantage of not altering the character of the streams they protect. These ponds can act as groundwater recharge sites and reduce water pollution through soil filtering.

Recommendation

The City should continue to regulate stormwater runoff and require retention facilities as appropriate.

Chapter 8. Emergency Services

People at risk from disasters, whether natural or human in origin, can take actions that save lives, reduce losses, speed response, and reduce human suffering when they receive accurate warnings in a timely manner. Warnings are becoming much more useful to society as lead-time and reliability are improved and as society devises ways to respond effectively. For example, computers are being programmed to respond to warnings automatically, shutting down or appropriately modifying transportation systems, lifelines, manufacturing processes, and such. Effective dissemination of warnings provides a way to reduce disaster losses that have been increasing as people move into areas at risk and as our infrastructure becomes more complex and more valuable.

Effective warnings should reach, in a timely fashion, every person at risk who needs and wants to be warned, no matter what they are doing or where they are located. Such broad distribution means utilizing not only government-owned systems such as NOAA Weather Radio and local sirens, but all privately owned systems such as radio, television, pagers, telephones, the Internet, and printed media.

Emergency management measures that protect people during and after disasters are described in local emergency operations plans and standard operating procedures. These plans should cover the following four areas:

- 8.1 Threat Recognition
- 8.2 Emergency Warning Dissemination
- 8.3 Response and Mitigation Operations
- 8.4 Post-disaster Recovery and Mitigation

8.1. Threat Recognition

Hazard analysis is the basis for both mitigation efforts and Emergency Operations Plans (EOPs). From an emergency operations planning perspective, hazard analysis helps a planning team decide what hazards merit special attention, what actions must be planned for, and what resources are likely to be needed.

The first step in responding to a disaster is knowing that one is coming. Scientists are developing more accurate and more numerous warnings as they deploy better sensors to measure key variables, employ better dynamic models, and expand their understanding of the causes of disasters. Warnings can now be made months in advance, in the case of El Niño, to seconds in advance of the arrival of earthquake waves at some distance from the earthquake. The new National Weather Service (NWS) Doppler radar systems are providing the capability to diagnose the potential for severe thunderstorms, tornadoes, and

flood-producing rainfall. As a result, warnings are becoming predictive in nature rather than reactive.

Local plans should describe how natural hazard threats are identified. The plan should include information on each of the hazards identified for the community. Of particular interest are the hazard's **frequency** of occurrence (both historical and predicted or probable, as available), **magnitude** and **intensity**, **location** (if the hazard is associated with a facility or landscape feature) and **spatial extent** (either around the known location of the hazard or as an estimate for non-localized hazards like tornado), **duration**, **seasonal pattern** (based on month by month historical occurrence), **speed of onset**, and **availability of warning**.

8.2 Emergency Warning Dissemination

Local disaster warnings are issued in conjunction with the National Weather Service and can be administered in a number of ways, including via sirens, radio, television, cable TV, mobile public-address systems, telephone trees, and even door-to-door contact. Posted signs can be used to identify risks at a particular site. Multiple or redundant warning systems are most effective, as they ensure that a message will be received even if one part of the warning system is not heard.

The plan should describe the warning systems in place in the jurisdiction and the responsibilities and procedures for using them. All components of the system should be identified and the provisions that have been made to implement warnings should be described.

8.3 Response and Mitigation Operations

Warnings are effective only if they are accurate and result in appropriate action. Appropriate response to warning is most likely to occur when people have been educated about the hazard and have developed a plan of action well before the warning.

Emergency Operations Plans (EOPs) developed using the functional approach consist of a Basic Plan, functional annexes, and hazard-specific appendices. These are supplemented by the SOPs and checklists necessary for implementation of the EOP. This is the approach used by the City of North Myrtle Beach.

The Basic Plan is an overview of the jurisdiction's emergency response organization and policies. It should:

- provide the legal authority for emergency operations,

- summarize the situations addressed by the EOP,
- explain the general concept of operations,
- assigns responsibilities for emergency planning and operations,
- describe how people and property will be protected in emergencies and disasters,
- identify steps to address mitigation concerns during response activities.

8.4. Post-disaster Recovery and Mitigation

After a disaster, communities should undertake activities that can prepare people and property for the next one. They are implemented during recovery to keep people from immediately going “back to normal” (i.e., the same way they were before the disaster). These measures include:

- Regulating reconstruction to ensure that it meets all code requirements, including the NFIP’s substantial damage regulations
- Public information to advise residents about mitigation measures they can incorporate into their reconstruction work
- Evaluating damaged public facilities to identify mitigation measures that can be included during repairs
- Acquiring substantially or repeatedly damaged properties from willing sellers
- Planning for long term mitigation activities
- Applying for post-disaster mitigation funds

Requiring permits, making inspections and enforcing the substantial damage regulations can be very difficult on local, understaffed offices after a disaster. If not done right, not only does a community miss a tremendous opportunity to redevelop or clear out a hazardous area, it may be violating its obligations to the National Flood Insurance Program (NFIP).

Post-disaster reconstruction plans

A hazard mitigation plan specifies actions a community will take to reduce its vulnerability to natural hazards or to minimize the impact of a hazard event. Post-disaster reconstruction plans outline the policies or planning instruments that community officials will rely on for post-disaster decision-making. The two are often linked because the post-disaster window is considered an opportune time to make a community more disaster resilient.

Post-disaster mitigation planning allows for redevelopment in a less hazard-prone manner. Reconstruction plans should be designed to be in concert with the long-range goals of the community (as measured by the comprehensive plan). In particular, they should outline the rules and priorities for any post-disaster acquisition of damaged properties. Two typical targets are buildings that have suffered damage amounting to a certain percentage of their value or properties

that lie within the hazard area. The degree of damage that would qualify a building for public acquisition should be identified in the plan, as should any other criteria for prioritizing purchases.

A reconstruction plan should also outline a post-disaster permitting process that facilitates repairs but remains steadfast to the need to mitigate against future disasters. One element of the plan should emphasize the need to obey the building code. One way to create time to assess the damage and plan for recovery is to institute a short-term building moratorium. Another is to do much of the planning in advance and create an overlay zone that is triggered by the hazard event.

Hazard mitigation and post-disaster plans allow for a substantial amount of decision-making to occur prior to a disaster event and aid in better decision-making after the event.

Moratorium

A moratorium is a short-term suspension of the right to develop, usually accomplished by not issuing permits.

Moratoria can play an important role following a disaster. They give officials time to assess the damage and set priorities for response, planning and mitigation efforts. They are often used to prevent property owners from repairing damaged structures before an acquisition program can go into effect. They can also allow officials to expand high-hazard designated areas to reflect the actual damages from a hazard event.

Since moratoria are frequently subject to legal and political challenges, the City must be prepared to show adequate justification for taking this action. With such justification, a moratorium is likely to withstand legal scrutiny.

8.5 The National Flood Insurance Program's Community Rating System (CRS) encourages comprehensive flood warning and response programs and recognizes them under Activity 610 (Flood Warning Program). This activity has five elements that provide credit for local flood warning and response planning:

- 1. Flood Threat Recognition System (FTR).** The first element of a flood-warning program is the operation of a system that tells the community that a flood is on its way. This is termed a flood threat recognition system and is recognized as element FTR under this activity. The notice that a flood is coming can be provided by the National Weather Service, by a state or regional agency, by monitoring local rain and river gages, and/or in other ways. However, the community must have a system for receiving meaningful early notifications.

In North Myrtle Beach watches and warnings for hurricanes, floods, tornadoes and other natural hazards are received from the National Weather Service at the Communications Center in the Department of Public Safety. These watches and warnings are passed on to the city manager, emergency management coordinator, and others as prescribed in the City's municipal incident management guide. The center operates 24/7.

CRS gives local governments more FTR credit when the flood threat recognition system can forecast various levels of threat. The National Weather Service (NWS) provides watches and warnings for hurricanes, floods, severe thunderstorm, tornadoes and other natural hazards. NWS numerical models are used in the hazards analysis to identify the timing, severity, and sequence of wind and hurricane surge hazards that can be expected from hurricanes of various categories, tracks, and forward speeds striking the area. In the North Myrtle Beach area the Sea, Lake and Overland Surges from Hurricanes (SLOSH) model is used to map inundation areas. During the preparation of the analysis, additional areas expected to be inundated by freshwater flooding from rainfall are added to the inundation maps.

- 2. Emergency Warning Dissemination (EWD).** The next element is the dissemination of the flood warning to residents of the community. This element is termed emergency warning dissemination and is identified as the acronym EWD. Various methods can be used, such as sirens, telephone calls, or the Emergency Alert System. Up to 60 points of credit can be earned based on the dissemination methods used. Credit for this element is available only if the community has a creditable flood threat recognition system, an annual outreach project that covers flood warning and flood safety and reaches at least 90% of the target audience, and an adopted flood response plan.

North Myrtle Beach citizens receive warnings through Emergency Alert System broadcast and mobile siren and public address systems on emergency vehicles.

- 3. Other Response Efforts (ORE).** If the community implements the first two elements (FTR and EWD), then it is eligible for up to 50 credit points for implementing activities to minimize flood damage under this third element, other response efforts (ORE). These include activities like sandbagging, coordinating evacuation, barricading hazardous area like flooded streets and bridges, and issuing status reports to the media.

The City's municipal incident management guide assigns disaster management responsibilities. Standard Operating Procedures (SOPs) are used to describe how these responsibilities are to be carried out.

Managing the hurricane or flood response is the responsibility of the City's Emergency Management Team. When a hurricane or flood is imminent, the Emergency Management Team is convened. North Myrtle Beach's City Manager, Mayor and several department heads participate on the Team.

The Team determines what needs to be done and tasks municipal departments and local agencies with assignments or requests. There are written standard operating procedures on emergency actions that need to be followed for public safety concerns. Actions generally taken to prevent or reduce damage or injury include:

- Directing evacuation
- Sandbagging certain areas
- Closing streets or bridges
- Shutting off power to threatened areas
- Releasing children from school
- Opening evacuation shelters
- Monitoring water levels

The North Myrtle Beach plan also includes a recovery section that identifies appropriate measures to take and which agencies will be responsible for carrying them out. These include:

- Patrolling evacuated areas to prevent looting
- Providing safe drinking water
- Vaccinating residents for tetanus and similar diseases
- Clearing streets
- Cleaning up debris and garbage
- Evaluating damaged buildings to determine if they can be reentered

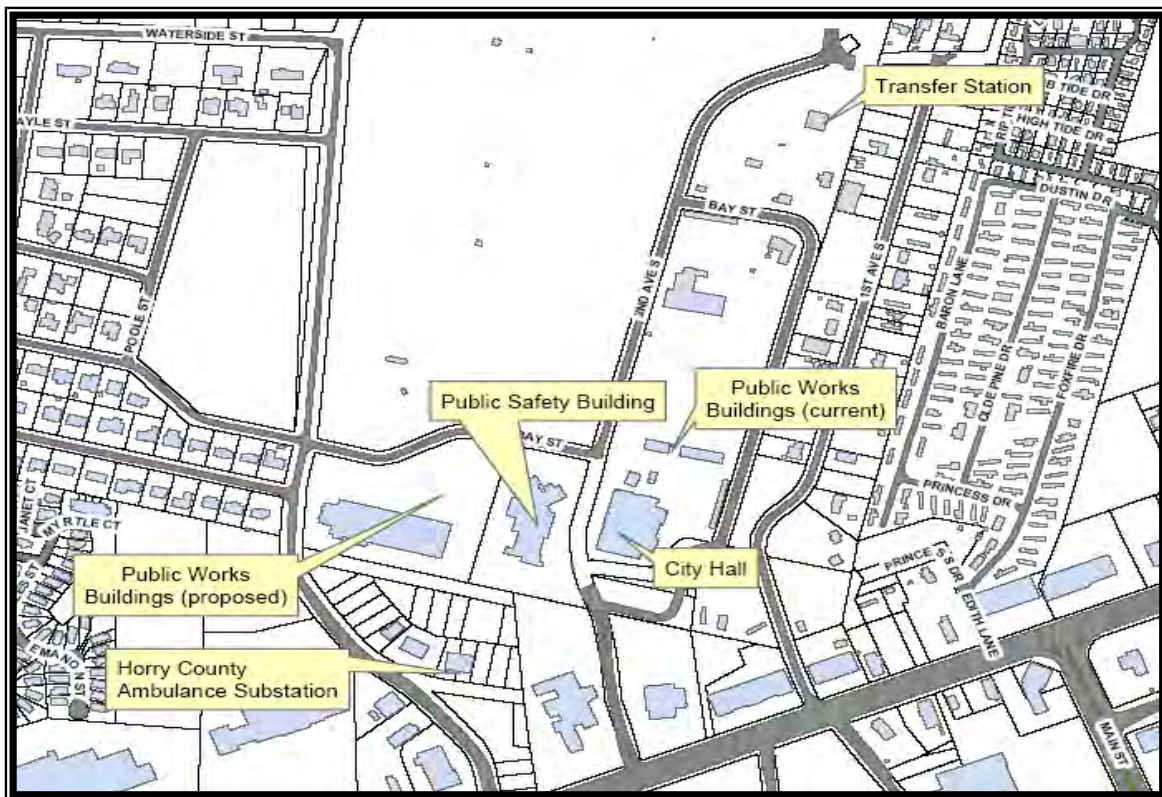
Additional flood damage can be prevented if the city's response plan includes appropriate tasks, such as moving building contents above flood levels.

- 4. Critical Facilities Planning (CFP).** If the community implements the first two elements, then it is also eligible for up to 50 credit points for implementing the fourth level of involvement: critical facilities planning, that is, coordination of the flood warning and response effort with critical facilities. A critical facility is a structure or a site that, if flooded, would result in severe consequences to public health and safety. Examples

include hospitals, emergency operating centers, important bridges, and hazardous materials storage areas. Critical facilities also include structures that are needed to complete disaster response and recovery missions. These may include schools and key businesses. Providing these facilities with early warning and coordinating with their flood response plans is recognized under this element.

The City, the County or a utility own most of the critical facilities identified in the City's emergency plan. One exception is the Alligator Farm.

Critical Facilities



City Hall – includes the Emergency Operations Center and is designed to withstand a Category 5 Hurricane.

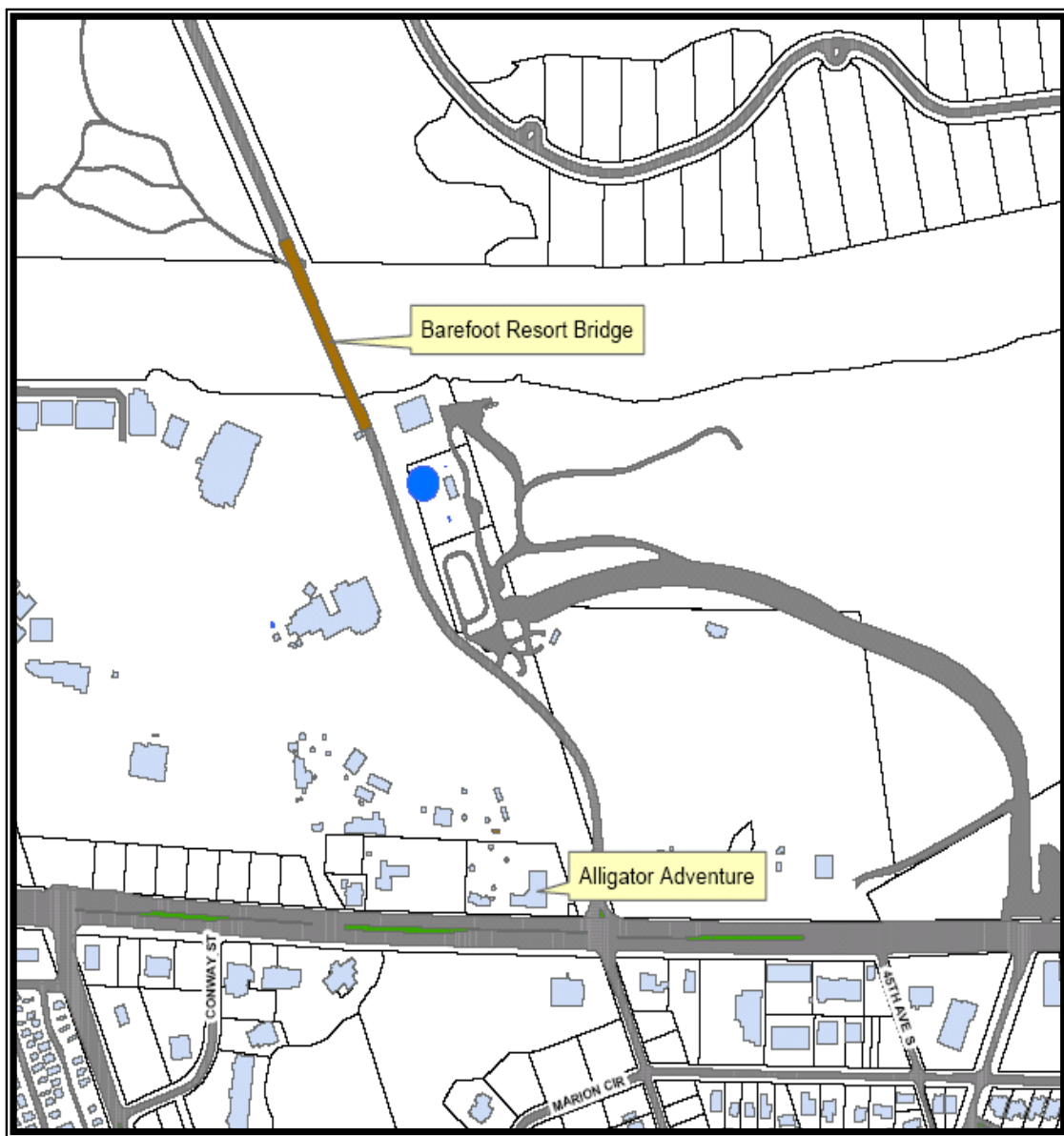
Public Works Building - includes offices for street maintenance and public utility staff.

Public Safety Building – has space for the Police Department, Fire Chief, and the main fire station. Other fire stations are located on Little River Neck Road, Sea Mountain Highway and 33 Avenue South.

Horry County Ambulance Substation – provides access to area hospitals during an emergency. There are no hospitals in North Myrtle Beach. The North Myrtle Beach Rescue Squad is collocated here with Horry County Fire and Rescue.

Transfer Station - is the central location for solid waste services.

Barefoot Resort Bridge – provides access across the Intracoastal Waterway to Barefoot Resort. This is the quickest access to the area for emergency response

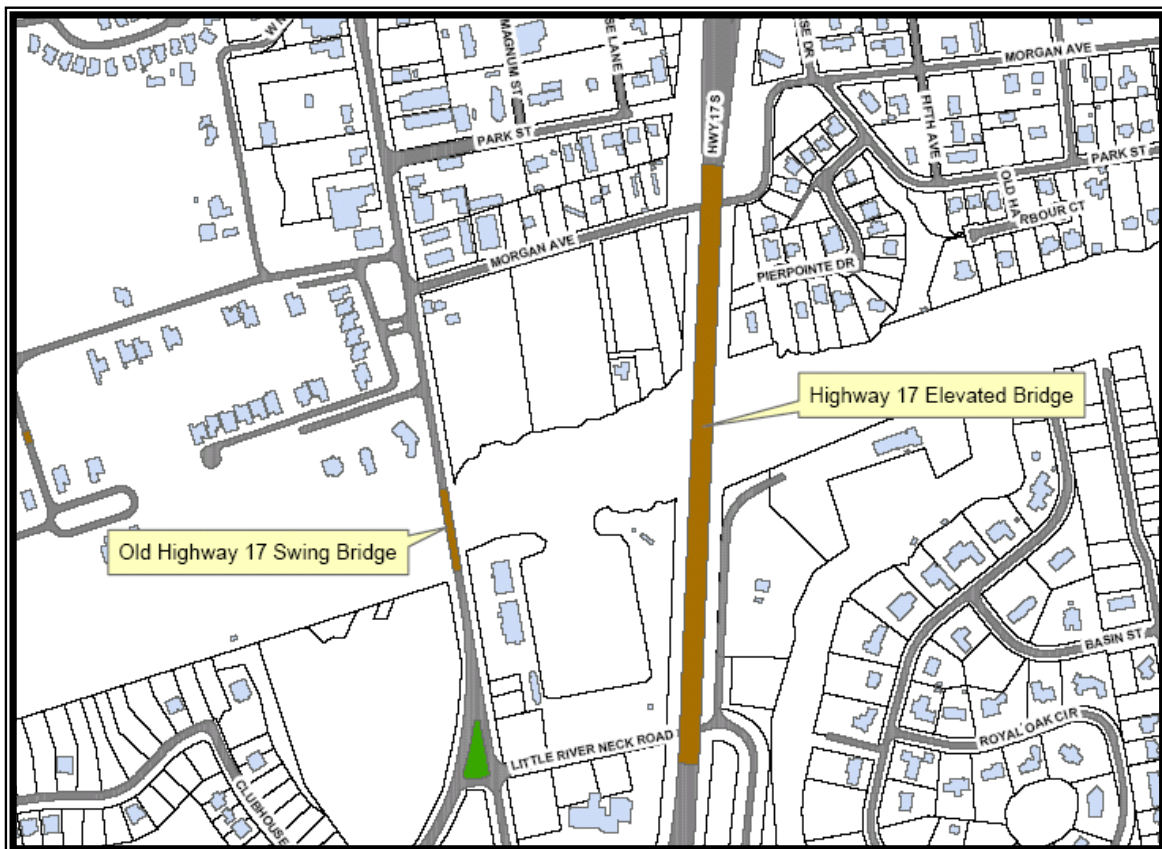


vehicles.

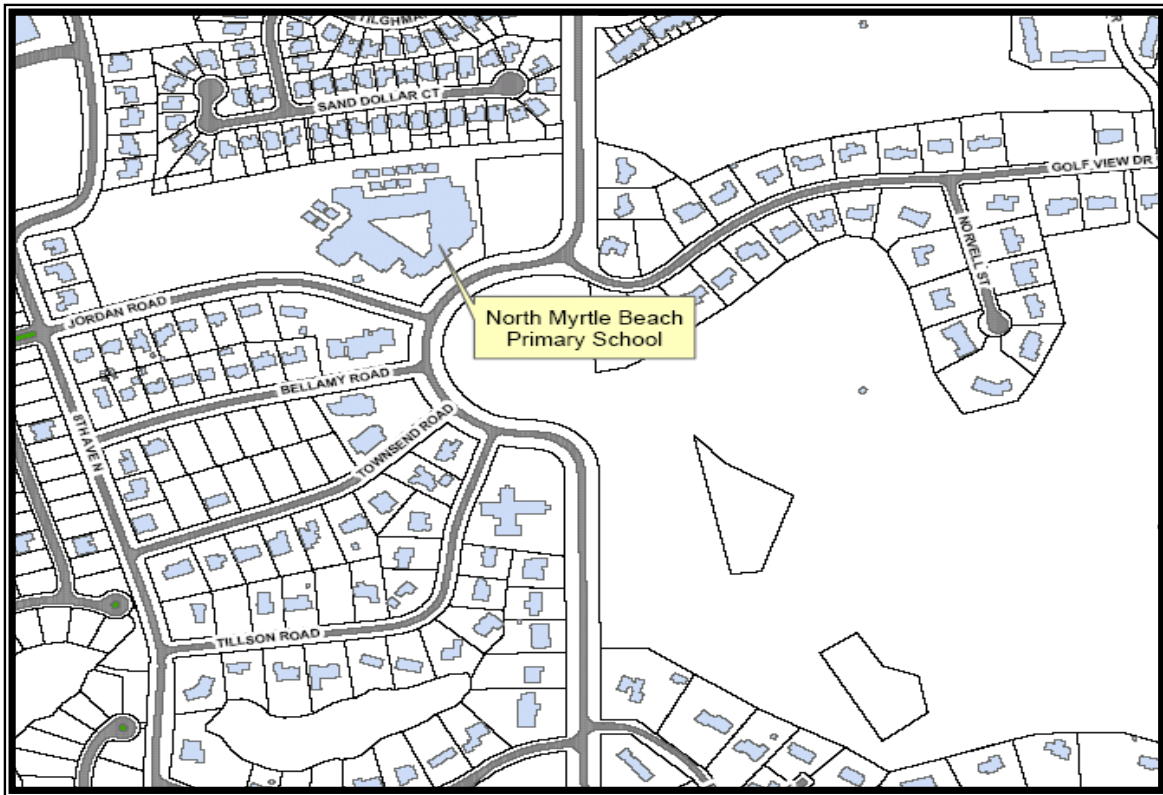
Alligator Adventure – has alligators that must be relocated during hurricanes. The City provides advanced warning and Alligator Adventure has a response and evacuation plan.

Highway 17 Elevated Bridge – provides the major route for evacuation during hurricanes.

Old Highway 17 Swing Bridge – provides a secondary route for evacuation, but must be closed before the elevated bridge over Highway 17.



North Myrtle Beach Primary School – is the only public school building in the City limits. It is used as an emergency shelter. The school is located on 11th Avenue North. The North Myrtle Beach Elementary School, North Myrtle Beach Intermediate and Middle Schools and North Myrtle Beach High School are all located west of the waterway.



- 5. StormReady community (SRC).** This element provides 25 credit points to a local government that has been designated by the National Weather Service as a StormReady community and has a flood threat recognition system able to forecast the arrival time and peak flow or elevations of floods.

8.6. Recommendations

1. Public information programs should explain hurricane/flood watches and warnings and appropriate safety and protection steps to take after they are issued. The City should continue to provide this information each year through brochures mailed to all property owners.
2. The City should keep all records and handouts from post-disaster recovery and mitigation efforts to guide City activities during future disasters.

3. The City should put the SLOSH inundation areas for hurricanes in the Geographic Information System to assist with disaster planning and evacuation.
4. The emergency operation plan should include a detailed vulnerability analysis for hurricanes, floods, wildfires and other hazards.
5. OPGON level triggers in the emergency plan should have operational definitions that permit easy recognition. Current OPGON level definitions should be reviewed.
6. Only formally adopted emergency plans are eligible for CRS flood insurance credit. These credits are used to adjust the flood insurance premiums charged to property owners. City Council should review the proposed draft emergency operations plan and adopt a final version.
7. The emergency operations center's alert list should be updated at least annually.
8. Standard Operating Procedures should be developed to describe how emergency warnings will be disseminated to the general public.
9. For each OPGON level the tasks that need to be implemented should be included in the plan. Standard Operating Procedures for each task should be developed. The SOPs should describe how the task will be carried out, who is responsible, what resources will be needed, and where and how those resources will be obtained.
10. Each department or agency SOP should include hazard mitigation measures to be implemented before and during a disaster or emergency situation.
11. Emergency operations and mitigation plans should be developed or updated for each critical facility. These plans should identify task to be implemented by the facilities, the amount of warning time needed to complete operational and mitigation tasks, and the resources necessary to complete their assigned missions.
12. At least one master copy of the latest emergency plan and the SOP for each Department, response agency and critical facility should be maintained in the emergency operations center.
13. A disaster management information system should be developed. The system should identify and track that status of disaster tasks assigned to departments and agencies. It should include a resource inventory and management component.

14. There should be an annual exercise of the emergency operations plan. This exercise should include a scenario that test current policies, procedures, and capabilities of departments and agencies with emergency response and recovery responsibilities.
15. The City should actively participate in the County's after action report prepared following local disasters.
16. The City should prepare an application for designation by the National Weather Service as a StormReady community.
17. The City should prepare a Post-disaster Mitigation and Recovery Plan.
18. The City should encourage the State to enhance the evacuation capacity of the transportation system by constructing a four-lane highway to I-95 from the northeastern side of the City.

Chapter 9. Public Information

The location of hazards and the risks associated with them should be available to public officials, public employees and agencies, the general public, and the private sector. It is important that information on the location of hazards is also shared between public agencies.

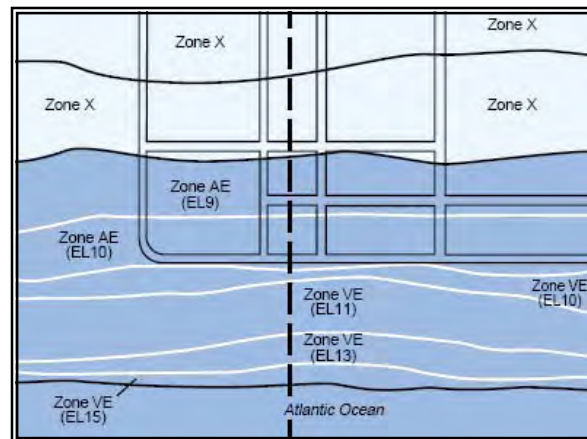
Public information activities advise property owners, potential property owners and visitors about the hazards, ways to protect people and property from the hazards, and the natural and beneficial functions of floodplains. They are usually implemented by a public information office. Public information measures can include:

- | | |
|----------------------------|--------------------------|
| 9.1 Map information | 9.4 Library |
| 9.2 Outreach projects | 9.5 Technical assistance |
| 9.3 Real estate disclosure | 9.6 Educational programs |

9.1. Map information

There are many benefits to providing map information to the public. Residents and businesses who are aware of the potential hurricane, flood and coastal erosion hazards can take steps to avoid problems and/or reduce their existing exposure. Real estate agents and house hunters can find out if a property is floodprone and whether flood insurance may be required.

Communities are the best source of map information because they can often supplement what is shown on the Flood Insurance Rate Map (FIRM) with maps that complement and clarify the FIRM and information on additional hazards, flooding outside mapped areas and zoning.



Current Practice in North Myrtle Beach: The City has the most recent FIRM available for review at City Hall. The Building Department provides map information to inquirers and advertises this service in the annual newsletter and in letters sent annually to local Realtors, lenders and insurance agents. When the information is provided, City staff are available to explain flood insurance, property protection measures and mitigation options that are available to property owners.

Each year, the Office of Ocean and Coastal Resource Management publishes the annual "State of the Beaches Report." This free document, available at

OCRM offices in Myrtle Beach, is a detailed study of erosion rates at approximately 400 coastal monitoring stations, including 50 stations in North Myrtle Beach. This information should be provided to those requesting flood map information.

North Myrtle Beach believes providing map or FIRM information is a valuable public information service, which can be the first step to educating residents on how to protect themselves from flooding and other natural disasters.

9.2. Outreach projects

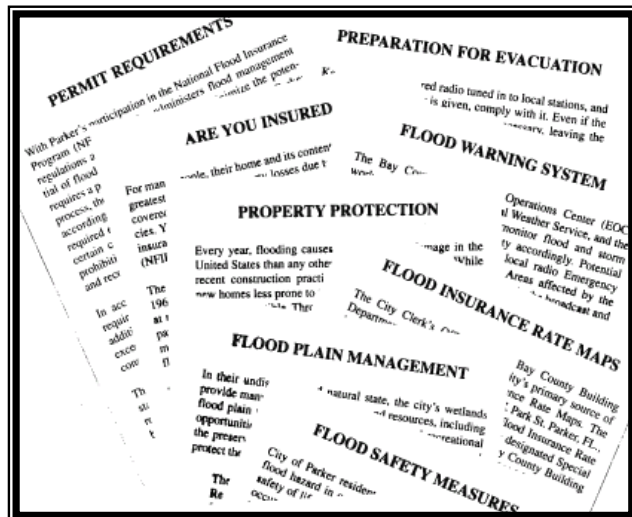
Information can be presented in a number of ways, including pamphlets, brochures, literature, workshops, radio and TV ads. Marking historical disasters, such as flood levels, in prominent places can be an effective way of increasing community awareness of natural hazards.

Important topics to cover with a general awareness program include: things to consider when purchasing a home or business; means of identifying hazards; and ways to limit exposure and reduce future property damages. Awareness programs that are specifically targeted at new home buyers should educate them on mitigation techniques and features to look for when considering the purchase of a home in a hazard area.

Both education and regulation are more effective when they are paired than when they stand alone. Planning could be considered a community awareness program, since participation in the planning process can help communities establish a feeling of "ownership" over mitigation measures. This, in turn, may help generate public support for mitigation.

Awareness and outreach programs should be targeted at people who are directly affected by mitigation activities, such as acquisition programs, to address their concerns and to explain the importance and consequences of these actions.

Outreach projects are a proactive approach to public information. They educate individual residents about various topics and are designed to encourage people to seek more detailed information in order to take action to protect property. They



can cover a variety of topics, such as the flood hazard, flood insurance, mitigation measures, flood warning procedures and local regulations.

Research has proven that outreach projects work. Not only do they educate residents, but local decisions makers become more aware of the hazards and ways to reduce their impact. However, awareness of the hazard is not enough; people need to be told what they can do about it, so outreach projects should include information on property protection measures. Research has also shown that a properly run local information program is more effective than national advertising or publicity campaigns. Therefore, outreach projects should be locally designed and tailored to meet local conditions.

Current Practice in North Myrtle Beach: The City has several public information activities:

- Mass mailings on flood hazards to all residents
- Mass mailings of the City Newsletter "Currents" with information on natural hazards, warning procedures, flood insurance, stormwater management and similar topics
- Notices directed to floodplain residents
- Presentations at meetings of civic and neighborhood groups
- Internet web sites

Horry County's Division of Emergency Preparedness has published a brochure, *Hurricane Preparedness – Are You Ready?* This provides detailed instructions to residents on preparedness, evacuation, re-entry and repairs. North Myrtle Beach makes these brochures available at City Hall and other locations.

Other measures that should be considered by the City:

- Displays or special sales in home improvement stores
- Newspaper articles and special editions or sections that focus on natural hazards
- Radio and TV news releases and interview shows
- A detailed property owner handbook tailored for local conditions

9.3. Real estate disclosure

Federally regulated lending institutions must advise mortgage or other loan applicants that the property is in a floodplain as shown on the Flood Insurance Rate Map. Because this requirement has to be met only ten days before closing, often the applicant is already committed to purchasing the property when he or she first learns of the flood hazard.

State laws and practices by local real estate boards can overcome this deficiency and advise newcomers about the hazard earlier. They may also require

disclosure of past flooding or storm sewer problems, regardless of whether the property is in a mapped floodplain.

In some areas state or local real estate disclosure laws require that the buyer be notified if property is located in a hazard-prone area. Advocates argue that a better-informed marketplace should result in better decision-making: as well-informed consumers will choose to avoid purchase in hazard areas, demand a lower price or pursue mitigation actions after purchase. Some examples of the hazard conditions that may require disclosure include: settling from any cause; flooding, drainage, or grading problems; flood insurance requirements; and property or structural damage from fires, hurricanes, earthquakes or floods.

Local practices by local real estate boards can make notification practices effective by requiring that newcomers be advised about hazard risks thoroughly and early in the home-buying process. Real estate boards may also require prospective homeowners to disclose past disaster events, regardless of whether the property is in a mapped high risk zone.

Current Practice in North Myrtle Beach:

Floodplain and flood insurance purchase requirements. South Carolina state law does not specifically require disclosure of whether a property is in a floodplain; however, a licensed real estate agent has a duty to disclose material facts that she or he knows or reasonably should know. The Department of Natural Resources has published a brochure, "The National Flood Insurance Program and the Real Estate Professional," which explains why real estate agents should determine and disclose whether a property is in a mapped floodplain. It notes that such disclosure will help the buyer get a mortgage, understand local regulations, and be aware of restrictions on disaster assistance and the cost of flood insurance premiums.

Coastal Erosion Hazard Information. In South Carolina a licensed real estate agent has a duty to disclose material facts that she or he knows or reasonably should know. Although real estate agents might not always know the erosion rates for particular oceanfront properties, they should advise their clients of the possibility of erosion and direct them to available sources of information. If a beachfront property is located, in whole or in part, seaward of the legislated setback line or the jurisdictional line, a contract of sale or transfer of real property must contain a disclosure statement. The statement must indicate that the property is or could be affected by the legislated lines; and the statement must include the local erosion rate most recently made available by OCRM for that zone.

South Carolina Law, Section 48-39-330. Disclosure statement requirement.

Thirty days after the initial adoption by the department of setback lines, a contract of sale or transfer of real property located in whole or in part seaward of the setback line or the jurisdictional line must contain a disclosure statement that the property is or may be affected by the setback line, baseline, and the seaward corners of all habitable structures referenced to the South Carolina State Plane Coordinate System (N.A.D.-1983) and include the local erosion rate most recently made available by the department for that particular standard zone or inlet zone as applicable. Language reasonably calculated to call attention to the existence of baselines, setback lines, jurisdiction lines, and the seaward corners of all habitable structures and the erosion rate complies with this section.

9.4. Library

The community library is an obvious place for residents to seek information on flooding, flood protection and protecting natural resources. Libraries are usually the first place people turn to when they want to research a topic.

Libraries also have their own public information campaigns with displays, lectures, and other projects, which can augment the activities of the City.

Current Practice in North Myrtle Beach: The City maintains and updates floodplain management materials in the Flood Protection Section of the North Myrtle Beach Branch of the Horry County library. This resource is described in newsletters and brochures distributed by the City. In addition to the Flood Insurance Study and Flood Insurance Rate Maps, the library collection has books and resources on flood damage prevention, including FEMA's Coastal Construction Manual.

9.5. Technical Assistance

As identified in the community survey, several property owners have implement property protection measures. Local governments can encourage and assist owners with identifying and implementing mitigation measures through technical assistance provided in one-on-one sessions with property owners. Community officials can provide advice and information on matters such as identifying flood hazards at the site, correcting local drainage problems, floodproofing, dealing with contractors, and funding.

Current Practice in North Myrtle Beach: The Building Department has given and can give advice to inquirers on flood protection measures appropriate for the inquirer's situation. This assistance is provided by the department's staff and by a list of professional architects and engineers. The office can also provide the names of contractors licensed to do the work. This service is advertised in newsletters and brochures distributed by the City.

9.6. Educational programs

Several respondents to the mitigation questionnaire identified workshops and public meetings as the best way to provide information on actions citizens can take to protect their property. Workshops can play a valuable role in preparing communities for a disaster. These workshops should include education regarding the potential hazards, possible mitigation steps that can be taken, and instruction on how to respond after a disaster occurs.

Specialized workshops are often aimed at those who will be implementing mitigation efforts, including members of the building and development industries.

Environmental education programs can teach children about flooding; the forces that cause it, the factors that cause flood problems, and the significance of protecting the natural and beneficial functions of watersheds and floodplains. These programs can be undertaken by schools, park and recreation departments, conservation associations, and youth organizations, such as the Boy Scouts, Campfire Girls and summer camps.

Current Practice in North Myrtle Beach: The South Carolina Department of Education is adopting an impressive and extensive set of state standards for local curricula. It begins in kindergarten with basic concepts of the water cycle and water conservation and goes through 10th grade. Topics include flooding, severe weather safety, landforms, identifying drainage divides, and "living in areas with natural hazards."

Horry County school teachers will be incorporating these topics into their learning plans over the next year or two. Teachers also have access to the Blackwater Swamp Environmental Center. Owned by a private foundation, public and private schools use the Center for site visits and science projects relating to wetlands and water quality.

Education and training to generate awareness of hazards, mitigation steps, and disaster response should be targeted to public employees, agencies, public officials, the general public and the private sector, especially developers and property owners.

9.7. Public Information Program Strategy (OPS)

Some communities develop public information strategies as part of their floodplain management program. Preparation of a Public Information Program Strategy (OPS) is encouraged by Activity 330 of the Community Rating System. These credits (100-points) are designed to encourage communities to develop their own public information program and to design outreach projects specifically tailored to their own needs. It also encourages public participation in the development of a strategy and outreach projects that address multiple hazards.

The benefit of the public information program strategy is that the outreach projects are better thought out and are more appropriate locally than would be the case if the community simply copied national models or designed projects based purely on CRS credit points. This approach assumes that a properly prepared strategy that reviews the problem, identifies the target audiences, determines how to best reach the target audiences, and coordinates with other information programs will produce the best outreach projects for that community.

The thing that is important for a strategy is the PROCESS that is followed. It is vital that people outside the community's government be involved in order to provide a different perspective and input on how to effectively reach residents and business owners.

Strategy Team: For CRS credit the community must establish a public information outreach strategy team. It need not be a formal organization. The team must have at least three members. At least one team member must be someone familiar with the community's floodplain management program, such as the CRS Coordinator. At least one member must be a representative from outside community government. This could be someone from the public schools, a neighborhood association, the Red Cross, insurance agencies, utilities, or other offices involved in education or floodplain management.

Other candidates for the strategy team could be

- The local emergency manager
- The community public information officer
- Floodplain residents
- Representatives of utilities or other companies that conduct their own public information programs and are concerned about public safety
- A motel or restaurant owner, since the City is dependent on tourism, and because explaining flood warning and evacuation procedures to tourists would be important.

The strategy team can be a very informal group and need only meet once or twice a year. Existing committees or advisory boards may fulfill the role if they include at least the representation noted above to ensure coordination with groups outside the city government.

9.8. Recommendations

1. Public information activities should cover the following flood protection topics.
 - Causes and extent of flooding
 - What is being done about flooding
 - What to do during a flood
 - How people can protect their homes
 - Flood insurance
 - Taking care of drainage ways
 - Status of implementing this *Mitigation Plan*
2. The City should continue to implement and publicize the following services that will inform and assist property owners who want to protect themselves from flooding.
 - Providing flood insurance map information and coastal erosion hazard data to inquirers
 - Making site visits to review problems and providing advice to the owner
3. Continue providing the library and other offices with a list of appropriate flood protection references, government publications, Internet web sites and maps. The list should include ordering or contact information for each item.
4. Continue providing mitigation articles for the City's newsletter, "Currents". The newsletter should provide updates on implementing this *Mitigation Plan*, announce upcoming events, and celebrate successful mitigation projects.
5. Continue sending two mitigation brochures each year, one to all property owners and another targeted to floodplain residents.
6. The following projects should be implemented to disseminate the messages on flood hazard mitigation and City services.
 - News releases and news articles on flood protection measures and the progress of implementing this *Mitigation Plan* should be prepared for the local newspapers at least once every quarter.
 - A homeowner's property protection manual should be prepared, made available for interested residents and businesses and given to other media that want to cover hurricane and flood protection.
7. Meetings with selected groups, including schools and teachers, should be held so their members will become familiar with flooding, flood protection measures, natural floodplain and wetland functions, and City services.
8. The City should meet with the Horry County Association of Realtors® to discuss possible changes in practice to disclose floodplain zones when house hunters view a property.

9. The City should appoint a committee to prepare an outreach strategy.

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Chapter 10 Repetitive Flood Losses

A "repetitive loss property" is one which has received two flood insurance claim payments of at least \$1,000 have been paid by the NFIP within any 10-year period since 1978 (e.g., two claims during the periods 1978–1987, 1979–1988, etc.). These properties are important to the National Flood Insurance Program because they account for one-third of the country's flood insurance claim payments. Therefore, FEMA programs encourage communities to identify the causes of their repetitive losses and develop a plan to mitigate the losses.

North Myrtle Beach is a Class 7 community in the NFIP's Community Rating System (CRS). Since there are more than 10 repetitive loss properties on the list provided by FEMA, the City must complete specific tasks to maintain its CRS rating. These include:

- review and describe its repetitive loss problem,
- prepare a map of the repetitive loss area(s),
- undertake an annual outreach project to the repetitive loss area(s) and submit a copy of the outreach project with each year's recertification.
- prepare a floodplain management plan for its repetitive loss area(s).

Description of the Repetitive Loss Problem

There are 222 repetitive flood loss properties on the North Myrtle Beach list provided by DHS – FEMA. Seven have been removed from the list by FEMA because insufficient information was provided to the City to identify their locations. Another seven properties are no longer considered repetitive loss properties because they have been mitigated by the removal of the structure or by constructing a new building on the site that meets the flood loss prevention code.

Another eight repetitive loss buildings have been removed from their sites and the City is requesting this be recognized on FEMA's next list of repetitive loss buildings.

This leaves 200 repetitive loss structures on the DHS – FEMA list that still need mitigation to eliminate or reduce future losses from flooding. These repetitive loss properties have had 465 claims paid since 1979. The flood insurance claim payments for these losses total \$8,633,009 for an average payment of \$18,567 per claim and \$43,165 per building.

Focusing on the repetitive loss list understates the magnitude of the flood hazard problem in the City. Most buildings in the City with flood insurance claim payments are not repetitive loss properties. This may be because the building

has had only one flood event, or the claim payments have been less than \$1,000, including some so small that the claim did not exceed the policy deductible. Many properties do not have flood insurance claims only because they are not covered by flood insurance.

An examination of the claim files shows the following flood events have caused flood losses within the City.

Flood Loss Events

Dates of Loss	Events	NMB Flood Frequency
September 4, 1979	Hurricane David	10-year
August 19, 1981	Tropical Storm Dennis	10-year
January 2, 1983	Heavy Rain	Less than 10-year
March 17, 1983	Storm from Gulf	10-year
September 13, 1984	Hurricane Diana	50-year
July 24-25, 1985	Hurricane Bob	10-year
January 1, 1987	Coastal Storm	25-year
September 22, 1989	Hurricane Hugo	50-year
August 12, 1991	Thunderstorm	Less than 10-year
December 25, 1994	Thunderstorm	10-year
September 5, 1996	Hurricane Fran	50-year
September 15, 1999	Hurricane Floyd	100-year

Source: Adapted from National Flood Insurance Program Claims File; National Weather Service, National Climatic Data Center, Extreme Weather and Climate Events File; and U. S. Weather Bureau (1961), "Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years." U. S. Weather Bureau, Technical Paper 40. National Weather Service Storm Reports from the National Climatic Data Center were also reviewed.

Identification of Repetitive Loss Areas

The City has mapped the locations of repetitive loss properties and identified three repetitive loss areas. These areas are shown on the repetitive loss maps later in this report.

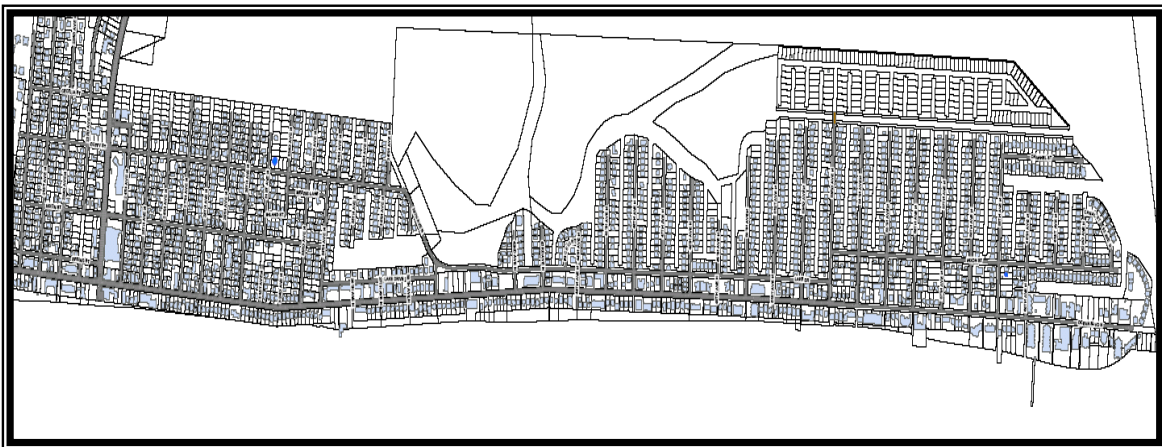
Cherry Grove Repetitive Flood Loss Area

This area is bounded by the Hog Inlet on the east, the Cherry Grove marsh on the north to Sea Mountain Road then along Duffy Street to 20th Avenue North. The western boundary runs south along 20th Avenue North to the Atlantic Ocean, which is the southern boundary.

There are 156 repetitive loss properties in this area. They represent 78 percent of the City's repetitive loss properties. These properties have had 365 flood insurance claims with payments totaling \$5,684,480 for an average payment of \$15,574 per claim and \$36,207 per building.

1,350 flood insurance claims have been paid for losses in the Cherry Grove area. These payments total \$18,284,043 and are 50 percent of the flood claims paid within the City.

Cherry Grove Repetitive Loss Area

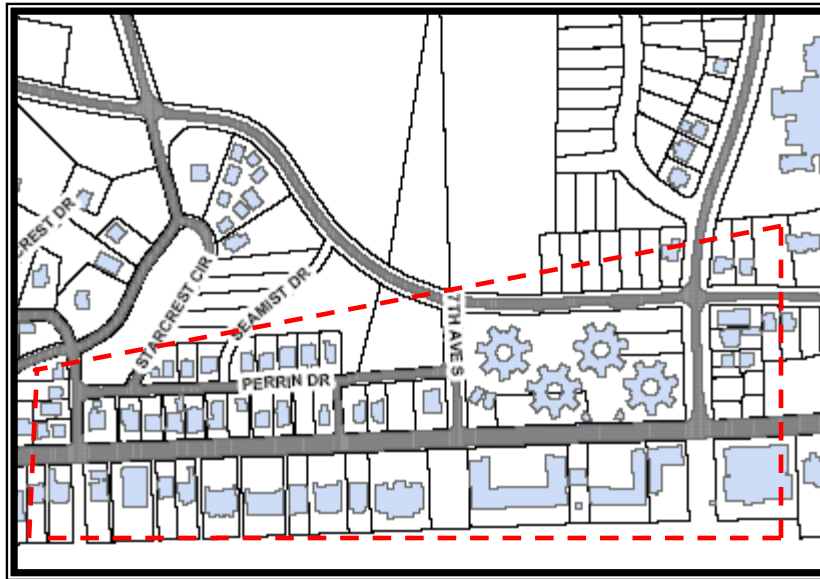


Hillside Drive Repetitive Loss Area

The Hillside Drive repetitive loss area is bounded north by Hillside Drive, on the east by 6th Avenue South, on the west by 9th Avenue South and on the east by the Atlantic Ocean.

There are 43 buildings in the floodplain in this area. Nine are classified as repetitive loss properties. Two of the properties have had seven paid flood insurance claims, two have had four paid claims, and two have had three claims paid. Flood insurance claim payments for these 9 repetitive loss buildings total \$740,983. Eight additional buildings in the area have received flood insurance claim payments totaling \$ 378,177. Since 1983 total payments for flood insurance claims (42) come to \$1,119,160 for the area.

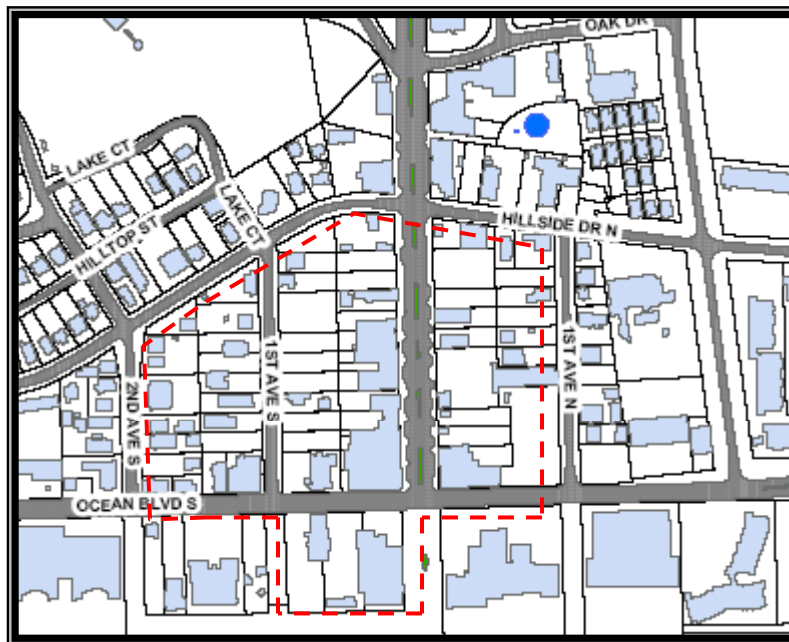
Hillside Drive Repetitive Loss Area



Main Street Repetitive Loss Area

The Main Street repetitive loss area is bounded on the east by 1st Avenue North, by Hillside Drive on the north, by 2nd Avenue South on the west, and by the Atlantic Ocean on the south.

Main Street Repetitive Loss Area



There are 60 buildings in the floodplain in this area. Twenty-five building have received flood damage since 1987 with flood insurance claim payments totaling

\$1,788,300. Ten buildings in the area have been classified as repetitive loss structures. Flood insurance claims paid on these repetitive loss structures totals \$767, 391 for an average claim of \$76,739.

Repetitive Loss Mitigation Actions

1. Implement an annual outreach project to the properties in the mapped repetitive loss areas. At a minimum the outreach project will advise the recipient of three things;
 - (a) that the property is in or near an area subject to flooding,
 - (b) property protection measures appropriate for the flood situation, and
 - (c) basic facts about flood insurance.
2. Hold Public Hearing and Consider Adoption of Coastal AE-Zone Regulations.
3. Hold Public Hearing and Consider Adoption of Enclosure Regulations.
4. Hold Public Hearing and Consider Adoption of Freeboard Regulations.
5. Develop a Mitigation Administrative Plan that Outlines Policies, Priorities and Procedures for the Use of Mitigation Grant Funds.
6. Update Public Information Materials to Include Methods to Protect Buildings from Flooding, High Winds, Shaking and Wildfire.
7. Provide Flood Map and Coastal Erosion Information to the Public.
8. Undertake a study to see how many property owners would potentially benefit from the addition of a repetitive loss provision in the ordinance.
9. The City should become a Cooperating Technical Partner for flood hazard mapping with the State and DHS – FEMA. Under this partnership the City should undertake a redelineation or restudy of its flood hazards.
10. Complete the drainage system projects described in Chapter 7.

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Chapter 11 Mitigation Action Plan

A fundamental premise of the mitigation plan is that current dollars invested in mitigation will significantly reduce the demand for future dollars by reducing the amount needed for emergency recovery, repair and reconstruction following a disaster. Mitigation also calls for conservation of natural and ecologically sensitive areas (such as wetlands, floodplains, dunes), which enables the environment to absorb some of the impact of hazard events. In this manner, mitigation programs can help the City attain a level of *sustainability*, ensure long-term economic vitality and promote the environmental health for the community as a whole.

Hazard mitigation requires that we build, rebuild and plan for today's development while considering the impact of natural hazards yet to come on inhabitants in the years ahead.

The Hazard Mitigation Committee developed recommendations to be implemented by a number of City Departments. The recommendations are in the form of action items. Each action item is related to the hazards, goals and mitigation activities identified in Chapters 2-10.

The Hazard Mitigation Action Plan Table that follows identified the primary hazards addressed by each mitigation activity. A priority is also assigned to each activity. Several factors were considered when assigning a priority to an activity including:

- the value of the property loss reduction benefit likely to be achieved by the activity.
- the potential economic recovery benefit.
- the cost of implementing the activity.
- the level of public support.

For each action item a lead Department or staff position has been identified. Each action item also has a deadline listed. Deadlines are either "ongoing" (for programs that should continue) or a date for the action to be completed.

Additionally, for each action item general categories of expenditure have been identified along with potential sources of funding.

No plan, however perfect in concept, will be perfect in execution. Revisions to the hazard mitigation plan are necessary to correct flaws that are discovered in the plan. There are always some contingencies that cannot be foreseen, or events which cannot be predicted. Revision incorporates those changes necessary to better fit the plan to real-life situations. Periodic revision of mitigation plans will also help to ensure that local mitigation efforts include the latest and most

effective mitigation techniques. Periodic revision of the mitigation plan will also keep it in compliance with state and local statutes and regulations.

Keeping the plan current will be a shared responsibility among elected officials, City staff and the Hazard Mitigation Committee appointed by City Council. The responsibilities of the Hazard Mitigation Committee are described in Chapter 12.

City of North Myrtle Beach, South Carolina

Hazard Mitigation Action Plan

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources
<u>Plan Monitoring, Evaluation and Update</u>						
5-year Plan Review and Update	City Council Mitigation Planning Committee	All	High	9/1/09 6/1/09	Staff time and contractor	General Fund and HMGF grant
Monitor Mitigation Plan Actions and Report Progress Annually	Mitigation Planning Committee City Departments	All	High	Sept. 1 annually August 1 annually	Staff time and contractor Staff time	General Fund General Fund
Adopt a Resolution to Continue the Mitigation Planning Committee	City Council	All	High	March 1, 2005	Staff time	General Fund
<u>Prevention Measures</u>						
Continue to Support Enforcement of Coastal Setback Regulations	Building Division	Coastal Erosion Hurricanes and Tropical Storms	High	Ongoing	Staff time	Permit Fees

City of North Myrtle Beach, South Carolina

Hazard Mitigation Action Plan

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources
Prevention Measures (continued)						
Maintain an Inventory of the Beach Profile and Erosion Data	City Engineer	Coastal Erosion Hurricanes and Tropical Storms	High	Ongoing	Staff time and contract services	Accommodations Tax
Update the City's Beachfront Management Plan	Planning Department	Coastal Erosion Hurricanes and Tropical Storms	High	2006	Staff time, consultant, and printing	General Fund
Maintain Adequate Building Inspection Staff and Provide Training & Resources Needed to Maintain a BCEGS Class 3/3.	City Council City Manager	All	Very High	Ongoing	Staff time	Permit Fees
Continue to enforce the International Building Codes	Building Division	All	High	Ongoing	Staff time	Permit Fees
Draft Coastal AE-Zone Regulations	Building Division	Coastal Erosion Hurricanes and Tropical Storms	High	9-1-05	Staff time and consultant	Permit Fees and General Fund
Hold Hearing and Consider Adoption of Coastal AE-Zone Regulations	City Council	Coastal Erosion Hurricanes and Tropical Storms	High	2-1-06	Staff time and consultant	Permit Fees and General Fund

City of North Myrtle Beach, South Carolina

Hazard Mitigation Action Plan

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources
Prevention Measures (continued)						
Draft Enclosure Regulations	Building Division	Coastal Erosion Hurricanes and Tropical Storms	High	9-1-05	Staff time and consultant	Permit Fees and General Fund
Hold Hearing and Consider Adoption of Enclosure Regulations	City Council	Coastal Erosion Hurricanes and Tropical Storms	High	2-1-06	Staff time and consultant	Permit Fees and General Fund
Draft Freeboard Regulations	Building Division	Flooding Hurricanes and Tropical Storms	Moderate	9-1-05	Staff time and consultant	Permit Fees and General Fund
Hold Hearing and Consider Adoption of Freeboard Regulations	City Council	Flooding Hurricanes and Tropical Storms	Moderate	2-1-06	Staff time and consultant	Permit Fees and General Fund
Maintain Flood Maps and Data	Building Division	Flooding Hurricanes and Tropical Storms	High	Ongoing	Staff time	Permit Fees
Draft Critical Facility Regulations	Building Division	Flooding Hurricanes and Tropical Storms	Moderate	9-1-06	Staff time and consultant	Permit Fees and General Fund

City of North Myrtle Beach, South Carolina

Hazard Mitigation Action Plan

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources
Prevention Measures (continued)						
Hold Hearing and Consider Adoption of Critical Facility Regulations.	City Council	Flooding Hurricanes and Tropical Storms	Moderate	2-1-07	Staff time and consultant	Permit Fees and General Fund
Draft Addition and Cumulative Substantial Improvement Regulations	Building Division	All	High	9-1-05	Staff time and consultant	Permit Fees and General Fund
Hold Hearing and Consider Adoption of Addition and Cumulative Substantial Improvement Rules	City Council	All	High	2-1-06	Staff time and consultant	Permit Fees and General Fund
Draft Wildfire Mitigation Plan	Fire Chief	Wildfire	Moderate	3/1/07	Staff time	General Fund
Property Protection						
Maintain the City's Class 3 ISO Fire Insurance Rating.	City Council Fire Chief	Wildfire Hurricanes Earthquakes	High	Ongoing	Staff time, training facilities, equipment and water distribution maintenance	General Fund

City of North Myrtle Beach, South Carolina

Hazard Mitigation Action Plan

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources
Property Protection (continued)						
Construct, Staff and Equip a New Fire Station at Barefoot Resort	City Council Fire Chief	Wildfire Hurricanes Earthquakes	High	8/1/05	Construction, equipment acquisition, staff time	General Fund
Develop a Mitigation Administrative Plan for the Use of Hazard Mitigation Grant Funds	Grants Coordinator	All	Moderate	6/1/06	Staff time	General Fund and Mitigation Grant
Continue to Upgrade Hazard Resistance of Traffic Control Equipment	City Council and City Engineer	Hurricane Earthquake Severe Winter Storms	Moderate	Ongoing	Equipment Purchases	Mitigation Grants and Street Improvement Fund
Continue to bury power and communication utility lines.	City Engineer and Utility Companies	Hurricane Earthquake Severe Winter Storms	Moderate	Ongoing	Equipment purchase, construction material and staff time	Utility Fees
Purchase Additional Emergency Generators for Critical Facilities	City Engineer and Grants Coordinator	All	High	Ongoing	Generator purchases and installations	General Fund and Mitigation Grants

City of North Myrtle Beach, South Carolina

Hazard Mitigation Action Plan

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources
<u>Property Protection (continued)</u>						
Conduct a Study on the Benefits of Adding a Repetitive Loss Provision to the Flood Ordinance	Building Division	Flooding Hurricanes	Moderate	6/1/07	Staff time and consultant	Permit Fees and General Fund
Encourage "Safe Room" Construction in Schools, Day Care Centers, Rest Homes, and other locations.	Building Division	Tornado	Low	Ongoing	Staff time and printing	Permit Fees
Encourage the Use of Seismic Retrofit Options	Building Division	Earthquake	Low	Ongoing	Staff time and printing	Permit Fees
<u>Natural Resource Protection</u>						
Ensure Erosion and Sedimentation Permits are Obtained	Building Division	Flooding Hurricanes	Moderate	Ongoing	Staff time	Permit Fees
Continue to Enforce Stream Dumping Regulations	Public Works	Flooding Hurricanes	Moderate	Ongoing	Staff time	General Fund

City of North Myrtle Beach, South Carolina
Hazard Mitigation Action Plan

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources
<u>Natural Resource Protection (continued)</u>						
Continue to enforce setback regulations from the shorelines, streams channels and their banks.	Building Division	Coastal Erosion Hurricanes and Tropical Storms	High	Ongoing	Staff time	Permit Fees
Review Wetlands Regulations for BMP Provisions and Incentives to Protect Wetland Areas	Planning Department	Flooding	Low	6/1/08	Staff time	General Fund
Evaluate Construction of a Walking Trail that Incorporates Natural Areas.	Planning Department	Flooding	Low	6/1/08	Staff time	General Fund
<u>Structural Projects</u>						
Complete the Beach Renourishment Maintenance Project	Public Works	Coastal Erosion Hurricanes and Tropical Storms	Very High	6/1/06	Construction and staff time	CORPS Maintenance Contract and City Beach Renourishment Fund

City of North Myrtle Beach, South Carolina

Hazard Mitigation Action Plan

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources
<u>Structural Projects (continued)</u>						
Continue to Maintain the City's Drainage System	Public Works	Flooding	High	Ongoing	Staff time and equipment maintenance	General Fund
Continue to Enforce the City's Stormwater Regulations	Public Works	Flooding	High	Ongoing	Staff time	Stormwater Fund
Complete Hillside Drainage Improvements	Public Works	Flooding	High	5/1/07	Construction and staff time	Stormwater Fund and Mitigation Grants
Complete the Main Street Drainage Improvements	Public Works	Flooding	High	5/1/09	Construction and staff time	Stormwater Fund and Mitigation Grants
Conduct a study of the drainage system improvements needed in the Cherry Grove Section.	Public Works	Flooding	High	5/1/08	Staff time and consultant	Stormwater Fund and Mitigation Grants
Document damages from inadequate drainage and develop a capital improvements program to eliminate problem sites.	Public Works	Flooding	High	Ongoing	Staff time	General Fund

City of North Myrtle Beach, South Carolina

Hazard Mitigation Action Plan

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources
<u>Emergency Services</u>						
Update Building Division SOP for Disaster Recovery Inspection Policies and Include ICC Provisions	Building Division	All	Moderate	5/1/07	Staff time and printing	Permit Fees
Adopt an updated Emergency Operations Plan that Includes Hazard Mitigation Actions and Identifies Resources Needed to Accomplish Response and Mitigation Tasks	City Council and City Manager	All	High	5/1/07	Staff time and printing	General Fund
Conduct an Annual Exercise of the Emergency Operations Plan	City Manager	All	High	Ongoing – Annually before Hurricane Season	Staff time	General Fund
Prepare an application for designation as a StormReady Community.	Fire Chief	All	Low	8/1/07	Staff time	General Fund

City of North Myrtle Beach, South Carolina

Hazard Mitigation Action Plan

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources
Public Information						
Provide Flood Map and Erosion Information to the Public	Building Division	Flooding Coastal Erosion	High	Ongoing	Staff time	Permit Fees
Send Mitigation Brochures to the Public	Building Division	Flooding	High	Annually	Staff time and printing	General Fund
Prepare News Releases on Property Protection Measures and Progress made in Implementing the Mitigation Plan	Assistant City Manager	All	Moderate	Quarterly	Staff time	General Fund
Prepare a Public Outreach Strategy	Assistant City Manager	Flooding Hurricanes	Moderate	8/1/05	Staff time	General Fund
Update Public Information Materials to Include Methods to Protect Buildings from High Winds, Shaking and Wildfire.	Building Division	Flooding Hurricanes Wildfire Earthquake	Moderate	5/1/06	Staff time and printing	General Fund
Continue to provide mitigation materials in the library.	Building Division	Flooding	Low	Update Annually	Staff time and printing	General Fund

City of North Myrtle Beach, South Carolina
Hazard Mitigation Action Plan

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources
<u>Public Information (continued)</u>						
Continue to require the 100-year flood contour to be shown on the final subdivision plat.	Planning Department	Flooding Hurricanes	High	Ongoing	Staff time	General Fund

City of North Myrtle Beach, South Carolina
Hazard Mitigation Action Plan

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Chapter 12 Plan Adoption Resolution

The following resolution was adopted by the City Council upon recommendation of the Mitigation Planning Committee and after a properly publicized public hearing. The resolution formally adopts the *Hazard Mitigation Plan* as the City's official mitigation policy.

RESOLUTION

A RESOLUTION ADOPTING THE NORTH MYRTLE BEACH HAZARD MITIGATION PLAN AND ESTABLISHING THE NORTH MYRTLE BEACH MITIGATION COMMITTEE.

WHEREAS, the City of North Myrtle Beach has been faced with coastal flooding and drainage problems over the years that have flooded buildings, closed businesses, disrupted traffic, and presented a general public health and safety hazard; and

WHEREAS, the City's Mitigation Planning Committee has prepared a recommended *Hazard Mitigation Plan* that reviews the City's options to reduce damage from flooding and drainage problems; and

WHEREAS, the recommended *Hazard Mitigation Plan* has been widely circulated for review by the City's residents, neighboring communities and federal, state and regional agencies and has been supported by those reviewers;

NOW THEREFORE BE IT RESOLVED by the City Council of the City of North Myrtle Beach, that:

Section 1. The *Hazard Mitigation Plan* is hereby adopted as an official plan of the City of North Myrtle Beach.

Section 2. The Mitigation Committee is hereby established as a permanent advisory body.

a. Committee members shall include:

- The Building Official
- A Certified Floodplain Manager
- The Director of Public Works
- The Zoning Administrator
- The Emergency Management Coordinator

- At least six residents whose composition shall include enough floodplain residents so that they represent at least 50 percent of the committee.
 - Other members as appropriate
- b. The Committee members and its Chair shall be appointed by the City Council.
- c. Resident Committee members shall serve two-year terms with one-half of the members' terms expiring each year. For the initial committee appointment, three resident members shall be appointed to a one-year term and three shall be appointed to a two-year term.
- d. The schedule of Committee meetings shall be posted in appropriate places. All meetings of the Committee shall be open to the public.
- e. The Committee shall meet as often as necessary to prepare or review mitigation activities and progress toward implementing the *Hazard Mitigation Plan*. It shall meet at least once each year to review the status of ongoing projects.

Section 3. By August 15 each year, the Committee shall prepare and present an annual evaluation report on the *Mitigation Plan* to the City Council. The report will cover the following points:

- A review of the original plan.
- A review of any floods, hurricanes or other natural disasters that occurred during the previous calendar year.
- A review of the action items in the original plan, including how much was accomplished during the previous year.
- A discussion of why any action items were not completed or why implementation is behind schedule.
- Recommendations for new projects or revised action items. Such recommendations shall be subject to approval by this Council as amendments to the adopted plan.

Adopted this the 6th day of December 2004.

Chapter 13 Monitoring and Evaluation of Mitigation Actions

Monitoring and evaluation involve the ongoing processes of compiling information on the outcomes that result from implementation of the hazard mitigation strategies contained in the plan. In other words, monitoring and evaluation measure how successfully the City is implementing each mitigation strategy.

Monitoring and evaluation also provide the City with an opportunity to make necessary revisions as local conditions change. Changes in development, technology or the capability of the City to implement mitigation actions may necessitate changes to the plan itself.

The primary issue that monitoring and evaluation should address is whether the City's vulnerability has decreased as a result of the plan. Where vulnerability has decreased, the City should determine why and consider implementing successful mitigation measures in other locations.

Where vulnerability has increased, or remained constant, the City should identify whether additional measures might be more successful, or whether revisions should be made to existing measures.

Other issues that should be assessed include:

- The adequacy of the City's resources to implement the mitigation strategies.
- Any redundancy among strategies that can be eliminated to free-up resources.
- Whether adequate funding is available.
- Any technical, legal or coordination problems associated with implementation.
- Whether mitigation actions are being implemented according to schedule.

Leading the evaluation effort for North Myrtle Beach is the Mitigation Planning Committee, which has been requested by the City Council to prepare and present an annual evaluation report on the *Mitigation Plan* by August 15 of each year. The report will cover the following points:

- A review of the original plan.
- A review of any floods, hurricanes or other natural disasters that occurred during the previous calendar year.
- A review of the action items in the original plan, including how much was accomplished during the previous year.
- A discussion of why any action items were not completed or why implementation is behind schedule.
- Recommendations for new projects or revised action items.

The following table will help the committee and the City as they track and evaluate mitigation actions identified in the *Hazard Mitigation Plan*.

Action Item	Description	Milestones	Evaluation Measures
<u>Plan Monitoring, Evaluation and Update</u>			
5-year Plan Review and Update	<p>5-year evaluation, progress report and revised plan are required by DMA 2000.</p> <p>5-year Plan Review and Update following 10 Step process used for the current Plan is required for participation in CRS.</p>	<p>Update is completed on schedule.</p> <p>Update is completed on schedule.</p>	
Monitor Mitigation Plan Actions and Report Progress Annually	An annual report on the progress of implementing mitigation actions identified in the Plan is required for continued participation in the CRS Program.	Annual reports are completed on schedule.	
Adopt a Resolution to Continue the Mitigation Planning Committee	Committee should include floodplain residents who make up at least 50% of the membership.	Committee is appointed before February 1, 2005.	Committee composition meets CRS requirements for planning credit.
Prevention Measures			
Continue to Support Enforcement of Coastal Setback Regulations	A setback line has been established by OCRM based on a 40-year erosion rate.		All permits issued by the City meet the setback requirement.
Maintain an Inventory of the Beach Profile and Erosion Data	This survey data is used to determine when the beach profile has declined to a condition where beach renourishment is justified under the City's agreement with the U S Army CORPS of Engineers.	Annual reports are completed on schedule.	Beach nourishment project provides expected level of property protection during future storms.
Update the City's Beach-front Management Plan	State law requires the plan to include beach profile and historic erosion rate data, an inventory of structures located beyond the ocean setback line, a drainage plan for the area seaward of the setback line, a post disaster plan for maintaining essential services, and other topics.	Update is completed on schedule.	Plan meets the State's planning requirements.

Action Item	Description	Milestones	Evaluation Measures
Prevention Measures (continued)			
Maintain Adequate Building Inspection Staff and Provide Training and Resources Needed to Maintain a BCEGS Class 3/3.	Add building code plan review and inspections staff. Ensure adequate training time and resources are provided so the staff can maintain their certifications.	Additional staff is authorized in the next budget.	The City maintains or improves its BCEGS rating.
Continue to enforce the International Building Codes	Includes the IBC and IRC.		Building constructed to the recent code perform better during hurricanes.
Adopt Coastal AE-Zone Regulations	Regulations will require V-Zone construction standards in an area designated as a Coastal AE-Zone.	Date of Adoption	Measure the effect on flood losses in NMB. Measure the effect on repetitive flood losses in NMB.
Adopt Enclosure Regulations	Regulations will limit the size of enclosures to no more than 299 square feet. Require owners that want to construct enclosures to sign a nonconversion agreement.	Date of Adoption	Measure the effect on flood losses in NMB. Measure the effect on repetitive flood losses in NMB.
Adopt Freeboard Regulations	Regulation to increase the freeboard requirement to 2 feet above the base flood elevation.	Date of Adoption	Measure the effect on flood losses in NMB.
Maintain Flood Maps and Data	Maintain a floodplain overlay map in the City's GIS. Inspect and maintain elevation reference marks. Participate in a new flood insurance study and contribute topographic and LIDAR data.	Task is completed at least annually.	Measure the effect on flood losses in NMB.
Adopt Critical Facility Regulations.	Unless on feasible alternative is available, regulations would prohibit critical facilities from being located in the 500-year floodplain.	Date of Adoption	Measure the effect on flood losses at critical facilities in NMB.

Action Item	Description	Milestones	Evaluation Measures
Prevention Measures (continued)			
Adopt Addition and Cumulative Substantial Improvement Rules	Clarify building addition rules and adopt rules to track building improvements over the life of the structure.	Date of Adoption	Number of buildings achieving better property protection at an accelerated rate.
Draft Wildfire Mitigation Plan	The plan will examine the wildfire risks and recommend mitigation techniques.	Plan Completion Date	Measure how the mitigation measures affect wildfire losses to buildings.
Property Protection			
Maintain the City's Class 3 ISO Fire Insurance Rating.	Provide staffing, equipment, training, water supply and distribution for fire suppression.		Monitor the ISO Rating.
Construct New Fire Station at Barefoot Resort	Construction, staffing and equipping a station in this area to provide adequate fire response capability for both structural fires and wildfire incidents.	Date Fire Station becomes operational.	
Develop a Mitigation Administrative Plan for the Use of Hazard Mitigation Grant Funds	The plan should describe the policies and procedures to be used by the City when using HMGP funding to acquire property, relocate structures, elevate buildings, complete drainage system projects, or acquire emergency support equipment.	Date of Plan completion.	The plan should be clear about how City priorities will be set for the use of recovery and mitigation grant funds.
Continue to Upgrade Hazard Resistance of Traffic Control Equipment	Installation of wind resistant traffic control devices.		Performance of traffic control devices during high windstorm events.
Continue to bury power and communication utility lines.	Encourage utilities to continue to bury electric, telephone and cable lines.		Record of service interruptions during storms.
Purchase Additional Emergency Generators for Critical Facilities	Purchase generators to use on a rotating basis at sewer lift stations.		Record of service interruptions during storms.

Action Item	Description	Milestones	Evaluation Measures
Property Protection (continued)			
Conduct a Study on the Benefits of Adding a Repetitive Loss Provision to the Flood Ordinance	This study would examine past flood claims to determine how many property owners might benefit from the addition of this provision to the ordinance. It would also describe local administrative procedures to be followed so property owners would be eligible for this assistance.	Date of study completion.	
Encourage "Safe Room" Construction in Schools, Day Care Centers, Rest Homes, and other locations.	Provide brochures and other materials to mobile home park owners and others interested in "Safe Room" construction.		Number of "Safe Rooms" constructed and used.
Encourage the Use of Seismic Retrofit Options	Provide brochures and other materials to those interested in seismic retrofit.		Number of permits issued for seismic retrofits.
Natural Resource Protection			
Ensure Erosion and Sedimentation Permits are Obtained	NFIP regulations require the City to ensure other permits are obtained.		
Continue to Enforce Stream Dumping Regulations	Respond to complaints when violations are reported and conduct periodic inspections to identify and correct violations.		
Continue to enforce setback regulations from the shorelines, streams channels and their banks.	Setback based on line established by OCRM.		All permits issued by the City meet the setback requirement.
Review Wetlands Regulations for BMP Provisions and Incentives to Protect Wetland Areas	During the next Comprehensive Plan review best management practices for stormwater runoff and potential incentives.	Date review and recommendations completed	
Evaluate Construction of a Walking Trail that Incorporates Natural Areas.	During the next Comprehensive Plan review look for ways to incorporate natural areas into a walk trail.		

Action Item	Description	Milestones	Evaluation Measures
Structural Projects			
Complete the Beach Renourishment Maintenance Project	Requires the addition of sand to the beach to move the high-water line offshore.	Renourishment occurs before beach profile is degraded below the standards set in the design manual and CORPS agreement.	Beach nourishment project provides expected level of property protection during future storms.
Continue to Maintain the City's Drainage System	<p>Inspect the drainage system at least annually and maintain when needed.</p> <p>An inspection is conducted after each storm the could adversely impact the drainage system.</p> <p>Inspections are conducted in response to citizen's complaints.</p>	Inspections and maintenance are completed is accordance with the City's maintenance plan.	
Continue to Enforce the City's Stormwater Regulations	Requires development runoff not to exceed predevelopment runoff.		All permits issued by the City meet the design manual requirements.
Complete Hillside Drainage Improvements	Construction of stormwater retentions ponds and raise the height of Hillside Drive between 6 th Avenue South and 9 th Avenue South.		Measure the effect on flood losses.
Complete the Main Street Drainage Improvements	Installation of catch basins, drainage pipe and an outfall 1,300 feet into the ocean.		Measure the effect on flood losses.
Conduct a study of the drainage system improvements needed in the Cherry Grove Section.	The study should look at options the City has to reduce flooding from drainage problems in the area.		Measure the effect on flood losses
Document damages from inadequate drainage and develop a capital improvements program to eliminate problem sites.	The system should collect data on building construction, building condition, value of buildings, depth of flooding, and flood loss data.	Completed within three months of a major storm.	

Action Item	Description	Milestones	Evaluation Measures
Emergency Services			
Update Building Division SOP for Disaster Recovery Inspection Policies and Include ICC Provisions	The SOP should include the proposed strategy on how damage assessment will be conducted, buildings tagged, and conditions reported. It should describe the staff and equipment resources needed. It should include provisions for determining whether buildings have been substantially damaged.	Date SOP is completed.	
Adopt an updated Emergency Operations Plan that Includes Hazard Mitigation Actions and Identifies Resources Needed to Accomplish Response and Mitigation Tasks	<p>The plan should identify how watches and warning are received and disseminated to the general public, emergency actions should be keyed to threat levels, and provisions should be made for the notification of critical facilities. Critical facility operation plans should be reviewed and maintained by the City.</p> <p>The plan or agency SOP should include mitigation tasks and identify resources necessary to complete response tasks.</p>		<p>Are new mitigation tasks completed by the City, businesses or property owners?</p> <p>What is the impact of these actions on disaster losses?</p>
Conduct an Annual Exercise of the Emergency Operations Plan with a Scenario that Test Policies and Procedures	The exercise may be a table top exercise, drill, or response to an actual disaster to meet the CRS flood warning credit prerequisite.	Annual Exercise	Are improvements made to the plan or operating procedures as a result of the exercise?
Prepare an application to the National Weather Service for designation as a StormReady Community.	The application requires documentation on the communications, training and operational capabilities if the City's emergency response.		Does the training and coordination offered by the NWS enhance the City's emergency response capability?

Action Item	Description	Milestones	Evaluation Measures
Public Information			
Provide Flood Map and Erosion Information to the Public	<p>Advertise that this service is available. Notices must be sent to Realtors, lenders and real estate agents.</p> <p>Information from the FIRM must be provided, plus erosion rate information for ocean front properties.</p>	Date City is prepared to provide erosion rate information to those who inquire.	
Send Mitigation Brochures to the Public	The City sends two brochures each year to property owners.		Do people who receive the information undertake mitigation projects?
Prepare News Releases on Property Protection Measures and Progress made in Implementing the Mitigation Plan	At least one article should be provided to the press each quarter.	Number of mitigation articles prepared.	
Prepare a Public Outreach Strategy	The strategy should be prepared by committee and include representatives from outside City government.	<p>Date Committee appointed.</p> <p>Date of strategy.</p>	
Update Public Information Materials to Include Methods to Protect Buildings from High Winds, Shaking and Wildfire.	The current brochure only includes flood hazard information. This would make the brochure a multi-hazard publication.	Date completed.	
Continue to provide mitigation materials in the library.	The City has placed a copy of the Flood Insurance Rate Maps and several publications on hazard resistant construction in the library.		
Continue to require the 100-year flood contour to be shown on the final subdivision plat.	The is required by local ordinance at Section 6 – 37.		

Appendix A

City Council Resolution Appointing The Mitigation Planning Committee

- 1. Request for City Council consideration of a resolution to create a Mitigation Planning Committee.**
- 2. Extract from Minutes of February 16, 2004 City Council Meeting where Mitigation Planning Committee Resolution was adopted.**
- 3. Adopted resolution creating a Mitigation Planning Committee.**
- 4. Request for City Council to appoint members of the Mitigation Planning Committee.**

REQUEST FOR CITY COUNCIL CONSIDERATION

Meeting Date: February 16, 2004

Agenda Item: 5-C	Prepared By: Myron Cox, Building Official
Agenda Section: Business: Resolution	Date: February 10, 2004
Subject: Establishment of Hazard Mitigation Committee and Outline of Responsibilities	Division: Building

Background:

The Federal Emergency Management Agency (FEMA) has mandated that municipalities who participate in the Community Rating System (CRS) program formally establish a Mitigation Planning Committee to help in the formulation and adoption of a hazard mitigation plan.

The committee will have such duties as holding public meetings; data collection; goal and objective formulation; impact assessment and the preparation of a formal plan. The major subjects of concern to the committee include hurricanes, strong winds and flooding.

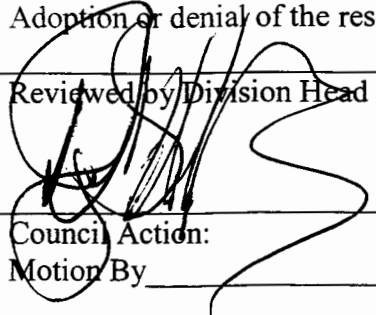
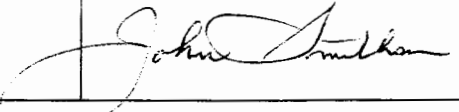
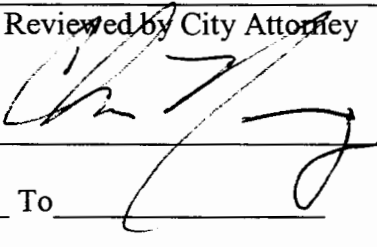
The Plan will be used to graphically and verbally outline the areas of the City the most vulnerable to major flooding and associated damage. It will further establish policies to help correct problems caused by hurricanes, nor'easters, major rainstorms, and other inclement weather conditions.

This committee shall be comprised of five (5) members of the public whose residence is located within a flood hazard area, along with three (3) members of the North Myrtle Beach administration staff.

A draft resolution is provided for Council's convenience.

Recommended Action:

Adoption or denial of the resolution.

Reviewed by Division Head 	Reviewed by City Manager 	Reviewed by City Attorney 
Council Action: Motion By _____ 2 nd By _____ To _____		

**Minutes from February 16, 2004 City Council Meeting
Authorizing the Appointment of a
Hazard Mitigation Planning Committee**

**CITY OF NORTH MYRTLE BEACH, SOUTH CAROLINA
NORTH MYRTLE BEACH MUNICIPAL COMPLEX
CITY COUNCIL MEETING
Monday, February 16, 2004
7:30 p.m.**

MINUTES

SUMMARY MINUTES OF CITY COUNCIL MEETING. Audiotapes of the meeting are on file and are included by reference as part of this meeting. An agenda of this meeting has been either mailed or made available to persons, organizations, and local news media as per their request. The agenda gives the date, time, and place of the meeting as well as the order of business. This disclosure is in compliance with the South Carolina Code of Laws of 1976, Section 30-4-80(e).

PRESENT:

COUNCIL:

MARILYN HATLEY, Mayor
TERRY WHITE
HAL HOFF
GREG DUCKWORTH
DORIS WILLIAMS
BOB CAVANAUGH

CITY MANAGER
CITY ATTORNEY
CITY CLERK

JOHN SMITHSON
CHRIS P. NOURY
MERIDETH SMITH

Mayor Hatley called the meeting to order at 7:35 p.m. The clerk then called the roll. A quorum was established. Rev. Harold Mitchell gave the invocation. Mayor Hatley led the Pledge of Allegiance.

**C. A RESOLUTION APPOINTING A FLOOD MITIGATION COMMITTEE
FOR CRS PROGRAM**

The City Manager read the Resolution by title and gave the background information.

**A RESOLUTION CREATING THE MITIGATION PLANNING COMMITTEE FOR
THE CITY OF NORTH MYRTLE BEACH, SOUTH CAROLINA.**

The Federal Emergency Management Agency (FEMA) has mandated that municipalities who participate in the Community Rating System program formally establish a Mitigation Planning Committee to help in the formulation and adoption of a hazard mitigation plan.

The committee shall be comprised of five (5) members of the public whose residence is located within a flood hazard area, along with three (3) members of the North Myrtle Beach administration staff.

Mayor Hatley asked for a motion to accept the draft Resolution. Motion made by Councilman Cavanaugh, seconded by Councilman White.

Mayor Hatley stated for clarification that this is not appointing the members for the committee but accepting the resolution to form a committee.

There were no comments from the public.

The motion passed. The Resolution was accepted.

Respectfully submitted,

Merideth J. Smith, City Clerk

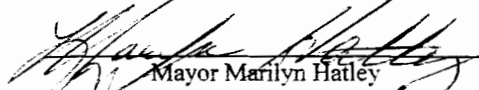
RESOLUTION
A RESOLUTION CREATING THE MITIGATION PLANNING COMMITTEE FOR
THE CITY OF NORTH MYRTLE BEACH, SOUTH CAROLINA


- WHEREAS, the Federal Emergency Management Agency requires the creation of a community committee in order to assist in identifying the issues related to floodplain mitigation; and
- WHEREAS, the city wants to remain eligible for certain Federal and State disaster assistance and hazard mitigation funds; and
- WHEREAS, the City has set a goal of reducing the cost of flood insurance premiums for property owners by improving the City Community Rating System classification under the National Flood Insurance Program; and
- WHEREAS, properties in the City of North Myrtle Beach have been severely flooded and damaged from high winds during hurricanes; and
- WHEREAS, there are hazard mitigation activities that can reduce losses from natural disasters and enhance the sustainability of the City;

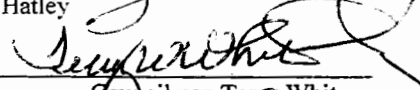
NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of North Myrtle Beach that:

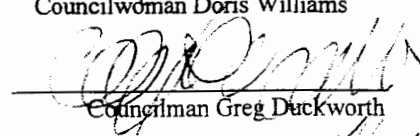
1. A Mitigation Planning Committee is hereby established. Its members shall be appointed by City Council and shall include four (4) floodplain property owners, one (1) citizen-at-large, and three (3) City of North Myrtle Beach staff.
2. The Mitigation Planning Committee is charged with the following:
 - a. Collect data on natural hazards and the vulnerability of buildings and critical facilities.
 - b. Assess the impact natural hazards could have on the people, property, and economy of the City.
 - c. Recommend hazard mitigation goals.
 - d. Review potential activities that will accomplish the proposed mitigation goals.
 - e. Prepare a mitigation plan that recommends actions the City should take to achieve the recommended mitigation goals.
 - f. Solicit public input on natural hazard problems and solutions both during and after the preparation of the plan.
 - g. Recommend procedures to evaluate the impact of the proposed actions.
3. The Committee will meet at least three times in order to review hazard analysis data and reports, to identify potential mitigation activities, and to review and propose modifications to the draft mitigation plan.

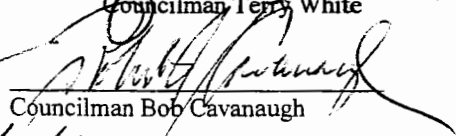
DATED at North Myrtle Beach this 16th day of February 2004.

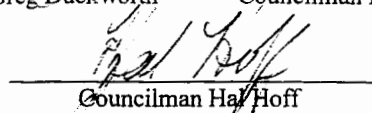

Mayor Marilyn Hatley

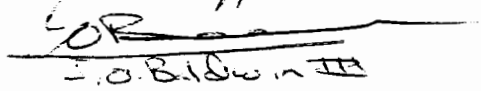

Councilwoman Doris Williams


Councilman Terry White


Councilman Greg Duckworth


Councilman Bob Cavanaugh


Councilman Hal Hoff


J.O.B. Brown III

REQUEST FOR CITY COUNCIL CONSIDERATION

Meeting Date: March 15, 2004

Agenda Item: 5-B	Prepared By: Myron Cox, Building Official
Agenda Section: Business: Motion to Appoint	Date: March 10, 2004
Subject: Appointment of Hazard Mitigation Committee Members	Division: Building

Background:

At the February 16, 2004 meeting, Council adopted the resolution to create a Hazard Mitigation Committee and recommended the administrative staff gather names of potential members to serve on that group. The following persons have expressed a willingness to participate and it is suggested that Council appoint them at this time.

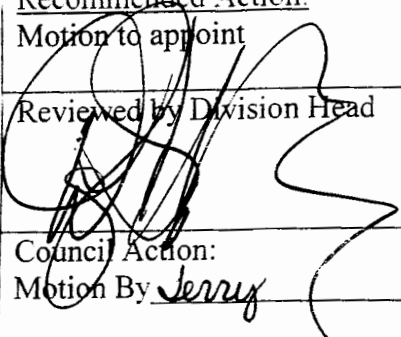
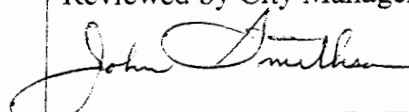
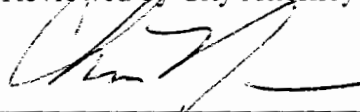
The persons are:

1. Hank Thomas
2. Dewayne Bates
3. Russell Burgess
4. Clinton Norris
5. Ed Prince
6. Tripp Morton – City Staff
7. Butch Coster – City Staff
8. Myron Cox – City Staff

A copy of the adopted resolution is provided for Council's convenience.

Recommended Action:

Motion to appoint

Reviewed by Division Head 	Reviewed by City Manager 	Reviewed by City Attorney 
Council Action: Motion By <u>Jerry</u> 2 nd By <u>Bob</u> To <u>Approve</u>		

Appendix B

Notices Advertising Public Meetings of the Mitigation Planning Committee

Cable Television Public Access Channel Advertisement for May 12, 2004 Hazard Mitigation Planning Committee Public Meeting.

"The City of North Myrtle Beach Hazard Mitigation Committee has scheduled a public meeting for input and comments on the hazard mitigation plan. Public comments on the planning process, hazard problems and potential solutions are welcome. All interested parties are encouraged to attend the meeting in City Council Chambers at 5:00 p. m. on May 12, 2004."

Sun Times announcement of the June 12, 2004 Hazard Mitigation Planning Committee Public Meeting.

NORTH MYRTLE BEACH

Survey part of natural disaster assessment

Residents should receive a survey with their water bill next week so a committee can get input on how to protect their homes and community from natural disasters.

The city has appointed a Mitigation Planning Committee to prepare and recommend a plan to address flooding, stormwater drainage and other natural disaster issues to City Council for consideration.

The committee held a public meeting Wednesday. The next meeting is scheduled for June 16.

The committee will use public comments and recommendations from city departments to help the city qualify for lower flood insurance rates and hazard mitigation grants.

Cable Television Public Access Channel Advertisement for June 16, 2004 Hazard Mitigation Planning Committee Public Meeting.

"The City of North Myrtle Beach Hazard Mitigation Committee has scheduled a public meeting for input and comments on the draft plan for hazard mitigation/floodplain management. All interested parties are encouraged to attend the meeting in City Council Chambers at 5:00 p. m. on June 16, 2004."

Appendix C

Coordination Letters

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April 19, 2004

Ms. Susan Wilson
Mitigation Division
FEMA Region IV
3003 Chamblee-Tucker Rd.
Atlanta, Georgia 30341

Dear Susan:

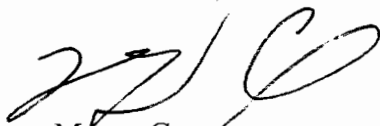
The City of North Myrtle Beach is in the process of preparing a hazard mitigation plan. As part of that effort we would like to do an analysis of flood insurance claims for properties within the city. To accomplish this we are requesting that FEMA provide all flood insurance claims data since the city entered the program.

Please provide the claims data in a Microsoft Access Data Base or Excel file. We will also need a copy of the Transaction Record Reporting and Processing (TRRP) Plan to identify the column titles and definitions used in the database. If this information is available in a format that is easier to use, that would be great.

The city has retained the services of Berry Williams to assist with preparing the mitigation plan. Please feel free to send the data and other information directly to him. Berry's address is Berry A. Williams and Associates, 1117 Manchester Drive, Raleigh, North Carolina. 27609. He may also be reached by phone on 919-786-0777 or by email at berrywms@minspring.com. Questions concerning this request may also be directed to Berry.

Thank you for your assistance in obtaining this information.

Best Wishes,



Myron Cox



December 10, 2004

Mr. Paul Whitten, Director
Horry County Emergency Management
2560 North Main Street, Suite 4
Conway, South Carolina 29526

Dear Paul:

Enclosed you will find a copy of the draft Hazard Mitigation Plan for the City of North Myrtle Beach. As you will see we have addressed several types of natural hazards in the plan.

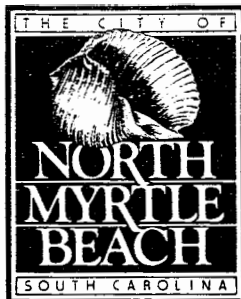
The City Council appointed a Mitigation Planning Committee to develop the draft plan. The Committee met 11 times, including two public meetings and two work sessions with City Council. Council held its public hearing for the Hazard Mitigation Plan on November 15.

City Council is still reviewing the draft plan and the purpose of this letter is to obtain any comments your agency may have concerning the recommendations in the plan. We expect the plan will be adopted in December, but evaluated and revised on an annual basis as needed.

Thank you for your assistance.

With Best Regards,

Myron Cox
Chief Building Official



December 10, 2004

Mrs. Lisa S. Jones, State NFIP Coordinator
South Carolina Department of Natural Resources
2221 Devine Street
Columbia, South Carolina 29205

Dear Lisa:

Enclosed you will find a copy of the draft Hazard Mitigation Plan for the City of North Myrtle Beach. As you will see flood claims data has been evaluated to develop several mitigation recommendations. One recommendation includes participation in the Cooperative Technical Partner Program. We would like to learn more about this effort and would appreciate any information your office can provide.

The City Council appointed a Mitigation Planning Committee to develop the draft plan. The Committee met 11 times, including two public meetings and two work sessions with City Council. Council held its public hearing for the Hazard Mitigation Plan on November 15.

City Council is still reviewing the draft plan and the purpose of this letter is to obtain any comments your agency may have concerning the recommendations in the plan. We expect the plan will be adopted in December, but evaluated and revised on an annual basis as needed.

Thank you for your assistance.

With Best Regards,

A handwritten signature in dark ink, appearing to read 'Myron Cox', with a stylized flourish at the end.

Myron Cox
Chief Building Official



December 10, 2004

Ms. Susan Wilson
Mitigation Division
FEMA Region IV
3003 Chamblee-Tucker Rd.
Atlanta, Georgia 30341

Dear Susan:


Enclosed you will find a copy of the draft Hazard Mitigation Plan for the City of North Myrtle Beach. Thank you for providing the flood insurance claims information for the City. As you will see this information has been used to develop several mitigation recommendations.

The City Council appointed a Mitigation Planning Committee to develop the draft plan. The Committee met 11 times, including two public meetings and two work sessions with City Council. Council held its public hearing for the Hazard Mitigation Plan on November 15.

City Council is still reviewing the draft plan and the purpose of this letter is to obtain any comments your agency may have concerning the recommendations in the plan. We expect the plan will be adopted in December, but evaluated and revised on an annual basis as needed.

Thank you for your assistance.

With Best Regards,


Myron Cox
Chief Building Official



December 10, 2004

Mr. Shawn Putnam
State Hazard Mitigation Officer
South Carolina Emergency Preparedness Division
1429 Senate Street
Columbia, SC 29201

Dear Shawn:

Enclosed you will find a copy of the draft Hazard Mitigation Plan for the City of North Myrtle Beach. As you will see we have addressed several types of natural hazards in the plan.

The City Council appointed a Mitigation Planning Committee to develop the draft plan. The Committee met 11 times, including two public meetings and two work sessions with City Council. Council held its public hearing for the Hazard Mitigation Plan on November 15.

City Council is still reviewing the draft plan and the purpose of this letter is to obtain any comments your agency may have concerning the recommendations in the plan. We expect the plan will be adopted in December, but evaluated and revised on an annual basis as needed.

Thank you for your assistance.

With Best Regards,

A handwritten signature in black ink, appearing to read 'Myron Cox'.

Myron Cox
Chief Building Official



December 10, 2004

Mr. Chris Mack
U. S. Army Corps of Engineers
Charleston District
Floodplain Management Section
69-A Hagwood Avenue
Charleston, South Carolina 29403-5107

Dear Chris:

Enclosed you will find a copy of the draft Hazard Mitigation Plan for the City of North Myrtle Beach. As you will see we have addressed several types of natural hazards in the plan, including coastal erosion.

The City Council appointed a Mitigation Planning Committee to develop the draft plan. The Committee met 11 times, including two public meetings and two work sessions with City Council. Council held its public hearing for the Hazard Mitigation Plan on November 15.

City Council is still reviewing the draft plan and the purpose of this letter is to obtain any comments your agency may have concerning the recommendations in the plan. We expect the plan will be adopted in December, but evaluated and revised on an annual basis as needed.

Thank you for your assistance.

With Best Regards,

Myron Cox
Chief Building Official

Appendix D

Land Use and Flood Hazard Map

See the disk in the CD holder.

**The Land Use and Flood Hazard Map is shown on
72 map sheets each measuring 11" x 17".**

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Appendix E

Mitigation Plan Adoption

- 1. Notice advertising the November 15, 2004 City Council Public Hearing. Notice was published in The Sun Times October 31, 2004.**
- 2. Extract from the City Council Minutes of December 6, 2004 where Council approved the resolution adopting the Draft Hazard Mitigation Plan.**
- 3. Resolution adopting the Hazard Mitigation Plan.**

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Purchasing Division
City of North Myrtle Beach
1120 2nd Avenue South, North Myrtle Beach SC 29582

Phone: 843-280-5660

Fax: 843-280-5504

To: THE SUN NEWS
Fax: 843-626-0808

Re: Blanket Purchase Order No. 24534 Acct # 300417
Release No.63612

Classified Ad: See Attached

- | | | |
|-------------------------------------|---|---|
| <input type="checkbox"/> | Bids - Legal Section | _____ |
| <input checked="" type="checkbox"/> | Public Notices - Legal Section | NMB Hazard Mitigation Plan
SEE ATTACHED |
| <input type="checkbox"/> | Public Hearing/Meeting -
Legal Section | _____
_____ |
| <input type="checkbox"/> | Employment | _____ |
| <input type="checkbox"/> | Abandoned Vehicles | _____ |
| <input type="checkbox"/> | Surplus Sale | _____ |
| <input type="checkbox"/> | Other | _____
_____ |

Run Date(s):**Sunday October 31, 2004**



Please Submit affidavit of ad with invoice.

Signed: *Jungla Street, Buyer*

Date: 10/26/2004

Number of Pages Faxed, including Cover Sheet **2**

PUBLIC NOTICE

The North Myrtle Beach City Council will hold a public hearing on Monday, November 15, 2004 at 7:30 p.m. in the Council Chambers of City Hall at 1018 2nd Avenue South, North Myrtle Beach, SC to discuss the proposed City of North Myrtle Beach Hazard Mitigation Plan.

This is a public meeting. All interested parties are encouraged to attend this meeting and express their concerns. Copies of the draft plan are available in the Office of Planning & Development for public review. Questions regarding this matter should be addressed to Myron Cox, Chief Building Official at (843) 280-5560.

**CITY OF NORTH MYRTLE BEACH, SOUTH CAROLINA
NORTH MYRTLE BEACH CITY HALL
CITY COUNCIL MEETING
Monday, December 6, 2004
7:30 p.m.**

MINUTES

SUMMARY MINUTES OF CITY COUNCIL MEETING. Audiotapes of the meeting are on file and are included by reference as part of this meeting. An agenda of this meeting has been either mailed or made available to persons, organizations, and local news media as per their request. The agenda gives the date, time, and place of the meeting as well as the order of business. This disclosure is in compliance with the South Carolina Code of Laws of 1976, Section 30-4-80(e).

COUNCIL:

PRESENT:	MARILYN HATLEY, Mayor GREG DUCKWORTH DORIS WILLIAMS HAL HOFF BOB CAVANAUGH
ABSENT	TERRY WHITE JAY BALDWIN
CITY MANAGER	JOHN SMITHSON
CITY ATTORNEY	CHRIS P. NOURY
CITY CLERK	MERIDETH SMITH

1. CALL TO ORDER:

Mayor Hatley called the meeting to order at 7:30 p.m. The clerk then called the roll. A quorum was established. The Rev. Henry Brock gave the invocation. Mayor Hatley led the Pledge of Allegiance.

D. Resolution to adopt the North Myrtle Beach Hazard Mitigation Plan.

The City Manager read the Resolution.

A RESOLUTION ADOPTING THE NORTH MYRTLE BEACH HAZARD
MITIGATION PLAN AND ESTABLISHING THE NORTH MYRTLE BEACH
MITIGATION COMMITTEE.

Mayor Hatley called for a motion to accept Ordinances A, C and D on Second Reading.
Councilman Cavanaugh made the motion to accept, seconded by Councilman
Duckworth. There was no public comment. The motion passed 5-0.

RESOLUTION

A RESOLUTION ADOPTING THE NORTH MYRTLE BEACH HAZARD MITIGATION PLAN AND ESTABLISHING THE NORTH MYRTLE BEACH MITIGATION COMMITTEE.

WHEREAS, the City of North Myrtle Beach has been faced with coastal flooding and drainage problems over the years that have flooded buildings, closed businesses, disrupted traffic, and presented a general public health and safety hazard; and

WHEREAS, the City's Mitigation Planning Committee has prepared a recommended Hazard Mitigation Plan that reviews the City's options to reduce damage from flooding and drainage problems; and

WHEREAS, the recommended Hazard Mitigation Plan has been widely circulated for review by the City's residents, neighboring communities and federal, state and regional agencies and has been supported by those reviewers;

NOW THEREFORE, BE IT RESOLVED by the City Council of the City of North Myrtle Beach, that:

Section 1. The Hazard Mitigation Plan is hereby adopted as an official plan of the City of North Myrtle Beach.

Section 2. The Mitigation Committee is hereby established as a permanent advisory body.

a. Committee members shall include:

- Building Official
- A Certified Floodplain Manager
- The Director of Public Works
- The Zoning Administrator
- The Emergency Management Coordinator
- At least six residents whose composition shall include enough floodplain residents so that they represent at least 50 percent of the committee.
- Other members as appropriate

b. The Committee members and its Chair shall be appointed by the City Council.

c. Resident Committee members shall serve two-year terms with one-half of the members' terms expiring each year. For the initial committee appointment, three resident members shall be appointed to a one-year term and three shall be appointed to a two-year term.

d. The schedule of Committee meetings shall be posted in appropriate places. All meetings of the Committee shall be open to the public.

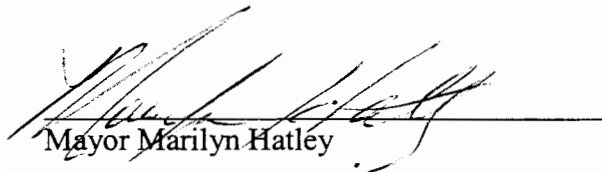
- e. The Committee shall meet as often as necessary to prepare or review mitigation activities and progress toward implementing the Hazard Mitigation Plan. It shall meet at least once each year to review the status of ongoing projects.

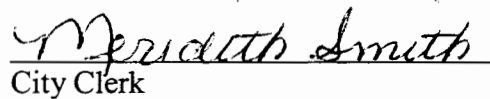
Section 3. By August 15 each year, the Committee shall prepare and present an annual evaluation report on the Mitigation Plan to the City Council. The report will cover the following points:

- A review of the original plan.
- A review of any floods, hurricanes or other natural disasters that occurred during the previous calendar year.
- A review of the action items in the original plan, including how much was accomplished during the previous year.
- A discussion of why any action items were not completed or why implementation is behind schedule.
- Recommendations for new projects or revised action items. Such recommendations shall be subject to approval by this Council as amendments to the adopted plan.

RESOLVED THIS 16 day of December, 2004.

ATTEST:


Mayor Marilyn Hatley


City Clerk

Appendix F

Potential CRS Credit Based on Implementation of the Hazard Mitigation Plan

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North Myrtle Beach Current and Potential CRS Credit

CRS Activity	Current Credit	Proposed Credit	Change in Credit
310 Elevation Certificates	71	71	
320 Map Information	140	140	
330 Outreach Projects OPC and OPF	195	177	-18
Public Information Strategy	0	100	100
340 Hazard Disclosure (DFH, ODR, DOH)	61	61	
Real Estate Brochure	10	10	
350 Library	30	30	
360 Flood protection Assistance	0		
Advise on retrofitting techniques.	0	59	59
410 Additional Flood Data	0		
Redelineation or new flood study	0	100 to 400	100
Special Hazards (Coastal Erosion) Map	0	25	25
420 Open Space Preservation	74	74	
New Open Space in parks, trails, etc.		38	38
430 Higher Regulatory Standards			
Freeboard	90	180	90
Foundation Protection Regulations	22	22	0
Protect Critical Facilities to 500-year.	0	50	50
Natural and Beneficial credit for shoreline setbacks along streams, etc.	0	15	15
Enclosure Limits	0	Up to 450	100

CRS Activity	Current Credit	Proposed Credit	Change in Credit
Coastal Erosion Setback Regulations	0	60	60
430 Higher Regulatory Standards			
Building Code Effectiveness Grading Schedule Classification	40	40	0
International Building Code Adoption and Enforcement	0	50	50
Building Code Staffing with Certified Floodplain Managers	0	25	25
Coastal AE-Zone Regulations	0	Up to 475	250
Adopt a “Repetitive Loss” provision.	0	20	20
Cumulative Substantial Improvement	0	90	90
Regulations for Additions	0	20	20
440 Flood Data Maintenance			
Overlay Map	56	72	16
Inspect Reference Marks	60	60	
Provide topographic and LIDAR data for a new flood insurance study.	0	Up to 100	100
450 Stormwater Management	195	195	
Water Quality Regulations and Incentives to Utilize Best Management Practices	0	25	25
510 Floodplain Management Planning	25	250	225
530 Flood Protection (Retrofit)	0		
540 Drainage System Maintenance	200	200	
Drainage Capital Improvements Plan	50	50	
Stream Dumping Regulations	0	30	30

CRS Activity	Current Credit	Proposed Credit	Change in Credit
610 Flood Warning Program			
Flood Threat Recognition System	0	40	40
Emergency Warning Dissemination	0	60	60
Other Response Efforts	0	50	50
Critical Facility Planning	0	50	50
StormReady designation by the National Weather Service	0	25	25
630 Dam Safety	57	57	
SUBTOTAL	1376		
Adjustment for Growth, etc. (1.32)	172		
TOTAL	1548		
New Credit Points for Current Activities			406
Additional Growth Adjustment for Current Activities			48
POTENTIAL TOTAL CRS SCORE ADDING CURRENT ACTIVITIES	2002		
Credit Points for New Activities Identified in the Mitigation Plan			1289
Growth Adjustment for New Activities			412
POTENTIAL CRS SCORE WITH IMPEMETATION OF MITIGATION PLAN ACTIVITIES	3703		

Table 1. CRS Premium Adjustments

Credit Points	Class	SFHA*	Non-SFHA**
4,500+	1	45%	5%
4,000 – 4,499	2	40%	5%
3,500 – 3,999	3	35%	5%
3,000 – 3,499	4	30%	5%
2,500 – 2,999	5	25%	5%
2,000 – 2,499	6	20%	5%
1,500 – 1,999	7	15%	5%
1,000 – 1,499	8	10%	5%
500 – 999	9	5%	5%
0 – 499	10	0	0

*Special Flood Hazard Area **Preferred Risk Policies are available only in B, C, and X Zones for properties that are shown to have a minimal risk of flood damage. The Preferred Risk Policy does not receive premium rate credits under the CRS because it already has a lower premium than other policies. Although they are in SFHAs, Zones AR and A99 are limited to a 5% discount. Premium reductions are subject to change.