

Mecklenburg County Floodplain Management Guidance Document

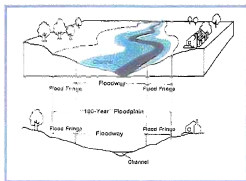


Table of Contents

Executive Summary	i
Chapter 1. Introduction	1-1
Chapter 2. Background	2-1
2.1 Introduction	2-1
2.2 Types of flooding and storm water system problems	2-2
2.2.1 Overbank flooding	2-2
2.2.2 Local drainage problems	2-4
2.2.3 Erosion and channel degradation	2-5
2.3 Flood Insurance and Repetitive Losses	2-6
2.4 Other Hazards	2-6
2.5 Critical Facilities	2-7
2.6 Natural and Beneficial Functions	2-7
2.7 Development Trends	2-8
2.8 Problem Statement	2-8
Chapter 3. Floodplain Management Measures	3-1
1. Structural Flood Control	3-1
a. Reservoirs	3-1
b. Levees and Floodwalls	3-1
c. Diversions	3-2
d. Channel Maintenance	3-2
e. Channel Improvements	3-2
f. Storm Drainage Improvements	3-3

2. Prevention	3-4
a. Planning	3-4
b. Zoning/Subdivision Ordinance	3-4
c. Retention/Detention Requirements	3-5
d. Watershed Measures	3-6
e. Soil Erosion and Sediment Control	3-6
f. Drainage Protection	3-7
g. Real Estate Disclosure	3-7
3. Flood Warning and Response	3-7
a. Flood Threat Recognition	3-7
b. Flood Warning	3-8
c. Flood Response	3-9
d. Critical Facilities Planning	3-9
e. Health and Safety Maintenance	3-10
4. Property Protection	3-10
a. Building Relocation	3-10
b. Acquisition	3-10
c. Building Elevation	3-11
d. Barriers	3-11
e. Dry Floodproofing	3-11
f. Wet Floodproofing	3-11
g. Sewer Backup Protection	3-12
h. Insurance	3-12

i. Community Programs	3-12
5. Preserving Natural Values	3-13
a. Open Space Preservation	3-13
b. Wetland Protection Regulations	3-13
c. Storm Water Quality Management	3-13
d. Multi-objective Projects	3-14
Chapter 4. Floodplain Management Policies and Recommendations	4-1
Phase 1 Strategies, Policies and Recommendations.....	4-3
I. New development should be managed so flood problems are not increased....	4-3
II. The flood warning and response plan should be evaluated to determine its effectiveness to protect people and property during and after a flood	4-4
III. The County's drainage system should be maintained to maximize its ability to carry and store water	4-6
IV. The public should be informed and involved in floodplain management	4-7
V. Floodplain management agencies and organizations should coordinate their efforts	4-8
Phase 2 Strategy, policies and recommendations	4-9
V. Flood hazard mitigation planning, based on watershed areas, should be prepared to identify the best mix of floodplain management measures to solve local flooding problems and development concerns	4-9

Appendices

Mecklenburg County Jurisdictions	A-1
Mecklenburg County Watersheds	A-2
Floodplain Definitions	B-1
Floodplain cross-section	B-2

Floodplain illustration	B-3
Density of floodprone structures	C-1
Westfield Road floodplain	D-1
Westfield Road flooding photographs	D-2
Scotland Avenue floodplain	E-1
Scotland Avenue flooding photographs	E-2
Density of flooding complaints	F-1
Flood insurance and repetitive loss areas.....	G-1
Mecklenburg County greenways and parks	H-1
G.P.S. Elevation Certificate	I-1

Floodplain Management Guidance Document

Executive Summary

Introduction

Recent flooding in Mecklenburg County demonstrated both the benefit of sound floodplain management practices and the potential for improvements to current floodplain management practices. Storm Water Services (SWS) is charged with the management of the floodplain and recognizes a need to evaluate current practices regardless of recent flooding events. In addition, SWS recognizes that all levels of government, all businesses, and all citizens have a stake in properly managed floodplains.

SWS, with the involvement of stakeholder groups, has developed a *Floodplain Management Guidance Document* to examine and potentially re-focus SWS efforts. This document will serve as the guideline to evaluate current floodplain management regulations and operations performed in Mecklenburg County.

Overview

Floodplain management aims to achieve two objectives:

1. To prevent or reduce the loss of life, disruption of vital services, and damage caused by floods.
2. To preserve and restore the natural and beneficial functions of the floodplains.

The floodplain management approach is not limited to the traditional flood control or land acquisition measures. A community should use as many different and effective measures as it can to reach the two objectives. The floodplain management approach also involves a variety of organizations, not just those concerned with channel maintenance and flooding. These can include planning and zoning offices, emergency managers, the Red Cross, parks departments, developers, and floodprone property owners themselves. These offices were involved in a planning process which reviewed the flood related problems and potential floodplain management measures. Even though additional reductions in flood insurance premiums may arise as a result of the development and adoption of this document, the savings are minor in comparison to the benefits generated by a multi-agency, multi-objective approach to floodplain management.

Floodplain Management Strategies, Guiding Policies and Recommendations

The *Guidance Document* was developed through two floodplain management workshops held in the fall of 1995. The Charlotte-Mecklenburg Storm Water Services Advisory Committee received citizens' input from three public meetings (November 1995, February 1996, and March 1996) and

"expert" opinions from a Floodplain Symposium (April 1997).

The general strategies developed from the workshops, public meetings and the Symposium are listed below. The status designation (proposed, initiated and on-going) and completion date for each strategy can be found in Chapter 4. Also located in Chapter 4 are the guiding policies and recommendations related to each strategy that should be further evaluated, considered, and implemented, if appropriate.

Phase I strategies relate to county-wide activities that are appropriate everywhere. The Phase II strategies relate to activities that are applied specifically to individual watersheds.

Phase 1 Strategies

- I. *New development should be managed so flood problems are not increased.*
- II. *The flood warning and response plan should be evaluated to determine its effectiveness to protect people and property during and after a flood.*
- III. *The County's drainage system should be maintained to maximize its ability to carry and store water.*
- IV. *The public should be informed about and involved in floodplain management.*
- V. *Floodplain management agencies and organizations should coordinate their efforts.*

Phase 2 Strategy

- VI. *Flood Hazard Mitigation Plans, based on watershed areas, should be prepared to identify the best mix of floodplain management measures to solve local flooding problems and development concerns.*

Implementation

The implementation of the *Floodplain Management Guidance Document* begins with its adoption. As mentioned above, each strategy has an associated status designation and completion date. The Charlotte-Mecklenburg Storm Water Advisory Committee, along with SWS's staff, will annually review the progress of strategies listed in the *Guidance Document*. Review and modification of guiding principles and/or recommendations will be performed in conjunction with the annual evaluation of current practices/techniques and any proposed changes to current regulations that occur as a result of this document. These potential changes will be presented to the Charlotte-Mecklenburg Storm Water Advisory Committee and a recommendation solicited prior to consideration by the governing bodies.

Chapter 1. Introduction

In an effort to meet the new EPA requirements for better water quality and respond to the identified \$100 million backlog of repairs and improvements, the Storm Water Services agencies were established in the City and County and a storm water service fee was implemented as a fair and dependable way to finance their operations.

Storm Water Services (SWS) has assumed responsibility for maintaining stream and drainage channels and developing flood protection projects for the most severely impacted areas. Some projects under consideration include the limited acquisition of floodprone properties and converting the land to open space use.

Meanwhile, other agencies have been active in the County's floodplains. For example, agencies responsible for infrastructure have made repairs to their flood damaged roads, bridges, culverts and utility lines and taken steps to protect them from future damage.

The floodplains have also been found to be an asset that provides special benefits to the community. The County has a greenway program which is preserving waterfront land for recreation and transportation uses, where possible. Conservation organizations have been working to set aside some of the more valuable floodplain habitat areas from development.

SWS recognized that they are not the only agencies that can affect flooding. Accordingly, they agreed to prepare a *Floodplain Management Guidance Document* to explore what additional activities and the associated organizations could be brought to bear on the area's flood problem. Rather than focus only on controlling flood waters, SWS wanted to take a comprehensive, holistic, floodplain management approach.

The floodplain management approach: Floodplain management aims to achieve two objectives:

1. To prevent or reduce the loss of life, damage, and disruption of vital services caused by floods and
2. To preserve and restore the natural and beneficial functions of floodplains.

The floodplain management approach is not limited to the traditional flood control or land acquisition measures. A community should use as many different and effective measures as it can to reach the two objectives. Examples of measures that work toward the first objective include channel improvements, floodplain construction building codes, early flood warning, and retrofitting damaged buildings. Examples of measures that protect natural and beneficial floodplain functions include development regulations that protect wetlands and storm water management practices that filter or clean the runoff that enters the streams. Some measures can work toward both objectives, while some measures good for one objective may adversely affect the other.

All measures that affect the floodplain should be consistent with other community needs and goals,

such as minimizing expenses to the taxpayers, supporting economic development, improving housing, and preserving residential neighborhoods. These measures should be evaluated based on a cost benefit analysis.

The floodplain management approach involves a variety of organizations, not just the public works agencies traditionally concerned with channel maintenance and flooding. These can include planning and zoning offices, emergency managers, the Red Cross, parks departments, developers, and floodprone property owners themselves.

Floodplain management involves:

- many different agencies, organizations, and people
- who implement many different activities that
- prevent and reduce flood damage and
- protect the natural and beneficial functions of floodplains.

Floodplain management planning: The key to coordinating all the activities and agencies to ensure that they support each other and other community goals and objectives is the preparation of a *Floodplain Management Guidance Document*. This document is the *Floodplain Management Guidance Document* for the County of Mecklenburg County, North Carolina.

This document was prepared following a standard seven step planning process that reviewed the problems and developed a coordinated response among many agencies:

Step 1. Describe the flooding problem and the natural and beneficial uses of the floodplain. This involved collecting a wealth of background information. The following data sources were reviewed:

- flood control studies and local floodplain management documents that are in use in other localities
- previous engineering studies by agencies such as U.S. Geologic Survey (USGS) and U.S. Army Corp of Engineers
- existing GIS coverages related to the floodplain
- City drainage and flooding complaint files
- County drainage and flooding complaint files
- identification of flood-prone structures in a pilot study area
- the National Wetland Inventory coverage from North Carolina Center for Geographic Information (NCCGIA)
- the Water Supply Watershed coverage from NCCGIA
- the NCDEM Stream Classification coverage from NCCGIA
- the Outstanding Resource Waters coverage from NCCGIA
- the Flood Insurance Study for Mecklenburg County and four newly modeled watersheds in the City of Charlotte

In addition to the document searches, background information was gathered on local floodplain activities and opinions through telephone interviews conducted with individuals and persons representing organizations associated with the floodplain.

The findings from step 1 are summarized in Chapter 2 of this document. They were also presented at a planning workshop held on August 29-30, 1995 that included representatives of most of the agencies and organizations involved in floodplain management activities.

- Step 2. Review the existing and alternative floodplain management measures that impact flood damage and protect natural and beneficial floodplain functions. A background paper was prepared and presented at the August, 1995 planning workshop. A capsulized version is included as Chapter 3 of this document.
- Step 3. Identify those measures appropriate for the County. This step was the thrust of the August 1995 workshop. The workshop process involved discussion among the participants on what solutions were technically effective and appropriate for the goals and objectives of the agencies, organizations, and people of the County. This discussion is summarized in Chapter 4 of this document. A preliminary draft was presented and reviewed at a second workshop held on October 3rd, 1995 subject to further review and comment.
- Step 4. Draft an action plan that identifies what will be done, by whom, and when. It was reviewed by representatives of the agencies involved at the second workshop held in October 1995.
- Step 5. Circulate the draft to those agencies and people most affected. This draft plan was sent to all of the workshop participants and others who will help implement the plan as well as anyone requesting copies. It was presented at three public meetings in November, 1995, February 1996, and March 1996. It was also discussed at a Floodplain Symposium which was held in April, 1997.
- Step 6. Revise, adopt and implement the plan. The SWAC will formally submit its recommended plan to the Mecklenburg Board of County Commissioners and the Charlotte City Council.
- Step 7. Monitor and evaluate implementation of the plan and make revisions, as needed. Adoption of the planning document is just the start to a floodplain management program. The Storm Water Advisory Committee (SWAC) will oversee implementation and maintenance of the plan.

Phased planning: For an area as large as Mecklenburg County, floodplain management planning needs to be done in phases. The first phase reviews and recommends county-wide measures. In the second phase, plans are developed for each watershed, with site specific measures that will be tailored for local conditions.

Depending on the approach to address specific area's flooding conditions during the second phase (which will last several more years), each of the County's watersheds could be studied in detail with the involvement of the residents and businesses affected by flooding. The resulting plans will

identify what should be done to reduce flood damage in that location, e.g., where and what type of channel improvements should be built, which buildings should be acquired or floodproofed, etc.

Chapter 4 identifies which recommendations are county-wide, i.e., first phase projects, and which are related to reducing flood losses and protecting the natural and beneficial floodplain functions of specific areas, i.e., second phase projects.

Chapter 2. Background

2.1 Introduction

The City of Charlotte and Mecklenburg County area is located in south-central North Carolina. It is in the Piedmont physiographic province, approximately midway between the Atlantic Coastal Plain and the Appalachian Mountains.

The study area includes the Cities of Charlotte, Cornelius, Davidson, Huntersville, Matthews, Mint Hill, and Pineville and the unincorporated areas of Mecklenburg County. The area covers a total area of 525 square miles. A map of Mecklenburg County and the associated corporate limits is shown in Appendix A-1.

The streams that drain the study area discharge to the south and west to the Catawba River and to the east to the Rocky River. The Catawba River and its associated chain of lakes (Lake Norman, Mountain Island Lake, and Lake Wylie) border Mecklenburg County on its western edge. The Rocky River is located outside of the County.

The study area is separated into 15 major and numerous minor watersheds that drain to these two river basins. Details of these major watersheds are provided in Table 1. These major watersheds are illustrated in Appendix A-2

Commonly used floodplain management terms are defined in Appendix B-1. Also included are graphical representations of a floodplain shown in Appendix B-2 and B-3.

Table 1 Mecklenburg County Watersheds

Watershed	Watershed Size (square miles)	River Basin	Flow Direction
Paw Creek	13.2	Catawba River	West
Coffey Creek	10.4	Catawba River	South
Steele Creek	14.3	Catawba River	South
Long Creek	36.0	Catawba River	West
McDowell Creek	28.5	Catawba River	West
Gar Creek	4.9	Catawba River	West
Mallard Creek	38.5	Rocky River	East
Clarke Creek	6.5	Rocky River	East
Little Sugar Creek	46.5	Catawba River	South

Briar Creek	21.6	Catawba River	South
Irwin Creek	29.9	Catawba River	South
McMullen Creek	15.2	Catawba River	South
Fourmile Creek	18.7	Catawba River	West
McAlpine Creek	56.7	Catawba River	West
Sixmile Creek	10.9	Catawba River	West

2.2. Types of flooding and storm water system problems

Mecklenburg County is subject to three types of flooding and storm water system problems:

- Overbank flooding, mainly on the major storm water system (FEMA regulated streams, Little Sugar, Briar, McAlpine, etc)
- Local drainage problems on the minor storm water system, and
- Channel erosion and degradation problems

These flooding types are discussed in the next three sections. The later sections cover the impact of flooding on human development in the county.

2.2.1 Overbank flooding

For the purposes of this report, overbank flooding is defined as the flooding on the larger streams as mapped by the Federal Emergency Management Agency (FEMA) on Flood Insurance Rate Maps (FIRMs). The FIRMs cover all drainage areas larger than one square mile (i.e. major storm water system).

Data Sources

Overbank flooding has been the cause of the greatest amount of damage and therefore has been the subject of the most studies. The data in this section is a summary from the following studies and/or efforts.

- *Measurement of Potential Flood Damages to Flood Prone Structures within the City of Charlotte*, performed for the City of Charlotte in 1978 by the Institute for Urban Studies and Community Service at UNC-Charlotte;
- *Measurement of Potential Flood Damages in Mecklenburg County, North Carolina*, performed for the County in 1979 by the Institute for Urban Studies and Community Service at UNC-Charlotte;

- *FEMA Flood Insurance Studies*, performed for the City of Charlotte (1976, revised 1994);
- *FEMA Flood Insurance Studies*, performed for Mecklenburg County (1980, revised 1993);
- *Sugar Creek Basin, Study to Determine the Feasibility of Providing Flood Control and Related Water Resource Improvements*, performed by the US Army Corps of Engineers in 1983;
- *Storm Water Management Study of the Westside Watersheds* (Paw, Coffey, Steele, Long, McDowell, and Mallard Creeks), completed by Ogden (formerly ERCE) in 1990; and
- SWS drainage complaints as collected by the telephone hotline (336-RAIN).
- *GPS Structures Survey*, performed by Ogden and Dewberry and Davis for Storm Water Services (1997).

General

Most overbank flooding has been caused by heavy rains during spring and early summer and by tropical storms which have veered inland. This type of flooding can result in minor to severe damage depending on the velocity of flows, depth of flow, and the amount and type of development in the floodwater's path.

The various studies report that there are approximately 1700 buildings, including approximately 1500 residences, subject to overbank flooding of the base, or 1% chance annual flood (also referred to as the 100-year flood). An estimated 300 of these are in the mapped floodway (encroachment area).

The majority of the problems are in the area generally west, south and east of the center city. The areas most affected are the Sugar-Irwin, Little Sugar, Briar, McMullen, and McAlpine watersheds.

The greatest problem area is in the Sugar Creek watershed. Annual expected damage for this basin is placed at \$1.9 million, and potential damage from 10-year and 100-year floods is estimated at \$4.8 million and \$15.8 million, respectively.

Floodprone Areas

Appendix C-1 shows the density of floodprone structures per stream reach. Most of the flood structures are located in several areas of overbank flood problems. Most of the structures were built prior to the implementation of floodplain regulations.

SWS is capable of describing the individual overbank flooding problems for any area in more detail. Two of these areas are described below.

Little Sugar Creek at Westfield Road

The following is a summary of flood related data for this area.

- Approximately 90 structures are located in the regulated floodplain
- The contributing watershed is approximately 13 square miles.
- The 100-year flood has an average velocity of 2.5 feet per second
- The 100-year depth of flow of about 14 feet above the channel bottom.
- Damaging flooding occurred in July 1997

Appendix D-1 indicates the location of structures and the regulated floodplain in the Westfield Road area. Several homes were flooded in the flood of July 23, 1997 with depths up to three feet in some homes. Appendix D-2 shows photographs of the flooding conditions during that storm event.

Briar Creek at Scotland Avenue

The following is a summary of flood related data for this area.

- Approximately 20 structures located in the regulated floodplain
- The contributing watershed is approximately 11 square miles
- The 100-year flood has an average velocity of 2 feet per second
- The 100-year depth of flow is about 14 feet above the channel bottom
- Damaging flooding occurred in August 1995 and July 1997

Appendix E-1 shows the location of houses and the regulated floodplain in the area. The area experienced extensive flooding during the August 1995 and July 1997 floods. Appendix E-2 shows photographs of this flooding.

2.2.2 Local Drainage Problems

For the purposes of this report, local drainage problems are those flood problems upstream of the overbank flooding areas. They involve either overloaded channels that drain less than one square mile or flooding where storm water cannot get into the drainage system and subsequently into the streams.

Local drainage problems in Mecklenburg County are due to three reasons:

- 1) construction of storm sewer systems and structures prior to the use of present day design criteria.
- 2) the collapse or clogging of existing storm water systems due to the age or lack of maintenance of the system, or other utility obstructions.
- 3) upstream development which occurred prior to the detention ordinance enacted in 1978, there by increasing the volume and peak flow to the downstream system.

The hydrologic and hydraulic models completed for Storm Water Services analyze all systems receiving drainage from areas larger than 50 acres using the XP-EXTRAN, HEC-1, and HEC-2 computer models at a much greater detail than previous studies. The results of these models identify numerous locations of local drainage problems throughout the county.

Another method of identifying local drainage problems is a check of flooding complaints. These have been collected by the Engineering Department of the City of Charlotte and Mecklenburg County for the last 20 years. In 1993, the system was upgraded to include the development of a database linked to a Geographic Information System.

Appendix F-1 illustrates the density of flooding complaints as determined from the database. It can be seen that the majority of complaints have been in areas above the one square mile drainage area in the older areas of the City of Charlotte. The major cause of this flooding is inadequate storm sewers. A less dense number of complaints has been registered in areas developed after 1980. There are very few complaints registered in the rural areas of Mecklenburg County.

Based on these sources of data, it is estimated that there are over 10,000 local drainage problems around the county.

2.2.3 Erosion and Channel Degradation

As documented by the main report completed for the *Stormwater Management Study of the Westside Watersheds*, the county is experiencing a significant stream and channel erosion problem.

Mecklenburg streams have a history similar to that of other streams in the Southern Piedmont. By mid-century, sedimentation and flooding problems associated with continued agriculture and urban development, triggered channelization that extended to smaller streams and tributaries. Aerial photographs taken in the late 1940's and the 1950's show widespread evidence of this with numerous straightened reaches and extensive spoil deposits.

The period from 1950 to 1970 was a time of major economic change in the Piedmont, and this was reflected in the landscape. As the industrial and service sectors grew, agriculture declined and abandoned cropland was reverted once again to forest.

In small wooded watersheds, peak discharge rates and sediment yield declined, streams were able to export accumulated sediment, and the streams assumed a more natural appearance and stable configuration.

Charlotte grew rapidly during the 1970's and 1980's, and many small drainage basins once again underwent land use change. The long-term effect of urbanization is an increase in the frequency and magnitude of runoff events. Impervious ground cover and storm sewer systems promote an increase in runoff.

At the same time, after the initial construction phase, there is relatively little soil erosion to contribute sediment to urban streams. Stream systems typically respond by degrading, which tends to reduce stream slopes, increase channel depths, increase channel widths (through

steepening banks and subsequent failure), and increase bed material size.

This type of stream degradation is evident in most channels in the urban areas or downstream from urban areas in the county.

A report prepared by the Stable Channel Committee of the US Army Corps of Engineers in 1995 indicated that the channels in Mecklenburg County were in relatively good condition compared to major rivers and streams they have observed. The report stated that there was little threat to the functioning of the stream system caused by instability problems. It made several recommendations including; increased stream-bank monitoring, use of less rip-rap on banks, use of Chevron weirs, continue or increase debris removal program, etc.

2.3 Flood Insurance and Repetitive Losses

There are a total of 1,171 flood insurance policies in force under the National Flood Insurance Program with total coverage of \$118,296,400. 671 of these properties have collected \$4,730,681 in loss benefits.

Because it has over ten properties which have made two or more flood insurance claims since 1978, the City of Charlotte has been designated by FEMA as a Repetitive Loss Community. There are 30 repetitive loss properties that had filed a total of 108 flood insurance claims. These have been grouped into 23 repetitive loss areas. Appendix G-1 provides a spatial representation of the flood insurance data. The data above was compiled prior to the July 23, 1997 flood.

There are several causes for the repetitive loss flooding. Most of the buildings simply were constructed in floodplains before they were mapped. These are subject to overbank flooding. The rest have been damaged because they are in local drainage problem areas.

Because the repetitive loss areas are typical of the three flooding problems addressed in this section, this plan is considered the City and County's repetitive loss plan for FEMA's purposes.

2.4 Other Hazards

The Charlotte-Mecklenburg area is only 200 miles from the Atlantic Ocean, well within the reach of hurricanes. Hurricane Hugo hit the coast in 1990 at Charleston, SC. When it reached Charlotte, it still had 80 mile per hour winds. The county lost power and suffered numerous reports of structural damage.

The McGuire Nuclear Power Station is located at the base of Lake Norman in northwest Mecklenburg County and is potentially hazardous should the safety precautions fail. The Nuclear Regulatory Commission regularly inspects the facility to ensure that safety practices are being properly implemented.

The American Association of Highway and Transportation Officials indicates that Mecklenburg County area is located in a Zone II earthquake risk area. This classification requires structures to be designed for a moderate risk of earthquakes.

As with any municipality of similar size of the Mecklenburg County area, the possibility of hazardous spills or fires is fairly high. However, the municipal service staff is well equipped to handle these situations without a significant hazard to the public.

2.5 Critical Facilities

"Critical facilities" are those properties that, if flooded, would result in severe consequences to public health and safety. FEMA defines a critical facility as:

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic, and/or water-reactive materials;
- Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a flood;
- Police stations, fire station, vehicle and equipment storage facilities, and emergency operation centers that are needed for flood response activities before, during, and after a flood; and
- Public and private utility facilities that are vital to maintain or restoring normal services to flooded areas before, during, and after a flood.

There are several sources of information on critical facilities. For example, the emergency management office maintains a database that tracks industries that house hazardous waste and facilities used for mass care during a disaster. The Charlotte Fire Department maintains a database that tracks the location of hospitals, fire stations, and police stations.

An effort is currently being performed to collect and compile these databases into a GIS graphical database to determine the total quantity of each facility that is directly affected by flooding. At a minimum, they will be addressed when detailed studies are conducted on each watershed.

2.6 Natural and Beneficial Functions

Floodplains serve many functions besides carrying or storing floodwaters. They provide habitat for flora and fauna, groundwater recharge, and recreation and aesthetic opportunities. A key determinate of an area's natural value is whether it is designated as a wetland.

The U.S. Army Corps of Engineers and North Carolina Department of Environment Health and Natural Resources (NCDEHNR) regulate and approve wetlands permitting and are the only delineator of wetlands within Mecklenburg County. Maps delineating the location of possible wetlands may be obtained from the County or from the North Carolina Center for Geographic Information and Analysis.

Another determinate of an area's beneficial function is whether the floodplain is being used as a greenway. The greenway program is implemented by the Charlotte-Mecklenburg Parks and Recreation under the authority described in the *Greenway Master Plan*.

Currently, the main thrust of the program is intended to acquire property along the floodplain to preserve greenspace, improve water quality, provide a trail system, and improve the overall quality of life for the Charlotte-Mecklenburg County residents. Appendix H-1 illustrates the greenway system in Mecklenburg County.

2.7 Development Trends

The majority of the watersheds within the City of Charlotte where most of the flooding problems exist at this time are almost entirely developed. Development is now proceeding in the outer fringes of the City of Charlotte and the adjacent areas of Mecklenburg County. In general, the south side of the county received the majority of the development over the last ten years. It is expected the north side of county will receive the majority of large scale developments over the next ten years.

The preceding sections describe the current flood problems and their impact on human development. Mecklenburg County is the 25th fastest growing urban area in the United States, experiencing over 38 percent growth in population since 1980. The current problems can get better or worse, depending on how the County manages its development.

For example, most of the overbank flooding problems are a result of structures built in the floodplain before the enactment of floodplain zoning. Application of the local floodplain regulations has controlled construction of new structures in undeveloped floodplains which should prevent flooding of new structures at the 100-year (1% annual chance) level.

Most of the local drainage problems are caused by inadequate drainage facilities, such as storm sewers. With the implementation of storm water ordinances in the late 1970's supplemented with an update to the drainage design criteria in 1994, flooding of structures in Mecklenburg County are not expected to increase. It would be prudent to periodically review Floodplain Regulations to determine their effectiveness in light of engineering technology and to ensure that they are consistent to the community's efforts regarding the use of floodplains.

2.8 Problem Statement

Three main flooding problems occur in parts of Charlotte and Mecklenburg County:

- Overbank flooding primarily affects about 1500 structures built prior to adoption of flood regulations
- Local drainage problems in up to 10,000 locations, and
- Erosion and channel degradation along channels in urban stream reaches in the county.

In general terms, where flooding problems occur they can be summarized by the following five statements.

- Flooding problems were created by development in floodplains and their watershed prior

to enactment of regulations.

- There are over 10,000 local drainage problems where better maintenance may reduce the severity of flooding damage.
- Flooding damages and problems will continue to increase if the public remains uninformed of the problem and how they can help solve it.
- The majority of overbank flooding problem locations do not have a system that forewarns and thereby provides flooding protection to reduce flooding damage depending on the location of the flooding problem and the technology implemented, there may or may not be adequate warning time for flood warning.
- There are a number of areas of overbank flood problems that need to be addressed.

Chapter 3. Floodplain Management Measures

As previously discussed, a community should use as many different and effective measures as it can to reach the objectives of floodplain management, i.e. "to prevent or reduce the loss of life, damage and, disruption of vital services, caused by floods; and to preserve and restore the natural and beneficial functions of floodplains". Based on previous experience and on research of other municipalities programs throughout the country, a list of possible floodplain management measures is compiled and described in the following sections.

1. Structural Flood Control

These measures involve construction of man-made structures to prevent floodwaters from reaching properties. County SWS has completed storm water master plans on six drainage basins to help guide capital improvement projects in un-developed areas of the watersheds. The intent of these master plans is to recommend and construct regional storm water facilities that serve multi-objective uses, channel improvements, levees and floodwalls, diversions, and storm drainage improvements. However, the actual construction of the recommended facilities has not been implemented because the cost of the recommendations outweigh the benefit of the recommendations.

1. Reservoirs

Reservoirs control flooding by holding high flows behind dams or in storage basins. After a flood peaks, water is released or pumped out slowly at a rate that the river can handle downstream. The lake created may provide recreational benefits. Wet or dry basins can serve multiple uses by doubling as parks or other open space uses.

Existing Floodplain Management Programs

Three dams along the Catawba River have created Mountain Island Lake and Lakes Wylie and Norman. These dams are maintained by Duke Power with a main purpose of providing hydroelectric generation. In addition to electrical generation, these facilities provide a secondary function of flood control, recreation, water quality enhancement, and wildlife habitat.

2. Levees and Floodwalls

Probably the best known flood control measure is a barrier of earth (levee) or concrete (floodwall) erected between the watercourse and the property to be protected. Levees and walls must be well designed to account for large floods, underground seepage, pumping of internal drainage, and erosion and scour. They 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.

Existing Floodplain Management Programs

Mecklenburg County constructed a levee along Sugar Creek in Pineville in the late 1970's following a major flood event. The levee is maintained by Storm Water Services. Levees are not viewed by MCSWS as a viable solution to regional flood problems but they are considered on a case by case basis, especially in localized conditions.

3. Diversions

A diversion is simply a new channel that sends floodwater to a different location, thereby reducing flooding along an existing watercourse. Diversions can be surface channels, overflow weirs, or tunnels. During normal flows, the water stays in the old channel. During flood flows, the stream spills over to the diversion channel or tunnel which carries the excess water to a lake or another river.

Existing Floodplain Management Programs

Diversions have not been implemented in Mecklenburg County.

d. Channel Maintenance

Channel maintenance in regulated floodplains is an ongoing program to clean out blockages caused by overgrowth or debris. This work is usually done by a public works crew. Channel maintenance addresses vegetative growth and debris that can block flows. Channel maintenance activities normally do not affect the shape of the channel, but they do affect how well the channel can do its job.

Existing Floodplain Management Programs

County Storm Water Services maintains the floodplain channels for watersheds larger than one square mile and other areas where complaints are consistently registered. The maintenance includes spraying for weed control, undergrowth clearing, repairing existing rip-rapped areas, and culvert/bridge obstruction clearing. Each year, a two-year stream maintenance schedule is reviewed and modified to reflect current needs. The program currently maintains approximately 20 miles of channel per year. In addition, the program provides a crew that remove channel blockages on an as-needed basis.

e. Channel Improvements

By improving channel conveyance, more water is carried away. Improvements include making a channel wider, deeper, smoother or straighter. Some smaller channels can be lined with concrete or even put in underground pipes.

Existing Floodplain Management Programs

In the past, a limited number of projects have been completed by Mecklenburg County Engineering, and Storm Water Services which have involved increasing channel capacity and rip-rapping the channel banks. Examples include Briar Creek upstream of Providence Road and Little Sugar Creek from 12th Street to 15th Street. However, SWS is not performing any additional channel

improvement projects with the exception of the channel protection projects described in the following section.

Mecklenburg County Storm Water Services has improved channel banks by regrading and rip-rapping the banks of approximately 30 miles of regulated streams since 1986. These improvements, as well as planned future improvements, are not intended to reduce flooding or increase channel capacity. Their main purpose is to reduce channel bank erosion and the associated loss of land by stream-side property owners during the most frequent and damaging storms.

f. Storm Drainage Improvements

Drainage and storm drainage improvements are designed to carry the runoff from smaller, more frequent storms away from areas that would otherwise flood, especially depressions and low spots that will not drain naturally. Storm drainage improvements include installing new culverts, enlarging small pipes, and preventing back flow. Streets in many developments are used as part of the drainage system, to carry or hold water from larger, less frequent storms. They collect runoff and convey it to a receiving culvert, ditch or stream. As long as public safety is not compromised, allowing water to stand in the streets and then draining them slowly can be a more effective and less expensive drainage measure than building bigger storm drains and ditches.

Existing Floodplain Management Programs

Prior to 1993, the City and County Engineering Department responded to flooding complaints in urban areas related to storm drainage inadequacy on an as-needed basis. However, due to limited funding, the ownership of the system and associated improvement of the system was delegated to the property owner. Therefore, the City and County only made routine improvements to systems that were related to or affected City and County property. The Capital Improvement projects associated with this effort has been on-going since the late 1980's.

The creation of Storm Water Services enlarged the program by expanding the ownership of the system. Since its creation, SWS have made improvements in response to hundreds of flooding and drainage complaints.

Charlotte Storm Water Services is currently implementing a citywide program to computer model all drainage systems receiving runoff from urban watersheds larger than 50 acres. The results of this modeling effort is being used to perform planning and design of improvements of flooding problems with consideration for the interaction of the flooded area with upstream and downstream facilities. Problem areas are identified based on historical complaint information and complaints currently received from a Storm Water Hotline (336-RAIN). A prioritization method to attack the worst problems first is performed that accounts for the potential for loss of life, structure damage, property damage, and accessibility.

Charlotte Storm Water Service's fee and Storm Water bonds (1994 bond issue of \$25 million) provide funding for the design and construction of these improvements on the minor (non-FEMA regulated) system. Methods to alleviate the flooding on the minor system include culvert/bridge replacement,

storm drainage replacement, channel widening and clearing, and detention/retention clearing.

2. Prevention

Prevention measures are designed to keep the problem from occurring or getting worse. They ensure that future development does not increase flood damage or they maintain the drainage system's capacity to carry away floodwaters.

1. Planning

Comprehensive plans and land use plans identify how a community should be developed. Use of the land can be tailored to match the land's hazards, typically by reserving flood hazard areas for open space, golf courses, backyards, or similar compatible uses. A capital improvement program identifies where major public expenditures will be made over the next 5 to 20 years. Capital expenditures may include acquisition of land for public uses, such as parkland, and extension or improvement of roads and utilities.

Existing Floodplain Management Programs

The City and County have a comprehensive land use plan to direct development through the year 2007. The main thrust of the plan is to direct the types of land use in specific areas of the County and does not directly address the reservation of flood hazard areas for open space. However, the comprehensive plan is supplemented by a *Greenway Master Plan* that does address the reservation of open space within and adjacent to floodplains. The *Greenway Master Plan* is described in more detail in Section Five of this Chapter.

2. Zoning/ Subdivision Ordinance

A zoning ordinance regulates development 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 only allow development that is not susceptible to damage by flooding. Appropriate districts include public use, conservation, agriculture, and cluster or planned unit developments that keep buildings out of the floodplain, wetlands, and other areas that are not appropriate for intensive development. Another approach is overlay zoning which simply adds special requirements in areas subject to flooding. The areas can be developed in accordance with the underlying zone, provided the flood protection requirements are met.

If the zoning for a site allows a structure to be built, then the applicable subdivision and building regulations will impose construction standards to protect buildings from flood damage and prevent the development from aggravating the flood problem. Subdivision regulations govern how land will be subdivided into individual lots, often requiring that every lot have a buildable area above flood level. These regulations set construction and location standards for the infrastructure provided by the developer, including roads, sidewalks, utility lines, storm drainages and drainageways. The building code may establish flood protection standards for all construction. These would include criteria to ensure that the foundation will withstand flood forces and that all portions of the building

subject to damage are above, or otherwise protected from, flooding.

Existing Floodplain Management Programs

Two Charlotte-Mecklenburg departments are involved in the approval process during the development of a parcel of land containing a floodplain area. Mecklenburg County SWS staff review and approve floodplain development on watercourses receiving runoff from a watershed larger than one square mile (Federal Emergency Management Agency - FEMA defined floodplain). Construction is restricted within the floodway area and allowed in the floodplain fringe as long as minimum first floor elevation criteria are met.

City of Charlotte and Mecklenburg County Land Development staff review and approve floodplain development on smaller watercourses receiving runoff from watersheds draining less than one square mile up to a size of watershed that discharge over 50 cubic feet per second during the 100-year storm event.

The Subdivision Ordinance states that the City or County Engineer shall approve a plan submitted by a professional engineer that determines the 100-year flood crest elevation (plus one foot) on the property. A building restriction line based on this inundated area shall be shown on the final record plat of the subject property. In addition, a flood protection elevation shall be recorded based on the 100-year (plus one foot) flood elevation. As described in the Subdivision Ordinance "All habitable buildings or structures shall be located outside the Building Restriction Floodline, or the lowest usable and functional part of the structure shall not be below the Flood Protection Elevation."

c. Retention/Detention Requirements

Unconstrained development in a drainage basin can aggravate downstream flooding and overload the drainage system. In some communities storm water management regulations require developers to build retention or detention basins. Best Management Practices (BMP's) are utilized in many communities and include wet detention ponds, dry basins, grassy swales, berms, infiltration basins, sand filters, etc. to minimize increases in runoff rates and volumes in comparison to pre-development conditions. In some communities, planners identify the most effective location for a regional basin. Communities may then require developers to contribute funds for a regional basin in lieu of constructing on-site detention.

Existing Floodplain Management Programs

Two Charlotte-Mecklenburg departments are involved in the approval process of detention/retention systems required for the development of a parcel of land. Mecklenburg County Land Development staff reviews and approves the detention/retention systems in the un-incorporated areas of the County and the six surrounding small cities (Davidson, Cornelius, Huntersville, Mint Hill, Matthews, and Pineville). City of Charlotte Land Development staff reviews and approves retention/detention systems in the incorporated area of the City of Charlotte.

Retention/detention basins are required for non-single family parcels of land that are being developed

to contain more than 20,000 square feet of impervious area. Detention/retention basins are not required for single family developments. The basins are required to attenuate post-developed discharges to pre-developed discharges during the 2-year and 10-year storm event. An emergency spillway is required to be designed and constructed to safely pass the 50-year storm event.

Retention/detention basins that are designed, constructed, and maintained to meet water quantity and water quality criteria provide the property owner with a storm water fee credit. 50 percent of fee credit is available for peak discharge control, 25 percent of fee credit is available for volume control, and 25 percent fee credit is available for water quality design and control.

d. Watershed Measures

Protecting areas that naturally hold water is an effective type of watershed measure. Most watersheds have wetlands, depressions and other natural storage areas, which, if preserved, help reduce the impact of urbanization.

In an effort to protect the quality of drinking water supplies, special regulations such as low density zoning or BMP's may be required for development in these areas.

Existing Floodplain Management Programs

As required by State Law, systems to control the quality of runoff are required to be constructed on high density developments within the water supply watersheds of Mecklenburg County. Otherwise the construction of facilities to prevent the degradation of the receiving water courses quality are not required except to receive storm water fee credit.

e. Soil Erosion and Sediment Control

Erosion and sediment control has two principal components: minimize erosion with vegetation and capture sediment before it leaves the site. Specific measures can be taken on farms and construction sites. Farm practices such as contour plowing, terracing, undisturbed buffers and no-till help reduce agricultural erosion and keep topsoil where it is needed. Soil loss can be cut at construction sites with techniques such as mulching, seeding, and erosion blankets. Silt fences and sediment traps slow runoff so sediment is dropped on-site before it gets to a watercourse.

Agricultural practices also can cause storm water runoff problems. Because farmland is usually bare, stormwater runoff can carry large amounts of sediment that can fill in downstream drainage facilities. The runoff can be slowed down by watershed measures, such as vegetation, terraces, contour plowing and no-till farm practices. Slowing runoff on the way to a drainage channel increases infiltration into the soil and controls the loss of topsoil from erosion and the resulting sedimentation.

Existing Floodplain Management Programs

City and County Land Development staff administer the state's regulatory requirements (under the authority of the Charlotte and Mecklenburg Soil Erosion and Sediment Control Ordinances and the

North Carolina Sedimentation Pollution Control Act of 1973) in all disturbed areas larger than one acre (farmland is exempt from the requirements). The process includes the submission, review, and approval of a sediment and erosion control plan for all construction sites. County and City staff also inspect the implementation of the sediment and erosion control plan for the sites. The enforcement of the plan includes notices of violations, stop-work orders, and ultimately legal action.

f. Drainage Protection

Stream dumping regulations are one approach to preventing intentional placement of trash, debris and other obstructions in watercourses. A drainage protection program should include public information materials that explain the reasons for the rules as well as the penalties. Regular inspections to determine violations also should be scheduled.

Existing Floodplain Management Programs

North Carolina statute #77-14 prohibits the dumping in or blocking of a waterway. SWS and the Mecklenburg County Department of Environmental Protection enforce the statute in response to citizen and agency complaints. The Mecklenburg County Environmental Court provides a setting for hearing arguments and rendering judgements related to enforcement of the statute.

g. Real Estate Disclosure

Many times after a flood, people say they would have taken steps to protect themselves if only they had known they had purchased a floodprone property. They can be forewarned if real estate agents, either voluntarily or because of a legal requirement, advise potential purchasers of a property's flood hazard. A community can support this effort by working with the local real estate agencies and providing map information to them.

Existing Floodplain Management Programs

In accordance with a recently enacted State Law, a real estate agent is required to disclose flood hazard information. The Flood Insurance Reform Act of 1994 strengthens requirements for flood insurance on mortgages. This information is also included in a number of public information brochures and publications including the local *Realtors Reflection's Magazine*.

3. Flood Warning and Emergency Response

These measures protect people during and after a flood. Their primary objective is usually to save lives and protect public health, rather than protect property.

a. Flood Threat Recognition

The first step in responding to a flood is knowing that one is coming. A flood threat recognition system provides early warning to emergency managers. A complete system measures rainfall, snow conditions, soil moisture, and stream flows upstream in order to calculate the time and height of the

flood crest downstream.

Existing Floodplain Management Programs

Duke Power is capable of recognizing a flood threat on the Catawba River Lake system with an extensive upstream system of rain gages and flood height measurements.

The United States Geologic Survey (USGS) currently maintains ten permanent stream gages in Mecklenburg County. The stream gages provide continuous stage recording (readings at 15 minute intervals) by which either instantaneous or mean daily discharges can be computed for any time, or any period of time. Statistical analyses of the data include annual total discharge, annual mean discharge, instantaneous peak discharge, and instantaneous peak stage. In addition, the USGS currently maintains 46 rain gages across the County. The rain gages collect depths of rainfall every five minutes by which either maximum intensities or total rainfall depth can be computed for any time, or any period of time. There are also 15 stream gages which collect data on the rate of rise and elevation of flood waters at these sites. This data is shared freely with City Fire Department as any other interested emergency response agencies. It should be noted that Storm Water Services assists with the collection of data and does not intend to be responsible for its use in a flood warning procedure.

The distribution of the rain gages throughout the County allows areal distribution of the storm depth and intensity to be performed so that the rainfall information can be input into computer models to perform model calibration and verification. Therefore, the accuracy of the prediction of flood peak discharges and water surface elevations based on the computer model output is improved.

Preliminary research into utilizing the rain gages in a flood threat recognition system has been undertaken. The National Weather Service has expressed interest in utilizing the information in their flood warning process. The City and County has asked the U.S. Geological Survey to consider developing a pilot project to add radio telemetry to a limited number of gages which would enable real time transfer of rainfall amounts

b. Flood Warning

Once the flood threat recognition system tells the emergency manager that a flood is coming, the next step is to notify staff in other agencies, the public and critical facilities that a flood is imminent. The earlier and the more accurate the warning, the greater the number of people who can implement protection measures. A complete warning system should have a public information component so people can relate a warning to their situation and know what to do when a flood threatens. A flood warning may be disseminated in a variety of ways, including, but not limited to: sirens, radio, TV, cable systems, mobile public address systems on emergency vehicles, telephone calling trees, and door-to-door contact. Multiple or redundant systems are most effective — if people do not hear one warning, they may still get the message from another part of the system.

Existing Floodplain Management Programs

Currently the National Weather Services issues flood warnings in advance of a flood in Mecklenburg County. However, the Charlotte-Mecklenburg Emergency Management office recently purchased a GIS compatible computer system to assist in emergency situations. A component of the system can dial numerous phone numbers in a short period of time. This could possibly be used in an effort to provide warning to flood threatened properties.

c. Flood Response

Once a flood threat is recognized, the first priority is to alert others through the flood warning system. The second priority is to respond with actions that can prevent or reduce damage or injury. A flood response plan helps ensure that all bases are covered and that the response activities are appropriate for the expected flood threat.

Response actions (and the responding parties) include:

- Activating the emergency operations center (emergency manager)
- Sandbagging certain areas (public works or township road department)
- Closing streets or bridges (police or sheriff's department)
- Shutting off power to threatened areas (utility company)
- Releasing children from school (school district)
- Ordering an evacuation (mayor)
- Opening evacuation shelters (churches, schools, or the Red Cross)
- Monitoring water levels (engineer)

Existing Floodplain Management Programs

The Emergency Management office coordinates several functions such as opening evacuation shelters and closing streets and bridges as a function of the *Charlotte-Mecklenburg All Hazards Plan*.

d. Critical Facilities Planning

There are two types of critical facilities:

1. Buildings or locations vital to the flood response effort, such as emergency operations centers and hospitals.
2. Buildings or locations that if flooded would create secondary disasters, such as hazardous materials facilities and nursing homes.

Most critical facilities would benefit from early flood warning, flood response planning, and coordination with community flood response efforts.

Existing Floodplain Management Programs

The Emergency Management office and the Fire Department maintain databases that contain information regarding critical facilities.

e. Health and Safety Maintenance

These measures help prevent dangers to health and safety after a flood. They include patrolling evacuated areas to prevent looting, providing safe drinking water, vaccinating residents for tetanus, and cleaning up debris and garbage. Normally, they are the police, sheriff, or public health authorities.

Existing Floodplain Management Programs

The Red Cross, Police Department, Fire Department, Medic, Emergency Management and several other agencies provide assistance during flood events.

4. Property Protection

Property protection measures are used to modify buildings subject to flood damage rather than to keep floodwaters away. They are usually undertaken by property owners on a building-by-building or parcel basis. Government agencies can provide information and technical or financial assistance to owners who want to elevate, floodproof, insure, or otherwise protect their property.

a. Building Relocation

Moving a building to higher ground is the surest and safest way to protect it from flooding.

Existing Floodplain Management Programs

There are no programs in Mecklenburg County to relocate buildings to protect them from flooding.

b. Acquisition

Like relocation, acquisition ensures that buildings in a floodprone area will cease to be subject to damage. The major difference is that acquisition is undertaken by a government agency, so the cost is not borne by the property owner, and the land is converted to public use, such as a park.

Existing Floodplain Management Programs

There are no established programs in Mecklenburg County to acquire buildings to remove them from flooding. However, Charlotte Storm Water Services has acquired flood prone property, including buildings, to carry out a storm drainage capital improvement project. The cost of acquiring the property and constructing a detention facility in its location was less expensive than other alternatives.

Mecklenburg County Storm Water Services strongly endorses acquisition as a viable means to prevent future flood damage.

c. **Building Elevation**

Raising a house above the flood level is the best way to protect a structure that cannot be removed from the floodplain. Water flows under the building, causing no damage to the structure or its contents.

Existing Floodplain Management Programs

SWS provides technical information regarding the process of elevating a building to interested property owners. Following the floods of July 1997, several property owners are pursuing elevation of their houses. MCSWS will assist them with needed technical information as well as providing construction information from members of the Engineering and Building Standards Department inspection staff.

d. **Barriers**

Barriers — levees, floodwalls and berms — keep floodwaters from reaching a building. Levees and floodwalls are discussed in section 1.2 of this Chapter. Berms are commonly used in areas subject to shallow flooding. Not considered engineered structures, berms are made by regrading or filling an area.

Existing Floodplain Management Programs

SWS provides technical information regarding barriers to interested property owners.

e. **Dry Floodproofing**

Through dry floodproofing, a building 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.

Existing Floodplain Management Programs

SWS provides technical information to interested property owners.

f. **Wet Floodproofing**

"Wet floodproofing" includes protection measures that deal with floodwaters *in* the building. Wet floodproofing approaches range from moving a few valuable items to rebuilding the floodable area. Wet floodproofing has one advantage over the other approaches: No matter how little is done, flood damage will be reduced. Thousands of dollars in damage can be prevented by simply moving furniture and electrical appliances out of the floodprone area.

Existing Floodplain Management Programs

SWS provides technical information to interested property owners.

g. Sewer Backup Protection

In areas where sanitary and storm sewers are combined, basement flooding can be caused by stormwater overloading the system and backing up into the basement through the sanitary sewer line. In areas where sanitary and storm waters are carried in separate pipes, the same thing can happen when there are cross connections between the storm and sanitary sewers or infiltration or inflow problems in the lines. Protection measures include: disconnecting downspouts, footing drain tile, and/or the sump pump connected to the sanitary sewer service; directing rain and ground water out onto the ground, away from the building; floor drain plug, floor drain standpipe, overhead sewer, and backup valve.

Existing Floodplain Management Programs

SWS provides technical information to interested property owners.

h. Insurance

Insurance does not prevent flooding or flood damage; it helps an owner pay for repairs and replacement items damaged in a flood. Flood insurance is required as a condition of certain types of federal aid and all bank loans and mortgages for buildings in the floodplain shown on FEMA's Flood Insurance Rate Maps. However, many policy holders drop it after a few dry years and/or do not purchase it for the building's contents once their mortgage is paid off. Despite the federal law, fewer than one floodplain property in four is covered. As these properties sell, flood insurance will be required.

Existing Floodplain Management Programs

Flood insurance is available in Mecklenburg County because of the regulatory program administered by SWS. SWS provides information to help make people aware of the availability of flood insurance. The total number of insured properties in Mecklenburg County is 723 with a total dollar value of the insured properties of \$69.2 million. Due to the aggressive approach Mecklenburg County SWS takes in floodplain management, a 10% discount is applied to all flood insurance policies in Charlotte and Mecklenburg County.

i. Community Programs

A community mitigation program includes measures to encourage and assist owners. It could provide three types of assistance: pertinent information, technical advice and financial assistance.

Existing Floodplain Management Programs

MCSWS has collected a wealth of data concerning flood prone structures using GPS surveying technology. This information includes the exact location and elevation of the building relative to the

floodplain. Other information such as tax value, year built, square footage, etc, is also included in a database which resides in a GIS system. This information has been condensed onto a GPS elevation certificate which is available to anyone interested in the flooding potential for these properties. An example of a GPS Elevation Certificate is included in Appendix I-1.

County SWS has a flood assistance program that provides elevation data and on-site technical assistance to property owners. SWS will perform a topographic survey of the property and provide the owner with a written report on how to protect the property from flood damage.

5. Preserving Natural Values

These measures work to conserve or restore natural areas or water resources that support the natural and beneficial functions of floodplains. Most of them are proactive measures that try to prevent development from damaging natural features.

a. Open Space Preservation

By preserving floodplains and natural sites, (such as wetlands and low-lying areas,) recreational areas are secured while habitats for local flora and fauna are similarly protected. Preservation can be via fee simple acquisition, purchasing an easement, or encouraging the dedication of an easement from subdividers and developers.

Existing Floodplain Management Programs

Several areas of floodplain have been preserved as parks, including Latta Plantation and McDowell Parks on the Catawba.

b. Wetland Protection Regulations

Wetlands are usually found in floodplains or depressional areas. In addition to providing habitat for species that cannot live or breed anywhere else, the wetlands store large amounts of floodwaters, reduce flood velocities and erosion, and filter water, making it cleaner for those downstream.

Corps of Engineers' (COE) permits are required for projects that will place fill or dredged materials in a wetland. Some communities also have their own wetland protection programs.

Existing Floodplain Management Programs

The Army Corps and NCDEHNR regulate and approve wetland permitting within Mecklenburg County. Maps indicating the location of possible wetlands may be obtained from the County map counter or from the North Carolina Center for Geographic Information and Analysis. All of SWS capital improvement projects require a COE wetlands permit.

c. Storm Water Quality Management

Storm water runoff is not clean. It picks up farm and commercial chemicals, road oils, and other pollutants left on top of the ground. Best management practices ("BMPs") can help filter or clean the runoff in addition to reducing runoff rates and volumes. BMPs can include swales, infiltration trenches, vegetative filter strips, and permeable paving blocks.

Existing Floodplain Management Programs

Storm water BMP's are not required for developing property within Mecklenburg County except within specific zones of the water supply watershed and when the development proposes an intensity greater than allowed. Storm water BMP's are encouraged for developers through the storm water fee credit system that provides a 25 percent fee credit for the construction and maintenance of a BMP that meets the design criteria listed in the *Storm Water Design Manual*.

In the fall of 1996, the Storm Water Improvement and Management (SWIM) committee was created by the Board of County Commissioners. The SWIM policy statement concludes that the surface waters of the county are a natural resource to be protected as a source of natural beauty and recreation. It also states that the use of these creeks as a storm water disposal method shall be secondary to the preservation of these waters.

The SWIM advisory committee with support from staff are in the process of research water quality conditions and needs within each watershed across the county. They will then make recommendations on how to maintain or improve water quality to meet their uses.

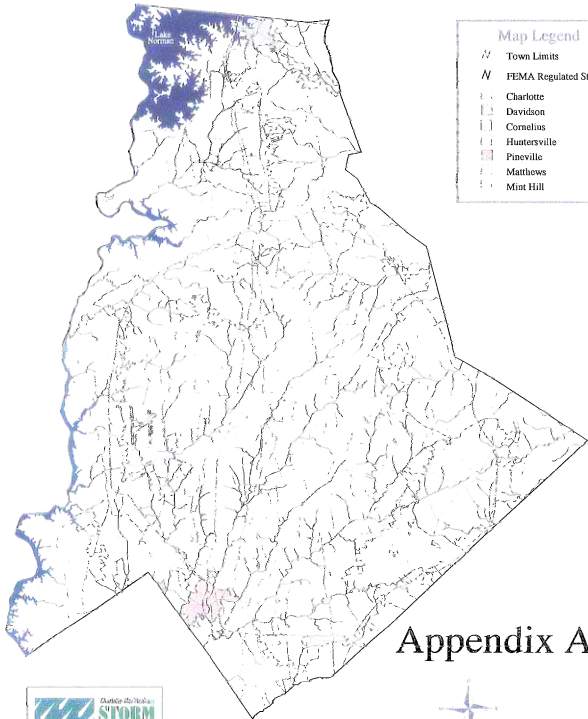
d. Multi-Objective Projects

Many natural areas coincide with scenic areas and water-related uses. Multi-objective projects, such as preserving areas for education, recreation, or transportation greenways, get more support from more people. As a result, they usually generate a higher level of community support.

Existing Floodplain Management Programs

The greenway program is implemented by the Charlotte-Mecklenburg Parks and Recreation under the authority described in the *Greenway Master Plan*. Currently, the main thrust of the program is to acquire property along the floodplain to preserve greenspace, improve water quality, provide a trail system, and improve the overall quality of life for the Charlotte-Mecklenburg County residents. The program is administered by a staff of one greenway planner with the support of four planners within that Parks and Recreation Department.

Mecklenburg County Jurisdictions



Map Legend

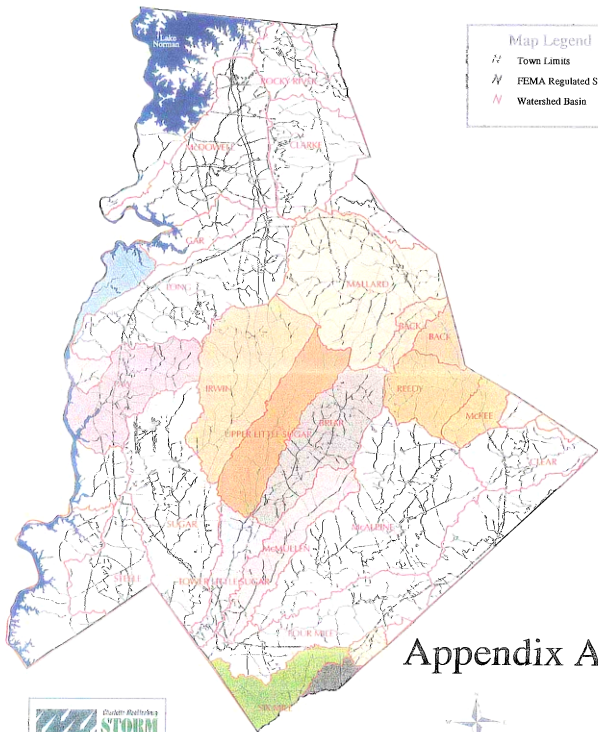
-  Town Limits
-  FEMA Regulated Streams
-  Charlotte
-  Davidson
-  Cornelius
-  Huntersville
-  Pineville
-  Matthews
-  Mint Hill

Appendix A-1



September 10, 1997

Mecklenburg County Watersheds



Map Legend

- Town Limits
- FEMA Regulated Streams
- Watershed Basin

Appendix A-2



September 10, 1997

Chapter 4. Floodplain Management Policies and Recommendations

Based on the input from the Floodplain Management Workshop, several public hearings, and a Floodplain Symposium, floodplain management staff, consultants and the Charlotte-Mecklenburg Storm Water Advisory Committee (SWAC) have prepared a series of twelve guiding policies and recommendations. The first five strategies relate primarily to county-wide activities that are appropriate everywhere. These are Phase 1 strategies and associated guiding policies and recommendations. The sixth strategy, watershed planning, addresses Phase 2: how to best prevent and reduce flood losses in specific watersheds. These policies and recommendations will be further evaluated as to their applicability, either county-wide (Phase 1) or specific area basis (Phase 2) by Mecklenburg County Storm Water Services (MCSWS), with support from Charlotte Storm Water Services (CSWS), and in coordination with other agencies impacted. They are organized under six general strategies that address:

Phase 1 Strategies

- I. New development
- II. Flood warning and response
- III. Drainage system maintenance
- IV. Public information
- V. Interagency coordination
- VI. Watershed planning

Phase 2 Strategies

Under these six strategies are twelve guiding policies. Each guiding policy has recommendations along with a status designation (proposed, initiated, and on-going) and a proposed completion date.

The six general strategies (I - VI) and 12 guiding policies which will be further evaluated are summarized below.

Strategies, Policies and Recommendations

- I. New development should be managed so flood problems are not increased.
 - 1. Support ongoing efforts separate from the development of this document which involve review of any need for and effectiveness of the following:
 - Allowing existing channels to remain in their natural state when development occurs,
 - Establishment of detention requirements based upon site specific needs versus the current system of utilizing uniform thresholds in all circumstances, and
 - Continuation or modification of existing storm water requirements for single-family development,
 - 2. Based on the review of current regulations allowing fill in the floodplain, there needs to be a more concerted effort in developing mechanisms to promote

preservation of floodplain areas. Floodplains are needed to store and convey flood waters and their preservation should be encouraged. However, in some instances fill may occur with little or no measurable impact on other properties or involve unusual hardship to the property owner.

- II. The flood warning and response plan should be evaluated to determine its effectiveness to protect people and property during and after a flood.
 3. The current flood warning procedures should be evaluated to determine if improvements can be made.
 4. After the completion of the evaluation of the flood warning procedures, the current flood response procedures should be evaluated.
- III. The County's drainage system should be maintained to maximize its ability to carry and store water.
 5. Procedures should be reviewed to ensure proper drainage system maintenance. The drainage system includes open channels, pipes, culverts, natural streams, retention/detention basins, and lakes.
 6. The design and maintenance of channels should use natural features where practicable.
- IV. The public should be informed about and involved in floodplain management.
 7. The public information program should be reviewed and modifications made, where necessary, to continually inform, educate, and involve the public in floodplain management activities.
- V. Floodplain management agencies and organizations should coordinate their efforts.
 8. Agencies and organizations involved in floodplain management should continue to communicate and coordinate their efforts as much as possible.
- VI. Flood Hazard Mitigation Plans, based on watershed areas, should be prepared to identify the best mix of floodplain management measures to solve local flooding problems and development concerns. The Flood Hazard Mitigation Plans (FHMP) should be developed using the following guiding policies:
 9. A systematic approach should be followed to reduce flood damage to existing development.
 10. Guidelines for acquisition of floodprone areas.

11. Guidelines for flood control projects.
12. Guidelines for retrofitting projects.

The FHMP's should also take into account other initiatives. These initiatives include, but are not limited to the following:

- allowing or prohibiting filling in the floodplain
- use of flood warning where feasible
- streams that have been designated as having poor water quality and identified alternatives to improve the water quality
- various agencies' capital improvement programs
- City Within a City or other neighborhood based problem solving efforts
- availability of funding sources

Phase 1 Strategies, Policies and Recommendations

As previously discussed, Phase 1 are guiding policies and recommendations to be evaluated that can possibly be applied as county-wide activities.

I. New development should be managed so flood problems are not increased.

1. Support ongoing efforts separate from the development of this document which involve review of any need for and effectiveness of the following:
 - Allowing existing channels to remain in their natural state when development occurs,
 - Establishment of detention requirements for non-single family development based upon site specific needs versus the current system of utilizing uniform thresholds in all circumstances, and
 - Continuation or modification of existing storm water requirements for single-family development,

Status: Initiated

Completion Date: Recommendation from SWAC to staff for:

- the "existing channel" issue is expected by the end of 1997
- the use of uniform thresholds for detention is expected by April 1, 1998
- continuation of existing storm water requirements for single-family development is expected by June 1, 1998

2. Based on the review of current regulations allowing fill in the floodplain, there needs to be a more concerted effort in developing mechanisms to promote dedication of floodplain area. Floodplains are needed to store and convey flood waters and their preservation

should be encouraged. However, in some instances fill may occur with little or no measurable impact on other properties or involve unusual hardship to the property owner.

- 2.1 Any increase in restrictions should be accompanied with offsetting compensation to affected property owners, such as, but not limited to:
 - a. Density credits
 - b. Abatement or reduction in property taxes
 - c. Purchase by City, County, State or related group (Catawba Lands Conservancy)
 - d. Tax credit for gift
- 2.2 Any increase in restrictions should also provide flexibility, such that, mitigation activities to offset the affect of filling will be considered.
- 2.3 The existing Floodway Ordinance requires new development in the floodplain to be one foot above the 100-year flood elevation. An evaluation should be conducted to determine if this is sufficient and if it should be increased/decreased?
- 2.4 After the review of the compensation issues and the evaluation related to the one foot above the 100-year flood elevation, the existing Floodway Ordinance should be modified accordingly. In addition, the Ordinance should ensure that all substantial improvements to a structure be calculated in a cumulative fashion. Any improvements that accumulate to greater than 50% of the structure value would require the structure be brought up to minimum regulations per the Floodway Ordinance.
- 2.5 Storm Water Services should continue to seek methods of ensuring the floodway maps are as accurate as possible. This can be accomplished through:
 - Aggressively pursue FEMA for remapping studies (currently underway)
 - Develop and manage a Watershed Management System (WMS) that validates or modifies floodway maps as development occurs

Status: Proposed

Completion Date: Recommendation from SWAC to staff for:

- the "offsetting compensation" issue is expected by the end of 1997
- the use of "one foot" above the 100-year elevation for new development is expected by April 1, 1998
- modification of the Floodway Ordinance is expected by June 1, 1998

II. The flood warning and response plan should be evaluated to determine its effectiveness to protect people and property during and after a flood.

3. The current flood warning procedures should be evaluated to determine if improvements can be made.
- 3.1 The evaluation should determine if the current flood warning procedures provide a flood threat recognition system that alerts appropriate agencies and citizens when flood conditions are likely. This evaluation should equally address the threat of flooding of structures (homes, businesses, etc) as well as roads and bridges.
- 3.2 The evaluation should determine if the current flood warning procedures provide a system that monitors rain and stream gages to provide early notice of flooding and to monitor conditions.
- 3.3 The evaluation should rely on the CMSWS pilot study that is being conducted in cooperation with the USGS. The pilot study will begin in early 1998 and is intended to determine the effectiveness, and associated costs, of modifying the current rain monitoring network to provide data quicker and to a wider variety of agencies (National Weather Service, local Fire Departments, etc).
- 3.4 The evaluation should determine if the current flood warning procedures account for floods that may be caused by dam failures as well as typical overbank flooding.
- 3.5 The evaluation should determine if the current flood warning procedures are designed to minimize false alerts and staff time.
- 3.6 The evaluation should determine if the current flood warning procedures are coordinated with the latest GIS and computer model coverage of the county's streams. In addition, the evaluation should take into account any technological advancements resulting from expanded floodplain management activities and/or WMS initiatives.

Status: Initiated
Completion Date: Recommendation to SWAC from staff will be included in the FY99 operational budget

4. After the completion of the evaluation of the flood warning procedures, the current flood response procedures should be evaluated.
- 4.1 The evaluation should determine the appropriate level of coordination with the flood warning system.
- 4.2 The evaluation should determine whether specific response activities are listed, keyed to predicted flood levels, including public safety precautions and recognition of threats to public safety personnel.

- 4.3 The evaluation should determine that the plan is prepared with the cooperation and input of other agencies that can help during an emergency.
- 4.4 The plan should be adopted by the appropriate governing bodies.
- 4.5 The plan should be exercised annually and kept current.

Status: On-going. After a significant flooding event, current flood warning and emergency management operations are evaluated in a post-disaster meeting.

Completion Date: An evaluation of the level of coordination will be developed in conjunction with the flood warning recommendation for the FY99 operational budget.

III. The County's drainage system should be maintained to maximize its ability to carry and store water.

5. Existing procedures should be reviewed to ensure proper drainage system maintenance. The drainage system includes open channels, pipes, culverts, natural streams, retention/detention basins, and lakes.
 - 5.1 Each agency should review appropriate maintenance procedures that minimize to the extent practicable the impact of their work on other properties and the natural and beneficial functions of the floodplain, including water quality.
 - 5.2 Periodic inspections should be continued and the responsible agencies should be notified of problems found.
 - 5.3 The existing program to obtain cooperation from property owners should be augmented. It would work to secure maintenance easements where needed and educate people about their role in maintenance.

Status: On-going. Based on the customer feedback and performance of channels following storm events, staff continually evaluates current maintenance practices. This has recently become important due to the change from "clear-cutting" of channel banks to removing ground vegetation and leaving the mature trees. Staff believes this reduces flooding, provides channel bank stability and fosters shade to the channel thus improving the diversity of aquatic habitat.

Completion Date: N/A.

6. The design and maintenance of channels should use natural features where practicable.

- 6.1 The term "natural channel" needs to be defined.
- 6.2 Where appropriate, channels should incorporate non-structural, "soft," or natural bank protection features but still be able to carry the runoff from upstream development.
- 6.3 A program should be implemented to educate and provide technical assistance to developers, designers, and maintenance personnel on these techniques and their benefits.
- 6.4 Where using these techniques is significantly more expensive than other approaches, incentives to reduce the cost or provide alternate benefits to the developer should be investigated.

Status: On-going. Mecklenburg County Storm Water Services has just completed it's largest soil bio-engineering project to-date. The lessons learned from this and other completed projects are always applied to future projects. In addition, water quality and aquatic habitat monitoring was conducted prior to construction. This will be reviewed with data collected after construction to determine the actual environmental benefits that may arise from this type of approach.

Completion Date: N/A.

IV. The public should be informed about and involved in floodplain management.

7. The public information program should be reviewed and modifications made, where necessary, to continually inform, educate, and involve the public in floodplain management activities.
 - 7.1 The program should include a description of the existing situation:
 - how the drainage system works,
 - what agencies are currently doing,
 - the various uses of the floodplain (greenway system, ball fields, parking lots, etc)
 - the use of natural features in the design and maintenance of channels, and
 - the impact of development on runoff, flooding and water quality.
 - 7.2 The public information program should advise people of flood warning procedures, flood safety, and actions to take during an emergency.
 - 7.3 It should include providing flood hazard data to existing residents and newcomers, businesses including renters.

- 7.4 It should instill a sense of responsibility on people's part as well as information on common problems caused by negligence or ignorance, such as dumping in channels.
- 7.5 The public information program should cover retrofiting, flood insurance and other self-protection measures.
- 7.6 It should cover existing regulations on dumping, floodplain development, and watershed development.
- 7.7 It should publicize successful examples that involve property owner and private-sector cooperation with public projects.
- 7.8 It should be closely coordinated with other agencies' information programs.
- 7.9 It should address disclosure of the potential for flooding to property buyers and renters.

Status: On-going.

Completion Date: A summary of existing and future public information activities will be developed by January 1, 1998, updated annually and available for review at any time.

V. Floodplain management agencies and organizations should coordinate their efforts.

- 8. Agencies and organizations involved in floodplain management should continue to communicate and coordinate their efforts as much as possible.
 - 8.1 Mecklenburg County Storm Water Services (MCSWS), with support from Charlotte Storm Water Services (CSWS), should continue to serve as a clearinghouse of flood problems and floodplain management projects to advise agencies about activities that may affect their floodplain projects.
 - 8.2 Each individual agency involved in floodplain management, or work that impacts the floodplain, should recognize MCSWS as the clearinghouse and the agencies continue to be committed to the following:
 - a. Share information on the floodplain activities,
 - b. Identify and recommend actions to correct redundancies, conflicts and common problems faced by the agencies,
 - c. Identify and recommend actions to streamline and otherwise improve floodplain management programs and projects,

- d. Advise impacted agencies of the latest developments in the field of floodplain management,
 - e. MCSWS act as a technical advisor and sounding board for proposed floodplain management activities, and
 - f. MCSWS provides the public with a single, coordinated statement about the county's floodplain management.
- 8.3 The SWAC, with assistance from CMSWS, should annually perform the following tasks:
- a. a review of the Guidance Document,
 - b. a review of any floods that occurred during the year,
 - c. a review of each element or objective of the Document, including how much was accomplished during the previous year,
 - d. a discussion of why any objectives were not reached or why implementation is behind schedule, and
 - e. new recommendations.

This review should occur in conjunction with each budget presentation so any new endeavors or termination of current practices/techniques are reflected financially.

Status: On-going. City and County staff are assigned to various advisory groups to stay abreast of changing policies and practices. The SWAC has always acting in an advisory/coordinating role and can be solicited to address sensitive issues, as requested by staff or other SWAC members.

Completion Date: N/A.

Phase 2 Strategy, Policies and Recommendations

As previously discussed, Phase 2 are guiding policies and recommendations to be evaluated that are best applied to watershed specific areas.

- VI. **Flood Hazard Mitigation Plans, based on watershed areas, should be prepared to identify the best mix of floodplain management measures to solve local flooding problems and development concerns.**

The Flood Hazard Mitigation Plans (FHMP) should be developed using a systematic approach to

reduce damages to existing properties by reviewing various mitigation techniques, to include but not limited to the following:

- property acquisition,
- construction and maintenance of flood control projects, and
- retrofitting of existing structures.

The FHMP's should also take into account other initiatives. These initiatives include, but are not limited to the following:

- allowing or prohibiting filling in the floodplain
- use of flood warning where feasible
- streams that have been designated as having poor water quality and identified alternatives to improve the water quality
- various agencies' capital improvement programs
- City Within a City or other neighborhood based problem solving efforts
- availability of funding sources

These FHMP's should be developed based on the following guiding policies:

9. A systematic approach should be followed to reduce flood damage to existing development.

Existing developments are faced with three types of flood problems:

- a. Single issue problems that are exclusively the responsibility of one agency.
- b. Minor problems that can be handled with minimal public expense.
- c. Major problems that require capital expenditures.

- 9.1 The appropriate agencies should continue to handle their single issue and minor problems according to their own priorities. They should keep MCSWS posted on their work, especially where their projects modify the drainage system (e.g., enlarging culverts).
- 9.2 An inventory of the county's major flood problems should be prepared. The inventory should be revised as problems are corrected and as new problems are identified. These problems should be evaluated based on the design criteria in-place at that time.
- 9.3 The inventory should prioritize major flood problems including FEMA designated repetitive loss areas, according to an objective system.
- 9.4 Each major problem area should be addressed in priority order with a flood protection plan. Where cost effective, the plan should recommend protecting the area through acquisition, flood control, or retrofitting
- 9.5 Each plan should be based on flood data that assumes full urbanization of the

DEFINITIONS

A complete list of definitions based on the National Flood Insurance Program (NFIP) model ordinance are included below.

"Area of special flood hazard" is the land in the floodplain within a community subject to a one percent or greater chance of flooding in any given year and with a drainage area of one square mile (640 ac) or greater. The area of special flood hazard includes floodway (encroachment area) and the flood fringe district (see attachment).

"Building Restriction Floodline" The line which follows the 20+2 or 100+1 elevations as prepared in a detailed flood study on non-FEMA regulated streams as required by subdivision regulations and the Charlotte-Mecklenburg Storm Drainage Design Manual.

"Base Flood" means the flood having a one percent chance of being equaled or exceeded in any given year.

"FEMA" Federal Emergency Management Agency. Administer the National Flood Insurance Program countrywide.

"FEMA Regulated Stream" A stream that has a drainage area of over one square mile. Detailed flood studies have been performed on these streams and corresponding flood maps produced.

"Flood" or "flooding" means a general and temporary condition of partial or complete inundation of normally dry land areas from:

- (1) the overflow of inland or tidal waters; and,
- (2) the unusual and rapid accumulation of runoff of surface waters from any source.

"Flood Insurance Rate Map (FIRM)" means an official map of a community, on which Federal Emergency Management Agency has delineated both the areas of special flood hazard and the risk premium zones applicable to the community.

"Flood Insurance Study" is the official report provided by the Federal Emergency Management Agency. The report contains flood profiles, as well as the Flood Boundary Floodway Map and the water surface elevation of the base flood.

"Flood Protection Elevation" is the elevation to which structures and uses regulated by the Floodway Ordinances are required to be elevated or flood-proofed. This elevation is shown on the Official Flood Areas Map Series (Flood info plotted on City-County topographic maps).

Appendix B-1

"Floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot (see attachment).

"Floodway encroachment lines" are lateral limits of a floodway district along streams or other bodies of water, within which, in the direction of the stream or other body of water no structure or fill may be added, unless specifically permitted herein. Their purpose is to preserve the flood-carrying capacity of the floodway. Their location is such that the floodway between them including the channel, will handle the base flood flow (see attachment).

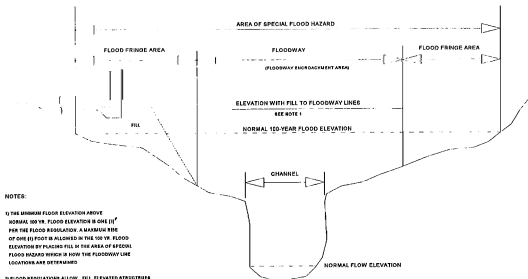
"Flood fringe district" is the land area located between the encroachment lines of the floodway district and maximum elevation subject to inundation by the base flood as defined herein (see attachment).

"Subwatershed" A division of a major watershed having an area of six(6) square miles. These were delineated in order to inventory and model the local drainage system.

"Watercourse" A natural or man-made channel for conveyance of storm water.

Appendix B-1 (cont)

TYPICAL CROSS-SECTION SHOWING THE FLOODWAY AND FLOOD FRINGE AREAS

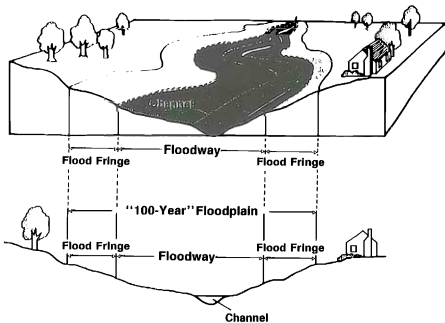


NOTES:

1) THE MINIMUM FLOOR ELEVATION ABOVE NORMAL 100 YR. FLOOD ELEVATION IS ONE (1)¹/₂ PER THE FLOOD REGULATION. A MAXIMUM ONE (1) FOOT IS ALLOWED IN THE 100 YR. FLOOD ELEVATION BY PLACING FILL IN THE AREA OF SPECIAL FLOOD HAZARD WHICH IS HOW THE FLOODWAY LINE LOCATIONS ARE DETERMINED

2) FLOOD REGULATIONS ALLOW FILL, ELEVATED STRUCTURES AND FLOOD-PROOFED STRUCTURES (NOW NON-RESIDENTIAL) IN THE FLOOD FRINGE AREA

The Floodplain with Floodway



watershed.

9.6 The decision to protect a major problem area should be based on a demonstration that the recommended protection measure is cost effective. Each flood protection plan should include an analysis that reviews factors such as:

- The dollar cost to the public, including long-term operation and maintenance costs,
- Contributions made by or costs incurred by property owners and private organizations,
- The benefits in terms of flood damage prevented,
- The project's impact on the environment, including water quality,
- The project's impact on public health and safety, and
- How the project supports other community goals and objectives for the area.

9.7 Flood protection plans should be developed with input from the affected residents and property owners. They should be fully appraised of the impacts of the alternative solutions, including the "do nothing" alternative.

9.8 Flood protection plans should include multiple approaches and, where appropriate, should be incorporated into multi-objective plans that further other community goals and objectives. For example a plan for an area could include:

- acquisition of those properties closest to the stream and subject to the deepest flooding,
- adding the acquired lots to a greenway,
- modifying the channel to minimize maintenance costs and incorporate natural bank protection measures,
- retrofitting other buildings in the problem area,
- implementing a special notification system to warn the residents of impending floods, and
- a public information program to encourage the purchase of flood insurance and remind residents of steps to take during a flood.

10. Guidelines for acquisition of floodprone areas.

10.1 Acquisition projects should be coordinated with other communities and agencies along the stream corridors to accomplish multiple objectives.

10.2 Financial and regulatory incentives should be provided to encourage setting aside vacant areas for public use in all developed and undeveloped floodplains. Priority to be given to those areas identified in official plans.

10.3 Implementation of the Greenway Master Plan should be accelerated to convert high

priority floodplain areas to public open space.

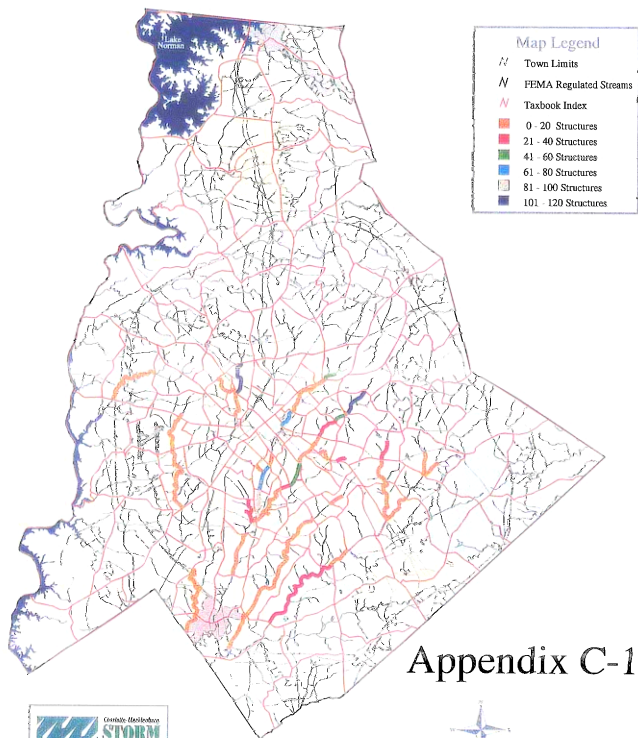
- 10.4 The Greenway/Trails Advisory Committee should be utilized where appropriate
- 10.5 Acquisition of a property should be voluntary where the sole purpose of the acquisition project is flood protection.
11. Guidelines for flood control projects. These include projects that:
- store floodwaters in retention basins, detention basins, or reservoirs,
 - modify the conveyance of water via channel, culvert or pipe improvements, or
 - contain flows via dikes or floodwalls.
- 11.1 Flood control projects should be designed with the entire watershed in mind. Adverse impacts on other properties should be minimized.
- 11.2 No project should be built to only protect vacant land from flooding.
- 11.3 Project designs should include operation and maintenance plans, including provisions for periodic inspections.
- 11.4 Projects should be coordinated with other agencies with interests in the area, such as utilities, greenways and publicly owned land to minimize duplication of efforts and to accomplish multiple objectives.
- 11.5 Owners of properties protected by the projects should be advised of the design and performance limitations to prevent a false sense of security and to encourage their cooperation in their maintenance.
12. Guidelines for retrofitting projects. Existing buildings should be protected by appropriate retrofitting projects.
- 12.1 Retrofitting projects should maximize the involvement, education, and financial participation of the owner.
- 12.2 Public funds should not be spent on retrofitting accessory, dilapidated or non-habitable structures.
- 12.3 Project designs should include operation and maintenance plans.
- 12.4 A special effort should be initiated to retrofit storage tanks and protect storage areas so they do not cause problems of floating debris. The effort should have the following components:

- a. All floodplain areas should be inspected for such problems,
- b. The owners should be advised of corrective measures, and
- c. An enforcement program should be developed and executed if necessary.

Status: New Initiative.

Completion Date: The majority of buildings in the floodplain that were built prior to the Floodway Ordinance are located in Irwin, Upper Little Sugar Briar and McMullen Creek watersheds. Also, hydrologic and hydraulic computer models have been recently developed for these watersheds. Based on these facts, these watersheds will have Flood Hazard Mitigation Plans developed, reviewed and approved by the SWAC by the end of 1998. The first FHMP (Upper Little Sugar Creek) will be completed by April 1, 1998.

Density of Flood Prone Structures



Appendix C-1



September 10, 1997

100 - Year Floodplain and Buildings Westfield Road Area



Appendix D-1

Appendix D-1



100 YEAR FLOOD PLAIN



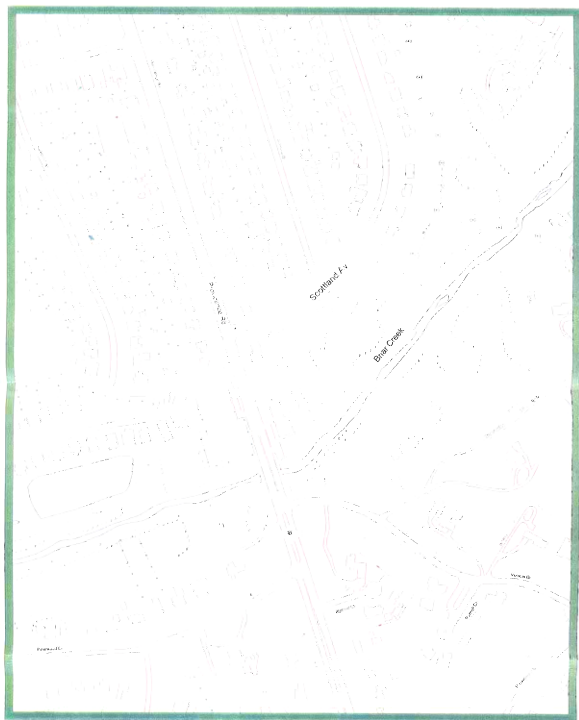


Appendix D-2

Westfield Road Flooding July 23, 1997

100 - Year Floodplain and Buildings

Scotland Avenue Area



Appendix E-1

Appendix E-1



100 YEAR FLOOD PLAIN





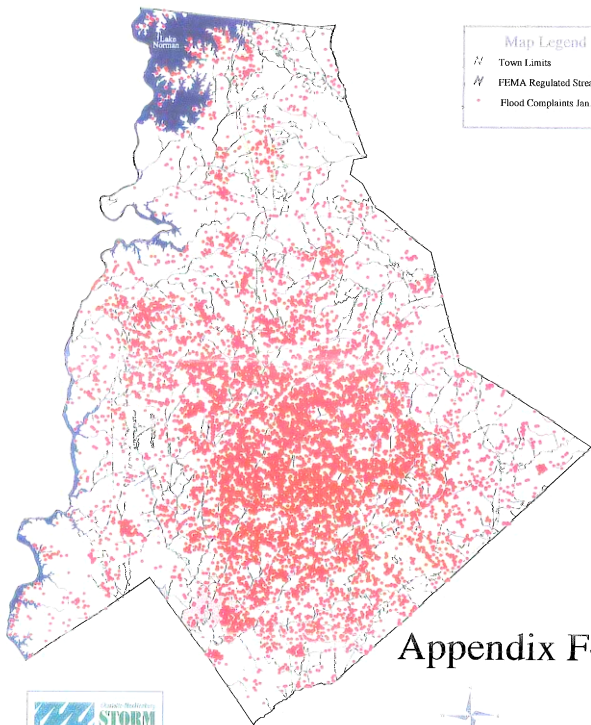
Home Built Prior to Floodplain Regulations



Home Built after Floodplain Regulations

Scotland Avenue Flooding, August 27, 1995

Density of Flooding Complaints

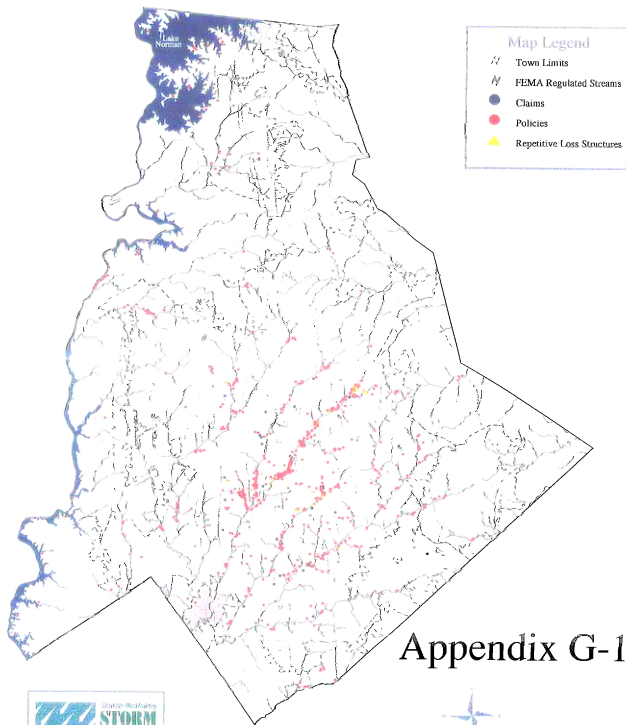


Appendix F-1



September 30, 1997

Flood Insurance and Repetitive Loss Areas

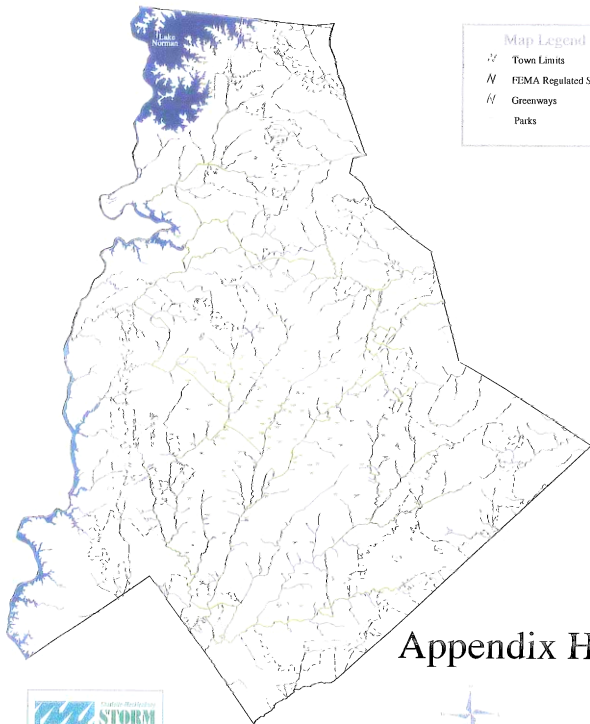


Appendix G-1



September 10, 1992

Mecklenburg County Greenways and Parks



Map Legend

- Town Limits
- FEMA Regulated Streams
- Greenways
- Parks

Appendix H-1



September 10, 1997