DRAFT

City of Huntsville, Alabama

Flood Mitigation Plan

1973

1999

2001

Prepared by

Flood Mitigation Planning Committee

June 1, 2001

DRAFT

Mitigation Plan Highlights

This Plan was prepared by the Flood Mitigation Planning Committee of the City of Huntsville. Chapter 2 summarizes the flooding hazard faced by the City and the 6,000 improved properties in the floodplain. Chapters 4 – 9 review the various ways the City and its residents can protect life and health and reduce flood damage.

Chapter 10 is the Action Plan. There are 16 individual action items to be implemented by 13 offices and agencies. Together they recommend:

- New floodplain maps and models as the basis for regulations and watershed plans
- Acquiring and clearing the floodway and expanding parks and greenways
- Reviewing and upgrading regulatory standards and procedures for new development
- Changes in stream maintenance
- Improved flood preparedness
- More information and assistance to the public
- A new stormwater utility to finance needed projects
- Follow through mechanisms to ensure the plan is implemented

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Flood Mitigation Plan Executive Summary

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Flood Mitigation Plan

Executive Summary

This Executive Summary is a synopsis of the City of Huntsville's draft *Flood Mitigation Plan*. The sections in this summary correspond to the chapters in the full *Plan*. The full Plan can be viewed at the Library, at City Hall, and on the City's web site, www.ci.huntsville.al.us.

1. Introduction

The City of Huntsville has extensive areas of floodplains that affect over 6,000 properties. These areas have always flooded. More recent damaging floods occurred in 1949, 1963, 1973, 1988, 1990, and 1999. Following floods in 1963 and 1973, many of the existing streams and channels that experienced flooding were straightened, widened, and concreted ("slope paved") to increase the capacity of the channel and reduce the potential for flooding.

1973 Flood

Today, the City continues to focus on improving its drainage infrastructure to eliminate flooding problems and reduce flood potential. Huntsville has also implemented other strategies besides structural projects to reduce the likelihood of flooding and protect people from financial losses due to floods. These include joining the National Flood Insurance Program and adopting regulatory requirements for stormwater management and floodplain construction.

All the City's efforts to improve drainage facilities and implement better plans to manage development have helped, but they have not eliminated all potential flooding. This can be seen by the flood damage that resulted from a severe rainfall and flood event in June 1999 along Aldridge Creek and its tributaries.

The *Plan:* Because there is a variety of other possible flood protection measures, the City of Huntsville opted to prepare a formal *Flood Mitigation Plan*. The objective of the plan is to guide flood protection activities for the next 5 – 10 years and ensure that the City implements flood related activities that are most effective and appropriate for its flooding situation.

The *Flood Mitigation Plan* was developed under the guidance of a Flood Mitigation Planning Committee. Half of the members represent the general public and interest groups and half are City staff. The committee met monthly since September 2000 and has encouraged public involvement in its work.

2. Problem Description

Watersheds: Floodwaters come from the watershed. The condition of the watershed affects what happens to the rain. For example, more rain will run off if the terrain is steep, if the ground is already saturated from previous rains, or if the watershed is covered with lots of pavements and parking lots.

For this Flood Mitigation Plan, Huntsville was divided into its 15 major watersheds. These are shown on the map on the next page. Some watersheds are large, but have few buildings exposed to flooding. Using the City's Geographic Information System (GIS), the planners collected the data on the City's watersheds as shown in the table below.

Floodplains: Flood studies and mitigation plans are based on the *risk* of future flooding. Flood studies determine the potential that storms and floods of certain magnitude will recur. Such events are measured by their "recurrence interval," i.e., a 10-year storm or a 100-year flood.

This *Plan* uses the 100-year flood and the 100-year floodplain mapped by the Federal Emergency Management Agency as the basis for planning and setting flood protection levels. The floodplain is divided into the floodway and the flood fringe.

Watershed and Floodplain Data

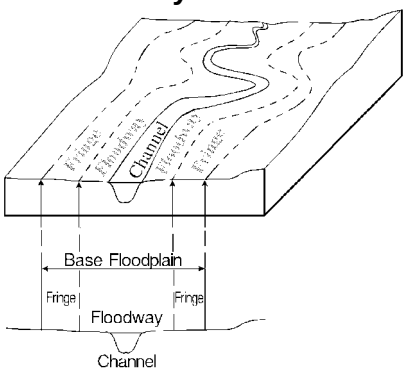
	Watershed		Floodplain	Billing Addresses *	
Watershed	**Area**	**In City**	**Area**	**Floodplain**	**Floodway**
Aldridge Creek	21	98%	3.2	1,164	45
Betts Spring Branch	9	61%	1.9	177	1
Big Cove Creek	22	56%	2.7	156	4
Broglan Branch	9	99%	1.0	923	57
Byrd Spring Wetlands	15	28%	0.8	77	0
Dallas Branch	4	100%	0.6	72	42
Eastern Boundary Canal	10	62%	1.9	280	0
Fagan Creek	4	100%	0.4	220	1
Flint River	470	5%	1.8	93	1
Huntsville Spring Branch	11	97%	2.8	1,239	404
Indian Creek	49	29%	1.4	47	3
McDonald Creek	11	77%	1.1	385	26
Pinhook Creek	23	100%	1.4	1,196	164
Tennessee River tributary	15	36%	0.9	4	1
Western Watersheds	214	17%	7.2	33	0
Total	887		29.1	6,066	749

Areas are in square miles. Floodplain areas are all in the City.

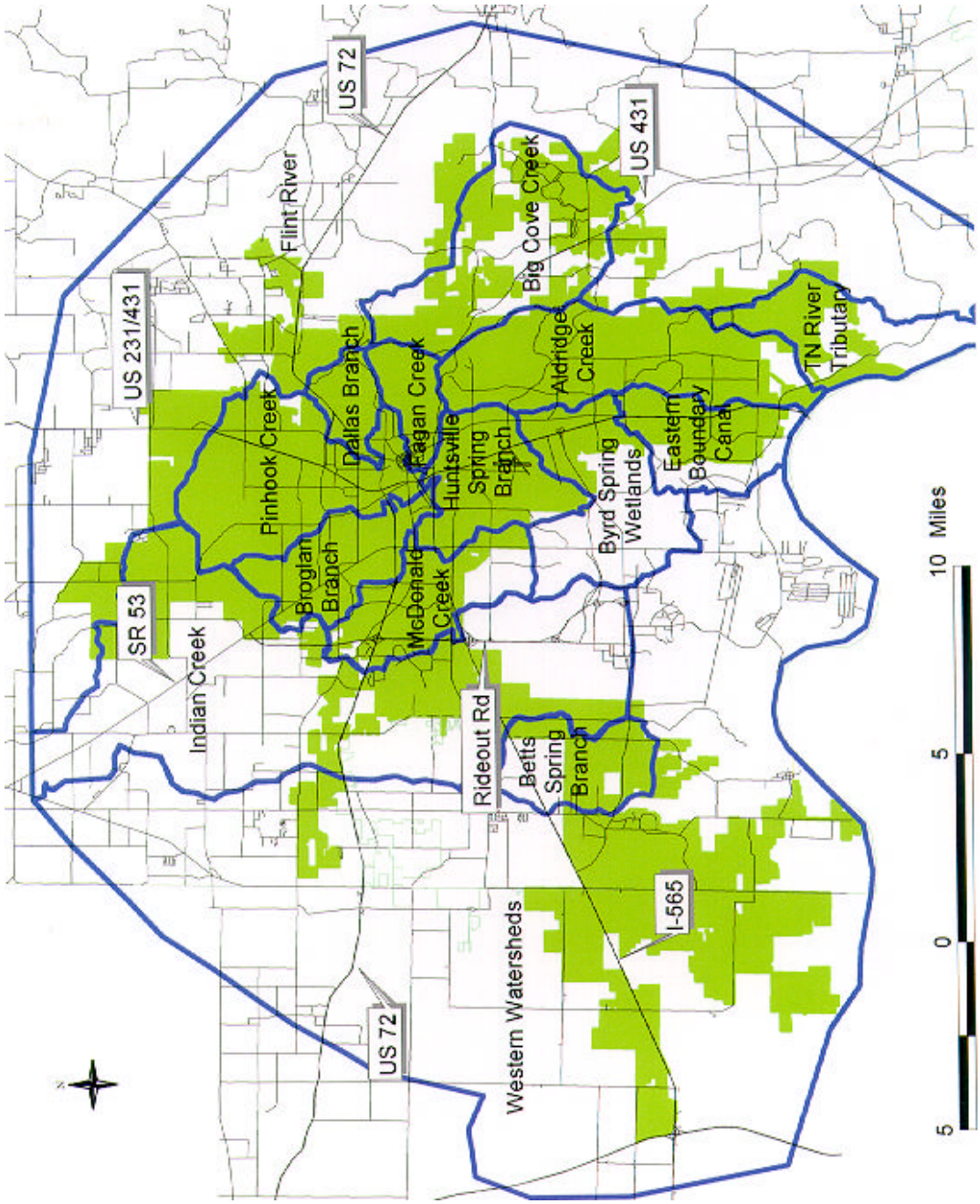
* A "billing address" is an improved property that receives a utility bill. The number of billing addresses is an approximation of the number of buildings exposed to flooding.

Floodways: The central part of the floodplain is called the "floodway." The floodway is the stream channel and that portion of the adjacent floodplain which must remain open to permit passage of the base flood. Floodwaters generally are deepest and swiftest in the floodway, and anything in this area is in the greatest danger during a flood. The remainder of the floodplain is called the "fringe," where water may be shallower and slower. 5.8 square miles (20%) of Huntsville's floodplains are in mapped floodways.

Floodway Delineation



Huntsville's Watersheds



Summary of the problem:

→ There are 29 square miles and 6,066 developed properties in the base or 100-year floodplain. These numbers mean that 17% of the City's land area and 6.7% of the City's developed property are subject to overbank flooding.

→ There are 749 improved properties in the floodway, the area of deepest and swiftest flooding.

→ While recent floods did not affect all the City's watersheds, they did cause considerable property damage where they did occur.

→ Floods also present hazards to safety, health and mental health. One person was killed in the June 1999 flood.

→ Construction of channel improvements and storage basins has lowered, but not eliminated, the flood threat on some streams.

→ Historically, flood protection work has produced channels that are not visually appealing and have little water quality, habitat or recreational benefit.

Source: Huntsville Times, June 29, 1999

Fagan Creek at Adams Street

→ Floodplains provide natural and beneficial functions and improve the recreational opportunities for City residents.

→ Without appropriate regulatory constraints, future development will increase flood heights, reduce water quality and damage habitat.

3. Goals

The Planning Committee set five goals for the *Mitigation Plan*:

1. Protect human life and health from flooding.
2. Mitigate the effects of flooding on existing development.
3. Protect new development from damage by the base flood.
4. Improve the quality of life in the City
5. Secure the resources needed to implement the *Flood Mitigation Plan*.

4. Preventive Measures

The Committee looked at measures that are designed to keep the problem from occurring or getting worse by preserving areas from development and by setting construction standards for new development. The Committee concluded:

→ The Greenway Plan, zoning ordinance and subdivision regulations are Huntsville's primary tools used to manage development in the floodplain. Other potential tools, such as an open space plan, are not currently used.

→ In areas where development is allowed in the floodplain, the city's program meets the minimum national requirements. Because minimum national standards do not cover all of Huntsville's needs, the City requires new buildings to be protected one foot higher than the national requirement.

Greenways have proven to be one of the best and safest uses of the floodplain.

→ The City's standards for stormwater detention cannot be considered effective in managing runoff from greater than the 10-year storm. The 10-year storm is an appropriate standard for the minor drainage system, but the first floor of buildings should be protected from larger floods through proper design of the major drainage system and detention

→ The City's procedures for administering regulations on floodplain construction should be streamlined with clear lines of responsibility between the Engineering and Inspection Divisions to be sure all requirements are met.

→ The most effective approaches to managing stormwater runoff in any particular location are best determined by a stormwater management master plan. The City is initiating such plans.

5. Property Protection

Property protection measures are used to modify buildings subject to flood damage rather than to keep floodwaters away. These can be inexpensive measures which often are implemented by or cost-shared with property owners. They include relocation, acquisition, local barriers, floodproofing and insurance. The Committee found:

→ A program to reduce damage to existing properties should focus on the floodway, where there are 749 improved properties in this area of deepest and swiftest flooding. The floodway should be the initial focus for acquisition projects where the acquired land can be converted to open space and greenways.

Relocation of this Huntsville landmark shows that any building can be relocated.

→ Property owners can implement some property protection measures at little cost, especially for sites in areas of low flood hazard.

→ Many people are not aware of the various ways they can protect their own property.

→ There is a low level of awareness of the availability and coverage provided by flood insurance.

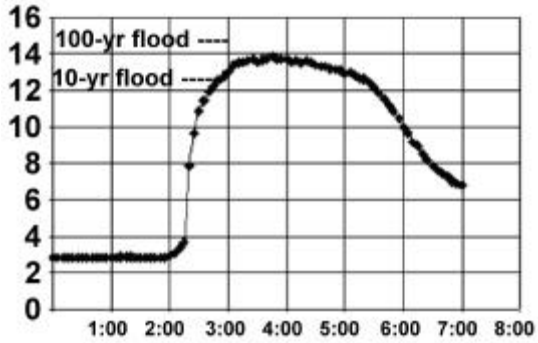
→ The City can promote and support property protection measures through a variety of activities.

6. Emergency Services

Emergency services measures protect people during and after a flood. Locally, these measures are coordinated by the Huntsville-Madison County Emergency Management Agency. The Agency's main guidance for implementing population protection measures is the *Emergency Operations Plan* which was just updated in 2000.

→ The City's ability to provide flood warning and detailed flood response plans is limited to the Tennessee and Flint Rivers.

A critical facility in the floodplain.



The Aldridge Creek gage at Mountain Gap Road, shows how little warning time there was for the flood of June 28, 1999.

→ Because many other Huntsville watersheds respond to rainfall in two hours or less, early flood warning on other streams is hampered by a lack of real-time rain and stream gages and local storm forecasts.

→ An improved flood response plan is dependent on early flood warning and flood stage forecast maps.

→ Critical facilities that will be affected by flooding need to be identified and included in flood response planning.

7. Structural Projects

Structural projects have traditionally been used by cities to control flows and water surface elevations. They include reservoirs, levees, floodwalls, channel modifications, dredging, and drainage system maintenance.

→ Each of these measures has been shown to work in Huntsville, but each has its own advantages and disadvantages.

→ Watershed planning is the best way to determine the most appropriate flood damage reduction measure(s) for an area.

→ Channel modifications, including slope paving of channels, and dredging have been two of the City's more common flood protection approaches. While channel modifications are effective, these approaches are expensive and can have adverse impacts on water quality, habitat, and downstream flooding.

Huntsville's traditional flood control measure.

→ Given available resources, the City has an appropriate program for maintaining channels and basins to ensure that they keep their design flood protection levels, but many residents have voiced displeasure with the way it works.

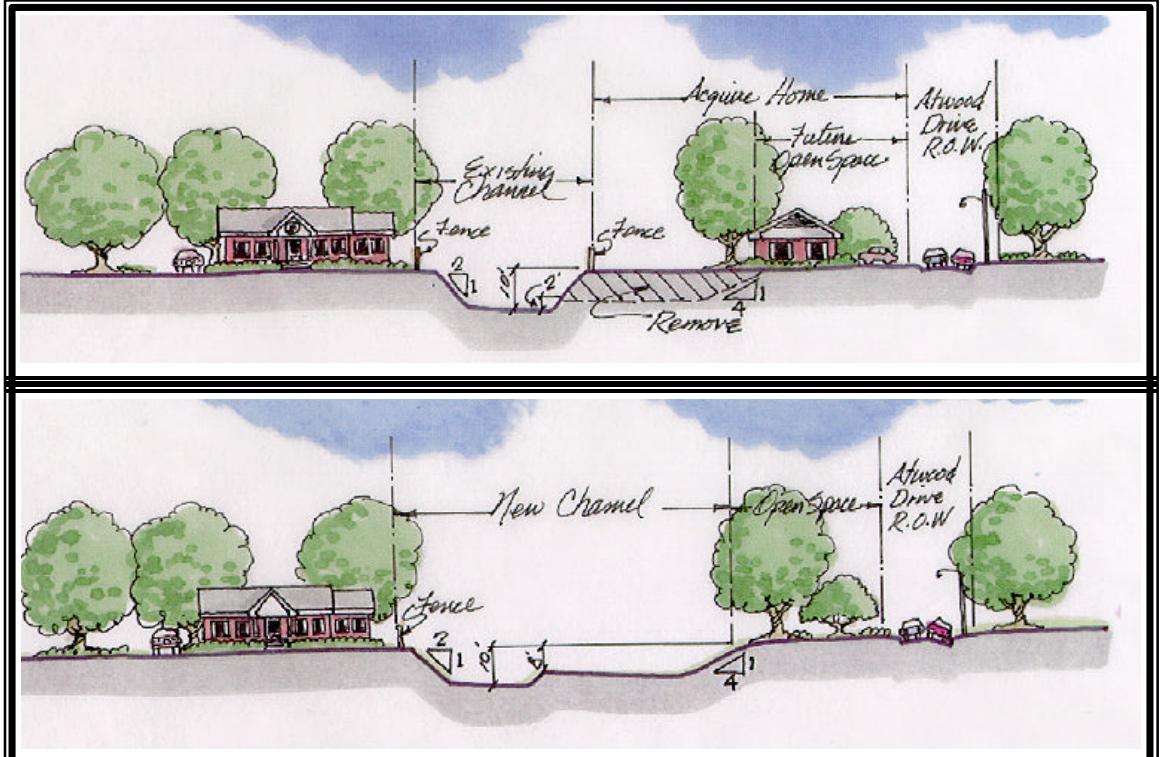
8. Natural Resource Protection

Natural resource protection activities are generally aimed at preserving (or in some cases restoring) natural areas. In so doing, these activities enable the naturally beneficial functions of floodplains and watersheds to be better realized. For example, protecting wetlands preseves areas that store and filter floodwaters.

→ A flood mitigation program can take advantage of interest in protecting wetlands and natural floodplain functions and utilize natural resource protection programs to support flood protection.

→ While wetlands and other areas have been damaged in the past, the current regulations on wetland protection, erosion and sediment control and dumping have effective standards. However, there are some gaps in enforcement.

→ The move toward river restoration (see the illustration on the next page) and nonpoint source best management practices are encouraging trends, but many property owners and developers are still learning about appropriate procedures.



Channels can be designed to carry floodwaters and be environmentally friendly.

9. Public Information

A successful hazard mitigation program involves both the public and private sectors. Public information activities advise property owners, renters, and businesses about flood hazards and ways to protect people and property from these hazards. These activities can motivate people to take flood protection steps and protect the natural and beneficial functions of floodplains and watersheds.

→ There are many ways that public information programs can be used so that people and businesses will be more aware of the hazards they face and how they can protect themselves. Many are currently being implemented.

→ The residents and businesses of Huntsville have a relatively low level of knowledge about the following flood mitigation topics:

- The various ways they can protect their own property from flooding.
- The availability and coverage provided by flood insurance.
- What to do when a flood warning is issued.
- The City's channel maintenance program.

→ There are opportunities for improved public information services, including:

- Providing more information and links on the City's web site
- Outreach projects that reach more people and cover more topics
- Providing real estate agents with flood hazard information

10. Action Plan

General recommendations appear at the end of Chapters 4 – 9 for each of the six mitigation strategies. The Action Plan converts those general recommendations to specific action items. It is organized according to the office that would be responsible for them.

Engineering Division

1. **Floodplain mapping:** Prepare watershed models and floodplain maps for all of the City's floodprone areas. These would include hydrologic and hydraulic computer models of the surface water flows in the watershed that can be used to evaluate alternative flood protection measures and the impact of new developments on drainage and flooding and a flood stage forecast map for emergency response planning.

2. **Watershed plans:** Prepare master flood protection plans using the models and mapping developed pursuant to the previous action item. Each plan should include an evaluation of structural and property protection measures (and combinations of those measures) that will protect existing development and a determination of the best approach to managing stormwater runoff from new development in the watershed, including locations for regional detention facilities. These plans should be coordinated with open space planning with the objective of acquiring properties in the floodway that will result in open space or greenways that will benefit the entire community.

3. **Stormwater management regulations:** Review the Subdivision Regulations and the Stormwater Management Manual to determine appropriate standards and procedures that will ensure that post-development flows leaving a development will not cause increased damage to downstream properties.

4. **Floodplain regulations:** Ensure that the City meets all required regulatory provisions and review the floodplain regulations and identify construction standards that are more appropriate for Huntsville's flood conditions.

Planning Division

5. **Zoning Ordinance:** Review the Zoning Ordinance to insure that the standards for new construction in the floodplain are appropriate.

6. **Open Space Plan:** Prepare an open space plan with associated funding recommendations to facilitate protection of land to provide flood protection and recreation benefits. The plan should be coordinated with watershed plans (Action Item #2) with the objective of acquiring properties in the floodway that will result in open space or greenways that will benefit the entire community.

Inspection Division

7. **Regulatory procedures:** Review the City's procedures to ensure that all the floodplain and stormwater regulations are properly and fully enforced.

Public Works Services

8. **Drainage maintenance program:** Prepare new drainage system maintenance procedures. Include streamside residents and interested organizations in the preparation of the procedures and incorporate maintenance standards and procedures that will protect sensitive areas and habitat.

Emergency Management Agency

9. **Pilot flood response plan:** prepare a pilot flood response plan for one floodplain, using a flood stage forecast map prepared pursuant to Action Item #1 and evaluate the benefits and costs of a flood warning program.

10. **Critical facilities plans:** Identify the critical facilities that are affected by flooding. Work with their managers to determine any special flood warning and response support they may need from the City and encourage them to prepare their own flood response plans.

Public information strategy – Engineering Division

11. **Ongoing public information activities:** Ensure that the following ongoing information and technical assistance activities are implemented:

    → Providing map and flood hazard information to inquirers
    → One-on-one advice and assistance on flood protection measures
    → Providing references to the library
    → Issuing news releases and news articles
    → Making presentations at meetings of associations and interested groups

12. **New public information projects:** Design and initiate the following new activities:

    → Publicity of property protection projects that have been constructed in Huntsville
    → Incorporating a flood protection web page in the City's web site
    → Providing a library of flood-related videos to the public access cable TV channel.
    → Preparing a homeowner's flood protection manual
    → Conducting an annual mailing to floodplain addresses
    → Pursuing measures to disclose the flood hazard to house hunters
    → Preparing sinkhole and landslide hazard maps and public information materials

Administrative Action Items –Mayor and City Council

13. **Plan adoption:** Adopt this *Flood Mitigation Plan* and create a standing Mitigation Committee.

Mitigation Committee

14. **Program oversight:** Monitor implementation of the Action Plan and report on progress and recommended changes to the Mayor and City Council.

15. Financial review: It is estimated that the City of Huntsville will need to spend in the neighborhood of $9 million per year if it is to significantly reduce flood losses over the next 10 – 20 years. This is the estimated total of current expenditures, the cost of the *Plan's* action items (see box), and the expected cost of implementing the watershed plans.

Current sources of revenue for flood protection and stormwater management activities are stretched to their limits. There are funding sources that have not been used, but there are many policy and financial issues that need to be reviewed and settled before a recommendation can be submitted to the Mayor and City Council. At a minimum, the following should be examined:

Estimated Plan Costs

Action Item	Estimated Annual Cost
1. Floodplain mapping	$1,000,000
2. Watershed plans	$1,000,000
3. Stormwater mgmt regulations	$60,000
4. Floodplain regulations	Staff time
5. Zoning ordinance	Staff time
6. Open space plan	Staff time
7. Regulatory procedures	Staff time
8. Drainage maintenance program	Staff time
9. Pilot flood response plan	Staff time
10. Critical facilities plans	Staff time
11. Ongoing public information	Staff time
12. New public information projects	$6,000
13. Plan adoption	Staff time
14. Program oversight	Staff time
15. Financial review	$5,000
16. Community Rating System	Staff time
Total estimated annual dollar costs	$2,071,000

These figures are the estimated annual costs for the recommended action items. For action items 1, 2, and 15, the estimated annual cost is the estimated total cost divided by 5 years. *Note:* These are only the costs of the recommended action items. They do not include the operations, administrative, maintenance and capital improvements costs being expended by the City for current flood and stormwater management activities. These numbers do not include the cost of implementing the recommendations of the watershed plans, which could run up to $5 million each year.

→ A stormwater user fee or utility
→ Fees for reviewing new development's stormwater plans and/or flood protection measures (currently the City does not charge for this extra permit review)
→ Using volunteers for activities such as stream maintenance

Engineering Division

16. Community Rating System: After sufficient action items recommended by this *Plan* are implemented, the City should submit a modification to move it to a CRS Class 7. This will produce a 15% flood insurance premium reduction and an average annual saving to Huntsville property owners of $44 per flood insurance policy.

The full *Plan* can be viewed at the Library, at City Hall, and on the City's web site, www.ci.huntsville.al.us. Comments on the draft *Plan* are requested. They should be presented at a public meeting to be held at *[time]* on June 11 at City Hall or submitted to the City's Engineering Division by that date. For more information, contact Dr. Warren Campbell at 427-5350.

City of Huntsville, Alabama

Flood Mitigation Plan

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Chapter 1. Introduction

1.1. Background

The City of Huntsville has extensive areas of floodplains that affect over 6,000 properties. These areas have always flooded. More recent damaging floods occurred in 1949, 1963, 1973, 1988, 1990, and 1999. Following floods in 1963 and 1973, many of the existing streams and channels that experienced flooding were straightened, widened, and concreted to increase the capacity of the channel and reduce the potential for flooding.

In the 1990's the City made substantial improvements to Huntsville Spring Branch, the City's main drainage course. Today, the City continues to focus on improving its drainage infrastructure to eliminate flooding problems and reduce flood potential.

Huntsville has also implemented other strategies besides structural projects to reduce the likelihood of flooding and protect people from financial losses due to floods. These include:

- Joining the National Flood Insurance Program in 1978 so that citizens could purchase flood insurance to protect their properties from losses due to flooding.
- In 1990, the City adopted its first comprehensive regulations on stormwater management.
- In 1991, it also adopted the Stormwater Management Manual to set standards for the design of storm drainage facilities.
- In the late 1990's, the City began developing hydrologic and hydraulic computer models for each watershed to evaluate its existing drainage facilities and to determine the impacts of proposed development on flooding potential.

All the City's efforts to improve drainage facilities and implement better plans to manage development have helped, but they have not eliminated all potential flooding. This can be seen by the flood damage that resulted from a severe rainfall and flood event in June 1999 along Aldridge Creek and its tributaries.

There are other ways to protect properties from flood damage, including flood proofing, flood insurance, flood warning, emergency preparedness, and various types of regulations for new development. Because of the variety of possible flood protection measures, the City of Huntsville opted to prepare a formal *Flood Mitigation Plan*. The objective of the plan is to guide flood protection activities for the next 5 – 10 years and ensure that the City implements flood related activities that are most effective and appropriate for the situation.

Simply stated, a flood mitigation plan is the product of a rational thought process that reviews alternatives and selects and designs those that will work best for the community. This process is the opposite of making quick decisions based on inadequate information. This Flood Mitigation Plan offers carefully considered directions to the City of Huntsville by studying the City's overall flood potential and ensuring that public funds are well spent.

1.2. Mitigation Planning Committee

This *Flood Mitigation Plan* was developed under the guidance of a Flood Mitigation Planning Committee. A resolution was passed on August 23, 2000, by the City Council that formally recognized the planning process and created the Committee. The resolution directed the Mayor to appoint the members, ensuring that at least half of them represented the general public and interest groups (see box).

Flood Mitigation Planning Committee

Ed Starnes	Chair
Sandra Lyles-Jackson	Council District 1
Dr. Sam Lowry	Council District 2
Ed Kiessling	Council District 3
Benny Dishroon	Council District 4
Bobby Grubbs	Council District 5
James Ledbetter	Developer
Louis Fleming	Farmer
Susan Weber	Environmental Concerns
Dr. Earl Gooding	Urban Planning
Ronald A. Hagler	Redstone Arsenal
Dr. Warren Campbell	City – Engineering
Dr. Ben Ferrill	City – Planning
Steve Abbott	City – Public Works/Drainage
Randy Cunningham	City – Inspection
Ralph Stone	City – Recreation and Landscape
Terry Hatfield	City – Mayor's Office
Rusty Russell	City/County Emergency Mgmt.
David Pope	Madison County Engineer

Technical Advisory Committee

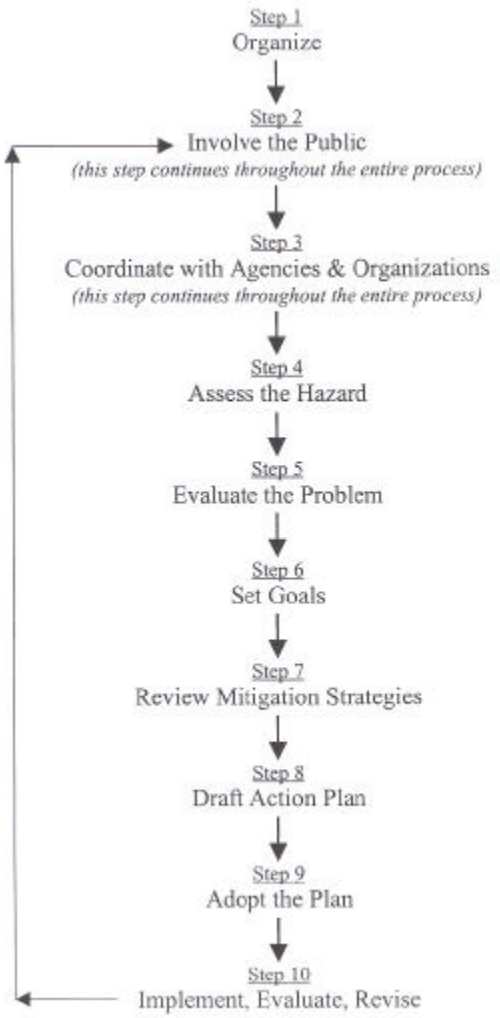
French Wetmore, CFM	Flood Mitigation Planner
Dr. John Christy	State Climatologist
Marie Bostick	Urban Planning
Marty Calvert	Engineer/CRS Coordinator
Tom Cunningham	City Engineer
Jesse Waddell	Watershed Modeling
Marjorie Holderer	Planning/Recreation
Ken Crane	Sherwood Park neighborhood
Chuck Sanders, CFM	State Floodplain Manager
Joe L. Berry	District Conservationist, NRCS
John D. Lyle, Jr.	Soil Conservationist, NRCS
Keith Mandel	Geotechnical Engineer
Regina McCoy	Tennessee Valley Authority

The committee met from September, 2000, through May, 2001. It reviewed the flood problems, considered a variety of ways to reduce and prevent flood damage, and recommended the most appropriate and feasible measures for implementation.

Technical support for the planning effort was provided by a Technical Advisory Committee. Most of the TAC members are from local, State or Federal agencies that have a role or can have a role in helping Huntsville reduce flood losses. Others represent special local concerns. Technical support was also provided by French & Associates, Ltd., a flood mitigation consulting firm.

Planning Approach: The Mitigation Planning Committee followed a standard 10-step process, based on guidance and requirements from the Federal Emergency Management Agency (FEMA). This process is summarized in the flow chart below.

Mitigation Planning Process



Public Involvement: After it's organizational meeting, the Committee's first job was to obtain input from the public, particularly floodplain residents. This was done through several concurrent means, including:

Planning Committee: Residents were encouraged to provide input through their representative on the Committee. They were also invited to attend meetings and provide their comments and concerns.

Public meetings: A Flood Mitigation Open House was held at Huntsville High School on October 30, 2000. Over 140 people attended. The planning process was explained and the Committee members were introduced. A dozen agencies and organizations had displays that explained various aspects of mitigation.

Flood Mitigation Open House

A second public meeting is scheduled for July 9, 2001, to review the draft recommended plan.

Newspaper and television coverage: Several news releases were issued during the planning process. The *Huntsville Times* followed the Committee's work closely and covered the Open House. It published several supportive editorials. Three television stations went to the Open House and interviewed participants.

Questionnaire: A one-page questionnaire was sent to all properties in the floodplain, distributed at the open house and posted on one television channel's web site. The questionnaire asked about the respondents' flood history, what steps they had taken to protect themselves from flooding, and what suggestions they had for the City's program. Of the 10,000 distributed, there were over 1,500 responses. The results are discussed in the later chapters.

Cable TV: Committee meetings and public meetings were publicized on the public access cable TV Channels 3 and 42. Short videos on topics such as mitigation planning, floodproofing and flood safety, were also shown on these channels during the planning process.

Organizations: Committee members and City staff spoke at and received input from several neighborhood association and organizations' meetings.

Coordination: During the planning process, contacts were made with the following agencies to determine how their programs affect or could support the City's flood mitigation efforts. In some cases, agency and organization representatives actively participated on the Planning Committee or the Technical Advisory Committee.

City of Huntsville
Public Information
Emergency Management
Engineering
Community Development
Inspection
Planning - regulations
Planning - planning
Planning - GIS
Natural Resources
Landscape Management
Public Works - Drainage Maint.
Huntsville Utilities

Private Organizations
American Red Cross
Chamber of Commerce
Huntsville Madison Co. Builders Assoc.
Historical Society
Spring City Cycling Club
Flint River Conservation Association
Sierra Club

Regional Agencies
Madison County
City of Madison
TARCOG

State Agencies
AL Emergency Management Agency
AL Dept. of Environmental Mgmt.
State Climatologist
State Geological Survey

Federal Agencies
TVA
FEMA
U.S. Geological Survey
U.S. Army Corps of Engineers
U.S. Fish and Wildlife Service
National Weather Service
USDA NRCS
Redstone Arsenal
Wheeler Wildlife Refuge
USDA Extension Service

At the end of the planning process, each of these agencies was sent a copy of the draft plan and asked to comment in time for the July 9 public meeting.

Mitigation Strategies: Everything that could affect flood damage in Huntsville was considered by the Mitigation Planning Committee. The technical support experts ensured that time was not wasted on irrelevant activities, but the process was not limited to just a few alternatives such as a channel improvement or acquisition project.

The committee's work and the subsequent plan document explored six general strategies for mitigating flood hazards. Each of these strategies is the subject of one of the chapters in this plan:

- preventive – e.g., zoning, floodplain, stormwater, and other ordinances
- structural projects – e.g., levees, reservoirs, channel improvements
- property protection – e.g., relocation, floodproofing, insurance
- emergency services – e.g., warning, sandbagging, evacuation
- natural resource protection – e.g., wetlands protection, best management practices
- public information – e.g., outreach projects, technical assistance

After the many alternatives were reviewed, the committee drafted an "action plan" that specifies recommended projects, who is responsible for implementing them, and when they are to be done. The action plan is included in the last chapter of this Flood Mitigation Plan.

It should be noted that this plan recommends flood mitigation measures that should be pursued. Implementation of these recommendations depends on adoption of this plan by the Huntsville City Council and the cooperation and support of the offices designated as responsible for each action item.

1.3. The Community Rating System

The City of Huntsville participates in the Federal Emergency Management Agency's National Flood Insurance Program (NFIP) and its Community Rating System (CRS). Under the CRS, flood insurance premiums for properties in the City are reduced to reflect the flood protection activities that are being implemented.

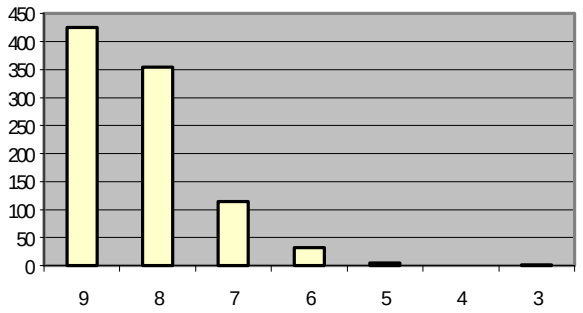
A community receives a CRS classification based upon the credit points it receives for its activities. It can undertake any mix of activities that reduce flood losses through better mapping, regulations, public information, flood damage reduction and/or flood warning and preparedness programs. There are ten CRS classes: class 1 requires the most credit points and gives the largest premium reduction; class 10 receives no premium reduction (see table, next page). A community that does not apply for the CRS or that does not obtain the minimum number of credit points is a class 10 community.

Community Rating System Classes and Premium Reductions

Credit Points	Class	Premium Reduction SFHA*	Premium Reduction Non-SFHA
4,500+	1	45%	10%
4,000 – 4,499	2	40%	10%
3,500 – 3,999	3	35%	10%
3,000 – 3,499	4	30%	10%
2,500 – 2,999	5	25%	10%
2,000 – 2,499	6	20%	10%
1,500 – 1,999	7	15%	5%
1,000 – 1,499	8	10%	5%
500 – 999	9	5%	5%
0 – 499	10	0	0

* Special Flood Hazard Area

CRS Communities by Class



As of April 1, 2000, there were 906 communities in the United States in the CRS. Their class distribution is shown in the chart below. There are over 19,000 communities in the NFIP. At first glance, having only 900 (5%) in the CRS looks like a low participation rate. However, these 906 cities and counties represent over 66% of all flood insurance policyholders. CRS communities have the bulk of the nation's flood problems.

There are 11 CRS communities in Alabama. Seven are Class 9 and three are Class 8 and there is one Class 7 (Birmingham). Huntsville is one of the Class 8 communities and therefore ranks in the top 3% of the communities in the National Flood Insurance Program.

Program incentive: The CRS provides an incentive not just to start new programs, but to keep them going. It does this in two ways:

First, Huntsville expects to receive CRS credit for this plan when it is adopted. To retain that credit, though, the City must submit an evaluation report on progress toward implementing this plan to FEMA by October 1 of each year. That report must be made available to the media and the public.

Second, the City must annually recertify to FEMA that it is continuing to implement its activities. Failure to maintain the same level of involvement in flood protection can result in a loss of CRS credit points and a resulting increase in flood insurance rates to residents.

It is expected that this undesirable impact of loss of CRS credit for failure to report on the plan's progress or for failure to implement flood loss reduction projects will be a strong encouragement for the City to continue implementing this plan in dry years when there is less interest in flooding.

Chapter 2. Problem Description

2.1. Sources of Flooding

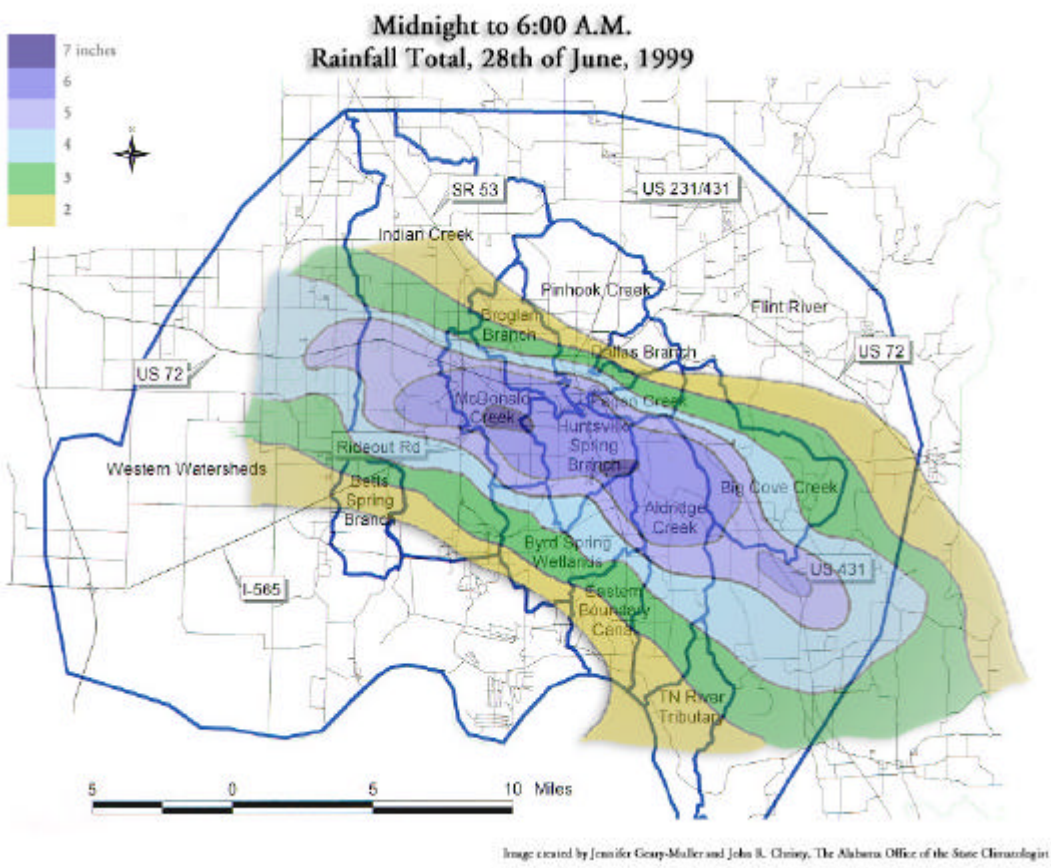
The frequency and extent of flooding in Huntsville depends on two factors: rainfall and the condition of the watershed.

Rain: Huntsville receives an annual average of 52 inches of rain. However, it is not spread out evenly over the year. The amount of rain that falls varies from storm to storm and varies over an area.

The isohyet map of the June 1999 storm shows how some areas of the City received over 7 inches of rain in a six hour period while other areas only a few miles away received less than 2 inches. Downtown Huntsville and the upper half of the Aldridge Creek watershed received six inches during that six hours.

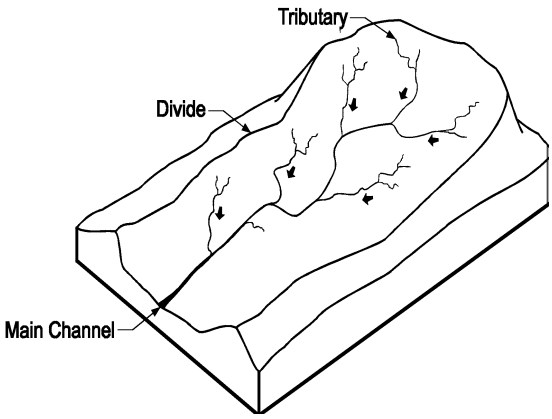
Watershed: A "watershed" is an area that drains into a lake, stream or other body of water. The figure at the top of the next page shows a watershed and some of the key terms. The boundary of a watershed is a ridge or "divide."

Rainfall Total, Midnight – 6:00 a.m., June 28, 1999



Source: Alabama State Climatologist

Watershed Terminology



The condition of the watershed affects what happens to the rain. For example, more rain will run off if the terrain is steep, if the ground is already saturated from previous rains or if the watershed is covered with lots of pavements and parking lots.

Floods: The run off from rain is collected by the smaller channels (tributaries) which send the water to larger channels and eventually to the lowest body of water in the watershed (main channel). When a channel receives too much water, the excess flows over its banks and into the adjacent area – causing a flood.

Flood risk: Past floods are indications of what can happen in the future, but flood studies and mitigation plans are based on the *risk* of future flooding. Flood studies extrapolate from historical records to determine the potential that storms and floods of certain magnitude will recur. Such events are measured by their "recurrence interval," i.e., a 10-year storm or a 50-year flood.

What are the odds of a base flood?

The term "100-year flood" has caused much confusion for people not familiar with statistics. Another way of looking at it is to think of the odds that a base flood will happen sometime during the life of a 30-year mortgage (26% chance).

Chance of Flooding over a Period of Years

Time Period	Flood Size 10-year	25-year	50-year	100-year
1 year	10%	4%	2%	1%
10 years	65%	34%	18%	10%
20 years	88%	56%	33%	18%
30 years	96%	71%	45%	26%
50 years	99%	87%	64%	39%

Even these numbers do not convey the true flood risk because they focus on the larger, less frequent, floods. If a house is low enough, it may be subject to the 10- or 25-year flood. During the proverbial 30-year mortgage, it may have a 26% chance of being hit by the 100-year flood, but the odds are 96% (nearly guaranteed) that a 10-year flood will occur during the 30 year period. Compare those odds to the only 5% chance that the house will catch fire during the same 30-year mortgage.

These terms are often misconstrued. Commonly, people interpret the 50-year flood definition to mean "once every 50 years." This is wrong. A 50-year flood could occur two times in the same year, two years in a row, or four times over the course of 50 years. It is possible to not have a 50-year flood over the course of 100 years.

Huntsville's major streams have been studied by the Federal Emergency Management Agency (FEMA). The study findings were published in April 1998 in FEMA's *Flood Insurance Study* and Flood Insurance Rate Map for the City. FEMA uses the "base" floodplain as the basis for its regulatory requirements and flood insurance rate setting. This plan uses the base floodplain, too.

The base floodplain is the area inundated by the base flood. The base flood is the one percent chance flood, i.e., the flood that has a one percent (one out of 100) chance of occurring in any given year. The one percent chance flood has also been called the 100-year flood.

It is also important to clarify that a 100-year rain may not produce a 100-year or base flood. As happened in June 1999, a local storm may rain heavily in one watershed or in one part of a watershed, but not elsewhere. If the ground is already saturated, a 50-year rain could cause a 100-year flood. Therefore, while gage records may show that a base flood occurred on Aldridge Creek, the flood on the Flint River may have been smaller and the Tennessee River may not have flooded at all.

Another term used is the "500-year flood." This has a 0.2% chance of occurring in any given year. While the odds are more remote, it is the national standard used for protecting critical facilities, such as hospitals and power plants.

2.2. Huntsville's Watersheds

As a City-wide product, this plan divides the City's flood problems into 15 major watersheds. These are shown on the map on the next page. Some basic data on these watersheds are shown in the table to the right. The figures show that 17% of the City's 175 square miles are in floodplain.

What happens in the watershed will affect events and conditions downstream. A key determinant of downstream flooding is the use of the land in the watershed. Stormwater runs off the land faster in urbanized areas. Runoff from developing areas and crop lands includes more sediment.

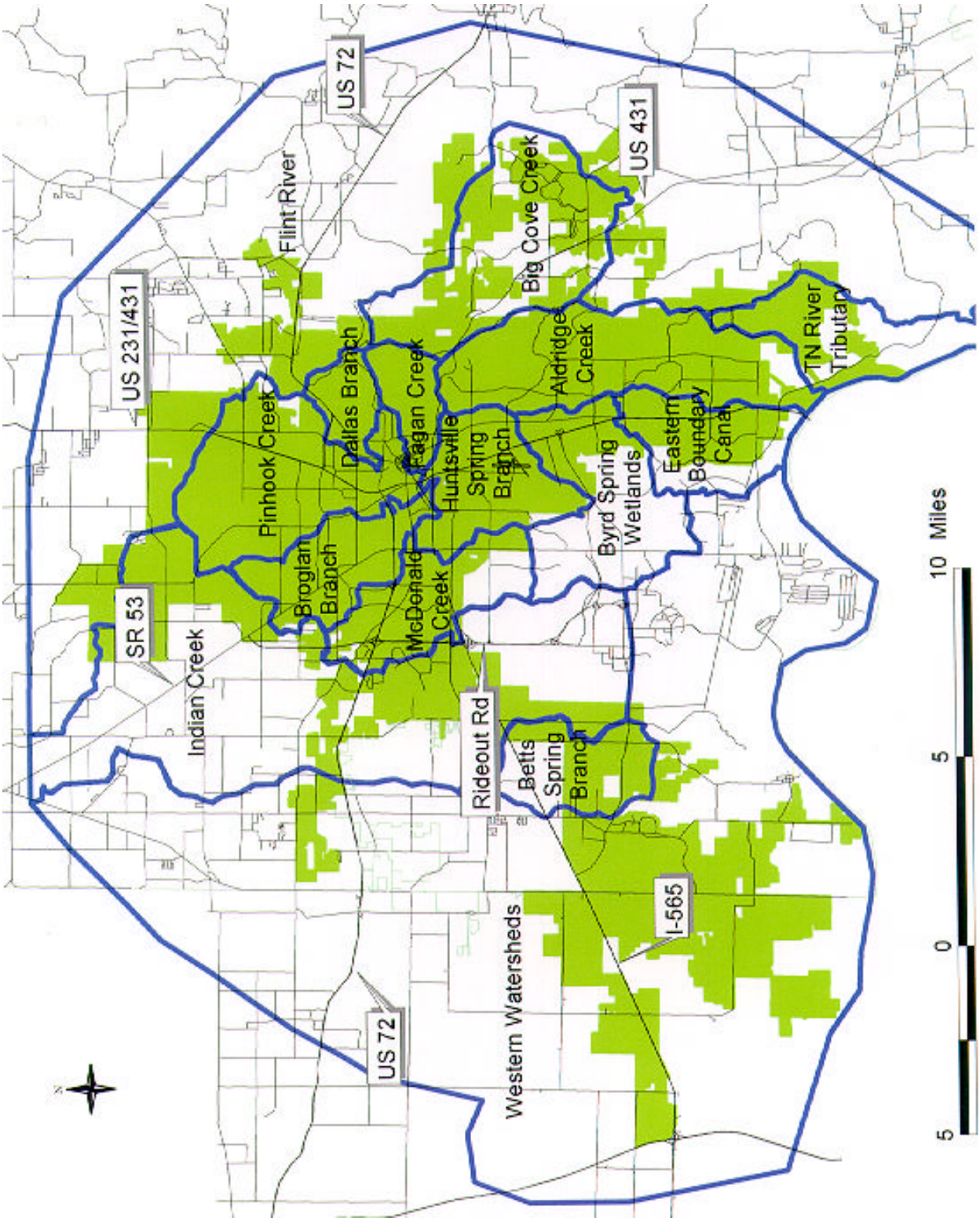
Huntsville's Major Watersheds

	Watershed		Floodplain
Watershed	**Area**	**In City**	**Area**
Aldridge Creek	21	98%	3.2
Betts Spring Branch	9	61%	1.9
Big Cove Creek	22	56%	2.7
Broglan Branch	9	99%	1.0
Byrd Spring Wetlands	15	28%	0.8
Dallas Branch	4	100%	0.6
Eastern Boundary Canal	10	62%	1.9
Fagan Creek	4	100%	0.4
Flint River	470	5%	1.8
Huntsville Spring Branch	11	97%	2.8
Indian Creek	49	29%	1.4
McDonald Creek	11	77%	1.1
Pinhook Creek	23	100%	1.4
Tennessee River tributary	15	36%	0.9
Western Watersheds	214	17%	7.2
Total	887		29.1

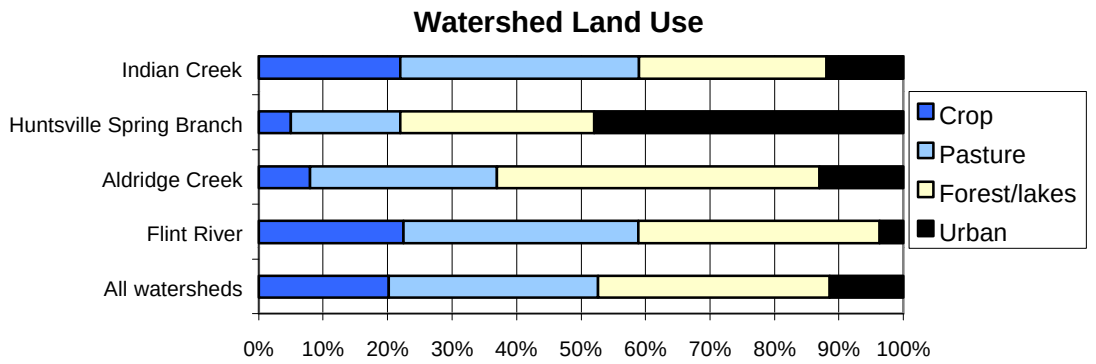
Area numbers are in square miles.
Floodplain areas are all in the City

The chart on page 2-5 illustrates the percentages for the four major land uses in Huntsville's major watersheds. It can be seen that the Huntsville Spring Branch watershed (which includes the tributaries of McDonald Creek, Broglan Branch, Fagan Creek, Dallas Branch, and Pinhook Creek) is the most urbanized. It also has a large amount of forest/lakes, most of which are in the Arsenal and Wheeler National Wildlife Refuge.

Huntsville's Watersheds



Data on these watersheds are in the table on the previous page.



Source: Watershed assessment conducted by the Madison County District Office of the Natural Resources Conservation Service, 1998. Note: figures are for Madison County only (i.e., Flint River numbers do not include the portion of the watershed in Tennessee).

2.3. Historical Flooding

Huntsville's city limits are bounded on the south by the Tennessee River, where the largest flood of record occurred during March 1867 with a river elevation (stage) of 582 feet above sea level. Another damaging flood occurred in 1949.

1963:. The July 1963 flood hit the eastern watersheds the hardest and was rated a 100-year (base) flood on the Flint River. After the 1963 flood, the Huntsville City Planning Commission prepared a report, "Toward a Flood Damage Prevention Program." The report called for a "Flood Study Committee" that would study flooding conditions and recommend both corrective (flood control, floodproofing, etc.) and preventive measures (regulations, public information, etc.). There is no record as to whether the Committee was appointed or the recommendations were implemented.

Channel improvements: Another product of the 1963 flood was a series of flood control projects. With assistance from the U.S. Army Corps of Engineers, the City undertook some extensive channel modifications. The most urbanized streams, Fagan Creek, Pinhook Creek, Dallas Branch, and Huntsville Spring Branch, were deepened, straightened and lined with concrete walls to increase their carrying capacity (see photo, page 2-27).

1973: The largest flood in recent history occurred in March 1973. The extent and severity of this flood is described in the following quote from the 1975 report by the Geological Survey of Alabama.

> Unusually heavy rains moved from southwest to northeast across a large part of the Tennessee River basin on March 14-18, 1973. On March 15-16, 7 to 9 inches of rain fell at Huntsville during a 22-hour period, causing major flooding in the city….The storm was fairly general over the city, ranging from about 7 to 9 inches in the southern part….
>
> The most severe general flooding occurred on Pinhook Creek downstream from Mastin Lake Road, and on Huntsville Spring Branch and Broglan Branch downstream from Southern Railroad. Parts of flood plains, inundated as much as 5

feet in depth, were occupied by housing developments, trailer parks, apartment buildings, commercial and industrial buildings, streets, and so forth….

The flood on Pinhook Creek at Clinton Avenue crested at 4 feet above the January 1949 flood, which was the previous highest known flood, and 8 feet above the March 1963 flood. According to flood history investigations made by the Tennessee Valley Authority (1964), this flood is the highest known on Pinhook Creek in the past 88 years. Channel improvements, such as deepening, widening, straightening, lining with concrete, and increasing bridge and culvert openings, reduced flood crests on other channel reaches in the Huntsville Spring Branch basin to about the same elevation of the 1949 flood and from 0 to 3 ½ feet higher than the 1963 March and July floods. On Aldridge Creek, the flood crest occurred 3 feet below the maximum stage of record that occurred in July 1963. Peak discharges ranged up to twice those of previously known recorded floods.

The Tennessee River crested 3 days later…. Backwater from the Tennessee River caused a greater extent of flooding, in depth and time, on the lower reaches of Aldridge Creek, Huntsville Spring Branch, and McDonald Creek than the floods that occurred on March 16.

– *Environmental Geology and Hydrology*, Huntsville and Madison County, Alabama, Geological Survey of Alabama, 1975

While Huntsville Spring Branch went well out if its banks, much damage upstream was prevented along those streams that had channel improvements. Flooding on Dallas Branch was reduced below levels of the smaller 1963 flood. To the east, Aldridge Creek channel improvements kept the 1973 flood to a non-damaging stage.

On the Tennessee River, the 1973 flood was estimated to be a 100-year flood. However, because of the installation of Tennessee Valley Authority dams, the river was kept to a maximum elevation of 575 feet, seven feet lower than the 1867 flood of record.

Historical Flood Records

Stream	Year	Recurrence Interval
Aldridge Creek	1973	50 years
	1999	100 years
Beaverdam Creek	1990	10 years
Fagan Creek	1988	100 years
Flint River	1973	200 years
	1990	80 – 90 years
Indian Creek	1973	300 years
	1990	40 years
Pinhook Creek	1973	25 years
Tennessee River	1973	70 years

Source: *Flood Insurance Study, Madison County, Alabama and Incorporated Areas*, Federal Emergency Management Agency, April, 1998.

The 1973 flood was the largest flood of record for the Flint River. “The Flint River valley, which is primarily in agricultural use, sustained only minor crop damage because most of the 1972 crop had been harvested. Fields, fences, and many roads in the area suffered considerable damage.” (Tennessee Valley Authority’s 1974 report on the 1973 flood)

Other floods: Available data on other historical floods are shown in the table on the previous page. Since 1973, there have been relatively few severe floods. In January 1990 and again in 1991, several days of rain over a large area produced flooding on the Flint and Tennessee Rivers and some of their tributaries.

In June 1999, a very heavy local storm caused a flash flood on Aldridge Creek. Floodwaters rose very fast and reached 100-year (base) flood levels

At Toney Drive, the creek had already risen five feet before the National Weather Service issued a flash flood warning. Problems were complicated by the fact that the flood occurred in the middle of the night, when staff of the emergency management offices and broadcast media were not at work.

Pinhook Creek At Clinton Avenue

USGS gage and flood heights

McDonald Creek at Centaur Boulevard

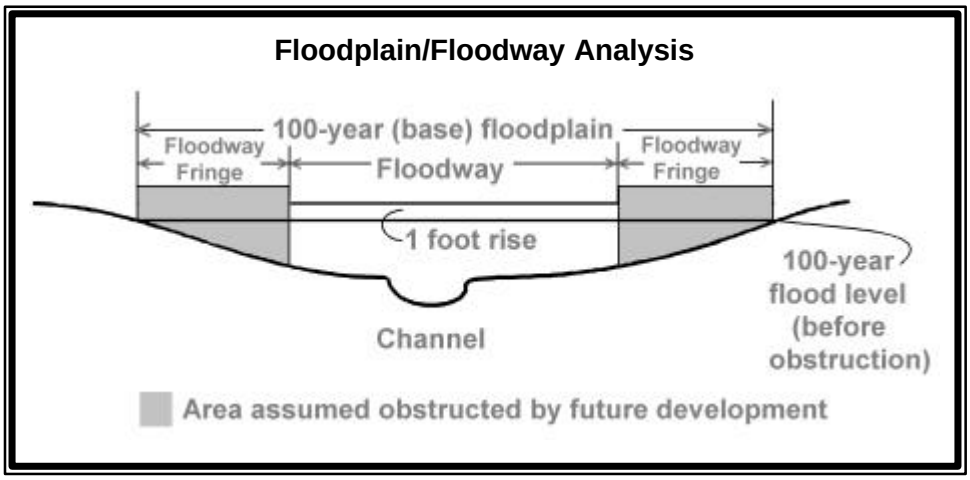
While the base flood is only one foot over the roadbed, adjacent properties, including the church are on lower ground.

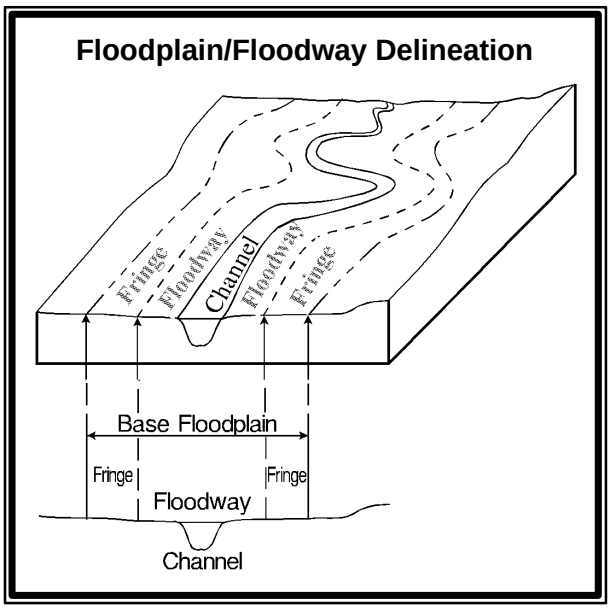
2.4. Flood Data

Area: The watersheds listed in the table on page 2-3 cover the entire City of Huntsville. Of the City's 175 square miles, 29 square miles or 17% of the City's area is in the base floodplain. The floodplains are widest in the southern portion of the City where the terrain is flatter. They are most narrow in the hilly areas and where there have been channel improvements.

The central part of the floodplain is called the "floodway." The floodway is the stream channel and that portion of the adjacent floodplain which must remain open to permit passage of the base flood. Floodwaters generally are deepest and swiftest in the floodway, and anything in this area is in the greatest danger during a flood. The remainder of the floodplain is called the "fringe," where water may be shallower and slower.

A floodway analysis determines the boundaries of the floodway. A floodway analysis is done with a computer program that calculates the effects of development in the floodplain. Beginning at both edges of the floodplain, the computer model starts "filling" the floodplain. This "squeezes" the floodwater toward the channel and causes the flood level to rise. At the point where this causes a 1 foot rise, the floodway boundaries are drawn.





The floodway boundaries at each cross section are then transferred to a map. The plotted points are connected to show the floodway and floodway fringe on the floodplain map.

5.8 square miles (20%) of Huntsville's floodplains are in mapped floodways.

Flood Insurance Rate Map: The official floodplain map for the City is the Madison County Flood Insurance Rate Map or "FIRM." This is published by the Federal Emergency Management Agency and forms the basis for the City's floodplain regulations and flood insurance rate setting.

FEMA cannot fund a detailed flood study on every stream in the County. On the larger rivers and the streams in the developed areas, it is cost-effective to conduct a detailed study which delineates the floodway and flood fringe.

In rural areas and on Federal lands, the potential for development does not warrant the cost of a detailed study, so "approximate" mapping methods are used. Approximate mapping only shows the general floodplain boundary and does not delineate the floodway and flood fringe.

The map on the next page shows that most of the City of Huntsville has been covered by detailed studies that show the floodway and flood fringe. However, FEMA has not provided the detailed flood data for many of the floodplains in the County, to the north of Huntsville.

With the FIRM, FEMA provides a Flood Insurance Study. This document includes a description of the study methods used and graphs and tables with flood elevations, velocities, and other flood data.

Velocity: The speed of moving water, or velocity, is measured in feet per second. Flood velocity is important to mitigation because the faster water moves, the more pressure it puts on a structure and the more it will erode stream banks and scour the earth around a building's foundation. Floodwater moving faster than 5 feet per second is generally considered high velocity flooding, requiring special design considerations for buildings, roads, bridges, and other manmade structures in its path.

The FEMA Flood Insurance Study includes the "average floodway velocity" for many streams during the base flood. This figure is helpful in determining the relative hazard of an area, but is not an accurate indication of the velocity of a flood at any individual site. Sites close to the channel will probably have higher velocities than this figure and sites at the fringe of the floodplain will be subject to lower velocities.

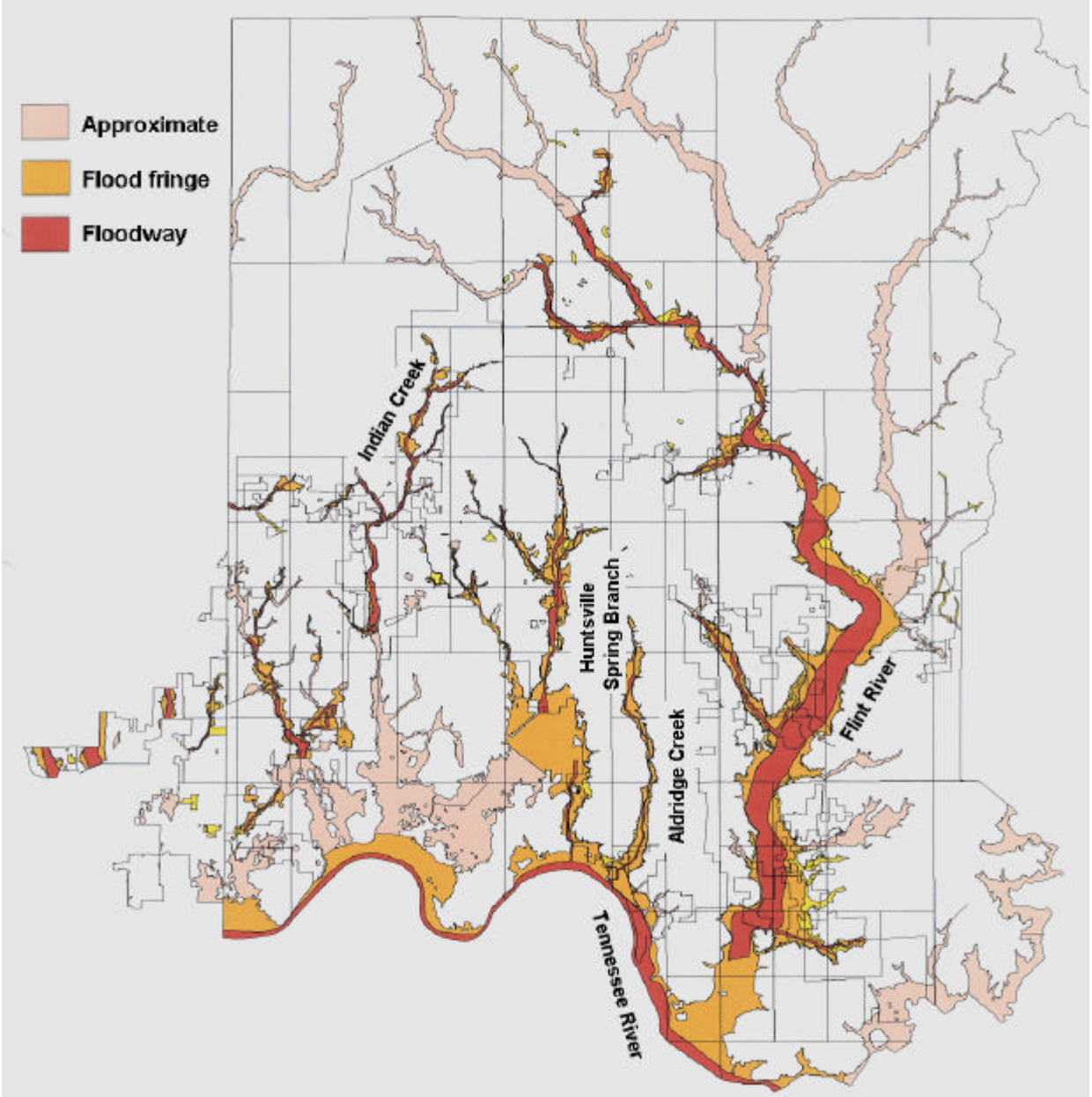
> It should be noted that the data in this plan are for the mapped base floodplains. FEMA's standard is to map floodplains on streams where the watershed is greater than one square mile. There are floods and flooding problems in smaller watersheds, but they are not shown on the FEMA maps and data for those areas are not readily available. Generally, in this plan, they are considered local drainage problems.

Velocities also vary along a stream. They are relatively slow in the south part of Huntsville, where the streams flow into the flat Tennessee River floodplain. Velocities are higher in the upland hilly areas. For example, average base flood velocities on Aldridge Creek range from 1.9 to 13.4 feet per second.

Velocities have similar ranges on the other streams in Huntsville. They are generally higher (greater than 5 feet per second) in the channelized streams around the downtown, like Broglan and Dallas Branches. These streams have been modified to carry more floodwaters faster, so velocities are expected to be higher. In many cases the floodway is limited to the improved channel, so there is little development exposed to the "average floodway velocity" and overbank flooding moves more slowly.

Although velocity is one factor that contributes to the potential harm of a flood, the total impact of moving water is related to the depth of the flooding. Studies have shown that deep water and low velocities can cause as much damage as shallow water and high velocities.

Madison County Flood Insurance Rate Map Floodplains

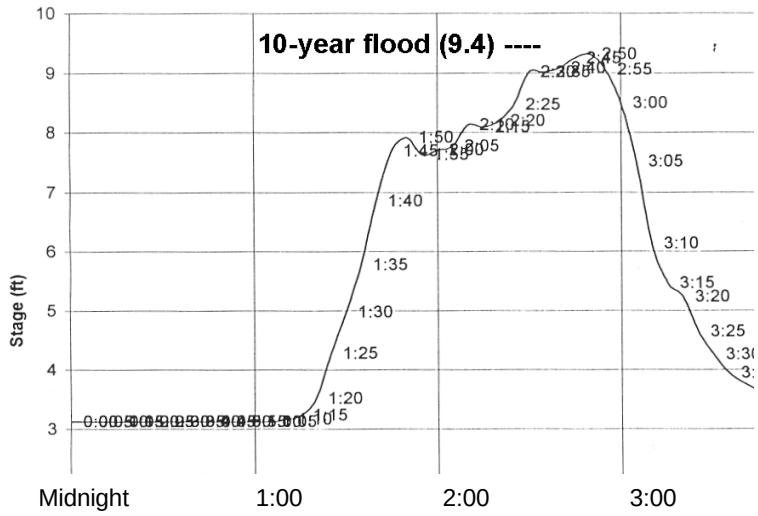


This map shows the floodplains that are delineated on the Madison County Flood Insurance Rate Map (FIRM). The FIRM shows incorporated cities and unincorporated areas in the County and those portions of the City of Huntsville in Limestone County.

All three areas shown are the base (100-year) floodplain. Both the floodway and flood fringe (see diagram, page 2-8) have been mapped for the larger rivers and the streams in the developed areas. “Approximate” mapping methods were used for the less developed areas and in the Arsenal. Approximate mapping only shows the general floodplain boundary and does not delineate the floodway and flood fringe.

Rate of rise: A third flood mitigation concern is how fast floodwaters rise. Floods in which waters rise quickly are known as flash floods. Flash floods occur in hilly areas and in urban areas where large parts of the watershed are covered with pavement and other impervious surfaces. In these areas, stormwater runs off quickly and can cause a stream to go overbank in a few hours.

Aldridge Creek gage at Toney Drive, June 28, 1999



"0" datum on this gage is elevation 653.62 feet above sea level. The flood crested at a level approximating the 10-year flood stage (9.4 feet gage stage or 663.0 feet above sea level).

Source: *June 28, 1999 Flash Flood, Incident Report*, Huntsville-Madison County Emergency Management Agency

Flash floods do occur in Huntsville. The graph above shows the fast rate of rise and short duration of the 1999 flood on Aldridge Creek at Toney Drive. The gage record shows that in the half hour between 1:15 and 1:45 in the morning, the Creek rose 4 ½feet. It crested an hour later at approximately the 10-year flood level.

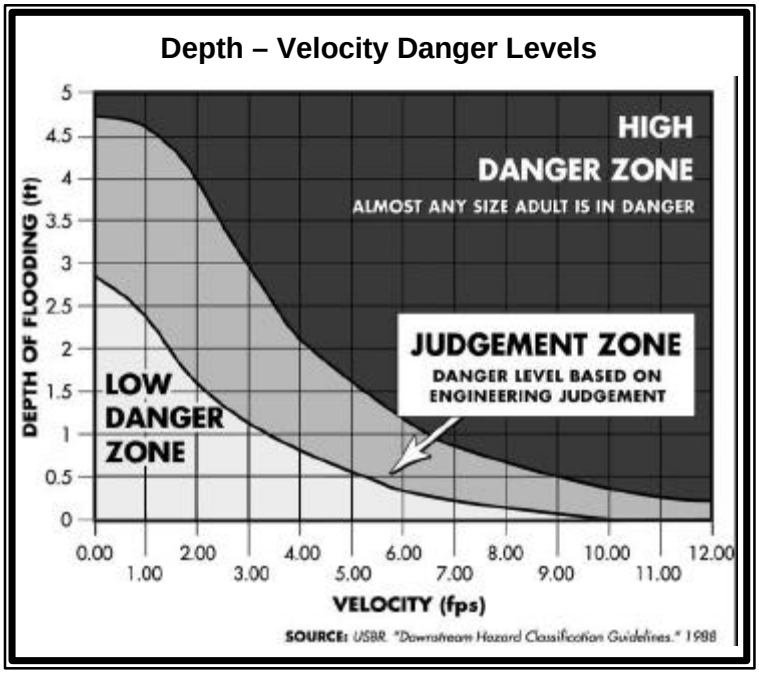
During the same flood, Aldridge Creek at Mountain Gap Road rose 10 feet between 2:00 and 3:00 a.m.. It rose 7 feet in one 20 minute period during that time (see page 6-3).

Duration: Another concern is how long floodwaters remain up ("duration"). The longer the duration, the more damage will be done to property and the longer businesses and roads will stay closed. Floods can take several days to rise and fall on the larger rivers, such as the Flint and the Tennessee.

Flooding in Huntsville can be of short duration on the smaller streams. In the example illustrated in the above graph, Aldridge Creek rose and returned to within its banks in less than three hours.

2.5. Safety and Health Hazards

Safety: No areas with moving floodwater can be considered safe. Studies have shown that floodwaters do not need to be deep or fast-moving to knock a person over (see chart, below). A car will float in less than 2 feet of moving water and can be swept downstream into deeper waters. This is one reason floods kill more people trapped in vehicles than anywhere else. Victims of floods have often put themselves in perilous situations by ignoring warnings about travel or mistakenly thinking that a washed-out bridge is still open.



Electrocution is the second most frequent cause of flood deaths, claiming lives in flooded areas that carry a live current created when electrical components short out. Floods also can damage gas lines, floors, and stairs, creating secondary hazards such as gas leaks, unsafe structures, and fires, which are particularly damaging in areas made inaccessible to fire-fighting equipment by high water or flood-related road or bridge damage.

Huntsville has experienced few fatalities during past floods. While there were electrical shorts and broken gas mains, the 1973 flood caused no deaths and only one severe injury (to a fireman). One person was killed during the 1999 flood when driving across a flooded road.

Health: There is no available data on health problems caused by floods in Huntsville. While such things are not reported, three general types of health problems accompany floods. The first comes from the water itself. Floodwaters carry whatever was on the ground that the upstream runoff picked up, including dirt, oil, animal waste, and lawn, farm and industrial chemicals. Pastures and areas where cattle and hogs are kept can contribute polluted waters to the receiving streams.

Flood waters saturate the ground which leads to infiltration into sanitary sewer lines. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment lead to overloaded sewer lines which back up into low lying areas and some homes. Even though diluted by flood waters, raw sewage can be a breeding ground for bacteria, such as e coli, and other disease causing agents.

The second type of health problem comes after the water is gone. Stagnant pools become breeding grounds for mosquitoes, and wet areas of a building that have not been cleaned breed mold and mildew. A building that is not thoroughly and properly cleaned becomes a health hazard, especially for small children and the elderly.

Post-Flood Silt, Mold and Mildew

Another health hazard occurs when heating ducts in a forced-air system are not properly cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants.

If the water system loses pressure, a boil order may be issued to protect people and animals from contaminated water. Private wells need to be tested by the Madison County Department of Public Health before the water is deemed safe to drink. Septic systems are put out of operation when inundated, adding to the health hazard.

The third problem is the long-term psychological impact of having been through a flood and seeing one's home damaged and irreplaceable keepsakes destroyed. The cost and labor needed to repair a flood-damaged home puts a severe strain on people, especially the unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

2.6. Floodprone Buildings

Damage to buildings, especially residences, is usually a city's largest single flood problem. In a few situations, deep or fast moving waters will push a building off its foundation, but this is rare. More often, structural damage is caused by the weight of standing water, known as "hydrostatic pressure."

Basement walls and floors are particularly susceptible to damage by hydrostatic pressure. Not only is the water acting on basement walls deeper, a basement is subjected to the combined weight of water and saturated earth. In addition, water in the ground underneath a flooded building will seek its own level, resulting in uplift forces that can break a concrete basement floor.

Due to the relatively shallow flood depths along Huntsville's creeks, the more common type of damage inflicted by a flood is caused by soaking. When soaked, many materials change their composition or shape. Wet wood will swell and, if dried too quickly, will crack, split or warp. Plywood can come apart. Gypsum wallboard will fall apart if it is bumped before it dries out.

The longer these materials are wet, the more moisture, sediment and pollutants they will absorb. Walls present a special problem: a “wicking” effect pulls water up through wood and wallboard, soaking materials several feet above the actual high-water line.

Soaking damages most household contents

Source: Huntsville Times, June 29, 1999

Soaking can cause extensive damage to household goods. Wooden furniture may become so badly warped that it cannot be used. Other furnishings such as upholstery, carpeting, mattresses, and books usually are not worth drying out and restoring. Electrical appliances and gasoline engines will not work safely until they are professionally dried and cleaned.

Effects of soaking on walls, floors and cabinets

In short, while a building may look sound and unharmed after a flood, the waters can cause a lot of damage. As shown in the photo to the left, to properly clean a flooded building, the walls and floors should be stripped, cleaned, and allowed to dry before being recovered. This can take days or weeks and is expensive.

Based on flood insurance claims, the average home flooded in Huntsville suffers approximately $25,000 in clean up, repair and replacement costs. This figure does not include uninsurable items, such as landscaping and automobiles, and the value of lost family heirlooms.

Building count: Huntsville Utilities’ Geographic Information System (GIS) was used to produce an approximate count of buildings. There are 90,200 “billing addresses” in Huntsville and 6,066 “billing addresses” in the City’s mapped base floodplain. For the most part, each billing address is considered one building (detached garages, storage sheds, etc. are not counted). This is an approximation as duplexes with two water meters are counted twice and apartment buildings may or may not have multiple addresses.

The floodplain represents 6.7% of the improved properties in the City. Considering that 17% of the City’s area is floodplains, it is a good sign that only 6.7% of the buildings are located there. The breakdown by watershed is shown in the table below.

The table shows that the floodplains with the most buildings are the three in the older, central portion of the City (Huntsville Spring Branch, Pinhook Creek and Broglan Branch) and Aldridge Creek. These four watersheds have 69% of all the floodprone buildings and 83% of the buildings in the mapped floodway.

Questionnaire: A questionnaire was sent to 9,800 properties located in the 500-year floodplain and was handed out at the Flood Mitigation Open House, held on October 30, 2000. Of the 9,800 properties, 1,549 responded, but 76 did not provide an address information sufficient to locate the property in one of the watersheds.

The numbers of respondents to the questionnaire are shown in the table below. The last two columns show that 57% of the respondents with plotable addresses were from Aldridge Creek and 57% of those who reported as having been flooded were from Aldridge Creek. The high level of Aldridge Creek resident interest is likely attributable to the 1999 flood which hit that floodplain harder than the others.

Floodplain Building Data

	Billing Addresses		Questionnaire Responses	
Watershed	**Floodplain**	**Floodway**	**Responses**	**Flooded**
Aldridge Creek	1,164	45	634	344
Betts Spring Branch	177	1	15	1
Big Cove Creek	156	4	59	23
Broglan Branch	923	57	84	25
Byrd Spring Wetlands	77	0	43	11
Dallas Branch	72	42	30	13
Eastern Boundary Canal	280	0	192	22
Fagan Creek	220	1	74	27
Flint River	93	1	90	40
Huntsville Spring Branch	1,239	404	54	16
Indian Creek	47	3	6	3
McDonald Creek	385	26	74	27
Pinhook Creek	1,196	164	113	47
Tennessee River tributary	4	1		
Western Watersheds	33	0	5	0
Insufficient address	N/A	N/A	76	25
Total	6,066	749	1,549	624

Questionnaire Responses

Source of floodwaters		
Storm sewer backup	70	11%
Sanitary sewer backup	9	1%
Saturated ground/leaks in walls	21	3%
Standing water next to house	10	2%
Drainage from adjacent property	82	13%
Overbank flooding	389	63%
Other	39	6%
Total	620	100%
Depth of flooding		
In crawl space or garage	193	31%
In basement: less than 2 feet.	20	3%
In basement: over 2 feet.	12	2%
Over first floor: less than 2 feet.	99	16%
Over first floor: over 2 feet.	29	5%
Water kept out of house by sandbagging or other measure	7	1%
In yard only.	260	42%
Total	620	100%

The table to the left shows the depth and source of floodwaters for 620 of the 624 flooded respondents. Of those 620, 82% were flooded by overbank or other surface water and 16% reported receiving sewer backup or basement seepage. The 344 Aldridge Creek addresses were plotted and all of them were located in the mapped base floodplain (including those reporting sewer backup, etc.).

Historical flooding has been relatively shallow – only 21% of those reporting having been flooded had water over their first floor and most of them had less than two feet.

Disaster figures: The cost of damage to buildings can be calculated in dollars. Estimates of the number of buildings damaged and the dollar damage caused by the 1973 flood are show in the table below.

1973 Flood Damage Estimates

Homes – destroyed	1
Homes – major damage	423
Homes – minor damage	326
Apartments damaged	260
Businesses damaged	237
Total	1,247
Dollar damage estimate (2000 dollars)	
Residential	$9,100,000
Business	$7,800,000
Public facilities	$1,000,000
Total	$17,900,000

Source: Huntsville-Madison County Emergency Management Agency, the American Red Cross, and *Environmental Geology and Hydrology*, *Huntsville and Madison County.*

The Emergency Management Agency's damage assessment following the 1999 flood estimated that 269 single family homes and 21 apartments had water in the homes or the garage. Flood depths ranged from one inch to two feet over the first floor to flooded basements.

More accurate, but incomplete, figures, can be obtained from Federal disaster assistance payments. Following the 1999 flood, the Small Business Administration (SBA) provided $2.9 million in low interest loans to 101 families and businesses

94	Homes/rentals
4	Businesses – physical damage
3	Businesses – economic damage
101	

These SBA figures only reflect loans that were issued. They do not include damage to properties that did not qualify for, could not afford, or did not want a low interest loan. However, the figures do show that the bulk of the damage from the 1999 flood was to homes. There was very little damage to public property, which was limited to repairs to channels, not to public buildings, roads or bridges. The economic impact was primarily in terms of property damage (the SBA loans for physical damage to homes and businesses averaged $30,000 while the loans for economic damage averaged only $4,000).

Flood insurance payments: Another readily available source of damage data is flood insurance claim payments. FEMA has paid $4.1 million for 251 flood insurance claims for properties in Huntsville since 1979. 200 of these were for the June 1999 flood and 190 of them were for properties in the Aldridge Creek area

Flood Insurance Claims Data

Type of building	Number of claims	Average payment	
		Structure	Contents
Single-family residence	226	$15,200	$8,700
Other residential	4	$34,000	$10,800
Non-residential	21	$3,900	$6,300

Source: Federal Emergency Management Agency

Repetitive Losses: A "repetitive loss property" is one which has received two flood insurance claim payments for at least $1,000 each since 1978. These properties are important to the National Flood Insurance Program and its Community Rating System because they account for one-third of the country's flood insurance claim payments. There are several FEMA programs that encourage communities to identify the causes of their repetitive losses and develop a plan to mitigate the losses (this *Flood Mitigation Plan* meets FEMA's repetitive loss planning criteria).

Huntsville has 4 designated repetitive loss properties in 4 different areas. These were mapped and repetitive loss area boundaries were drawn for the 4 areas that include 47 additional properties that are exposed to the same flood hazard. Three of the areas are in the floodplain, two near Aldridge Creek and the third near where Fagan Branch joins Huntsville Spring Branch. The fourth is not in the floodplain. It is a one-building repetitive loss area that was flooded due to unique local drainage problems.

2.7. Critical Facilities

"Critical facilities" are not strictly defined by any agency. Generally, they fall into two categories:

- Buildings or locations vital to the flood response and recovery effort, such as police and fire stations and telephone exchanges and

- Buildings or locations that, if flooded would create secondary disasters, such as hazardous materials facilities and nursing homes.

Critical Facilities

Critical facilities include power substations and other "lifelines" that could be damaged by a flood.

The Huntsville-Madison County Emergency Management Agency maintains an "Inventory of Critical Facilities in Madison County." This master list includes all sites that could be considered critical facilities for a variety of types of disasters. For this *Plan*, the Inventory was trimmed down to include only those that would be considered critical during a flood.

The critical facility flood list in the box on the next page assumes that floodwaters are not over six feet deep. For example, cellular phone towers are on the Inventory because a tornado or terrorist incident would have a major impact on them. They are not included in the flood list because the water will not be deep enough to affect their operation.

2.8. Economic Impact

Floods cause other problems that are not as easy to identify as damage to buildings and critical facilities. Businesses that are disrupted by floods often have to be closed. They lose their inventories, customers cannot reach them. and employees are often busy protecting or cleaning up their flooded homes. In addition to lost income, there are costs for fighting the floods, finding temporary housing, and cleaning up. Repetitively flooded areas tend to deteriorate over time and property values go down.

A recent study completed on the businesses affected by Hurricane Floyd in North Carolina found that the average repair cost for all business sizes was $40,000 and the lost revenue per business averaged $80,000. Across the 44 counties surveyed in the report, almost 75 percent of the businesses shut down because of the storms and floods. The length of shutdown for most was between 5 and 8 days, but some never reopened.

Many businesses are not properly insured to protect against natural hazards. While most businesses had liability, property and casualty and fire insurance, most were not insured for loss of revenue or floods. Less than half of the businesses surveyed after Floyd reported that their insurance covered the replacement cost of their losses. When asked what portion of their losses was covered by insurance, the average estimate was 18 percent.

Based on the disaster and flood insurance data reviewed in previous sections, businesses account for 10% - 20% of the properties affected by the 1973 and 1999 floods. While this may seem small in terms of total property damage, the loss of services, products, employment and taxes has a relatively larger effect on the local economy than does damage to residences.

Flood-Specific Critical Facilities

Emergency and disaster operations
- 911 Center
- Huntsville-Madison County Emergency Management Agency's Emergency Operations Center(EOC)
- Fire Stations
- Huntsville-Madison County Rescue Squad
- Madison County Sheriff offices
- Huntsville Police stations
- Jail
- Public works facilities
- National Guard Armories and Reserve Centers
- American Red Cross Offices
- Disaster shelters

Hospitals
- Huntsville Hospital
- Huntsville Hospital East
- Crestwood Medical Center
- Surgery Center of Huntsville
- HealthSouth Rehabilitation Hospital
- Fox Army Clinic
- Blood Bank

Schools

Dependent Care Facilities
- Nursing Homes

Utilities
- Huntsville Utilities Dispatch Center
- Huntsville Utilities Equipment Yards
- Huntsville Utilities Electric Substations
- BellSouth Exchange
- Water treatment plant

Hazardous materials
- Redstone Arsenal
- SARA Title III Filers
- Wastewater treatment plant(s)

Airports
- Huntsville International Airport
- Huntsville Executive Airport
- Redstone Arsenal Airport

Key highways and intersections

This list is taken from Huntsville-Madison County Emergency Management Agency's "Inventory of Critical Facilities in Madison County." These facilities may or may not be located in the mapped floodplain.

2.9. Other Natural Hazards

Flooding is not the only natural hazard facing Huntsville. Other hazards can threaten the City: tornadoes, severe winter storms, sinkholes, landslides, dam failure, and earthquakes. Most of these events are not concentrated in any particular area—the entire municipality is exposed to damage by them.

Alabama's Weather Scorecard

Deaths from severe weather events

	1995	1996	1997	1998	1999	2000	Average
Floods	1	1		7	1		1.7
Tornadoes	7	7	1	34		1	8.3
Wind	4	1		3	1	3	2.0
Winter storms				1			0.2
Lightning	4	1	1	1	2		1.5

Source: National Weather Service

It is important that this mitigation plan recognize these other hazards. Several mitigation measures, such as building codes, public information programs and emergency response planning, can address multiple hazards. Mitigation planning needs to make sure that these activities are coordinated and implemented in the most efficient manner.

Tornadoes: The severe thunderstorms that produce tornadoes occur more often in the Spring. A secondary tornado season occurs in the Fall, typically in November, but no month of the year is completely safe from tornadoes.

Tornadoes have wind speeds that vary from as little as 65 miles an hour to as high as nearly 300 miles an hour. Tornadoes move at speeds varying from nearly a standstill to over 70 miles an hour. Tornados can lift and move very heavy objects. They generate a lot of debris which causes additional damage.

Historically, tornadoes have caused more deaths and damage in Huntsville than any other natural hazard. The worst natural disaster to hit the City in modern history was the November 15, 1989, tornado that concentrated on Airport Road, killing 21 people and destroying 250 homes, 80 businesses and over 1,000 vehicles.

Alabama experiences about 20 tornadoes per year over its 50,766 square miles of area. The probability of any single structure being in the path of a tornado is minuscule (less than once in 700 years) because these paths are typically only 200 yards wide and a few miles long.

However, the City of Huntsville, with its 20-mile north-south extent and almost 200 sq. miles of area, presents a very large target to these southwest-to-northeast moving storms. Thus, there is the expectation that once in every few decades, a tornado will cause the city some damage, as happened in December 1967 and November 1989.

Winter storms: Winter storms bring ice, snow, sleet, freezing rain, cold temperatures, and hazardous driving. Snow, freezing rain and ice, especially when accompanied by wind, may cause widespread damage to trees and power and telephone lines and cause roads, overpasses and bridges to be closed or to be below minimum acceptable conditions for school busses.

The threat to life and safety is relatively low because people usually prepare before the storms arrive. Extended power losses or closed roads may threaten the safety and well-being of the elderly and those dependent on continuing medical care such as dialysis patients.

In addition, some major highways in Madison County (I-565, US Highways 72, 231 and 431) traverse steep hills, bridges, overpasses or have elevated portions which are subject to freezing and icing when surrounding areas are passable. Some major roads (Keel Mountain Road, Green Mountain Road, Monte Sano Boulevard, Bankhead Parkway) have steep grades and are subject to closures. These geographic factors may combine to bottle neck traffic at key places.

If roads and highways are icy or blocked by downed trees or power lines, there is an added hazard to drivers. When streets are icy or blocked, travel by emergency equipment is difficult and response times are lengthened. This causes a secondary threat to life and safety if responses are delayed by police, fire, rescue, ambulance and utility crews. Such calls often increase during storms and power outages due to accidents, fires, road clearing operations, power restoration efforts and required travel.

The major damage to property is to exposed utilities, especially power and telephone lines and water pipes. Ice, wind, falling trees and limbs wreak havoc on utility poles and overhead wires. Water pipes break in buildings with water lines that do not meet the current building code (which requires the pipes to be in interior or insulated walls). Another problem is lost business when businesses are closed due to inclement weather or loss of power.

The records of the Huntsville-Madison County Emergency Management Agency shows an average of three winter storm advisories or incidents each year since 1985. These vary in severity from snow flurries to closing major highways. In February 1996, ice and sleet closed I-565, knocked out the power to 10,000 customers, closed schools for three days and resulted in one death. In January 1997, the National Guard was activated to provide transportation when school buses could not negotiate icy roads. A storm in December 1998 caused a 30 car pile up.

Sinkholes: Much of the state of Alabama is underlain by soluble, carbonate rocks. Based on maps by the Geological Survey of Alabama, all of Madison County has active sinkhole formation. They are most likely to occur during rain following a drought.

Sinkholes occur frequently in the Huntsville area. The greatest cost to mitigating the damage occurs where the regolith depth is greater than 20 feet. The regolith is all of the unconsolidated material above bedrock. This includes soil, gravel, and rocks that are detached from the bedrock.

Sinkholes have been found to form near other recently formed sinkholes. In Madison County, these sinkholes often form along straight lines. These linear features are presumed to be joints or faults with significant solution. A joint is a bedrock crack without vertical displacement of the two sides of the crack.

The City of Huntsville has begun a sinkhole survey of the city. This survey will be used to develop risk maps for sinkhole formation. Risks will be based on proximity to recent sinkholes and lines of sinkhole formation, depth of regolith, and proximity to pumping wells or dewatered quarries.

Recent sinkhole in Governor's Bend subdivision

Sinkholes pose a significant threat to Huntsville residents. Normal homeowner insurance does not cover sinkhole damage, but sinkhole insurance can be obtained for $50 - $100 per year.

OMI, Inc., a Huntsville geotechnical engineering firm, usually receives 2 to 5 sinkhole calls a year. From the mid-1980s to the present, they only had one house threatened by a sinkhole. The cost to repair would have been extremely high, so the insurance company gave the homeowner a check and bulldozed the house. The value of the house was approximately $120,000. In the late 1970s, another home had $30,000 repair cost because of sinkhole damage. This homeowner had no sinkhole insurance.

Landslides: Most landslides occur when there is too much water. When the ground is saturated, a landslide may occur where there is loose soil on a steep hillside. Activities that steepen slopes or add weight or water to the slope can cause slides. Grading for road construction and other purposes and erosion are examples of how slopes are steepened. Adding fill material to a slope, increasing the saturation of a slope by removing vegetation, and altering drainage and runoff flow patterns are examples of increasing the weight of the slope. Water also can weaken the material's ability to resist sliding.

Generally, a combination of these factors work together, cumulatively decreasing the stability of a slope until one triggering event initiates the landslide. Triggering events include heavy rains, earthquakes or heavy traffic that shake a saturated area, or when the lower edge of a hillside is removed or washed out.

Some of the higher mountains in the Huntsville area have a risk of slope failure or landslides. The landslides in this area are most commonly characterized by saturated soils on sloping terrain that fail due to gravitational shear stress that exceeds the natural resisting forces on the slope.

The soils most prone to failure in Huntsville are found on the upper parts of Monte Sano, Huntsville, Green, and Wallace Mountains. The geologic formations here contain numerous shale layers that weather to what is known as an "expansive clay." These clay soils, also called "colluvium," are capable of absorbing a lot of water. When these clays become saturated, they have a tendency to become plastic and flow like a liquid.

Natural and man-made disturbances to saturated colluvium, such as natural sinkhole collapse or man-made road cuts can locally reduce the lateral resisting force on colluvial slopes and trigger landslides. Although, some landslides are triggered by unknown means, every active landslide that has been discovered in the Huntsville area within the last 11 years has been activated either during periods of heavier than normal rainfall or within a few days after heavy rainfall.

Landslide maps of Huntsville's mountains indicate that several ancient (forested) landslides started near the top of the mountains and flowed all the way to the valley floor. Besides having a serious threat to human safety and property, landslides could cause secondary flooding by flowing down and across narrow valleys and blocking or damming the natural stream drainage. With sufficient rainfall, a stream could pond behind such a blockage and eventually overtop the landslide "dam." Were this to happen, a flood could be induced due to rapid erosion of the loose, colluvial soils.

There are no known historical accounts of such an occurrence in north Alabama that caused downstream flooding. However, a landslide occurred on a natural forested slope in Monte Sano State Park in 1989 and flowed down to the valley below and caused a minor blockage of a few feet in the stream bed.

The City is currently conducting a comprehensive landslide study and preparing a map of Huntsville to determine areas that have a landslide hazard. This study will consider locations where a landslide could block streams and cause a potential flooding hazard. FEMA has funded a preliminary phase of this study and a draft report should be completed by the end of 2001.

Dam failure: A break in a dam can produce an extremely dangerous flood situation because of the high velocities and large volumes of water released by such a break. Sometimes they can occur with little or no warning on clear days when people are not expecting rain, much less a flood.

Dam breaks occur for one of three reasons:

- The foundation fails due to seepage, settling or earthquake.
- The design, construction, materials or operation were deficient.
- Flooding exceeds the capacity of the dam's spillway.

Madison County has many small dams. Nine are large enough to be listed on the Corps of Engineers' Dam Inventory. None of the dams are known to directly threaten life or residences. Only one would affect properties in Huntsville, the Madison County Nature Trail dam in Alum Cave Hollow.

Guntersville Dam is on the Tennessee River in Marshall County, approximately 25 miles upstream from Huntsville. If Guntersville Dam were to fail when the Tennessee River is at its normal stage, floodwaters could reach Huntsville in less than a half hour. Low lying areas along and inland from the Tennessee River would flood.

The Tennessee Valley Authority produced a dam failure inundation map that shows backwater flooding up the Huntsville Spring Branch as far north as Governors Drive. Much of Redstone Arsenal would be affected, too. The City's emergency action plan for a failure of Guntersville Dam was updated in October 2000.

It should be noted that, unlike most other states, there is no state dam safety program that would have authority over the construction of new dams and maintenance of existing dams.

Earthquakes: Huntsville could be affected by earthquakes along the New Madrid or Central Tennessee faults. Smaller nearby faults may produce lower magnitude events, but their ground shaking and damage can be intense because of the fault's proximity and local soil conditions.

Earthquakes can trigger other types of ground failures which could contribute to the damage. These include landslides, dam failures, and liquefaction. In the last situation, shaking can mix groundwater and soil, liquefying and weakening the ground that supports buildings and severing utility lines. This is a special problem in floodplains where the water table is relatively high and the soils are more susceptible to liquefaction.

Vulnerable buildings, roads, bridges and utility lines and the unpredictability and instantaneous nature of earthquakes can result in enormous losses of life. Because the greatest potential for loss of life is to people within a collapsing building, the true extent of the risk is dependent on a review of each building. Usually, the existing inventory of buildings built to earlier standards (or no standard) can pose major threats to life safety or the functioning of key public services.

The impact of an earthquake is described in terms of magnitude and intensity. Magnitude characterizes the total energy released, and intensity subjectively describes effects at a particular place. While an earthquake has only one magnitude, its intensity varies throughout the affected region. Magnitude is typically measured by the Richter scale. In qualitative terms, an earthquake of 5.0 is a moderate event, 6.0 characterizes a strong event, 7.0 is a major earthquake, and a great quake exceeds 8.0.

The most commonly used intensity scale is the Modified Mercalli Intensity (MMI) Scale. This scale is an evaluation of the severity of ground motion at a given location measured relative to the effects of earthquakes on people and property. It provides a convenient way for observers to summarize what happened at different locations (see next page).

Probability of Earthquake Occurrence

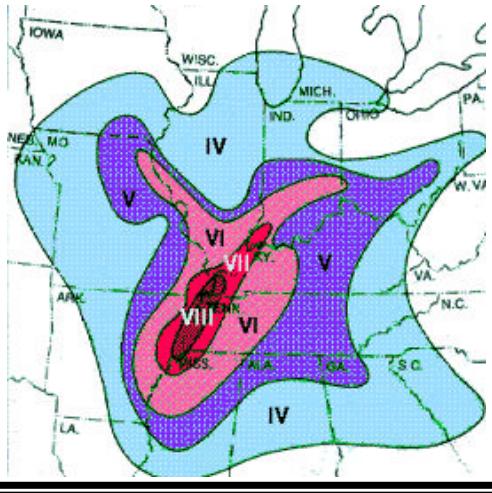
Magnitude	Average Repeat Time	Probability in 15 years (%)	Probability in 50 years (%)
6.3	70 ± 15	40 - 63	86 - 97
7.6	254 ± 60	5.4 - 8.7	19 - 29
8.3	550 ± 125	0.3 - 1.0	2.7 - 4.0

Earthquakes happen all the time in the New Madrid seismic zone (about 150 per year), but most are too small to be felt by people. The largest earthquakes felt in the New Madrid region in recent times happened in 1976 (magnitude 5.0 with a 4.5 aftershock) and on September 26, 1990 (magnitude 4.8). However, larger quakes are possible. The box to the left shows the relative risk of such

greater events. The Central US Earthquake Consortium states that the worst quake Huntsville could expect would be VII on the MMI scale.

The map to the right shows where a hypothetical magnitude 5.0 earthquake would be felt in the New Madrid Seismic Zone and the estimated equivalent intensity for the areas affected. Such a "moderate event" would be felt in Huntsville and Northern Alabama.

Central US Earthquake Intensity



Earthquake Felt Intensity: the Modified Mercalli Intensity Scale

MMI	Felt Intensity
I	Not felt except by a very few people under special conditions. Detected mostly by instruments.
II	Felt by a few people, especially those on upper floors of buildings. Suspended objects may swing.
III	Felt noticeably indoors. Standing automobiles may rock slightly.
IV	Felt by many people indoors, by a few outdoors. At night, some people are awakened. Dishes, windows, and doors rattle.
V	Felt by nearly everyone. Many People are awakened. Some dishes and windows are broken. Unstable objects are overturned.
VI	Felt by everyone. Many people become frightened and run outdoors. Some heavy furniture is moved. Some plaster falls.
VII	Most people are alarmed and run outside. Damage is negligible in buildings of good construction, considerable in buildings of poor construction,
VIII	Damage is slight in specially designed structures, considerable in ordinary buildings, great in poorly built structures. Heavy furniture is overturned.
IX	Damage is considerable in specially designed buildings. Buildings shift from their foundations and partly collapse. Underground pipes are broken.
X	Some well-built wooden structures are destroyed. Most masonry structures are destroyed. The ground is badly cracked. Landslides occur on steep slopes.
XI	Few, if any, masonry structures remain standing. Rails are bent. Broad fissures appear in the ground.
XII	Virtually total destruction. Waves are seen on the ground surface. Objects are thrown in the air.

2.10. Natural and Beneficial Floodplain Functions

Floodplain lands and adjacent waters combine to form a complex, dynamic physical and biological system found nowhere else. When portions of floodplains are preserved in their natural state, or restored to it, they provide many benefits to both human and natural systems.

Some are static conditions—such as providing aesthetic pleasure—and some are active processes, such as reducing the number and severity of floods, helping handle stormwater runoff and minimizing non-point water pollution. Such natural processes cost far less money than it would take to build facilities to correct flood, stormwater, water quality and other community problems.

In some of Huntsville's floodplains, natural areas have been preserved, such in the National Wildlife Refuge and a few golf courses. This has become more of a practice in recent years. The situation in the older developed areas is different.

Natural and Beneficial Floodplain Functions

Water Resources: resources and functions that are part of or provide a benefit to the hydrologic cycles on the earth's surface and below ground

Natural Flood and Erosion Control
- Provide flood storage and conveyance
- Reduce flood velocities
- Reduce flood peaks
- Reduce sedimentation

Water Quality Protection
- Filter nutrients and impurities from runoff
- Process organic wastes
- Moderate temperature fluctuations

Groundwater Recharge/Discharge
- Promote infiltration and aquifer recharge
- Help to maintain natural base flows instream

Biological Resources: resources and functions that benefit plants and animals

Biological Productivity
- Support high rate of plant growth
- Maintain biodiversity
- Maintain integrity of ecosystem

Fish and Wildlife Habitats
- Provide breeding and feeding grounds
- Create and enhance waterfowl habitat
- Protect habitats for rare/endangered species

Societal Resources: resources and functions that directly benefit human society

Harvest of wild and cultivated products
- Enhance agricultural lands
- Provide sites for aquaculture
- Restore and enhance forest lands

Recreational Opportunities
- Provide areas for active and passive uses
- Provide open space
- Provide aesthetic pleasure

Areas for Scientific Study and Outdoor Education
- Contain cultural resources (historic and archaeological sites)
- Provide opportunities for environmental and other studies

Source: *A Unified National Program for Floodplain Management*, 1994, Federal Interagency Floodplain Management Task Force, FEMA - 248.

Fagan Creek at Adams Street

The high banks, flat bottoms and straight channels of many Huntsville streams do not provide for habitat or encourage people to view them as a recreational asset.

As with most flood control projects of 30 – 40 years ago, the channel improvements to the downtown streams left the City with concrete drainageways which separate people from what could be an aesthetic and recreational resource. These structures do not offer any habitat or provide many natural benefits.

Wetlands: One key determinant of an area's natural value is whether it is designated as a wetland. Wetlands provide habitat for species that cannot live or breed anywhere else. They reduce flood velocities and erosion. Wetland vegetation filters water, making it cleaner for those downstream. Wetlands and measures to protect them are discussed in Chapter 9.

2.11. Future Development

The problem: A review of the map on page 2-4 and the subsequent data on land use show that several floodplains and some watersheds are substantially built up while others have much developable land. Flood problems are greatly increased when buildings and other forms of development are located in the floodplain. A community's flood problem can become worse if new development is allowed that does not account for the flood hazard.

Development within the floodplain contributes to flooding problems. As development occurs near channels, overbank flood flows are obstructed. As a result, flood levels rise upstream. Development that fills in floodplains means less area to store floodwaters. If there is no compensation for this loss of storage, water surface levels will rise downstream.

New development impacts the quality and quantity of runoff into the City's streams.

Development in the overall watershed also has an impact on flooding. Stormwater runoff increases when vacant land is replaced with rooftops, pavements and storm sewers. Unconstrained watershed development often will aggravate downstream flooding and overload the community's drainage system. Similarly, development uphill can increase the likelihood of a landslide downhill.

Development constraints: Generally, future development is constrained by one or more of four types of constraints:

- Physical features, such as steep terrain or bad soils,
- A slow economy and slow or no population growth,
- The desires of property owners, and/or
- Stringent development regulations.

Physical features: The major physical features that affect development in Huntsville are the mountains to the east and north of the downtown area. Construction is not prevented on the mountains, but it is constrained because there are few roads, it is more expensive to build there, and precautions must be taken to protect new construction from landslides. These constraints have slowed development on the hillsides, but not stopped it. Over the last few decades, development has leapfrogged over these hills and continued in the Aldridge Creek, Big Cove Creek and Flint River basins.

Economy: Huntsville does not have a slow economy. There are great pressures to develop land for new businesses and for homes for the people who work in them. The Huntsville area has been and will likely continue to be a fast growing community. In short, the economy will not constrain future development.

Property ownership: Who owns the land has been a major factor in where development will proceed. The Redstone Arsenal, National Wildlife Refuge, City parks and Monte Sano State Park preserve certain areas from development. Fortunately, some of those areas are valuable wetlands, extensive floodplains and hazardous hillsides.

Similarly, the Jones Farm owners have kept development out of much of the Aldridge Creek floodplain for many years. However, many lands in private ownership are available for conversion to residential or urban construction. Urban sprawl continues, especially in the flatter lands to the north and west within easy reach of the newer employment centers.

Regulations: The fourth constraint on development's adverse impact on flooding is the regulations that developers must comply with. They can prevent or compensate for obstructions to flood flows, loss of floodwater storage, and increases in watershed runoff. In some cases, regulations can require that the impact of construction on wetlands and natural areas be mitigated. Some valuable natural areas will be preserved through public ownership, but other, smaller areas, may not be. And, the impact of development on water quality is carried to all areas downstream.

This flood mitigation plan can have the greatest influence on the regulatory constraints to new development. The effectiveness of Huntsville's regulations is reviewed in Chapter 4.

2.12. Conclusions

Chapter 2 summarizes Huntsville's flood problems. The summary is based on available information. While some of the data may be incomplete, the information does show some patterns that are important to the design of a flood mitigation plan. The key considerations are:

1. Over 29 square miles of the City of Huntsville is in the base floodplain. This comprises 17% of the City's land area.

2. Approximately 6,066 "billing addresses" are subject to overbank flooding. These represent 6.7% of the developed properties in Huntsville. There are 749 improved properties in the floodway, the area of deepest and swiftest flooding.

3. Since 1973, Huntsville has had two major floods, in 1990 and 1999. While these did not affect all the City's watersheds, they did cause considerable property damage where they did occur and one person was killed.

4. Construction of channel improvements and storage basins has lowered, but not eliminated, the flood threat on some streams.

5. The severity of the next flood cannot be predicted. To provide a sufficient level of protection, the City should prepare a plan based on both historic flood levels and the risk of higher floods in the future.

6. Flooding presents a safety hazard. Flooding also has a short and long-term impact on health and mental health. A flood protection program should address safety, health and mental health aspects in addition to protecting buildings, streets, and public facilities.

7. Some critical facilities are exposed to damage or disruption by flooding. They deserved special attention and an appropriate flood protection level.

8. Huntsville is subject to damage and threats to safety and health from tornadoes, winter storms, sinkholes, landslides, dam failure, and earthquakes. Some of these hazards affect the entire community, but others, such as sinkholes, landslides and dam failure, could be mapped so that those who are vulnerable could be notified.

9. Floodplains provide natural and beneficial functions and improve the recreational opportunities for City residents. Past projects have resulted in straightened concrete channels which are not visually appealing and have little water quality, habitat or recreational benefit.

10. Future development will aggravate the City's flooding problems. Regulatory constraints are needed to prevent or minimize the impact new development has on flood heights, water quality and habitat.

2.13. References

1. *A Unified National Program for Floodplain Management*, Federal Interagency Floodplain Management Task Force, FEMA – 248, 1994.

2. *Environmental Geology and Hydrology, Huntsville and Madison County,* Alabama, Geological Survey of Alabama, 1975
3. Flood insurance claims records, Federal Emergency Management Agency, as of July 2000.

4. *Flood Insurance Study, Madison County, Alabama and Incorporated Areas*, Federal Emergency Management Agency, April, 1998.

5. *Huntsville-Madison County Emergency Operations Plan*, Huntsville-Madison County Emergency Management Agency, 2000.

6. *June 28, 1999 Flash Flood Incident Report and Supporting Documentation,* Huntsville-Madison County Emergency Management Agency (undated).

7. *Managing Floodplain Development Through the National Flood Insurance Program*, Federal Emergency Management Agency, 1999.

8. *Multi-Hazard Identification and Risk Assessment*, Federal Emergency Management Agency, 1997

9. Responses to questionnaires submitted by City residents, 2000.

10. Tennessee Valley Authority, Division of Water Control Planning, Report No. 0-7129, *Floods of March 1973 in the Tennessee River Basin,* 1974.

11. *Toward a Flood Damage Prevention Program for Huntsville, Alabama, and its Environs*, Huntsville City Planning Commission, 1964.

12. Watershed assessment conducted by the Madison County District Office of the Natural Resources Conservation Service, 1998.

Chapter 3. Goals

3.1. Findings

The previous chapter's description of the flood problem sets the stage for what the City should do about flooding. The City's approach is based on the following findings.

1. Flooding is a natural occurrence. Over the centuries, flooding has created floodplains, wetlands, riparian areas and other flood-related landscapes. Flood problems, in the form of threats to life and health, damage to property and disruption of commerce, occur when development intrudes into these natural landscapes.

2. Development has changed the landscape over the past 200 years. Unmanaged development in watersheds increases the amount of stormwater runoff and shortens the time to peak flows, increasing the flood hazard downstream. Development in floodplains exposes human activity to flood damage and disrupts flood flows, sometimes to the detriment of other development.

3. While development is at the root of flood problems, it must be remembered that development is what made Huntsville the great city that it is. To be successful, flood mitigation must account for both the natural and human facets that comprise the floodplain. To do this, this plan must address

    a. The causes of flood problems,
    b. The impact of development on natural landscapes and functions,
    c. Mitigation strategies and measures that are effective and affordable, and
    d. The public's perception of what is appropriate and feasible.

4. There is never 100% protection from the forces of nature and what protection can be afforded will take time to plan, fund and implement.

5. Every property owner in Huntsville shares in the flood problem. Those in the watershed contribute to the runoff and those in the floodplain own development that has disrupted the natural landscape. Everyone in Huntsville can share in the solution.

3.2. Goals

It should be noted that goals are long range targets that the City's flood mitigation program should aim for. They are kept in mind when the current and needed mitigation measures are reviewed and when the specific recommendations and action items are drafted by the Flood Mitigation Planning Committee. Available resources, statutory authority and staffing levels limit the City's ability to attain all desired goals.

With the above findings in mind, the Flood Mitigation Planning Committee set five overall goals for the mitigation planning effort, each with more detailed objectives.

1. **Protect life and health from flooding.**

    a. Provide flood hazard information to all inquirers.
    b. Advise citizens and businesses of flood safety and health precautions.
    c. Improve the detection and advance warning of flooding.

2. **Mitigate the effects of flooding on existing development.**

    a. Mitigate flood damage to buildings using the most appropriate and cost effective mitigation measures.
    b. Design new developments in the watershed so they will not increase stormwater runoff to the detriment of downstream properties.
    c. Design new developments in the floodplain so they will not obstruct, divert or increase flood flows onto other properties.
    d. Minimize the loss of use of roads and infrastructure during the base flood.
    e. Prioritize flood protection projects, starting with those areas facing the greatest threat to life and property.
    f. Maintain stream channels, storage basins and flood protection structures .

3. **Protect new development from damage by the base flood.**

    a. Protect new buildings and improvements to buildings from damage by the base flood.
    b. Ensure that roads will be useable by emergency vehicles during the base flood
    c. Ensure that standards for new construction will not be so restrictive that they effectively prohibit all new development.

4. **Improve the quality of life in the City**

    a. Incorporate opportunities for economic development, housing improvement, recreation, environmental and other multiple uses of floodprone lands into all flood mitigation projects.
    b. Expand the greenway corridors to preserve floodplain open space, provide recreation opportunities, protect habitat, reduce erosion and filter runoff.
    c. Preserve wetlands and other sensitive areas so they may store floodwaters, improve water quality, and provide their other natural and beneficial functions.
    d. Improve the habitat and water quality in streams and riparian areas.

5. **Secure the resources needed to implement the Flood Mitigation Plan.**

    a. Develop the data base, watershed models, and maps needed to identify and regulate floodplains and areas subject to sinkholes, landslides, and other geological hazards
    b. Obtain the cooperation and participation of the people who are directly affected by flood protection measures.
    c. Use County, State and Federal programs to the fullest extent possible.
    d. Fund flood mitigation programs and projects through contributions by the users of the City's drainage system and the beneficiaries of the flood protection projects.

Chapter 4. Preventive Measures

Preventive measures are designed to keep the problem from occurring or getting worse. Their objective is to ensure that future development does not increase flood damage. Preventive measures are usually administered by building, zoning, planning, and/or code enforcement offices. They include the following:

1. planning
2. open space preservation
3. zoning
4. subdivision regulations
5. building codes
6. floodplain development regulations
7. stormwater management

The first three measures, planning, zoning and open space preservation, work to keep damage-prone development *out* of the hazardous or sensitive areas.

The next three measures, subdivision regulations, building codes, and floodplain development regulations, impose construction standards on what is allowed to be built *in* the floodplain. They protect buildings, roads, and other projects from flood damage and prevent development from aggravating the flood problem.

The last measure, stormwater management, addresses the runoff of stormwater from new developments onto other properties and into floodplains.

Citizen concerns: Managing new development to keep flood problems from worsening has been a prime concern of the residents who have spoken at meetings. “Control development” was the second most common response to the question “In your opinion, what is the most important thing the City of Huntsville can do to protect people from flooding?” in the questionnaire that was received from over 1,500 residents.

4.1. Planning

Background: Comprehensive planning defines how a community should be developed (and where development should not occur). Use of the land can be tailored to match the land's hazards, typically by reserving flood hazard areas for parks, greenways, golf courses, backyards, wildlife refuges, natural areas, or similar compatible uses.

Generally, a plan has limited authority. It reflects what the community would like to see happen. Its utility is that it guides other local measures, such as capital improvement programs, zoning ordinances, and subdivision regulations.

A community's capital improvement program states where major public expenditures will be made over the next 5-20 years. Capital expenditures may include acquisition of land for public uses, such as parkland, wetlands, or natural areas, and extension or improvement of roads, utilities, channels and drainage structures.

Local implementation: The City of Huntsville does not have a comprehensive plan in a single document. The City's Comprehensive Plan is composed of numerous adopted master plans which are specific in nature, such as the Major Street Plan, Downtown Master Plan, Land Use Plans, Recreation Plan and Greenways Plan.

However, some of these plans, specifically the Recreation Plan, were last reviewed approximately 10 years ago, and are now due for a periodic review and update. The Recreation Plan only addresses active recreation facilities, with no focus on passive recreation alternatives.

The City has an annual Capital Improvements Program Budget that includes expenses needed for, among other things, greenways and drainage projects. The Budget is tied to the implementation of various officially adopted plans, such as the 2025 Transportation Plan, Greenways Plan and Recreation Plan.

4.2. Open Space Preservation

Background: Keeping the floodplain free from development is the best approach to preventing flood damage. Open space preservation should not be limited to floodplains, as some sites in the watershed may be key to controlling runoff that adds to the flood problem.

Comprehensive and capital improvement plans should identify areas to be preserved by acquisition and other means, such as purchasing an easement. With an easement, the owner is free to develop and use private property, but property taxes are reduced or a payment is made to the owner if the owner agrees to not build on the floodprone part or the part set aside in the easement.

Although there are some Federal programs that can help acquire or reserve open lands, open space lands and easements do not always have to be purchased. Developers can be encouraged to dedicate park land and required to dedicate easements for drainage and maintenance purposes. These are usually linear parcels along property lines or channels. Maintenance easements also can be donated by streamside property owners in return for a community channel maintenance program.

Local implementation: Huntsville has 52 parks which cover over 1,900 acres of the City. There are also Monte Sano State Park, Wheeler National Wildlife Refuge, Huntsville/Madison County Ditto Landing Marina, and several properties preserved through the Land Trust of Huntsville and North Alabama. Together, these comprise around 10% of the area in the mapped floodplains.

There are still areas of the City and adjacent unincorporated areas that can be developed. An open space plan or passive recreation plan tied to the Capital Improvement Budget could identify floodprone open space worthy of acquisition.

Greenways: "Greenways are protected corridors of open space along natural features, such as streams and ridges…" (Huntsville's Greenways brochure). Greenways provide two key flood mitigation benefits.

1. First, they preserve some floodplain from buildings and other more damage-prone development. While these may be narrow strips of open space, they are usually the area closest to the channel, i.e., the most dangerous area during a flood and that part of the floodway where the most water is carried.

2. Second, they draw people to the rivers where they can learn to appreciate the benefits of open space and become more familiar with the rivers and creeks in the City. This second benefit is discussed more in Chapter 9. Public Information.

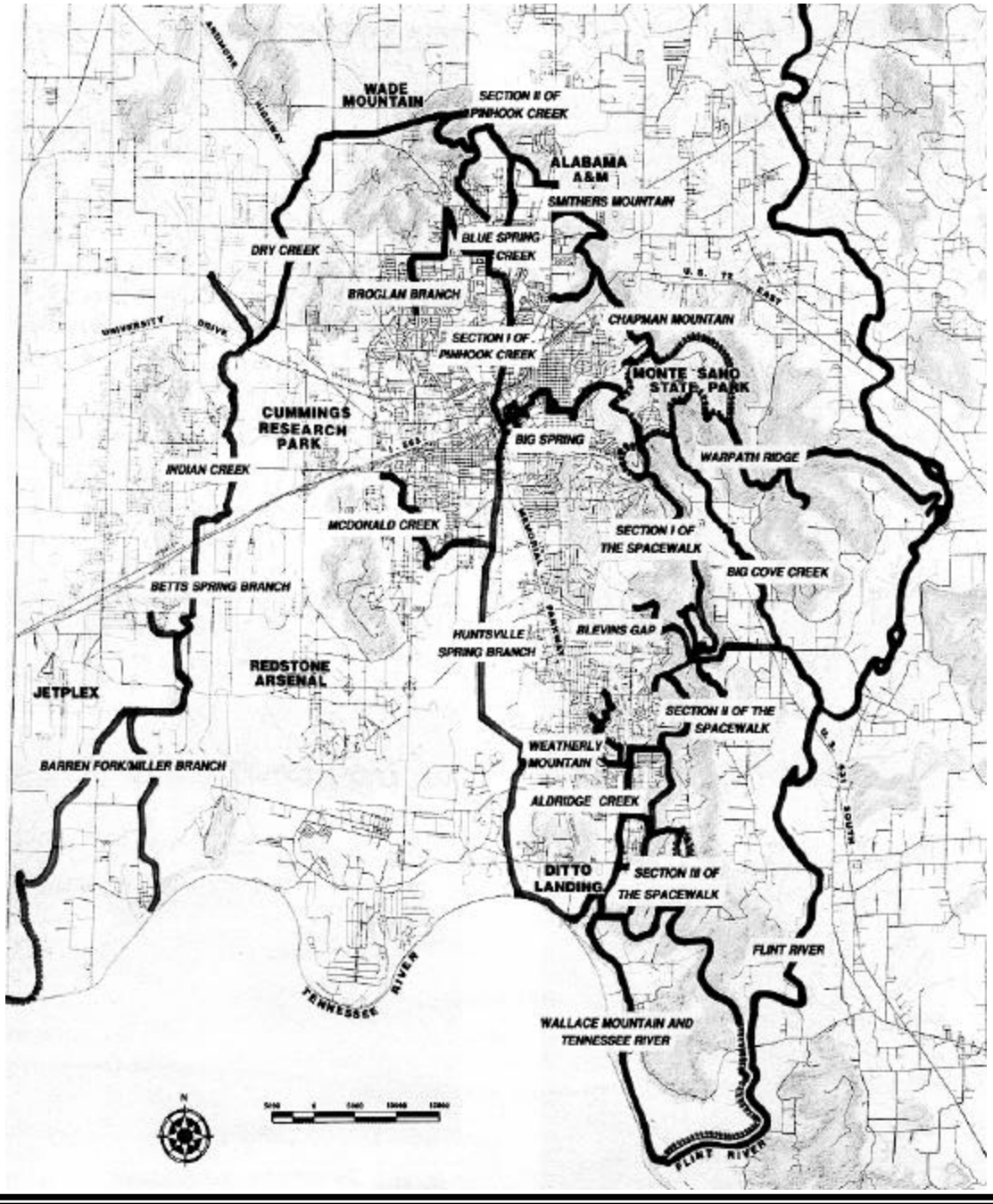
The City has plans for an extensive greenway system. As noted on the Greenways Plan map on the next page, there is a substantial overlap between the proposed greenways and floodprone streams. When completed, the system will have over 130 miles of interconnected trails.

The Greenways Plan sets priorities for acquisition and development of land for the proposed system. They favor sites with significant natural resources (e.g., floodplains and wetlands), connections to public facilities, development pressure and multi-use opportunities. Funds to implement the plan are budgeted in each year's Capital Improvement Program. Over the last four years, approximately $300,000 per year has been allocated to greenways within the Capital Improvement Budget.

The Land Trust: The Land Trust of Huntsville and North Alabama is a non-profit organization which was incorporated in 1987 with the support and encouragement of the City of Huntsville. The Trust's mission statement is to preserve land for public use to enhance recreation, education, conservation and prosperity in the North Alabama region.

The Trust has been successful during its existence and has received continuing support from the City of Huntsville, in both land and monetary contributions. Through the Trust's endeavors, over 2400 acres of land within Madison County have been preserved. This protected land is largely composed of wetlands and mountainside lands.

Huntsville's Greenways Plan

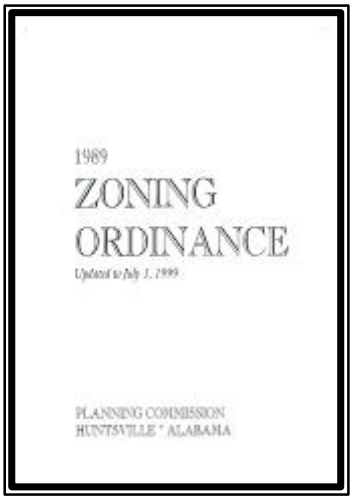


4.3. Zoning

Background: A zoning ordinance regulates development by dividing a community into zones or districts and setting development criteria for each zone or district. The floodplain can be designated as one or more separate zoning districts created to permit only those uses or activities that are not susceptible to damage by flooding, such as conservation areas and agricultural uses.

Another approach is to designate the floodplain as an overlay district in order to prevent development that would contribute to or cause increased flood damage, regardless of the use in the underlying zone.

Local implementation: The City's Zoning Ordinance addresses flooding in two ways.



1. Article 62 creates a Flood Hazard District and sets the standards for new construction in that district. This is an overlay zone which does not specify land uses, but does set flood protection construction standards (Section 62.5). In other words, the overlay zone applies whether or not the floodplain will be developed for residential or commercial use, as long as the project is in compliance with the flood hazard district regulations. These construction standards are discussed in section 4.6 Floodplain Development Regulations.

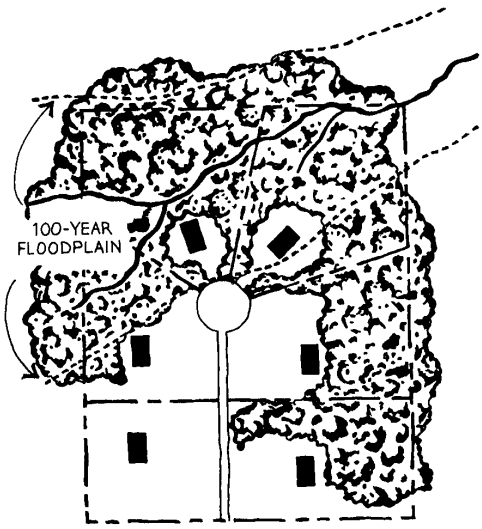
2. Land uses are specified for each zoning district, such as residential, commercial, etc. There is little correlation between these districts and the mapped floodplain.

The Zoning Ordinance also has Article 65 – Slope Development District Regulations. This is another overlay district that covers steeper hillsides (15% or greater slopes). The Article requires a geotechnical analysis before construction to determine the potential slope hazards, such as landslides, and specifies setbacks, lot coverage, construction, landscaping and other development standards to minimize disruption of natural features. The amount of disruption permitted in the Slope Development District is designed to minimize stormwater runoff and maximize slope stability.

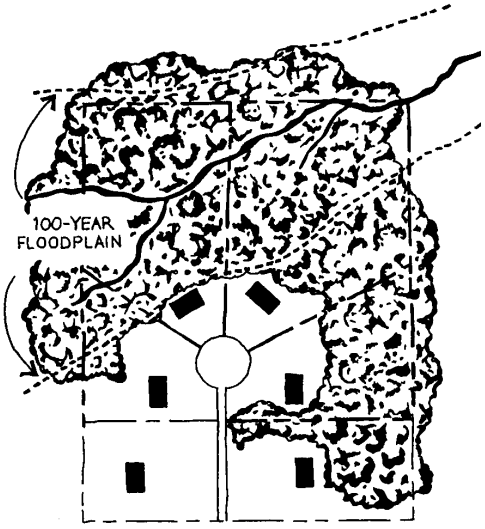
4.4. Subdivision Regulations

Background: Subdivision regulations govern how land will be subdivided into individual lots, and sets the construction and location standards for the infrastructure the developer builds to serve those lots, including roads, sidewalks, utility lines, storm sewers, and drainageways. For example, some communities, including Huntsville, require that every subdivision in a floodplain provide a building site above the flood level for every lot and/or require streets to be at or no more than one foot below the base flood elevation.

Another approach,(which the city allows) is clustering of a subdivision. The clustering of building sites within a subdivision (e.g., on high ground, above flood levels) is actually controlled through the zoning ordinance. Zoning criteria and density controls, such as lot sizes, setbacks and lot coverage requirements, determine the ability to implement the clustering concept that is illustrated on the next page.



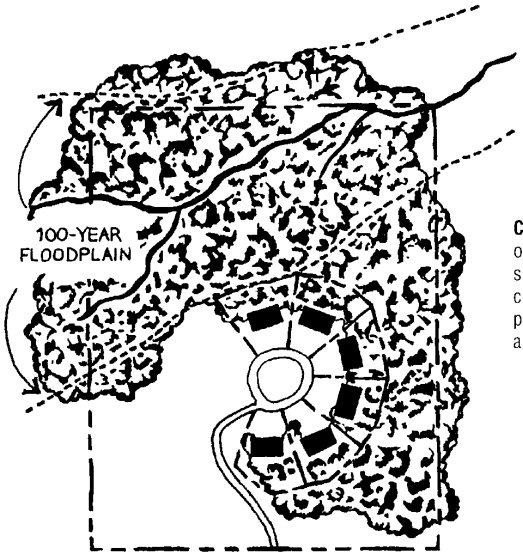
CONVENTIONAL PLAN A



CONVENTIONAL PLAN B

Conventional Plan A: All land on site is subdivided into lots; some lots partially or entirely in floodplain; some homesites in floodplain.

Conventional Plan B: All land on site is subdivided into lots; some lots partially in floodplain; homesites restricted to natural high ground; setbacks and sideyard restrictions modified to accommodate structures out of floodplain.

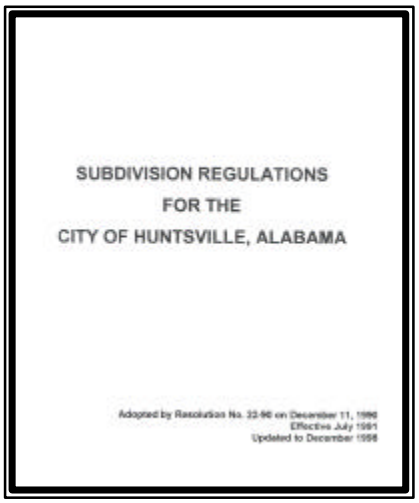


Cluster Plan: All floodplain lands and other sensitive lands kept as open space; net density remains equal to conventional plans; lot sizes reduced to protect natural features; all homesites are on natural high ground.

CLUSTER PLAN

Clustering allows developers to have the same number of building sites while preserving the floodway or floodplain for open space.
Source: *Subdivision Design in Flood Hazard Areas*

Local implementation: Huntsville's Subdivision Regulations require a lot of information from the developer. A Site Assessment Map and a Site Assessment Report must describe the area's soils, sinkholes, landslide history, wetlands, springs and seeps, vegetation and endangered or threatened species.


SUBDIVISION REGULATIONS
FOR THE
CITY OF HUNTSVILLE, ALABAMA

Adopted by Resolution No. 32-90 on December 11, 1990
Effective July 1991
Updated to December 1998

The Site Assessment Report must include "Recommendations for mitigating all located and described on-site hazards and sensitive environmental features" (Section 3.2(3)D(v)). If there has been previous disturbance of the ground (e.g., a dump site) or there is potential for a landslide, a geotechnical investigation is required.

The final plat must show all restricted use and flood hazard areas and note whether a geotechnical investigation was conducted. In flood hazard areas, the minimum floor elevations must be shown and it must be at least one foot above the base flood elevation.

Easements are required along watercourses. They must be large enough for both the drainageway and maintenance access. A minimum 15 foot buffer of natural vegetation is required next to sensitive lands "as designated by the Planning Commission."

> "Lands within a floodway shall not be subdivided or developed except that certain minimal grading and construction may be allowed to provide for public utility service and/or roadways to cross said floodway." (Section 4.7(3)C)

Subdivision Plat Easement and Flood Hazard Disclosure Example

These flood protection standards are stronger than most communities, although there is still room for criteria for new roads and construction outside the floodway. The Subdivision Regulations also set standards for drainage and stormwater retention. These are discussed in Section 4.7 on Stormwater Management.

Procedures: Just as important as the regulatory standards are the procedures that must be followed. Applicants are advised to meet with the Planning Division staff before they prepare their layout. An application for approval of the layout (with the Site Assessment Map and Site Assessment Report) must be submitted to staff and then to the Subdivision Committee of the Planning Commission. After approval of the layout, the preliminary plat is reviewed and presented at a public hearing and then the final plat is approved by the Planning Commission.

These are thorough procedures that allow for detailed review of potential problems from flooding and other hazards. It is up to the Planning Commission to ensure that those problems are addressed and that there are no variations from the subdivision and construction standards.

4.5. Building Codes

Background: Flood protection standards for all new and improved or repaired buildings can be incorporated into the local building code. These standards should 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.

There is a new program that measures local building code natural hazard protection standards and code administration. The Building Code Effectiveness Grading Schedule is used by the insurance industry to determine how well new construction is protected from wind, earthquake and other non-flood hazards. It is similar to the 10-year old Community Rating System and the century-old fire insurance rating scheme: community programs are reviewed and scored, a class 1 community is the best, and a class 10 community has little or no program.

Local implementation: Huntsville administers the Standard Building Code published by the Southern Building Code Congress International, Inc. The Standard Building Code is one of the nation's three model building codes. It does not include all of the flood protection standards needed to meet the requirements of the National Flood Insurance Program (see next section).

All three national code organizations have agreed to replace their codes with the new International Code Series (the last version of a Standard Code was published in 1999). The International Codes have extensive flood protection provisions that meet or exceed the NFIP minimum requirements.

Huntsville's Building Code Effectiveness Grading Schedule classification is a Class 4, one of the better classifications given. Of the 150 Alabama communities that have been classified, only 16 are a Class 4 or better.

4.6. Floodplain Development Regulations

Background: Most communities with a flood problem participate in the National Flood Insurance Program (NFIP). The NFIP sets minimum requirements for the participating communities' subdivision regulations and building codes. These are usually spelled out in a separate ordinance.

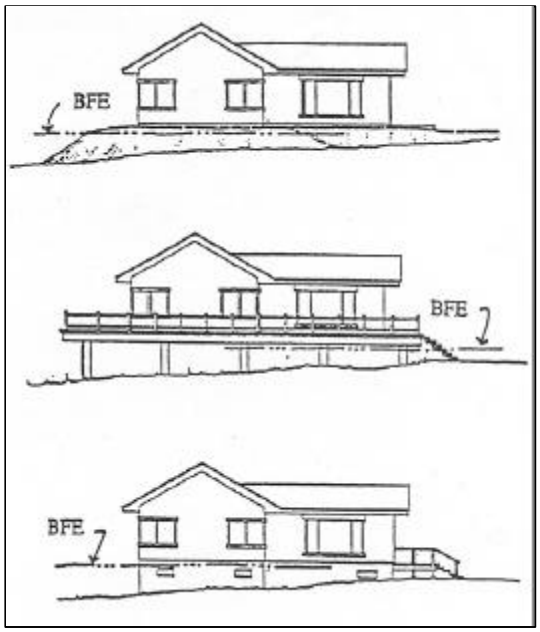
The NFIP minimum requirements are summarized in the box on the next page. The Community Rating System has identified numerous regulatory provisions that exceed these minimums and provides the insurance premium reduction as an incentive for communities to adopt them.

Minimum National Flood Insurance Program Regulatory Requirements

The National Flood Insurance Program (NFIP) is administered by the Federal Emergency Management Agency (FEMA). As a condition of making flood insurance available for their residents, communities that participate in the NFIP agree to regulate new construction in the area subject to inundation by the 100-year (base) flood.

There are four major floodplain regulatory requirements. Additional floodplain regulatory requirements may be set by state and local law.

1. All development in the 100-year floodplain must have a permit from the community. The NFIP regulations define "development" as any manmade change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.
2. Development should not be allowed in the floodway. The NFIP regulations define the floodway as 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. The floodway is usually the most hazardous area of a riverine floodplain and the most sensitive to development. At a minimum, no development in the floodway may cause an obstruction to flood flows. Generally an engineering study must be performed to determine whether an obstruction will be created.
3. New buildings may be built in the floodplain, but they must be protected from damage by the base flood. In riverine floodplains, the lowest floor of residential buildings must be elevated to or above the base flood elevation (BFE). Nonresidential buildings must be either elevated or floodproofed.
4. Under the NFIP, a "substantially improved" building is treated as a new building. The NFIP regulations define "substantial improvement" as any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the start of construction of the improvement. This requirement also applies to buildings that are substantially damaged.



Communities are encouraged to adopt local ordinances that are more comprehensive or provide more protection than the state or Federal criteria. This is especially important in areas with older Flood Insurance Rate Maps that may not reflect the current hazard. Such ordinances could include prohibiting certain types of highly damage-prone uses from the floodway or requiring that structures be elevated 1 or more feet above the BFE. The NFIP's Community Rating System provides insurance premium credits to recognize the additional flood protection benefit of higher regulatory standards.

Local implementation: Huntsville is in the NFIP. Because the building code and other regulations do not include all the necessary NFIP language, a separate section (Article 62) was included in the Zoning Ordinance to meet the requirements specified in the box on the previous page.

Article 62 has one important provision that exceeds the NFIP minimums. All new buildings must be protected to a level at least one foot above the base flood elevation. This receives credit under the Community Rating System. The CRS would also credit many other types of higher regulatory standards as listed in the box below.

CRS Credit for Higher Regulatory Standards

- Disclosure of flood hazard during property sales or rentals
- Developer provides flood data when none available
- More restrictive floodway mapping standard
- Hazardous areas preserved as open space
- Freeboard (buildings protected to higher than the base flood)
- Standards to protect floodplain fill from erosion and scour
- Specifications for foundations in floodplains
- Cumulative substantial improvement requirement
- Substantial improvement threshold lower than 50%
- Prohibiting critical facilities from all or parts of the floodplain
- Prohibition of hazardous materials
- Prohibition of health hazards, such as septic tanks
- Prohibition of fill
- Compensatory storage to offset the impact of fill
- Buffers adjacent to streams or natural areas
- Restrictions on use of enclosures below elevated buildings
- Low density zoning of floodprone districts
- Drainage plans for all buildings, including those not in the floodplain
- Erosion and sedimentation requirements on construction sites
- Incorporating best management practices on detention basins
- Penalties for dumping in streams

A review of these regulatory standards identified the following as appropriate for Huntsville's flooding conditions:

Protecting fill from erosion and scour: As with most floodplain regulations, the Zoning Ordinance is silent on how buildings must be elevated above flood levels. The most common approach is on fill. The CRS provides up to 20 points for language such as the following:

> The fill shall be placed in layers no greater than one foot deep before compacting and shall extend at least ten feet beyond the foundation of the building before sloping below the base flood elevation. The fill shall be protected against erosion and scour during flooding by vegetative cover, rip rap, or bulkheading. If vegetative cover is used, the slopes shall be no steeper than 3 horizontal to 1 vertical. [*Note:* this is sample ordinance language. Language drafted for the City should be reviewed for CRS credit before it is adopted.]

Prohibiting critical facilities: Critical facilities are discussed in Sections 2.7 and 6.4. A higher level of protection for critical facilities serves several purposes: it reduces damage to vital public facilities, it reduces pollution of flood waters by hazardous materials, and it ensures that the facilities will be operable during most flood emergencies. Therefore, the CRS provides credit for regulations that protect critical facilities from the 500-year flood. The following language would be worth up to 50 points.

> Critical facilities shall be constructed on properly compacted fill and have the lowest floor (including basement) elevated at least one foot above the elevation of the 500-year flood. A critical facility shall have at least one access road connected to land outside the 500-year floodplain which is capable of supporting a 4,000 pound vehicle. The top of the road must be no lower than six inches (6") below the elevation of the 500-year flood.

Prohibition of health hazards: Ten CRS points are provided for regulations that prohibit all activities in the floodplain that may be hazardous to public health or water quality. Five points are provided for regulations that prohibit one or two specific activities in the floodplain that may be hazardous, such as sanitary landfills or septic systems. Prohibiting hazardous materials, such as chemical storage, is credited under protection for critical facilities.

Stream buffers: The CRS credits regulations that require new floodplain developments to avoid or minimize disruption to shorelines, stream channels, and their banks. This is usually done through a setback requirement that prevents development from an area adjacent to a channel. It is worth up to 15 points.

> For all activities involving construction within 25 feet of the channel, the following criteria shall be met:
>
> (a) A natural vegetation buffer strip shall be preserved within at least 25 feet of the ordinary high water mark of the channel.
>
> (b) Where it is impossible to protect this buffer strip during the construction of an appropriate use, a vegetated buffer strip shall be established upon completion of construction.
>
> (c) The use of native riparian vegetation is preferred in the buffer strip. Access through this buffer strip shall be provided for stream maintenance purposes.

Enclosure restrictions: Most new buildings constructed in floodplains are elevated. If the building is on an elevated foundation, rather than on fill, the area below the first floor must be kept open to allow flood waters to flow inside and equalize hydrostatic pressures on the walls. Where flood depths exceed 5 or 6 feet, builders often elevate the lowest floor 8 feet above grade. This allows the lower area to be used for parking and storage.

One problem that has arisen is that owners enclose the lower areas of elevated buildings and put materials in them that are subject to flood damage. Owners forget (or new owners are not aware of) the reason for keeping the lower areas open and

free from items that can be damaged by a flood. The interior is converted to family rooms, bedrooms, and even bathrooms.

The CRS encourages communities to adopt regulatory language that prevents enclosing the area below the regulatory flood elevation. This can be in the form of prohibiting all enclosures, limiting walls to a percentage of the surface area, or allowing only transparent walls, such as screening and open lattice-work.

The community can opt to enforce these enclosure limits only where the lowest floor is more than five feet above grade. Where the lowest floor is less than five feet above grade, a crawlspace with the proper openings may be more appropriate than an open area elevated on columns or piles. With less than five feet in height, the lower area is not likely to be improved or modified into a livable space and the enclosure limits are not needed.

Because FEMA has paid large flood insurance claims on buildings that had altered enclosures, the CRS provides up to 300 points for ordinance provisions such as the following:

> New construction or substantial improvements of elevated buildings that include enclosed areas formed by foundation and other exterior walls shall be designed to preclude finished living space below the base flood elevation by providing openings in each wall having a total net area of not less than 50% of the total wall area subject to flooding. At least one opening per wall shall be no higher than one foot above grade to allow for the entry and exit of floodwaters to automatically equalize hydrostatic flood forces on the exterior walls.

Drainage plans for all buildings: Drainage plans for subdivisions and larger projects are already required by the City. The CRS credits requirements for such plans for all development, including single family homes. The plan can be a drawing. The objective is to ensure that both the applicant and the community check how the project will affect flows on the lot and from and onto adjoining properties.

This requirement would affect all projects in the City, not just those in the floodplain. It would receive up to 50 points.

> An application for a development project shall include a plan of the parcel showing pre-development and post-development surface drainage flows.

Procedures: As with subdivision regulations, the procedures for floodplain development regulations can be as important as the construction standards. One problem that has arisen with the separate ordinance in Huntsville is that the regulations are administered by two different offices. Permit applications are processed by the Urban Development Department's Inspection Division. If the property is in the floodplain, the application is forwarded to the Department's Engineering Division to verify compliance with Article 62 (Flood Hazard District Regulations) of the Zoning Ordinance.

This division of labor means that some requirements fall through the cracks. In August 2000, a Community Rating System verification visit uncovered problems with the Eleva-

tion Certificates that are the final record that shows compliance with the NFIP rules. The problems were traced to the procedures where the Engineering Division only reviews the plans (not the final project) and the Inspection Division assumes that once the plans are approved, all floodplain requirements are met. (Section 62.14.5 makes it the building inspector's responsibility to obtain the elevation record.)

Related to this is a problem that has been recently found across the country. Most ordinances focus on elevating the lowest floor above the base flood elevation. The city's ordinance requires that all utility systems, such as furnaces, air conditioning units and ductwork "be designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding." It was not discovered that many communities (including Huntsville) left utilities unprotected until the required use of a new FEMA Elevation Certificate which mandates surveys of the elevation of utilities and garage floors.

Another problem found is that the Inspection Division's work is tied to buildings. The NFIP requires communities to regulate all "development" in the floodplain, which includes things like regrading, filling, fences, and anything else that can affect flood flows. For example, the City does not require a permit for a fence, even though one could easily obstruct drainage.

4.7. Stormwater Management

Background: Development outside a floodplain can contribute significantly to flooding problems. Runoff is increased when natural ground cover is replaced by urban development. To prevent stormwater from flooding roads and buildings, developers construct storm sewers and improve ditches to carry the water away more efficiently. This combination of increased runoff and more efficient stormwater channels leads to increases in downstream storm peaks and changes in the timing when storm peaks move downstream. Unconstrained watershed development often will aggravate downstream flooding and overload a community's drainage system.

A second problem with stormwater is its impact on water quality. Runoff from developed areas picks up pollutants on the ground, such as road oil and lawn chemicals, and carries them to the receiving streams.

Stormwater management regulations—usually part of a subdivision ordinance—require developers to build retention or detention basins to minimize the increases in runoff caused by impervious surfaces and new drainage systems. Generally, each development must not let stormwater leave at a rate higher than that under pre-development conditions.

The Community Rating System uses three factors to measure the impact of stormwater management regulations on downstream flooding:

1. What developments have to account for their runoff? If only larger subdivisions have to detain the increased runoff, the cumulative effect of many small projects can still produce greater flows to downstream properties.

2. How much water is managed? Historically, local stormwater management programs address smaller storms, such as the 2- or 10-year storms. The CRS reflects the growing realization nationally that the runoff from larger storms must be managed. It provides full credit only for programs that address all storms up to the 100-year storm.

3. Who is responsible to ensure that the facility works over time? Roads and sewers are located on dedicated public rights of way and the community assumes the job of maintaining them in the future. Stormwater management detention basins, have traditionally stayed on private property and maintenance has been left up to owner. Often homeowners associations do not know how and do not have the capability to properly maintain these facilities. Half the CRS credit is based on whether the community assumes responsibility to ensure that the facilities are maintained.

Poorly maintained detention basins loose their storage capacity and can become eyesores.

The standard regulatory approach of requiring each development to manage stormwater to the same criteria has several shortcomings:

1. It does not account for differences in stream and watershed conditions.

2. Municipalities within the same watershed may require different levels of control of stormwater.

3. There is no review of the downstream impacts from runoff or any determination of whether the usual standards compound existing flooding problems.

4. It results in many small basins on private property that may or may not be properly maintained.

The way to correct these deficiencies is to conduct a master study of the watershed to determine the appropriate standards for different areas and, sometimes, to identify where a larger central basin would be more effective and efficient than many smaller ones. The CRS provides up to double the stormwater management regulations credit if communities adopt such master plans.

Local implementation: Huntsville's subdivision regulations require a drainage plan prepared in compliance with the "City of Huntsville Stormwater Management Manual." (The drainage plan focuses on the drainage area upstream of the development, not the entire watershed, so it does not qualify as a stormwater management master plan.) This requirement, plus the standards for facility design qualify for some CRS credit:

1. What developments have to account for their runoff? All projects with more than 10,000 square feet of impervious area. This receives 15 of the maximum possible CRS credit of 25 points.

2. How much water is managed? "The calculated peak rate of stormwater runoff resulting from a ten-year return period, twenty-four (24) hour duration … shall be no greater after development of a site than before development of a site" (Ordinance 94-265). This is the standard for the "minor drainage system," i.e., the ditches and storm sewers that are designed to carry the smaller, more frequent storms.

   The "major drainage system" includes the streets and other facilities that are to carry the overland flows from larger, less frequent storms. The Stormwater Management Manual requires that open channels and culverts handle the 25-year storm and culvert and bridges be checked to ensure that the 100-year flood is no more than 1 foot over the curb.

   At one time these standards were the national norm. However, the CRS and current national standards have been revised over the years based on experiences from larger floods. The 10-year design storm now receives 10 out of the 90 possible CRS points. Higher credit would depend on detaining the peak flows from larger than 10-year storms before the stormwater leaves the developer's property.

3. Who is responsible to ensure that the facility works over time? The City leaves maintenance up to the property owner and therefore receives none of the 110 maximum possible points.

City staff understand that these regulatory standards could be upgraded. Rather than do it piecemeal, staff has favored the more comprehensive approach of the stormwater management master plan. Such a plan has been initiated on Aldridge Creek and funding has been approved to start planning for other watersheds. The City can receive CRS credit for these plans as they are adopted. When all watersheds are covered by them, the City could receive the maximum of 225 more points.

Unincorporated areas: The City has no authority to regulate development outside of its corporate limits. However, 61% of Huntsville's watersheds are in the unincorporated areas of Madison and Limestone Counties (this figure does not include the Flint River watershed, where stormwater management will have a smaller impact farther upstream). Without stormwater management, increased runoff from unincorporated developments will increase flood heights downstream, in the City.

Madison County's subdivision regulations have a similar stormwater management performance standard, but do not include specific standards, such as the design storm. In practice, the developer must convince the County Engineer that increased runoff can be handled by the receiving streams. Because there are no specific standards, the County's program would not receive CRS credit.

In recent years, the unincorporated part of Madison County has sustained tremendous growth in residential subdivisions. Because of the uncertainties in the County regulations, the City is concerned about unplanned urban sprawl from a flood control standpoint, especially as it relates to the drainage basins in the City that are downstream of those parts of the County that are actively developing.

Floodplain mapping standards: The regulatory floodplain maps prepared by FEMA delineate the base floodplain based on conditions at the time the Flood Insurance Rate Maps (FIRMs) are prepared.

FEMA cannot predict future growth, so its maps do not reflect the resultant increases in stormwater runoff. If development trends continue and large parts of unincorporated Madison County are converted to residential and urban development, the regulatory FIRMs for the streams with watersheds in the County will become outdated and will understate the flood hazard.

If the current maps are kept, new construction in the floodplain will not be fully protected from the base flood. Because the City cannot regulate the new development in the County, an alternative is to prepare floodplain maps based on assumed future conditions, i.e., that the watersheds are fully developed without retention and detention basins or other stormwater management precautions.

4.8. Conclusions

1. Comprehensive plans, open space preservation and appropriate zoning districts are preventive measures that can keep damage-prone development out of the floodplain. Other than the City's Greenway Plan and overlay zoning district flood protection standards, the City has not used these measures to direct inappropriate development away from floodprone areas.

2. The City's subdivision regulations have strong provisions for keeping mapped floodways as open space. Their criteria for development in other floodprone areas could be strengthened.

3. The City's program meets the *minimum* NFIP requirements for construction of new buildings in floodplains. Minimum national standards may not be the best standards for Huntsville. That is why the City has a one foot freeboard requirement.

4. There is an immediate need to revise the City's procedures for administering the NFIP requirements. The current procedures result in new buildings that are not fully compliant with either the requirements of the NFIP or participation in the CRS.

5. If flood problems are to be contained, effective regulations on building in the floodplain must be coupled with equally effective stormwater management regulations. The City's standard for the design of storm water detention facilities cannot be considered effective in managing increased runoff from development for storms greater than the ten year storm. The ten year storm is an appropriate standard for the design

of the primary spillway (outlet) but the City needs to check the flooding potential during larger storms. In particular, the lowest floor of buildings should be protected during larger floods through proper design of the detention storage volume, and the outlets from the detention pond. Provisions needs to be made to protect people and property by considering the impact of stormwater flows during larger storm events.

6. The most effective approaches to managing stormwater runoff in any particular location are best determined by a stormwater management master plan. The City is initiating such plans.

4.9. Recommendations

1. The City should develop an open space plan coupled with appropriate funding for acquisition through the Capital Improvement Program. The result would be the acquisition of lands for permanently protected open space that would provide flood protection, recreation and greenway benefits. The open space plan could be used to encourage the dedication of identified sensitive lands and/or the conveyance of conservation easements to public or open space use.

2. The City should review the Zoning Ordinance's flood protection standards to ensure appropriate protection is afforded floodplain properties. .

3. The higher regulatory standards credited by the Community Rating System should be used as a checklist to determine where the floodplain regulations could be strengthened. The following are recommended for review:

   → Standards to protect floodplain fill from erosion and scour
   → Prohibiting critical facilities from all or parts of the floodplain
   → Prohibition of health hazards in the floodplain
   → Buffers adjacent to streams
   → Restrictions on use of enclosures below elevated buildings
   → Drainage plans for all buildings, including those not in the floodplain

4. The City's procedures for administering the building and floodplain development ordinances should be revised as soon as possible to ensure that all of the NFIP and CRS requirements are met for all development in the floodplain.

5. The City should proceed to prepare stormwater management master plans on all watersheds subject to future development. Those plans should set appropriate standards for new developments.

6. Until a master plan is prepared for a watershed, development will be regulated by the Subdivision Regulations. The standards and procedures in the Subdivision Regulations and the Stormwater Management Manual should be reviewed to determine whether they adequately protect downstream development and whether the City should assume responsibility for ensuring that new detention facilities are properly maintained.

7. Madison and Limestone Counties should be encouraged to adopt stormwater management regulations that protect existing and future downstream development from increased flows due to stormwater runoff.

8. When stormwater management plans are prepared for watersheds with substantial areas outside the City limits, the flood modeling should be based on the assumption that the watersheds are fully developed without retention or detention.

4.10. References

1. *CRS Coordinator's Manual*, FEMA, 1999
2. *Floodplain Management In Alabama – Local Officials Reference Manual*, Alabama Emergency Management Agency, 1999.
3. *Greenways Plan*, City of Huntsville, 1993.
4. Interviews with City and County regulatory staff, Fall, 2000.
5. *Madison County Alabama Flood Damage Prevention Ordinance*, (undated)
6. *Ordinance No. 94-965 (untitled)*, City of Huntsville, 1994
7. *Subdivision Design in Flood Hazard Areas*, American Planning Association and FEMA, PAS Report 473, 1997
8. *Subdivision Regulations for Madison County*, Alabama, 1985
9. *Subdivision Regulations for the City of Huntsville, Alabama*, 1998
10. *Stormwater Management Manual*, City of Huntsville, 1991
11. *Zoning Ordinance*, City of Huntsville, 1999

Chapter 5. Property Protection

Property protection measures are used to modify buildings subject to flood damage rather than to keep floodwaters away. A community may find these to be inexpensive measures because often they are implemented by or cost-shared with property owners. Many of the measures do not affect the appearance or use of a building, which makes them particularly appropriate for historical sites and landmarks. These measures include the following:

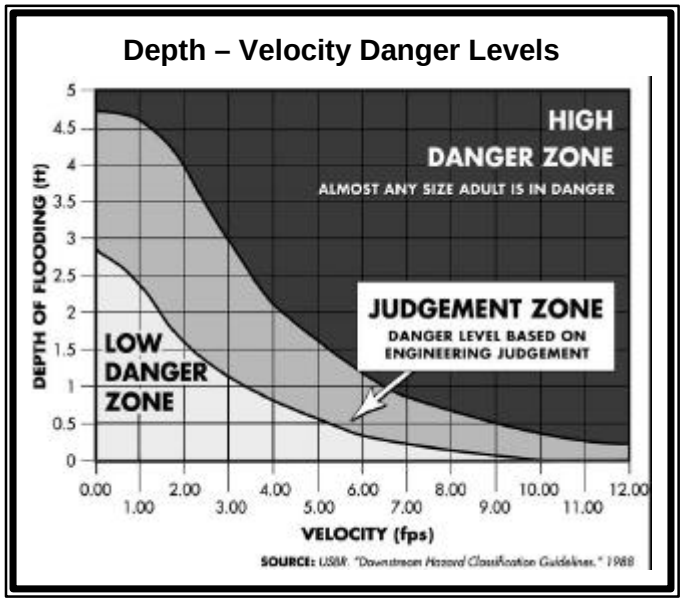
1. relocation
2. acquisition
3. building elevation
4. local barriers
5. dry floodproofing
6. wet floodproofing
7. sewer backup protection
8. insurance

These measures fall under three approaches to protect buildings and other property:

1. Keep the water away from the building through relocation, acquisition, elevation or a local barrier. This is appropriate where floodwaters are deeper or faster moving and present a threat to people in or around the property.

2. Modify the building so floodwaters will not cause damage. This is appropriate where flooding is shallow and slow moving, the safety threat to people is low, and the typical structure can withstand the hydrodynamic and hydrostatic pressures placed on it. The chart identifies the "low danger zone" where wet and dry floodproofing are viable property protection measures.

   These approaches can also be less disruptive to a neighborhood than relocation, acquisition, and elevation.



3. Don't stop the flooding or flood damage, but prepare the owner and occupants for repairs and recovery. This is the insurance approach. Where the first two approaches are not feasible or have not yet been incorporated, an insurance claim provides the finances needed to recover and, often, to pay for constructing or installing a property protection measure before the next flood.

5.1. Relocation

Moving a building to higher ground is the surest and safest way to protect it from flooding. While almost any building can be moved, the cost goes up for heavier structures, such as those with exterior brick and stone walls, and for large or irregularly shaped buildings. However, experienced building movers know how to handle any job.

In areas subject to flash flooding, deep waters, or other high hazard, relocation is often the only safe approach. Relocation is also preferred for large lots that include buildable areas outside the floodplain or where the owner has a new flood-free lot (or portion of their existing lot) available.

Any building can be moved

Relocation of this Huntsville landmark in 1991 shows that any building can be relocated. Photo courtesy of Hollis Kennedy House Movers.

Smaller houses are easier to move

This house was moved out of Madison County in 1990 to make way for a new highway. Photo courtesy of Hollis Kennedy House Movers.

Relocation can be expensive, with costs ranging for $30,000 for a small wood frame building to over $60,000 for masonry and slab on grade buildings. Two story houses are more expensive to move because of the need to relocate wires and avoid overpasses. Additional costs may be necessary for acquiring a new lot on which to place the relocated building and for restoring the old site.

Relocation costs do not increase proportionally with the size of a building. The cost per square foot for relocating a building larger than 1,000 square feet may be less, but some larger buildings may have to be cut and the parts moved separately.

Local implementation: Buildings have been relocated out of floodplains in many areas of the country, including Birmingham, Elba and Lacy Springs, Alabama and Lawrenceburg and Fayetteville, Tennessee. Huntsville building movers are very experienced. One mover estimates that he has relocated over 2,000 homes.

5.2. Acquisition

Like relocation, acquisition of buildings in a floodprone area ensures that they will no longer 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.

Acquiring buildings and removing them from the floodplain is not only the most effective flood protection measure available, it is also a way to convert a problem area into a community asset and obtain environmental benefits.

Occasionally acquisition and relocation projects are undertaken jointly. The purchasing agency typically sells the building for salvage. Sometimes, the original owner of the acquired building can make arrangements to buy it back at the salvage value. The advantage of this approach is that the owner relocates the building rather than demolishes it. This way, the owner gets to keep the building and may have enough money from the sale to pay for a new lot and moving expenses. There is a further savings in that the local government does not have to pay for demolition of the building.

While acquisition is appropriate for any type of flood hazard, it is more cost-effective in areas subject to flash flooding, deep waters, or other severe flood hazards where other property protection measures are not feasible. Acquisition, followed by demolition, is most appropriate for buildings that are difficult to move—such as larger, slab foundation, or masonry structures—and for dilapidated structures that are not worth protecting.

Demolition of a floodprone building

An acquisition budget should be based on the median price of similar properties in the community, plus $10,000 to $20,000 for appraisals, abstracts, title opinions, relocation benefits, and demolition.

Costs may be lower after a flood. For example, the community may have to pay only the difference between the full price of a property and the amount of the flood insurance claim received by the owner. Another way to keep costs down is to offer the acquired building for sale. The new buyer would be responsible for clearing the lot and the local government would save demolition expenses.

Communities should avoid creating a “checkerboard” acquisition pattern in which nonadjacent properties are acquired. This can occur when some owners, especially those who have and prefer a waterfront location, prove reluctant to leave. Creating such an acquisi-

tion pattern in a community simply adds to the maintenance costs that taxpayers must support.

Local implementation: The City is experienced in acquiring property for rights of way, park expansion, and similar public purposes. The City recently received $2.9 million from FEMA to acquire homes along Aldridge Creek. The owners will receive the fair market value for the property while the City assumes the cost of appraisals, closing and demolition. The funds will not be sufficient to acquire all 33 homes targeted.

5.3. Building Elevation

Raising a building above the flood level is the best on-site property protection method. Water flows under the building, causing little or no damage to the structure or its contents. Alternatives are to elevate on continuous foundation walls (creating an enclosed space below the building) or elevation on compacted earthen fill.

Although elevating on compacted fill is sometimes the most desirable elevation solution, it is a complicated alternative. The building has to be temporarily moved, so that the fill can be placed and properly compacted, and then replaced. This process may make elevation on fill more costly than elevating on an open foundation or continuous foundation walls.

Elevating a building will change its appearance. If the required amount of elevation is low, the result is similar to putting a building on a 2- or 3-foot-high crawlspace. If the building is raised 2 feet, the front door would be three steps higher than before. If the building is raised 8 or more feet, the lower area can be wet floodproofed and used for parking and for storage of items that will not be damaged by flood waters.

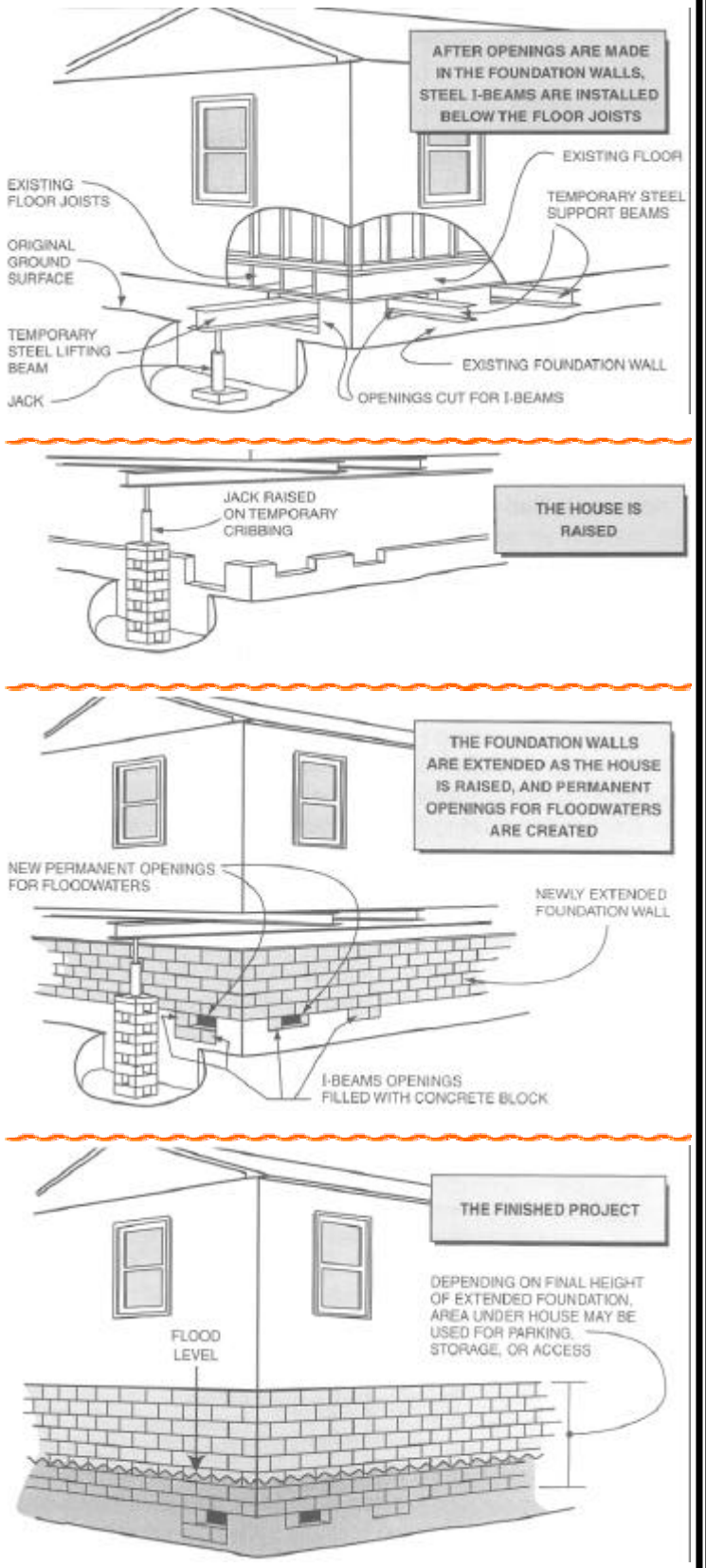
Raising a building above the flood level is cheaper than moving it and can be less disruptive to a neighborhood. Elevation has proven to be an acceptable and reasonable means of complying with NFIP regulations that require new, substantially improved, and substantially damaged buildings to be elevated above the base flood elevation.

As with relocation, the cost depends on the construction type (e.g., frame or masonry) and the type of existing foundation (e.g., basement, crawlspace, or slab-on-grade). They vary from $17 to $47 per square foot for elevating on an extended crawlspace as shown in the drawings on the next page.

Precautions: During a flood, the streets, utilities, and other infrastructure that serve a building will still be exposed to flood damage. Therefore, the building may be isolated and without utilities, and therefore unusable. There will also be a risk to the occupants who may try to enter or leave the building during a flood.

Another problem arises when newly created lower stories are used for storage of vulnerable items, which puts them at risk for flood damage.

Steps in elevating a building on a crawlspace



Source: *Homeowner's Guide to Retrofitting, FEMA 312, 1998, pages 93 - 94*

Local implementation: New residential buildings have been elevated in Huntsville's floodplains since the 1973 flood. Huntsville's home movers report that they have raised over 25 houses in Madison County to protect them from flooding.

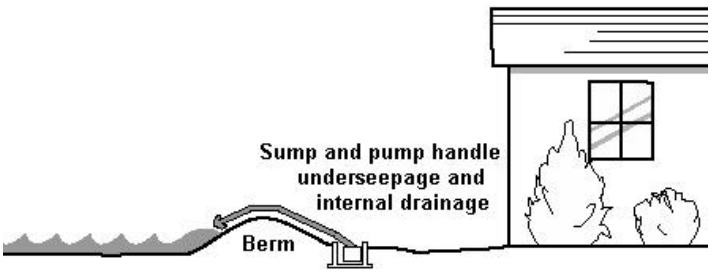
New homes elevated in the Dallas Branch floodplain

Hollis Kennedy House Movers estimates that it would cost $25 per square foot to elevate a typical brick veneer Huntsville house, build the new foundation, utilities, steps, porches and landscaping. They note that because of problems with bridges and overhead wiring, in many cases it makes more sense to elevate tall houses than to pay the cost of relocating them.

5.4. Local Barriers

Barriers keep surface floodwaters from reaching a building. A barrier can be built of dirt or soil ("berm") or concrete or steel ("floodwall"). The standard design for earthen berms is three horizontal feet for each vertical foot (3:1 slope).

Internal drainage is handled by a sump and pump



As a result, an area six feet wide is the minimum needed for each foot in height. Floodwalls need less room, but are more expensive. Barriers must be placed so as not to create flooding or drainage problems on neighboring properties, nor can they be constructed in the floodway.

Depending on how porous the ground is, if floodwaters will stay up for more than an hour or two, a barrier needs to handle leaks, seepage of water underneath, and rainwater that falls inside the perimeter. This is usually done with a sump and/or drain to collect the internal groundwater and surface water and a pump and pipe to pump the internal drainage over the barrier.

Precautions: Some barriers have openings for driveways and sidewalks. Closing these openings is dependent on someone being available and strong enough to put the closure in place. Another precaution is to account for water in the sewer lines that may back up under the barrier and flood inside the building (see Section 5.7 on sewer backup protection).

Openings are a concern with barriers

Barriers can only be built so high. They can be overtopped by a flood higher than expected. Earthen berms are susceptible to erosion from rain and floodwaters if they are not properly sloped and covered with grass and maintained. Settling lowers their protection levels and the roots from trees or shrubs can cause leaks.

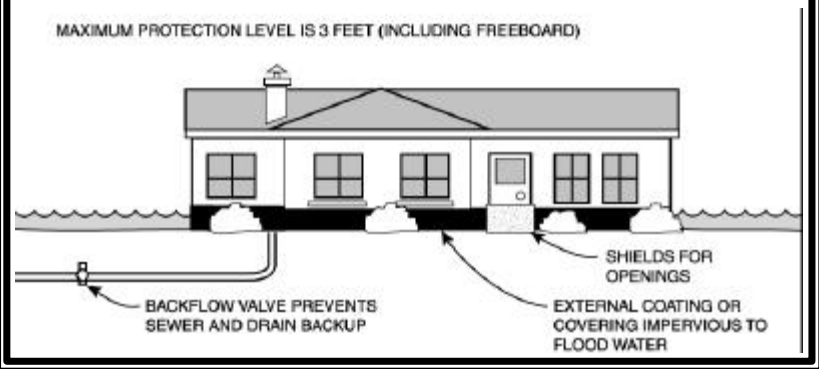
Local implementation: 71 respondents to the flood mitigation questionnaire reported that they had regraded their yards or otherwise improved the drainage. It should be noted that regrading a yard or constructing a wall or levee requires a City grading permit.

5.5. Dry Floodproofing

This term covers several techniques for sealing up a building to ensure that floodwaters cannot get inside it. All areas below the flood protection level are made watertight. Walls are coated with waterproofing compounds or plastic sheeting. Openings (doors, windows, and vents) are closed, either permanently, with removable shields, or with sandbags. Many dry floodproofed buildings do not look any different from those that have not been modified.

Dry floodproofing is only appropriate for buildings on concrete slab floors (without basements) and with no cracks. To ensure that the slab is watertight and sound, an engineering analysis is recommended. The maximum flood protection level for dry floodproofing is two feet above the slab. Deeper water will put pressure on the walls and slab floor that they are not built to withstand.

Dry floodproofed house



Precautions: During a flood, the streets, utilities, and other infrastructure that serve a building will still be exposed to flood damage. Therefore, the building may be isolated and without utilities, and therefore unusable. There will also be a risk to the occupants who may try to enter or leave the building during a flood.

It is very tempting for the owner of a dry floodproofed building to try to keep the flood out if floodwaters get deeper than two or three feet. This can result in collapsed walls, buckled floors, and danger to the occupants.

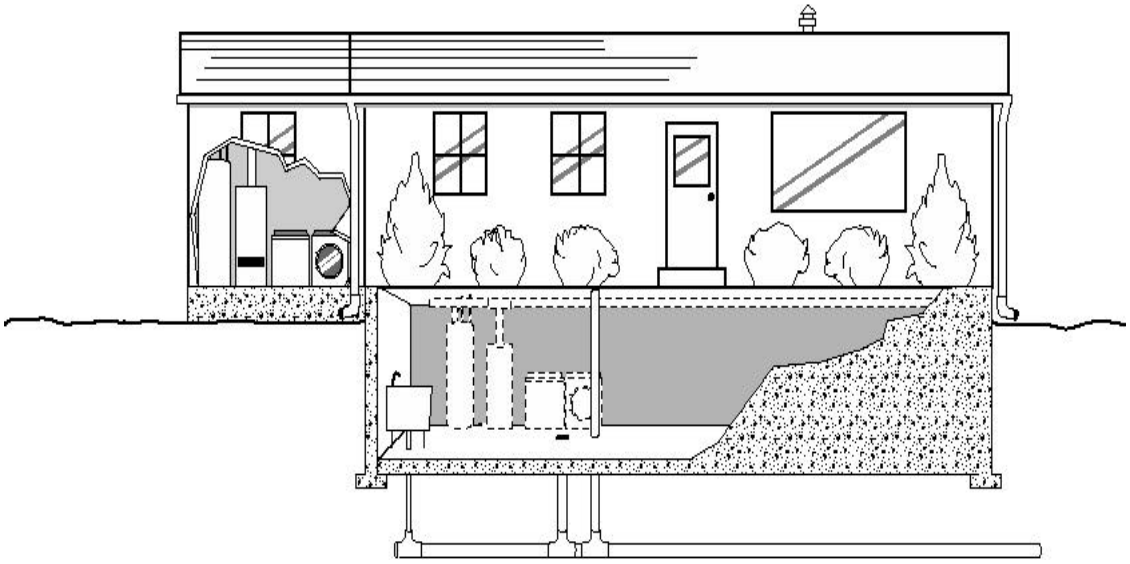
Dry floodproofing of new and existing nonresidential buildings in the regulatory floodplain is permitted under the NFIP. Dry floodproofing of existing residential buildings in the floodplain is also permitted as long as the building is not substantially damaged or being substantially improved. Owners of buildings located outside the regulatory floodplain can always use dry floodproofing techniques.

Local implementation: Twelve of the respondents to the flood mitigation questionnaire stated that they had waterproofed their walls.

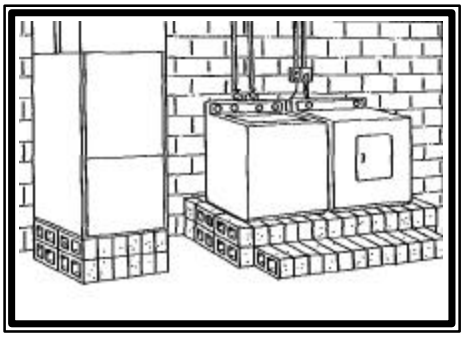
5.6. Wet Floodproofing

Wet floodproofing means letting the water in and removing everything that could be damaged by a flood. There are several ways to modify a building so that floodwaters are allowed inside, but minimal damage is done to the building and its contents. These techniques range from moving a few valuable items to rebuilding the floodprone area.

With wet floodproofing, appliances and hard to move contents are relocated permanently to a high and dry level.



In the latter case, structural components below the flood level are replaced with materials that are not subject to water damage. For example, concrete block walls are used instead of wooden studs and gypsum wallboard. The furnace, water heater, and laundry facilities are permanently relocated to a higher floor. Where the flooding is not deep, these appliances can be raised on blocks or platforms.



Wet floodproofing is not feasible for one-story houses because the flooded areas are the living areas. However, many people wet floodproof their basements, crawlspaces, garages, and accessory buildings simply by relocating all hard-to-move valuables, such as the furnace, heavy furniture and electrical outlets. Light or moveable items, like lawn furniture and bicycles, can be moved if there is enough warning. Fuse and electric breaker boxes should be located high and near a door in order to safely turn the power off to the circuits serving floodprone areas.

Wet floodproofing has one advantage over the other approaches: no matter how little is done, flood damage is reduced. Thousands of dollars in damage can be prevented by simply moving furniture and electrical appliances out of a basement.

Precautions: During a flood, the streets, utilities, and other infrastructure that serve a building will still be exposed to flood damage. Therefore, the building may be isolated and without utilities, and therefore unusable. There will also be a risk to the occupants who may try to enter or leave the building during a flood.

Moving contents is dependent on adequate warning and the presence of someone who knows what to do. Flooding a basement or garage where there is electricity, paint, gasoline, pesticides, or other hazardous materials creates a safety hazard. There will still be a need for cleanup, with its accompanying health problems.

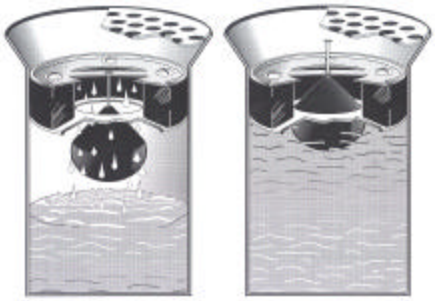
Local implementation: In response to the flood mitigation questionnaire, 27 people reported that they had moved things out of the basement, onto shelves in the garage, or otherwise elevated damage-prone contents.

5.7. Sewer Backup Protection

Cross connections between the sanitary and storm sewers and infiltration and inflow can overload the sanitary sewers during a storm. Buildings that have downspouts, footing drain tile, and/or a sump pump connected to the sanitary sewer service may be flooded inside during heavy local rains. These should be disconnected. Rain water and surface water should be directed out onto the ground where it will flow away from the building.

Four other approaches may be used to protect a structure against sewer backup: floor drain plugs, floor drain stand-pipes, overhead sewers, and backflow protection valves. The first two devices keep water from flowing out of the lowest opening in the building, the floor drain. They cost less than $25. However, if water becomes deep enough in the sewer system, it can flow out of the next lowest opening, such as a toilet or tub, or it can overwhelm a drain plug by hydrostatic pressure and flow into the building through the floor drain.

Automatic floor drain plug



The other two measures are more secure, but more expensive ($3,000-$4,000). An overhead sewer keeps water in the sewer line during a backup. A backflow protection valve prevents backups from flowing into the building.

Local implementation: Twelve percent of the respondents to the questionnaire noted that their flooding was caused by storm or sanitary sewer backup.

5.8. Insurance

Insurance has the advantage that, as long as the policy is in force, the property is protected and no human intervention is needed for the measure to work. Although most homeowner's insurance policies do not cover a property for flood damage, an owner can insure a building for damage by surface flooding through the National Flood Insurance Program.

Flood insurance coverage is provided for insurable buildings and their contents damaged by a "general condition of surface flooding" in the area. Building coverage is for the structure. This includes all things that typically stay with the building when it changes ownership, including:

- Utility equipment, such as a furnace or water heater
- Wall-to-wall carpeting
- Built-in appliances
- Wallpaper and paneling

Ten percent of a residence's building coverage may apply to a detached garage or carport. Other appurtenant structures must be insured under a separate policy.

Contents coverage is for the removable items inside an insurable building. A renter can take out a policy with contents coverage, even if there is no structural coverage. Certain items are not insurable. These include:

- Items outside a building, such as fences, car ports, landscaping and driveways,
- Jewelry, artwork, furs and similar items valued at more than $250
- Finished structural parts of a basement, such as paneling and wall to wall carpeting

- Animals and livestock
- Licensed vehicles
- Money or valuable papers
- Contents in a basement

Note: The NFIP considers any floor below grade as a basement and limits coverage in these areas. This includes the lower levels of split level and bi-level homes.

Some people have purchased flood insurance because it was required by the bank when they got a mortgage or home improvement loan. Usually these policies just cover the building's structure and not the contents. Renters can buy contents coverage, even if the owner does not buy structural coverage on the building.

Cost: The table below shows the costs for a single family home located in the base floodplain, on a slab or crawlspace, with the standard $1,000 deductibles. Rates are lower for buildings built after 1979 that have been elevated above the base flood level. Properties outside of the mapped floodplain with no history of flooding can be covered by an even less expensive "preferred risk policy."

Many insurance policies will only pay to repair the damage incurred. If damage is severe enough, the owner may have additional costs to bring the building up to current codes. Flood insurance now covers these costs (up to $20,000) when there is a flood. This is called "Increased Cost of Compliance" coverage and is automatically included in all policies.

In most cases, a 30-day waiting period follows the purchase of a flood insurance policy before it goes into effect. The objective of this waiting period is to encourage people to keep a policy at all times. FEMA does not want folks to wait for the river to rise before they buy their coverage.

Flooding Pours Out Insurance Lessons

Excerpts from an article in the *Huntsville Times*, July 4, 1999

…"We were glad we had it," Richard Morgan said "I never resented it."

The Morgans have flood insurance, but only partial coverage. "We've only got structural (coverage)," Terry Morgan said. "It didn't ever occur to us to get contents (coverage)." …

Jim and Cara Wedding, who are renting a house on Old Albany Circle, had up to 6 inches of water in their floor. They have renters insurance, but didn't take the rider for flood coverage.

"We were trying to save money," said Jim Wedding, who now plans to look into obtaining flood coverage. Cara Wedding said residents need to be more informed about the various types of flood insurance coverage available….

Leon Bell, who lives on Hickory Hill Lane, was in his house for 10 years before realizing it was in a flood zone. He got flood insurance in 1972 after his yard and garage flooded.

For 27 years he paid the $550 annual premium to cover his home and possessions with a $1,000 deductible on each. With an estimated $60,000 in damage from Monday's flooding, Bell is filing his first claim on his flood coverage.

Up to a foot of water in his house Monday, ruined Bell's carpet, his wife's arts and crafts, furniture and other items.

"It was worth it," Bell said about paying the flood insurance premiums all those years.

Amount of coverage	Cost for coverage	Constants and fee	Annual premium
$100,000 structural coverage	$440	$155	$825
$40,000 contents coverage	$230		
$50,000 structural coverage	$340	$155	$653
$20,000 contents coverage	$158		

Source: *Flood Insurance Agent's Manual*, FEMA, 2000

Local implementation: Flood insurance has been available in Huntsville since 1979. There are 2,140 flood insurance policies in the City, providing over $80 million in coverage. Huntsville residents are paying over $770,000 in premiums each year. By participating as a Community Rating System Class 8, the City is saving floodplain residents 10% of those premiums.

1,660 policies are in the mapped 100-year floodplain While these numbers are impressive, this means that *less than 27% of the properties in the mapped floodplain are protected with a flood insurance policy*. As noted in the table on page 2-2, these properties are nearly 5 times more likely to be hit by a flood than by a fire.

It is apparent that the majority of floodplain residents do not have flood insurance coverage. The Huntsville Times article in the box notes some of the stories residents had to tell about flood insurance after the 1999 Aldridge Creek flood.

Other hazard insurance: Private insurance companies cover the other hazards that threaten Huntsville property owners. Tornadoes and winter storm coverage is part of most homeowner's policies. Separate endorsements are usually needed for sinkhole and earth movement (e.g., landslide and earthquake) coverage. Unlike flood insurance, there are no readily available statistics on how many homeowners policies or special hazard endorsements are in force in Huntsville.

5.9. The City's Role

Property protection measures are usually considered the responsibility of the property owner. However, the City should be involved in all strategies that can reduce flood losses. There are various roles the City can play in encouraging and supporting implementation of these measures.

Public Information: Providing basic information to property owners is the first step in supporting property protection measures. Owners need general information on what can be done. They need to see examples, preferably from nearby. Public information activities that can promote and support property protection are covered in Chapter 9 of this *Plan*.

Financial Assistance: Communities can help owners by helping to pay for a retrofitting project, just like they pay for flood control projects. Financial assistance can range from full funding of a project to helping residents find money from other programs. Some communities assume responsibility for sewer backups and other flood problems that arose from an inadequate public sewer or drain system.

Less expensive community programs include low interest loans, forgivable low interest loans and rebates. A forgivable loan is one that does not need to be repaid if the owner does not sell the house for a specified period, such as five years. These approaches don't fully fund the project but they cost the community treasury less and they increase the owner's commitment to the flood protection project. Often, small amounts of money act as a catalyst to pique the owner's interest to get a self-protection project moving.

The more common outside funding sources are listed on the next page. Unfortunately the first five are only available after a flood, not before, when damage could be prevented. Following the 1999 flood, the Emergency Management Agency provided advice and assistance so residents could receive disaster assistance and Small Business Administration disaster loans.

- Flood insurance claims
- The National Flood Insurance Program's Increased Cost of Compliance provision (which increases the claim payment to cover a flood protection project required by code as a condition to rebuild the flooded building)
- FEMA's disaster assistance (for public properties)
- Small Business Administration disaster loans (for non-governmental properties)
- FEMA's Hazard Mitigation Grant Program
- FEMA's Flood Mitigation Assistance Program
- Community Development Block Grant

Other Incentives: Sometimes only a little funding is needed to motivate a property owner to implement a retrofitting project. A flood insurance premium reduction will result if a building is elevated above the flood level. This reduction is not enough to take much of a bite out of the cost of the project, but it reassures the owner that he or she is doing the right thing. Other forms of floodproofing are not reflected in the flood insurance rates for residential properties, but they may help with the Community Rating System which provides a premium reduction for all policies in the community.

Other incentives to consider are programs to help owners calculate the benefits and costs of a project and a "seal of approval" for retrofitted buildings. The latter would be given following an inspection that confirms that the building meets certain standards. There are many other personal but noneconomic incentives to protect a property from flood damage, such as peace of mind and increased value at property resale.

Mandates: Mandates are considered a last resort if information and incentives aren't enough to convince a property owner to take protective actions. An example of a mandate is the requirement that many communities have that downspouts be disconnected from the sanitary sewer line.

There is a mandate for improvements or repairs made to a building in the mapped floodplain. If the project is worth more than 50% of the value of the original building it is considered a "substantial improvement" (see item 4 in the box on page 4-9). The building must then be elevated or otherwise brought up to current flood protection codes.

Another possible mandate is to require less expensive flood protection steps as a condition of a building permit. For example, many communities require upgraded electrical service as a condition of a home improvement project. If a person were to apply for a permit for electrical work, the community could require that the service box be moved above flood level or the installation of separate ground fault interrupter circuits in the basement.

5.10. Conclusions

1. There is a variety of ways to protect individual properties from flood damage. Each appropriate in certain situations and each has advantages and disadvantages.

2. Property owners can implement some property protection measures at little cost, especially for sites in areas of low flood hazard. For other measures, such as relocation and elevation, the owners may need financial assistance.

3. Many people are not aware of the various ways they can protect their own property. There is a low level of awareness of the availability and coverage provided by flood insurance. There is probably a similar level of awareness of other hazard insurance.

4. The City can promote and support property protection measures through a variety of activities.

5.11. Recommendations

1. When flood protection alternatives are considered for any particular site, property protection measures should be considered along with the traditional flood control alternatives.

2. Property owners should be advised of the property protection measures that can help them reduce flood losses.

3. The City should pursue the following activities to encourage and support measures taken by property owners

    a. Public information (reviewed in more detail in Chapter 9)

    b. Outside funding sources that can assist property owners fund property protection measures, especially after a disaster declaration.

4. The City should work with property owners to identify other activities the City should undertake to encourage and support property protection measures, including

    a. Site-specific technical assistance to individual property owners

    b. Rebates or other low levels of financial assistance

    c. Awards or other non-financial incentives that recognize good practices

5. The City should publicize projects that have been implemented by property owners in the past.

5.12. References

1. *Engineering Principles and Practices for Retrofitting Flood Prone Residential Buildings*, Federal Emergency Management Agency, 1995.

2. *Flood Insurance Agent's Manual*, FEMA, 2000

3. *Flood Proofing Techniques, Programs and References*, U.S. Army Corps of Engineers National Flood Proofing Committee, 1991.

4. *Homeowner's Guide to Retrofitting: Six Ways to Protect Your House from Flooding.* Federal Emergency Management Agency, FEMA-312, 1998.

Chapter 6. Emergency Services

Emergency services measures protect people during and after a flood. Locally, these measures are coordinated by the Huntsville-Madison County Emergency Management Agency. The Agency's main guidance for implementing population protection measures is the *Emergency Operations Plan* which was just updated in 2000. Emergency services measures include the following:

1. flood detection
2. flood warning
3. flood response
4. critical facilities protection
5. post-disaster recovery and mitigation

1. Flood Detection

Detection is the key. The first step in responding to a flood is knowing that one is coming. Without a proper and timely flood threat detection system, adequate warnings by the National Weather Service cannot be disseminated. A flood threat detection system provides early warning to emergency managers. A good system will predict the time and height of the flood crest. This can be done by measuring rainfall, soil moisture, and stream flows upstream of the community and calculating the impact on the community.

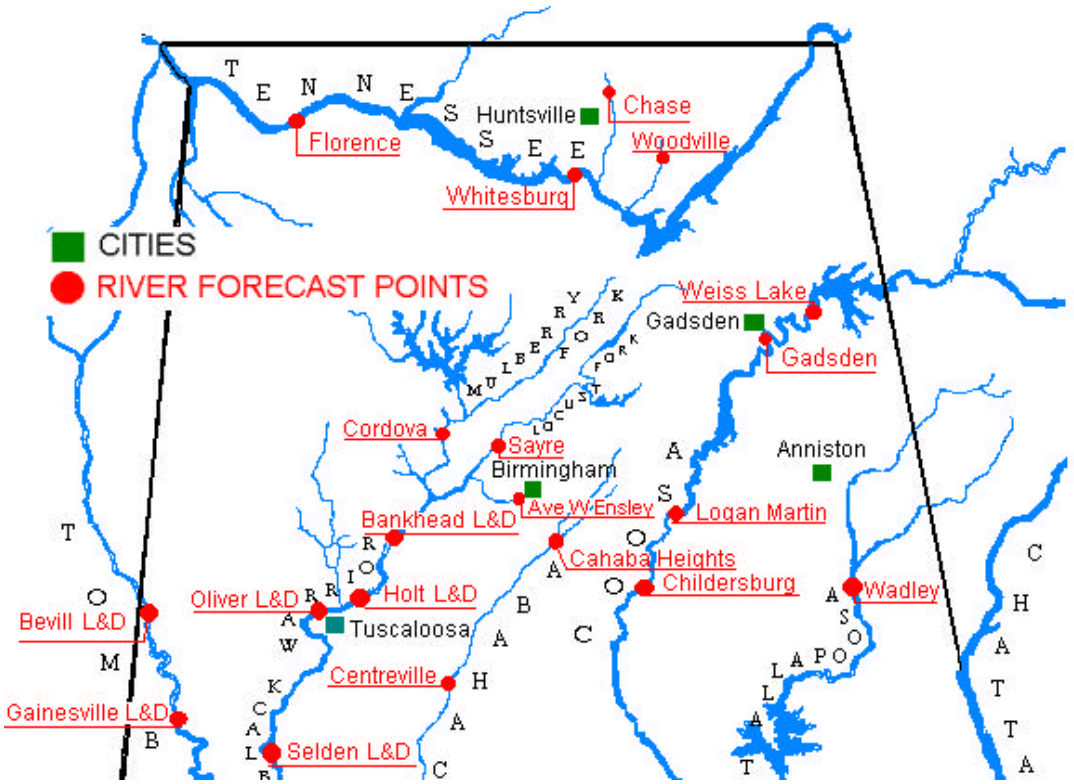
On larger rivers, the measuring and calculating is done by the National Weather Service which is in the U.S. Department of Commerce's National Oceanic and Atmospheric Administration. Flood threat predictions are disseminated on the NOAA Weather Wire or NOAA Weather Radio. NOAA Weather Radio is considered by the federal government as the official source for weather information. The National Weather Service issues notices to the public, using two levels of notification:

Flood watch: conditions are right for flooding
Flood warning: a flood has started or is expected to occur

The National Weather Service may issue a "flash flood watch." This means the amount of rain expected will cause ponding and other flooding on small streams. These events are so localized and so rapid that a "flash flood warning" may be seldom issued, especially if no remote detection equipment is available.

On smaller rivers, locally established rainfall and river gages are needed to establish a flood threat detection system. If the system inaccurately predicts too high a flood, much energy and resources can be wasted responding to a threat that doesn't exist. A false warning provides an added hazard of the "cry wolf syndrome:" people won't listen to the next warning.

National Weather Service River Forecast Points



Source: National Weather Service, Birmingham

Streamflow reporting gages in Huntsville

Aldridge Creek @ Sherwood
Aldridge Creek @ Toney Drive (note 1)
Aldridge Creek near Farley
Big Cove Creek @ Dug Hill Road
Broglan Branch @ Clinton Ave
Broglan Branch @ Oakwood Ave
Dallas Branch @ Coleman Street
Fagan Creek @ Adams Street
Huntsville Spring Branch @ Johnson Road
Indian Creek near Madison
McDonald Creek @ Patton Road
Pinhook Creek @ Clinton Ave (note 2)
Pinhook Creek @ Mastin Lake Road
East Fork Pinhook Creek @ Winche Road
West Fork Pinhook @ Blue Spring Road
Tennessee River @ Whitesburg

1. Gage record is shown on page 2-11
2. Gage is in the photo on page 2-7

Local implementation: The map above shows the National Weather Service's river forecast points. It can be seen that they only cover the larger rivers. Only two are for gage sites that affect Huntsville, the Flint River at Chase and the Tennessee River at Whitesburg.

The National Weather Service does not issue flood statements on smaller streams. There are gages that report current flow conditions at 16 sites that affect the City (see box). However, their data can be up to 6 hours old. There is no system to convert the data to a flood threat prediction before the stream rises. The Emergency Management Agency subscribes to a radar service that provides storm information, but not stream-specific flood data.

The City has investigated the cost of converting 14 of the sites to real time reporting gages. The cost of installing hourly reporting systems was estimated to cost $35,000 if done in cooperation with the US Geological Survey (USGS). The USGS recommended adding two new gages on the Flint River and upgrading the Indian Creek gage. The total recommended package was for $98,800. There are also annual operation charges, which the Emergency Management Agency currently pays.

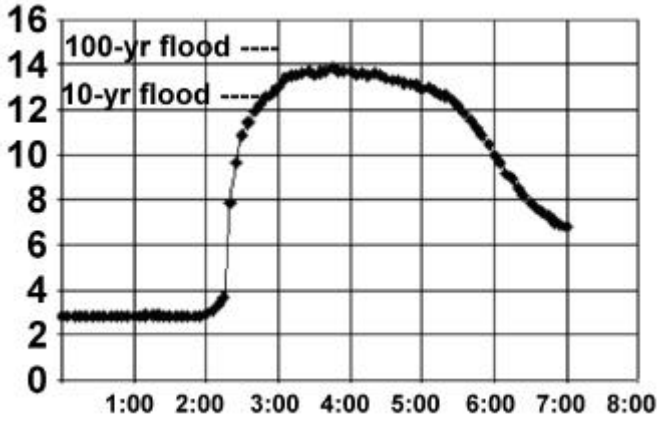
The need for a system on the smaller streams was underscored during the June 1999 flood on Aldridge Creek. The storm was so localized, that the National Weather Service had not even issued a flood watch. Occurring in the middle of the night, there was no emergency management staff alerted to be on duty.

The gage record to the right shows that Aldridge Creek at Mountain Gap Road rose 10 feet between 2:00 and 3:00 a.m. It rose 7 feet in one 20 minute period during that time.

This gage can be called to determine current stream conditions, but it does not report automatically, and a model to predict flood crests and times has not been developed. An automatic reporting system with flood prediction models would correct this.

Such a system would need to have real time data reporting with the computers and software to quickly convert data to predictions. This is different from the hourly reporting gages proposed above with the USGS. Such a reporting and prediction system would cost in the neighborhood of $500,000 to design and install.

Aldridge Creek gage at Mountain Gap Road, June 28, 1999



"0" datum on this gage is elevation 575.9 feet above sea level. The flood crested at a level under the 50-year flood stage (14.3). The 100-year flood stage is 14.7 (590.6 feet above sea level).

Source: *June 28, 1999 Flash Flood, Incident Report*, Huntsville-Madison County Emergency Management Agency and *Madison County Flood Insurance Study.*

The office of the State Climatologist (which works out of the University of Alabama in Huntsville) has proposed that the technology now exists for a "state-of-the-science severe weather detection and warning system." The office notes that there are high levels of expertise in the Huntsville area, including NASA, TVA the Weather Service and private industry, that could develop the gauging, transmission, modeling and warning systems that would be needed. A proposal has been submitted for funding.

2. Flood Warning

After the flood threat detection system tells the emergency management coordinator that a flood is coming, the next step is to notify the public and staff of other agencies and critical facilities that a flood is imminent. The earlier and the more specific the warning, the greater the number of people who can implement protection measures.

A flood warning may be disseminated in a variety of ways. The following are the more common methods:

- outdoor warning sirens
- sirens on public safety vehicles
- commercial or public radio stations
- commercial or public television stations
- mobile public address systems
- cable TV emergency news inserts
- NOAA Weather Radio
- telephone trees
- 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. Outdoor warning sirens can reach the most people quickly (except those around loud noise, such as at a factory or during a thunderstorm), but they do not explain what hazard is coming and cannot be sounded unless a timely means of remote detection exists. Radio and TV provide a lot of information, but people have to know to turn them on. Telephone trees are also fast, but can be expensive and do not work where phones lines are down.

Local implementation: Huntsville has an extensive system of overlapping outdoor warning siren coverage. There are 56 sirens in the City, each with a one mile radius (see map, next page). The outdoor warning sirens can be controlled individually, so if only one stream is flooding, only the nearby outdoor warning sirens need to be sounded.

Other methods for disseminating flood warnings in Huntsville include Weather Radios, local commercial radio and television stations, alarms in all schools, and the Broadcast Media Group Alerting System, which can access 4 local radio stations and 5 TV stations.

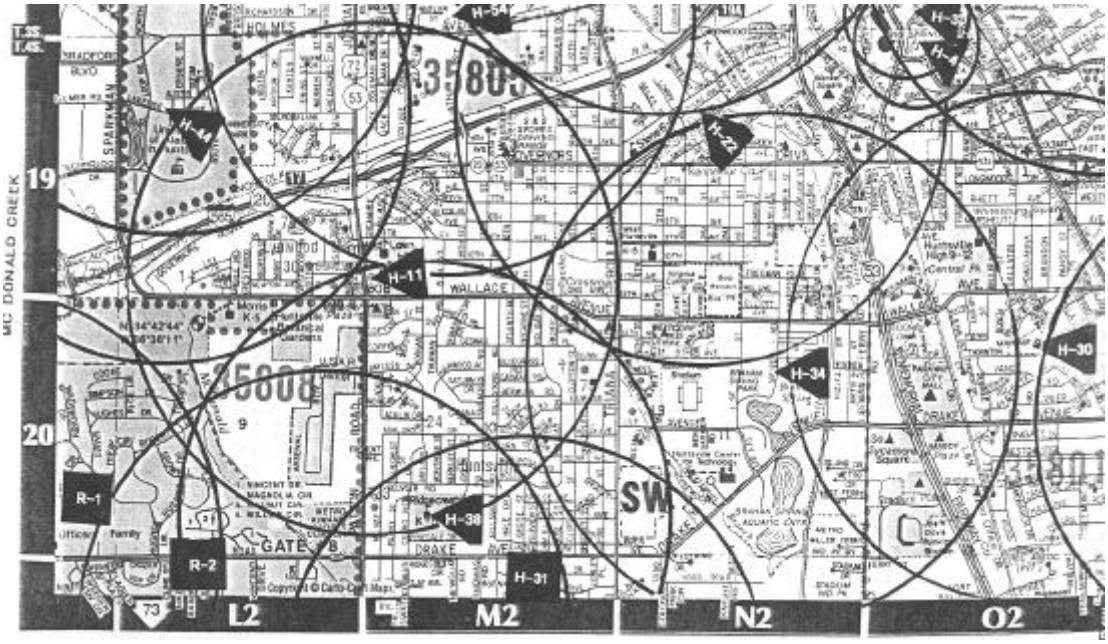
Flood warning in Huntsville is complicated by three factors. The first is when to issue the flood warning. As noted earlier, a false warning can mean the “cry wolf syndrome” and people won't listen to the next warning. Without timely remote detection devices and accurate models to predict flooding stages, the National Weather Service and the Emergency Management Agency has no system to determine when to alert what areas. Without a formal detection system with a technical basis, the staff is understandably hesitant to activate the outdoor warning sirens.

A second concern is whether the public will know what the warning means and what to do about it. This is primarily a concern with outdoor warning sirens. While there is good coverage of the floodplains, the *Emergency Operations Plan* only calls for their use for tornados, hazardous materials spills and nuclear attack.

If people hear the outdoor warning siren, would they immediately seek shelter in a basement or low spot? That would not be prudent during a flood, so the public needs to have a Weather Radio to receive the appropriate weather statement so they can take proper actions or tune in to a local radio or TV station to get additional details.

The third complication has been the relocation of the local National Weather Service office to Birmingham. The National Weather Service is cutting back on its local offices and it and other federal agencies are cutting back on the number of rain and river gages they maintain and monitor. It is hoped that Doppler radar can fill some of the information gap, but nothing replaces the personal and frequent contacts between National Weather Service and emergency management staff at the local level.

Emergency Management Agency's siren coverage map



Emergency Management Agency's siren coverage index

Streams & Rivers Indexed to Siren Sites

Stream/River		Covering Sirens, Upstream to Downstream		Map Pages
Aldridge Creek		Drake Avenue East	H-19	68, 74 & 80
		Jones Valley Rec. Assn.	H-58	
		Fire Station 9	H-16	
		Grissom High	H-48	
		Esslinger Tank	H-9	
		Willow Park	H-47	
		Fire Station 14	H-17	
		McGucken Park	H-32	
Bradford/Mill Creek/Barren Fork Creek		Liberty School	M-5	65 & 71
		Rickwood Park	M-9	
		Jetplex Circle	M-4	
Betts Spring/Lady Ann Lake		Sunlake	H-42	72
Flint River & tributaries	Flint River	Moores Mill VFD #1	MC-4	47, 54, 55, 62, 69, 75, 76, 81, 87 & 88
		Moores Mill VFD #2	MC-8	
		R.T. Jones Golf	H-37	

3. Flood Response

The protection of life and property is the foremost important task of emergency responders. Concurrent with detection and issuing flood warnings by the National Weather Service, the community responds with actions that can prevent or reduce damage and injuries. Typical actions and responding parties include the following:

- activating the emergency operations room (emergency management)
- closing streets or bridges (police or fire department)
- shutting off power to threatened areas (utility company)
- holding children at school/releasing children from school (school district)
- ordering an evacuation (mayor)
- opening evacuation shelters (locations and logistics coordinated by the Red Cross)
- providing timely remote monitoring of water levels (engineering)
- security and other protection measures (police)

A flood response or emergency action plan ensures that all bases are covered and that the response activities are appropriate for the expected flood threat. These plans are developed in coordination with the agencies or offices that are given various responsibilities as detailed in the *Emergency Operations Plan* and supporting departments and agencies' specific standing operating procedures.

Planning is best done with adequate data. One of the best tools is a flood stage forecast map that shows what areas would be under water at various flood stages as determined by the National Weather Service Flash Flood Guidance. Emergency management staff can identify the number of properties flooded, which roads will be under water, which critical facilities will be affected, etc.. With this information, an advance plan can be prepared that shows problem sites and determines what resources will be needed. The plans would be ready to use when ground reports verify flood heights.

Actual emergencies and required drills and exercises occur between floods to test functional capabilities for handling most emergency and disaster situations. This also ensures that key participants understand their duties. These coordinated efforts are implemented by Emergency Management and emergency response groups who have experience working together so that available resources can be used more efficiently.

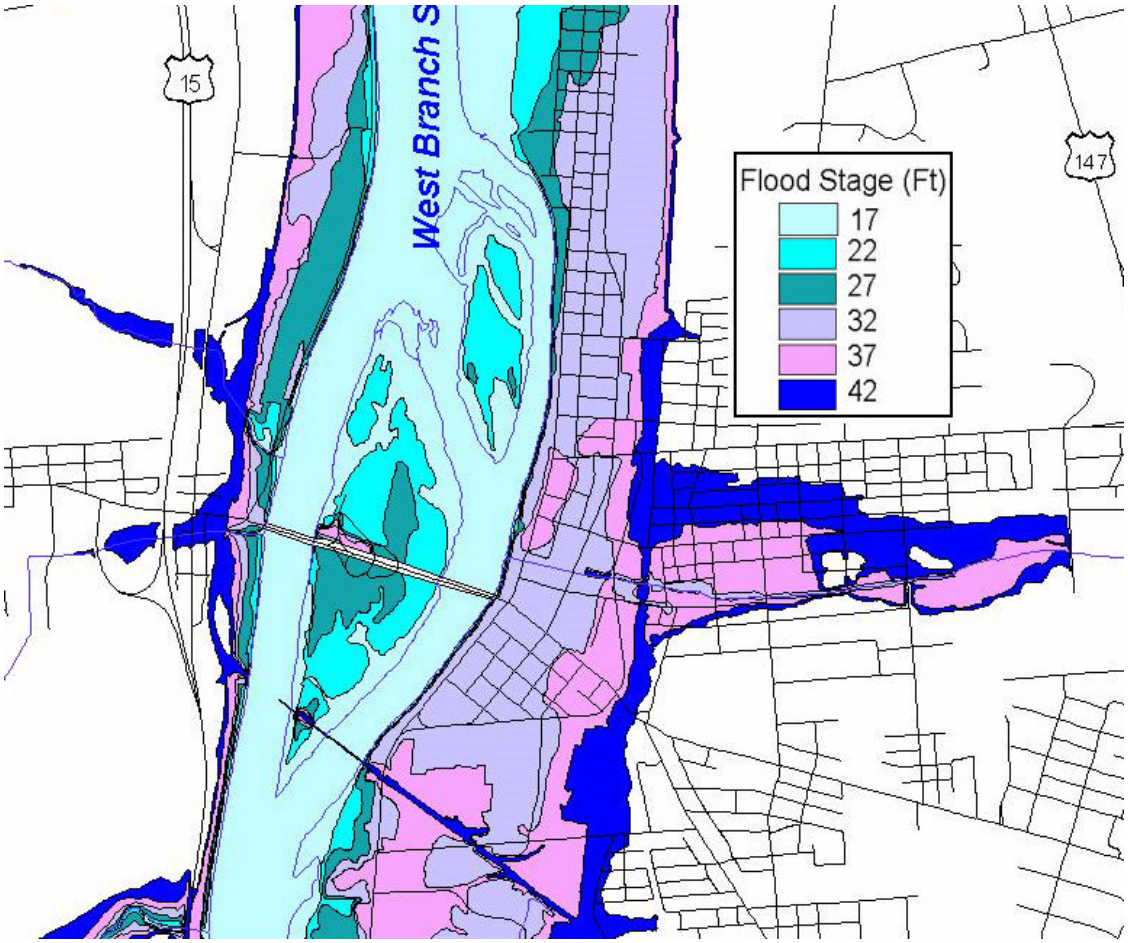
Local implementation: Annex U of Appendix 3 of the Emergency Management Agency's 2000 *Emergency Operations Plan* identifies the response measures for floods. When a flood warning is issued, the Emergency Operations Room (EOR) will be staffed depending on several factors such as time of day, holiday, week-end, or available staffing, etc.. As the flood unfolds, the EOR coordinates response measures to meet the situation based upon requests from responding agencies.

Like most cities' flood plans, Annex U has general instructions for any type of flood situation. For example, it uses phrases like "disseminate flood warning as appropriate." Some more specific functions and actions are identified in the agency's specific standing operating procedures, published separately from the 2000 *Emergency Operations Plan.*

A more detailed flood response plan is not feasible without timely remote detection equipment, a flood stage forecast map and the models to predict flood stages. With a detection system, staff could be ready before the crest reaches an area. Until all these tools are available, the City will have to respond to floods as and after they occur.

Flood response is managed in the EOR

Flood Stage Forecast Map



A flood stage forecast map shows what areas of a community will be under water at different flood stages. This helps emergency managers make the most efficient use of their resources. For example, a flood predicted to go as high as 27 feet will completely cover the islands in this community.

4. Critical Facilities Protection

Protecting critical facilities during a flood is the responsibility of the facility owner or operator. However, if they are not prepared for a flood, the rest of the community could be impacted. If a critical facility is flooded, workers and resources may be unnecessarily drawn away from other flood response efforts. If such a facility is adequately prepared by the owner or operator, it will be better able to support the community's flood response efforts.

Huntsville Utilities Substation in the Huntsville Spring Branch floodplain

The Community Rating System gives the same weight to critical facility protection as it does to the rest of the community's flood response plan. CRS credit focuses on coordinating the community's efforts with the facilities and helping the facilities develop their own flood-specific emergency plans.

Local implementation: Huntsville's critical facilities are discussed in Chapter 2. It has not yet been determined which ones would be affected by flooding. A first step would be to identify those most impacted by a flood and then work with each facility to help prepare their own flood response plans.

5. Post-Disaster Recovery and Mitigation

After a disaster, communities should undertake activities to protect public health and safety, facilitate recovery and help people and property for the next disaster. Throughout the recovery phase, everyone wants to get "back to normal." The problem is, "normal" means the way they were before the disaster. Measures needed include the following:

Recovery actions

- patrolling evacuated areas to prevent looting
- providing safe drinking water
- monitoring for diseases
- vaccinating residents for tetanus
- clearing streets
- cleaning up debris and garbage
- regulating reconstruction to ensure that it meets all code requirements, including the NFIP's substantial damage regulations

Mitigation actions

- conducting a public information effort to advise residents about mitigation measures they can incorporate into their reconstruction work
- evaluating damaged public facilities to identify mitigation measures that can be included during repairs
- acquiring substantially or repeatedly damaged properties from willing sellers
- planning for long term mitigation activities
- applying for post-disaster mitigation funds

Requiring permits, conducting inspections, and enforcing the NFIP substantial improvement/substantial damage regulations can be very difficult for local, understaffed overworked offices after a disaster. If these activities are not carried out properly, not only does the municipality miss a tremendous opportunity to redevelop or clear out a hazardous area, it may be violating its obligations under the NFIP.

Local implementation: The Emergency Management Agency's 2000 *Emergency Operations Plan* has annexes for public information, health, law enforcement, and damage assessment. These provide general directions of what should be done, but do not include hazard-specific measures that are included in the agency's and other departments and agencies' specific standing operating procedures. The public health and safety needs following a disaster are well covered and do not vary much for different types of hazards. After the 1999 Aldridge Creek flood, City crews conducted a large clean up effort, down to and including sweeping the streets.

The *Emergency Operations Plan* has general guidance for public information and reconstruction regulation. Annex U, Appendix 3, Floods, provides some general flood safety instructions for the public. For post-flood reconstruction regulations and mitigation, Appendix 3 refers to Annex P. Public Works/Engineering/Utilities. While Appendix 3 mentions the need for habitability inspections, there are no details in Annex P. They are tasked as a responsibility of the Inspections Division.

Immediately following a disaster, a windshield survey is completed for a preliminary damage assessment. This is followed by a more comprehensive inspection of damage with state and federal staff to determine if a disaster declaration should be requested. These damage assessment procedures (Annex S) collect a lot of information that can help permit officials determine where their workloads will be, including which buildings are likely to be substantially damaged. However, these procedures are designed to provide a rapid, general and overall picture of the severity of damage for local, state and federal reporting. If time allowed, damage surveyors could collect more information on each building and provide guidance to their owners.

The *Plan* also has Annex V, Hazard Mitigation. This has five pages of procedures that are applicable to all disasters and all tasked agencies. As with the other annexes, it notes that the subject is important and sets the framework for handling it, but does not provide detailed instructions on what should be done in case of a flood. This is because floods aren't the only hazard that can be mitigated. The Annex is written to cover all hazards.

6. Conclusions

1. The flood threat detection and prediction system for the City works for the Tennessee and Flint Rivers.

2. While some of the gauging equipment is present, there is no system to provide flood threat detection and crest and timing predictions on the many smaller streams that flood Huntsville. Unless there are new technologies that have not been publicized, the cost to install such a system would be around $500,000.

3. While the City is well covered by outdoor warning sirens, their usefulness for flood warning is limited without

   a. an accurate and reliable means of flood threat detection and prediction,
   b. clear procedures on when the sirens should be activated, and
   c. general public knowledge of what to do when a warning is issued.

4. Flood stage forecast maps can be very helpful in identifying areas and facilities affected by a flood. They are useful during flood operations and even more useful in preparing pre-flood response plans.

5. The *Emergency Operations Plan* is comprehensive and covers a variety of hazards and threats to the City, including flooding. However, an improved flood response plan cannot be developed without:

   a. remote detection equipment installed at key points,
   b. the models to predict flood stages, and
   c. a flood stage forecast map.

6. Flood response planning needs to include those critical facilities that will be affected by flooding, but a list has not yet been prepared.

7. The Emergency Operations Plan has guidance on City recovery and reconstruction activities to be undertaken after a flood. Detailed plans and procedures that coordinate these activities with inspections of building repairs would better prepare the City to quickly take advantage of post-flood mitigation opportunities.

7. Recommendations

1. The “state-of-the-science severe weather detection and warning system” proposed by the State Climatologist should be pursued. The results would be immediately useful to Huntsville, but also would have national benefits as a pilot project.

2. Flood stage forecast maps (see example, page 6-7) should be prepared whenever a watershed is modeled and mapped.

3. When alternative approaches to flood protection are reviewed for a watershed, the planning should include an analysis of the costs and benefits of installing gages needed to detect and predict downstream flooding.

4. A pilot flood stage forecast map and watershed-specific flood response plan should be prepared. The plan would include:

   a. Procedures that clarify when and how flood threats are detected,
   b. How flood warnings are issued,
   c. What critical facilities are affected,
   d. What support is needed by the critical facilities,
   e. A specific list of flood response activities, and
   f. Resource needs.

5. Upon completion of the pilot, staff should determine the utility of financing improvements to the stream gages and preparing similar plans for other areas.

6. Inspections Division staff should review some other communities' post-flood mitigation procedures to determine if the current guidance should be modified or expanded.

7. When these items are completed, the City should apply for Community Rating System credit for its flood warning program.

8. References

1. *CRS Coordinator's Manual*, Community Rating System, FEMA, 1999

2. *CRS Credit for Flood Warning Programs*, FEMA, 1999

3. *Emergency Operations Plan*, Huntsville-Madison County Emergency Management Agency, 2000

4. *Guidelines on Community Local Flood Warning and Response Systems*, Federal Interagency Advisory Committee on Water Data, 1985

5. *June 28, 1999 Flash Flood, Incident Report and Supporting Documentation*, Huntsville-Madison County Emergency Management Agency

6. Web sites of the National Weather Service (http://www.srh.noaa.gov/bmx/)and U.S. Geologic Survey (http://al.water.usgs.gov/)

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Chapter 7. Structural Projects

Structural projects have traditionally been used by cities to control flows and water surface elevations. Structural projects keep flood waters away from an area. They are usually designed by engineers and managed or maintained by public works staff. Five types are reviewed in this chapter:

1. Reservoirs
2. Levees and floodwalls
3. Channel modifications
4. Dredging
5. Drainage system maintenance

These measures are popular with many because they "stop" the flooding problem. The last item in the questionnaire to residents that was distributed in the Fall of 2000 asked "In your opinion, what is the most important thing the City of Huntsville can do to protect people from flooding?" Drainage maintenance was the most common response and channel improvements was the third.

However, structural projects have several important shortcomings that need to be kept in mind when considering them for flood hazard mitigation:

- They are expensive, sometimes requiring capital bond issues and/or cost sharing with Federal agencies, such as the U.S. Army Corps of Engineers or the Natural Resources Conservation Service.

- They disturb the land and disrupt natural water flows, often destroying habitats.

- They are built to a certain flood protection level that can be exceeded by a larger flood, causing extensive damage.

- They can create a false sense of security when people protected by a structure believe that no flood can ever reach them.

- They require regular maintenance to ensure that they continue to provide their design protection level.

7.1. 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 accommodate downstream. The lake created may provide recreational benefits.

Reservoirs are suitable for protecting existing development downstream from the project site. Unlike levees and channel modifications, they do not have be built close to or disrupt the area to be protected.

Reservoirs are most efficient in deeper valleys where there is more room to store water, or on smaller rivers where there is less water to store. Building a reservoir in flat areas and on large rivers may not be cost-effective, because large areas of land have to be purchased.

One complication that arises from reservoirs is the threat of a flood should the dam fail. Dam failure as a separate hazard is discussed in Chapter 2.

In urban areas, some reservoirs are simply manmade holes dug to store floodwaters. In some areas, costs have been reduced by using abandoned quarries as reservoirs. When built in the ground, there is no dam for these retention and detention basins and no dam failure hazard. Wet or dry basins can also serve multiple uses by doubling as parks or other open space uses.

Local implementation: The best known reservoir upstream of Huntsville is Guntersville Lake on the Tennessee River. The TVA reports that the lake, when combined with upstream reservoirs and floodplains, provides "a measurable amount of flood control benefit for downstream locations… But all in all, it is a small amount of flood storage compared to the size of floods which come down the river."

The ponds at Research Park West are flood control reservoirs

The City of Huntsville has constructed several small reservoirs. Sherwood Branch flooding is reduced with the help of two retention basins in Research Park West and another in Oakwood College. These are on public property and are maintained by the City. Construction of additional projects are limited by available funds.

7.2. Levees and Floodwalls

Probably the best known structural flood control measure is a barrier of earth (levee) or steel or concrete (floodwall) erected between the watercourse and the properties to be protected. Levees occupy more space than floodwalls; therefore, when adequate space for a levee is not available, floodwalls are used, although they are usually more expensive than levees.

Levees and floodwalls have the following shortcomings:

- They may not be constructed in the regulatory floodway.
- There should be compensation for any loss of flood storage
- They block traffic so they must provide for access through (e.g., watertight closures) or over (e.g., ramps or stairs) the barrier.

— They obstruct views, so they may be opposed by those who want to be close to the channel.

— If there are doors or gates that need to be closed, there should be periodic drills by those responsible for ensuring things will be in place before the flood.

Floodwall near South Memorial Parkway

Local implementation: Levees and floodwalls have not been used very much in Huntsville. There is one small floodwall that protects a few properties on South Memorial Parkway. It is fitted with several one-way rubber valves that keep high water from backing up the drains and into the protected area (see photo).

7.3. Channel Modifications

By increasing the conveyance of a stream channel or drainage ditch, more water is carried away. While this benefits those immediately affected, often, the extra water will cause increased flooding downstream. This section covers three general types of structural projects that rely on modifying channels to control floodwaters.

1. Channel improvements: These include making a channel wider, deeper, smoother or straighter. Some smaller channels can be lined with concrete ("slope paving") or even put in underground pipes. Modifications that result in faster moving water may also increase bank erosion which can lead to undercut properties and downstream sedimentation.

Local implementation: This was the primary approach to Huntsville's flood problems in the 1960's and 1970's. Most of the streams in the central portion of the City have been modified by straightening and widening and, in many cases, slope paving to make them smoother and easier to maintain. The photo to the right shows how one of the streams, Huntsville Spring Branch, can now carry large flood flows within its banks.

Huntsville Spring Branch was widened and straightened

These projects produced their intended result: flood stages were reduced. Here are some "testimonials" from the 1998 Flood Insurance Study based on data from TVA flood reports.

> The City of Huntsville has an active flood damage reduction program. On some of the flooding sources within the city, protection for floods exceeding a 500-year event is provided. Protection measures include channel straightening, deepening, lining with concrete, and enlarging culverts and bridge openings….
>
> On most small streams in the City of Huntsville, the March 1973 flood produced record discharges, but channel improvements lowered stages at many locations…
>
> The improved channel of Aldridge Creek in the City of Huntsville, reduced the March 1973 crest to a nondamaging stage below the July 1963 flood of record.
>
> …the Dallas Branch channel had been improved, and flooding in March 1973 was not as great as in the July 1963 flood, the previous flood of record… [*Flood Insurance Study*, Madison County, Alabama, Federal Emergency Management Agency, April 20, 1998, pages 11 and 12.]

These projects come at a price. As noted in Chapter 2, the channelization projects "separate people from what could be an aesthetic and recreational resource. These structures do not offer any habitat or provide many natural benefits…."

Channel improvements are not "maintenance free." The photo to the right shows one of the smaller streams that have been lined with concrete. Over the years, the concrete can crack and break up and the channel can collect sediment, debris and growth.

McDonald Creek at Patton Road

> In the City of Huntsville, most of the March 1973 flood damage that occurred on Fagan Creek was to the channel itself. The Creek had been rechanneled and lined, but floodwater undermined the concrete lining and eroded the banks, causing approximately $50,000 in damage. [*Flood Insurance Study*, Madison County, Alabama, Federal Emergency Management Agency, April 20, 1998, page 12.]

2. Bridge and culvert improvements: Bridge and culvert improvements include the replacement, enlargement, or removal of existing bridge decks and culverts at road and railroad crossings over streams. There are three situations where such projects can produce flood control benefits:

1. The original opening was too small to carry much floodwater.

2. Upstream development resulted in increased peak flows so that the existing structure is no longer adequate.

3. Debris can block the opening.

Enlarging the openings, lowering the roadway or approaches, and removing bridges or culverts at abandoned roads or railways can reduce flood heights in that location, but such projects can also transfer the problem downstream.

Local implementation: As reported in the Flood Insurance Study:

> Even with a continual program of channel improvements on some of the streams, Huntsville's flood problems persist because of inadequate bridge and culvert openings, fill in the floodplain at bridge crossings, and residential and commercial encroachment in the floodplains….
>
> Some bridge openings are still insufficient to carry the flows for which the channel improvements are designed, which constricts flow at these structures. [*Flood Insurance Study*, Madison County, Alabama, Federal Emergency Management Agency, April 20, 1998, pages 11 and 12.]

This pipe crossing at Aldridge Creek at Weatherly obstructs higher flows

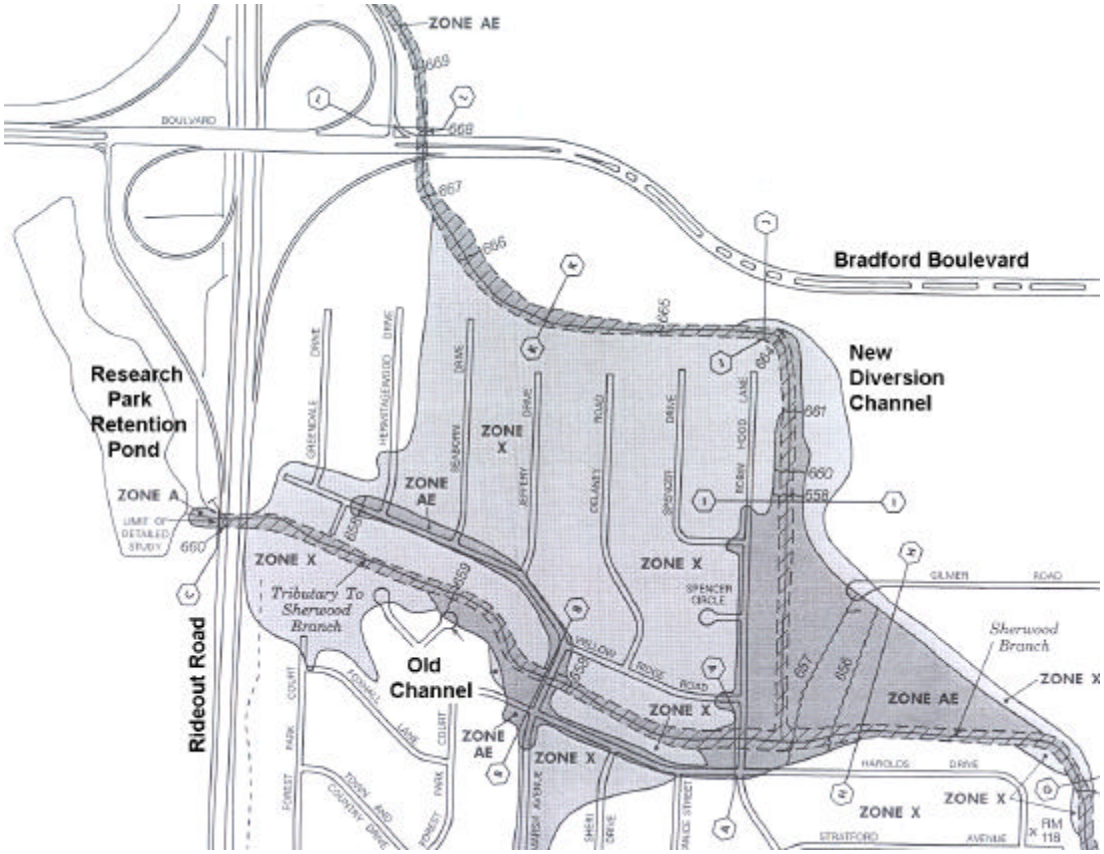
The City's Public Works Services drainage office has compiled a list of undersized bridges and culverts that are known obstructions to flows and maintenance problems. There are several sewer pipe crossings over Aldridge Creek that are proposed for elimination by running a new sewer line down the other side of the channel. Construction of additional projects are limited by available funds.

3. Diversions: A diversion is a new channel that sends floodwaters 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 floodwaters spill over to the diversion channel or tunnel, which carries the excess water to a receiving lake or river.

Diversions are limited by topography; they will not work in some areas. Unless the receiving water body is relatively close to the floodprone stream and the land in between is low and vacant, the cost of creating a diversion can be prohibitive. Where topography and land use are not favorable, a more expensive tunnel is needed.

Local implementation: There is a natural diversion where Huntsville Spring Branch and Indian Creek join during high flows. This is made possible by the very flat terrain in the Arsenal area. In most cases, the watersheds are divided by high ground that would make cutting an open diversion channel too expensive. An example of a man-made diversion is on the next page.

A combination of structural projects



A combination of structural flood control measures reduced flooding substantially in the Sherwood Park subdivision in northwest Huntsville. Sherwood Branch meandered across Rideout Road and entered the subdivision from the west. A straighter, shorter diversion channel was constructed to carry much of the stream around the north and east side. One of the Research Park West ponds acts as a reservoir to store high flows from the old channel and channel improvements to the old channel make it more efficient. The Flood Insurance Rate Map shows the new floodplain as the darker Zone AE.

7.4. Dredging

Dredging removes sediment from the bottom of the stream channel. While it may appear that by making the channel deeper, it will carry more floodwaters, there are four problems with this approach:

1. Given the large volume of water that comes downstream during a flood, removing a foot or two from the bottom of the channel will have little effect on flood heights.

2. Dredging is often cost prohibitive because the dredged material must be disposed of somewhere and the stream will usually fill back in with sediment in a few years.

3. If the channel has not been disturbed for many years, dredging will destroy the habitat that has developed.

4. To protect the natural values of the stream, Federal law requires a Corps of Engineers permit before dredging can proceed. This can be a lengthy process that requires much advance planning and many safeguards to protect habitat.

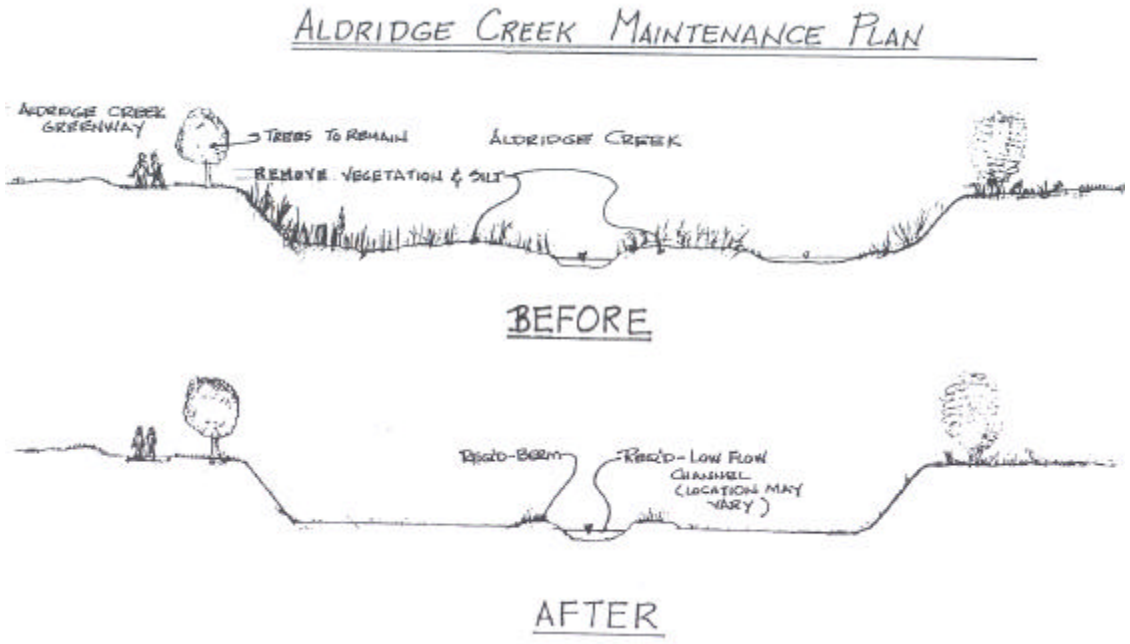
Dredging

Because of these shortcomings, dredging is usually undertaken on larger rivers only to maintain a navigation channel.

Local implementation: The City has periodically dredged channels that have been clogged by sediment. The work has become more complicated because permits are required from the Corps of Engineers.

Only short reaches can be dredged at any one time and many precautions must be taken to minimize disruption of the stream and to ensure that the dredged material is property disposed of. Access to the channel can be a problem, too. Where there is no public access, equipment must be brought up the channel, further disturbing habitat.

Excerpt from the application for the Corps of Engineers dredging permit



In April 1997, the Corps approved a dredging project for Aldridge Creek. It had to be done in 9 segments that were between 200 and 1,300 feet in length. While relatively short sections of the Creek, an estimated 57, 000 cubic yards of sediment were planned for removal. The Corps required a small berm be constructed to channelized low flows for habitat maintenance.

7.5. Drainage System Maintenance

Trash, debris and growth can obstruct a channel or the inlet or outfall to a retention basin. Such obstructions can convert low flows to flooding situations. Channel and detention basin maintenance is an ongoing program to clean out such blockages. This work is usually done by a public works or drainage district crew. These activities normally do not affect the shape of the channel or basin, but they do affect how well they can perform.

Sometimes it is a very fine line that separates debris that should be removed from natural material that helps form habitat. The illustrations on pages 7-10 and 7-11 were prepared by the American Fisheries Society and The Wildlife Society to illustrate cases where "trash" such as downed tree limbs can and should be left in place.

Local implementation: As noted at the beginning of this chapter, drainage maintenance was the most common concern raised by respondents to the City's flood mitigation questionnaire. Generally, public facilities are well maintained while some in private ownership show signs of neglect.

Private retention basin with headwall erosion and growth

Public retention basin incorporated into a highway interchange

A recent map of "drainage maintenance hotspots" prepared by Public Works Services identified problems throughout the City. They fall under the following categories:

14 Debris
9 Concrete channel
4 Undersized pipe or culvert
12 Vegetation growth

This list changes as new problems are reported.

The City has a "Drainage Facilities Maintenance Standard Operating Procedure (SOP)." The SOP assigns the following responsibilities:

- The Engineering Division is responsible for the administration of the SOP and for coordinating inspections.
- The Landscape Management Division is responsible for inspecting and controlling the growth of vegetation in the drainage facilities.
- Public Works Services is responsible for the removal of silt, large obstructions, trash, debris and other items of work requiring heavy equipment and trucks.
- Property owners are responsible for maintaining drainage swales and detention and retention facilities located on their property.

The SOP identifies 41 stream reaches and a dozen detention/retention facilities and lakes that are covered. Inspections are conducted twice a year, during early Fall and before the Spring flood season. Additional inspections of problem sites are conducted after storms, in anticipation of storms, and after reports from citizens or other City offices.

CITY OF HUNTSVILLE

DRAINAGE REQUEST INSPECTION REPORT

DATE: 3-30-00 INSPECTOR: Gerald Self

LOCATION: Identify stream or basin name, downstream and upstream streets or reference points, and location of problem. Provide sketch if needed.

"Dry Creek" – Upper flow line Culvert under Oakwood Rd.

TYPE OF PROBLEM:

____ TRASH X MINOR ____ OBSTRUCTION

RECOMMENDED MAINTENANCE:

Clean Trash & Debris from upper flow line Culvert under Oakwood Rd.

IS EQUIPMENT NEEDED? No IF SO, LIST EQUIPMENT NEEDED:

The SOP formalized previous practices. It was prepared to document those practices and standardize reports for Community Rating System credit. Huntsville receives the maximum credit possible for its drainage system maintenance program.

Smaller ditches are inspected by the Landscape Management Division and the larger "blue line" streams are inspected by Public Works Services. Minor work, such as brush clearing, is managed by the Landscape Management Division, with inmate labor, when available. Heavy equipment is run by Public Works Services. Major obstructions such as culvert damage require approval by the Director of Engineering, which also conducts some inspections.

On public property and drainage easements, trash, tree limbs and other natural debris are removed. On natural streams, the natural debris is not removed unless it causes an obstruction to flows. The City cannot always respond to problems quickly when crews are needed elsewhere.

In practice, City crews have found it easier to maintain streams in public ownership, such as Huntsville Spring Branch. Access is available and there are few trees and other growth to clog the channel. The Capital Improvement Plan for drainage has a goal to increase access points along the major channels, but funds for this are limited.

Definition of Stream Obstruction Conditions

Condition One

These stream segments have acceptable flow and no work would be required. They may contain various amounts of instream debris and fine sediment, such as silt, sand, gravel, rubble, boulders, logs and brush. In certain situations flow may be impeded, but due to stream and land classification or adjacent land-use, this is not a problem.

Condition Two

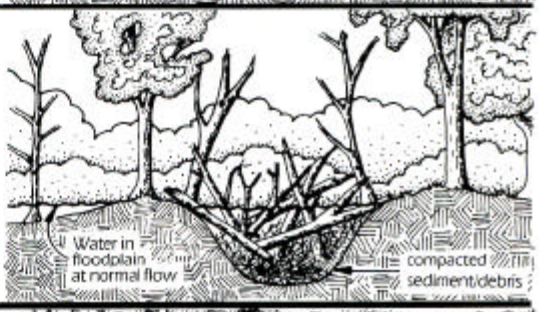
These stream segments currently have no major flow impediments, but existing conditions are such that obstructions are likely to form in the near future, causing unacceptable problems. This condition is generally characterized by small accumulations of logs and/or other debris which occasionally span the entire stream width. Accumulations are isolated, not massive and do not presently cause upstream ponding damages.

Condition Three

These stream segments have unacceptable flow problems. Obstructions are generally characterized by large accumulations of lodged trees, root wads, and/or other debris that frequently span the entire stream width. Although impeded, some flow moves through the obstruction. Large amounts of fine sediment have not covered or lodged in the obstruction.

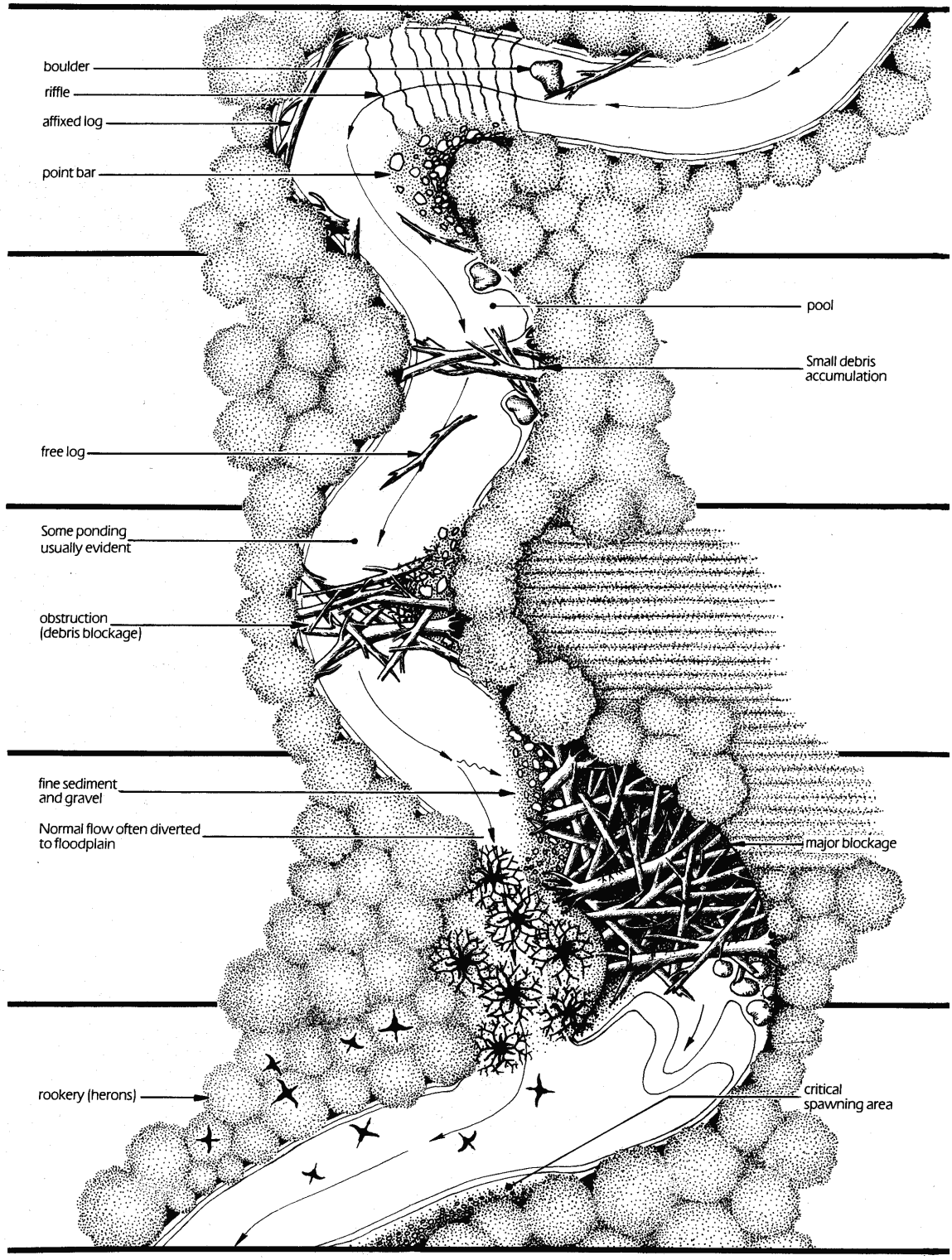
Condition Four

These stream segments are characterized by major blockages causing unacceptable flow problems. Obstructions consist of compacted debris and/or sediment that severely restricts flow.



Condition Five

These stream segments possess unique, sensitive, or especially valuable biotic resources and should be dealt with on a case-by-case basis. Examples include, but are not limited to: Areas harboring rare or endangered species, shellfish beds, fish spawning and rearing areas, and rookeries.



Source: *Stream Obstruction Removal Guidelines,*
The Wildlife Society and American Fisheries Society, 1983

Complicating the City's efforts are State and Federal regulations and the desire by many to maintain the more natural streams, such as portions of Aldridge and McDonald Creeks. Residents don't want trees cut or heavy equipment moving through their yards. Controversy arises when beavers build dams – a natural occurrence that impacts development.

The City is, in effect, caught between the desires of some residents for a "squeaky clean" channel and the desires of others (as well as government regulations) to protect and preserve habitat. The current SOP, being modeled on a national example, does not provide much specific guidance for this type of situation. The guidance on the previous two pages is another national example.

In addition to City maintenance crews, Huntsville has an active voluntary clean up program, Operation Green Team. Adopt-A-Stream is a new Green Team activity with a few participants so far. With one or two exceptions (such as the Sierra Club, which has adopted portions of Aldridge Creek), participants conduct one time only clean ups of reported problem sites. They remove trash and litter, but not all potential obstructions to flow. They rely on donations to cover landfill fees and other expenses.

7.6. Conclusions

1. Structural projects, especially channel modifications, have been used to control flooding in Huntsville. They have reduced the frequency and extent of flooding

2. Channel modifications, especially slope paving, have converted natural streams into man made concrete ditches that are still subject to maintenance needs.

3. There are still sites that could benefit from structural flood control projects, such as bridge and culvert improvements. Construction of additional projects are limited by available funds.

4. The best way to determine the most appropriate flood protection approach is to prepare a watershed plan that looks at all alternatives and designs the most cost effective mix of structural and nonstructural (e.g., acquisition) measures.

5. Dredging has been used in the past, but is becoming more expensive and time consuming. The long term impact and merits of dredging natural streams is debatable.

6. The City has an appropriate program for maintaining channels and basins, but many residents have voiced displeasure with the way it works and resources to correct all the problem sites are limited.

7.7. Recommendations

1. The City should continue to construct flood control projects where they are shown to be the most cost-effective flood mitigation approach.

2. Future flood control projects should incorporate appearance, long-term maintenance, water quality and habitat protection. Design of new projects should be coordinated with parks and landscaping staff.

3. The City's policies and procedures for dredging and channel maintenance should be reviewed in light of the concerns raised in this chapter. Participation in the review process by representatives of streamside residents is recommended.

4. A secured source of funding would help consolidate the City's flood control and maintenance activities and ensure that today's policies and objectives can be implemented over future years.

7.8. References

1. *Drainage Facilities Maintenance Standard Operating Procedure (SOP)*, City of Huntsville, revised 9/1/2000.

2. *Flood Insurance Study*, Madison County, Alabama, Federal Emergency Management Agency, April 20, 1998

3. Department of the Army Permit, City of Huntsville – Engineering Division, Permit No. 44,506, 4/23/97.

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Chapter 8. Natural Resource Protection

Natural resource protection activities are generally aimed at preserving (or in some cases restoring) natural areas. In so doing, these activities enable the naturally beneficial functions of floodplains and watersheds to be better realized. These natural and beneficial floodplain functions include the following:

- storage of floodwaters
- absorption of flood energy
- reduction in flood scour
- infiltration that absorbs overland flood flow
- groundwater recharge
- removal/filtering of excess nutrients, pollutants, and sediments from floodwaters
- habitat for flora and fauna
- recreational and aesthetic opportunities

This chapter reviews four natural resource protection activities that protect floodplains and minimize local flood hazards. Integrating these activities into flood mitigation programs will not only reduce the City's susceptibility to flood damage, but will also improve the overall environment.

1. wetland protection
2. erosion and sedimentation control
3. river restoration
4. best management practices
5. dumping regulations

8.1. Wetland Protection

Wetlands are often found in floodplains and depressional areas of a watershed. Many wetlands receive and store floodwaters, thus slowing and reducing downstream flows. They also serve as a natural filter, which helps to improve water quality, and provide habitat for many species of fish, wildlife, and plants.

Wetlands

- Store large amounts of floodwaters
- Reduce flood velocities and erosion
- Filter water, making it cleaner for those downstream
- Provide habitat for species that cannot live or breed anywhere else

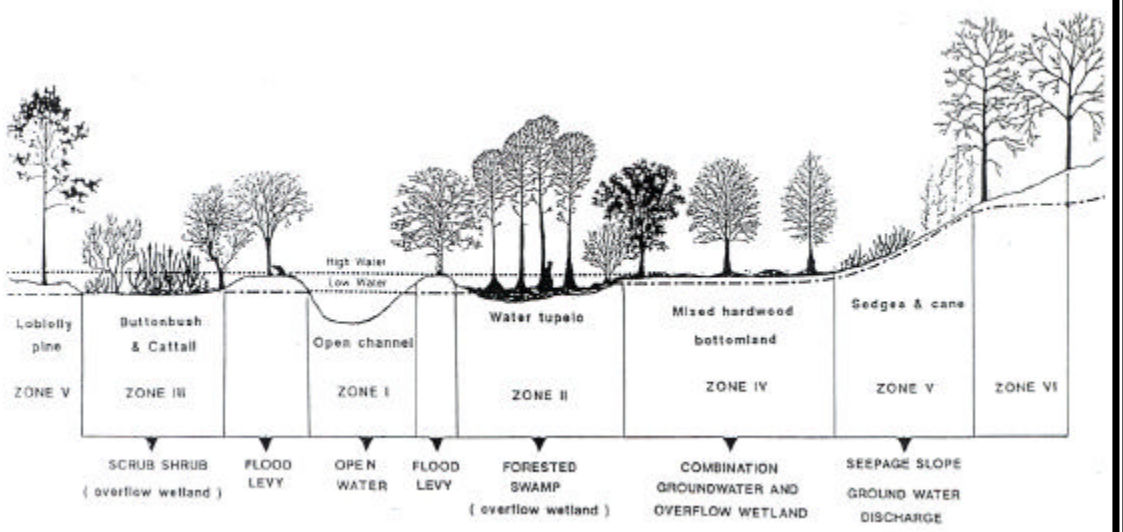
Wetlands are regulated by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency under Section 404 of the Clean Water Act. Before a "404" permit is issued, the plans are reviewed by several agencies, including the Corps and the U.S. Fish and Wildlife Service. Each of these agencies must sign off on individual permits. There are also nationwide permits that allow small projects that meets certain criteria to proceed without individual permits.

Generally, these agencies want to protect wetlands by preventing development that will adversely affect them. If a permit is issued, the impact of the development is typically required to be mitigated. Wetland mitigation can include creation, restoration, enhancement or preservation of wetlands. The appropriate type of mitigation is addressed in each permit.

If the mitigation action is to preserve or develop an equivalent or larger wetland on another site, there are two drawbacks. First, it takes many years for a new wetland to approach the same quality as an existing one. Second, a new wetland in a different location (especially if it's in a different drainage basin) will not have the same flood protection benefits as the original one did.

Another concern with Corps of Engineers wetland regulations, is that the Corps' jurisdiction is limited to wetlands that are connected to the "waters of the United States." A recent court ruling clarified this and limited the Corps' protection even more in small, isolated wetland areas. Many states and communities have their own wetland protection programs. They address the gaps in Federal regulations, particularly to cover smaller wetlands and unregulated activities.

Schematic of Huntsville floodplain community types



Huntsville Advance Identification Project Area Wetlands (draft), page 20

Local implementation: In 1994, City planning and U.S. Environmental Protection Agency staff conducted an Advanced Identification (ADID) project. The objective of ADID is to identify and assess the functions of local wetlands. The ADID results do not have any regulatory authority, but they do provide valuable information for both public and private development planning. The report noted:

> The majority of wetland acreage in the Huntsville ADID project area is characterized as bottomland hardwood forest. This forest category is represented in the project area by three types of wetlands: floodplain forests, wet flat forests, and swamps. Some freshwater marsh and scrub/shrub wetlands exist as well. The floodplain wetlands are the most prevalent of the three forest types.

Wetlands in the Huntsville area are valuable ecosystems. Most that remain in the ADID project area provide important ecological functions in one or more of the following areas: water quality enhancement, flood/storm water detention, and wildlife habitat. Although the majority of wetlands evaluated in depth for this project were impacted to some degree, it was evident that certain functions were still being performed to a noticeable extent by the vast majority of these wetlands. Indications of sediment trapping, flood or storm water retention, and observation of wildlife tracks in wetlands were some of the more common indicators of the functioning of project area wetlands. Evidence of undesirable impacts to adjacent streams or surrounding land where historic wetlands no longer exist was further indication of the need for protection of these systems….

Heather Spring, a wetland on the Arsenal

Because of much larger adjacent acreages of wetlands on Redstone Arsenal and Wheeler National Wildlife Refuge that provide vital habitat for waterfowl and other terrestrial and aquatic animals, project area wetlands are important as corridors and buffer areas for wildlife survival.

A few sub-basins in particular are at higher risk for increased future water quality and flooding problems. The Flint River system on the eastern edge of the project area has undergone significant floodplain wetland loss, and experienced three severe flooding events in the past thirty years. The Aldridge Creek basin has lost almost all of its wetland acreage due to urbanization of the watershed…. In all the above situations, channelization of portions of these systems has created or exacerbated water quality and quantity problems…. [*Technical Summary Document, Environmental/Regulatory Planning for the Huntsville Advance Identification Project Area Wetlands (draft)*, City of Huntsville Planning Department, 1994, pp. iv and v]

The report estimated that there were 2,800 acres of wetland in Madison County, of which, less than 1,000 are in the City of Huntsville. It also estimated that the City has lost at least 70% of its wetlands since 1947.

In addition to the 404 regulations, developers must meet the requirements in the City's Subdivision Regulations. An environmental assessment is required for all proposals in environmentally sensitive areas. The Site Assessment Report must include "Recommendations for mitigating all located and described on-site hazards and sensitive environmental features" (Section 3.2(3)D(v)). Developers must avoid disrupting wetlands or mitigate the impact of the development on them.

J. D. and Annie S. Hays Nature Preserve

8.2. Erosion and Sedimentation Control

Farmlands and construction sites typically contain large areas of bare exposed soil. Surface water runoff can erode soil from these sites, sending sediment into downstream waterways. Sediment tends to settle where the river slows down and loses power, such as when it enters a lake or a wetland.

Huntsville construction site

Construction projects expose large areas to erosion.

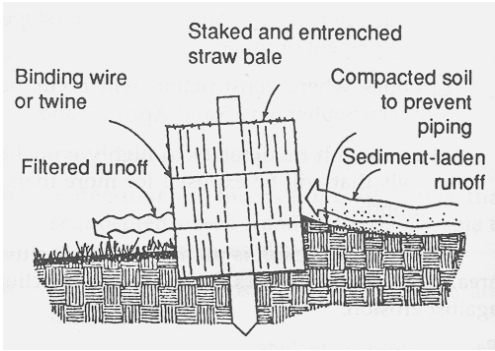
Sedimentation will gradually fill in channels and lakes, reducing their ability to carry or store floodwaters. When channels are constricted and flooding cannot deposit sediment in the bottomlands, even more is left in the channels. The result is either clogged streams or increased dredging costs.

Not only are the drainage channels less able to do their job, but the sediment in the water reduces light, oxygen, and water quality and often brings chemicals, heavy metals and other pollutants. Sediment has been identified as the nation's number one nonpoint source pollutant for aquatic life.

Practices to reduce erosion and sedimentation have two principal components:

1. minimize erosion with vegetation and
2. capture sediment before it leaves the site.

Straw bales catch sediment

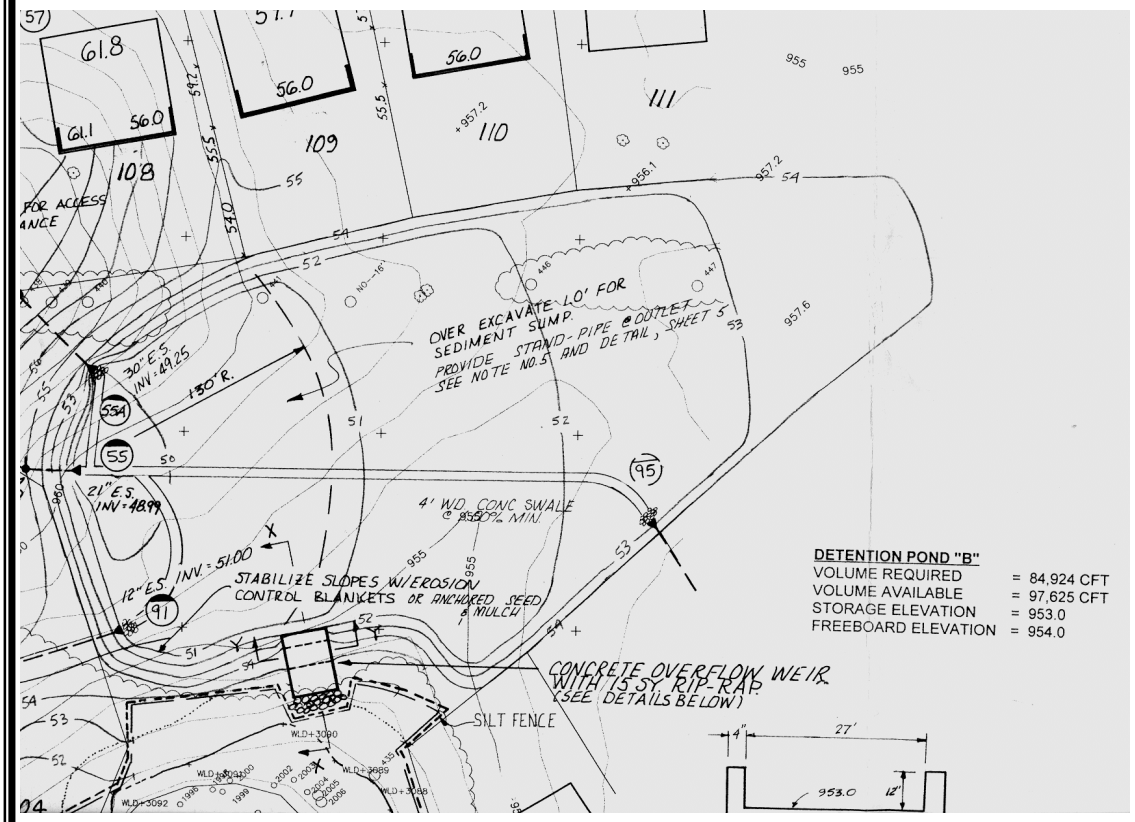


Slowing surface water runoff on the way to a drainage channel increases infiltration into the soil and reduces the volume of topsoil eroded from the site. Runoff can be slowed down by measures such as terraces, contour strip farming, no-till farm practices, sediment fences, hay or straw bales (as illustrated) , constructed wetlands, and impoundments (e.g., sediment basins and farm ponds).

Erosion and sedimentation control regulations mandate that these types of practices be incorporated into construction plans. They are usually oriented toward construction sites rather than farms. The most common approach is to require applicants for permits to submit an erosion and sediment control plan for the construction project. This allows the applicant to determine the best practices for the site.

One tried and true approach is to have the contractor design the detention basins with extra capacity. They are built first, so they detain runoff during construction and act as sediment catch basins. The extra capacity collects the sediment that comes with the runoff until the site is planted and erosion is reduced (see example next page).

Erosion and sediment control plan



Local implementation: All projects reviewed by the Engineering Division include grading plans. The Division makes sure that erosion and sedimentation control provisions are included. This procedure has two possible shortcomings.

1. Some projects, such as single family homes, don't go to the Engineering Division.

2. As with other regulations discussed in Chapter 4, it is up to the Inspection Division to ensure that the plans are properly implemented.

Inspection staff do not check sites to ensure that the erosion and sedimentation control plans are being followed. Since the Engineering Division is the agency responsible for these provisions, the Inspection Division leaves inspection and enforcement up to Engineering.

Huntsville construction site

A careless contractor allowed the silt fence to fall into the channel, sending large amounts of sediment into Sherwood Branch.

8.3. River Restoration

There is a growing movement that has several names, such as “stream conservation,” “bioengineering” or “riparian corridor restoration.” The objective of these approaches is to return streams, streambanks and adjacent land to a more natural condition, including the natural meanders. Another term is “ecological restoration” which restores native indigenous plants and animals to an area.

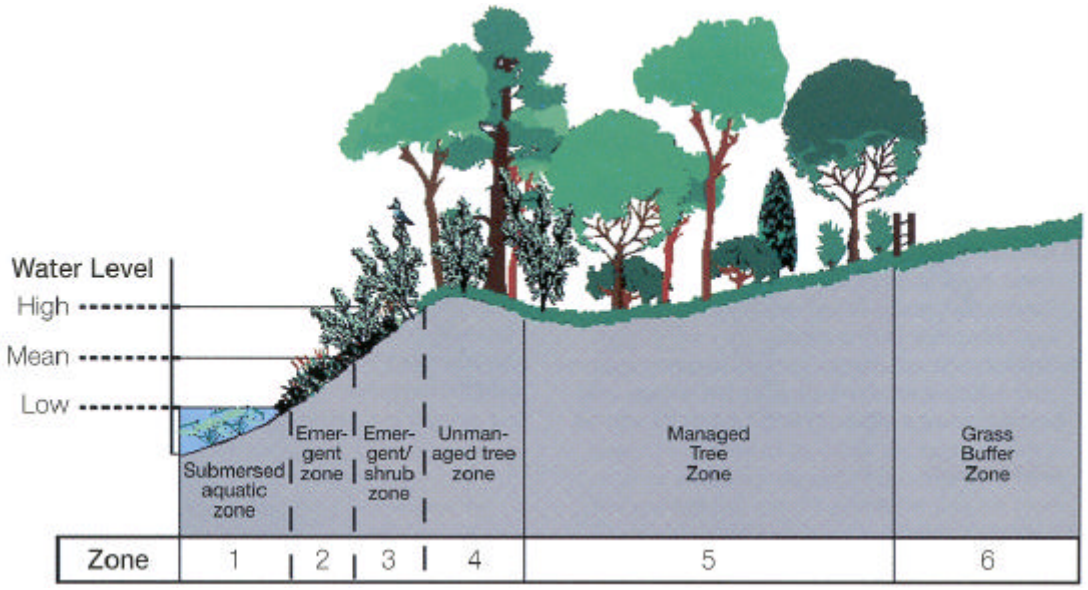
A key component of these efforts is to use appropriate native plantings along the banks that resist erosion. This may involve “retrofitting” the shoreline with willow cuttings, wetland plants, and/or rolls of landscape material covered with a natural fabric that decomposes after the banks are stabilized with plant roots.

Studies have shown that after establishing the right vegetation, long term maintenance costs are lower than if the banks were concrete. The Natural Resources Conservation Service estimates that over a ten year period, the combined costs of installation and maintenance of a natural landscape may be one-fifth of the cost for conventional landscape maintenance, e.g., mowing turf grass.

The Tennessee Valley Authority is a proponent of river restoration. It notes that restoring the right vegetation to a stream has the following advantages:

- reduces the amount of sediment and pollutants entering the water
- enhances aquatic habitat by cooling water temperature
- provides food and shelter for both aquatic and terrestrial wildlife
- can reduce flood damage by slowing the velocity of water

Aquatic and riparian buffer plant zones



Source: *Banks and Buffers – A Guide to Selecting Native Plants for Streambanks and Shorelines*, Tennessee Valley Authority

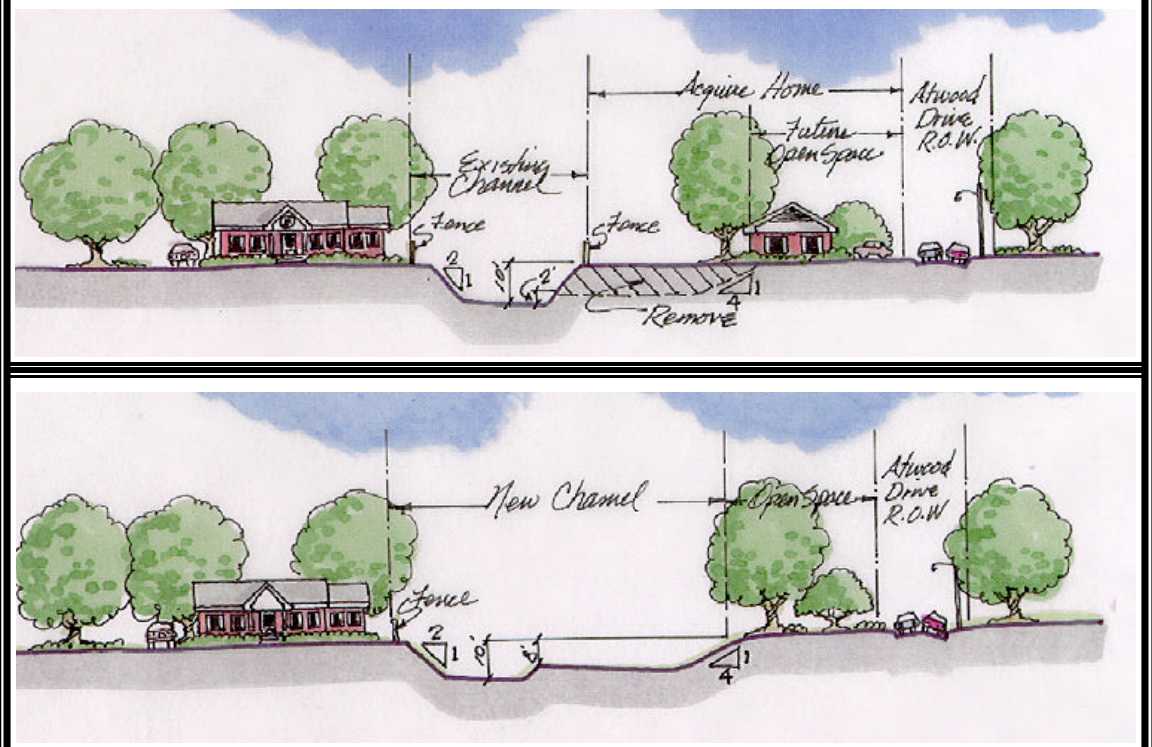
- increases the beauty of the land
- increases property value
- prevents property loss due to erosion
- provides recreational opportunities (hunting, fishing, bird watching)

Different types of plants are used in different buffer zones along a channel (see previous page). Zone 1 plants are normally submerged while zone 2 plants are inundated during much of the growing season. Zone 3 plants are water tolerant, but are flooded only during high water. By using the proper plants in each zone, they stabilize streambanks, filter polluted runoff, and provide habitat.

Local implementation: As noted in Chapters 2 and 7, Huntsville is ripe for an alternative to its traditional concrete channels. There are problems with "natural" streambanks, too. A December 2000 report by the City Forester reviewed the status of 90 trees along a reach of a tributary to Aldridge Creek. The report noted that 2/3 of the trees are too close to the banks and are leaning over or will probably have to be removed as part of a bank stabilization effort. The Forester recommended replanting with different types of trees.

Alternatives to concrete channels have been considered in City flood control plans. Recent plans for Aldridge Creek proposed acquiring some buildings close to the channel so it could be widened. This would allow the channel to carry more water and would provide land to extend the greenway (see the illustration below). Incorporating bioengineered banks and other habitat amenities would be easy to include in the plans.

New channel concept



Aldridge Creek presentation by Ogden Environmental and Energy Services

The Greenways Plan includes incorporating buffers along streams. These are setbacks that allow natural growth along the banks which also filter runoff into the stream. Another benefit of greenways is that they bring the public closer to the river and the riparian corridor. People learn to appreciate the streams and want to keep them as recreational and natural amenities, and not view them as just ditches to carry water.

8.4. Best Management Practices

Point source pollutants come from pipes such as the outfall of a municipal wastewater treatment plant. They are regulated by the Alabama Department of Environmental Management (ADEM). *Nonpoint source* pollutants come from non-specific locations and are harder to regulate. Examples of nonpoint source pollutants are lawn fertilizers, pesticides, and other farm chemicals, animal wastes, oils from street surfaces and industrial areas and sediment from agriculture, construction, mining and forestry. These pollutants are washed off the ground's surface by stormwater and flushed into receiving storm sewers, ditches and streams.

Best management practices ("BMPs") are measures that reduce nonpoint source pollutants that enter the waterways. BMPs can be implemented during construction and as part of a project's design to permanently address nonpoint source pollutants.

There are three general categories of BMPs:

1. Avoidance: setting construction projects back from the stream.

2. Reduction: Preventing runoff that conveys sediment and other water-borne pollutants, such as planting proper vegetation and conservation tillage.

3. Cleanse: Stopping pollutants after they are en route to a stream, such as using grass drainageways that filter the water and retention and detention basins that let pollutants settle to the bottom before they are drained.

In addition to improving water quality, BMPs can have flood related benefits. By managing runoff, they can attenuate flows and reduce the peaks after a storm. Combining water quality and water quantity measures can result in more efficient multi-purpose stormwater facilities.

Because of the need to clean up our rivers and lakes, there are several laws mandating the use of best management practices for new developments and various land uses. The farthest reaching one is the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) requirements.

Local implementation: In part to meet Federal and State NPDES requirements, the City enacted the Storm Water Quality Control Ordinance in 1998. This ordinance is intended to control the discharge of pollutants to the City's storm sewer system. Specifically the ordinance

- prohibits the illicit discharge of pollutants to the City system,
- prohibits the dumping, spilling or disposal of materials into the storm sewers, and
- controls the discharge of pollutants to the system from sites of industrial activity.

"High risk facilities" (including hazardous material facilities and landfills) and facilities which have significant materials exposed to stormwater are required to develop a Best Management Practice plan for preventing stormwater pollution. Natural Resources Division staff inspects industrial operations and responds to 30 – 40 complaints each year. The Water Quality Control Ordinance focuses on industrial sites, high risk facilities and intentional discharges of pollutants. It charges commercial properties with keeping trash out of the sewer system, but it does not set special requirements for, say residential construction or incorporating water quality provisions into retention and detention basins.

The City has its own good practices. It uses sand instead of road salt for icy streets and it sweeps the streets to pick up potential sediment and some of the more common nonpoint source pollutants.

8.5. Dumping Regulations

NPDES and the Water Quality Control and Sewer Use Ordinances address liquid pollutants. Dumping regulations address solid matter, such as shopping carts, appliances and landscape waste that can be accidentally or intentionally thrown into channels or wetlands. Such materials may not pollute the water, but they can obstruct even low flows and reduce the channels' and wetlands' ability to convey or clean stormwater.

Many cities have nuisance ordinances that prohibit dumping garbage or other "objectionable waste" on public or private property. Waterway dumping regulations need to also apply to "nonobjectionable" materials, such as grass clippings or tree branches which can kill ground cover or cause obstructions in channels.

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

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

Local implementation: Ordinance 88-419, Section 20-264, prohibits depositing "any article or material the would tend to impede the flow of water…" Code enforcement officers respond to dumping complaints and can cite violators. The City is receiving CRS credit for this regulation.

The Environmental Section of the Madison County Health Department helps clean up dumping sites and will prosecute violators. The County had a grant to set up a video camera at problem sites. Recent enforcement has reduced the number of violations.

The City's Operation Green Team has tried a program used by many other communities: stenciling messages at storm sewer inlets reminding people that what they dump goes into the streams. There have been some operational problems with using school children on this approach and it has not been expanded.

8.6. Conclusions

1. A flood mitigation program can take advantage of interest in protecting wetlands and natural floodplain functions and utilize natural resource protection programs to support flood protection.

2. While wetlands and other areas have been damaged in the past, the current regulations on wetland protection, erosion and sediment control and dumping have effective standards. However, there are some gaps in enforcement.

3. The move toward river restoration and nonpoint source best management practices are encouraging trends, but many property owners and developers are still learning about appropriate procedures.

8.7. Recommendations

1. The City should incorporate river restoration-type approaches in plans for channel improvements and maintenance.

2. Standards for best management practices for stormwater management facilities should be reviewed to see if they should be expanded to include all types of developments, not just industrial.

3. City procedures should be reviewed to close any gaps in enforcement of existing ordinances.

8.8. References

1. *Alabama Handbook For Erosion Control, Sediment Control, And Stormwater Management On Construction Sites And Urban Areas*, Alabama State Soil And Water Conservation Committee, June, 1992, as amended.

2. *Banks and Buffers – A Guide to Selecting Native Plants for Streambanks and Shorelines*, Tennessee Valley Authority, 1997

3. *A Citizens' Guide to Protecting Wetlands in Alabama*, Southern Environmental Law Center, 1990.

4. *Living With Wetlands, A Handbook for Homeowners in Northeastern Illinois*, The Wetlands Initiative, 1998

5. *Restoring Streams to Reduce Flood Loss*, National park Service and Trout Unlimited, 2000 (brochure)

6. *Solid Waste Ordinance* (Ordinance 88-419), City of Huntsville

7. *Stormwater Management Manual*, City of Huntsville, 1991, as amended

8. *Stream Corridor Restoration Principles, Processes and Practices*, Federal Interagency Stream Restoration Working Group, 1998. Copies available through the USDA Natural Resource Conservation Service.

9. *Subdivision Regulations*, City of Huntsville

10. *Tackling Nonpoint Source Pollution in Madison County*, Susan Weber, available through the U.S. Fish and Wildlife Service.

11. *Technical Summary Document, Environmental/Regulatory Planning for the Huntsville Advance Identification Project Area Wetlands (draft)*, City of Huntsville Planning Department, 1994

12. *Trees along Aldridge Creek Tributary 10 between Blevins Gap Road and Willowbrook Drive*, Chuck Weber, City Forester, Huntsville, Alabama, December 6, 2000.

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Chapter 9. Public Information

A successful hazard mitigation program involves both the public and private sectors. Public information activities advise property owners, renters, businesses, and local officials about flood hazards and ways to protect people and property from these hazards. These activities can motivate people to take flood protection steps and protect the natural and beneficial functions of floodplains and watersheds.

The Community Rating System provides special credit for a "public information program strategy." The strategy must be prepared by a public/private group, like the Flood Mitigation Planning Committee. It must cover six points, which are addressed in various sections of this *Plan*:

(1) The local flood hazard (covered in Chapter 2 Problem Description of this *Plan*),
(2) The flood safety and property protection measures appropriate for that hazard (in Chapters 5 and 6),
(3) The flood-related public information activities currently being implemented within the community (including those by non-government agencies) (addressed in this Chapter 9),
(4) Goals for the community's public information program (goals are in Chapter 3),
(5) The outreach projects that will be done each year to reach the goals (in Chapter 10's Action Plan), and
(6) The process that will be followed to monitor and evaluate the projects (in Chapter 10's Action Plan).

Therefore, this *Flood Mitigation Plan* qualifies as Huntsville's public information program strategy for CRS credit. There are six general public information activities that are covered in this chapter:

1. map information
2. library
3. outreach projects
4. technical assistance
5. real estate disclosure
6. educational programs

9.1. Map Information

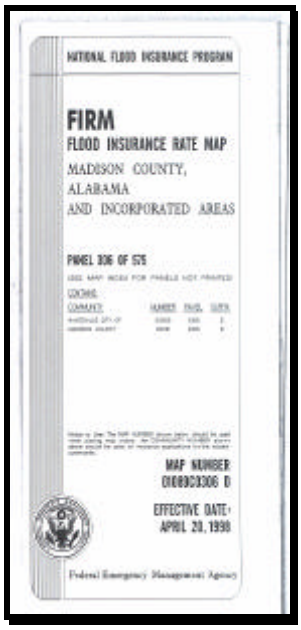
Many benefits stem from providing map information to inquirers. Residents and businesses who are aware of the potential flood hazards can take steps to avoid problems and/or reduce their exposure to flooding. Real estate agents and house hunters can find out if a property is floodprone and whether flood insurance may be required.

Flood maps have a wealth of information about past and potential flood hazards. However, they can be hard to obtain and many people have trouble reading maps. Therefore, communities that provide map information from FEMA's Flood Insurance Rate Maps (FIRMs) perform a valuable public information service. Communities may also assist

residents in submitting requests for map amendments and revisions when they are needed to show that a building is outside the mapped floodplain.

Communities can often supplement what is shown on the FIRM with maps that complement and clarify the FIRM and information on additional hazards, flooding outside mapped areas and zoning. When the information is provided, community staff could also explain flood insurance, property protection measures and mitigation options that are available to property owners.

Users and inquirers need to remember that maps are not perfect; they display only the larger floodprone areas that have been studied. Some maps are based on data that are more than 20 years old. In some areas, watershed developments make even recent maps outdated. A map information service needs to remind inquirers that being outside the mapped floodplain is no guarantee that a property will never get wet.


NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
MADISON COUNTY,
ALABAMA
AND INCORPORATED AREAS

PANEL 306 OF 575

MAP NUMBER
01089C0306 D

EFFECTIVE DATE:
APRIL 20, 1990

Federal Emergency Management Agency

Local implementation: The City's Engineering Division provides a map information service. Publicity materials advise people to call 427-5300 to find out if a property is in the FIRM's floodplain.

Engineering Division staff receive at least 30 calls each week. Their work is greatly facilitated by having the FIRMs entered into the GIS. The City receives the maximum CRS credit for this service. Their workload would be eased if access to the GIS were made available to the public through a web site. However, there are some technical and legal complications that would need to be worked out.

The Engineering Division has also initiated requests to revise the FIRM where better local data shows corrections that are needed and when new flood studies provide more accurate data.

Other hazards: The City has or can prepare maps that identify areas subject to other site-specific hazards, such as sinkholes and landslides. These have been used for planning and regulatory purposes, but could be made more accessible to the public.

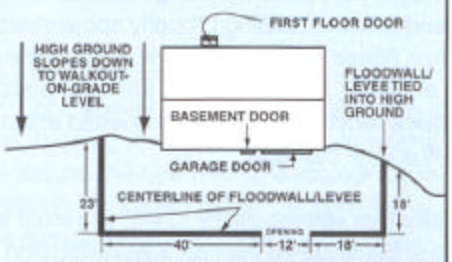
9.2. Library and Web Sites

The community library and local web sites are obvious places for residents to seek information on flooding, flood protection, and protecting natural resources. Historically, libraries have been the first place people turn to when they want to research a topic. Interested property owners can read or check out handbooks or other publications that cover their situation. Libraries also have their own public information campaigns with displays, lectures, and other projects, which can augment the activities of the local government.

Excerpt from FEMA's *Homeowner's Guide to Retrofitting*, a reference that is available at both the Huntsville Library and FEMA's web site, www. FEMA.gov

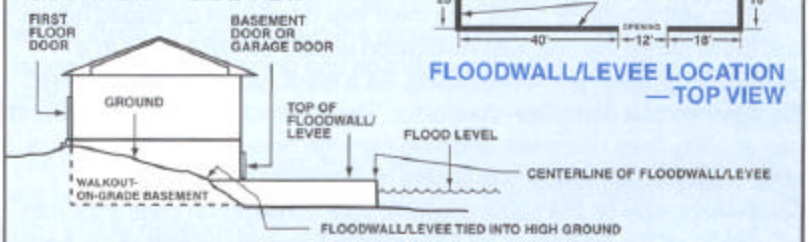
SAMPLE COST ESTIMATE

It may be helpful to consider two examples, in which a 40-foot by 25-foot house with a walkout-on-grade basement is protected by a 4-foot-high levee or a floodwall of the same height. In these examples, the floodwall/levee encloses an area at the walkout-on-grade level at the back of the house, ties into existing high ground on the sides of the house, and contains one opening that can be used for pedestrian or vehicle access (see figures).



FLOODWALL/LEVEE LOCATION — TOP VIEW

FLOODWALL/LEVEE LOCATION — SIDE VIEW



Levee:

Length of levee = 99 feet (not including opening)

Construction cost = $69 per linear foot x 99 feet = **$6,831**
Cost of interior drainage system = **$4,200** (lump sum)

Size of opening = 4 feet high by 12 feet wide = 48 square feet
Cost of closure = 48 square feet x $73 per square foot = **$3,504**

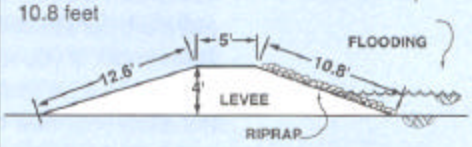
Area of levee face requiring riprap =99 feet x 10.8 feet = 1,069 square feet

Riprap required (assuming thickness of 1 foot) = 1,069 cubic feet = 40 cubic yards
Cost of riprap = $31 per cubic yard x
40 cubic yards = **$1,240**

Area of property to be reseeded is assumed to be top of levee (5 feet), face of levee on house side (12.6 feet), and a 5-foot-wide strip on each side of levee. Total width = 27.6 feet. Total area to be reseeded = 99 feet (length of levee) x 27.6 feet = 2,732 square feet.
Cost of reseeding = 2,732 square feet x $0.05 per square foot = **$137**

Total Cost of Levee = $15,912 or approximately $143 per linear foot (including closure)

With a height of 4 feet and a slope of 2.5:1 the face of the levee on the water side would span 10.8 feet



CROSS-SECTION SHOWING DIMENSIONS OF A 4-FOOT-HIGH LEVEE

Floodwall:

Length of floodwall is same as length of levee = 99 feet
Construction cost = $124 per linear foot x 99 feet = **$12,276**
Cost of interior drainage system = **$4,200** (lump sum)
Cost of closure is same as for levee = **$3,504**
Cost of reseeding is same as for levee = **$137**

Total Cost of Floodwall = $20,117 or approximately $181 per linear foot (including closure)

NOTE

The costs for levee construction can vary greatly depending on the distance between the construction site and the source of the fill dirt used to build the levee. The greater the distance that fill dirt must be hauled, the greater the cost.

Today, web sites are becoming more popular as research tools. They provide quick access to a wealth of public and private sites and sources of information. The Community Rating System is expected to grant municipal web sites a similar level of credit as public libraries.

Local implementation: The Huntsville Madison County Public Library has a collection of flood-related and flood protection documents in the Information and Periodicals Department. The material cannot be checked out, but can be read during regular library hours and copied on available copying machines.

The Library's collection includes:

- the Madison County FIRM
- documents on flood insurance
- FEMA and Corps of Engineers publications on property protection
- the City's *Stormwater Management Manual*
- directories of sources of assistance

The city receives close to the maximum CRS credit for this collection. Huntsville's web site, *www.ci.huntsville.al.us*, provides a good deal of information about the City's government, services and regulations. As yet there is no information targeted on flood protection, although the activities of the Flood Mitigation Committee are posted.

9.3. Outreach Projects

Mapping and library activities are not of much use if no one knows they exist. An outreach project can remedy this. Sending notices to floodprone property owners can help introduce the idea of property protection and identify sources of assistance.

Outreach projects are the first step in the process of orienting property owners to property protection and assisting them in designing and implementing a project. They are designed to encourage people to seek out more information and take steps to protect themselves and their properties.

The CRS provides the most credit for outreach projects that are mailed or otherwise distributed to floodprone property owners or to everyone in the community. Other approaches include the following:

- displays in public buildings or shopping malls
- articles and special sections in newspapers
- radio and TV news releases and interview shows
- flood protection video for cable TV programs or to loan to organizations
- presentations at meetings of neighborhood, civic or business groups
- floodproofing open houses
- web site with hyperlinks to other sources of information
- elementary school curriculum on flood preparedness and flood safety

Research has proven that outreach projects work. However, awareness of the hazard is not enough; people need to be told what they can do about the hazard, so projects should include information on flood safety and property protection measures. Research has also shown that a properly run local information program is more effective than national advertising or publicity campaigns. Therefore, outreach projects should be locally designed and tailored to meet local conditions.

Local implementation: Outreach projects conducted by Huntsville include:

- Flood safety tips, flood insurance, property protection measures and drainage maintenance, are discussed in the "Yellow Book's" "Customer Guides" pages. This is distributed to all properties in the City.

- A brochure on flood insurance (see box) that is provided in racks in public places.

- Both of the above projects publicize the City's map information service.

- A display board has been prepared for meetings with the public explaining the causes and effects of obstructing or altering local drainage (see boxes, below).

- During the preparation of this *Plan*, the public access cable TV channels 3 and 42 ran notices of Committee and public meetings and videos on flood protection topics, such as planning, property protection and flood safety.

From the City's portable display

The fence in the picture obstructs a drainage swale between houses and is built on an easement. This can divert surface drainage into a neighbor's yard and the fence may have to be removed at the owner's expense.

From the City's portable display

Any obstruction in gutters can increase flooding during heavy rainfall. Leaves, grass clippings, and trash cans can plug sewer inlets and cause street flooding.

– Operation Green Team provides speakers to groups interested in keeping Huntsville and its streams clean.

– Comcast Cable (channel 3) periodically plays public service announcements on flood insurance.

These efforts have rated relatively low for CRS credit. The City is receiving 47 out of a possible 250 points. The chart to the right notes that the City's projects could cover more topics for more CRS credit.

Up to 130 points are available for a direct mailing to all floodplain residents. The mailing would have to clearly state that the recipient is in a floodplain and subject to flooding. This message has been shown to motivate people to take flood protection measures more than general discussions about the City's flood problems.

CRS credits for outreach projects

Topic	Yellow Book	Floodplain Mailing	Other Projects *
Local flood hazard	5		4
Flood safety	4		4
Flood insurance	8		4
Property protection			
Natural & beneficial functions			
Local flood hazard map			
Flood warning system	2		4
Permit requirements			
Substantial improvement/damage			
Drainage maintenance	4		4
Maximum possible points	60	130	* 60

* Credit for other projects will be replaced by 100 points for this *Plan's* public information strategy.

9.4. Technical Assistance

While general information helps, most property owners do not feel ready to retrofit their buildings without help or guidance. Local building department staff are experts in construction. They can provide free advice, not necessarily to design a flood protection measure, but to steer the owner onto the right track.

Some building department or public works staff visit properties and offer suggestions. Most can recommend or identify qualified or licensed companies, an activity that is especially appreciated by owners who are unsure of the project or the contractor.

Technical assistance can be provided in one-on-one sessions with property owners or can be provided through seminars. For instance, seminars or "floodproofing open houses" can be provided on retrofitting floodprone structures, selecting qualified contractors, and carrying out flood preparedness activities.

Another effective technique is called a *flood audit*. A property protection expert visits a floodprone site, locates past and potential (e.g., the 100-year) flood depths on the property, and discusses alternative protection measures with the owner. The owner is given a written report with recommendations and a photograph of the property showing flood depths.

Local implementation: The City publicizes that it provides the following service:

> The City of Huntsville Engineering Division has qualified engineers who are knowledgeable and can give you advice on how to protect your home and property from flooding. City engineers will also make site visits to review flooding, drainage, and sewer problems and provide one-on-one advice to property owners to discuss solutions and remedies to their problems. The engineers will also review flood maps and discuss your property concerns about past flooding and the potential for future flooding. They will also review existing maps and information to determine the approximate depth of flooding in your flood hazard area.

City staff providing technical assistance

This service draws over 100 calls for assistance each month.

9.5. Real Estate Disclosure

Many times after a flood or other natural disaster, people say they would have taken steps to protect themselves if only they had known they had purchased a floodprone property. Federally regulated lending institutions must advise applicants for a mortgage or other loan that is to be secured for a building that the property is in a floodplain as shown on the FIRM.

However, because this requirement has to be met only 10 days before closing, often the applicant is already committed to purchasing the property when he or she first learns of the flood hazard.

A property in need of flood hazard disclosure

State laws and practices by local real estate boards can overcome this deficiency and advise newcomers about the hazard earlier. They may also require disclosure of past flooding or sewer problems, regardless of whether the property is in a mapped floodplain.

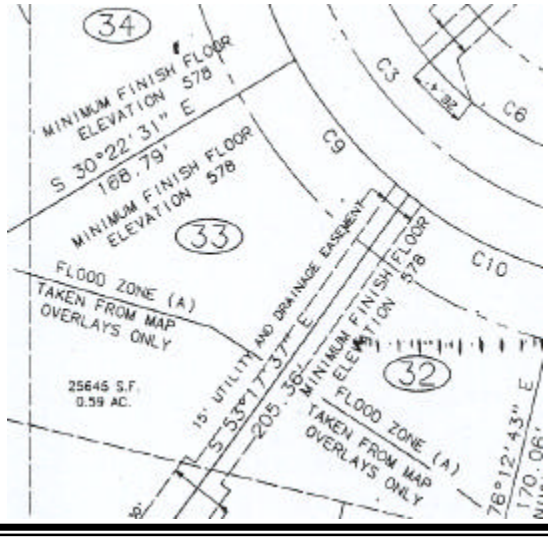
The Community Rating System provides up to 46 points for notifying house hunters that the property is in the mapped floodplain. Additional points are provided for notifying people about other hazards, such as erosion and landslides.

Local implementation: The City of Huntsville's Subdivision Regulations require that the final subdivision plat show:

- the floodplain boundary
- the floodway boundary
- the lowest allowable finished floor elevation for each lot

As noted in Chapter 4, the Subdivision Regulations also require that the final plat show all restricted use areas and note whether a geotechnical investigation was conducted. This information is filed with the official records for the subdivision and would be seen during a title search or other review of the property records.

Subdivision Plat Easement and Flood Hazard Disclosure Example



These provisions receive a small amount of CRS credit. The real points are obtained if real estate agents disclose the hazard when a house hunter is first interested in a property.

Alabama is considered a "buyer beware" state in the real estate industry. There is a state law that requires disclosure of health or safety hazards, but to date that has not been considered to include flooding. If the seller or the real estate agent are aware of latent or hidden structural defects, they must disclose them, but there is no consistently practiced system to check flood maps before a property is listed for sale.

Such a system would not be difficult to initiate. Over 95% of the active real estate agents participate with the Multiple Listing Service of the Huntsville Board of Realtors®. Local agents and the MLS have access to FEMA's "Q3" floodplain map. A more accurate system would use the City's GIS. CRS credit would be provided if the flood zone was included with each property's MLS listing.

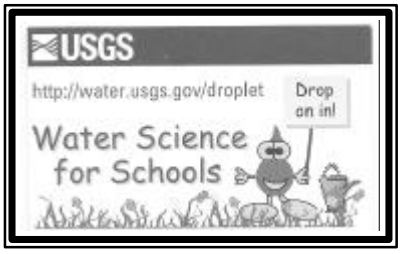
9.6. Educational Programs

A community's most important asset is its children, the future generations who will inherit the resources, infrastructure and development left to them. They will be facing the same natural forces that cause periodic flooding. The watersheds and floodplains will be theirs to farm, build on and care for.

Environmental education programs can teach children about flooding, the forces that cause it, the factors that cause flood problems, and the significance of protecting the natural and beneficial functions of watersheds and floodplains. These programs can be undertaken by schools, park and recreation departments, conservation associations, and youth organizations, such as the Boy Scouts, Campfire Girls and summer camps. An activity can be as involved as course curriculum development or as simple as an explanatory sign near a river.

Educational programs do not have to be limited to children. Often adults learn about innovative concepts or new ideas from their children. If the children come home with an assignment for their new water quality monitoring project, the parents become interested in finding out about water quality monitoring.

There are many programs that provide support and curriculum materials for school and other educational programs. These include web sites ("FEMA for Kids," USGS' "Water Science for Schools," etc.), posters, coloring books, games, and references. There are hands-on models where students can see the effects of different land use practices (see below).



US EPA's tabletop watershed model

Local implementation: Huntsville City Schools follow the required state curriculum. The guidelines for the earth science courses of study for the various grade levels show the progression of flood-related concepts that are taught:

K – 2 Identify the Earth's features in the local community.
Examples: lakes, rivers, mountains, beaches, valleys, plains
Relate events in daily life to aspects of weather patterns.
Examples: appropriate clothing, outdoor activities, safety precautions
Recognize the impact of weather, e.g., drought, flood and structural damage

3 – 5 Describe the water cycle.
Identify geological features of the Earth.

6 – 8 Describe reasons for monitoring soil, air, and water for dangerous levels of harmful substances.

9 – 12 Discuss factors that affect the dynamic equilibrium of ecosystems.
Disasters – Examples: fire, flood
Activities of organisms – Example: human impact, management, and conservation of natural resources

Aquascience elective
Demonstrate knowledge and skill in management of water for aquaculture, e.g., sources of water, water quality management

Geology elective
Identify the characteristics of a local watershed, e.g., average annual rainfall, run-off patterns, aquifers, location of river basins, reservoirs
Analyze factors that impact watersheds, e.g., floods, droughts, urban development, industrialization, irrigation

Earthscope: Huntsville City Schools has received special funding from a solid waste grant to run Earthscope. All City schools can participate and almost all of the students do. Fourth graders take an all day field trip from the headwaters to the mouth of Aldridge Creek. They stop at different spots to discuss nonpoint source pollution, channelization, the greenway, etc.. They also take water samples.

Fifth graders spend a day at the wetlands in Redstone Arsenal. This program provides a unique opportunity to review flooding, flood hazards and natural and beneficial floodplain functions with every public school student in the City.

9.7. Conclusions

1. There are many ways that public information programs can be used so that people and businesses will be more aware of the hazards they face and how they can protect themselves.

2. Some of the public information activities can be implemented by City staff.

3. Other public information activities require coordination with the educational activities in schools and other potential partners.

4. The City is receiving at or close to the maximum possible Community Rating System credit for several of its public information services, but only one-fifth of the possible credit for its outreach projects and less for flood hazard disclosure.

9.8. Recommendations

1. The City should implement and publicize the following services that will inform and assist property owners who want to protect themselves from flooding.

    a. Providing map and flood hazard data to inquirers. The City should pursue making this readily available to anyone via the City's web site.

    b. Making site visits to review problems and providing advice to the owner

    c. Providing the library and other offices with a list of appropriate flood protection references, government publications, Internet web sites and maps.

2. The following projects should be implemented to disseminate the messages on flood hazard mitigation and City services.

    a. News releases and news articles on flood protection measures and the progress of implementing this *Flood Mitigation Plan* should be prepared for the local media.

    b. A flood protection page should be developed for the City's web site, including links to other sites that would help Huntsville residents.

    c. Flood-related videos and news tapes should be regularly shown on the public access cable TV channel and be available for loan to interested organizations.

    d. A homeowner's flood protection manual should be prepared, made available for interested residents and businesses and given to other media that want to cover flood protection.

    e. A mailing should be sent to floodplain property owners and tenants each year, to remind them of the hazard, identify City flood services, and review ways they can protect themselves and their property.

    f. Staff should make presentations at meetings of neighborhood associations.

    g. Staff should make presentations at meetings of interested groups, such as contractors and teachers.

    h. Staff should investigate other means of disclosing flood hazards and meet with the Huntsville Board of Realtors® to discuss possible approaches.

3. Public information activities should cover the following topics:

    a. What the City is doing about flooding, stormwater and water quality
    b. The City's map information and technical assistance services
    c. Where residents can get help with flooding issues
    d. The City's flood hazard
    e. Flood safety
    f. Flood insurance
    g. Property protection measures that property owners can take on their own
    h. The natural & beneficial functions of Huntsville's floodplains
    i. The City's flood warning system and signals
    j. Permit requirements
    k. The Substantial improvement/damage
    l. Drainage maintenance responsibilities of property owners

4. The City should develop sinkhole and landslide risk maps, make people aware of the risks, and publicize the availability of insurance for homes and businesses.

9.9. References

1. *CRS Credit for Outreach Projects*, Federal Emergency Management Agency, 1999

2. February 20, 2001, interview with Larry Perreault, Huntsville Board of Realtors®

3. *Floodproof Retrofitting: Homeowner Self-Protective Behavior*, Shirley Bradway Laska, University of Colorado, 1991.

4. *Stormwater Management Public Information Resource Guide*, South Suburban Mayors and Managers Association, 1999

Chapter 10. Action Plan

10.1. Summary of Conclusions

This section summarizes the conclusions drawn in the previous chapters. The parentheses after each statement refer to the conclusions in Chapters 2 and 4 – 9. For example, "(2.12, 1 and 2)" means that the statement summarizes the first and second conclusions listed in section 2.12 of Chapter 2.

The problem (Chapter 2)

1. There are 29 square miles and 6,066 developed properties in the base or 100-year floodplain. These numbers mean that 17% of the City's land area and 6.7% of the City's developed property are subject to overbank flooding. (2.12, 1 and 2)

2. There are 749 improved properties in the floodway, the area of deepest and swiftest flooding. The floodway is also the area of greatest importance to habitat and with the greatest recreation potential. (2.12, 2 and 9)

3. While recent floods did not affect all the City's watersheds, they did cause considerable property damage where they did occur. Floods also present hazards to safety, health and mental health. (2.12, 3, 5 and 7)

4. Construction of channel improvements and storage basins has lowered, but not eliminated, the flood threat on some streams. (2.12, 4)

5. The City is subject to damage and threats to safety and health from tornadoes, winter storms, sinkholes, landslides, dam failure, and earthquakes. (2.12, 8)

6. Floodplains provide natural and beneficial functions and improve the recreational opportunities for City residents. Historically, flood protection work has produced channels that are not visually appealing and have little water quality, habitat or recreational benefit. (2.12, 9)

7. Without appropriate regulatory constraints, future development will increase flood heights, reduce water quality and damage habitat. (2.12, 10)

Preventing the problem from getting worse (Chapters 4 and 8)

1. The Greenway Plan, zoning ordinance and subdivision regulations are Huntsville's primary tools used to manage development in the floodplain. Other potential tools, such as an open space plan, are not currently used. (4.8, 1 and 2)

2. The City's floodplain regulations meet or exceed the minimum national requirements. Because minimum national standards do not cover all of Huntsville's needs, the City requires new buildings to be protected one foot higher than the national requirement. (4.8, 3 and 8.6, 2)

3. The City's standards for stormwater detention cannot be considered effective in managing increased runoff from development for storms greater than the 10-year storm. The 10-year storm is an appropriate standard for the minor drainage system, but the first floor of buildings should be protected from larger floods through proper design of the detention storage volume and outlets. Provisions need to be made to protect people and property from stormwater flows during larger storm events. (2.12, 5 and 4.8, 5)

4. The City's procedures for administering regulations on floodplain construction should be streamlined with clear lines of responsibility between the Engineering and Inspection Divisions to be sure all requirements are met. (4.8, 4 and 8.6, 2)

5. The most effective approaches to managing stormwater runoff in any particular location are best determined by a stormwater management master plan. The City is initiating such plans. They should include best management practices that address nonpoint sources of pollution (4.8, 6 and 8.6, 1 and 3)

Reducing flood damage to existing properties (Chapters 5 and 7)

1. There are a variety of ways to reduce damage to existing properties, including structural projects to control floodwaters, acquisition, elevation, floodproofing, and emergency response steps taken during a flood. Each has been shown to work in Huntsville, but each approach has its own advantages and disadvantages. Some are best implemented by the City and some are the responsibility of the property owner. Watershed planning is the best way to determine the most appropriate flood damage reduction measure(s) for an area (5.10, 1 and 7.6, 1, 3 and 4)

2. A program to reduce damage to existing properties should focus on the floodway, where there are 749 improved properties in this area of deepest and swiftest flooding. The floodway should be the initial focus for acquisition projects where the acquired land can be converted to open space and greenways. (5.10, 1 and 7.6.3)

3. Construction of flood protection projects is limited by available funds. Property owners can pay for some property protection measures, such as floodproofing in low hazard areas, but the measures needed in other areas require public funding support. (5.10, 2 and 4 and 7.6, 3)

4. Channel modifications, including slope paving of channels, and dredging have been two of the City's more common flood protection approaches. While channel modifications are effective, these approaches are expensive and can have adverse impacts on water quality, habitat, and downstream flooding. (7.6 2 and 5)

5. Given available resources, the City has an appropriate program for maintaining channels and basins to ensure that they keep their design flood protection levels, but many residents have voiced displeasure with the way it works. (7.6, 6)

Responding to a flood (Chapter 6)

1. The City's ability to provide flood warning and detailed flood response plans is limited to the Tennessee and Flint Rivers. Because many other Huntsville watersheds respond to rainfall in two hours or less, early flood warning on other streams is hampered by a lack of real-time rain and stream gages and local storm forecasts. (6.6, 1, 2 and 3)

2. An improved flood response plan is dependent on early flood warning and flood stage forecast maps. (6.6, 4 and 5)

3. Critical facilities that will be affected by flooding should be identified and included in flood response planning. (6.6, 6)

Informing the public (Chapter 9)

1. There are many ways that public information programs can be used so that people and businesses will be more aware of the hazards they face and how they can protect themselves. The following are currently being implemented:

    a. Providing map information
    b. Providing references on flood mitigation topics in the library
    c. Flood protection videos and information on cable TV
    d. Advice on technical aspects of property protection
    e. Hazard disclosure on subdivision plats
    f. Educational programs in the schools (9.7, 1, 2 and 3)

2. The residents and businesses of Huntsville have a relatively low level of knowledge about the following flood mitigation topics:

    a. The various ways they can protect their own property from flooding. (5.10, 3)
    b. The availability and coverage provided by flood insurance. (5.10, 3)
    c. What to do when a flood warning is issued. (6.6, 3)
    d. The City's channel maintenance program (7.6, 5)

3. There are opportunities for improved public information services, including:

    a. Providing more information and links on the City's web site
    b. Outreach projects that reach more people and cover more topics
    c. Providing real estate agents with flood hazard information (9.7, 4)

10.2. Program Action Items

General recommendations appear at the end of Chapters 4 – 9 for each of the six mitigation strategies. This section converts those general recommendations to specific action items. This section is organized according to the office that would be responsible for them. If more than one office is identified, the action item is listed under the lead agency.

For each action item, the action plan identifies the goal(s) and objective(s) from Chapter 3 that the action item supports and the recommendation(s) in Chapters 4 - 9 that are being implemented. These recommendations and the discussions in the earlier chapters provide more background and direction on these action items.

Following this section, Section 10.4 lists the public information action items and Section 10.5 reviews additional tasks needed to administer and support these proposals. At the end of Section 10.5 is a matrix that summarizes the action items and the offices responsible for them.

Several action items refer to the Mitigation Committee. This organization is proposed for creation when this *Plan* is adopted (Action Item # 14).

Action Plan Highlights

There are 16 individual action items to be implemented by 13 offices and agencies. Together they recommend:

- New floodplain maps and models as the basis for regulations and watershed plans (# 1, 2).
- Acquiring and clearing the floodway and expanding parks and greenways (#2, 6)
- Reviewing and upgrading regulatory standards and procedures for new development (#3, 4, 5, 7)
- Changes in stream maintenance (#8)
- Improved flood preparedness (#9, 10)
- More information and assistance to the public (#11, 12)
- A new stormwater utility to finance needed projects (#15)
- Follow through mechanisms to ensure the plan is implemented (#14, 16)

Each of the recommended actions has an associated cost. These costs are beyond the resources currently allocated for flooding and stormwater management. Consequently, new funding sources must be identified as noted in Action Item # 15.

Engineering Division

1. Floodplain mapping

a. Description: Prepare watershed models and floodplain maps for all of the City's floodprone areas. Each model and map should include the following:

1) Hydrologic and hydraulic computer models of the surface water flows in the watershed that can be used to evaluate alternative flood protection measures and the impact of new developments on drainage and flooding. The Aldridge Creek study is an example of this.

2) A map of the base floodplain and floodway that can be submitted to FEMA for a revision of the Flood Insurance Rate Map if appropriate. The Aldridge Creek study is an example of this.

3) A flood stage forecast map for major historical floods, the 10-, 25- 50-, 100-, and 500-year floods, and the 100-year floodplain based on a fully urbanized watershed for use in flood protection planning and emergency management.

4) Maps for watersheds with substantial areas outside the City limits should be based on the assumption that the watersheds are fully developed without retention or detention. This assumption should account for the lower density development expected in unzoned areas without sanitary sewers.

b. Supporting goal(s) and objective(s): 1.a, 2.a, 2.d, 2.e, 3.a, 3.b, 5.a

c. Recommendation reference(s): 4.8, 6.1

d. Deadline:

1) December 31, 2001: Prepare the flood stage forecast map for Aldridge Creek
2) December 31, 2003: Prepare the floodplain, floodway and flood stage forecast maps where studies are underway for the Huntsville Spring Branch tributaries of Pinhook Creek, Dallas Branch, Fagan Creek and Broglan Branch.
3) December 31, 2006: Finish the preparation of the floodplain, floodway and flood stage forecast maps for the rest of the watersheds (if funds are available).

e. Estimated cost:

1) The flood stage forecast map for Aldridge Creek: $10,000
2) Models and maps for the Huntsville Spring Branch tributaries: $900,000
3) Developing the watershed models and map the remaining watersheds: $4,100,000.

2. Watershed plans

a. Description: With input from the Planning and Natural Resources Divisions, prepare master flood protection plans using the models and mapping developed pursuant to the previous action item. Each plan should include the following:

1) An inventory of the floodprone buildings, critical facilities and infrastructure and the threat to life, safety and health in the area.

2) An evaluation of structural and property protection measures (and combinations of those measures) that will protect lives, safety, health and existing development. The evaluation would compare the effectiveness of all feasible alternatives including regional retention basins, channel modifications, acquisition, relocation and floodproofing. The evaluations should examine:

(a) The benefits and costs of the alternatives,
(b) Their impact on natural areas, habitat and water quality, and
(c) How they can support other objectives of the community, such as expansion of open space and greenways and economic development.

3) Priority should be given to acquiring properties in the floodway.

4) Recommendations for those measures that will protect the greatest amount of property at the least cost to the City. The recommendations should also identify whether the flood protection benefits would exceed the construction and long term maintenance costs of the flood protection portion of the recommended projects.

5) Determination of the best approach to managing stormwater runoff from new development in the watershed, including locations for regional detention facilities.

6) Incorporation of river restoration-type approaches and greenway expansion in plans for channel improvements on major streams and appropriate tributaries.

7) Incorporation of appearance, long-term maintenance, preservation of wetlands and other sensitive areas, water quality and habitat protection in project design.

8) An analysis of the costs and benefits of installing gages needed to detect and predict downstream flooding.

9) An evaluation of the impact of zoning changes on flooding, based on the watershed models that will be developed.

b. Supporting goal(s) and objective(s): 1.c, 2.a, 2.d, 2.e, 4.a, 4.b, 4.c, 4.d

c. Recommendation reference(s): 4.1, 4.5, 5.1, 5.3, 6.1, 6.2, 7.1, 7.2, 8.1,

d. Deadline:

1) December 31, 2001: Prepare the watershed plan for Aldridge Creek
2) December 31, 2003: Complete the watershed plan for the Pinhook Creek area being studied by the Corps of Engineers.
3) December 31, 2001: Develop a priority list for plans for the remaining watersheds and submit it to the Mitigation Committee.

e. Estimated cost:

1) The watershed plan for Aldridge Creek: $100,000
2) The watershed plan for the Pinhook Creek area (after the watershed model has been developed): $100,000
3) Plans for the remaining watersheds: $3,000,000 - $7,000,000

3. Stormwater management regulations

a. Description: With the Natural Resources, Inspection, Planning and Legal Divisions, review the standards and procedures in the Subdivision Regulations and the Stormwater Management Manual for new development. The review should in-

clude engineers and technical advisors who are familiar with stormwater management practices in Huntsville and in other communities. The review should consider the following concerns:

1) Appropriate standards to ensure that post-development flows leaving a development will not cause increased damage to downstream properties.

2) City inspections to ensure maintenance of new stormwater management facilities that will be located on private property.

3) Best management practices that protect water quality and other provisions to meet upcoming NPDES requirements.

4) Replacement of the Manual's regulatory standards with watershed specific criteria when watershed plans are completed and adopted (Action Item #2).

5) The impact of different standards and procedures on the cost of development and the long term costs of flooding and facility maintenance.

b. Supporting goal(s) and objective(s): 2.b, 3.a, 3.b, 3.c, 4.c

c. Recommendation reference(s): 4.5, 4.6,

d. Deadline: December 31, 2002: Submit a report to the Mitigation Committee

e. Estimated cost: Staff time. Several efforts, such as inspecting privately owned stormwater management facilities and the more intensive review of the impact of new developments are well above current staffing levels. Additional funding in the neighborhood of $60,000 per year will be needed.

4. Floodplain regulations

a. Description:

1) Ensure that the City meets all regulatory provisions required by the National Flood Insurance Program or credited by the Community Rating System.

2) With the Inspection, Planning, Natural Resources and Legal Divisions, review the floodplain regulations and identify construction standards that are more appropriate for Huntsville's flood conditions. The following are recommended by the Flood Mitigation Planning Committee and are credited under the Community Rating System. The details on these measures are discussed in Chapter 4, section 4.6.

(a) Standards to protect floodplain fill from erosion and scour
(b) Prohibiting critical facilities from all or parts of the floodplain
(c) Prohibition of health hazards
(d) Buffers adjacent to streams or natural areas
(e) Restrictions on use of enclosures below elevated buildings

(f) Drainage plans for all buildings, including those not in the floodplain

b. Supporting goal(s) and objective(s): 2.b, 2.c, 3.a, 3.b, 3.c, 4.b, 4.c, 4.d

c. Recommendation reference(s): 4.3, 8.2

d. Deadline: December 31, 2002: Submit draft revisions to the Mitigation Committee

e. Estimated cost: Staff time

Planning Division

5. Zoning Ordinance

a. Description: With the Engineering, Inspection, Natural Resources and Legal Divisions, review the Zoning Ordinance to insure that the standards for new construction in the floodplain are appropriate. Once the new watershed models and floodplain maps are available, a procedure should be adopted to evaluate the flood impact caused by zoning changes to assure that they do not have detrimental impacts on flooding and drainage.

b. Supporting goal(s) and objective(s): 2.c, 3.a, 3.b, 3.c, 4.b, 4.c, 4.d

c. Recommendation reference(s): 4.2, 4.3, 8.2

d. Deadline: December 31, 2002: If the review concludes that revisions are needed, submit a draft ordinance amendment to the Mitigation Committee

e. Estimated cost: Staff time

6. Open Space Plan

a. Description: Prepare an open space plan with associated funding recommendations, including stable funding through the Capital Improvement Program, to facilitate protection of land to provide flood protection and recreation benefits. The plan should be coordinated with watershed plans (Action Item #2) with an objective of acquiring properties in the floodway that will result in open space or greenways that will benefit the entire community.

b. Supporting goal(s) and objective(s): 2.c, 3.a, 3.b, 4.b, 4.c, 4.d

c. Recommendation reference(s): 4.1

d. Deadline: June 30, 2002: Submit a draft plan to the Mitigation Committee

e. Estimated cost: Staff time

Inspection Division

7. Regulatory procedures

a. Description:

1) With the Engineering, Natural Resources, Planning and Legal Divisions, review the City's procedures for development plan review, permit issuance and inspections to ensure that all the floodplain and stormwater regulations that are dependent on more than one office are properly and fully enforced.

2) With the Emergency Management Agency, review the procedures to be followed after a flood to ensure that all repairs and reconstruction will meet the requirements of the National Flood Insurance Program. The procedures should account for potential disaster assistance and other sources of funding for mitigation opportunities.

3) Conduct an annual review of the procedures to identify whether any further changes are needed.

b. Supporting goal(s) and objective(s): 2.b, 2.c, 3.a, 3.b, 3.c, 4.c

c. Recommendation reference(s): 4.2, 4.3, 4.4, 4.6, 6.5, 8.3

d. Deadline:

1) September 30, 2001: Identify all current procedures that involve more than one office.
2) November 30, 2001: Determine appropriate measures to correct any problems.
3) August 31 each year: Conduct an annual evaluation of the procedures.

e. Estimated cost: Staff time

Public Works Services

8. Drainage maintenance program

a. Description: In cooperation with the Engineering, Natural Resources, and Landscape Management Divisions and the Public Information and Operation Green Team offices, prepare new drainage system maintenance procedures.

1) Include streamside residents and interested organizations in the preparation of the procedures.
2) Account for the requirements of relevant agencies and programs, including ADEM, the Corps of Engineers, NPDES and the Community Rating System.
3) Incorporate cooperative efforts by streamside residents and the general public.
4) Incorporate maintenance standards and procedures that will protect sensitive areas and habitat.

5) Review the long term costs and benefits of dredging and alternative ways to reduce sedimentation.

b. Supporting goal(s) and objective(s): 2.a, 2.c, 2.f, 3.a, 3.b, 4.c, 4.d, 5.b

c. Recommendation reference(s): 7.3, 8.1, 8.2

d. Deadline: June 30, 2002: Submit draft procedures to the Mitigation Committee

e. Estimated cost: Staff time

Emergency Management Agency

9. Pilot flood response plan

a. Description: In conjunction with law enforcement, fire and medical response agencies, prepare a pilot flood response plan for one floodplain.

1) Use a flood stage forecast map prepared pursuant to Action Item #1 Floodplain mapping.
2) Evaluate the costs and benefits of the plan, with and without rain and stream gages that would provide early flood detection.
3) Evaluate the costs and benefits of a flood warning system for the City.

b. Supporting goal(s) and objective(s): 1.c, 2.a, 2.d

c. Recommendation reference(s): 6.1, 6.2, 6.3, 6.4

d. Deadline: Within 6 months of completion of the flood stage forecast map

e. Estimated cost: Staff time

10. Critical facilities plans

a. Description: Identify the critical facilities that are affected by flooding. Work with their managers to determine any special flood warning and response support they may need from the City and encourage them to prepare their own flood response plans.

b. Supporting goal(s) and objective(s): 1.c, 2.a, 2.d

c. Recommendation reference(s): 6.3, 6.4

d. Deadline:

1) December 31, 2001: Submit a list of critical facilities affected by flooding to the Mitigation Committee
2) August 31, 2002: Prepare a model critical facility flood response plan

e. Estimated cost: Staff time

10.3. Public Information Strategy

These two action items are listed separately to facilitate credit under the Community Rating System.

Engineering Division

11. Ongoing public information activities

a. Description: In cooperation with the Public Information Officer and the Mitigation Committee, ensure that the following ongoing information and technical assistance activities are implemented:

   1) Providing map and flood hazard information to inquirers
   2) One-on-one advice and assistance on flood protection measures
   3) Providing references to the library
   4) Issuing news releases and news articles
   5) Making presentations at meetings of associations and interested groups

   The above activities should cover the following topics:

   1) The City's flood hazards and floodprone areas
   2) What the City is doing about flooding and stormwater problems
   3) Flood warning and safety procedures
   4) Drainage maintenance rules and procedures
   5) Self-help property protection measures
   6) Flood insurance
   7) Regulatory requirements and procedures
   8) Protecting water quality and natural and beneficial floodplain functions

b. Supporting goal(s) and objective(s): 1.a, 1.b, 2.a, 5.b

c. Recommendation reference(s): 5.2, 5.3, 5.4, 9.1, 9.2, 9.3

d. Deadline: ongoing

e. Estimated cost: Staff time

12. New public information projects

a. Description: In cooperation with the Public Information Officer and the Mitigation Committee, design and initiate the following new activities:

   1) Publicity of property protection projects that have been constructed by Huntsville homeowners
   2) Incorporating a flood protection web page in the City's web site
   3) Providing a library of flood-related videos to the public access cable TV channel.

4) Preparing a homeowner's flood protection manual
5) Conducting an annual mailing to floodplain addresses
6) Coordination with the Huntsville Board of Realtors® to discuss City support of disclosure of flood hazards
7) Preparation of sinkhole and landslide hazard maps and public information materials to explain them and insurance.

b. Supporting goal(s) and objective(s): 1.a, 1.b, 2.a, 5.b

c. Recommendation reference(s): 5.2, 5.3, 5.5, 9.1, 9.2, 9.3

d. Deadline:

1) December 31, 2001: Publicize existing property protection projects
2) December 31, 2001: Incorporate a flood protection web page on the City's web site
3) December 31, 2001: Provide flood-related videos to the public access cable TV channel.
4) December 31, 2002: Publish a homeowner's flood protection manual
5) July 31, each year: Conduct an annual mailing to floodplain property owners and tenants
6) December 31, 2001: Meet with the Huntsville Board of Realtors®
7) December 31, 2003: Prepare sinkhole and landslide hazard maps

e. Estimated cost:

1) Construction and publicity of a city-funded demonstration property protection project: Incorporated as part of a watershed plan's flood protection project
2) Homeowner's flood protection manual:
   Drafting: staff time
   Printing 2,000 copies of a 16 page booklet: $1,600
3) Annual mailing to floodplain property owners and tenants (annual cost)
   Printing 7,000 copies of a 6 page letter: $2,100
   Postage: $2,380

4) Other activities: Staff time

10.4. Administrative Actions

This section reviews the additional action items that are needed to administer and support the recommendations of the two previous sections. As such, some are not related to specific goals, objectives or mitigation recommendations in the previous chapters.

Mayor and City Council

13. Plan adoption

a. Description: Adopt this *Flood Mitigation Plan* by passing the resolution in Section 10.6. The resolution creates the Mitigation Committee which is described in Section 10.5. The Mayor should appoint its members at the time the resolution is passed.

b. Deadline: August 31, 2001

c. Estimated cost: Staff time

Mitigation Committee

14. Program oversight

a. Description: Monitor implementation of the Action Plan and report on progress and recommended changes to the Mayor and City Council.

   1) The format of the report is described in the resolution in Section 10.6. An annual evaluation of the plan's implementation is required for credit under the Community Rating System.

   2) A public information subcommittee should be created to monitor and evaluate the public information strategy. Its members should include representatives of the following offices (and do not need to be members of the full Committee):

      (a) Public Information Officer
      (b) Planning Division
      (c) Engineering Division
      (d) Natural Resources Division
      (e) Inspection Division
      (f) Public Works Services
      (g) Operation Green Team
      (h) American Red Cross
      (i) Huntsville City Schools
      (j) Neighborhood associations
      (k) Other interested organizations

   3) After this Flood Mitigation Plan is well underway, the Committee should address other mitigation activities, including:

(a) Encouraging coordination of City watershed mapping, plans and regulations with Madison County and the City of Madison.
(b) Hazard mitigation activities for other hazards
(c) Becoming a Project Impact community

b. Supporting goal(s) and objective(s): 5.b

c. Deadline:

1) September 1 each year: Submitted the annual evaluation report to the Mayor and City Council. This timing coincides with the plan evaluation report that must be submitted by October 1 for CRS credit.
2) July 31, 2006: A five year update is required for continuing credit of this *Plan* under the Community Rating System
3) Timing of the other activities depend on the Committee's ability to take on additional work.

d. Estimated cost: Staff time

15. Stormwater utility

It is estimated that the City of Huntsville will need to spend in the neighborhood of $9 million per year if it is to significantly reduce flood losses over the next 10 – 20 years. This is the estimated total of current expenditures, the cost of the *Plan's* action items (see box), and the expected cost of implementing the watershed plans.

Current sources of revenue for flood protection and stormwater management activities are stretched to their limits. There are funding sources that have not been used, but there are many policy and financial issues that need to be reviewed and settled before a recommendation can be submitted to the Mayor and City Council.

Estimated Plan Costs

Action Item	Estimated Annual Cost
1. Floodplain mapping	$1,000,000
2. Watershed plans	$1,000,000
3. Stormwater mgmt regulations	$60,000
4. Floodplain regulations	Staff time
5. Zoning ordinance	Staff time
6. Open space plan	Staff time
7. Regulatory procedures	Staff time
8. Drainage maintenance program	Staff time
9. Pilot flood response plan	Staff time
10. Critical facilities plans	Staff time
11. Ongoing public information	Staff time
12. New public information projects	$6,000
13. Plan adoption	Staff time
14. Program oversight	Staff time
15. Stormwater utility	$5,000
16. Community Rating System	Staff time
Total estimated annual dollar costs	$2,071,000

These figures are the estimated annual costs for the recommended action items. For action items 1, 2, and 15, the estimated annual cost is the estimated total cost divided by 5 years. *Note:* These are only the costs of the recommended action items. They do not include the operations, administrative, maintenance and capital improvements costs being expended by the City for current flood and stormwater management activities. These numbers do not include the cost of implementing the recommendations of the watershed plans, which could run up to $5 million each year.

a. Description: Determine the appropriate mechanisms and rates for establishing a stormwater user fee or utility. This method of financing flood protection and stormwater management activities is being used by more and more communities around the country. It has proven to be stable, adequate, flexible and equitable. It deserves special attention as the recommended funding mechanism. Include the following in this work:

> **Stormwater Utility**
>
> A stormwater utility is based on the premise that each property should be charged according to how much it uses the system (i.e., how much stormwater runoff it generates). Everyone pays (unlike a tax, no one is exempt). Each single family home would pay a base rate while other properties would pay according to their "equivalent residential unit" amount of impervious surface.

1) Prepare a description of the benefits, costs, and operational aspects of a stormwater utility.
2) Prepare an estimate of the annual stormwater management and flood protection financing needs of Huntsville
3) Develop a budget that shows how the income will be used.
4) Develop rates that are fair to all users of the stormwater system.
5) Keep the public informed
6) Review other sources of income, such as charging for reviewing new development's stormwater plans and/or flood protection measures (currently the City does not charge for this extra permit review)

b. Supporting goal(s) and objective(s): 5.d

c. Recommendation reference(s): 7.4

d. Deadline: Prepare a report to the Mayor and City Council by December 31, 2001

e. Estimated cost: Staff time. Technical consultant for stormwater utility feasibility study: $25,000.

Engineering Division

16. Community Rating System

a. Description: Submit a modification to the CRS, after sufficient action items are implemented to warrant the additional credit. The City currently has 1,016 points for a Class 8. A Class 7 will produce a 15% flood insurance premium reduction and an average annual saving to Huntsville property owners of $44 per flood insurance policy. The City will need 1,500 points. The 500 new points can be obtained by implementing the following action items:

1) 100 points – Action item #3: amendments to stormwater management regulatory standards
2) 100 – 200 points – Action item #4: amendments to the floodplain regulations
3) 120 points – Action item #9: annual mailing to floodplain properties
4) 46 points – Action item #9: initiating a real estate agent flood hazard disclosure program

5) 290 points – Action item #10: adopting this *Plan* and its public information program strategy (these credits are dependent on conducting the annual evaluations and submitting progress reports to the Mayor and City Council)
6) Additional credits will be provided over the years as new mapping and watershed plans are prepared.

b. Supporting goal(s) and objective(s): 5.c

c. Recommendation reference(s): 4.3, 6.6,

d. Deadline: Within 2 months of implementation of enough action items to warrant the class modification.

e. Estimated cost: Staff time

Matrix of Action Items by Responsible Office

Action Item	Mayor and City Council	Mitigation Committee	Engineering	Inspection	Planning	Natural Resources	Landscape Management	Public Works Services	Public Information	Legal	Operation Green Team	Emergency Management	Other organizations
1. Floodplain mapping			**L**										
2. Watershed plans			**L**		S	S							
3. Stormwater mgmt regulations			**L**	S	S	S				S			
4. Floodplain regulations			**L**	S	S	S				S			
5. Zoning ordinance			S	S	**L**	S				S			
6. Open space plan			S		**L**	S	S						
7. Regulatory procedures			S	**L**	S	S							
8. Drainage maintenance program			S			S	S	**L**	S		S		
9. Pilot flood response plan			S									**L**	
10. Critical facilities plans			S									**L**	
11. Ongoing public information		S	**L**						S				
12. New public information projects		S	**L**						S				
13. Plan adoption	**L**												
14. Program oversight		**L**	S	S	S	S	S	S	S		S	S	S
15. Stormwater utility		**L**	S										
16. Community Rating System			**L**	S	S				S				

L – this office is the lead agency for this action item

S – this office is to provide support for this action item

10.5. Mitigation Committee

Floods have often been compared to fires: communities that face these hazards adopt both preventive measures, such as building code standards, and emergency measures to respond to the hazard when it occurs. One important difference is that every city has a fire chief – one person who administers fire prevention and fire fighting activities – while no city has a flood chief.

This plan recommends that the City create a permanent body that would assume the role of the flood chief. The proposed Mitigation Committee would assess the progress of the City's flood mitigation activities, i.e., the action items recommended by this *Flood Mitigation Plan*.

The Committee would be created by passage of the resolution in the following section. It would be an official advisory board to the Mayor and City Council. It would be composed of members of the public who have an interest in flooding, stormwater and drainage problems and the City staff who work on those problems. Hopefully, much of the membership would be drawn from those who worked on this *Plan*.

The size of the Committee does not have to be fixed. If more people are interested and want to work on the issues, the Committee could be expanded to accommodate them. A public information subcommittee is also proposed. Its members would not necessarily also be members of the full Committee.

The Chair of the Committee would be appointed by the Mayor. That person could be drawn from either the public members or the City staff. Both approaches have been used in other communities and they both can work.

Staff support would be provided to the Committee by the appropriate City staff members in the same way that staff support was provided to prepare this *Plan*. Consultants may also provide support.

The Committee would not have any powers over City staff or other committees or commissions. It would be purely an advisory body. Its primary duty is to collect information and report to the Mayor and City Council and the public on how well this *Plan* is being implemented. Other duties include reviewing mitigation proposals and hearing resident concerns about flood protection and stream related matters.

The Mitigation Committee would be, in effect, the City's flood conscience. The resolution charges it with seeing the *Plan* carried out and recommending changes that may be needed. While it has no formal powers, its work should act as a strong incentive for the offices responsible for the action items to do their jobs.

The Committee should meet at least quarterly during the first years. There will be plenty of activities to monitor and review. As more and more new initiatives evolve into routine tasks, the workload will reduce. The Committee should eventually tackle mitigation issues related to tornadoes, landslides, sinkholes, and other hazards facing Huntsville. The resolution allows for this flexible approach.

10.6. Plan Adoption Resolution

The following draft resolution is recommended for adopting this *Flood Mitigation Plan* and establishing the Mitigation Committee.

Resolution No. ____

Whereas the City of Huntsville has been faced with overbank flooding and drainage problems over the years that have flooded buildings, closed businesses, disrupted traffic, and presented a general public health and safety hazard; and

Whereas the City's Flood Mitigation Planning Committee has prepared a recommended *Flood Mitigation Plan* that reviews the City's options to reduce damage from flooding and stormwater problems; and

Whereas the recommended *Flood Mitigation Plan* has been widely circulated for review by the City's residents, neighborhood groups, and federal, state and regional agencies and has been supported by those reviewers;

Now, therefore, be it resolved that:

1. The *Flood Mitigation Plan* is hereby adopted as an official plan of the City of Huntsville.

2. The Mitigation Committee is hereby established as a permanent advisory body.

a. The Committee members and its Chair shall be appointed by the Mayor, subject to the approval of the City Council.

b. Resident Committee members shall serve two year terms with one-half of the members' terms expiring each year.

c. The schedule of Committee meetings shall be posted in appropriate places. All meetings of the Committee shall be open to the public.

3. The Committee shall meet as often as necessary to prepare or review mitigation activities and progress toward implementing the *Flood Mitigation Plan*. It shall meet at least once each year to review the status of ongoing projects.

4. By September 1 each year, the Committee shall prepare an annual evaluation report to the Mayor and City Council on the *Mitigation Plan.* The report will cover the following points:

– A review of the original plan.

– A review of any floods that occurred during the previous calendar year.

- A review of the action items in the original plan, including how much was accomplished during the previous year.
- A discussion of why any action items were not completed or why implementation is behind schedule.

- Recommendations for new projects or revised action items. Such recommendations shall be subject to approval by this Council as amendments to the adopted plan.

5. The Committee should not restrict itself to only flood hazard mitigation. As time and interests become available, it should also investigate mitigation measures appropriate for tornadoes, landslides, sinkholes, and other hazards facing Huntsville and Madison County.

6. The City Engineer is charged with supervising the implementation of the plan's recommendations within the funding limitations provided by the City Council or other sources. The Engineer shall give priority attention to those action items recommended by the *Flood Mitigation Plan* with the earliest deadlines.

7. The City Engineer shall name a staff member as Community Rating System (CRS) Coordinator for the City. The CRS Coordinator shall be the main point of contact for all matters relating to the CRS. He or she is responsible for submittal of all documentation needed for the application, verification and annual recertification.

ADOPTED this the _____ day of _____, 2001

_____
President of the City Council of
The City of Huntsville, Alabama

APPROVED this the _____day of_____, 2001

_____
Mayor of the City of Huntsville,
Alabama

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