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The Iowa City 100-Year Floodplain: Land Uses and Management Options

Todd Griffith  
*University of Iowa*

Mark Moran  
*University of Iowa*

Al Stroh  
*University of Iowa*

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Prepared for the City of Iowa City
Planning Department

Todd Griffith
Mark Moran
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The University of Iowa Graduate Program in Urban and Regional Planning
Field Problems in Planning
102:215

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We would like to thank the following people for their contributions and assistance in completing this report: Karen Franklin, Director, Iowa City Planning Department; Don Yucuis, Director, Iowa City Finance Department; Marianne Milkman, Community Development Block Grant Coordinator, Iowa City Department of Planning and Program Development; Diana Cook, of the University of Iowa Business Office; and our advisor, Heather MacDonald, for her organizational guidance and support.

Todd Griffith
Mark Moran
Al Stroh

The Graduate Program in Urban and Regional Planning
347 Jessup Hall
The University of Iowa
Iowa City, Iowa 52242
EXECUTIVE SUMMARY

Scope and Purpose

This report was commissioned, following the severe summer flooding of 1993, to identify options for a floodplain management strategy that will minimize the public costs of future flood damage in Iowa City. Effective floodplain management is imperative for reducing public damage costs, private costs of damage to individuals and businesses, as well as the emotional stress related to flooding.

Alternatives and considerations for the future management of the developed and undeveloped floodplain are presented and discussed. As a basis for this discussion, land and structures in Iowa City's 100-year floodplain are identified, as are the public costs attributable to the summer's flooding.

To assess the degree of flood damage in the City, only public costs have been identified. Public costs were identified as any expenditure by the local, state, or federal governments as a result of damage from the 1993 flood.

Methodology

A parcel by parcel inventory of the existing land and structures in the 100-year floodplain and adjacent land forms the foundation of the report. Assigned numbers and common names are used to describe structures and other physical characteristics that are present in the parcels. The boundaries of the 24 parcels were delineated based on features such as: current land uses, zoning classifications, neighborhoods, and physical characteristics.

To define the 100-year floodplain, a United States Geological Survey map was utilized. The map is the most current floodplain delineation available from the Iowa City Engineering Department. Direct measurements were taken from the map to approximate the total number of acres within the City's 100-year floodplain as well as the number of acres in each parcel. Aerial maps and field observation were used to determine the number of structures in each parcel. Figures summarizing the costs of flood damage to the City were acquired from the Iowa City Department of Planning and Program Development, and the Iowa City Finance Department. Cost figures for damages sustained to University of Iowa (University) property were obtained from the University
Business Office. The City and University figures are believed to be the most current representation of the quantifiable costs of the 1993 flood, as of February, 1994.

Findings

The total amount of land in Iowa City's 100-year floodplain was estimated to be 383.5 acres. Of this total area, the predominant land use is residential. Public land owned by the City is the second largest area, followed by land currently zoned as interim development. University property accounts for the smallest portion of the study area.

A total of 122 structures are located in the 100-year floodplain. With 71 units, the Baculis Mobile Home Park has the largest number of structures from one zoning classification in the floodplain. Single-family structures are the next most common floodplain land use. Two University buildings and no commercial structures are located in the floodplain.

While most roads in the City remained open during the flooding, several others were adversely affected. Dubuque Street, Normandy Drive, Taft Speedway, South Gilbert (to the south of Highway 6), Riverside (near the University Art Building), and the Baculis access roads were all inundated at some time during the flood. Access to neighborhoods and businesses served by these roads was restricted during the inundation.

Excluding damage costs borne by the University, the City has incurred over $1 million in flood damages, as of February, 1994. In terms of the costs to the City, parks located along the river sustained the greatest amount of damage from the summer flooding. At this time, the total cost of damage to City Park, Crandic Park, and Terrill Mill Park is more than $900,000. The Baculis Mobile Home Park also sustained a large amount of costly damage. Nearly $240,000 in Community Development Block Grant funds are currently budgeted as relief for residents of the park. These funds are not expected to cover the full amount of flood damage. Costs associated with damage were substantial for the University as well. Though not in the 100-year floodplain, its buildings and property sustained over $4 million in damages.
Recommendations

Based on our inventory of the 100-year floodplain land uses and the costs associated with damages from the flooding of 1993, we have developed recommendations for four categories of floodplain development. The intent of the recommendations is to reduce the physical and economic damage from floods while promoting the preservation of environmentally sensitive areas.

1. New Construction

We recommend for the City to encourage planned developments in the 100-year floodplain while strictly enforcing the current floodplain building standards. We also encourage the City to encourage or require the use of riparian vegetated buffer strips in the open space produced by planned developments as well as in riparian areas that are already developed.

2. Existing Non-Conforming Structures

Houses
We recommend the City consider creating a floodproofing program for highly vulnerable floodplain homes. A floodproofing program can be expected to reduce the long-term costs of flood damage.

Mobile Homes
We recommend the City undertake a feasibility study for relocating the Baculis Mobile Home Park. The study should focus on identifying possible areas for relocation and analyzing financial feasibility.

3. Parks

We recommend the City relocate recreational amenities out of 100-year floodplain where possible. Recreational facilities at City Park, such as ball-diamonds and tennis courts, should be relocated to higher ground within the park. Consideration should be given to elevating facilities that cannot be relocated within the park for lack of space. Recreational amenities such as picnic tables, playground equipment, and shelters should be constructed using flood resistant techniques.
4. Roads

Flooding problems on Iowa City roads were limited to Dubuque Street, Normandy Drive, Taft Speedway, South Gilbert (to the south of Highway 6), Riverside (by the University Art Building), and the Baculis access roads. We recommend a study be undertaken to weigh all of the benefits and costs of elevating these individual roads. The study should be used to make an informed decisions on whether street elevation projects are feasible.

Finally, we recommend that the City reexamine the potential costs and benefits associated with elevating Dubuque Street on a cost-share basis with the federal government. In light of the expected benefits, correcting the problem with substantial funding assistance from the federal government may prove to be a good flood management investment.
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INTRODUCTION

This report was requested by the City of Iowa City following the severe flooding that occurred in the summer of 1993. For a duration of more than three months, the Iowa River spilled out of its banks and into the lives of many Iowa City residents. In addition to the emotional strain incurred by local residents whose lives were affected by the flood, the City has and continues to bear the financial costs of weathering and recovering from the event. This report was commissioned to identify options for a floodplain management strategy that will minimize the public costs of future flood damage. In addition to reducing public damage costs, effective floodplain management should reduce the private costs of damage to individuals and businesses as well as the emotional stress related to flooding.

While the existence of a floodplain management ordinance indicates public concern for flood protection, no comprehensive study has been undertaken to assess the degree of floodplain development or the public costs of flood damage to such development. Alternatives and considerations for the future management of the developed and undeveloped floodplain are presented and discussed. As a basis for this discussion, land and structures in Iowa City's 100-year floodplain are identified, as are the public costs attributable to the summer's flooding.

The report is divided into three sections: an inventory of the 100-year floodplain, the developed 100-year floodplain, and the undeveloped 100-year floodplain. Based on the information contained in these sections, recommendations are made for future floodplain management.

In the first section, the 100-year floodplain and adjacent land are divided into manageable parcels. The number of acres and structures have been identified for each parcel. Costs from flood damage are also presented on a parcel by parcel basis. In the context of last summer's flood, the floodplain and adjacent land are then discussed in detail.

Section two begins with the presentation of the current Iowa City floodplain management regulations and other relevant City policies. The remainder of the section is devoted to a discussion of the developed 100-year floodplain. Floodproofing methods, the
development of a floodproofing program, and the implications of flooding on University property are each discussed in detail.

The third section focuses on the undeveloped land in the 100-year floodplain. Three regulatory options for managing future development in the floodplain are presented and discussed. Amending the existing floodplain ordinance, implementing a transferable development rights policy, and continuing to encourage planned developments are each examined. The use of vegetated riparian buffer strips and the possible implications of wetland regulations on future development are also discussed.

Our recommendations are founded on the effects of last year's flooding, existing Iowa City policy, and available floodplain management options. Specific recommendations are presented for new construction, existing non-conforming structures, parks, and roads.
SECTION 1-INVENTORY OF 100-YEAR FLOODPLAIN

This section presents and discusses an inventory of the land and structures in Iowa City's 100-year floodplain as well as the costs of damages resulting from the 1993 flood. To begin, a brief explanation of the methodology is given. Next, summary information is presented about the acreage of floodplain land, the number of floodplain structures, and the costs of flood damage. Lastly, the effects of the flood on individual parcels of land within the floodplain are discussed in detail. Assigned numbers and common names are used to describe structures and other physical characteristics that are present in the parcels. The boundaries of the 24 individual parcels were delineated based on features such as: current land uses, zoning classifications, neighborhoods, and physical characteristics. All areas adjacent to the Iowa River within the City limits have been included in the inventory, although many of the parcels with steep river banks do not meet the commonly used definition of a floodplain since they are not susceptible to being inundated by water.

Methodology

To define the 100-year floodplain, the 100-Year Flood Boundary Map, prepared by the United States Geological Survey in 1977, was utilized. The map is currently used by the Iowa City Engineering Department and is drawn to a scale of 1 inch equals 400 feet. Direct measurements were taken from the map to approximate the total number of acres within the City's 100-year floodplain as well as the number of acres in each parcel. Aerial maps obtained from the University of Iowa and field observation were used to determine the number of structures in each parcel. Figures summarizing the costs of flood damage to the City were acquired from Marianne Milkman of the Iowa City Department of Planning and Program Development, and Don Yucuis of the Iowa City Finance Department. Cost figures for damages sustained to University property were furnished by Diana Cook of the University Business Office. The City and University figures are believed to be the most current representation of the quantifiable costs of the 1993 flood, as of February, 1994.
The 100-Year Floodplain

Land Uses.
Using both aerial photographs and direct observations, the total amount of land in Iowa City's 100-year floodplain was estimated to be 383.5 acres. Of this total area, the predominant land use is residential, accounting for 140 acres. Public land owned by the City comprises 90 acres or 23 percent of the total land in the 100-year floodplain. More than 80 acres of the floodplain is currently zoned as interim development. In these areas, agricultural and other non-urban uses are planned to continue until the time when municipal services can be provided for urban development. Commercial land uses and University property account for the smallest portions of the study area. The number of acres in the 100-year floodplain by land use and the percent of total acres in the floodplain by land use are presented in Table 1.1.

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Number of Acres</th>
<th>Percent of Total Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public-Iowa City</td>
<td>90.0</td>
<td>23</td>
</tr>
<tr>
<td>Public-University</td>
<td>18.5</td>
<td>5</td>
</tr>
<tr>
<td>Interim Development</td>
<td>81.3</td>
<td>21</td>
</tr>
<tr>
<td>Commercial</td>
<td>53.8</td>
<td>14</td>
</tr>
<tr>
<td>Residential</td>
<td>140.0</td>
<td>37</td>
</tr>
<tr>
<td>Total</td>
<td>383.5</td>
<td>100</td>
</tr>
</tbody>
</table>

Structures.
A total of 122 structures are located in the 100-year floodplain. Located on the west side of the river, south of Highway 6, the Baculis Mobile Home Park accounts for the largest number of structures from one zoning classification in the floodplain. Seventy-one mobile homes in the park are situated within the 100-year boundary. Single-family structures are the second most common land use in the floodplain. A total of 41 residential structures are located in three separate areas: Taft Speedway, Normandy Drive, and the Showers Addition. There are no commercial structures in the study area. The total number of floodplain structures by land use classification is summarized Table 1.2 on the following page.
In addition to the number of structures in the floodplain, a large number are located adjacent to it. These structures are included in the inventory since flooding can affect many of them by physically damaging the property or by restricting access to it. Of the total 254 adjacent structures, 115 are mobile homes located in the Baculis park. The Normandy Drive residential area has the next largest number of structures adjacent to the boundary with 92. Another area that can be effectively isolated by the flooding is the Cliff Apartments. If serious flooding occurs on Dubuque Street, all 24 units can be isolated.

Some of the 13 University buildings that are adjacent to the floodplain may also experience damage and access problems when major flooding occurs. Access problems may also occur for 10 commercial buildings on Sand Road that are located just outside the 100-year boundary. No publicly owned structures occupy adjacent land. The number of structures adjacent to the 100-year floodplain, categorized by land use, is displayed in Table 1.2.

### Table 1.2
Number of Structures by Land Use Within and Adjacent to the 100-Year Floodplain

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Number of Structures in 100-year Floodplain</th>
<th>Number of Structures Adjacent to 100-year Floodplain</th>
</tr>
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<tbody>
<tr>
<td>Public-Iowa City</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Public-University</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Commercial</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Mobile Homes</td>
<td>71</td>
<td>115</td>
</tr>
<tr>
<td>Residential</td>
<td>41</td>
<td>92</td>
</tr>
<tr>
<td>Apartment Units</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>124</strong></td>
<td><strong>254</strong></td>
</tr>
</tbody>
</table>

**Costs.**
To assess the degree of flood damage in the City, only public costs have been identified. Subject to their availability, public costs were identified as any expenditure by the local, state, or federal governments as a result of damage from the 1993 flood. The total costs presented in this report represent the sum of funds already spent for clean-up and repairs and the funds needed to restore property to its pre-flood condition. Though costs incurred
by private individuals and businesses from flood damage have been substantial, they are beyond the scope of this study.

In terms of costs to the City, parks located along the river sustained the greatest amount of damage from the summer flooding. At this time, the total cost of damage to City Park, Crandic Park, and Terrill Mill Park is more than $900,000. This figure includes funds already spent to clean and repair the parks as well as additional funds that will be necessary to restore the parks to their pre-flood conditions. The flood damage that occurred in interim development and commercial areas resulted in small costs for debris removal. For the Baculis Mobile Home Park, damage costs were equated with the full amount of Community Development Block Grant (CDBG) funds budgeted for the relief of individual residents of the park. The nearly $240,000 in CDBG relief funds that are currently budgeted are not expected to cover the full amount of flood damage. The CDBG funds are considered a public cost since, if not for the flooding, they could be applied to community betterment projects instead of relief.

Costs incurred by the University as a result of flooding are included since the University is a public institution. The public must eventually cover the University's costs just as it does the City's. Damage costs were substantial for the University. Though not in the 100-year floodplain, its adjacent buildings and property sustained over $4 million in damages. A summary of all public costs is provided in Table 1.3.

<table>
<thead>
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<th>Land Use</th>
<th>Cost of Flood Damage</th>
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<tr>
<td>Public-Iowa City</td>
<td>$917,262</td>
</tr>
<tr>
<td>Public-University</td>
<td>$4,165,800</td>
</tr>
<tr>
<td>Interim Development</td>
<td>$3,287</td>
</tr>
<tr>
<td>Commercial</td>
<td>$441</td>
</tr>
<tr>
<td>Residential</td>
<td>$237,536</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$5,324,326</strong></td>
</tr>
</tbody>
</table>
Parcels in the 100-Year Floodplain

This section provides an inventory and a parcel by parcel discussion of properties in the 100-year floodplain. Information included in the narrative is derived largely from three detailed tables that are presented in the Appendix. For each of the parcels, the tables show the number of acres, structures, and flood costs. Individual parcels are identified by number on the map on the following page.

Parcel 1.
Zoning classification: ID-RS
Common name: Peninsula

This 77 acre area is a portion of a larger (approximately 300 acre) tract that is presently not serviced by City roadways and other infrastructure. In the 1989 update of the Comprehensive Plan, this area is identified for future development beginning in the year 2010. Land within the floodplain is mostly forested, while a large portion of the area not within the floodplain is under cultivation. No structures exist within the floodplain in the Peninsula parcel. There were no costs to the City as a result of flooding in this parcel.

Parcel 2.
Zoning classification: RS5
Common name: Taft

This area is located between Taft Speedway and the Iowa River, across the river from City Park. It is partially developed, and contains 11 single family homes. The homes are located within the floodplain, and suffered substantial flood damage during the 1993 episode. Flooding costs to the City, totaling $9,959, were restricted to cleaning and street repairs. In the months following the flood, the federal government incurred costs associated with elevating the damaged homes.

There is no uniformity in the general construction of these dwellings. Their designs differ and their lowest floors are of varying elevations. It appears that at the time of the flood, many of the structures did not meet current City requirements for new construction in the floodplain. The age of the structures indicates that they were grandfathered in when the floodplain regulations were adopted. Though situated in the 100-year floodplain, the potential exists for future development in this parcel. Approximately three river front lots are undeveloped, as well as a larger parcel of approximately 12 acres adjacent to the river.
Parcel 3.
Zoning classification: PDH5
Common name: Idyllwild

This area lies just to the north of Taft Speedway. It has been approved for the construction of planned development housing (PDH), consisting of 25 two story condominium structures, each containing four 2 or 3 bedroom units. At this time, two of the condominiums have been completed, and a third is under construction. Since this area has only recently been zoned for development, the current floodplain management regulations have guided this project from its inception. Flooding costs to the City were limited to cleaning and street repairs that totaled $2,156.

Parcel 4.
Zoning classification: P
Common name: Terrill Mill

This portion of the floodplain lies within Terrill Mill Park, and contains no structures. It is bottom land that was reclaimed from the south bank of the river when the channel was redirected in the early part of this century. Terrill Mill contains few developed recreational amenities, and as a result, the costs of flood damage were restricted to turf replacement, roadways, repairs, and debris removal. Damage costs for this parcel are currently estimated to be approximately $60,000.

Parcel 5.
Zoning classification: P
Common name: Mayflower

This area is largely composed of portions of the Dubuque Street right-of-way and a small portion of the Mayflower residence hall, owned by the University. The 326,287 gross square feet residence hall contains 471 apartment units which house approximately 1,000 students. The lower two levels of Mayflower are devoted to automobile parking, and served to limit to some extent the damage to the building during the 1993 flooding. Of greater importance was the inundation and closing of Dubuque Street in this area, which effectively rendered Mayflower unusable. Costs to the University included $334,000 for damage to the structure, and an additional unknown amount of lost revenue while the building was unoccupied. The closing of Dubuque Street also resulted in the isolation and closure of the Cliffs Apartments, displacing the occupants of 48 units.
Parcel 6.
Zoning classification: P
Common name: Crandic Park

This portion of the floodplain lies within Crandic Park, and contains no structures. The area is bottom land that lies at the outside bend of the river near the junction of Rocky Shore Drive and Highway 6. Flood damage to this parcel totaled approximately $20,000. Costs were attributed to street repairs, debris removal, and site repairs.

Parcel 7.
Zoning classification: RS5
Common name: Normandy Drive

This residential neighborhood consists of single family houses that may be reached from the streets of Normandy Drive, Eastmoor Drive, Manor Drive, Grenada Court, and Park Place. There are 25 single family homes in the neighborhood that actually lie within the floodplain. At least two of these homes sustained substantial damage from the summer's high water. These two structures have since been elevated to eliminate the possibility of future flood damage. An additional 84 homes are sited where they will suffer some restrictions on access during major flooding. During the summer of 1993, some of these homes were effectively isolated as a result of flooded streets.

The Normandy Drive parcel was developed in the early 1970s, before the current floodplain management regulations were adopted. Existing floodplain regulations are intended to prevent such structural damage and access problems.

Parcel 8.
Zoning classification: P
Common name: City Park

Flooding is not new to City Park; the inundation of some areas near the Park Road Bridge is a fairly common occurrence. The extent and duration of the 1993 episode, however, inundated large areas that had not been under water since the Coralville Dam became operational in 1956. Even though permanent structures, with the exception of two service buildings, are located well above the 100-year floodplain, the park suffered extensive damages.
A total of $837,079 in damages to the park have been reported by the City. These costs have been categorized into four areas: street repairs, debris removal, structural repairs, and site repairs. Substantial damages occurred to such amenities as ball-diamonds, tennis courts, playground equipment, picnic tables, turf, and trees.

Parcel 9.
Zoning classification: RM44
Common name: Fraternities

This small parcel is located between Dubuque Street and the river, and between the northern boundary of the University and the Park Road Bridge. The area consists primarily of the river frontage behind the fraternities located along Dubuque Street. The houses themselves are located above the 100-year flood plain, and suffered no serious effects from the flooding.

Parcel 10.
Zoning classification: P
Common name: University East Campus

This parcel is composed of the University-owned property on the east bank of the river. The steepness of the bank throughout this area serves to minimize the actual land included in the 100-year floodplain, but certain buildings were affected by flooding during the 1993 event. North Hall, English-Philosophy, and the Iowa Memorial Union suffered basement flooding. These buildings total 477,234 gross square feet. Although English-Philosophy is not in the 100-year floodplain, water entered the building through the foundation. In addition, a severe problem developed near the site of the President's residence, located on a bluff above the river near this parcel. The steep slope near the house required two different stabilization efforts to protect the structural integrity of the property. These two stabilization projects totaled $238,500.

The Iowa City water plant is also located in this parcel, and was "under siege" for a substantial period of time during the flooding. Efforts by City employees and volunteers helped prevent the plant from being swamped and a costly emergency from occurring. Had floodwaters entered the plant and contaminated the water supply, the effects would have been severe. A similar situation actually occurred in Des Moines, where the water plant was inundated and the water supply was contaminated and cutoff. Water service was not completely restored to the City for more than a month.
Parcel 11.
Zoning classification: P
Common name: Arts Campus

Two University buildings actually lie within the 100-year floodplain in this area of the campus. However, activities in all of the Arts Campus buildings were severely affected by the 1993 flood. Water entered the basements of the Art Building, The Museum of Art, and the Music Building/Hancher Auditorium complex. This flooding forced the evacuation of these structures and the Alumni Center for most of the summer, and caused damage to interior finishes and mechanical equipment. These buildings total 442,664 gross square feet. The costs of structural damage exceeded $1,400,000. In addition, the closing of Riverside Drive through this area caused a major disruption to traffic flow.

Parcel 12.
Zoning classification: P
Common name: Crandic Railroad

This area is located on the east bank of the river between the Burlington Street Bridge and the Iowa Interstate Railroad Bridge. Although it is zoned Public, it is mostly owned by the Crandic Railroad, and consists of a largely unused railroad switchyard. There are no structures within the 100-year floodplain in this parcel and no costs have been attributed to 1993 flooding.

Parcel 13.
Zoning classification: I1
Common name: Recycle Plant

This area consists of the east bank of the river between the Iowa Interstate Railroad Bridge and the Iowa City Waste Water Treatment Plant. The bank is quite steep, and served to minimize effects from the flood. No structures are within the 100-year floodplain in this parcel, and no damages have been reported.

Parcel 14.
Zoning classification: P
Common name: Waste Water Treatment

This area consists of the east bank of the river between the Recycling Plant and Highway 6. As was the case at the recycling plant, the bank is quite steep here, and served to
minimize the effects from the flood. No costs were incurred from damages in this parcel, and there are no structures within the 100-year floodplain.

Parcel 15.
Zoning classification: P
Common name: Hydraulics

This area is made up of the University-owned property on the west bank of the river, south of Burlington Street. The steepness of the bank throughout this area serves to minimize the actual land included in the 100-year floodplain. No structures occupy the 100-year floodplain in this parcel.

Parcel 16.
Zoning classification: CC2
Common name: Riverside West - Commercial

This area of the 100-year floodplain crosses the river frontage of the businesses on the east side of Riverside Drive, between Burlington Street and Highway 6. All the businesses located in this parcel are located outside of the 100-year floodplain and well above the threat of flooding. The steep banks along this portion of the river serve to eliminate the potential adverse effects of high water. No costs were sustained from the flood in this parcel.

Parcel 17.
Zoning classification: CI1
Common name: Sand Road

This commercial area is occupied by 10 structures, none of which are actually within the 100-year floodplain. The activities of the businesses in this area were adversely affected by the flooding. Extensive sandbagging had to be undertaken to protect against the high water. Access to the structures was obstructed by the closing of Sand Road. Less than $400 was spent by the City to remove debris that was deposited by the flood.

There appear to be large areas within the Sand Road parcel that could be subject to further commercial development, although they are perilously close to the 100-year floodplain. If buildings are constructed on these currently undeveloped tracts, they will not be subject to floodplain building regulations since they are not officially in the 100-year floodplain.
Parcel 18.
Zoning classification: P
Common name: Napoleon Park

This portion of the floodplain lies within Napoleon Park, and contains no structures. Improvements in this area consist largely of softball diamonds and other park amenities. The park escaped damages during the 1993 flood.

Parcel 19.
Zoning classification: ID-RM
Common name: Showers Addition

This residential area is partially within the Iowa City limits and partially within Johnson County. Of the Iowa City portion, 5 houses are located within the 100-year floodplain, and 8 other homes are located adjacent to it. Development in this area has proceeded somewhat outside the influence of the City, and adherence to current housing building codes appears to be lacking. City incurred flood costs in this area totaled $3,287. The whole amount was spent on the removal of debris.

Parcel 20.
Zoning classification: P
Common name: Sturgis Ferry

This area of publicly owned land abuts the river to the south of Highway 6, on the west bank. It is currently occupied by the city maintenance and bus operation, and Sturgis Ferry Park. All buildings and developed areas are elevated above the 100-year floodplain and did not receive any damage as a result of the flood.

Parcel 21.
Zoning classification: II
Common name: West Bank, North of Railroad.

The river bank is fairly steep throughout this parcel, and the floodplain boundary crosses the river frontage of various commercial properties in the area. All structures are located well above the threat of flooding, and, in general, the steepness of the bank serves to minimize the adverse effects of high water. The City did not incur any flood related costs in this parcel.
Parcel 22.
Zoning classification: CI1
Common name: Commercial Drive

This commercial area is occupied by 10 structures, none of which are actually within the 100-year flood plain. Their activities were minimally affected by the flooding, and the present physical configuration of the area appears to be acceptable from the standpoint of flooding. Development of this area is substantially complete.

Parcel 23.
Zoning classification: RFBH
Common name: Baculis Mobile Home Park

This portion of the flood plain is almost completely occupied by mobile homes in the Thatcher and Baculis Mobile Home Parks. There are 186 mobile homes located in or near the parcel, with 71 actually within the 100-year floodplain. Access roads to the parks are also partially within the floodplain. As a result, all mobile homes were affected by either the actual inundation or by severely restricted access. The City has budgeted $222,234 of CDBG funds for the relief of residents of the area. Of this amount $47,741 is earmarked for personal loans, with the balance to be outright grants to residents.

Parcel 24.
Zoning classification: P-IC
Common name: Mesquakie Park

This undeveloped area is the site of the former City landfill. No structures are located on the property at this time. The summer flooding did not result in damage or costs to this parcel.
SECTION-2 THE DEVELOPED 100-YEAR FLOODPLAIN

Current Floodplain Regulations

Chapter 11 of the Iowa City Code contains the current floodplain management regulations for the City. This is a summary of the provisions from the chapter which are relevant for assessing and evaluating existing and future development in the floodplain.

Current regulations apply to all lands and uses which have significant flood hazards. According to the provisions of the ordinance, all new or substantially improved residential and nonresidential structures must be elevated a minimum of one foot above the 100-year flood level. The flood insurance rate map, prepared for the Iowa City flood insurance study in 1985, is used to identify the Iowa River's 100-year flood level within the City's limits.

The "substantially improved" clause is important for homes in already developed areas that were not built according to current floodplain standards. There are two criteria which define a substantial improvement to a structure. First, a substantial improvement is "any repair, reconstruction, or improvement of a structure, the cost of which equals or exceeds fifty (50) percent of the market value of the structure..." (Iowa City Code, Ch. 11-8.- (2)a). Second, "any addition which increases the original floor area of a building by twenty-five (25) percent or more" constitutes a substantial improvement (Ch. 11-8.- (2)b). When enforced, this clause allows the City to gradually bring sub-standard structures into compliance with current floodplain management regulations.

Factory built homes, including mobile homes, must be elevated on a permanent foundation such that the lowest floor structure is a minimum of one foot above the 100-year flood level. These homes must also be anchored to resist flotation. Subdivisions, including factory built home parks, must provide all lots with a means of vehicular access that will remain passable during the occurrence of a 100-year flood.

A permit must be obtained for any floodplain development (any man-made change to improved or unimproved real estate, including buildings and the placement of factory built homes). The City's building inspection official decides whether floodplain
development applications meet applicable floodplain management standards. An applicant whose proposed development fails to gain the approval of the building official may request a variance from the board of adjustment.

The building official is responsible for the enforcement of the floodplain management regulations. Violations of the regulations may be treated as a misdemeanor or a municipal infraction. Refer to Chapter 11 of the Iowa City Code for the complete floodplain management ordinance.

**National Flood Insurance Program**

Iowa City's floodplain management regulations meet the minimum standards required for eligibility in the National Flood Insurance Program (NFIP). Established in 1968 by the National Flood Insurance Act, the NFIP offers flood insurance to property owners within a recognized floodplain. To be eligible for the insurance in Iowa City, the insured property must be within the 100-year floodplain. Minimum floodplain management standards established by the 1968 legislation are designed to prevent new development from increasing the threat of flood damage and to protect new and existing buildings from anticipated flood events. The NFIP program is administered by the Federal Insurance Administration (FIA), which is part of the Federal Emergency Management Agency (FEMA) (DeMoe and Merriam 1988).

**Relevant Iowa City Policies**

Various policies are identified in the 1989 update of the Iowa City Comprehensive Plan that, if implemented, can be useful in mitigating the adverse effects of future flooding. These policies are intended to guide the decisions and subsequent actions of the City. The following are environmental policies with particular relevance to decision making regarding the floodplain.

- Preserve and protect environmentally sensitive areas, as identified by the City, by accepting land dedications and easements where desirable, by purchasing threatened environmental areas where no other means of protection is available, or by other means, as appropriate.
• Encourage the use of Planned Developments in fragile environmental areas.

• Acquire land or defray clearance costs when existing structures in the floodway deteriorate.

• Establish a continuous green area on both sides of the Iowa River through Iowa City.

• Preserve and promote the creation of buffer areas and open space as identified by the City.

Protected Structures in Developed Areas

As previously explained, not all developed areas in or adjacent to the floodplain were adversely affected by the flood. No damage occurred to the structures in the Idyllwild subdivision, nor was vehicle access affected. The subdivision was built according to current floodplain regulations. Although access was obstructed during the worst of the flooding, the commercial structures in the Sand Road area are elevated above the 100-year level and were not damaged by high water. These two areas represent the best examples of structures built in and adjacent to the floodplain that are protected from 100-year flooding. They may serve as reference points for planning future development in or near the floodplain.

Roads Affected by Flooding

Since most roads in the City remained open during the flooding, it may prove useful to list only those which were adversely affected. As discussed in the inventory section, Dubuque Street, Normandy Drive, Taft Speedway, South Gilbert (to the south of Highway 6), Riverside (near the University Art Building), and the Baculis access roads were all inundated at some time during the flood. While each road closing posed inconveniences for vehicle travel, the Dubuque Street closing was especially problematic. As floodwaters receded, a debate developed about whether or not the City should take corrective actions.
**Dubuque Street.**

In the fall of 1993, the City determined that elevating both lanes of the street to a level where flooding will not impede traffic would cost $2.5 million. To help defray the costs, the City submitted a grant proposal to the Economic Development Administration (EDA) for a Special Disaster Recovery Grant. When the funding was originally applied for, the City was led to believe that the grant would fund 75 percent of the project's cost. With this cost-sharing ratio, Iowa City's share of the project would be $625,000.

In March, 1994, the EDA accepted the grant request and offered to pay the federally required 50 percent of the project's cost. Accepting this offer would increase the City's funding responsibility to $1.25 million. On March 29, the city council decided against funding the street elevation project.

While funding the Dubuque Street elevation project would have required a large capital outlay, accepting the EDA offer would have been an effective method of reducing future flood damage costs. Unlike existing structures in the floodplain that the City does not own and cannot alter, Dubuque Street is a floodplain problem that can be corrected.

The benefits of the elevated street would be at least twofold. First, traffic would continue to move freely on Dubuque Street in the event of Iowa River flooding. Residents living to the north of Park Road would no longer be "isolated" during the flooding. Likewise, access from Interstate-80 to the central business district would not be obstructed. Though difficult to quantify, it is probable that restricted vehicle access to downtown businesses has some negative effect on those businesses. Second, the elevated street would act as a levee, eliminating the possibility of future flood clean-up and repair costs to the street and to the Mayflower dormitory. Structural damage to the building from last year's flood resulted in repair costs that exceeded $330,000.

**Floodproofing Existing Structures**

Flood damages from this past summer's high water were greatest for homes situated near the river on Normandy Drive, Taft Speedway, in the Showers Addition, and in the Baculis Mobile Home Park. In the months following the flood, several homes on Taft Speedway and two homes on Normandy Drive were floodproofed by elevating the structures above the 100-year floodplain. Federal aid was available to these homeowners
through the NFIP. Many of the other structures in these areas are highly prone to flooding, and, without modifications, will continue to be vulnerable to damage from severe floods. Floodproofing these structures that were grandfathered in when the current floodplain management ordinance was adopted would help to reduce the reoccurring, long-term costs of flood damage in the City.

**Floodproofing Methods.**
Determining which of several available floodproofing methods is appropriate for a given structure depends on the type of structure and the severity of the flooding to which it is vulnerable. Elevating the existing structure is generally the chosen method of floodproofing highly flood prone homes. Commonly used methods for homes that are less prone to severe flooding are floodwalls or berms to divert the flow of flood waters, and wet or dry floodproofing for basements and garages. Structural works such as floodwalls must be approved by the Iowa Department of Natural Resources (DNR). Dry floodproofing seals walls to prevent floodwaters from entering the structure. Structures that are wet floodproofed are designed to "...automatically equalized hydrostatic forces on exterior walls by allowing for the entry and exit of floodwaters" (Iowa City Code, Ch. 11-10.-4a) (Illinois Association for Floodplain and Stormwater Management, 1993).

Though effective in reducing flood damages and costs, property owners are typically reluctant to voluntarily floodproof their property. In Iowa City, as in most cities, the private property owner is required to initiate the corrective action. The cost of floodproofing, especially that of elevating a home, is usually the major obstacle preventing homeowners from acting (Glassford, 1993).

**Floodproofing Program.**
A municipality can play a significant role in initiating floodproofing activities in the community. For example, the city of Homewood, Illinois has initiated a pilot floodproofing program. In the first phase of the program, eight floodprone homes were elevated above the established flood protection level (up to two feet above the existing lowest floor). In the subsequent phase of the program, Homewood intends to elevate another 24 flood prone homes. The approximate average cost of elevating one home is $25,000. Also, as part of the program, 11 homes with basements or lower levels that are prone to flooding are eligible for cost-share floodproofing. Participating homeowners must pay the first $1,500 of the total floodproofing cost while the city covers the balance.
Total floodproofing costs vary according to the method of floodproofing used (Glassford, 1993).

Iowa City may want to consider establishing a floodproofing program similar to that of Homewood. Further investigation would be necessary to determine exact lowest floor elevations of the homes in the floodplain. This information would be needed to determine program eligibility. Once eligible homes are identified, the program could be structured to target low income residences. The cost of funding such a program would depend on the type of floodproofing necessary and the number of homes included. Based on the 1993 flood event, Normandy Drive, Taft Speedway, and the Shower Addition would each have some eligible homes. The Baculis Mobile Home Park would likely have the largest number of homes eligible for assistance. As mentioned, Baculis residents already have more than $222,000 of CDBG funds earmarked for their relief. The amount of the allotted funds that will be used for floodproofing in Baculis remains unclear at this time.

**An Alternative for Baculis.**

If the City creates a floodproofing program, Baculis residents could mitigate future flooding problems by participating in the program. Assuming that such a program is not established and that most Baculis structures are not floodproofed with the current relief funds, relocating the park to a higher elevation may be a feasible alternative.

Since relocation would be the initiative of the City, the City would be responsible for financing the project. Two major costs would be associated with moving the mobile home park. First, though moving a mobile home is less expensive than moving a traditional house, the City would be faced with the cost of moving each of the approximate 186 homes. Second, the City would be obligated to pay the costs of purchasing and making ready a site for the park. Lack of available land within the City limits would, at this time, require the City to annex land or look to Johnson County for a site to be developed. If an undeveloped site were chosen, the costs of extending or providing sewer and water service would have to be borne by the City.

Although the current and recent City Councils have opposed the idea of relocation, the possibility for future support of the idea exists. Relocation would be an effective method of eliminating any future costs of flood damage to the Baculis homes. While evaluating
the relocation option, the City Council should consider that the cost of damage from just one summer's flooding exceeded $222,000. The long-term potential for the accumulation of public flood damage costs should be given strong consideration when evaluating the relocation alternative. To disperse the cost over time, a relocation plan could be structured in phases, moving the most vulnerable homes first.

Section 404 Buyouts

Federal buyouts of floodplain property is another technique that may be used to manage the floodplain at the local level. The 1993 Hazard Mitigation and Relocation Assistance Act, makes approximately $130 million available to midwestern communities for floodplain management. Most of the funds are administered by FEMA through its Section 404 disaster mitigation program. In addition to buyouts, communities can use the funds for mitigation measures such as elevating buildings, improving drainage, and building small floodwalls. Nearly all of the funds distributed since last summer's flooding have been used for buyouts. Funds can only be used for structures in the 100-year floodplain that were damaged by the 1993 flood (Tibbetts 1994).

Iowa City may be able to utilize the Section 404 program to alleviate some of its most severe floodplain problems. Although any damaged floodplain structures would be eligible for funds received by the City, vulnerable homes in the Baculis park could be targeted. By buying out and relocating the problematic Baculis homes, the City would be mitigating a large part of its floodplain problem.

University of Iowa

The University has made a substantial capital investment in the construction of buildings on the Iowa River floodplain. Implicit in the decisions to build these structures was the belief that the Coralville Dam would protect the investments of the taxpayers of the state of Iowa. The 1993 flooding undermined that belief, and the total flood costs incurred by the institution have exceeded $4,000,000. Much of that amount will be reimbursed from insurance and the FEMA, but fundamental problems remain in the floodplain areas of the campus.
Although a detailed analysis of these problems and potential solutions are beyond the scope of this report, the effects of the closing of two Iowa City streets deserve mention. The closing of Riverside Drive and North Dubuque Street served to effectively isolate the Mayflower Residence Hall, Hancher Auditorium, the Music Building, the Theater Building, the Alumni Center, the Museum of Art, and the Art Building. The lack of access to these buildings had dramatic effects on the programs of the University, in addition to actual damages, personnel costs, and other adverse effects on the Physical Plant. The point is that although these buildings will continue to be exposed to some level of flooding by virtue of their location, the fact that these two city roadways are within the 100-year floodplain exacerbates the situation. From the perspective of the University, roadway improvements would have real tangible benefits in the case of future flooding.

**Issues for City Concern**

The isolation of University buildings also appears to be an issue of concern for the City. Though no City buildings are isolated by the road closures, the closures likely have a negative effect on the local economy. Individuals and groups that would normally be attending programs at buildings such as Hancher Auditorium and the Museum of Art are prevented from doing so. These same people often spend money at area businesses prior to and/or following the programs. The same behavior occurs before and after University sporting events. As long as the roads are susceptible to flooding, the potential for lost local revenue exists.

When University students are displaced from Mayflower by flooding, there is a possibility that the local housing market will be forced to accommodate them. This situation was avoided in 1993 since the flooding occurred only in the summer when other residence hall space was available. If the flooding occurs in the fall, many of the 1,000 Mayflower residents will have to seek housing in the local market. Whether the market can accommodate the students is questionable.
SECTION-3 THE UNDEVELOPED 100-YEAR FLOODPLAIN

Any new development that occurs in the 100-year floodplain must comply with the current floodplain management regulations. While the regulations may be effective in reducing damages and costs, options are available to alter the regulations and/or make them more stringent. This section discusses three regulatory options, amending the existing ordinance to make it more stringent, implementing a transferable development rights policy, and continuing to encourage planned developments. In addition, the benefits of riparian buffer strips and the implications of wetlands on future development are discussed.

Floodplain areas with development potential include: the Peninsula, Taft Speedway, Idyllwylde, and Sand Road.

Increase Building Standards

Building standards for new construction in the floodplain can be made more stringent than currently required by the floodplain management ordinance. Current standards were created to meet the minimum criteria for eligibility in the NFIP. The NFIP criteria can be exceeded by raising the minimum elevation standard from one foot above the 100-year floodplain to two or three feet. However, if the intent is to reduce damages from a 100-year flood, the one foot building requirement may be sufficient. As earlier discussion showed, structures and access routes built according to the current regulations successfully passed the test of last summer's flooding.

Transferable Development Rights

Restricting new development in the floodplain is the most effective method of controlling both the number of structures that are prone to flood damage and the costs associated with such damage. Since current regulations allow development in the floodplain, the City would have to acquire undeveloped floodplain property to ensure that no future development occurs. Though the City can acquire private property by exercising its police power, the costs of compensating landowners will undoubtedly be high. An
alternative to the costs of compensation which may be feasible for Iowa City is a land-
management device called Transferable Development Rights (TDR).

In utilizing TDR, a municipality establishes conservation zones and transfer zones. No
development may occur in areas designated conservation zones. Since the development
potential is eliminated from conservation zones, transfer zones are established as
alternative potential development zones.

Transfer zones are located in areas more suited than the floodplain for intense
development. The availability of municipal services and compatibility with existing land
uses and the natural environment should be the basis for delineating transfer zones. The
allowable maximum density in transfer zones may be exceeded by the purchase of
development rights from conservation zone landowners. These landowners acquire
development rights when the city designates their property a conservation zone. When a
density transfer deal is made, "The buyer gains extra density; the seller reaps profit from
the sale; the community benefits from whatever is preserved by the development
restriction - open space or environmentally sensitive lands" (Pizor 1986, p. 203). By
implementing a TDR policy, a city is, in effect, allowing the local market to compensate
the owner of the land whose development has been restricted by the city (Hagman and
Miszynski 1978).

The TDR mechanism has withstood the allegation that it violates the Fifth Amendment's
prohibition on the taking of private property without just compensation. "In Penn Central
(438 U.S. 104, 1978) the U.S. Supreme Court upheld New York City's landmark zoning
and also seemed to imply that transfer of development rights could be used to mitigate the
effects of a taking" (Pizor 1986, p. 203). However, this precedent is not likely to prevent
a TDR policy from all legal challenges today.

**TDR and Planned Developments.**
The TDR concept overlaps with the planned development housing (PDH) and planned
unit development (PUD) mechanisms contained in Iowa City's current zoning ordinance.
Both of these land use mechanisms allow for flexibility in the placement and clustering of
buildings without altering the density of the tract. The TDR concept differs from PDH
and PUD in that the density is not transferred within the tract, but rather to a completely
different tract.
An important distinction exists between open space that is the product of TDR and that which is the product of planned developments. For PDH and PUD developments, the private property owner has control of the open space that is created by clustering structures. From the standpoint of the community, that land may not be useful. On the other hand, the city has complete control of open space created by development transfer (TDR). A public natural area is an example of a land use which is ideal for a conservation zone. Parks may also be acceptable if the floodplain uses will not be significantly damaged during flooding. For instance, City Park’s ball-diamonds were severely damaged by the 1993 flood. In choosing a land use for a conservation zone, the likelihood of inundation must be given strong consideration. The land use should be able to flood without resulting in significant damage costs.

In Iowa City, there are two ways to view the potential of TDR to be an effective land use mechanism. On one hand, the relatively small amount of undeveloped floodplain land in Iowa City may render its consideration as a floodplain management device unnecessary. Likewise, since there is a minimal amount of undeveloped, non-floodplain land in the City, annexation may be required if transfer zones are to be established. In consideration of these land constraints, the existing PDH and PUD provisions may be adequate for controlling floodplain development. On the other hand, preserving the relatively small amount of undeveloped floodplain land may be effectively accomplished with a TDR policy. The number of affected landowners would be small and the amount of density transfer would be minimal. Considering these facts, support for such a TDR policy may be easily garnered.

Policy Justification
Creating a TDR policy can be justified by several of the environmental policies that are defined in the Comprehensive Plan. The City could support the following policies by acquiring floodplain property through a TDR purchase.

- Preserve and protect environmentally sensitive areas by purchasing threatened environmental areas where no other means of protection is available.

- Establish a continuous green area on both sides of the Iowa River through Iowa City.
• Preserve and promote the creation of buffer areas and open space as identified by the City (p. 6).

A Successful Planned Development.
Iowa City's Comprehensive Plan encourages the use of planned developments in fragile environmental areas. By upholding this policy, it appears that both PDH and PUD can be used as floodplain management devices. The Idyllwylde development is an example of the effective use of PDH in the floodplain. Two large condominiums were constructed in the floodplain according to regulations and survived the summer flooding without any damage. The developer worked with the City when planning the development and utilized the clustering component of the PDH. By clustering, the developer was able to situate the structures away from the river on the most elevated area of the large tract. Idyllwylde is an example of creative and effective floodplain development.

Riparian Buffer Strips

Buffer strips can be effectively used to reduce the severity of flooding while producing water quality benefits for the community. Ideally, buffer strips should be used in conjunction with existing floodplain management mechanisms.

Reducing the Quantity of Flow.
When created in riparian areas, vegetated buffer strips can reduce the flow of surface runoff and, consequently, reduce the velocity of floodwaters. According to the Iowa City Comprehensive Plan,

Rivers and creeks are the natural drainage channels of any area. As development increases and the impervious surface area increases, more and more surface water runs off directly into the creeks and rivers. The floodway and floodplain of streams are the natural corridors for this water and should be maintained for its flow. If, in addition, vegetation is maintained along the river and creekbanks, more water can be absorbed and the risk of flooding is reduced (1989, p. 36).

Furthermore, "If green belts are maintained along rivers and creeks they provide diversity of habitat and by their linear nature extensively, affect adjacent development. Protection of the Iowa River and Ralston and Willow Creek floodplains will reduce the need for
further extensive modifications of their channels in order to reduce flooding" (1989, p. 36).

**Improving Water Quality.**
The primary function of a buffer strip is to remove soil particles and nutrients (especially nitrogen and phosphorus) from overland flow (unchannelized surface runoff) before it reaches a waterbody. As overland flow passes through a buffer strip, it infiltrates into the soil or is stored in small depressions on the ground. An organic duff layer functions as a water and nutrient sponge while trees and other vegetation in the strip utilize phosphorus and other nutrients in the stormwater. Buffer strips are most effective when comprised of undisturbed woodland and undergrowth. Buffer strips may also consist of grass or other close growing vegetation designed to receive overland flow. However, their effectiveness is a function of individual site conditions.

Buffer strips also provide an "edge effect" which helps to ensure the structure and stability of the riparian plant community. These areas promote wildlife habitat and help to maintain the composition of existing stream banks by decreasing the effects of erosion.

River front buffer strips can be used to reduce the water quantity and quality impact of new development. Wooded filter strips have been proven especially effective in reducing the amount of surface water runoff, soil transport to the river, as well as the amount of phosphorus and nutrients entering the water (Burby, French, 1985).

**Potential for City Involvement**
The potential exists for the City to encourage or regulate the use of vegetated buffer strips along the Iowa River in Iowa City. Three methods that the City may use are: requiring new developments to plant buffer strips, negotiating with developers during the planned development design process to include buffer strips in PUDs and PHDs, and encouraging riverfront property owners to establish buffer strips. These options are not all-inclusive.

A requirement for any new development to plant a buffer strip on property adjoining the river could be included in the zoning ordinance. Property owners affected by this regulation should be allowed flexibility in the placement and clustering of buildings on their tract. Negotiating during the planned development design process may be as effective as requiring buffer strips with new development. Since a relatively small
amount of riverfront land remains to be developed, the City would be involved in few negotiations. During a negotiation, the City should emphasize that the long-term cost of establishing and maintaining a buffer area would be less than the cost of landscaping and/or maintaining a lawn. Finally, the City could take an active role and encourage owners of developed riverfront property to plant buffer strips. An educational effort, including the distribution of informational brochures, could be targeted at these landowners.

**Justification for City Involvement**

City involvement in regulating or encouraging the use of vegetated riparian buffer strips may be justified by environmental policies identified in the Comprehensive Plan. The use of buffer strips would support the following Iowa City environmental policies.

- Preserve and promote the creation of buffer areas and open space as identified by the city.

- Preserve and protect stream channels and their headwaters.

- Establish a continuous green area on both sides of the Iowa River through Iowa City (p. 6).

**Wetlands and Floodplain Development**

A recent assessment of Iowa City's sensitive environmental areas raises new issues regarding the future development of the Iowa River floodplain. The Rust Environment and Infrastructure consulting firm prepared a detailed map for the City entitled "Sensitive Areas Inventory." Of particular interest to this study is the map's identification of both potential unwooded wetlands and potential wooded wetlands. The "potential" classification is used since Iowa City, like most cities in the country, does not have a legal definition of a wetland. Consequently, Iowa City wetlands are not protected by a local ordinance. This situation may change in the near future.

The inventory and mapping of potential wetlands are representative of the first steps of developing a wetlands regulatory policy. The move towards regulation has continued as
the City is currently involved in drafting a wetland protection ordinance. However, at this time it is unclear when the ordinance will completed and if it will be approved.

**Existing Regulations.**
Wetlands are protected to some degree in Iowa City by federal legislation, although no specific wetland law exists. At the federal level, the Water Pollution Control Act (commonly known as the Clean Water Act (CWA)) regulates the "release of dredged and fill material into the waters of the United States" (U.S. Environmental Protection Agency (EPA), Office of Wetlands, 1992). Included in this definition of "waters" are any wetlands adjacent to waters. Through the CWA's Section 404 permitting program, both the Corps of Engineers (Corps) and the EPA are granted the authority to delineate wetlands. Corps district engineers are given the authority to enforce the regulation (Mitsch and Gosselink 1993).

While the federal regulation of wetlands is intended to act as a minimum requirement for their protection, Iowa's state policy is even less stringent. In Iowa, wetlands are defined as "two or more acres in a natural condition that is mostly under water or waterlogged during the spring growing season and is characterized by vegetation of hydric soils" (Iowa Code, Ch. 356B.1 1993). According to Chapter 456 of the Iowa Code, a protected wetland cannot be drained without a permit from the Iowa Department of Natural Resources (DNR). "A permit will not be issued by the DNR unless the protected wetland is replaced by a wetland of greater or equal value as determined by the DNR" (Ch. 456B.13, 1993). No Iowa municipalities regulate the use of wetlands.

**Future Development.**
Within the undeveloped areas of 100-year floodplain, the Peninsula area is the only major land area where proposed development would encounter wetland protection regulations. The Sensitive Areas Inventory identifies potential wooded wetlands on the southwest and east corners of the Peninsula. Both of these areas are immediately adjacent to the Iowa River and are subject to the aforementioned federal and state wetlands regulations. If development in the Peninsula area occurs according to the Comprehensive Plan (beginning in the year 2010), it will likely be subject to a local wetlands protection ordinance that is at least as restrictive as the existing regulations. A required set-back from the river would be the likely consequence of the regulations for development in the Peninsula.
If the Peninsula is developed for urban use, adherence to wetlands regulations would follow environmental policies that are defined in Iowa City's Comprehensive Plan. As discussed, current policies exist that call for the preservation of environmentally sensitive areas and the preservation and promotion of the creation of buffer areas and open space. Developing the Peninsula according to wetlands regulations would promote City environmental policies and reduce the potential for damage costs associated with flooding.
RECOMMENDATIONS

Based on our inventory of the 100-year floodplain land uses and the costs associated with damages from the flooding of 1993, we have developed recommendations for four categories of floodplain development. The intent of the recommendations is to reduce the physical and fiscal damage from floods while promoting the preservation of environmentally sensitive areas.

1. New Construction

During the 1993 flooding, the City's current floodplain regulations were tested rigorously. While substantial damages occurred to structures and property, the problems occurred nearly exclusively in areas that were developed before the regulations were created. Using the Idyllwylde subdivision as an example, it is our belief that the City's current floodplain management regulation is effective. Idyllwylde was built according to floodplain regulations and endured the 1993 flooding without sustaining damages or their associated costs.

Based on the Idyllwylde success, it is our recommendation for the City to encourage planned developments in the 100-year floodplain while strictly enforcing the current floodplain building standards. We also encourage the City to encourage or require the use of riparian vegetated buffer strips in the open space produced by planned developments as well as in riparian areas that are already developed. As discussed earlier, the use of buffer strips is justified by several of the City's environmental policies. Without buffer strips, the impervious surfaces created by planned developments can be expected to increase the quantity and velocity of surface water runoff into the river. Though difficult to quantify, the runoff can be expected to have negative effects on water quality and riverbank stabilization.

2. Existing Non-Conforming Structures

Houses
Mandatory retrofitting to floodplain building standards is not a feasible option for the City. Instead of mandating conformance, we recommend the City consider creating a
floodproofing program for highly vulnerable floodplain homes. A floodproofing program can be expected to reduce the long-term costs of flood damage. In the wake of the 1993 flood, a window of opportunity exists that may provide the public and political support necessary to fund such a program.

**Mobile Homes**

Based on the magnitude of the Baculis flood damage, relocation of the park's mobile homes is the best alternative for reducing damages and costs in the future. We recommend the City undertake a feasibility study, focusing on identifying possible areas for relocation and analyzing financial feasibility. The Section 404 disaster mitigation program should be explored as a source of funding for relocation. Without relocation, damages and costs from flooding will continue to occur in the Baculis Mobile Home Park.

**3. Parks**

Recreational amenities should be relocated out of 100-year floodplain if possible. Recreational facilities at City Park, such as ball-diamonds and tennis courts, should be relocated to higher ground within the park. Consideration should be given to elevating facilities that cannot be relocated within the park for lack of space. Recreational amenities such as picnic tables, playground equipment, and shelters should be constructed using flood resistant techniques. An example would be building picnic tables out of concrete rather than wood.

**4. Roads**

Flooding problems on Iowa City roads were limited to Dubuque Street, Normandy Drive, Taft Speedway, South Gilbert (to the south of Highway 6), Riverside (by the University Art Building), and the Baculis access roads. The cost of raising any or all of these roads would be enormous. In evaluating the cost of elevating the roads, the real costs to the City of having the roads closed should be considered. The loss of access to the City from Dubuque Street, for instance, in all likelihood had significant repercussions on the business sector, the University, emergency medical services, and other urban activities. A cost-benefit analysis would be helpful in quantifying such costs. The analysis would be useful not only for Dubuque Street, but for the other affected arterial streets as well. We
recommend a study be undertaken to weigh all of the costs in an effort to make an informed decision on whether street elevation is feasible.

Finally, we recommend that the City reexamine the potential costs and benefits associated with elevating Dubuque Street on a cost-share basis with the federal government. Although the closing of Dubuque Street due to high water occurs relatively infrequently and unpredictably, elevating the street would act as a levee to protect Mayflower and could result in significant benefits to the City over time. In light of the expected benefits, correcting the problem with substantial funding assistance from the federal government may prove to be a good flood management investment.
Bibliography


Iowa Code. 1993. Chapter 456 B.


Vesely, Rima. 1994. Plan to raise Dubuque Street abandoned. The Daily Iowan. (April 3) 6A.
Table 1
LAND AREA BY ZONING CLASSIFICATION IN THE 100-YEAR FLOODPLAIN
Iowa River 100-Year Floodplain
Iowa City, Iowa

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Summary of Land Area:

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Total 383.5 acres

Source: U.S. Geological Survey "100-Year Flood Boundary Map" 1977
### TABLE 2
STRUCTURES WITHIN THE 100-YEAR FLOODPLAIN
Iowa River 100-Year Floodplain
Iowa City, Iowa

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Source: University of Iowa Aerial Photograph, Direct Observation
Table 3
Flood Costs Within the 100-year Floodplain
Iowa River 100-Year Floodplain
Iowa City, Iowa

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<td>$62,500</td>
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Summary by Land Use:
- Public-Iowa City: $917,252
- Public-University: $4,165,800
- Industrial Development: $3,287
- Commercial: $441
- Residential: $257,556

Total: $5,324,326

Source: Iowa City Department of Planning and Progress Development, Iowa City Finance Department, University of Iowa Business Office.