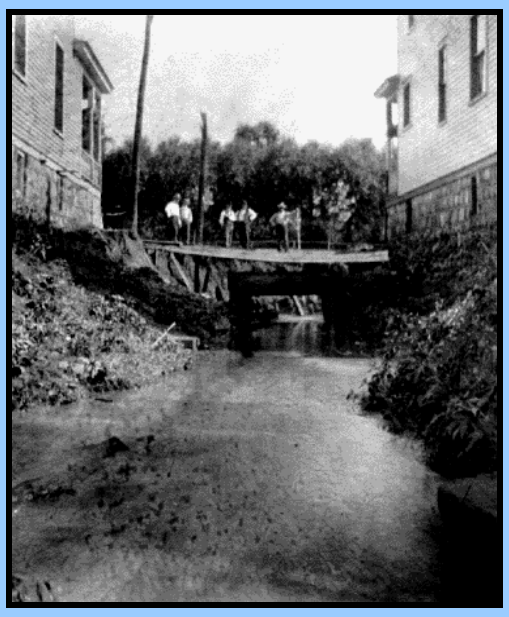
FLOOD MITIGATION PLAN

City of Ann Arbor

March 2007



RESOLUTION TO SUPPORT THE APPROVAL OF
THE CITY OF ANN ARBOR FLOOD MITIGATION PLAN

Whereas, The City of Ann Arbor accepted grant funding from the Michigan Department of the State Police, Emergency Management Division to prepare a Flood Mitigation Plan;

Whereas, This City is committed to the mitigation of potential hazards, including flood related hazards, and the protection of the public health, and the reduction of property damage and loss of life that can result from flood events;

Whereas, The preparation of a Flood Mitigation Plan is a recommended action of the City of Ann Arbor's Hazard Mitigation Plan;

Whereas, The City of Ann Arbor is required for grant compliance to approve a Flood Mitigation Plan by April 30, 2007;

Whereas, The City of Ann Arbor prepared a Flood Mitigation Plan outlining mitigation strategies;

Whereas, One of the stated goals of the Flood Mitigation Plan is to "Create a flexible plan that can adapt to changes in community values and technological advancements"; AND the modeling and mapping contained in the plan will be updated periodically to utilize the best available data; AND the modeling and mapping contained in the plan will be updated when the results from FEMAs map modernization project are adopted by the City of Ann Arbor; and

Whereas, Adoption of a Flood Mitigation Plan will make the City eligible for future grants to implement the recommendations of the plan, if and when funds become available;

RESOLVED, The Environmental Commission recommends that Ann Arbor City Council approve the Flood Mitigation Plan.

Approved by the Environmental Commission
January 25th, 2007

RESOLUTION TO SUPPORT THE APPROVAL OF
THE CITY OF ANN ARBOR FLOOD MITIGATION PLAN

Whereas, The City of Ann Arbor accepted grant funding from the Michigan Department of the State Police, Emergency Management Division to prepare a Flood Mitigation Plan;

Whereas, This City is committed to the mitigation of potential hazards, including flood related hazards, and the protection of the public health, and the reduction of property damage and loss of life that can result from flood events;

Whereas, The preparation of a Flood Mitigation Plan is a recommended action of the City of Ann Arbor's Hazard Mitigation Plan;

Whereas, The City of Ann Arbor is required for grant compliance to approve a Flood Mitigation Plan by April 30, 2007;

Whereas, The City of Ann Arbor prepared a Flood Mitigation Plan outlining mitigation strategies;

Whereas, One of the stated goals of the Flood Mitigation Plan is to "Create a flexible plan that can adapt to changes in community values and technological advancements"; AND the modeling and mapping contained in the plan will be updated periodically to utilize the best available data; AND the modeling and mapping contained in the plan will be updated when the results from FEMAs map modernization project are adopted by the City of Ann Arbor; and

Whereas, Adoption of a Flood Mitigation Plan will make the City eligible for future grants to implement the recommendations of the plan, if and when funds become available;

RESOLVED, The Ann Arbor City Planning Commission recommends that Ann Arbor City Council approve the Flood Mitigation Plan.

Approved by City Planning Commission
February 6, 2007

City of Ann Arbor

NOTE: THE FOLLOWING RESOLUTION IS A DRAFT FOR REVIEW ONLY. THE RESOLUTIONS WILL BE SUBJECT TO THE APPROVAL OF THE ANN ARBOR CITY COUNCIL.

RESOLUTION TO APPROVE

THE CITY OF ANN ARBOR FLOOD MITIGATION PLAN

Whereas, The City of Ann Arbor accepted grant funding from the Michigan Department of the State Police, Emergency Management Division to prepare a Flood Mitigation Plan;

Whereas, This City is committed to the mitigation of potential hazards, including flood related hazards, and the protection of the public health, and the reduction of property damage and loss of life that can result from flood events;

Whereas, The preparation of a Flood Mitigation Plan is a recommended action of the City of Ann Arbor's Hazard Mitigation Plan;

Whereas, The City of Ann Arbor is required for grant compliance to approve a Flood Mitigation Plan by April 30, 2007;

Whereas, The City of Ann Arbor prepared a Flood Mitigation Plan outlining mitigation strategies;

Whereas, One of the stated goals of the Flood Mitigation Plan is to "Create a flexible plan that can adapt to changes in community values and technological advancements"; AND the modeling and mapping contained in the plan will be updated periodically to utilize the best available data; AND the modeling and mapping contained in the plan will be updated when the results from FEMAs map modernization project are adopted by the City of Ann Arbor; and

Whereas, Adoption of a Flood Mitigation Plan will make the City eligible for future grants to implement the recommendations of the plan, if and when funds become available;

RESOLVED, The Ann Arbor City Council approves the Flood Mitigation Plan.

Approved by City Council
March 19, 2007

Table of Contents	Page #

SECTION 1: BACKGROUND

1.0 INTRODUCTION

Mitigation is any action taken prior to, during or after a disaster that reduces or eliminates the disasters potential to cause damage to persons or property. In November of 2004 Ann Arbor City Council adopted a Hazard Mitigation Plan. The Hazard mitigation Plan recommended that the City pursue the development of flood mitigation plan to address the City's risk in its flood prone areas. Floods are not only the most prevalent naturally caused disaster in the United Stated but are also among the most successfully mitigated due to the ability to define affected areas and implement tested mitigation activities. The City of Ann Arbor Hazard Mitigation Plan of 2004 recommended investigating the feasibility of the following mitigation activities:

- **Acquisition.** Public acquisition and management of flood prone properties.
- **Relocation.** Permanent relocation of flood prone structures to areas outside the floodplain.
- **Redevelopment.** Rebuilding damaged or flood prone structures in such a way that the risk is reduced.
- **Modifications**. Site and structural modification to flood proof structures.
- **Public Works Measures**. Storm water management system improvements to reduce flooding. Examples include in-line detention facilities, storm water pipe modifications, reforestation, and native landscaping.

Table 1:

Hazard	Ranking
Convective Weather (Severe Winds, Lightning, Tornados, Hailstorms)	1
Infrastructure Failures	2
Severe Winter Weather Hazards (Ice/Sleet Storms and Snow Storms	3
Hazardous Materials Incidents: Fixed Site	4
Hazardous Materials Incidents: Transportation	5
Extreme Temperatures	6
Fire Hazards: Structural Fires	7
Flood Hazards: Dam Failures	8
Flood Hazards	9
Civil Disturbances	10
Transportation Accidents: Land and Air	11
Public Health Emergencies	12
Sabotage & Terrorism	13
Petroleum and Natural Gas Pipeline Accidents	14
Nuclear Power Plant Accidents	15
Fire Hazards: Wildfires	16
Oil and Gas Well Accidents	17
Nuclear Attack	18
Drought	19
Earthquake	20
Fire Hazards: Scrap Tire Fires	21

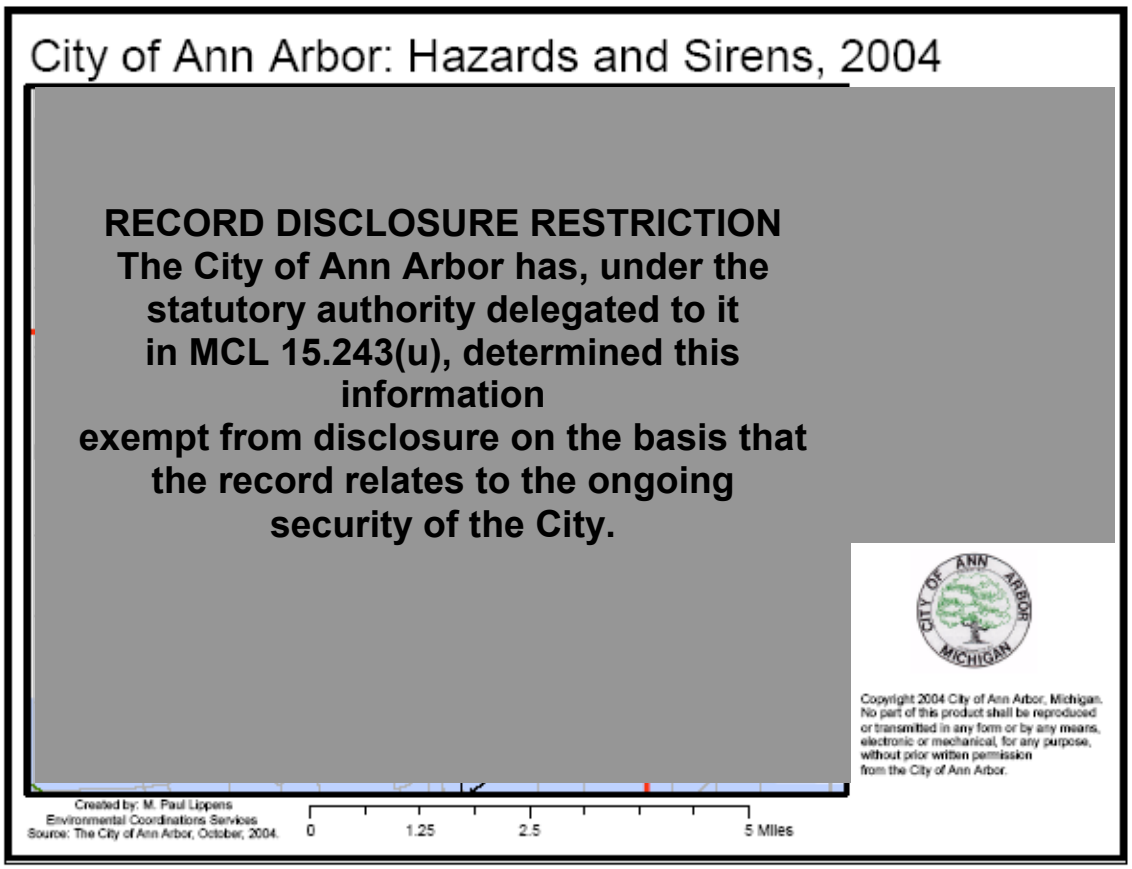
- **Planning and Regulatory Measures.** Modifying land use plans, modifying zoning, re-mapping floodplain boundaries, developing additional floodplain development regulations, development moratoria, and open space planning.
- **Incentives**. Create financial incentives and disincentives based on flood risk factors.

- **Lead by Example.** Establish clear and consistent government policy for public owned land in the floodplain aimed at preventing public buildings in the floodplain.
- **Public Education and Awareness Measures**. Tools include; public relations, information dissemination, public hearings, surveys, polls, workshops, seminars, etc.

The above activities are not an exhaustive list but they served as a basis to begin a public discussion about the development of this plan.

Flood Hazards, dam inundation and rain events, are the 8th and 9th ranked hazard according to the City of Ann Arbors Hazard Mitigation Plan (table 1). Floods rank behind hazards that result from severe weather, hazardous material incidents, infrastructure failure and structural fire.

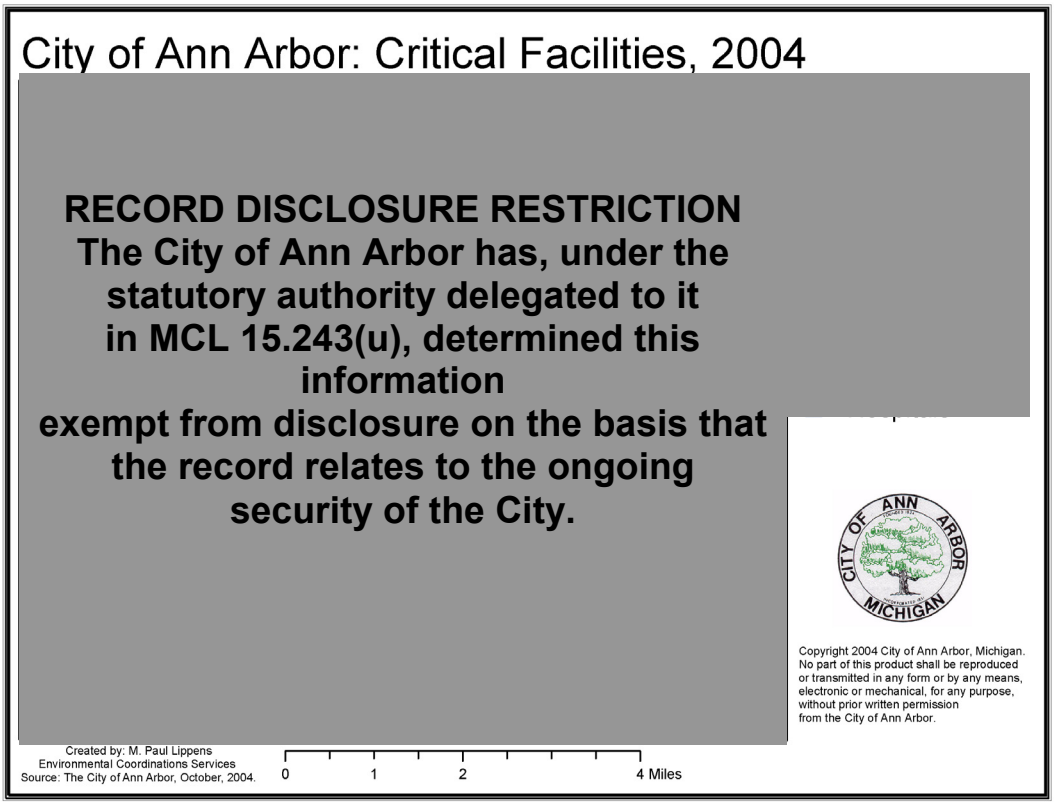
Map 1:



The City has 22 warning sirens that are intended to provide border-to-border coverage during hazardous events (map 1). Securing funding for the updating and maintenance of the sirens is a recommendation of the All-Hazard Plan. The City's Emergency Management team is responsible for reacting to hazard events in the City. The group is comprised of professionals from multiple fields and they meet regularly and conduct drills and exercises to ensure that the City is prepared for the multitude of events, including flood response. Mitigation

Objective 7 in the System Recommendations section of this plan includes projects that aim to improve the City's ability to respond to flood events. The City's Emergency Management Team is also aware of the Critical Facilities which where mapped as a part of the All-Hazard Plan activities (map 2).

Map 2:



Mitigation in Practice

A comprehensive mitigation plan is one that collects a broad array of actions via strategies, projects, policies, or regulations (often referred to as mitigation tools), so that in the future there will be many options to achieve the goals and objectives of a mitigation plan. Mitigation planning can be viewed metaphorically as a process of opening doors to future solutions.

This plan is sponsored in part by a grant by the Michigan Department of State Police Emergency Management Division and the Federal Emergency Management Association (FEMA). The City of Ann Arbor is one of nine communities in the State to receive funding for the development of a flood mitigation plan. The development of this plan makes the City eligible for Federal assistance to implement of mitigation activities in accordance with Robert T. Stafford Disaster Relief and Emergency Assistance Act - the Stafford Act.

History of Flood Management in Ann Arbor

FEMA first began the process of mapping floodplains in 1974. The first official flood insurance rate maps were delivered to City Officials in 1982. The initial floodplain and floodway boundaries were based somewhat on anecdotal information collected after a 100-year flood event the City experienced in 1968. Prior to 1968, the City experienced flood events of similar size in 1902 and 1947. With the regulatory framework established the City was able to begin efforts to manage risk in the designated flood areas, however until the City became a full participating member of the National Flood Insurance Program (NFIP) in 1982 there was little recourse for homeowners and business owners to protect themselves from flooding.

Figure 1:

The '68 Dixboro Bridge Wash Out.
Source: The City of Ann Arbor, June 2005

The NFIP requires flood insurance to be purchased for all mortgaged properties in the floodplain, however; prior to the 1993 there was no penalty if the property owners did not acquire flood insurance. The City of Ann Arbor has 442 properties that purchase flood insurance. Approximately 71% of total buildings in floodplain zone AE and A (see table 2).

In June of 2001 the City of Ann Arbor Planning Commission charged the City's Planning Department with the task of outlining an official policy for dealing with City owned property in the floodplain. The project identified two central goals and seven related goals that are threaded throughout City, State, and Federal Code and referenced in City Planning documents.

Central Goals

- Minimize Life Endangerment
- Minimize Property damage and loss

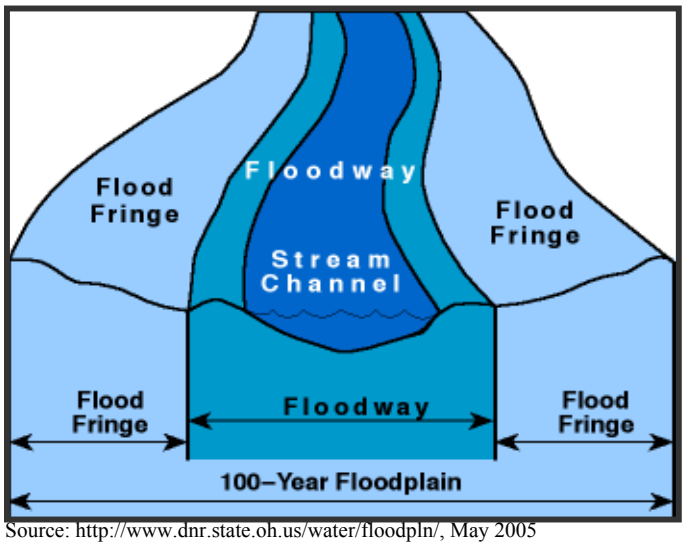
Related Goals

- Preserve market value of existing real property
- Promote water quality and ecological health of each creekshed
- Reduce Allen Creek Drain contamination to reduce outflow of contaminants into the Huron River
- Create Allen Creek Greenway in floodplain area
- Preserve neighborhood character
- Create affordable housing on vacant City-owned parcels

- Retain National Flood Insurance Program by limiting/prohibiting development in floodplain

Planning Commission and staff made a decision to roll the discussion about the Development of a Policy for City owned property into the development of this broader Flood Mitigation Plan. The goals mentioned above, in addition to the unofficial report titled "Floodplain Policy Discussion" of October 2001 serve as a starting point for the development of this plan. See Appendix A – Floodplain Policy Discussion.

Figure 2:

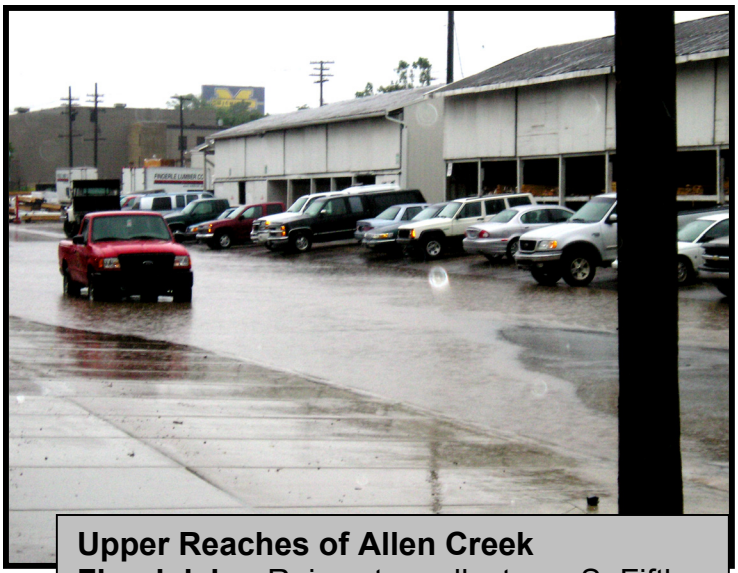


Source: http://www.dnr.state.oh.us/water/floodpln/, May 2005

In July of 2004 the City of Ann Arbor began working with FEMA to coordinate an update and remapping project for the City's Floodplains and Floodways, officially called the Map Modernization Project. This is a part of FEMA national effort to digitize the Flood Insurance Rate Maps (FIRMs). The results of this process will be delivered in 2007.

This plan and actions taken as a result of the plan implementation intend to anticipate and incorporate modeling and technology advancements like the FEMA Map Modernization Project.

Figure 3:



Upper Reaches of Allen Creek Floodplain: Rainwater collects on S. Fifth between Madison and Hill and affects local businesses parking areas.

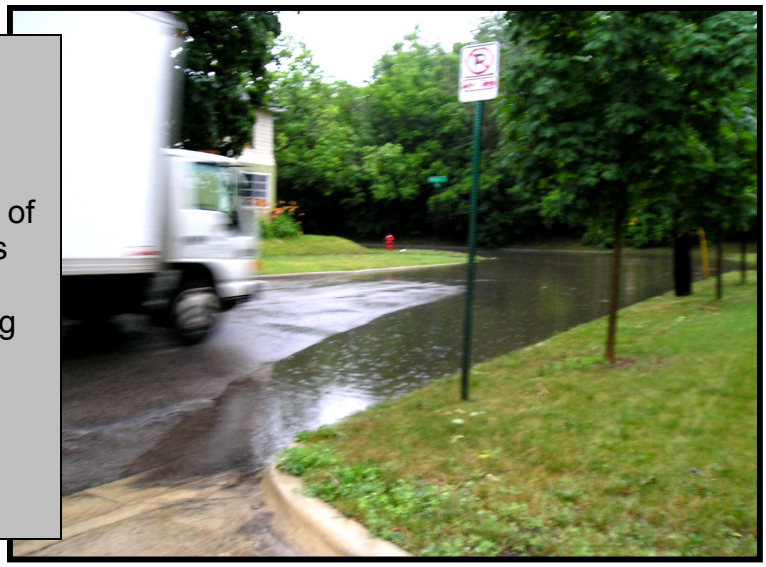
Evidence of the need for flood mitigation projects can be seen even in smaller and more common rain events. The City of Ann Arbor Systems Planning Unit took the following series of photographs on June 30th 2005 during a rain event in which less than one inch of rain fell in a 40 minute time period[1].

[1]Source: http://www.wunderground.com/history/airport/KARB/2005/6/30/DailyHistory.html?req_city=NA&req_state=NA&req_statename=NA, May 2006.

Figure 4:

In the Middle Reaches of Allen Creek Floodplain: The pressure from the rainwater pushes a stormwater manhole cover out of place on Ashley St. between Madison and Jefferson; a common occurrence throughout the Floodplain during storm events.

Figure 5:



Below the Confluence of the West Park-Miller Branch and the Main Branch of Allen Creek: The low area at the corner of Kingsley St. and First St. is one of the first areas to experience surface flooding within the Allen Creek floodplain. The road routinely becomes impassable and cars occasionally are stranded.

Figure 6:

Outlet of Allen Drain into the Huron River: Torrents of rainwater rush from the exasperated Allen Drain into the Huron River. Poor water quality can be inferred from visible suspended solids and a distinct odor reminiscent of engine exhaust.

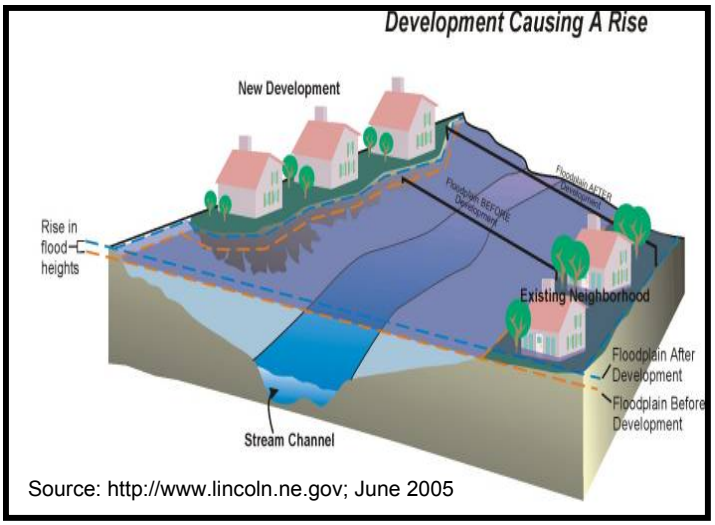
1.1 COMMUNITY

Development Trends in the Floodplain and Watersheds

The largest and most prominent water feature in the City of Ann Arbor is the Huron River. The Huron River is not only an important feature to Ann Arbor, but also to the region of Southeastern Michigan. The headwaters of the Huron River originate in Oakland County and the Huron River Watershed spans Oakland, Livingston, Washtenaw and Wayne County. For Ann Arbor residents the river is the primary drinking water source and provides valued recreational opportunities. The Huron River is also a source of hydropower generated at two of the four City dams.

The City of Ann Arbors landscape is part of seven creeksheds all tributaries of the Huron River: Traver, Malletts, Miller, Allen, Honey, Swift Run, and Flemming. For the purpose of this plan we will refer to these creeksheds as watersheds. All of Ann Arbors creeksheds flow into and are a part of the Huron River Watershed. Within Ann Arbor there is an area surrounding the Huron that flows directly to the Huron, not into one of the seven tributary watersheds associated with the City's creeks. For the purposes of this plan when we refer to the Huron river watershed we will mean the area that drains directly to the Huron.

Figure 7:



Source: http://www.lincoln.ne.gov; June 2005

All open watercourses have an associated floodplain. In a large precipitation event it is a natural occurrence for the water levels of streams, rivers, and lakes to rise above their banks onto the adjacent lands. In urban areas these occurrences are exacerbated by the alteration of the natural landscape by the built environment. Homes, businesses, roadways, and other types of fill reside within the path of a watershed systems overflow. In effect, during a flood event, these human structures act as dams and push the overflow even further out into the watershed affecting lands that would not be at risk otherwise.

Flooding is also exacerbated in urban watersheds as a result of increased imperviousness. Impervious surfaces, such as buildings, driveways, and roads, prevent storm water from being absorbed in areas of the watershed most suited for infiltration. Instead storm water moves quickly to the floodplains. Increases in impervious surfaces generally equate to an increase in the frequency of flood

events because the watershed systems methods for absorbing storm events are being blocked.

There are also some problems unique to Ann Arbor. Allen Creek, in the City's central area, was put underground in about 1926. It had become an open sewer with household waste from the growing population and industrial waste from the tanneries and factories crowded along its banks. The creek flooded frequently due to the changes in land use that replaced absorbent vegetation with streets and buildings, leaving those of lower economic status, who tended to live along its banks, with flooded and unhealthy basements and yards. Allen Creek was piped and submerged under the ground to help improve health conditions and stop flooding in its immediate area. Though this solution may have been an improvement to the conditions that existed in the twenties, nothing was done to curb the development patterns in and around the creeks floodplain. Unfortunately, in the long-term, burying the creek may have had the opposite effect with several buildings subsequently being constructed directly in the center of the watercourse. Burying the stream did not effectively mitigate the flooding experienced by residents in this area and it still continues today.

Related Projects:

Planning and Implementation of Storm Water Improvements in Allen Creekshed
Washtenaw County in partnership with the City of Ann Arbor, is conducting a feasibility assessment of the Allen Creek basin to determine practical options for storm water improvement projects. Issues to be addressed include flow management, flooding, phosphorus loading, and pathogen levels. Public input to the process of developing recommendations and public acceptability of recommendations are critical.

Ann Arbor Storm Water GIS Data Collection and Hydraulic Model Development
The City of Ann Arbor is working to develop a hydraulic model to better plan for storm water issues. Among other objectives, the project aims to create a GIS inventory of all storm water catch basins and catch basin leads, confirm connectivity of catch basins to the main storm water system. Information collected will be analyzed for system deficiencies and used to create the model. From the model a list of recommended storm water improvement projects will be created and a budget level of cost estimates for the recommended improvements will be prepared.

1.2 PLAN PURPOSE AND PROCESSS

Flood mitigation is an important activity for the City and its residents to pursue because for the most part the potential for damage associated with flooding in flood prone areas is preventable. The science associated with determining floodplains delivers a more exact risk area than that associated with other natural disasters like earthquakes or severe weather. Areas that have been determined through FEMA approved methodologies and designated, as a 100-year floodplain will eventually experience a large-scale flood event. During the course of a 30-year mortgage a house in a 100-year floodplain has a 26% chance of being flooded. Compare that to a 9% chance of fire. For this reason dollars invested in flood mitigation pay off greater than dollars invested in other types of mitigation activities. By investing in time and resources into flood mitigation the City will ensure the safety of its residents and prevent the damage and loss of property.

Planning Team:
The City of Ann Arbor's Systems Planning Unit developed this plan. The plan supervisor role was delegated to the position of the Natural Resource and Environmental Planning Coordinator with technical and writing support of an Environmental Planning Research Assistant. The Systems Planning Unit's manager and staff provided plan review and presentation development.

Additionally, the Planning and Development Services departments' manager and staff, the Emergency Management Team, and the Downtown Development Authority provided substantial draft review, commenting, and direction.

The planning team formed a staff advisory committee to help develop the plan process, formulate the goals and objectives, and design the public engagement process. This team included:

- Systems Planning Staff:
    - Natural Resource and Environmental Planning Coordinator
    - Environmental Planning Research Assistant
    - Environmental Coordinator
    - Civil Engineer V
    - Community Development Administrator
- Downtown Development Authority Director
- Emergency Management Team Staff
- Planning and Development Services Staff

The staff advisory committee met three times during the first six months of the plans work period. The input of this committee was crucial to ensuring the development of a fair and comprehensive planning process that would allow the City to meet the expectations of residents and accomplish the comply with the grant requirements.

Plan Goals:
At the beginning of the planning process three goals were outlined to guide the plan. These goals form the core of all of the mitigation activities outlined.

- Reduce flood losses, minimize damage to public and private property and protect public health and safety.
- Enhance community confidence and maintain a positive community image.
- Create a flexible plan that can adapt to changes in community values and technological advancements.

Plan Objectives:
To achieve these goals the Flood Mitigation Plan outlines mitigation strategies and activities that are organized into seven different objective areas:

- Objective 1: Mapping and Technology - Maintain and utilize up-to-date floodplain mapping techniques to assist in the identification and mitigation of flood related hazards
- Objective 2: Education and Outreach - Employ education and outreach as a means to reduce potential flood hazards and increase community knowledge about the floodplain.
- Objective 3: Planning and Zoning – Integrate floodplain management into master plan revisions new planning projects to prevent possible hazards associated with previously planned uses that are not supported by current floodplain management standards.
- Objective 4: Regulation and Development Standards - Implement regulatory measures and development standards to limit flood impacts caused by the build environment.
- Objective 5: Corrective Actions - Identify opportunities where corrective actions can be used to mitigate the flood risk for properties in the floodplain.
- Objective 6: Infrastructure - Evaluate the City's infrastructure within the floodplain and protect it from flood related hazards.
- Objective 7: Emergency Services - Develop and/or refine a flood response/preparedness method for servicing the community before and after flood related disasters.

The plan outlines the current requirements based on the City's obligation to uphold the Standards of the National Flood Insurance Program (NFIP), and the minimum code requirements for each objective area. The City of Ann Arbor currently works with the State of Michigan to insure that the relevant building codes and regulations are enforced in the City's floodplains. This plan looks at ways to improve the current requirements with the recommended mitigation activities and strategies. To help gage the level of improvements the recommended mitigation activities and strategies will fall into one of two groups: *Local improvements* and *a new standard*.

- Local Improvements: Strategies labeled “local improvement” will generally be widely accepted flood mitigation actions that go above and beyond the current State of Michigan requirements and local regulations. Local improvements strategies are common mitigation actions that have been implemented in many flood prone areas.
- A New Standard: Strategies labeled “a new standard” will generally represent the cutting edge of flood mitigation actions. New standard strategies may not be commonly found in flood prone areas yet, however, they represent current trends in mitigation activities.

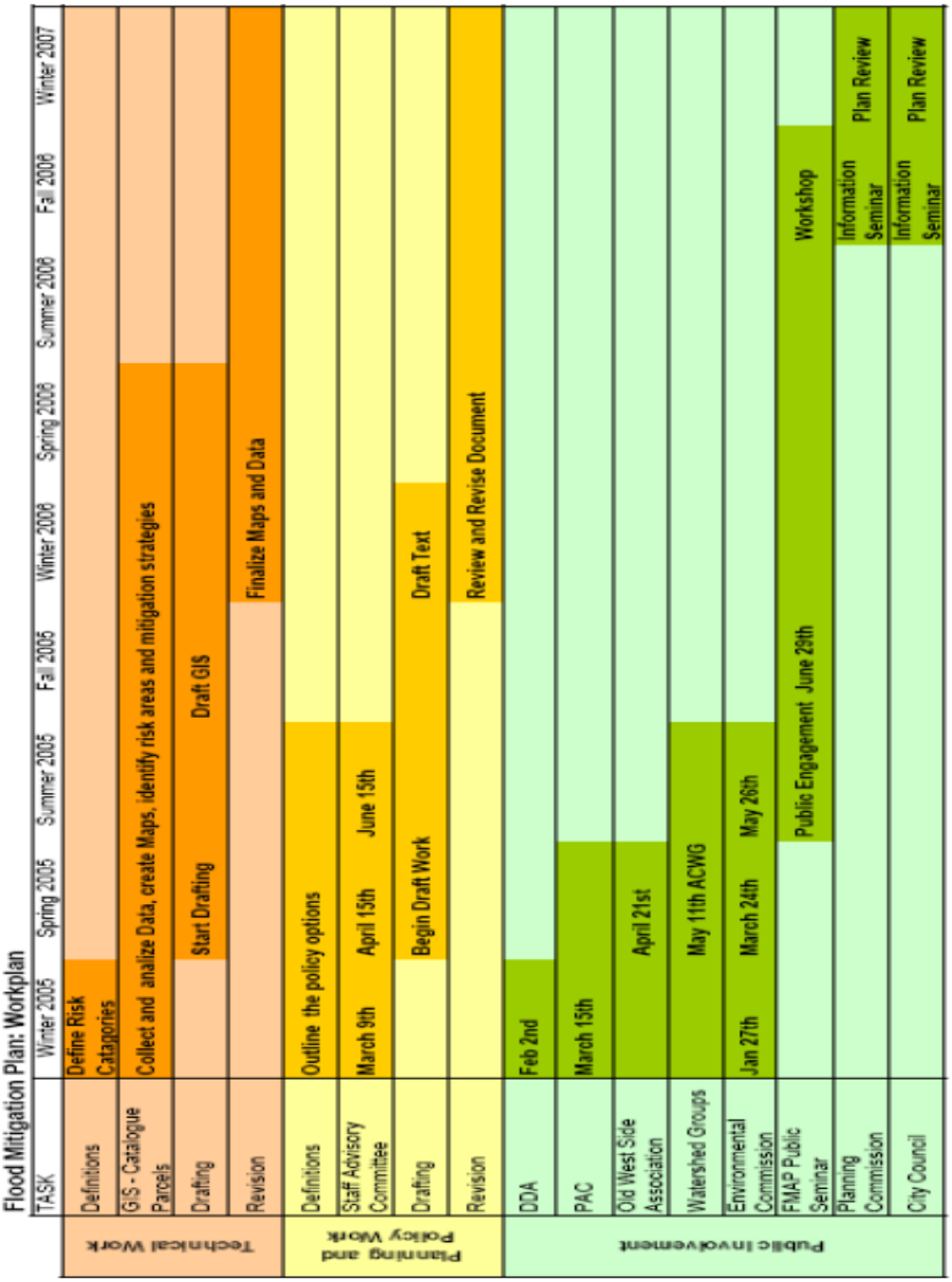
This system for grouping the mitigation strategies and activities is intended to help decision makers with the implementation of the plan. It provides both a point of reference to how Ann Arbor will compare with the mitigation activities being pursued in other cities and a way to measure the feedback the city received from the public through two iterations of feedback exercises.

The plan also summarizes current requirements, both to provide a point of comparison to the mitigation strategy being discussed and to serve as a good reference tool.

Plan development for the City of Ann Arbor Flood mitigation plan falls into three concurrent work tracks: The planning track, the technical track, and the public engagement track. Each of these tracks is essential to the plans process and success. The tasks associated with each of the work tracks are also intended to inform and compliment each other.

The workplan below identifies the tasks, and the general timeframe the tasks were accomplished. The tasks and timeframe outlined on the workplan illustrate that all three of the planning process elements were pursued simultaneously and that the workplan was designed to allow each of the tracts to support and inform the entire process.

Figure 8:



Plan Review

In addition to the local review process, consisting of review by the Environmental Commission, Planning Commission, and final approval by City Council, the City has given State of Michigan multiple opportunities for review. Review opportunities have also been offered to FEMA. The plan will be approved at the Local, State, and Federal Level.

1.3 PUBLIC ENGAGEMENT

The public engagement element of Flood Mitigation Plan planning process was given careful consideration by the planning team. In addition to recognizing the importance of keeping the public informed about the plans development, two of the three goals of the plan relate directly to the values of Ann Arbor residents.

- Enhance community confidence and maintain a positive community image.
- Create a flexible plan that can adapt to changes in community values and technological advancements.

The success of these two goals depends on the ability to collect and assess feedback from Ann Arbor residents. The implementation of the central goal to reduce flood losses, minimize damage to public and private property, and protect public health and safety, will be greatly enhanced by success in these goal areas.

While it is possible to create a mitigation plan that focuses strictly on the goal of reducing flood losses, damage, and risk, the City of Ann Arbor recognizes that there are many ways to achieve this reduction. Further, only by receiving feedback from Ann Arbor residents about the kinds of mitigation strategies and activities that can be implemented can the City expect this plan to positively impact and reduce Ann Arbors flood risks.

City staff developed a process to attain the feedback needed to create a well-informed Flood Mitigation Plan through the use of public forums, outreach meetings, website updates, television broadcasts, radio educational presentation, mailings, and press release, newspaper articles, telephone conversations, emails, and the public approval process.

- Public Forums – The planning team attended six regular public meetings of various public entities including: the Downtown Development Authority, the Environmental Commission, and the Parks Advisory Commission. The report was also discussed at a Planning Commission working session in October of 2006. The Flood Mitigation Plan will be submitted for review and endorsement by the Environmental Commission and Planning Commission. The plan must be approved by City Council and the State of Michigan. The Flood Mitigation Plan was also discussed publicly in meetings that were held to discuss related events and planning efforts, such as the Allen Creek Greenway Task Force meetings and FEMA Map Modernization meetings.
- Outreach Meetings – The planning team conducted outreach to local interest groups and held a special outreach meeting in Council Chambers on June 29th 2005 dedicated solely to gaining public feedback on the Flood Mitigation Plan. The planning team met with; the Old West

Side Association and the Allen Creek, Millers Creek, and Malletts Creek, watershed groups.

- Website Updates – A page was maintained on the City's Environmental Coordination website that contained an online information packet to update the public on the status of the project. This packet also contained contact information for the planning team and the workplan.
- Television Broadcasts - All of the public forum presentations and the special outreach meeting on June 29th were recorded and broadcasted on the local cable network CTN.
- Radio Broadcasts – An interview regarding the project was aired on "Issues of the Environment" on 89.1 WEMU in the spring of 2006.
- Educational Presentations – Several presentations were made regarding the plan at the University of Michigan and Eastern Michigan University
- Mailings – A mailing was sent to a list of over 200 people with development interests, planning interests and neighborhood interests seeking attendance at the special outreach meeting held on June 29th.
- Press Release – A Press Release was published in the Sunday June 25th addition of the Ann Arbor News announcing the special outreach meeting held on June 29th.
- Newspaper Articles – The Flood Mitigation Plan was mentioned in several Ann Arbor News articles during the planning period that dealt with downtown Ann Arbor planning and development issues. The planning team assisted in providing accurate information to Ann Arbor News Reporters. The Old West Side Association also publishes a Newsletter that featured an article about the Flood Mitigation Plan.
- Telephone Conversations – As a result of the outreach and provision of information the planning team received and responded to many telephone inquiries regarding the Flood Mitigation Plan.
- Emails – In addition to responding to telephone inquiries the planning team also responded to many email inquiries regarding the Flood Mitigation Plan.
- Public Approval Process – Public review presentations to Environmental Commission, Planning Commission, and City Council from January 2007- April 2007, with resolutions of support requested from Environmental Commission and Planning Commission and a resolution of approval requested from City Council.

As a part of the public engagement process the planning team worked with a staff advisory committee to develop a feedback exercise that would engage the public and answer the following question:

- What do Ann Arbor Residents view as acceptable methods to accomplish the goals of the Flood Mitigation Plan? This question deals broadly with the policy and planning issues. The planning team sought to develop a list of community-endorsed mitigation strategies and activities.

Two feedback tools were developed to address the question - *iteration 1* and *iteration 2*. The feedback tools were administered in two separate meetings. The first was a meeting with the Old West Side Association. The Second was the special outreach meeting held on June 29th mentioned above.

Iteration 1:
To develop the first feedback exercise the planning team put together a comprehensive list of mitigations strategies that were organized around the seven mitigation areas:

- Objective 1: Mapping and Technology
- Objective 2: Education and Outreach
- Objective 3: Planning and Zoning
- Objective 4: Regulation and Development Standards
- Objective 5: Corrective Actions
- Objective 6: Infrastructure
- Objective 7: Emergency Service

For each of the mitigation objective areas above, current regulations were explained (NFIP and Code Minimum) and a list of 55 strategies was presented in the local improvements/new standard format. Participants were asked to answer a general question – "Should the City of Ann Arbor pursue the following mitigation strategy?" for each of the 55 possibilities.

Iteration 2:
The results of the first exercise were compiled and used to create a refined exercise. The planning team decided to further examine all of the mitigation Strategies that received less than a 50% approval rating in the first exercise. It was also decided that rather than asking about specific mitigation strategies that a list of questions be developed that would address multiple strategies and examples would be provided during the exercise. There were 19 strategies that received an approval rating of less than 50%. A list of 11 questions was developed to further assess these strategies. For more information on these exercises and the results tabulation please see Appendix B

Finally, it should be noted that the public engagement process is ongoing with regards to the implementation of this plan. Please see the Implementation section to be advised on future opportunities to provide feedback and input into the City of Ann Arbor's Flood Mitigation process.

SECTION 2: FLOOD MITIGATION STRATEGIES

2.0 RISK AND VULNERABILTTY

The primary focus of flood mitigation in the City of Ann Arbor is planning for 100-year storm events. This is because there is a known risk area associated with the 100-year flood: the 100-year floodplain and floodway. The implementation of mitigation activities that address 100-year storm events will help to mitigate for storms that occur more frequently, improve the health of the watershed, and serve as a means to achieve the goals outlined in this plan.

FEMA provides the City with National Flood Insurance Rate Maps that outline the 100-year floodplain and flood way, these maps serve as a basis for understanding the City's risks and vulnerability to flood events. Risk analysis and vulnerability assessment are central steps to the success and eventual implementation of a mitigation plan. In order to make informed decisions about the implementation of mitigation activities decision makers and residents need accurate information about the risk the hazard poses and how vulnerable the City is to damage from the risk.

- Risk Analysis: What is the chance that a flood will occur in Ann Arbor? What Areas of Ann Arbor will be affected during a flood event?
- Vulnerability Assessment: If a flood occurs in Ann Arbor how much damage can it potentially cause to property? How many buildings will be affected?

Risk Analysis

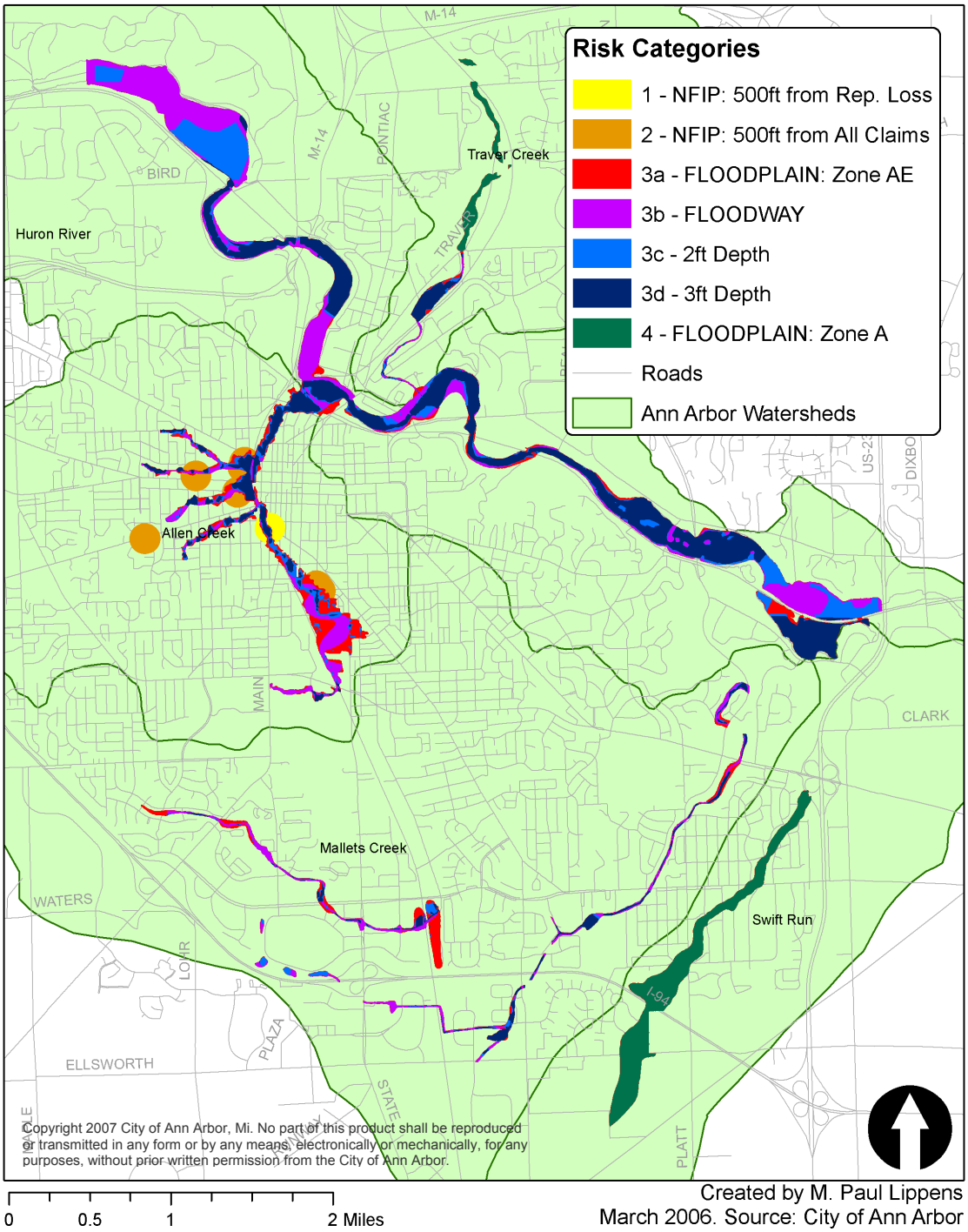
The 100-year floodplain is a starting point to understand the flood risk and conduct a flood risk analysis for Ann Arbor. The 100-year floodplain has a 1% chance of flooding every year. All of the properties, including parcels of land and the associated structures or buildings within this area are located in an area with known flood risk. It is possible to further differentiate the risk by looking at other data. For instance, looking specifically at the floodway. The floodway describes the flow area of a flood event, which makes properties more susceptible to impacts from debris. It is also possible to examine the risk by using topology to look at where the flood is deeper. Properties are more vulnerable to the hydrostatic and hydrodynamic forces of floodwater in deeper flood areas. Lastly, it is possible to analyze potential risk based on what has happened before, if a property has been flooded, or repeatedly flooded, and no action has been taken to mitigate the risk, it is likely at risk to future flood events as well. These principles of flood risk were used to conduct a location assessment of flood risk.

Vulnerability Assessment

Risk categories are used to conduct a vulnerability assessment. By calculating the number of parcels and buildings that fall into each risk category a measure of vulnerability is developed. We can further understand this vulnerability measure by land use or by watershed.

Map 3:

FMAP RISK ANALYSIS



Created by M. Paul Lippens
March 2006. Source: City of Ann Arbor

2.1 RISK ANALYSIS AND VULNERABILITY ASSESSMENT RESULTS

Flood Risk Analysis

The following risk categories form the basis for the vulnerability assessment. These categories should be used to prioritize the implementation of all the mitigation strategies outlined in section 2.2 and serve as the guiding factor in the implementation of this plan.

1. First - Repetitive loss structures: Properties that have received multiple payouts from the NFIP.
2. Second - Reported damage: Properties that have made claims to the NFIP.
3. Third - Location assessment: Properties located in the 100-year floodplain examined by location risk
   - 3a: 100-year floodplain: All properties in the 100 yr floodplain (zone AE).
   - 3b: 100-year floodway: Only properties in the floodway.
   - 3c: 2ft flood depth: All properties in the 100-year floodplain that will be in greater than 2 feet of floodwater. The depth at which cars can be swept along by hydrodynamic forces.
   - 3d: 3ft flood depth: All properties in the 100-year floodplain that will be in greater than 3 feet of floodwater. The depth at which hydrostatic forces can cause structures to collapse.
4. Fourth - Floodplain zone A: All properties that are in floodplain zone A. In Ann Arbor there are two such zones mapped: Swift Run and the upper reaches of Traver Creek.

Figure 9: Downtown Floodplain

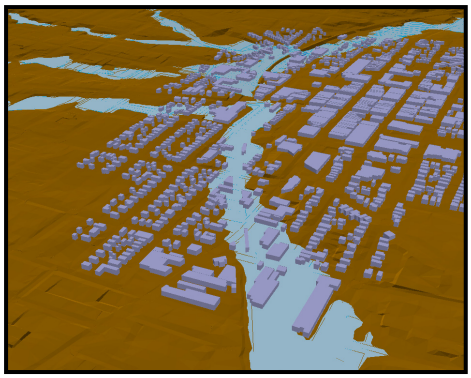


Figure 10: Downtown Floodplain-2ft

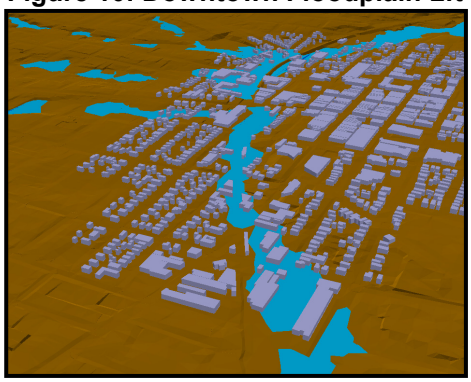
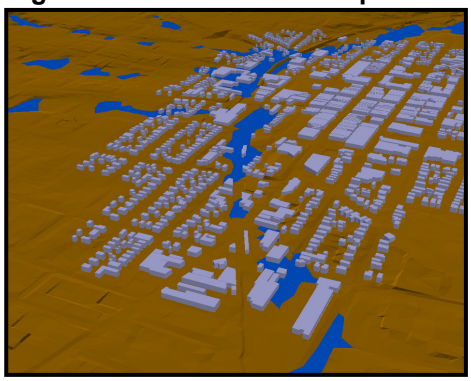


Figure 11: Downtown Floodplain-3ft



Category 1 is the highest priority for flood mitigation activities and Category 2 is the second highest priority. At this time the City of Ann Arbor only has 1 repetitive loss site (Category One) and 8 other sited that have made NFIP claims (category 2). All of these sites are in the Allen Creek Watershed. Mitigating for properties that have a history of flood damage is proven to be a successful method for of preventing flood loss. Properties and structures that fall into Category 3 are vulnerable to future flood damage and could in the future move into one of the higher priority categories. The City of Ann Arbor has not experienced a 100-year storm event over the entire City since the inception of

the NFIP. The City has an opportunity to preempt a significant portion of the vulnerable properties and structures from moving into higher risk categories by implementing mitigation activities on properties and structures prior to the next large storm event. Specifically, properties and structures in category 3 that have flood insurance will most likely make claims if flood damage occurs to the property and will move into Category 1 and 2 if nothing is done prior to the next large storm event in the City. Category 4 will be eliminated as the floodplains in Ann Arbor are restudied and remapped as part of the ongoing FEMA Map Modernization process. The risk categories are not mutually exclusive. For prioritization of properties a point value of one is assigned to each category. Additive values for risk categories of individual properties yields a vulnerability index to further describe each property's vulnerability (see Appendix C).

Vulnerability Assessment

Since the City of Ann Arbor joined the national flood insurance program in 1978 there have been 18 claims made, coming from 9 unique properties. These 18 claims represent 37% of the total claims in Washtenaw County; however, less than 1% of the total claims in the State of Michigan. The total pay out of Claims in Ann Arbor is $103,903, 27% of the pay out to Washtenaw County, also less than 1% of the total State payout. The average amount per payout in Ann Arbor has been about $8 thousand dollars. There are 1452 (floodplain zone AE + zone A) properties that could be affected in a 100-year storm event. Multiplying the average payout of $8 thousand by 1452 gives an estimate of over $11 million dollars in damage when the next 100-year flood occurs, because while all the properties may not be affected it is reasonable to assume that the damage will be more extensive due to the size of the storm. See

Table 2:

FMAP Parcel Vulnerability

PARCELS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	1	1	0	0	0	0	0
2 - NFIP Reported Damage	8	8	0	0	0	0	0
3a - Floodplain Zone AE	1180	707	136	298	0	62	23
3b - Floodway	773	359	117	263	0	45	11
3c - 2ft Depth	814	444	95	229	0	55	9
3d - 3ft Depth	671	325	89	212	0	54	9
4 - Floodplain Zone A	272	0	0	0	257	15	0

FMAP Building Vulnerability

BUILDINGS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	1	1	0	0	0	0	0
2 - NFIP Reported Damage	8	8	0	0	0	0	0
3a - Floodplain Zone AE	506	425	11	49	0	23	2
3b - Floodway	263	200	10	38	0	16	1
3c - 2ft Depth	256	235	4	4	0	15	2
3d - 3ft Depth	185	169	3	3	0	11	1
4 - Floodplain Zone A	116	0	0	0	116	0	0

The table above presents the number of vulnerable parcels and structures within each of the risk categories defined in the risk analysis. The total for each category is presented along with a breakdown by watershed area. The redundancy column explains parcels or structures that may be partially in two or even three watershed areas.

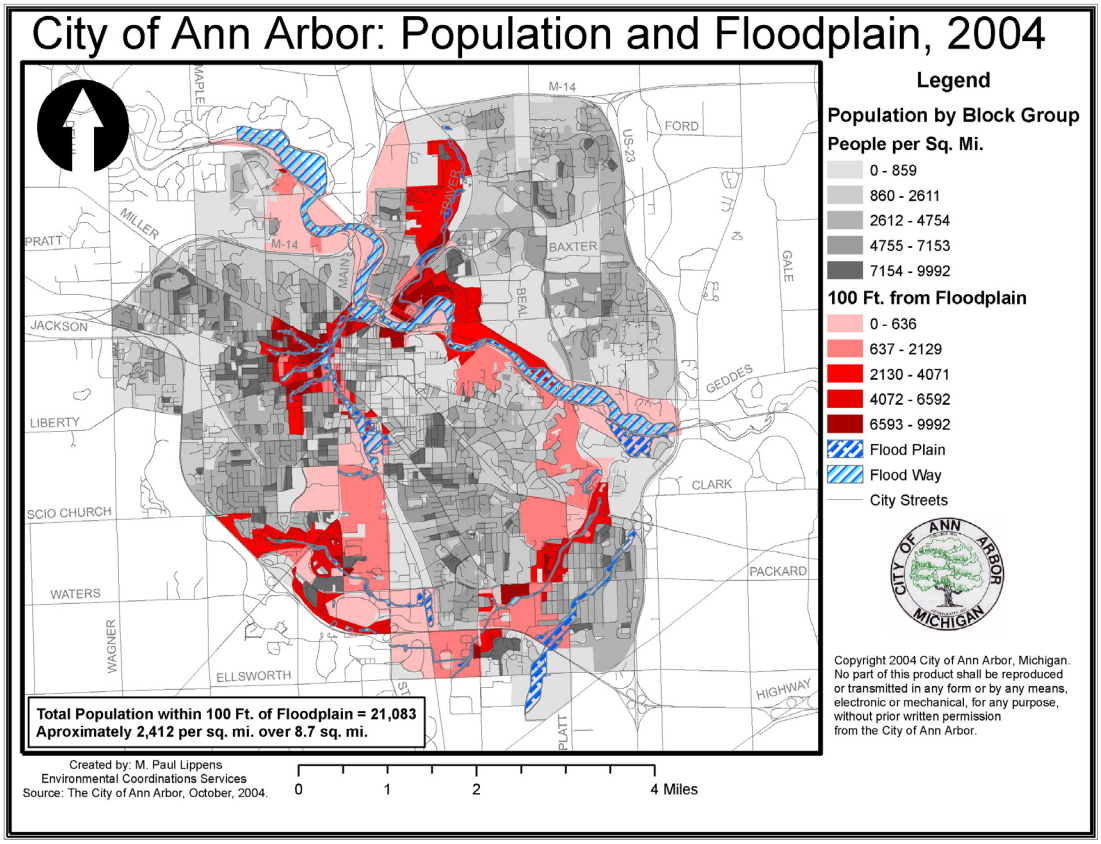
The vulnerability assessment confirms the severity of the flood risk in the Allen Creek Watershed. This watershed contains the 60% of the parcels and 84% of the structures in the Floodplain Zone AE (category 3a) and similarly high percentages of Category 3b, 3c, and 3d. Allen also contains all of the NFIP claims to date, suggesting it is more vulnerable to smaller storm events as well. Based on the information in the table above, it is also possible to develop a monetary estimate of the flood vulnerability in Ann Arbor. The bullets below are intended to illustrate possible loss scenarios in the event of a 100-year flood. Loss estimates are based on the 2000 Census Median Housing Value for the City of Ann Arbor of $181,400.

- *What would the loss be if the City were to experience a 25% average loss on all the parcels located in the floodplain?* A 25% loss on all floodplain parcels would equal $53,966,500.
- *What would the loss be if the City were to experience a 25% average loss on all the parcels located just in the floodway?* A 25% loss on all floodway parcels would equal $35,055,550.
- *What would the loss be if the City were to experience a 50% average loss on all the parcels located in the floodplain?* A 50% loss on all floodplain parcels would equal $107,933,000.
- *What would the loss be if the City were to experience a 50% average loss on all the parcels located just in the floodway?* A 50% loss on all floodway parcels would equal $70,111,100.
- *What would the loss be if the City were to experience a 75% loss on all the parcels located just in the 3ft depth areas?* A 75% loss on all 3ft depth floodplain parcels would equal $91,289,550.
- *What would the loss be if the City were to experience a 75% average loss on all the parcels located just in the 2ft depth areas?* A 75% loss on all 2ft depth floodway parcels would equal $110,774,700.

The questions above do not tell the whole story but rather begin to show how cost-benefit analysis can be conducted to evaluate the potential benefits of implementing flood mitigation strategies. It is also important to note that flood losses are not one-time losses, the more flood events that occur in the City before mitigations strategies have been implemented, the more vulnerability the City has to properties becoming classified as repetitive loss structures. Currently, the City of Ann Arbor only has one repetitive loss structure meaning there is an opportunity to conduct significant mitigation prior to the occurrence of a large-scale loss event like the ones estimated in the above bullets. Project # 15 - Detailed Flood Loss Model, describes creating a model to create a more detailed assessment of flood loss than the one above.

In addition to financial losses that can be incurred through property damage during a flood event, floods also pose a risk to human health. There are numerous tragic threats that can harm people caught in a catastrophic flood event including from drowning in aggressive waters, being trapped in vulnerable structures, or being struck by hazardous flood debris. Based on the year 2000 census estimate for average household size in Ann Arbor of 2.5, there are approximately 2,295 persons whose parcels are in a floodplain zone AE and zone A (see table 3). City wide the total number of persons living in a census block within 100 feet of the floodplain area is 21,083.

Map 4:



One way to manage resident's exposure to these risks is to employ sound land use planning in flood prone areas. Different land uses have inherently different vulnerabilities. For instance, residential use is a 24-hour land use in which people are particularly vulnerable during sleeping hours. Comparatively, commercial and recreational uses may only be partial day uses, and many recreational uses have the added benefit of creating open spaces. Industrial uses may also be partial day uses, but they are also potential threats because industrial chemicals and toxins can be carried in floodwaters if facilities were to become compromised. Mitigation strategies for addressing these concerns are discussed in the systems recommendation section under Mitigation Objective 3 – Planning and Zoning. The following tables examine the parcel and structure vulnerability by watershed for the land uses mentioned above: Residential, Commercial, Recreational and Industrial.

Table 3:

FMAP Residential Zone Parcel Vulnerability

PARCELS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	0	0	0	0	0	0	0
2 - NFIP Claims	8	8	0	0	0	0	0
3a - Floodplain Zone AE	736	501	22	173	0	47	7
3b - Floodway	424	229	16	152	0	30	3
3c - 2ft Depth	497	299	21	137	0	41	1
3d - 3ft Depth	398	206	21	131	0	41	1
4 - Floodplain Zone A	182	0	0	0	179	3	0

FMAP Residential Zone Building Vulnerability

BUILDINGS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	0	0	0	0	0	0	0
2 - NFIP Claims	8	8	0	0	0	0	0
3a - Floodplain Zone AE	417	362	6	30	0	21	2
3b - Floodway	210	166	6	26	0	14	2
3c - 2ft Depth	212	197	2	0	0	14	1
3d - 3ft Depth	148	136	1	0	0	11	0
4 - Floodplain Zone A	110	0	0	0	110	0	0

Residential use is the most prominent land use in the floodplain, comprising approximately 62% of the total land uses in the Floodplain Zone AE (category 3a). Of the residential use, the largest share, 68%, is concentrated in Allen Creek. This is followed by Malletts Creek, which has 24%.

Table 4:

FMAP Commercial Zone Parcel Vulnerability

PARCELS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	1	1	0	0	0	0	0
2 - NFIP Claims	0	0	0	0	0	0	0
3a - Floodplain Zone AE	150	86	6	52	0	7	1
3b - Floodway	105	51	5	42	0	7	0
3c - 2ft Depth	99	65	5	23	0	6	0
3d - 3ft Depth	81	49	5	21	0	6	0
4 - Floodplain Zone A	6	0	0	0	6	0	0

FMAP Commercial Zone Building Vulnerability

BUILDINGS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	1	1	0	0	0	0	0
2 - NFIP Claims	0	0	0	0	0	0	0
3a - Floodplain Zone AE	24	18	0	4	0	2	0
3b - Floodway	12	7	0	3	0	2	0
3c - 2ft Depth	10	9	0	0	0	1	0
3d - 3ft Depth	8	8	0	0	0	0	0
4 - Floodplain Zone A	1	0	0	0	1	0	0

Commercial land use is the third most intensive use of the land uses analyzed. It accounts for approximately 13% of the total land in the Floodplain Zone AE

(category 3a). Of the commercial use, the largest share, 57%, is concentrated in Allen Creek. This is followed by Malletts Creek, which has 35%.

Table 5:

FMAP Parks & Vacant Zone Parcel Vulnerability

PARCELS by Risk Category	Total	Allen	Huron	Mallets	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	0	0	0	0	0	0	0
2 - NFIP Claims	0	0	0	0	0	0	0
3a - Floodplain Zone AE	219	64	97	47	0	14	3
3b - Floodway	185	48	82	45	0	17	7
3c - 2ft Depth	163	35	76	41	0	16	5
3d - 3ft Depth	150	31	72	37	0	15	5
4 - Floodplain Zone A	136	0	0	0	121	15	0

FMAP Parks & Vacant Zone Building Vulnerability

BUILDINGS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	0	0	0	0	0	0	0
2 - NFIP Claims	0	0	0	0	0	0	0
3a - Floodplain Zone AE	9	7	1	1	0	0	0
3b - Floodway	6	4	1	1	0	0	0
3c - 2ft Depth	4	3	0	1	0	0	0
3d - 3ft Depth	2	2	0	0	0	0	0
4 - Floodplain Zone A	2	0	0	0	2	0	0

Parks & Vacant land uses is the second most intensive use of the land uses analyzed. It accounts for approximately 18% of the total land in the Floodplain Zone AE (category 3a). Only 4% of the 219 parcels in category 3a have buildings locates in the area.

Table 6:

FMAP Industrial Zone Parcel Vulnerability

PARCELS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	0	0	0	0	0	0	0
2 - NFIP Claims	0	0	0	0	0	0	0
3a - Floodplain Zone AE	84	57	1	20	0	6	0
3b - Floodway	68	45	0	19	0	4	0
3c - 2ft Depth	63	43	0	16	0	4	0
3d - 3ft Depth	54	36	0	14	0	4	0
4 - Floodplain Zone A	0	0	0	0	0	0	0

FMAP Industrial Zone Building Vulnerability

BUILDINGS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	0	0	0	0	0	0	0
2 - NFIP Claims	0	0	0	0	0	0	0
3a - Floodplain Zone AE	10	8	0	2	0	0	0
3b - Floodway	7	5	0	2	0	0	0
3c - 2ft Depth	6	6	0	0	0	0	0
3d - 3ft Depth	5	5	0	0	0	0	0
4 - Floodplain Zone A	0	0	0	0	0	0	0

Industrial land use is the least intensive use of the land uses analyzed. It accounts for approximately 7% of the total land in the Floodplain Zone AE (category 3a). Of the industrial land use, the largest share, 67%, is concentrated in Allen Creek. This is followed by Malletts Creek, which has 23%.

This land use analysis shows the different land use development patterns of the different watersheds in the City. For instance, looking at residential uses in Table 3 shows that only 17% of the buildings on the 173 parcels Malletts Creeks floodplain are also located the floodplain. Generally the assumption can be made that buildings in this watershed were built further away from the stream corridor than in Allen Creek, where 72% of the buildings on the 501 parcels in the floodplain are also located in the floodplain.

The land uses in these tables are illustrated with the flood risk categories on the following map (map 5).

Future Building and the Flood Vulnerability

Implementation of the projects recommended in sections 2.2 and 2.3 will reduce vulnerability to any building projects that may be proposed within the risk areas. Many of the recommended projects require planning, research, and/or ordinance development/amendments. It is strongly recommended that all future projects proposed in the flood risk areas make a voluntary effort to comply with the recommended projects in this plan immediately upon the plans approval. Since the implementation process may take an upwards of five years voluntary compliance will help to assure that no new vulnerable structures are added to the totals listed above. This is consistent with the primary goal of the plan:

- Reduce flood losses, minimize damage to public and private property and protect public health and safety.

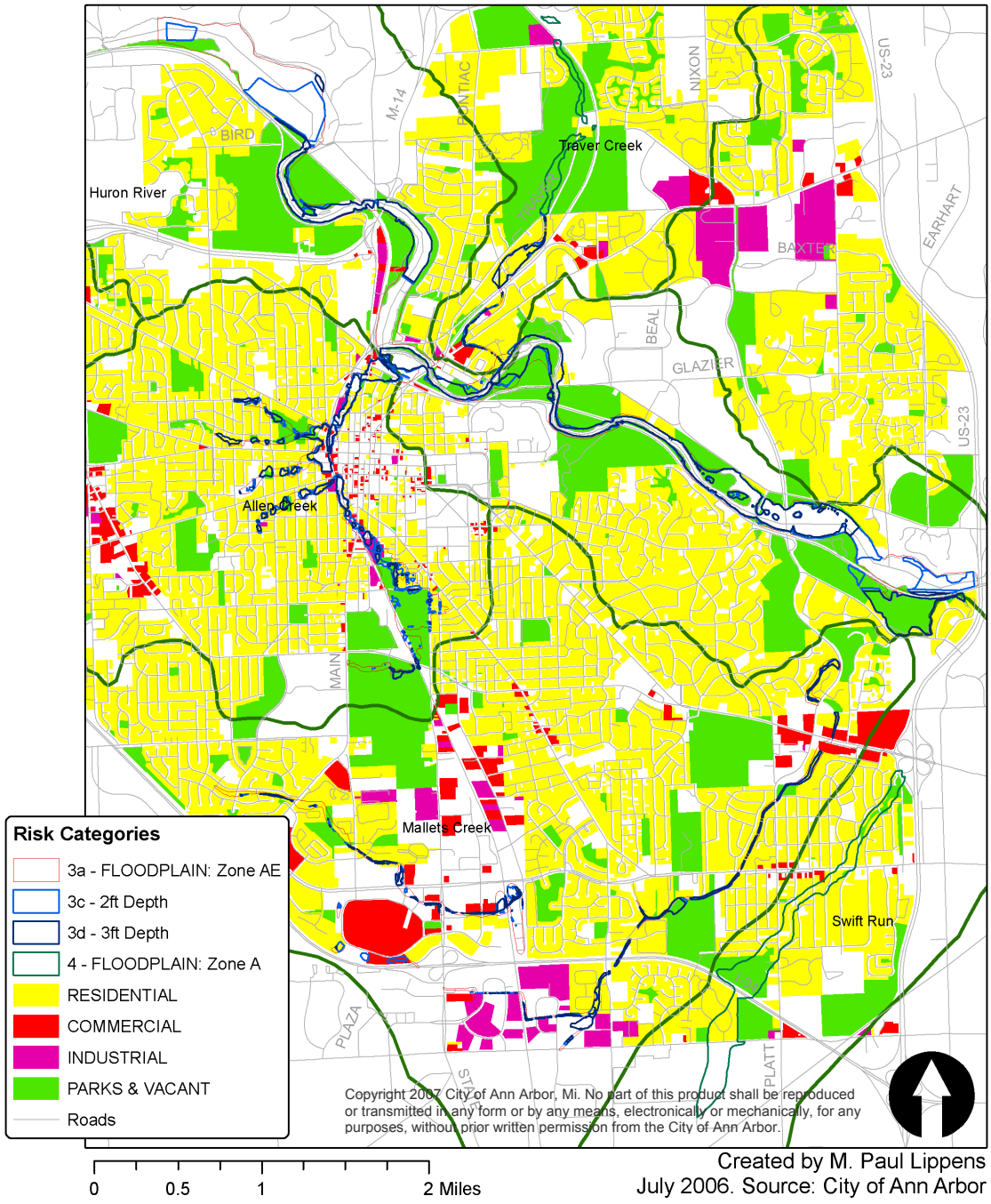
Any future buildings built consistent with the recommendations of this report, and existing structures that are mitigated in ways consistent with the recommendations of this report, can be tracked in future revisions as mitigated structures.

Understanding the Vulnerability Assessment

The estimates included in this section for vulnerability of parcel/buildings by watershed and land use are made using the best available data to the City of Ann Arbor. The estimates utilize the most current geographic and informational data maintained by the City of Ann Arbor and are intended to be used for planning purposes. These estimates are not at a “survey” level of detail and individual properties that fall into the risk categories should be subject to verification of vulnerability prior to conducting mitigation activities.

Map 5:

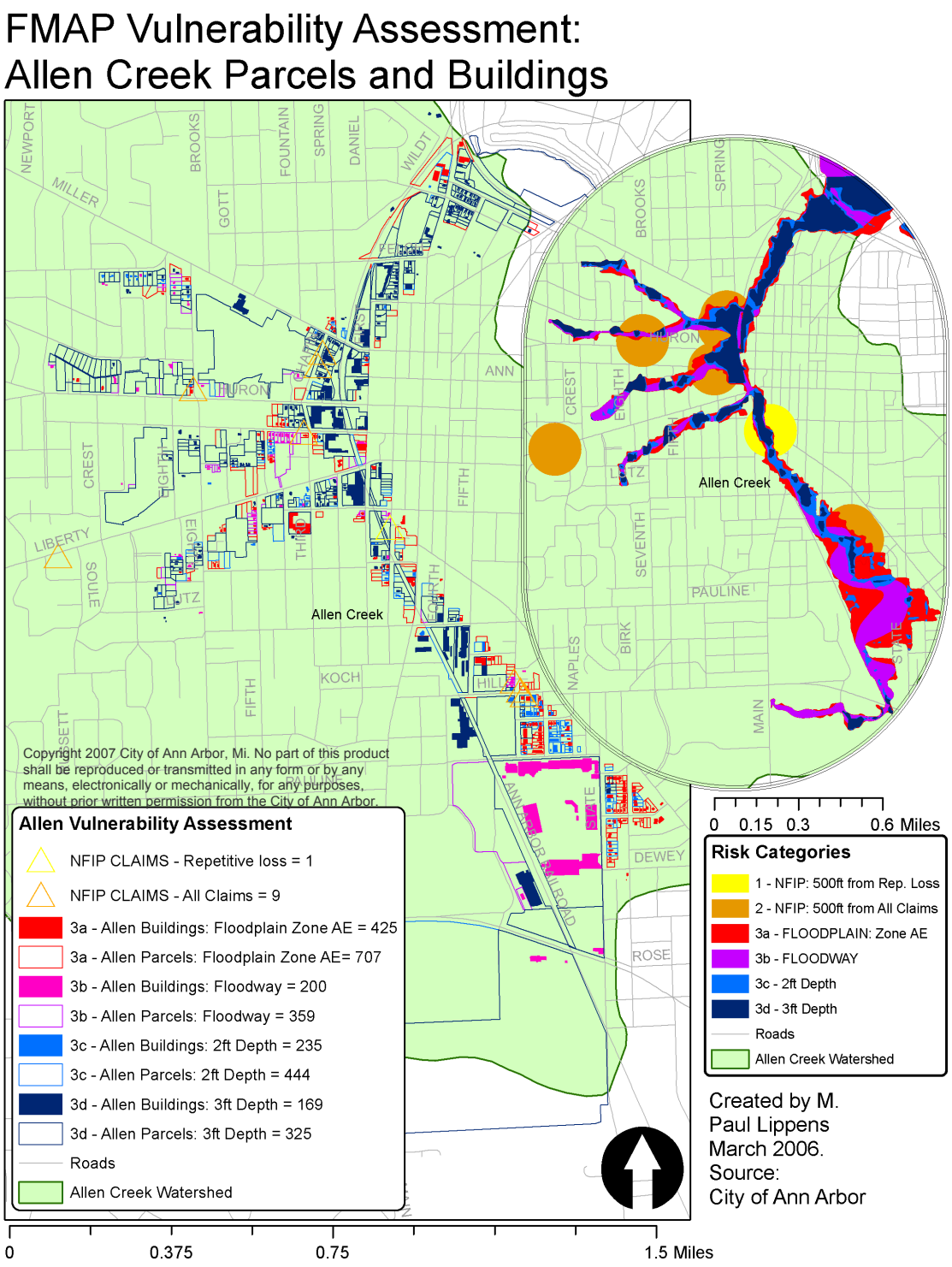
FMAP Vulnerability Assessment: Residential and Non Residential Land Uses



Created by M. Paul Lippens
July 2006. Source: City of Ann Arbor

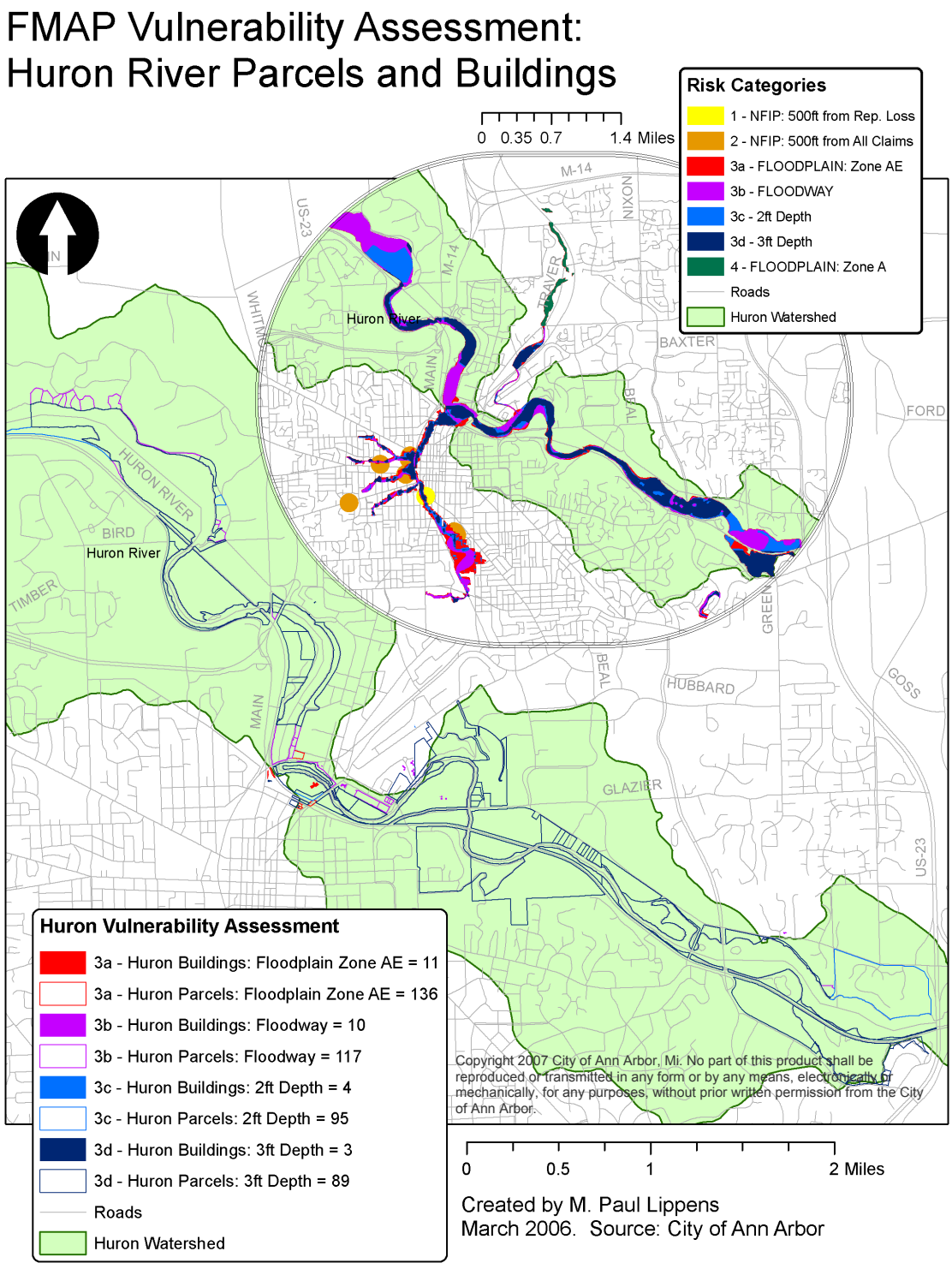
The following pages contain maps of the vulnerability assessment by watershed. These maps show the actual parcels and building structures that fall within each risk category by watershed.

Map 6:



The “circular” inset shows the risk categories for Allen Creek. The larger rectangular frame shows the results of the vulnerability analysis for Allen Creek.

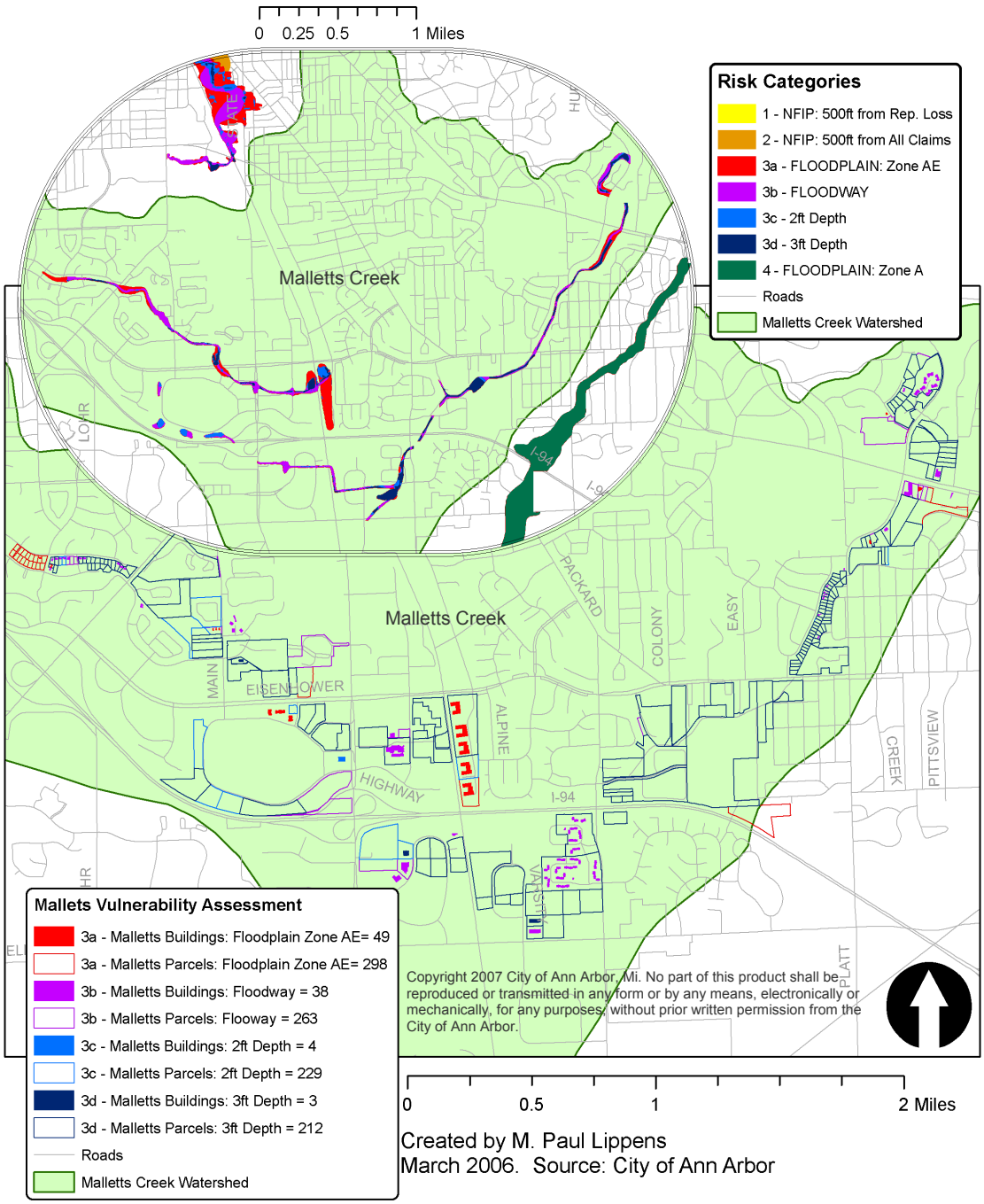
Map 7:



The “circular” inset shows the risk categories for the Huron River. The larger rectangular frame shows the results of the vulnerability analysis for the Huron River.

Map 8:

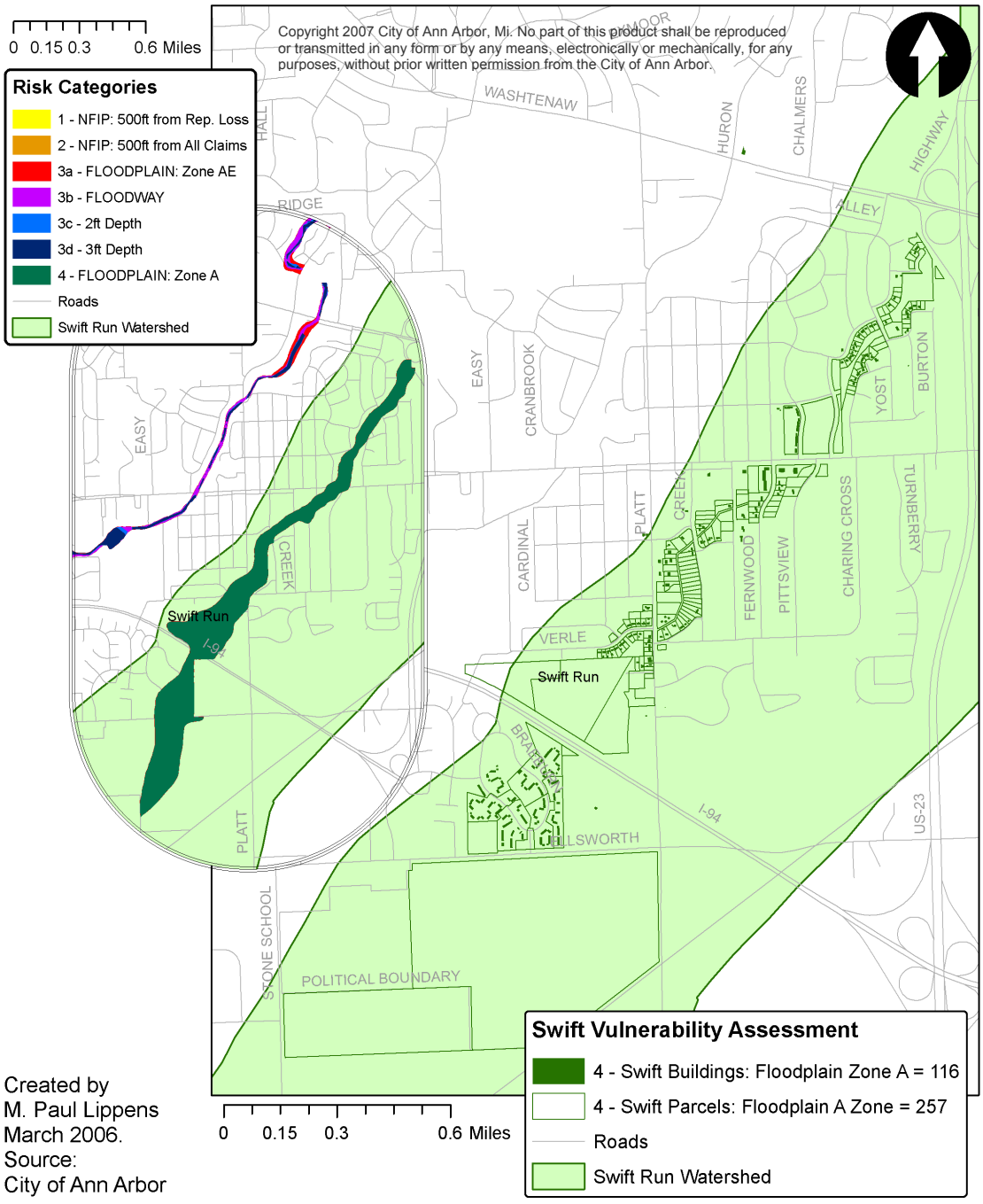
FMAP Vulnerability Assessment: Mallets Creek Parcels and Buildings



The “circular” inset shows the risk categories for Malletts Creek. The larger rectangular frame shows the results of the vulnerability analysis for Malletts Creek.

Map 9:

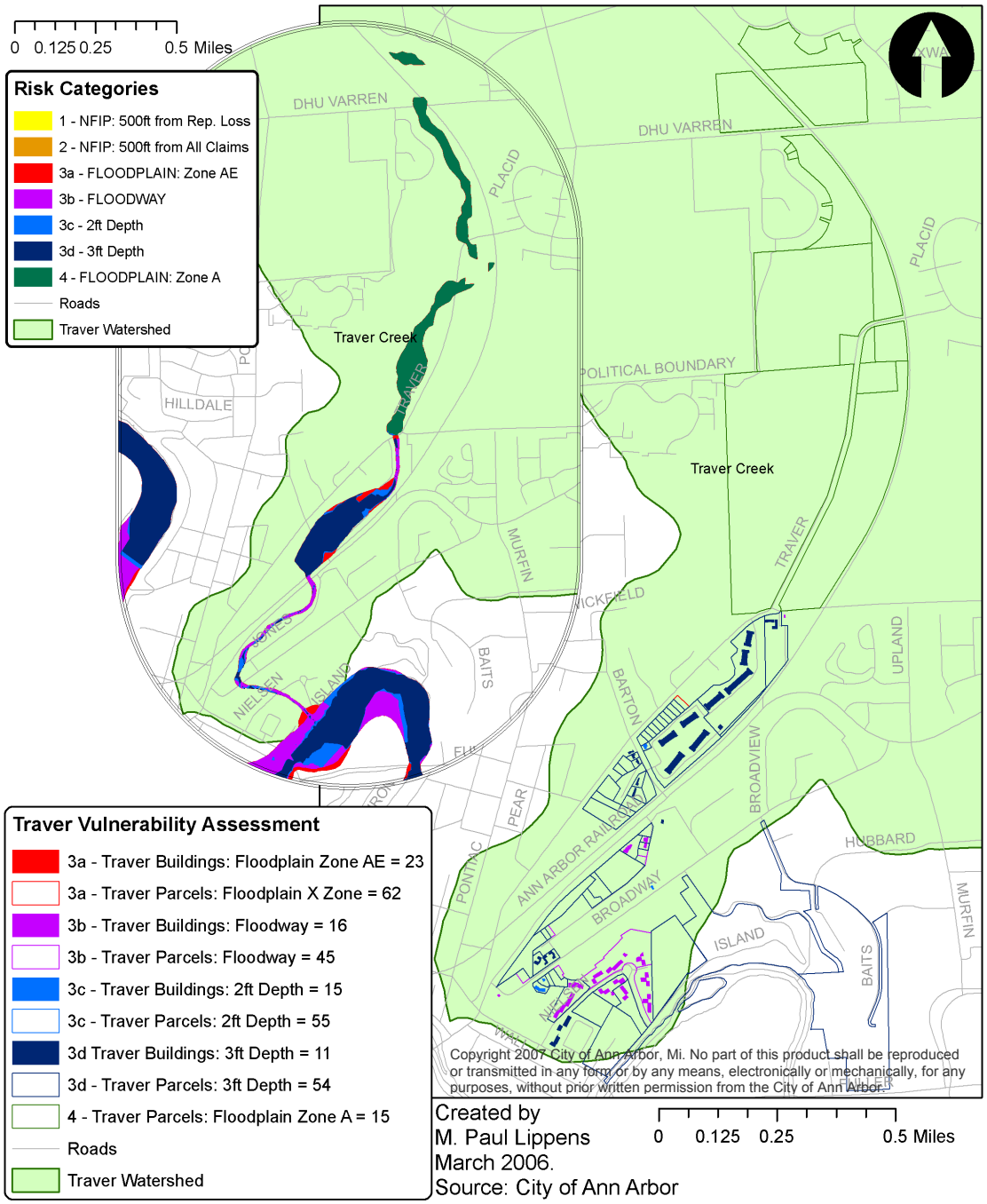
FMAP Vunerability Assessment: Swift Run Parcels and Buildings



The “circular” inset shows the risk categories for Swift Run. The larger rectangular frame shows the results of the vulnerability analysis for Swift Run.

Map10:

FMAP Vulnerability Assessment
Traver Creek Parcels and Buildings



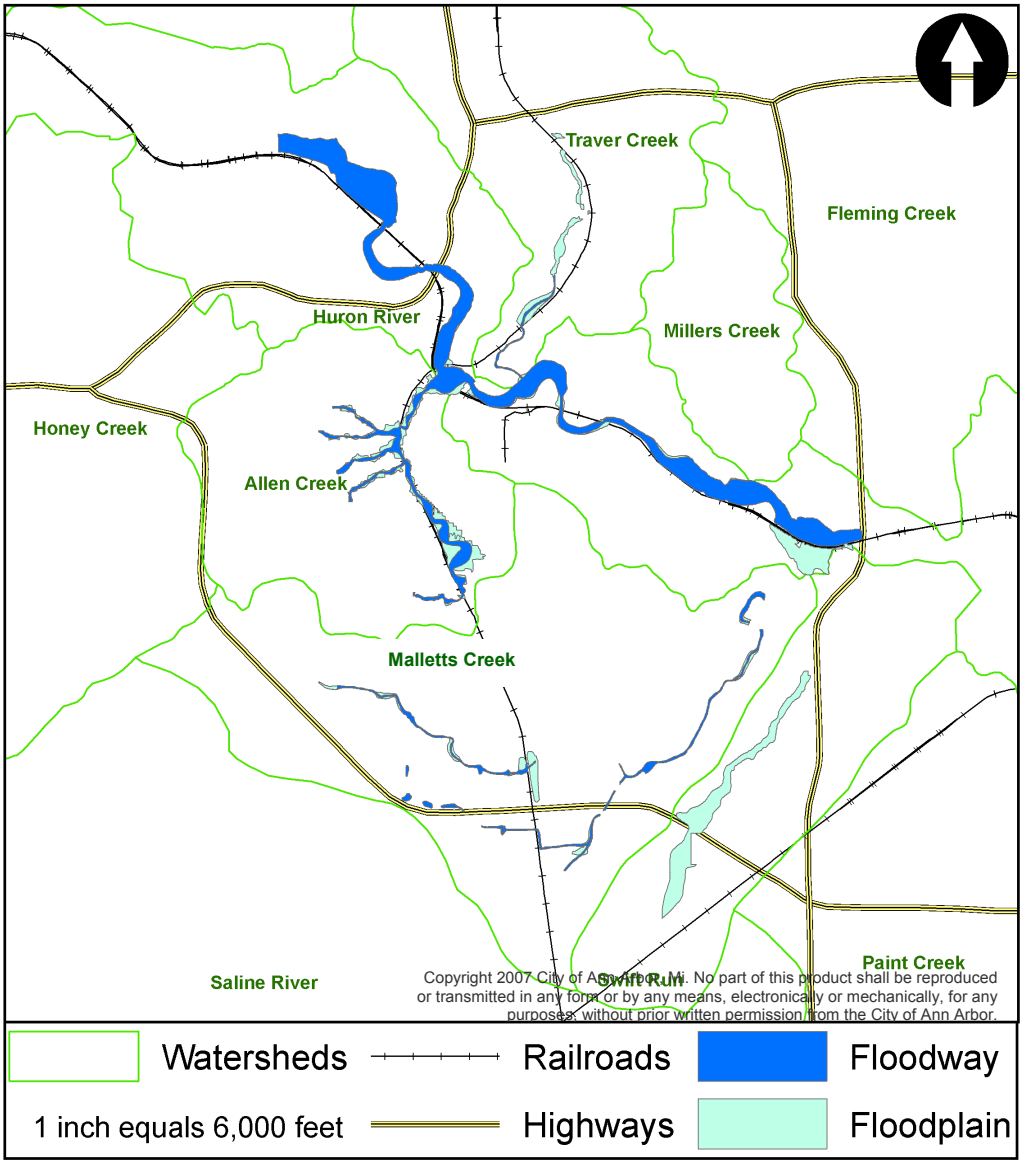
The “circular” inset shows the risk categories for Traver Creek. The larger rectangular frame shows the results of the vulnerability analysis for Traver Creek

2.2 SYSTEM RECOMMENDATIONS

The City of Ann Arbor watersheds[2] are part of the Huron River Watershed System. While each of the watersheds have specific considerations there are many recommended mitigation strategies and activities the City of Ann Arbor could implement that are important to the entire system. This section is dedicated to mitigation strategy recommendations that apply to the whole watershed system. Cost estimates are based on a burdened salary figure of $100,000.

Map 11:

Ann Arbor Watersheds



[2] Or creeksheds - depending on the unit of analysis. See Section 1.1.

Mitigation Objective 1: **Mapping and Technology**

Maintain and utilize up-to-date floodplain mapping techniques to assist in the identification and mitigation of flood related hazards.

NFIP& Code Minimum –

Currently the City of Ann Arbor is a participant in the National Flood Insurance Program. As a participant FEMA supplies the City with Flood Insurance Rate Maps (FIRMs). These Maps show the City's floodplain and floodway and are used by FEMA to determine the rate that homeowners will pay to receive flood insurance. The City of Ann Arbor is required to enforce at a minimum regulations that apply to these designated areas[3]. Some example regulations that the FIRM is used for:

- Residential development must be elevated above the Base Flood Elevation (BFE)
- All other development in floodway and floodplain must meet building code requirement for flood resistant construction

As a participant in the National Flood Insurance Program the City of Ann Arbor is required to adopt the FIRM. The current FIRM is dated January 2nd 1992. Starting in 2004, FEMA embarked on a National FIRM re-mapping effort that aimed to digitize & update the Nations FIRMs[4]. From 2005 – 2007 FEMA worked on developing digital FIRMS for all of Washtenaw County. The MDEQ has partnered with FEMA on this effort. The City of Ann Arbor assisted in this process and supported FEMAs team with data and staff time.

The FIRM provides local governments and residents with the best tool available for the mitigation of future flood event. This is because the maps are designed to predict the areas that are most vulnerable to large storm events. The FIRM maps are most accurate when calibrated with sufficient local data for rainfall, flow, and land uses; however, topography alone can yield an estimate for the fluvial floodplain. The fluvial floodplain is the area in a watershed that has been shaped by historic flood events. The FIRM allows local governments to have a more detailed understanding of the various levels of risk within the fluvial floodplain.

Because the FIRM is such a useful tool the City of Ann Arbor is committed to finding ways to improve the flood mapping process to ensure accuracy of the maps.

[3] The State of Michigan has jurisdiction only in floodplain and floodway areas with more than two square miles of drainage area.
[4] The FEMA re-mapping project is mentioned in Section 1.0

Local Improvements –

Project 1: Detailed Hydrologic Data.
The City of Ann Arbor could invest in the collection of detailed hydrologic data that might result in a better representation of the floodway and floodplain. Collecting hydrological data will become more important in the coming years to gage the effects of global climate change on local whether patterns. Better data would aid in flood model calibration. This project would have four components: *planning*, *technical implementation*, *hydraulic information gathering*, and *data maintenance*.

- Planning: Plan for the purchasing and placement of rain gages. Lead community through the initial phases.
  - Timeframe – Year 2
  - Cost – 1 staff at .25 time = $25,000
- Technical implementation: Purchase and install rain gages. Set up staff for the data collection.
  - Timeframe – Year 2
  - Cost – 1 staff at .25 time = $25,000 + Technology Cost
- Hydrologic information gathering: Gather hydrologic information for both flood depth and velocity
  - Timeframe – Year 2
  - Cost – 1 staff at .25 time = $25,000 + Technology Cost
- Data maintenance: Organize rain flow data for model updating. Check gages for accuracy. Provide information when requested.
  - Timeframe – Year 2, ongoing
  - Cost – 1 staff at .25 time = $25,000 + Technology Cost

Total Project Cost: $100,000 + Technology

Project 2: Map Additional Flood Related Hazards.
The current flood mapping procedure does not necessarily include a sensitivity analysis for certain kinds of flood hazards that may affect risk areas during a storm event. The types of hazards that should be examined are: Dam failure inundation; uncertain flow paths, and debris & sediment blockage. The three components of this process will be *sensitivity analysis*, *flood modeling*, and *emergency management updating*.

- Sensitivity analysis: Identify dams that may fail, areas that may have uncertain flow paths and areas that are susceptible to blockage.
  - Timeframe – Year 3
  - Cost – 1 staff at .5 time = $50,000
- Flood modeling: Use the sensitivity analysis to model how the FIRM designations may change under certain scenarios.
  - Timeframe – Year 3
  - Cost – 1 staff at .5 time = $50,000
- Emergency management updating: Ensure that this information is included in the City of Ann Arbors Emergency Response Plan.

- Timeframe – Year 3
- Cost – 1 staff at .1 time = $10,000

Total Project Cost: $110,000

A New Standard –

Project 3: Use Future Conditions Hydrology for Flood Mapping.
One of the data used to create the FIRMs is a run off coefficient. The run off coefficient is a value that is assigned to each land use within the watershed. This value is used to determine the amount of water that will flow off of the land and contribute to a flood. A Future Conditions Hydrology approach would estimate the floodplain and floodway based on the planned future land use instead of the existing land use. NFIP allows the future conditions hydrology lines to be drawn on the FIRM for informational purposes. This project would require a *future conditions hydrology map update* and a *floodplain volumes analysis*.

- Floodplain volumes analysis: To assist in future land use modeling a floodplain volumes analysis can be conducted. How much of the volume of the floodplain area can be attributed to displaced water due to the buildings that currently occupy floodplain area?
  - Timeframe – Year 2
  - Cost – 1 staff at .5 time = $50,000
- Future conditions hydrology map update: Assign a runoff coefficient based on future land use and place new lines on FIRM.
  - Timeframe – Year 3-4
  - Cost – 1 staff at .5 time = $50,000

Total Project Cost: $100,000

Project 4: Use Future Condition Hydrology for City Plans and Regulations.
The City of Ann Arbor could choose to use a future conditions hydrology approach to regulate the floodplain and floodway. Taking this approach would ensure that the City's comprehensive planning efforts could be implemented without increasing the risk to properties and people in and near the City's flood prone areas. This project would consist of two components, an *ordinance development* and a *plan and regulation update*.

- Ordinance development: Write an ordinance and conduct the public outreach to inform residents of the proposed change. Work with decision makers throughout the process. This project could also be covered in a Flood Management Ordinance, see Mitigation Objective 4.
  - Timeframe – Year 5
  - Cost – 1 staff at .1 time = $10,000
- Plan and regulation update: Update the relevant planning documents and regulatory procedures to reflect the change in policy.
  - Timeframe – Year 5
  - Cost – 1 staff at .4 time = $40,000

Total Project Cost: $50,000

Mitigation Objective 2: **Education and Outreach**

Employ education and outreach as a means to reduce potential flood hazards and increase community knowledge about the floodplain.

NFIP& Code Minimum –

Currently it is the policy of the City of Ann Arbor to respond to residents and developers inquiries regarding property in the floodplain and floodway. City staff works to answer questions that are asked promptly. City staff provides answers to basic inquiries:

- Is my property in the floodway?

Staff also provides answers to more complicated inquiries:

- What are the permitted uses on this property?
- How can I modify my structure in the floodplain to comply with the building code?
- Can I get the FIRM amended to take my structure out of the floodplain?

Providing this information is an essential part of the City's current efforts to ensure the responsible use of properties in the City's flood prone areas.

In addition to staff efforts the City uses its website to provide information. Currently the FIRMs are available on the website as well as information about emergency response and planning efforts.

The City of Ann Arbor is committed to providing flood information to property owners and prospective developers as well as looking for opportunities to improve on the current education and outreach policies.

Local Improvements –

Project 5: Improve Flood Maps on City Website
The City of Ann Arbor currently provides static images of the FIRM maps on the City's website through the Planning and Development Services Department. The City could improve this service by creating an interactive flood map that would be user-friendly. This project would consist of a *web update* using the available GIS information.

- Web update: Use the available GIS information to create an interactive web page for residents to learn about the location of the flood way and floodplain.
  - Timeframe – Year 1
  - Cost – 2 staff at .1 time = $20,000

Total Project Cost: $20,000

Project 6: Flood Information Links on City Website
The City of Ann Arbor can use the web as resource to link residents to information about flood hazards. Many residents do not fully understand flood risk or how they are vulnerable to flood events. There are many groups that provide flood information including:

- FEMA
- Association of State Floodplain Managers
- State of Michigan

Providing links to these groups, and providing information from the risk analysis and vulnerability assessment in section 2, is a simple way to help inform Ann Arbor Residents about Flood preparedness. This project would consist of a *web update*.

- Web Update: Find and research organizations that provide web based information on Flood Risk and Flood Preparedness. Create a web page to link, display and describe the information available.
  - Timeframe – Year 1
  - Cost – 1 staff at .05 time = $5,000

Total Project Cost: $5,000

Project 7: Public Information Campaign.
The City of Ann Arbor could pursue a Public Information Campaign that could consist of any of the following elements: *brochures*, *mailings*, *displays*, *articles*, *videos*, *signs*, *presentations*, and *emergency action plans*.

- Brochures: Create a brochure that describes the City of Ann Arbor's Flood Risk and Mitigation Objectives and distribute.
  - Timeframe – Year 1
  - Cost – 1 staff at .1 time = $10,000 + production
- Mailings: Create a mailing that describes the City of Ann Arbors Flood Risk and Mitigation Objectives.
  - Timeframe – Year 1
  - Cost – 1 staff at .1 time = $10,000 + production
- Displays: Create a display that describes the City of Ann Arbor's Flood Risk and/or Mitigation Objectives. Find places to exhibit the display.
  - Timeframe – Year 1
  - Cost – 1 staff at .1 time = $10,000 + production
- Articles: Encourage local papers and publications to write about the City of Ann Arbor's Flood Risk and Mitigation Objectives.
  - Timeframe – Year 1
  - Cost – 1 staff at .1 time = $10,000 + production
- Videos: Create a video that illustrates the City of Ann Arbor's Flood Risk and Mitigation Objectives in an easily accessible way. Make video accessible on the web and show on CTN.
  - Timeframe – Year 1
  - Cost – 1 staff at .1 time = $10,000

- Signs: Create signage that describes the City of Ann Arbor's Flood Risk and/or Mitigation Objectives. Post signs marking the location of the floodplain and risk categories or flood depth.
    - Timeframe – Year 1
    - Cost – 1 staff at .1 time = $10,000 + production
- Presentations: Create a presentation that describes the City of Ann Arbor's Flood Risk and Mitigation Objectives. Look for forums to give the presentation.
    - Timeframe – Year 1
    - Cost – 1 staff at .1 time = $10,000
- Emergency Action Plans: Create an Emergency Action Plan summary sheet that describes what steps residents should take in the event of a flood and distribute.
    - Timeframe – Year 1
    - Cost – 1 staff at .1 time = $10,000 + production

Total Project Cost: $80,000 + production

Project 8: Make Information Available at the Public Library
The public library is a convenient and central location where residents can go to access important public documents and other information. The City of Ann Arbor should make an effort to assure that handbooks, maps and other publications that address flood mitigation are available at the public library. This project consists of *information coordination*.

- Information coordination: Collect the relevant information and bring copies to the library
    - Timeframe – Year 1
    - Cost – 1 staff at .05 time = $5,000

Total Project Cost: $5,000

Project 9: Flood Protection Advice
As mentioned earlier it is already a City policy that staff provides information to property owners and potential developers regarding property in the floodplain and floodway. This practice could be improved if staff is encouraged to provide flood protection advice about Best Management Practices (BMP) for the protection of floodplain and floodway properties. This project would consist of a *BMP training* element to relevant City Staff.

- BMP training: Identify the staff that interacts with the public regarding the floodplain and floodway. Designate a staff member to provide training to the relevant staff. Train the staff on the Best Management Practices and ways to provide flood protection advice.
    - Timeframe – Year 1
    - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $10,000

A New Standard –

Project 10: Flood Hazard Training and Education
Preparing for flood hazards and implementing flood mitigation strategies is a difficult task that affects many of the City of Ann Arbor's departments. Basic floodplain training should be provided to City Staff to foster a greater understanding of flood issues in the Ann Arbor. This project would consist of developing a *floodplain 101 training session* for participating departments.

- Floodplain 101 training session: Identify the departments that would benefit from floodplain training. Designate a staff member to develop and provide the training. Implement a training schedule.
    - Timeframe – Year 1
    - Cost – 1 staff at .1 time = $10,000 + Minimal Staff Time

Total Project Cost: $10,000 + Minimal Staff Time

Project 11: CFM Employment Criteria
The Association of State Floodplain Managers administers the Certified Floodplain Manager (CFM) program. The knowledge and training required to become a CFM would benefit many of the staff positions responsible for oversight of the floodplain and floodway. The City should establish a *CFM training* requirement for appropriate staff positions.

- CFM Training: Identify the staff that interacts with the public regarding the floodplain and floodway. Make CFM Training a required element of these positions.
    - Timeframe – Year 1
    - Cost - 1 staff at .05 time = $5,000 + $1,000 exam fees & travel

Total Project Cost: $6,000 per employee

Project 12: Educating Decision Makers
Elected and appointed decision makers will often be required to make difficult decisions regarding policy concerns in the floodplain and floodway. The City of Ann Arbor should be dedicated to providing these officials with the appropriate education and training to properly represent the concerns of their post in light of the decision at hand. The City of Ann Arbor should require that decision makers attend workshops, conferences, and presentations that address floodplain management issues. To aid in this requirement the City should host a *floodplain management even*t once per year.

- Floodplain management event: Designate a staff member responsible for organizing the hosting of an event related to floodplain management.
    - Timeframe – Year 1
    - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $10,000

Project 13: Environmental and Safety Education Program
The City of Ann Arbor could also choose to pursue a formalized education program and partner with the Ann Arbor Public Schools to provide education to kids. An environmental and safety education program could cover many of the issues associated with floodplain management, including:

- The natural function of watersheds and floodplains
- The forces of nature that cause large storm events and floods
- Basic safety tips for storm events
- Environmental stewardship

The implementation of an *environmental and safety education program* would consist of development of educational materials and program coordination.

- Environmental and safety education program: Development the curriculum to cover within the program. Form a partnership with the AAPS to coordinate with teachers on how to teach the program.
  - Timeframe – Year 2
  - Cost – 1 staff at .5 time = $50,000

Total Project Cost: $50,000

Mitigation Objective 3: **Planning and Zoning**

Integrate floodplain management into planning projects and prevent possible hazards associated with an unplanned floodplain.

NFIP& Code Minimum –

The City of Ann Arbor actively engages in comprehensive planning. Master Planning in the City is divided into five sub areas: the South Area Plan, the Central Area Plan, the Ann Arbor Downtown Plan, Northeast Area Plan, and the West Area Plan. These plans guide the future land uses and development patterns in the City. The plans do not, however, make specific recommendations for land uses in the floodplain and floodway that are based specifically on the City's flood risk and vulnerability.

In addition to the master planning effort the City has several special subject plans. Including transportation plans, the Parks and Recreation Open Space Plan, the Natural Features Master Plan and the Hazard Mitigation Plan. The City also has a Storm Water Management plan and a Watershed Plan for Malletts Creek. The City required a plan be developed for Millers Creek as a part of a PUD approval; this plan is completed but has not yet been adopted by City Council. Special subject plans are often good ways to plan for unique situations and interests. This Flood Mitigation Plan is one example of a special subject plan.

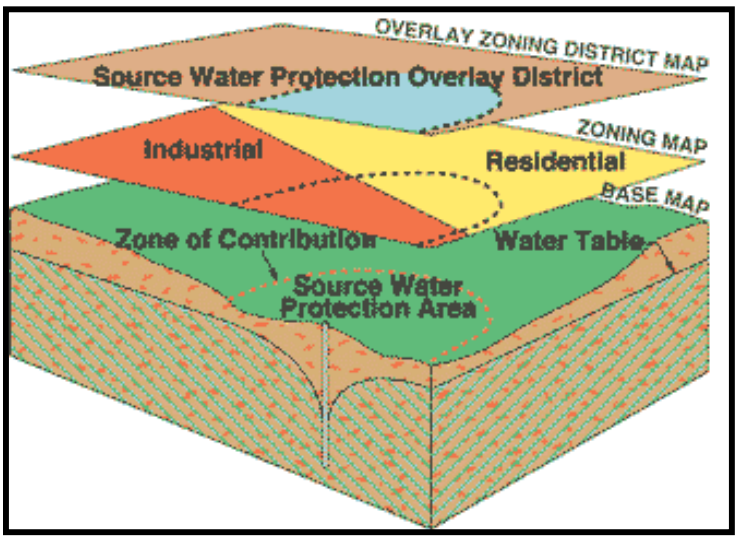
The City of Ann Arbor uses its Zoning Ordinance to regulate land uses. If planning documents recommend changes in zoning those changes must be made through amendments to the Zoning Ordinance. Similar to special subject plans the City can create special zoning districts and overlay zoning districts. In early 2005 the City of Ann Arbor began a project to create a downtown-zoning district, officially called A2 Downtown Development Strategy. This project represents an opportunity to rezone areas of the downtown that are within the floodplain and floodway; however, much of the City's floodplain and floodway is outside of the focus area of this project.

Local Improvements –

Project 14: Floodplain Overlay Zoning District

The City of Ann Arbor could pursue the creation of a Floodplain Overlay Zoning District to implement changes in the development patterns within the City's floodplain and floodway. Sometimes called a Special Zoning District, a Floodplain Overlay Zoning District would provide the City with an enforceable way to regulate land use within the floodplain. Undertaking a project of this kind would also provide residents, property owners and decision makers the opportunity to consider floodplain and floodway land use independently of other zoning decisions. Based on the feedback received through public engagement exercises these are the kinds of development restrictions a Floodplain Overlay Zoning District might help to implement:

Figure 12:



Accessed At: http://www.planning.org/thecommissioner/19952003/winter01.htm; October, 2005

- Restrict residential development in floodway
- Restrict residential development entire floodplain
- Restrict all development in floodway
- Restrict damage-prone development

Over 70% of surveyed respondents strongly believed that these were appropriate restrictions that the City should pursue. There was far less support for the restriction of all development in the flood fringe. The idea of restricting damage prone development would add a new caveat to floodplain regulation; for instance making zoning decisions based on the two foot and three foot flood depth areas mentioned in Section 2.

Floodplain and floodway development restrictions are already implemented by the State of Michigan, however, the State only has jurisdiction in areas of the floodplain that have over two square miles of drainage area. This leaves much of the City's floodplain and floodway unprotected. A floodplain overlay district would provide the City with measures to regulate property that falls outside of State jurisdiction. This project would consist of three elements: *public engagement*, *writing and analysis*, and *approval*.

- Public engagement: Interact with residents, the development community, property owners and decision makers on the best use of land within the floodplain and floodway.
  - Timeframe – Year 2
  - Cost – 2 staff at .5 time = $100,000
- Writing and analysis: Compile and analyze the information gathered, write the code for the overlay district.
  - Timeframe – Year 3
  - Cost – 2 staff at .5 time = $100,000
- Approval: Take the project through the approval process. Make changes if necessary
  - Timeframe – Year 4
  - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $210,000

Project 15: Detailed Flood Loss Model
To fully understand the impacts that flood events may pose on the City of Ann Arbor the City could prepare a Detailed Flood Loss Model. A Detailed Flood Loss Model combined with vulnerability assessment and the flood risk analysis can be used to estimate the actual economic loss of flood events at a variety of levels. A Detailed Flood Loss Model can be done in conjunction with map and model updating. This project would consist of two components: *Data collection* and *GIS analysis.*

- Data collection: Gather the data necessary to estimate the economic loss of flood events; including at a minimum parcel tags, square footage, footprint area, assessed value, and replacement value.
    - Timeframe – Year 2
    - Cost – 1 staff at .5 time = $50,000
- GIS analysis: Create a flood loss estimation model to estimate the economic loss of various degrees of flood events.
    - Timeframe – Year 3
    - Cost – 1 staff at .5 time = $50,000

Total Project Cost: $100,000

Special Recommendation: Watershed Management Planning
The City of Ann Arbor could consider the development of watershed management plans for the all of the watersheds that fall with in its jurisdictional boundaries. Malletts Creek is the only watershed in Ann Arbor that has a City Council approved watershed management plan, however, the Millers Creek plan is completed but not yet approved. There is a resident sponsored watershed management plan for Allen Creek that could be used as a cornerstone for the development of a City sponsored updated plan. The City also should consider partnership with Washtenaw County or with neighboring townships for watersheds that overlap jurisdictional boundaries, like Honey creek and Traver creek. This recommendation will be detailed further by watershed in Section 2.3 Watershed Recommendations.

A New Standard –

Project 16: Multi-Objective Management Planning
Multi-Objective Management (M-O-M) Planning is a process in which all impacts, economic and environmental, are considered and incorporated. As the City comprehensive plans are consolidated M-O-M strategies can be employed. This project would consist of conducting research and writing a *feasibility report.*

- Feasibility report: Research M-O-M planning and write a feasibility report on it's use in Ann Arbor.
    - Timeframe – Year 2 and 3
    - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $10,000

Mitigation Objective 4: **Regulation and Development Standards**

Implement regulatory measures and development standards to limit flood impacts caused by the build environment.

NFIP& Code Minimum –

In 1991 the City of Ann Arbor adopted the current flood insurance study (FIS) and flood insurance rate map (FIRM) dated January 2, 1992 by enacting a floodplain management resolution, which allows the City to participate in the National Flood Insurance Program (NFIP). By participating in the NFIP, the City agrees to enforce to all state and federal regulations governing floodplain development. As a participant in the NFIP the city must enforce a minimum of four basic requirements for floodplain regulations. These minimum standards are as follows:

- Floodplain development permits – All developments in the floodplain must obtain a permit. Development is defined by the NFIP as any man made change.

- Discourage new buildings in floodway – All development in the floodway should be discouraged and residential uses in the floodway should be strongly discouraged. For development in the floodway that is under State jurisdiction the developer must submit and engineering study certifying that the development will not raise the Base Flood Elevation (BFE).

- Standards for new buildings floodfringe – New buildings may be built in the floodfringe but: residential must be elevated above the BFE, and non-residential must be either elevated above the BFE or flood proofed to the BFE.

- Substantially improved buildings treated as new – All structures that are improved in the floodplain and floodway must meet the standards for new buildings if the value of the improvements exceeds 50% of the market value of the structure.

All of the above standards are legally enforced through the Michigan Building Code of 2003. The Michigan Building Code of 2003 additionally requires that structures in the floodplain must be elevated or flood proofed to 1 foot above the BFE. The State also prohibits residential uses in the floodway in areas under the Jurisdiction of the MDEQ. It should be noted that historic structures are exempt from the substantial improvement requirement.

There are two additional regulations that apply to floodplains in the City of Ann Arbor. First, the Washtenaw County Drain Commissioner requires a 30-foot easement on either side of the centerline of all above ground and underground

creeks that fall within County jurisdiction. Second, Chapter 57 of City Code states that new development in the City's floodplains must result in no-net loss of flood storage capacity.

Special Recommendation:
City of Ann Arbor Floodplain Ordinance –
The City of Ann Arbor should facilitate the development of a floodplain ordinance. A floodplain ordinance will allow the City of Ann Arbor to go above and beyond the County, State and Federal floodplain regulations for floodplains within the municipal boundaries. All of the following projects should be considered for inclusion in a City of Ann Arbor Floodplain Ordinance.

Local Improvements –

Project 17: Additional Freeboard –
Currently new and substantially improved buildings must be raised to 1 foot above the base flood elevation (BFE). Additional height requirements above the BFE would benefit property owners by reducing their insurance rates by up to 27 cents per 100 dollars of coverage at a 3-4 foot freeboard. Additional freeboard will also protect structures if in the future the BFE were to rise, as a result of increased development in the watershed. This project would consist of *freeboard level research* and *ordinance drafting*.

- Freeboard level research: Research the appropriate level of freeboard, include economic benefit of insurance reduction and build out scenario analysis that examines risk associated with rising BFE.
    - Timeframe – Year 2
    - Cost – 1 staff at .2 time = $20,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
    - Timeframe – Year 2
    - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $30,000

Project 18: Floodplain Foundation Certification
Buildings in the floodplain and floodway can be vulnerable to increased damage resulting from the erosion, scouring, or settling of the material used to fill around the building. A higher standard for foundation protection of structures in the floodplain and floodway can assure that the placement, compaction, and protection of fill material is appropriate considering the flood risk of the structure. A Floodplain Foundation Certification program can set standards for foundation protection in the floodplain and require that developers or architects certify the adequacy of the foundation. This project would consist of *foundation standards research* and *ordinance drafting*.

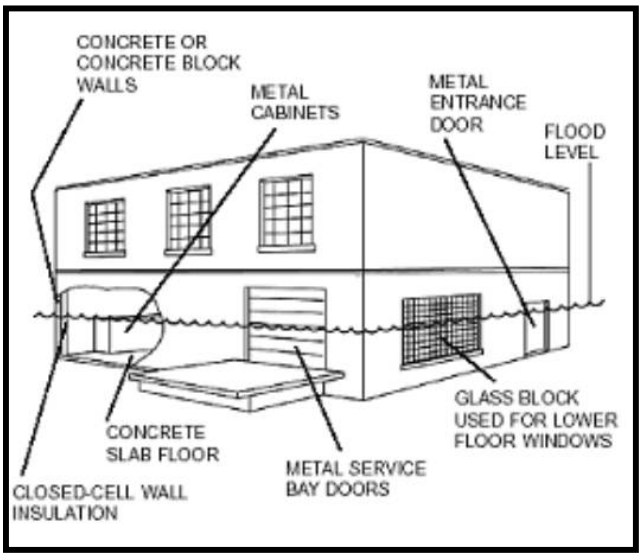
- Foundation standards research: Research measures, methods, levels, and other criteria to be used for certification. Outline certification process.
  - Timeframe – Year 2
  - Cost – 1 staff at .2 time = $20,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $30,000

Project 19: Cumulative Improvement Standard

Currently, structures in the floodplain and floodway are required to meet the standards for new buildings if the value of the improvements is greater than 50% of the market value of the structure. This requirement encourages property owners who do not wish to comply with flood resistant construction standards to "split" one projects into several project iterations of lesser value. The City of Ann Arbor could implement a Cumulative Improvement Standard to encourage compliance with flood resistant construction standards. The City of Ann Arbor has the ability to track permits and could trigger a flood standard at a 50% value over a period of years. A Cumulative Improvement Standard could have a permit sunset clause that would suggest an appropriate number of years for an improvement to be tracked. This project would consist of two elements, an *improved permit tracking system* and *ordinance drafting*.

Figure 13:



Accessed At: http://lift.wvlc.lib.wv.us/wvfema; October 2005

- Improved permit tracking system: Modify the current permit tracking system that was implemented on April 25th 2001 for this new use. Define the period of time that improvements will be counted cumulatively.
  - Timeframe – Year 2
  - Cost – 1 staff at .1 time = $10,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $20,000

Project 20: Lower Threshold Improvement Standard
Another method to achieve a greater compliance with flood standards is to lower the threshold for substantial improvements from 50%. By lowering the threshold more construction projects will need to comply with the flood resistant construction criteria and it will be more difficult to avoid the regulations by "splitting" one project into several iterations. This project would consist of *threshold level research* and *ordinance drafting*.

- Threshold level research: Research an appropriate threshold level for substantial improvements.
  - Timeframe – Year 2
  - Cost – 1 staff at .1 time = $10,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $20,000

Project 21: Addition Improvement Standard
The City of Ann Arbor could require that all additions to floodplain and floodway structures that are outside of the original footprint of the structure must comply with the requirements for new buildings in the floodplain and floodway. This project would consist of *ordinance drafting*.

- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $10,000

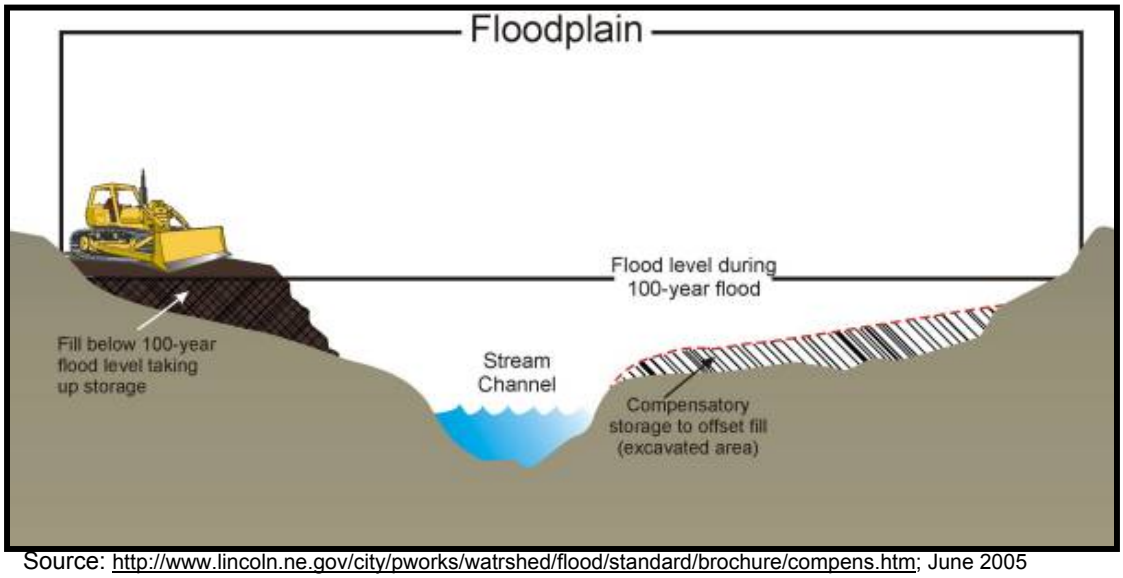
Project 22: Flood Fringe Limits
The City could place additional restrictions on fill or buildings that displace floodwater in flood fringe. This could be achieved by requiring structures in the flood fringe to be placed on columns to allow the free flow of floodwaters. This project would consist of *ordinance drafting*.

- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $10,000

Project 23: Equivalent Compensation
Another approach would be to require hydrologically equivalent compensatory storage to replace all fill that is added. The City could require that all fill, whether it is in the form of buildings, earthen fill, barriers, etc. must be accompanied by the removal of an equivalent amount of material in or below the same hydrological area of the floodplain that it is added. This approach would allow new buildings to be placed on mounds of fill if hydrologically equivalent flood storages capacity is added elsewhere. This project would consist of a *methodology component* and *ordinance drafting*.

Figure 14:



Source: http://www.lincoln.ne.gov/city/pworks/watrshed/flood/standard/brochure/compens.htm; June 2005

- Methodology component: Define a methodology for determining hydrological equivalency.
  - Timeframe – Year 2
  - Cost – 1 staff at .1 time = $10,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $20,000

Project 24: Green Infrastructure[5]
The City could place additional measures to protect or create natural features in floodplain because green space aids in storm water conveyance. Natural features, trees, grasses, bushes, and other elements can be thought of as green infrastructure. Water quality improvements opportunities like rain garden installation or possible delighting of creek segments can also be included. By

[5] See Related Project under Objective 6 – Project # 43 Opens Space Creation

protecting green space and natural features in the floodplain as green infrastructure the City would acknowledge these resources as necessities and further commit to ongoing maintenance and restoration of this resource. This project would consist of a *feature characterization assessment* and *ordinance drafting*.

- Feature characterization assessment: Determine measures that will be used to define green infrastructure. Assess the floodplains to determine areas that will be characterized as green infrastructure zones.
    - Timeframe – Year 2
    - Cost – 3 staff at .1 time = $30,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
    - Timeframe – Year 2
    - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $40,000

Project 25: Freestanding Structures and Obstructions

Freestanding structures, like dumpsters, sheds, and even recreational structures like gazebos, fences, or picnic tables can present a serious hazard during a flood event. Hydrodynamic forces of the floodwater can sweep these objects up leading to injury or creating damming effects. In addition, the City right of way is used for parking of vehicles. As mentioned in Section 2.1 cars can be moved by floodwaters that reach two feet in depth. The City could regulate these potential hazards though a floodplain ordinance. This project would consist of three steps; conduct a *freestanding hazard assessment*, *regulatory approach* research, and *ordinance drafting*.

- Freestanding hazard assessment: Determine the number of industrial, or commercial properties in the floodplain have onsite waste storage and/or freestanding dumpsters, or sheds etc. Conduct a similar assessment for residential properties, apartment complexes, and public land. Determine how many public and private parking spots exist in the floodplain.
    - Timeframe – Year 2 - 3
    - Cost – 1 staff at .75 time = $75,000
- Regulatory approach: Research options for addressing results of the freestanding hazard assessment.
    - Timeframe – Year 2 - 3
    - Cost – 1 staff at .2 time = $20,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
    - Timeframe – Year 2 - 3
    - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $105,000

A New Standard –

Project 26: Prohibit Floodway Development

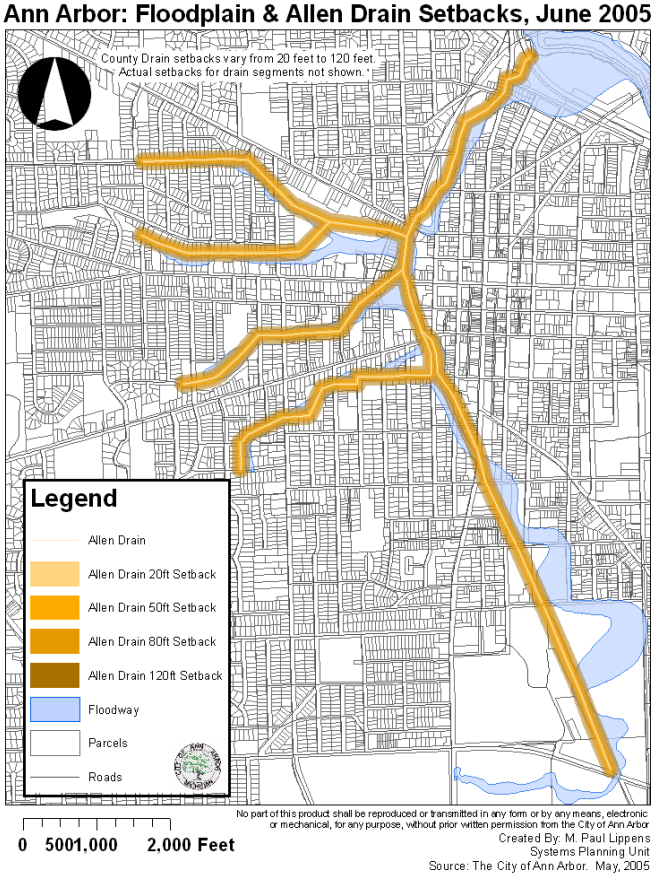
The City of Ann Arbor could prohibit all new development in the floodway. This act would both preserve a long-term vision for reserving the floodway for flood events and support the other recommendations of this plan that deal with mitigating for existing structures. This project would consist of *ordinance drafting*.

- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $10,000

Map 12:

Ann Arbor: Floodplain & Allen Drain Setbacks, June 2005



Project 27: Drain Setbacks

Even though a drain is enclosed it will still have an associated floodplain. In addition there are portions of drains in Ann Arbor that do not have a Washtenaw County Drain Easement. The City of Ann Arbor could require a standard setback from enclosed drains in the floodplain. This project would consist of a *setback investigation* and *ordinance drafting*.

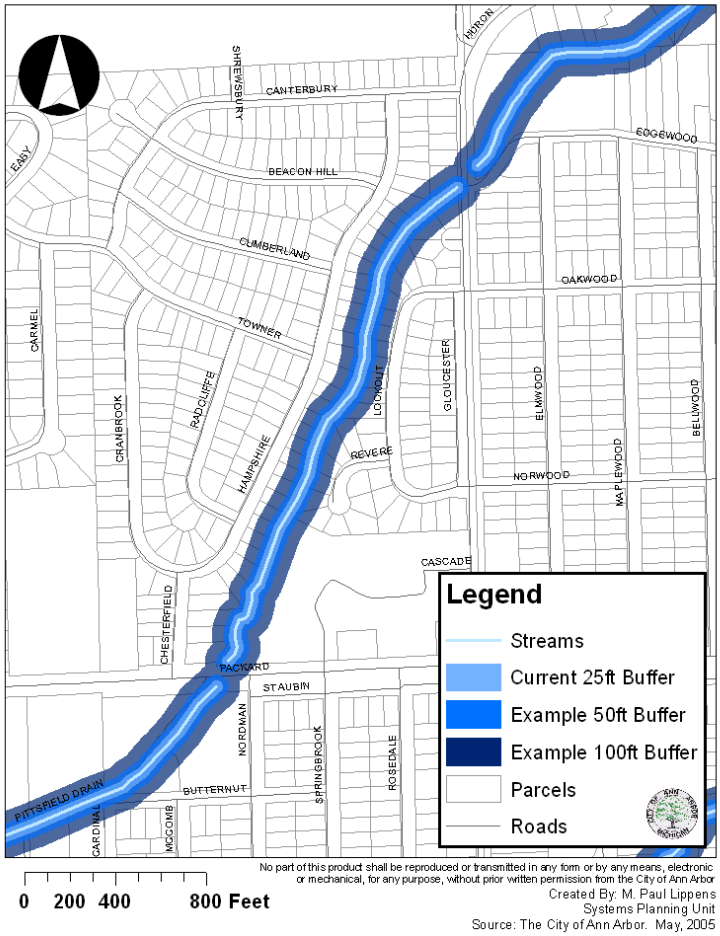
- Setback investigation: Gather data about the current drain easements in Washtenaw County. Compare to the Setback requirements for open watercourses. Suggest an appropriate distance for a drain Setback in the floodplains
  - Timeframe – Year 2
  - Cost – 1 staff at .1 time = $10,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $20,000

Project 28: Stream Buffer Zones

Map 13:

City of Ann Arbor: Malletts Creek Buffer, June 2005



Currently there is a required setback of 25 feet from streams in Ann Arbor. There are a number of methods that could be employed to make this buffer more effective in flood prone areas.

- Change width to greater than 25 ft
- Measure buffer from floodway or floodplain edge
- Link buffer size to stream size, floodway size, or floodplain size
- Clarify the definition of buffer
  - Undisturbed zone
  - No build zone
- Apply buffer to non-site planned projects

Implementing some or all of the above methods could create an effective way to regulate the floodplain. This project would consist of a *buffer zone definition* and *ordinance drafting*.

- Buffer zone definition: Investigate the above methods to create an appropriate definition of a Stream Buffer Zone for floodplains in Ann Arbor.
  - Timeframe – Year 2
  - Cost – 2 staff at .1 time = $20,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $30,000

Project 29: Floodplain Open Space Dedication.
The City often requires that new developments set aside open space as a part of the site planning and approval process. Open space requirements are frequently applied to planned unit developments (PUDs) but can also be applied to other projects that need to offer public benefit like Brownfield developments. Currently, the City's Parks Recreation and Open Space (PROS) plan guides parkland dedication. The City of Ann Arbor could offer incentives to link open space dedication requirements to land in the floodplain and floodway. Consider the following examples.

- 1 acre onsite dedication = .25 floodway acres
- 1 acre onsite dedication = .5 floodplain acres

This would give the development community the option of utilizing their whole site and purchasing land in the floodway to dedicate to open space or get a premium for dedicating onsite floodplain land. This project would consist of a *land ratio investigation* and *ordinance drafting*.

- Land ratio investigation: Conduct an investigation to determine the appropriate land ratios to create incentives for floodplain open space dedication. Consider economic values of land and the public benefit of the land in each alternative use.
  - Timeframe – Year 2
  - Cost – 1 staff at .2 time = $20,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $30,000

Project 30: Greenway Open Space Dedication
The Above project, Floodplain Open Space Dedication, could be further refined by adding the requirement that the open space dedication be in the floodway or floodplain AND conform to a greenway plan (See Objective 6.0). This project would consist of *additional land ratio investigation* and *ordinance drafting*.

- Additional land ratio investigation: Conduct additional investigation to determine the appropriate land ratios to create the incentive for floodplain & greenway open space dedication. Consider economic values of land and the public benefit of the land in each alternative use.
  - Timeframe – Year 2
  - Cost – 1 staff at .2 time = $20,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $30,000

Project 31: Floodplain PDR and TDR

The City of Ann Arbor could also create incentives for the protection of floodplain and floodway lands by enabling the City to purchase the development rights (PDR) of floodplain properties for mitigation activities. Likewise a transfer of development rights (TDR) program allows residents and developers to purchase development rights in these areas and transfer the development rights for use the rights in other areas of the City. If land in the floodplain was zoned for single-family residential use the property owner could sell that use to a developer who could use that credit toward a density bonus on another property. This project would consist of a *PDR and TDR administration outline* and *ordinance drafting*.

- PDR and TDR administration outline: Outline the process for administering a PDR and TDR program for floodplain and floodway projects. Define how the rights that are purchased for each type of zoning in the floodplain could be applied to future development projects in other areas of the City. Consider a sending and receiving zone approach. Consider prioritization based on risk areas and vulnerability index. Additional prioritization can be based on parcels/buildings area, volume, assessed value, and/or replacement value. Decide what would happen to the land/rights after purchase, whether it would be dedicated to the City or if property owners could hold on to the properties and reserve some of the associated property rights.
    - Timeframe – Year 2
    - Cost – 1 staff at .2 time = $20,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
    - Timeframe – Year 2
    - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $30,000

Mitigation Objective 5: **Corrective Actions**

Identify opportunities where corrective actions can be used to mitigate the flood risk for properties in the floodplain.

NFIP& Code Minimum – Structural Flood Control and Flood Insurance

The City of Ann Arbor participates in the National Flood Insurance Program. This program offers flood insurance to property owners in the floodplain because they cannot be covered by standard homeowners insurance. The NFIP offers separate coverage's in addition to the standard reimbursement for property damage.

- Flood insurance can be purchased to cover part of the cost of relocation, acquisition, elevation, or other corrective mitigation actions.
- Increased Cost of Compliance (ICC) can provide additional mitigation funding, like structure replacement and the cost to bring the structure into compliance with the flood resistant construction standards.
- Flood insurance can be purchased to cover damage to the structures contents.

In addition to the insurance there are several examples of structural flood control projects that the City of Ann Arbor has undergone. Structural flood control projects are manmade system modifications that are believed to reduce flood risk and vulnerability. Some examples of structural flood control projects are: reservoirs, storage basins, levees, floodwalls, barriers, channel modifications, bridge and culvert Improvements, dredging, and channel diversion. There is a misconception that structural flood control projects can significantly reduce the base flood elevation (BFE) of a floodplain, or perhaps eliminate the floodplain all together. While structural flood control projects may reduce flood damages they also may cause adverse impacts like habitat destruction, a false sense of security, increased damages in the event of failure, high maintenance and construction cost, diversion of floodwaters, and reduction of the floodplains storage capacity. Some example of structural flood control projects in Ann Arbor:

- Private Storm water Detention – The City requires site-planned projects to provide onsite storm water detention for first flush, bank full events, and 100yr storm events.
- Public Storm water Detention – The City provides storm water detention in public projects like road improvements and parks and recreation construction projects whenever possible. Examples:
    - Fuller Road near the VA
    - Liberty Street Detention Facilities (Between Virginia and I-94)
    - Maple Road, South of Liberty
- The City has installed Storm Water Quality Devices in:
    - Packard Road
    - Stadium Blvd.
    - Benz Road

- The City installed the Depot Street Relief Drain that provides storm water conveyance in the 100yr floodway through the 10yr storm event.
- The Washtenaw County Drain Commission provides regional storm water detention for the following water bodies:
    - Malletts Creek in Brown Park
    - Swift Run, north of I-94
    - Sister Lake Drain

Local Improvements[6] –

Special Recommendation:
Explore Joining the Community Rating System (CRS) –
The City of Ann Arbor could explore joining the Community Rating System (CRS) that is managed through the National Flood Insurance Program. If the City joins the CRS they will receive a ranking between 1 and 10 based on the overall flood management activities conducted by the municipality. For each rank below 10 all residents who purchase flood insurance will receive a 5% discount on their rate up to 45%. City of Ann Arbor residents currently pay $275,856 annually in flood insurance. Each 5% increment will save Ann Arbor residents $13,793 or $32 per policy. The discount received can help to defray any cost that residents may incur if they choose to voluntarily implement corrective mitigation actions on their property.

Project 32: Code Enforcement
There may be instances where code requires property owners to make changes that are not enforced. Property owners may not know they are in violation or they may not want to incur the cost of compliance. If one property owner is allowed to violate a community flood standard it could make it very difficult for City officials to enforce the standard at all. Code enforcement is currently being done but emphasis may be increased. The City of Ann Arbor could increase staff's ability to enforce of code. This project would consist of three elements, establish a *floodplain permit*, create a *floodplain permit review*, and conduct *floodplain inspection*.

- Floodplain permit: Require that all projects that take place in the floodplain acquire a special floodplain permit. Research and implement the permitting procedures.
    - Timeframe – Year 1
    - Cost – 1 staff at .1 time = $10,000
- Floodplain permit review: Permits requested in the floodplain need a higher scrutiny. This requires extra staff time, training (see Objective 2), and a longer review period. If the City could implement a performance based service objective for floodplain properties that is 2-3 times the length of the normal permit review service objective.

[6] All illustrations in this section accessed at :http://www.usace.army.mil/inet/functions/cw/cecwp/NFPC/fptpr/chap1.htm; October 2005.

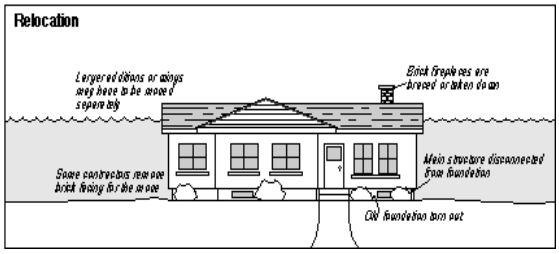
- Timeframe – Year 1
- Cost – 1 staff at .1 time = $10,000

- Floodplain inspection: Projects in the floodplain should be inspected. Staff time should be allotted for on-site follow up on all complete projects in the floodplain. Staff communication and on-site visits should be the standard service objective for all floodplain projects even when flood resistant construction compliance is not required.
  - Timeframe – Year 1
  - Cost – 1 staff at .5 time = $50,000

Total Project Cost: $70,000

Project 33: Relocation

Figure15:



Relocating structures outside of the floodplain is the best way to assure that properties won't be damaged in flood events; however, in some cases moving structures to higher ground on the property as well could reduce flood risk. Relocation projects will need to be examined case by case but all properties that fit into the risk categories outlined in Section 2 should be considered candidates, with priority going to the higher risk categories.

- Timeframe – Ongoing
- Cost – Case by case

Total Project Cost: TBD

Project 34: Acquisition

The City of Ann Arbor could consider acquiring properties for structure removal. Removing structures in the floodplain and floodway is the best method available to protect against flood damage. Properties could be considered for acquisition and removal if:

- The property fits into an open space or greenway plan
- If the structure has no historic value
- If the property owner is unwilling or unable to pursue another corrective measure.

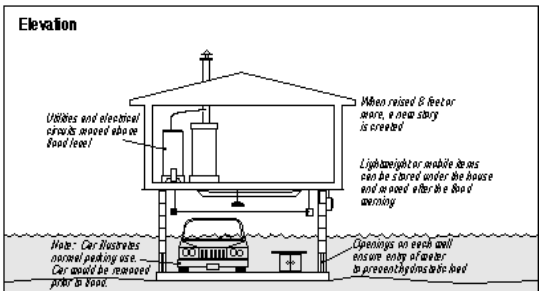
The City could also consider acquiring properties in the floodplain and floodway without structures to assure that they remain open. Acquisition projects would need to be examined case by case but all properties that fit into the risk categories outlined in Section 2 should be considered candidates, with priority going to the higher risk categories.

- Timeframe – Ongoing
- Cost – Case by case

Total Project Cost: TBD

Project 35: Elevation

Figure 16:



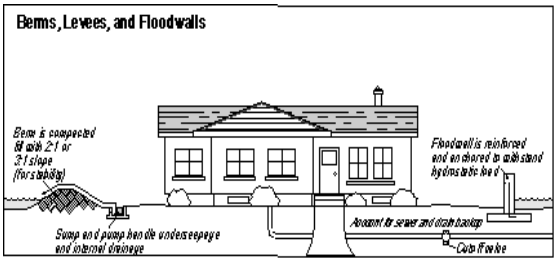
Structures in the floodplain and floodway can be protected from flood damage through elevation. The foundation of structures can be raised so that the first floor is above the base flood elevation of the floodplain. Elevation projects will need to be examined case by case but all properties that fit into the risk categories outlined in Section 2 should be considered candidates, with priority going to the higher risk categories.

- Timeframe – Ongoing
- Cost – Case by case

Total Project Cost: TBD

Project 36: Barriers

Figure 17:



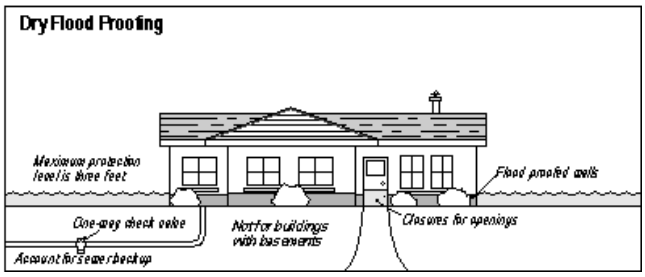
In some cases barriers can be installed that protect the foundation from flood events. Barriers installed close to a foundation will have a minimal impact on displaced floodwaters and may in some cases be cheaper than alternative corrective measures. Barrier projects will need to be examined case by case but all properties that fit into the risk categories outlined in Section 2 should be considered candidates, with priority going to the higher risk categories.

- Timeframe – Ongoing
- Cost – Case by case

Total Project Cost: TBD

Project 37: Dry Flood Proofing

Figure 18:



Dry flood proofing is the process of sealing a building so that floodwaters cannot penetrate the foundation. Dry flood proofing is a good option for structures with finished basements. Dry flood proofing may be a good tool for historic districts that are exempt from the flood resistant construction requirements or elevation may not be desirable due to design standards. Dry flood proofing projects will need to be

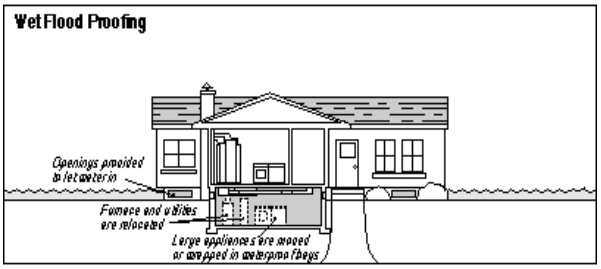
examined case by case but all properties that fit into the risk categories outlined in Section 2 should be considered candidates, with priority going to the higher risk categories.

- Timeframe – Ongoing
- Cost – Case by case

Total Project Cost: TBD

Project 38: Wet Flood Proofing

Figure 19:



Wet flood proofing is the process of preparing to allow floodwater into a structure during a flood event. Furnaces, water heaters, fuse boxes, and other items stored in basements can be raised above the BFE and "breakaway" walls can be installed that allow floodwaters in safely. Wet flood proofing may be a good tool for historic districts that are exempt from the flood resistant construction requirements or elevation may not be desirable due to design standards; however, wet flood proofing is generally considered better for commercial properties than for residential properties. Wet flood proofing projects will need to be examined case by case but all properties that fit into the risk categories outlined in Section 2 should be considered candidates, with priority going to the higher risk categories.

- Timeframe – Ongoing
- Cost – Case by case

Total Project Cost: TBD

A New Standard –

Project 39: Floodplain-Monitoring Program

To gage the success of corrective measures the City of Ann Arbor could implement a floodplain-monitoring program. As corrective mitigation projects are implemented they can be tracked to judge which methods are the most successful in relation to the costs. This project will consist of two elements *program outline* and *program monitoring*.

- Program outline: Define and outline the variables necessary to assess the variety of corrective measures taken in the floodplain. Prepare a workplan for the floodplain-monitoring program that assigns responsibilities to staff.
  - Timeframe – Year 4
  - Cost – 2 staff .2 time = $40,000

- Program monitoring: Implement the workplan defined for the floodplain-monitoring program.
    - Timeframe – 5 and ongoing
    - Cost – 1 staff at .1 time per year = $10,000 (ongoing)

Total Project Cost: $50,000

Project 40: Environmental Remediation

The City of Ann Arbor could seek ways to pursue environmental remediation though floodplain management. Environmentally contaminated properties in the floodplain and the floodway present an additional risk in that, if flooded, the properties could spread the contamination onto adjacent lands and into the floodwaters and ecosystem. Additionally, household hazardous waste poses an additional threat in floodplain properties. There are currently known environmentally contaminated properties in the City's floodplain and floodway; and household hazardous waste may be present in many of the parcels identified in the vulnerability assessment. The remediation of contaminated sites should be pursued in conjunction with corrective measures taken for flood protection. Household hazardous waste removal should be instituted and prioritized for floodplain properties. Finally, dam removal opportunities are another area where there are potential environmental and flood mitigation benefits to be examined. Environmental contamination could be used as an additional factor to the risk categories in determining a priority for implementation.

- Timeframe – Years 3, 4, 5 and ongoing
- Cost – Case by case

Total Project Cost: TBD

Mitigation Objective 6: **Infrastructure**

Evaluate the City's infrastructure within the floodplain and protect it from flood related hazards.

NFIP& Code Minimum

Currently the City of Ann Arbor has no specific policy with regards to protecting infrastructure against flood events. Damage to infrastructure resulting from a flood will be handled as would damage resulting from any other Hazard; if damage were to occur the City would respond by rebuilding or replacing the infrastructure.

Local Improvements –

Project 41: Public Buildings - Flood Audit & Flood Insurance
The City does not currently hold flood insurance on any public properties in the floodplain and floodway. The properties are self-insured by the City. Conducting a flood audit would allow the City to evaluate which properties should be protected by flood insurance. This project would consist of an *audit report* and an *insurance evaluation*.

- Audit report: Compile a report on the current value and the replacement value of the City infrastructure within the floodplain and the floodway.
  - Timeframe – Year 3
  - Cost – 1 staff at .5 time = $50,000
- Insurance evaluation: Use the audit report to weigh the replacement value with the cost of insurance.
  - Timeframe – Year 3
  - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $60,000

Project 42: Critical Facilities – Flood Audit and Emergency Action Plans
Critical Facilities located in or near the floodplain and floodway deserve special attention because of the function that they serve to the community: storing hazardous chemicals, serving as shelters, serving as emergency operation centers. The proximity of these facilities to flood prone areas may inhibit their operation during flood events. The City of Ann Arbor could invest to protect critical facilities during a flood event. The City could conduct a *flood audit* of critical facilities to assess the vulnerability and encourage the facilities to develop *emergency action plans* to prepare for flood events.

- Flood audit: Conduct a flood audit that includes a list of hazardous substances stored in the floodplain and the roles that the facilities might

play during a flood event. Include the value and replacement costs of the structure and the feasibility of relocation. Identify specific structures for relocation.
    - Timeframe – Year 3
    - Cost – 1 staff at .5 time = $50,000
- Emergency action plans: Work with critical facilities to develop emergency operation plans to assure their ability to function during a flood event.
    - Timeframe – Year 3
    - Cost – 1 staff at .5 time = $50,000

Total Project Cost: $100,000

A New Standard –

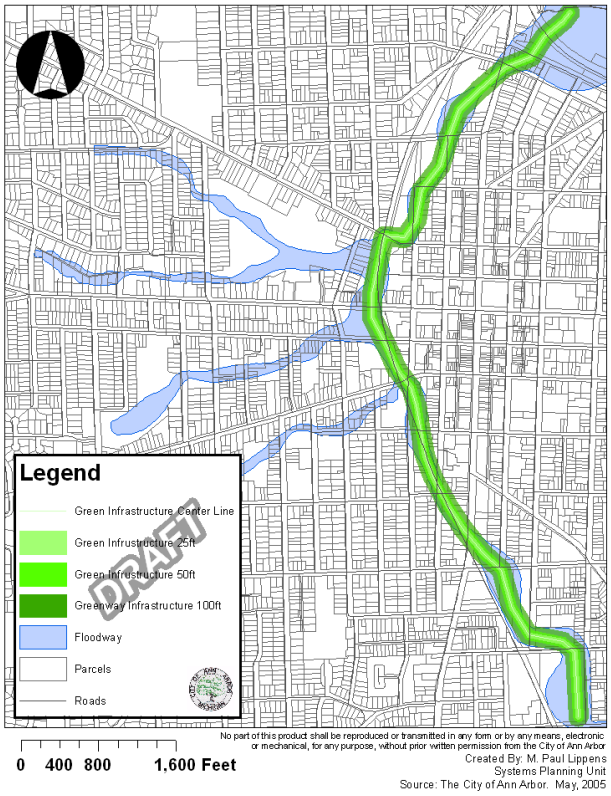
Project 43: Critical Facilities – Higher Standards for New Critical Facilities
As mentioned earlier, critical facilities are unique in that they require special attention to protect them from vulnerability from flood events. The federal standard is to go beyond the 100-year flood event and protect critical facilities from the 500-year flood event. In much of the City the 500-year floodplain has not been mapped. In these areas it may make sense to have a proximity definition, for instance, all critical facilities within ¼ mile from the 100-year floodplain or the area 1-2 feet above the BFE. This project would require two steps, the definition of the *critical flood zone* and the application of the *"critical facilities – flood audit and emergency action plans"* project to the defined zone

- Critical flood zone: Define the protected area for critical facilities based on flood vulnerability and risk.
    - Timeframe – Year 3
    - Cost – 1 staff at .1 time = $10,000
- Critical facilities – flood Audit and emergency action plans: See earlier project definition and apply to the Critical Flood Zone area.
    - Timeframe – Year 3
    - Cost – 1 staff at full time = $100,000

Total Project Cost: $110,000

Project 44: Open Space Creation

Map 14:
Ann Arbor: Floodplain & Draft Green Infrastructure Zone, June 2005



Most floodplain managers would agree that the best use for the floodplain is open space, "The floodplain is for floods". The more open space that is created in the floodplain the easier it will be for flood waters to pass through the system – less obstruction = less damage. One obvious way to create open space is to acquire land for parks and recreation; however, there is also a non-recreational component of open space, the landscape. Natural features, trees, grasses, bushes, and other elements can be thought of as green infrastructure. The maintenance and creation of green infrastructure can be extremely beneficial to a floodplains ability to pass a storm event. The development of a greenway plan can be a catalyst to link a parks and recreation component with the concept of green infrastructure creation. Open space creation can be divided into three processes; *green infrastructure assessment*, a *greenway plan*, and *land acquisition & construction*.

- Green infrastructure assessment: Conduct a natural features inventory of the floodplain and floodway. Create a strategy that outlines opportunities for improvements.
  - Timeframe – Year 2
  - Cost – 1 staff at .75 time = $75,000
- Greenway plan: Develop a greenway plan to implement the recommendations of the Green Infrastructure Assessment. Target land for acquisition including pocket parks & linear corridor easements. Plan greenway amenities.
  - Timeframe – Year 3
  - Cost – 3 staff at .25 time = $75,000
- Land acquisition & construction: Use a flood loss estimation model to target properties or easements to incorporate the results of the green infrastructure assessment and the greenway plan.
  - Timeframe – Year 4 - 5
  - Cost – 1 staff at full time = $100,000 + land & construction cost

Total Project Cost: $250,000 + land & construction cost.

Mitigation Objective 7: **Emergency Services**

Develop and/or refine a flood response/preparedness method for servicing the community before and after flood related disasters.

NFIP& Code Minimum –

The City of Ann Arbor has an Emergency Response Plan that is maintained by the City's Office of Emergency Management. In addition to this plan the City maintains a web page designed to help residents prepare for an emergency and respond in the event of an emergency. This website offers instructions to residents on several emergency situations common in the State of Michigan including floods. This website offers information about flood forecasts, flood warnings and watches, and flash flooding. It also offers instructions on what residents should do before a flood event, during a flood warning, during a flood event, and after a flood event.

Local Improvements

Project 45: Flood Preparedness Plan
The City of Ann Arbor could pursue the development of a flood preparedness plan that deals specifically with responding to flood events. A flood preparedness plan could include information and processes that are specific to flood events and are not necessarily covered in a generic emergency response plan. A flood preparedness plan may consist of the following elements:

- Create flood threat recognition system: Create a system that predicts the time and the height of the flood crest through measuring rainfall, stream flow, and soil moisture.
    - Timeframe – Year 2
    - Cost – 2 staff at .5 time = $100,000 + Technology
- Flood warning: Further define the process issue flood warnings and response, how a flood warning will be distinguished from other disasters.
    - Timeframe – Year 2
    - Cost – 1 staff at .1 time = $10,000
- Flood information and instructions: Create a plan for the distribution of information in a flood event,
    - Timeframe – Year 2
    - Cost – 1 staff at .1 time = $10,000
- Flood response actions and responsible parties: Clearly define the actions and responsibilities of different agencies and emergency responders during flood events. Make sure those organizations are aware of their role in response
    - Timeframe – Year 2
    - Cost – 1 staff at .5 time = $50,000

- Flood stage forecast map: Prepare a flood stage forecast map to aid emergency responders in responding to a flood event. A flood stage forecast map would show which areas of the City would be affected at different flood heights. Topographic information can be used to determine which areas will flood first and the time that these areas may be at risk. This information can be used to warn specific houses in the affected area.
    - Timeframe – Year 2
    - Cost – 1 staff at .2 time = $20,000

Total Project Cost: $190,000

2.3 WATERSHED RECOMMENDATIONS

The watersheds in the City of Ann Arbor have specific considerations and there are many mitigation strategies and activities that could benefit one watershed that may not be applicable to another. The different watersheds in the City have different development patterns and pressures. The Allen Creek watershed is centrally located in the downtown area where there are considerable commercial use considerations, while Traver and Swift Run have agricultural land uses to consider. Malletts and Millers Creek both also have commercial uses to consider. This section is dedicated to mitigation strategy recommendations that apply to the specific watershed systems. Additional projects can be added in future revisions of this plan as identified.

2.3A HURON RIVER

Project 46: Watershed Management Planning - Huron
Review watershed plans for the Huron River and incorporate recommendations that are consistent with flood mitigation objectives into future revisions of the Flood Mitigation Plan.

Project 47: Huron River Impoundment Study
The City of Ann Arbor is currently undertaking a study of the impoundment areas of the Huron River in the area. The City should look for opportunities to implement flood mitigation strategies as this project unfolds.

2.3B NEWPORT CREEK

Project 48: Watershed Management Planning - Newport
Conduct a watershed management planning study for Newport Creek and incorporate recommendations that are consistent with flood mitigation objectives into future revisions of the Flood Mitigation Plan.

2.3C TRAVER CREEK

Project 49: Watershed Management Planning – Traver
Review existing watershed plans for the Traver Creek and incorporate recommendations that are consistent with flood mitigation objectives into future revisions of the Flood Mitigation Plan. Conduct a watershed management planning study.

2.3D ALLEN CREEK

Project 50: Historic District Preservation
Examine guidelines in the building code and the historic preservation ordinance that apply to floodplain management. Examine ways to apply regulatory measures to historic districts.

Project 51: Railroad Berm Fill Removal
Examine ways to remove the berm located between Depot St. and the Huron River, as well as other portions of the railroad berm in the Allen Creek corridor, to

allow floodwater to travel to the river without a major barrier impeding the flow, acting like a dam. Examine the costs of creating a terraced rail system. Compare costs estimates to complete project with the estimated costs of removal/relocating structures that may be outside of the floodplain if the berm is removed.

Project 52: Watershed Management Planning - Allen
Review existing watershed plans for the Allen Creek and incorporate recommendations that are consistent with flood mitigation objectives into future revisions of the Flood Mitigation Plan. Conduct a watershed management planning study.

Project 53: Downtown City Owned Sites
The City of Ann Arbor owns several properties in the floodplain and floodway. Appendix A – *the Floodplain Policy Discussion* initiated by the City of Ann Arbor Planning Commission discusses the various policy options for addressing City owned property in the floodway. In addition, in 2006 Ann Arbor City Council assembled a greenway task force charged with looking at three of the City's largest holdings in the area (report pending can be attached as an appendix to this plan). All city properties are opportunities for corrective mitigation actions. These sites should be examined for priority implementation. The recommendations of the reports mentioned above should also be considered for mitigation funding provided they are consistent with the recommended strategies of this plan.

2.3E MALLETTS CREEK

Project 54: Watershed Management Planning - Malletts
Review the Malletts Creek Restoration Plan and incorporate recommendations that are consistent with flood mitigation objectives into future revisions of the Flood Mitigation Plan.

2.3F MILLERS CREEK

Project 55: Watershed Management Planning - Millers
Review the Millers Creek Watershed Improvement Plan and incorporate recommendations that are consistent with flood mitigation objectives into future revisions of the Flood Mitigation Plan.

2.3G SWIFT RUN

Project 56: Watershed Management Planning - Swift
Conduct a watershed management planning study for Swift Run and incorporate recommendations that are consistent with flood mitigation objectives into future revisions of the Flood Mitigation Plan.

SECTION 3: FLOOD MITIGATION IMPLEMENTATION

3.0 PLAN OVERSITE

The City of Ann Arbor Flood Mitigation Plan contains an extensive list of different mitigation strategies and activities that all will work to achieve the plans goals when implemented. The strategies in this plan can be used as guidelines for residents and developers in approaching properties in the Floodplain. They also can help to inform the City's decision makers on responsible uses of properties with a high flood risk.

In and of itself the adoption of this plan by Ann Arbor City Council will not affect flood mitigation in the City. The various technology improvements, code changes, regulatory changes, physical landscape changes, emergency preparations, infrastructure developments, and educational programs, outlined herein need additional steps to be implemented. To become Ann Arbor City policy the mitigation projects included in Section 2.0 must be integrated into the City's development process. To achieve corrective actions in the physical landscape the city needs to be ready to assist residents who voluntarily pursue these actions, and be prepared to initiate projects if opportunities become available.

The implementation of this plan would be a difficult without a formalized process for oversight. For this reasons the planning team recommends that the responsibility of implementation be attached to two specific positions in the Systems Planning Unit of Public Services.

- **The Natural Resource and Environmental Planning Coordinator (NREPC)** – this is a newly created position responsible for stormwater management, floodplain management, and natural features planning.
- **The Water Quality Coordinator (WQC) –** this is a newly created position responsible for handling issues relating to water resource protection and preservation.

These to positions will coordinate the implementation with all staff and departments that are affected by issues relating to floodplain management including but not limited to: building, planning, infrastructure, engineering, and emergency management.

Further, the NREPC and WQC will be responsible for coordinating the implementation with the City of Ann Arbor Planning Commission. Planning Commission can provide direction in the prioritization of the mitigation strategies and offer a critical opportunity to continue the public engagement process though out implementation. The NREPC and WQC can also look to the Environmental Commission and City Council for oversight.

To assure that the process is kept on task the NREPC and the WQC will convene an annual meeting to discuss progress, plan updates, and set an agenda for the next year.

> **Special Recommendation:**
> The NREPC and the WQC convene an annual flood mitigation advisory meeting to address the Flood Mitigation Plans oversight and implementation.

The flood mitigation advisory meeting attendance should consist of a minimum of 9 members including but not limited to:

- The NREPC and/or The WQC
- A City Council representative
- A Planning Commission representative
- A staff member from the Attorneys Office
- A staff member from Planning and Development Services Department
- The city building official
- A staff member of the Office of Emergency Management
- Representatives from local watershed groups
- Washtenaw County Drain Commissioner representative

A meeting with attendance of these representative interests will guide the NREPC and the WQC in implementation. The actual attendees of the meeting can be left to the discretion of the NREPC and the WQC and can change depending on the agenda of each meeting.

As mentioned above the flood mitigation advisory meeting will be where the NREPC and the WQC develop an agenda for the coming year. Included in Section 3.1 is an implementation schedule that can be updated it at the annual meeting. The meeting will provide an opportunity to review the implementation schedule with respect to four guiding principals: flood risk prioritization, project feasibility, public engagement, and NFIP compliance.

- Flood Risk Prioritization – Look at how each project can have an impact on the flood risk categories. If it is a project that involves structural changes is it in a prioritized category? If it is a planning or a regulatory project how will it impact the City's ability to mitigate the prioritized categories?
- Project Feasibility – Look at the project from different angles. Further examine the specific costs of the project and the benefits. Is there a property owner looking for assistance? Is there political will? Is there financial support available? If the project is not a high priority, could the project be done as easily in future? If the project is a high priority, would its completion fiscally prevent the implementation of several other mid-level priority projects? Does the project pass a cost-benefit analysis?

- Public Engagement – The Committee should continually seek public input on the implementation schedule. Do residents express an interest in a specific project? If so weigh this interest with the first two principals.
- NFIP Compliance – Annual NFIP reporting and compliance should be addressed each year at the annual meeting.

The four above-mentioned principals will help the NREPC and the WQC and the meeting attendees to discuss the implementation of this plan, review and revise the implementation schedule, and set an agenda for the coming year.

3.1 IMPLEMENTATION SCHEDULE

Each of the projects suggested in this plan has been placed in an implementation schedule. This schedule aims to suggest a timeframe in which each project should be approached and completed (Column A-E). The NREPC and the WQC will be responsible for the maintenance and revision of this schedule. The NREPC and the WQC should revise the schedule, as needed based on *proactive opportunities* and *reactive opportunities*.

- Proactive opportunities: Staff creates opportunities to implement the projects. The committee meets regularly to discuss current projects and plan for projects staff included on the annual agenda.

- Reactive opportunities: Staff stays current on development proposals, planning processes, outreach campaigns and looks for opportunities to implement projects based on “unplanned” opportunities.

The schedule is broken into columns A-E to suggest a timeframe for task completion. The mitigation strategies have been placed in different categories primarily on the basis of difficulty.

- Column A – Low hanging fruit to be implemented immediately. Roughly Year 1.
- Column B – Sight difficulty or research item. To be implemented as column A is nearing completion. Roughly Year 2.
- Column C – Difficult project with research component. To be implemented as column A-B are nearing completion. Roughly Year 3.
- Column D – Difficult project with research component. May build on the completion of other mitigation projects. To be implemented as column A-C are nearing completion. Roughly Year 4.
- Column E – Difficult project with research component. May build on the completion of other mitigation projects. To be implemented as column A-D are nearing completion. Roughly Year 5.

Table 7:

Flood Mitigation Plan: Implementation Schedule

Project #	Project Title	Page #	A	B	C	D	E	$ Labor	$ Other
1	Detailed Hydrologic Data.	39						$100,000	Technology
2	Map Additional Flood Related Hazards	39						$110,000	None
3	Use Future Conditions Hydrology for Flood Mapping	40						$100,000	None
4	Use Future Condition Hydrology for City Plans and Regs	40						$50,000	None
5	Improve Flood Maps on City Website	41						$20,000	None
6	Flood Information Links on City Website	42						$5,000	None
7	Public Information Campaign	42						$80,000	Production
8	Make Information Available at the Public Library	43						$5,000	None
9	Flood Protection Advice	43						$10,000	None
10	Flood Hazard Training and Education	43						$10,000	Staff Time
11	CFM Employment Criteria	44						$6,000	Per Person
12	Educating Decision Makers	44						$10,000	None
13	Environmental and Safety Education Program	45						$50,000	None
14	Floodplain Overlay Zoning District	46						$210,000	None
15	Detailed Flood Loss Model	48						$100,000	None
16	Multi-Objective Management Planning	48						$10,000	
17	Additional Freeboard	50						$30,000	None
18	Floodplain Foundation Certification	50						$30,000	None
19	Cumulative Improvement Standard	51						$20,000	None
20	Lower Threshold Improvement Standard	52						$20,000	None
21	Addition Improvement Standard	52						$10,000	None
22	Flood Fringe Limits	52						$10,000	None
23	Equivalent Compensation	53						$20,000	None
24	Green Infrastructure	53						$40,000	None
25	Freestanding Structures and Obstructions	54						$105,000	None
26	Prohibit Floodway Development	55						$10,000	None
27	Drain Setbacks	55						$20,000	None
28	Stream Buffer Zones	56						$30,000	None
29	Floodplain Open Space Dedication	57						$30,000	None
30	Greenway Open Space Dedication	57						$30,000	None
31	Floodplain PDR and TDR	58						$30,000	None
32	Code Enforcement	60						$70,000	None
33	Relocation	61						TBD	TBD
34	Acquisition	61						TBD	TBD
35	Elevation	62						TBD	TBD
36	Barriers	62						TBD	TBD
37	Dry Flood Proofing	62						TBD	TBD
38	Wet Flood Proofing	63						TBD	TBD
39	Floodplain Monitoring Program	63						$50,000	Ongoing
40	Environmental Remediation	64						TBD	TBD
41	Public Buildings - Flood Audit & Flood Insurance	65						$60,000	None
42	Critical facilities – Flood Audit and Emergency Action Plans	65						$100,000	None
43	Critical facilities – Higher standards for new critical facilities	66						$110,000	None
44	Open Space Creation	67						$250,000	Land&Cstr.
45	Flood Preparedness Plan	68						$190,000	None
46	Watershed Management Planning - Huron	70						TBD	None
47	Huron River Impoundment Study	70						TBD	None
48	Watershed Management Planning - Newport	70						TBD	None
49	Watershed Management Planning – Traver	70						TBD	None
50	Historic District Preservation	70						TBD	None
51	Railroad Berm Fill Removal	70						TBD	None
52	Watershed Management Planning - Allen	71						TBD	None
53	Downtown City Owned Sites	71						TBD	None
54	Watershed Management Planning - Mallets	71						TBD	None
55	Watershed Management Planning - Millers	71						TBD	None
56	Watershed Management Planning - Swift	71						TBD	None
	Totals							$2,141,000	

3.2 FUNDING

Another component that will affect the NREPC and the WQC's ability to implement this plan is funding availability. The good news is by approving this plan the City could be eligible to receive Mitigation Project Funds through the State of Michigan and FEMA, however this is not the only means available and the City of Ann Arbor needs to consider all funding possibilities. Three funding activities should be considered the responsibility of the NREPC and the WQC to coordinate with staff: *Grant writing*, *capital improvement plan participation*, and *budget participation*.

- Grant writing –FMAC should actively research grant opportunities that coincide with projects on the implementation schedule.
- Capital improvement plan participation – FMAC should participate in the capital improvement planning process. Outline flood mitigation projects to include in the City's capital improvement plan.
- Budget participation – FMAC should participate in the City budget drafting and approval process. There may be some projects that should be included in the annual budget, whether as a line item or within a specific department.

Through participation in these process the NREPC and the WQC can achieve planned funding for the implementation schedule and avoid opportunistic implementation based on funding availability.

3.3 PLAN MONITORING

The NREPC and the WQC will be responsible for the monitoring of this plan. The monitoring should consist of three elements: *Plan updating*, *project evaluation*, and *annual reporting*.

- Plan updating – Some circumstances will require updating of this plan. For instance, when map amendments are filed with the City the plan should be updated to reflect the changes. Further, when new NFIP claims are made those structures will become higher priority.
- Project evaluation – As projects are completed an evaluation should be completed and attached to this plan for future review.
- Annual reporting – Staff should prepare an annual progress report and presentation. This report should be submitted to the Environmental Commission, Planning Commission, and City Council for review.

The completion of these three tasks will help assure the successful implementation of the projects contained in this plan. Keeping the plan current through updates, evaluating the success of projects as they are completed, and reporting on progress to decision makers, will assure that the goals outlined in Section 1.0 are realized during the implementation process.

APPENDIX A – FLOODPLAIN POLICY DISCUSSION

Document Index

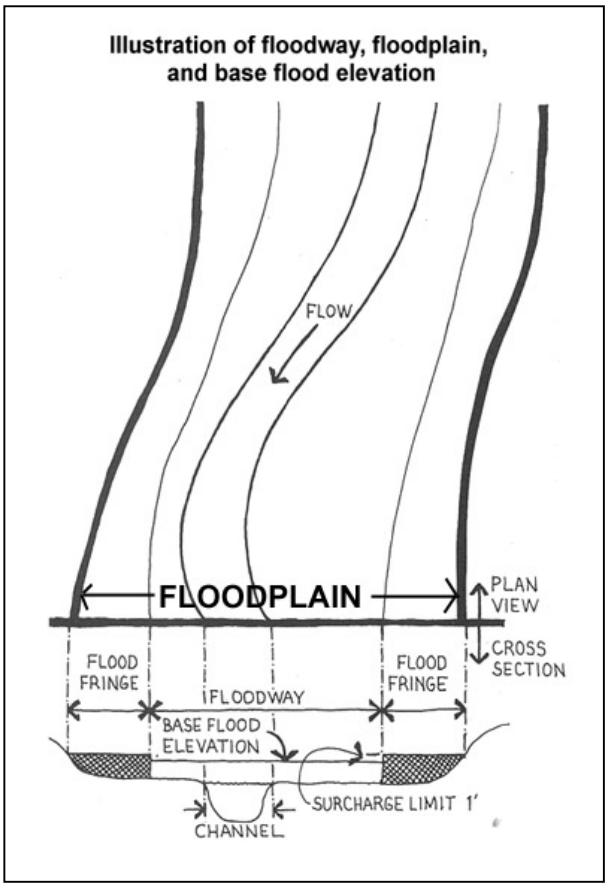
Introduction

On June 5, 2001, the City Planning Commission asked staff to present them with policy options for floodplain parcels owned by the City. The goal of this document is to inform policy primarily on City-owned parcels, but discussion of specific policy options also explores the implications for privately-owned properties in the floodplain.

As the City moves forward with this policy discussion, it will become more important to involve the community, especially because of the implications for private property in the floodplain.

Parcels administered by the Parks and Recreation Department and used as recreational space are generally not included in this analysis. However, policy decisions made by the City will impact future use of those parcels as well.

Floodplain Background
The City of Ann Arbor contains property that is located within the floodplains for five drainage basins: Allen Creek, Malletts Creek, Swift Run, Traver Creek, and the Huron River (see cover page map). The following background information provides a framework for discussion of policy options.



Definitions

Base Flood/100-year flood – The flood having a one-percent chance of being equaled or exceeded in any given year.

"Cavity" Effect – The spread of property disinvestment from vacant/condemned properties to adjacent properties.

Community Rating System (CRS) – A program of the Federal Emergency Management Agency for communities participating in the National Flood Insurance Program. A municipality may apply for a higher rating (the default is 10) of their floodplain management system. Property owners receive a 5 percent discount on flood insurance for each one-point improvement in the municipality's score. The CRS also provides a guide to what FEMA values in floodplain management.

FEMA – (Federal Emergency Management Agency) The agency responsible for emergency planning and management at the federal level. FEMA administers the National Flood Insurance Program.

Floodplain – The area covered by floodwaters in a 100-year flood. (The floodplain *contains* the floodway and the flood fringe.)

Flood Fringe –The area of floodplain that does *not* have a strong current, i.e. the area not identified as the floodway.

Floodway – The area of floodplain where the water is flowing.

National Flood Insurance Program (NFIP) – Allows property owners in the floodplain to receive a subsidy for flood insurance. If communities do not enforce floodplain regulations, property owners in the City must pay market rate for flood insurance.

Shadow of Condemnation – The belief, founded or unfounded, that property will be condemned by a public entity. This belief typically causes disinvestment and neglect.

City-owned properties in the floodplain

This document focuses on City-owned properties with structures in the floodplain. The City can also utilize City-owned floodplain parcels without structures to maximize storm water management space. Examples of unobstructed floodplain parcels are parks, vacant lots, and parking lots.

The City owns 13 parcels/parcel groups in the floodplain, other than parkland. They are:

With structures in floodplain

- 406 Maple Ridge (single-family dwelling)
- 3432 Platt (single-family dwelling)
- 223 S. Seventh (four duplex dwellings)
- 3457 Platt (four duplex dwellings)
- 2800 Ellsworth (Landfill structure)
- North Main City Yard (123 W. Summit etc.) (three maintenance buildings)
- Parks & Recreation Maintenance Yard (415 W. Washington etc.) (several maintenance buildings)

No structure on parcel

- Surface parking at William & First (216 W. William etc.)
- 404-406 S. Ashley (parking leased to Avalon housing; not mapped)
- 1585 Jones (vacant parcel; not mapped)
- Other Springbrook parcels (vacant; mapped with 3432 Platt)

Structure on parcel not in floodplain

- 2756 Hikone (not mapped)
- 805 W. Washington (not mapped)

These properties are described in Appendix A, and maps of each site (except as noted) can be found at the end of this document.

Public right-of-way in the floodway

Flooded streets represent a special hazard to human life, as do flooded sidewalks and other right-of-way surfaces. According to FEMA, over half of all fatalities associated with flash flooding are automobile-related. Just two feet of moving water is enough to wash away any size passenger vehicle, including trucks and SUVs, because of their proportionate buoyancy. Lower levels of moving water can also cause vehicles to lose traction. Depending on water velocity, even a few inches of flowing water can be dangerous to pedestrians.

This document focuses on parcels, not right-of-way. Looking ahead, however, the City may wish to address safety in the right-of-way with policies in the following areas:

- Emergency Response Plan
- Guidelines for new right-of-way through the floodplain
- Guidelines for creating access to flood-prone areas
- Permanent road signage in the floodway
- Public information campaigns

The City may also consider using right-of-way for storm water surcharge storage. Several Illinois municipalities currently use streets to temporarily store storm water surcharge, apparently motivated by problems with a combined sewer system (see References).

Note on floodplain mapping

The Michigan Department of Environmental Quality must certify the floodplain and floodway boundaries for any specific development site. The digitized maps currently used by the City show the floodplain and floodway as they were digitized from the Floodplain Insurance Rate Map (FIRM) paper copies, and have been determined to be accurate within 50 feet.

In the City of Ann Arbor, Swift Run's floodway and flood elevations are unmapped by FEMA, and Miller's Creek has not been studied at all, possibly because of its small catchment area (2.35 square miles). Recent site studies have also shown that the Allen Creek floodway may be underestimated on current FIRMs. For some policy goals, the City may consider commissioning hydrologic studies of these areas. For example, a new study of the Swift Run floodplain and floodway may show that the Springbrook parcels (3432 Platt, etc.) are outside the floodplain, or at least the floodway.

Regulatory Framework for Floodplain Policy

The focus of Michigan regulation is to "assure that the flow carrying capacity of a watercourse is not harmfully obstructed, and that the floodway portion of the floodplain is not used for residential construction" (Michigan Department of Environmental Quality (MDEQ) webpage). The laws governing floodplains are contained in Part 31 – Water Resources Protection, within the Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended. State regulations are coordinated with the Federal Emergency Management Agency (FEMA).

Michigan State Laws (NREPA, 1994 PA 451, Part 31 – Water Resources Protection; new Michigan Building Code)

Existing structures, residential or commercial/industrial, may continue to be maintained as they stand, subject to the following:

- *Substantial Improvement Rule.* For existing structures, if improvements worth over 50% of the value of the building are made, the structure must be brought into compliance with the regulations below.
- *Historic structure exemption.* Those structures listed on the National Register of Historic Places or a State Inventory of History Places are exempt from the substantial improvement rule.

No new residential construction is allowed in the floodway.

Residential construction is allowed in the flood fringe, outside the floodway but in the 100-year floodplain. However, all floors, including the basement, must be 1 foot above the flood level. Floodproofing is not sufficient for residential structures in the flood fringe.

Commercial and industrial construction are allowed in the floodway and floodplain but must have all floors elevated one foot above the flood water level or be floodproofed. However, development in the floodplain is subject to special scrutiny by the Michigan Department of Environmental Quality and will not be approved if it compromises floodwater movement or storage.

County Drain Commissioner's limits on building in the floodplain

Drain easement. The County Drain Commissioner requires a 30-foot easement to either side of the centerline of underground or aboveground creeks under County jurisdiction. This places distinct limits on any structures proposed for the area around the floodway, even those in compliance with building codes.

City regulations affecting floodplains

Chapter 57 (Subdivision and Land Use Control) of the City Code requires new development within the floodplain to create no net loss of floodwater storage capacity.

Floodplain Management Resolution. The City of Ann Arbor has passed a resolution pledging to adhere to the federal and state regulations governing floodplain development.

City of Ann Arbor

City Goals Related to Floodplain Properties

The future of floodplain properties touches on many issues related to the public health, safety and welfare of the City of Ann Arbor. This policy discussion focuses on interests as expressed in the laws, resolutions and plans adopted by the State of Michigan or the City of Ann Arbor.

	Goals	Related plans, laws, & resolutions
Two central goals	**1. Minimize life endangerment**	• MI: Part 31 of the NREPA • FEMA/NFIP: 44 CFR Parts 59-78 • Ann Arbor Floodplain Management Resolution
	2. Minimize property damage and loss	• MI: Part 31 of the NREPA • FEMA/NFIP: 44 CFR Parts 59-78 • Ann Arbor Floodplain Management Resolution
Related goals	a. **Preserve market value** of existing real property	• City Long Term Financial Plan (p. 7) • Central Area Plan (pp. 27-28) • West Area Plan (p. 36)
	b. Promote **water quality and ecological health** of each creekshed	• Parks and Recreation Open Space Plan (pp. F35-F36)
	c. **Reduce Allen Creek Drain contamination** to reduce outflow of contaminants into the Huron River	• Parks and Recreation Open Space Plan (p. F32)
	d. **Create Allen Creek Greenway** in floodplain area	• Downtown Plan (pp. 54, 57, 58)
	e. Preserve **neighborhood character**	• Central Area Plan (p. 24) • West Area Plan (p. 36)
	f. Create **affordable housing** on vacant City-owned parcels	• Central Area Plan (pp. 25-26) • West Area Plan (p. 38)
	g. **Retain National Flood Insurance Program** by limiting/prohibiting development in floodplain	• Ann Arbor Floodplain Management Resolution • West Area Plan (p. 33)

Detailed Policy Discussions

The following represent several potential policy options for City-owned property in the floodplain. A summary table of all options and their relationship to community goals is provided in Table 1. Table 2 outlines probable short-term outcomes for the properties with structures and others under consideration for development.

1: DO NOTHING (No change to current policy)

City would buy and sell properties in the floodplain just as any other landowner would. Parks and Recreation Department may long-term assume management responsibilities for properties in line with their goals for land acquisition.

Short Term:

Residential properties: no immediate changes. Properties continue under possibility of destruction/damage through flooding.

Non-residential properties: no immediate changes. Properties continue under possibility of destruction/damage through flooding.

Long Term:

Residential properties will become vacant through natural loss of structure (fire, flood, etc.) or high maintenance needs (over 50 percent of value of structure), after which they cannot be rebuilt under Michigan laws.

Non-residential properties will need extensive remodeling when normal maintenance needs exceed 50 percent of the value of the property. At this point, buildings must be brought into compliance with Michigan State building code (all floors must be elevated to one foot over 100-year flood level or flood-proofed) which may be cost-prohibitive for their continued use.

Parks and Recreation Department assume administration over some parcels, but with a limited mandate, may not wish to focus on these issues. The current PROS (Parks and Recreation Open Space) Plan makes related recommendations, but acquisition is not focused specifically on floodplain properties.

Pro (DO NOTHING)

- Preserves old neighborhoods as long as possible, as they are
- Preserves older, more affordable housing stock

Con (DO NOTHING)

- Not clear when, if ever, Allen Creek Drain could be cleared of contaminants
- No plan for eventual replacement of housing that clears over time (e.g., Springbrook properties, where thwarted plans for housing development have left land in limbo)
- "Cavity" effect may accelerate over time as floodplain structures are removed or, like 3432 Platt, are allowed to decay in place
- Improvement of creekshed conditions indefinitely postponed

For Private Property, extending the DO NOTHING policy would also...

…(+) postpone tax income loss from floodplain property

…(+) retain commercial & industrial tax income

…(+) be short-term neutral for "shadow of condemnation"

…(–) contribute long-term to "cavity" effect

2: REACTIVE RESPONSE (Monitor natural decay of structures, and aggressively convert properties past a certain point of decay; provide some support for properties bordering on the floodplain.)

The City would begin by setting standards for levels of structural decay that lead to a building being unfit for occupancy. City-owned residential and non-residential properties would be measured based on these standards regularly. Properties which surpass pre-determined levels of maintenance needs (approaching demolition) would be converted to usable open space aggressively to prevent decayed structures from blighting neighborhoods.

For private properties, a tracking system would be set up to follow assessments, building inspections, and other measures of structural maintenance needed/completed on floodplain properties. This would also lead to conversion (through grants or public acquisition) to usable open space. In addition, the City could initiate a program of grants and other incentives for home improvements on parcels within a certain distance of floodplain properties.

For City properties in good shape, decisions would be made as in the DO NOTHING approach (buy and sell as any other property owner).

Short term

The need for this program will not be immediate, especially when the real estate market in Ann Arbor is strong. This program may however provide some security for the housing market should it decline or stop growing.

Long term:

As floodplain properties age, fall into disrepair and are declared unfit for occupancy, this program would become more important. The program can also shift funding to the private sector by encouraging neighbors to purchase empty lots.

Pro (REACTIVE RESPONSE)

- Avoids “cavity” effect.
- Avoids “shadow of condemnation” effect.
- Preserves neighborhood strengths at minimal cost.
- Preserves older housing abutting the floodplain.

Con (REACTIVE RESPONSE)

- Does nothing to reduce danger to property or life.
- Does not improve ecological health of the creekshed.
- Would be most costly at times of economic and real estate market weakness.

For Private Property, extending the REACTIVE RESPONSE policy would also...

(-)…cause increased open space in the floodplain, long-term increasing the value of other floodplain properties. This would make these properties more expensive should the City wish to purchase them at some point in the future.

(-)…cause increased open space, long-term reducing the rate of attrition through neglect, thereby prolonging the life of structures which are out of compliance with code.

3: REDEVELOPMENT AS NON-RESIDENTIAL (Since residential redevelopment in the floodplain is prohibited, promote commercial/industrial redevelopment that is consistent with floodplain regulations (elevated or floodproofed).)

No change to residential properties (406 Maple Ridge, 3432 and 3457 Platt, and 223 Seventh) unless they become marketable for commercial or industrial redevelopment. Non-residential structures would be torn down and their uses relocated (Ellsworth landfill structure, City Yard on N. Main, Parks and Recreation Maintenance facility at 415 W. Washington), and the City would sell these parcels for redevelopment with elevated/floodproofed buildings.

Short term

If any residential properties were commercialized, neighborhoods would likely see some change. Selling City properties in the floodplain could create revenue sources for other floodplain activities, however. Some overlay zoning or new floodplain zoning policy would be required in residential areas.

Private developers may find flood-appropriate building techniques prohibitively expensive, especially in high flood elevation areas. Barrier-free access, for example, is more expensive in elevated buildings.

Long term:

Neighborhoods would be reconfigured around a line of industrial/commercial properties similar to current areas around railroad lines. Storm water flow may improve somewhat if buildings are elevated on 'stilts' to allow water to pass beneath.

Pro (REDEVELOPMENT AS NON-RESIDENTIAL)

- Preserves real property values of parcels in floodplain.

Con (REDEVELOPMENT AS NON-RESIDENTIAL)

- Not in line with spirit of National Flood Insurance Program.
- Makes very little contribution to ecological health of floodplain.
- Not clear when Allen Creek Drain can be cleaned to reduce outflow of contaminants into the Huron River.
- No contribution to affordable housing; may call for removal of current affordable housing stock at some point.
- Neighborhood character would change with new buildings and new uses inserted.
- Puts newer property in path of flood and liable to damage if floodproofing fails.

For Private Property, extending the REDEVELOPMENT AS NON-RESIDENTIAL policy would also...

(+)…bolster value of commercially viable properties in floodplain.

(-)…create some neighborhood upheaval as businesses spring up along the floodway.

(-)…leave a policy void for properties which are not suitable for commercial redevelopment.

4: FLOODPLAINS FOR FLOODS (Plan to remove all structures, replace with parks/open space)
Residential properties (406 Maple Ridge, 3457 and 3432 Platt, and 223 Seventh) would be torn down and converted to parks. Non-residential structures would be torn down and their functions relocated (Ellsworth landfill structure, City Yard on North Main, Parks and Recreation Maintenance facility at 415 W. Washington).

Short term:

Funding sources are not clear for relocation of residents, but if it were successful, removing residential structures would create some upheaval in the affected neighborhoods. The City would also need to work to manage the demolition and park/open space conversion to prevent the "cavity" effect. For example, 3432 Platt (one of the Springbrook properties) has a single-family home that is currently standing vacant and is decaying rapidly for lack of another plan for the site or the structure.

Relocating non-residential structures (City Yard on North Main, 415 W. Washington) would be costly, especially with no revenues from sale of current sites. Some stretches of Allen Creek Drain would be open to cleanup.

Long term:

If this policy were carried out with private parcels, eventually the City would have a large greenway through several parts of Ann Arbor. Some sites are likely to be valuable enough that owners would prefer to flood-proof buildings than move, however, meaning the greenway will be incomplete.

Pro (FLOODPLAINS FOR FLOODS)

- Allen Creek Drain would be open to cleanup on City maintenance sites.
- Parkland/open space could be beneficial to neighborhoods if constructed properly.
- Prevents accidental loss of property, danger to life.

Con (FLOODPLAINS FOR FLOODS)

- Real property value would be lost by changing use (where the value of a City-owned site is measured by the cost of building a new one).
- Funding source unclear, both for conversion and maintenance.
- Loss of affordable housing units.
- Loss of residential continuity in neighborhoods.
- "Cavity" effect could be detrimental to neighborhood if new open space is not managed properly.

For Private Property, extending the FLOODPLAINS FOR FLOODS policy would...

(+)…remove residents from flood-prone properties

(-)…need a vigilant City staff to minimize "shadow of condemnation"

(-)…possibly cause real property value loss on parcels earmarked for condemnation.

(-)…if project were only partially completed, could cause detrimental "cavity" effect

(-)…cause a loss of business/property tax revenue

5: VARIED RESPONSE BASED ON FLOOD LEVEL (Rate the risk to each parcel in the floodplain based on flood elevations; depending on risk level, apply policy avenues 1-4.)

For residential properties where flood elevations have been determined (406 Maple Ridge and 223 Seventh), the policy would be DO NOTHING/OCCUPY CRUMBLING STRUCTURES. They would be kept in use – until decay takes over – because the flood elevations are relatively low (less than two feet) at these parcels. Long-term, the non-residential value would be tracked to determine if properties could be redeveloped (REDEVELOPMENT AS NON-RESIDENTIAL); otherwise, they would be converted to private or public open space.

Non-residential structures in the Allen Creek floodplain would fall under the FLOODPLAINS FOR FLOODS policy. They would be torn down and their functions relocated (City Yard on North Main, Parks & Recreation Maintenance facility at 415 W. Washington). Non-residential parcels without structures (e.g., parking lot at William and First) would not be built on if the flood elevation levels were above two feet.

The Swift Run floodplain would be studied to determine the flood elevations for the Springbrook Properties, 3457 Platt, and the structure on the City landfill (2800 Ellsworth). Action would be taken based on this information.

Short term:

The City must cover the loss of property value as the two maintenance facilities are downgraded to a lower use (open space/parks). This loss can be understood as the cost of building new sites for these functions. Also, the City must cover costs of cleaning and renovating these two properties, which are likely to have some contamination. Residential properties would see no changes.

Long term:

The City would have two high-quality parks for use near the downtown area. The parks could also be designed to improve storm water management.

As the residential properties are lost to natural decay and destruction, the City will need to invest in a productive re-use for these areas.

Pro (VARIED RESPONSE BASED ON FLOOD LEVEL)

- Minimizes life endangerment and potential for property damage by prioritizing areas with deep waters.
- Preserves neighborhood character in areas with low flood elevations.
- Preserves the value of real property in areas with low flood elevations.

Con (VARIED RESPONSE BASED ON FLOOD LEVEL)

- Lowers the value of property with high flood elevations.
- Does not quite align with the spirit of the National Flood Insurance Program, in that it creates a new flood risk measure not endorsed by the NFIP.
- The City would need to seek expert help in specifying an appropriate flood risk measure (based on elevations, possibly also considering duration of flooding and flood water velocity).

For Private Property, extending the VARIED RESPONSE BASED ON FLOOD LEVEL policy would...

(+)…remove residents and workers from buildings likely to flood to high levels.

(-)…cause upheaval in neighborhoods where flood elevations would call for removing houses.

(-)…cause a loss of tax revenue if industrial properties in the deeper areas of the Allen Creek floodplain are condemned by the City.

(-)…cause “shadow of condemnation” problems for areas falling under the FLOODPLAINS FOR FLOODS policy (those under deeper water).

6: VARIED RESPONSE BASED ON FLOODWAY/FLOODPLAIN (Rate the risk to each parcel and to different areas within each parcel based on whether it is in the floodway or the flood fringe, allowing limited structures to remain/be built in the flood *fringe*, while allowing no structures to remain or be built in the flood*way*.)

Areas of parcels in the floodway are closed to all new structures. City-owned structures in the floodway would be removed. The City would seek funds from grants or other sources to remove existing structures. Also, the City may commission a study of the Swift Run floodway to determine which areas are in the floodway.

In the flood fringe, critical facilities (see Appendix B) would be prohibited. This would disallow the City Yard and the Parks maintenance building, as well as housing used for disabled or elderly occupants. Ideally, these areas would have 'unoccupied' structures only (e.g., parking decks). Existing structures in the flood fringe would be brought into code compliance as the opportunity arises. The City would seek funds for bringing such buildings into compliance.

Short term:

Residents of the current 12 units in floodplain properties would be relocated. Most buildings would be removed from City-owned areas within the floodplain. Appropriate redevelopment of the flood fringe (no critical facilities) would be examined parcel by parcel.

Long term:

City properties would be in full compliance with FEMA regulations and recommendations for floodplain properties. Re-use (park, open space, surface parking) of non-structured parcel space would have to be determined separately.

Pro (VARIED RESPONSE BASED ON FLOODWAY/FLOODPLAIN)

- Some structured uses would still be allowed in the flood fringe (in contrast to FLOODPLAINS FOR FLOODS policy).
- Limited redevelopment as non-residential would be allowed in the flood fringe areas.
- Prevents low-income tenants from being housed in flood-prone dwellings.

Con (VARIED RESPONSE BASED ON FLOODWAY/FLOODPLAIN)

- Using the flood fringe for parking puts property in the way of floodwaters.
- Funding for resident relocation, and new City facilities unclear.

For Private Property, extending the VARIED RESPONSE BASED ON FLOODWAY/FLOODPLAIN policy would...

(+)…remove residents from flood-prone properties

(-)…need a vigilant City staff to minimize "shadow of condemnation"

(-)…possibly cause real property value loss on parcels earmarked (or suspected to be earmarked) for condemnation.

(-)…if project were only partially completed, could cause detrimental "cavity" effect

(-)…cause a loss of business/property tax revenue

Table 1: Policy avenue pro/con overview, relative to City goals

Policies	1. Minimize Life Endangerment	2. Minimize Property Damage	a. Preserve Value of Real Property	b. Promote Ecological Health	c. Reduce Allen Creek Contamination	d. Create Allen Creek Greenway	e. Preserve Neighborhood Character	f. Preserve Affordable Housing	g. Retain National Flood Insurance Program
1. DO NOTHING	-	-	-	-	-	-	-	μ	-
2. VARIED RESPONSE BASED ON FLOOD LEVEL	μ	μ	μ/λ	-	-	μ/λ	μ	-	-
3. VARIED RESPONSE BASED ON FLOODWAY/ FLOODPLAIN	μ	μ	μ/λ	μ	μ	μ	μ/λ	λ	μ

μ positive contribution towards goal

λ detrimental for goal

- no net gains or losses in terms of goal

Table 2: Probable short-term outcomes for selected City-owned properties in the floodplain under each policy avenue

	1. DO NOTHING	2. VARIED RESPONSE BASED ON FLOOD LEVEL	3. VARIED RESPONSE BASED ON FLOODWAY/ FLOODPLAIN
406 Maple Ridge	Sell property or convey to AAHC* for rental	Sell property or convey to AAHC for rental	Remove structure, convert to open space/water storage use (almost all in floodway)
3432 Platt Road	Sell structure if possible, otherwise demolish and lump with other Springbrook properties	Study Swift Run to determine flood levels; if no study, remove structure to be safe, convert to open space use.	Remove structures; study Swift Run to assess possibility for unoccupied use on part of parcel
Other Springbrook properties	Sell if possible; otherwise consider as park	Study Swift Run to determine flood levels; if no study, convert to open space use to be safe.	Study Swift Run to determine floodway; if no study, convert to open space use to be safe.
223 S. Seventh	Maintain as is (occupied)	Maintain as is (occupied)	Remove all current structures; relocate residents; part of property could be redeveloped as unoccupied use (in flood fringe)

* AAHC: Ann Arbor Housing Commission

	1. DO NOTHING	2. VARIED RESPONSE BASED ON FLOOD LEVEL	3. VARIED RESPONSE BASED ON FLOODWAY/ FLOODPLAIN
North Main City Yard *Assuming this facility *does* need an upgrade currently	Sell for redevelopment	Remove structure, convert to open space/water storage use	Remove structure; part of parcel could be redeveloped for unoccupied use; part of parcel would need to be open space/water storage use

Appendix A: City-owned property in the floodplain

City-owned properties with structures in the floodplain

(Does not include Parks properties)

Map No.	Address	Description	Watershed	Acres in floodplain	Total acreage of parcel	Percent of parcel in floodplain
1	406 Maple Ridge	Single-family residence, currently vacant, administered by Utilities	Allen Creek	0.196	0.209	93.78%
2	3432 Platt	Small single-family home in residential neighborhood, currently vacant, no department is administering property	Swift Run	0.339	0.377	89.92%
(2)	Springbrook Parcels	Parcels adjacent to 3432 Platt, determined to be within floodplain by MDEQ.	Swift Run	n/a	1.356	n/a
3	223 S. Seventh	Duplex on Old West Side, administered by Ann Arbor Housing Commission	Allen Creek	0.825	0.880	93.75%
4	3457 Platt	4 multi-family buildings, administered by Ann Arbor Housing Commission	Swift Run	0.780	0.781	99.87%
5	2800 Ellsworth	Municipal Landfill – small structure located in floodplain area.	Swift Run	30.270	142.830	21.19%
6	123 W. Summit 717 N. Main	City Yard parcels (off N. Main Street).	Allen Creek	4.304	4.722	91.15%
7	415 W. Washington 300 W. Liberty 314 W. Liberty	Parks and Recreation Maintenance Facility, on Old West Side	Allen Creek	2.355	2.522	93.38%

Note: Digital floodplain and floodway maps are accurate to within 50 feet; final jurisdiction over floodplain boundaries rests with the Michigan Department of Environmental Quality (MDEQ).

City-owned properties with no **structures in floodplain**

(Does not include Parks properties)

Map No.	Address	Description	Watershed	Acres in floodplain	Total acreage of parcel(s)	Percent of parcel(s) in floodplain
8	216 W. William 307 S. First	Parking lot at 1st & William, under consideration for development	Allen Creek	0.886	0.893	99.22%
	406 S. Ashley 404 S. Ashley	Parking leased long-term to Avalon Housing	Allen Creek	0.040	0.178	22.47%
	1585 Jones	Vacant – purchased by Ann Arbor Engineering for Jones Street right of way; parcel contains Traver Creek culvert	Traver Creek	0.070	0.338	20.71%
	805 W. Washington	Duplex on Old West Side	Allen Creek	0.039	0.536	7.28%
	2756 Hikone	Multi-family housing	Malletts Creek	0.140	3.234	4.33%

Map 9: Parking structure at 1st & Washington

Note: Digital floodplain and floodway maps are accurate to within 50 feet; final jurisdiction over floodplain boundaries rests with the Michigan Department of Environmental Quality (MDEQ).

Appendix B: Excerpt from the FEMA Community Rating System Manual

This document is referenced in Policy Avenue 6, VARIED RESPONSE BASED ON FLOODWAY/FLOODPLAIN*. Critical facilities would be disallowed in any part of the floodplain under that policy avenue.*

Critical Facilities:

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

References

44 Code of Federal Regulations, Parts 59-78.

City of Ann Arbor (1992). *Central Area Plan.*

City of Ann Arbor (1988). *Ann Arbor Downtown Plan.*

City of Ann Arbor (1995). *West Area Plan.*

City of Ann Arbor Floodplain Management Resolution, November 19, 1991.

City of Ann Arbor (2000). *Long Term Financial Plan, 2001-2005.*

City or Ann Arbor (2000). *Parks and Recreation Open Space Plan, 2000-2005.*

City of Ann Arbor (2000). *Malletts Creek Restoration Plan: Final Report*. Prepared by Environmental Consulting and Technology, Inc.

Federal Emergency Management Agency (1999). Community Rating System Manual. http://www.fema.gov/nfip/crs.htm

Federal Emergency Management Agency (1992). *Flood Insurance Study, City of Ann Arbor, Michigan, Washtenaw County*.

Federal Emergency Management Agency, National Flood Insurance Program. *Flood Insurance Rate Maps*.

Federal Emergency Management Agency. http://www.fema.gov/nwz96/autofld2.htm (explains basic statistics on automobile-related flooding fatalities).

McNamee, Porter and Seeley (1983). *Study of Allen Creek*.

Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, Part 31 – Water Resources Protection.

United States Environmental Protection Agency, Office of Water (2000). *Street Storage for Combined Sewer Surcharge Control: Skokie and Wilmette, Illinois*.

APPENDIX B – FEEDBACK TOOL

Feedback Tool – Iteration 1

Residents were presented with the following questionnaire. A presentation was given that walked through each of the 55 elements and questions were addressed as they arose to make sure everyone understood the details of each mitigation strategy. The items are arranged based on the seven mitigation objectives outlined in the plan.

Floodplain Mitigation Project Options

Please Consider Providing Supplemental Information

This Information is Considered Confidential

Name:
Address:
Telephone:
Email:
Today's Date:
Group Affiliation?:
What Watershed Do You Live in?:
What Watershed Do You Work in?:
Additional Comments:

Floodplain Mitigation Project Options

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 1 - Mapping and Technology:

Description: Maintain and utilize up-to-date floodplain mapping techniques to assist in the identification and mitigation of flood related hazards	Mitigation Projects:	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Mapping additional flood related hazards. Dam failure inundation; uncertain flow paths, and debris & sediment blockage						
A NEW STANDARD	Use future conditions hydrology for mapping						
	Incorporate future condition hydrology into plans and regulations						

Mitigation Objective 2: Education and Outreach

Description: Employ education and outreach as a means to reduce potential flood hazards and increase community knowledge about the floodplain.	Mitigation Projects:	Strongly Agree	Somewhat Agree	No Preference	Somewhat Disagree	Strongly Disagree	Need More Information
LOCAL IMPROVEMENTS	Make flood maps available on City website						
	Make other flood information and links available on City websites						
	Outreach projects: Brochures, mailing, displays, articles, video, signs, presentations, and emergency action plans						
	Make handbooks, maps and other publications available at public library						
	Flood protection advice						
A NEW STANDARD	Flood hazard training and education of City staff						
	Establish certified floodplain manager employment criteria for appropriate staff positions						
	Educating Decision Makers, workshops and conferences, models or presentations						
	Environmental and safety education						

Floodplain Mitigation Project Options

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 3: Planning and Zoning

Description: Integrate floodplain management into planning projects and prevent possible hazards associated with an unplanned floodplain	Mitigation Projects:	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Restrict residential development in floodway						
	Restrict residential development in entire floodplain						
	Restrict all development in floodway						
	Restrict all development in entire floodplain						
	Restrict damage-prone development						
	Low density zoning in floodplain						
	Pursue detailed vulnerability analysis and flood loss modeling						
	Develop watershed management plans						

Mitigation Objective 4: Regulation and Development Standards

Description: Implement regulatory measures and development standards to limit flood impacts caused by the built environment	Mitigation Projects:	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Freeboard – additional height requirements above the BFE						
	Higher standard for foundation protection						
	Count improvements cumulatively						
	Lower threshold for substantial improvements						
	Additions meet new standards						
	Limit fill or buildings that displace floodwater in flood fringe						
	Require hydrologically equivalent compensatory storage to replace fill						
	Protect or create natural features in floodplain as green infrastructure						
A NEW STANDARD	Prohibit development in floodway						
	Prohibit development entire floodplain						
	Require setbacks from enclosed drains in floodplains						
	Increase stream buffer zone requirements						
	Link open space dedication requirements to floodplain						
	Create parks and greenways in floodplain						
	Purchase development rights in floodplain						
	Develop stream restoration program						

Floodplain Mitigation Project Options

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 5: Corrective Actions

Description: Identify opportunities where corrective actions can be used to mitigate the flood risk for properties in the floodplain	Mitigation Projects:	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Increase staff enforcement of code						
	Structure Relocation						
	Property Acquisition						
	Structure Elevation						
	Install Protective Barriers						
	Dry floodproofing of structures						
	Wet floodproofing of stuctures						
A NEW STANDARD	Floodplain and watershed management plan monitoring						
	Seek ways to pursue environmental remediation though floodplain management						

Mitigation Objective 6: Infrastructure

Description: Evaluate the City's infrastructure within the flood plain and protect it from flood related hazards.	Mitigation Projects:	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Public property – flood audit & flood insurance						
	Critical facilities – flood audit and emergency action plans						
A NEW STANDARD	Parks – acquisition and greenway plan						
	Critical facilities – higher standards for new critical facilities						

Mitigation Objective 7: Emergency Services

Description: Develop and/or refine a flood response/preparedness method for servicing the community before and after flood related disasters.	Mitigation Projects:	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Create flood threat recognition system						
	Flood warning						
	Flood information and instructions						
	Flood response actions and responsible parties						
	Flood stage forecast map						

Feedback Tool – Iteration 1, Results

The results for iteration #1 are presented below. The total responses are tabulated on the far left. The percentages are represented by color categorization for visual ease.

- Red = Greater than 50% support
- Dark Blue = 25-50% support
- Light Blue = 0-25% support
- Dark Grey = No Response or 0% support.

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 1 - Mapping and Technology:

Description: Maintain and utilize up-to-date floodplain mapping techniques to assist in the identification and mitigation of flood related hazards	Mitigation Projects:	Responses	Strongly Agree	Somewhat Agree	Neutral	Some-what Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Mapping additional flood related hazards. Dam failure inundation, uncertain flow paths, and debris & sediment blockage	15	86.67%	6.67%	0.00%	0.00%	0.00%	6.67%
A NEW STANDARD	Use future conditions hydrology for mapping	11	72.73%	0.00%	18.18%	0.00%	0.00%	9.09%
	Incorporate future condition hydrology into plans and regulations	16	87.50%	0.00%	6.25%	0.00%	0.00%	6.25%

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 2: Education and Outreach

Description: Employ education and outreach as a means to reduce potential flood hazards and increase community knowledge about the floodplain.	Mitigation Projects:	Responses	Strongly Agree	Somewhat Agree	Neutral	Some-what Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Make flood maps available on City website	16	87.50%	12.50%	0.00%	0.00%	0.00%	0.00%
	Make other flood information and links available on City websites	16	87.50%	6.25%	0.00%	6.25%	0.00%	0.00%
	Outreach projects: Brochures, mailing, displays, articles, video, signs, presentations, and	16	68.75%	25.00%	6.25%	0.00%	0.00%	0.00%
	Make handbooks, maps and other publications available at public library	16	87.50%	6.25%	0.00%	0.00%	6.25%	0.00%
	Flood protection advice	16	87.50%	12.50%	0.00%	0.00%	0.00%	0.00%
A NEW STANDARD	Flood hazard training and education of City staff	14	85.71%	14.29%	0.00%	0.00%	0.00%	0.00%
	Establish certified floodplain manager employment criteria for appropriate staff positions	14	78.57%	21.43%	0.00%	0.00%	0.00%	0.00%
	Educating Decision Makers, workshops and conferences, models or presentations	13	92.31%	7.69%	0.00%	0.00%	0.00%	0.00%
	Environmental and safety education	16	75.00%	25.00%	0.00%	0.00%	0.00%	0.00%

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 3: Planning and Zoning

Description: Integrate floodplain management into planning projects and prevent possible hazards associated with an unplanned floodplain	Mitigation Projects:	Respons es	Strongly Agree	Somewha t Agree	Neutral	Some- what Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Restrict residential development in floodway	16	75.00%	18.75%	0.00%	0.00%	0.00%	6.25%
	Restrict residentialdevelopment entire floodplain	16	68.75%	6.25%	6.25%	12.50%	0.00%	6.25%
LOCAL IMPROVEMENTS	Restrict all development in floodway	16	81.25%	0.00%	0.00%	6.25%	0.00%	12.50%
	Restrict all development entire floodplain	15	46.67%	26.67%	6.67%	0.00%	13.33%	6.67%
	Restrict damage-prone development	14	71.43%	14.29%	0.00%	0.00%	0.00%	14.29%
	Low density zoning in floodplain	14	50.00%	7.14%	14.29%	0.00%	14.29%	14.29%
	Pursue detailed vulnerability analysis and flood loss modeling	15	73.33%	13.33%	13.33%	0.00%	0.00%	0.00%
	Develop watershed Management Plans	15	86.67%	0.00%	0.00%	0.00%	0.00%	13.33%

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 4: Regulation and Development Standards

Description: Implement regulatory measures and development standards to limit flood impacts caused by the build environment	Mitigation Projects:	Responses	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Freeboard – additional height requirements above the BFE	11	45.45%	9.09%	9.09%	0.00%	0.00%	36.36%
	Higher standard for foundation protection	11	45.45%	18.18%	0.00%	0.00%	0.00%	36.36%
	Count improvements cumulatively	13	46.15%	7.69%	15.38%	0.00%	0.00%	30.77%
	Lower threshold for substantial improvements	14	28.57%	7.14%	7.14%	14.29%	7.14%	35.71%
	Additions meet new standards	14	57.14%	14.29%	7.14%	0.00%	0.00%	21.43%
	Limit fill or buildings that displace floodwater in flood fringe	14	71.43%	0.00%	7.14%	0.00%	0.00%	21.43%
	Require hydrologically equivalent compensatory storage to replace fill	16	37.50%	25.00%	0.00%	0.00%	12.50%	25.00%
	Protect or create natural features in floodplain as green infrastructure	16	87.50%	6.25%	0.00%	0.00%	0.00%	6.25%
A NEW STANDARD	Prohibit development in floodway	15	80.00%	0.00%	0.00%	6.67%	0.00%	13.33%
	Prohibit development entire floodplain	14	35.71%	42.86%	0.00%	0.00%	7.14%	14.29%
	Require setbacks from enclosed drains in floodplains	15	73.33%	6.67%	0.00%	0.00%	0.00%	20.00%
	Increase stream buffer zone requirements	13	69.23%	7.69%	0.00%	0.00%	0.00%	23.08%
	Link open space dedication requirements to floodplain	15	66.67%	13.33%	6.67%	0.00%	0.00%	13.33%
	Create linear parks and greenways in floodplain	15	66.67%	6.67%	0.00%	0.00%	0.00%	6.67%
	Purchase development rights in floodplain	15	53.33%	13.33%	13.33%	6.67%	6.67%	6.67%
	Develop stream restoration program	15	53.33%	33.33%	6.67%	0.00%	0.00%	6.67%

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 5: Corrective Actions

Description: Identify opportunities where corrective actions can be used to mitigate the flood risk for properties in the floodplain	Mitigation Projects:	Responses	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Increase staff enforcement of code	13	69.23%	7.69%	15.38%	0.00%	0.00%	7.69%
	Structure Relocation	13	30.77%	15.38%	23.08%	15.38%	0.00%	15.38%
	Property Acquisition	13	30.77%	15.38%	23.08%	15.38%	0.00%	15.38%
	Structure Elevation	11	18.18%	18.18%	27.27%	0.00%	27.27%	9.09%
	Install Protective Barriers	12	8.33%	16.67%	8.33%	8.33%	16.67%	41.67%
	Dry floodproofing of structures	13	0.00%	7.69%	23.08%	0.00%	15.38%	53.85%
	Wet floodproofing of stuctures	13	0.00%	7.69%	23.08%	7.69%	7.69%	53.85%
A NEW STANDARD	Floodplain and watershed management plan monitoring	11	90.91%	9.09%	0.00%	0.00%	0.00%	0.00%
	Seek ways to pursue environmental remediation though floodplain management	15	80.00%	6.67%	0.00%	0.00%	0.00%	13.33%

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 6: Infrastructure

Description: Evaluate the City's infrastruoture within the flood plain and protect it from flood related hazards.	Mitigation Projects:	Responses	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Public property – flood audit & flood insurance	12	33.33%	8.33%	8.33%	0.00%	8.33%	41.67%
	Critical facilities – flood audit and emergency action plans	13	53.85%	15.38%	7.69%	0.00%	0.00%	23.08%
A NEW STANDARD	Parks – acquisition and greenway plan	15	86.67%	6.67%	0.00%	0.00%	0.00%	6.67%
	Critical facilities – higher standards for new critical facilities	12	66.67%	8.33%	8.33%	0.00%	0.00%	16.67%

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 7: Emergency Services

Description: Develop and/or refine a flood response/preparedness method for servicing the community before and after flood related disasters.	Mitigation Projects:	Responses	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Create flood threat recognition system	14	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Flood warning	14	92.86%	0.00%	0.00%	0.00%	0.00%	7.14%
	Flood information and instructions	14	92.86%	0.00%	0.00%	0.00%	0.00%	7.14%
	Flood response actions and responsible parties	14	85.71%	0.00%	0.00%	0.00%	0.00%	14.29%
	Flood stage forecast map	14	85.71%	7.14%	0.00%	0.00%	0.00%	7.14%

Feedback Tool – Iteration 2

The Items from Iteration # 1 that received less than 50% support from residents were chosen to receive additional feedback. The following list of questions was developed to address these issues.

Item	*Mitigation Project*	*Central Concept*	*New Question*
1	Restrict all development entire floodplain	Uses in the floodfringe	1 - Should the flood plain be a special zoning district
2	Freeboard – additional height requirements above the BFE	Construction standards in floodplain	2 - Should the bulding standards for construction in the floodp[lain be strenthened
3	Higher standard for foundation protection	Construction standards in floodplain	
4	Count improvements cumulatively	Trigger for floodproofing requirements	3 - Should the limit for home improvements without flood proofing be strengthened
5	Lower threshold for substantial improvements	Trigger for floodproofing requirements	
6	Additions meet new standards	Trigger for floodproofing requirements	
7	Limit fill or buildings that displace floodwater in flood fringe	Flood water displacement	4 - Should the regulations limiting the displacement of floodwater be strefthened
8	Require hydrologically equivalent compensatory storage to replace fill	Flood water displacement	
9	Prohibit development entire floodplain	Development Resriction	5 - Should the Floodfringe be regulated as strictly as the floodplain
10	Require setbacks from enclosed drains in floodplains	Development Resriction	6 - Should State standards be enforced on entire floodplain
11	Increase stream buffer zone requirements	Development Resriction	7a - Should Steam buffers and setbacks be increased? 7b - Should buffers and setbacks be pplied to enclosed drains?
12	Structure Relocation	Voluntary Corrective Action	8 - Should the City support residents in pursuing voluntary corrective mitigation actions?
13	Property Acquisition	City Sponsored Corrective Action	9 - Should the City pursue corrective mitigation actions on public parcels if funding becomes available?
14	Structure Elevation	Voluntary Corrective Action	10 - Should the City activley aquire property in the floodplain
15	Install Protective Barriers	Voluntary Corrective Action	
16	Dry floodproofing of structures	Voluntary Corrective Action	
17	Wet floodproofing of stuctures	Voluntary Corrective Action	
18	Public property – flood audit & flood insurance	Public Risk	11 - Shoudld the City conduct a flood audit and insure public investments in the floodplain?
19	Critical facilities – flood audit and emergency action plans	Public Risk	

Feedback Tool – Iteration 2, Results.

Two additional questions were added to this list.

1. Should the City prohibit new structures in the floodway?
2. Should the City prohibit new structures in the entire floodplain?

The questions were also ordered subjectively from least restrictive to most restrictive.

The results for iteration #2 are presented below. The total responses are tabulated on the far left. The percentages are represented by color categorization for visual ease.

- Red = Greater than 50% support
- Dark Blue = 25-50% support
- Light Blue = 0-25% support
- Dark Grey = No Response or 0% support

Iteration # 2 Results:

Question to Address Resultsof Iteration #1	Responses by #						Responses by Percentage					
	Big Yes	Yes	Neutral	No	Big No	Total	Big Yes	Yes	Neutral	No	Big No	Total
1 - Should the City conduct a flood audit and insure municipal investments in the floodplain?	3	4	3	1	0	11	27%	36%	27%	9%	0%	100%
2 - Should the City support property owners in finding alternative funding sources for voluntary corrective mitigation actions?	7	1	2	1	0	11	64%	9%	18%	9%	0%	100%
3 - Should the City pursue corrective mitigation actions on municipal parcels (including public housing) if funding becomes available?	8	2	1	0	0	11	73%	18%	9%	0%	0%	100%
4 - Should the City actively acquire property in the floodplain for mitigation activities?	8	1	1	1	0	11	73%	9%	9%	9%	0%	100%
5 - Should the building standards for construction in the floodplain be strengthened?	8	2	1	0	0	11	73%	18%	9%	0%	0%	100%
6 - Should the regulations limiting the displacement of floodwater be strengthened?	9	2	0	0	0	11	82%	18%	0%	0%	0%	100%
7 - Should the limit for home improvements, or other building improvements without flood resistant construction be strengthened?	6	2	2	1	0	11	55%	18%	18%	9%	0%	100%
8 - Should stream buffers and setbacks be increased?	10	0	0	0	1	11	91%	0%	0%	0%	9%	100%
9 - Should stream buffers and setbacks be applied to enclosed drains?	8	1	1	1	0	11	73%	9%	9%	9%	0%	100%
10 – Should the City apply State standards to the entire floodplain?	9	1	0	0	1	11	82%	9%	0%	0%	9%	100%
11 - Should the flood fringe be regulated as strictly as the floodway?	4	3	2	1	1	11	36%	27%	18%	9%	9%	100%
12 - Should the floodplain be a special zoning district?	8	2	0	0	1	11	73%	18%	0%	0%	9%	100%
13 - Should the City prohibit new structures in the floodway?	10	0	0	0	1	11	91%	0%	0%	0%	9%	100%
14 - Should the City prohibit new structures in the entire floodplain?	4	3	3	0	1	11	36%	27%	27%	0%	9%	100%

The results of the feedback exercises assisted the planning team with the development of the recommendation strategies that were included in the plan. These results can also assist the Implementation committee with the task of prioritizing the project recommendations.

APPENDIX C – CATEGORY ADDRESS LIST EXPLANATION

ADDRESS LIST

The City of Ann Arbor has an address list for each of the properties identified in the vulnerability assessment based on the categories described in the risk analysis. In addition to maintaining a separate list for each category an additive vulnerability index for each property reflects the number of risk categories that affect each property. The list will be available for internal use only and is intended to serve as a tool to assist the implementation committee in identifying mitigation projects to pursue.