All-Hazards Plan for Baltimore City:
A Master Plan to Mitigate Natural Hazards

Prepared for the City of Baltimore by the City of Baltimore Department of Planning
Adopted by the Baltimore City Planning Commission
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Chapter One: Introduction

Like many other communities across the United States, the City of Baltimore has suffered the devastating effects of natural hazards. Weather and flooding events have caused extensive property damage, disrupted businesses and lives, and sometimes led to the loss of life. In fact, seven times over 25 years, natural hazard events caused damage enough to make the City of Baltimore eligible for Presidential disaster declarations.

In order to reduce the damages associated with natural hazards, the Federal Emergency Management Agency (FEMA) requires each local jurisdiction in the United States to adopt an all natural hazards mitigation plan to be eligible for disaster-related grants. Hazard mitigation is the process of developing strategies to reduce or eliminate the loss of life and property damage resulting from natural hazards. The hazard mitigation planning process entails engaging community resources for research, expertise, and input; assessing the potential losses hazards may inflict upon the community; developing strategies to address the identified risks; and implementing the plan. This All-Hazards Plan for the City of Baltimore provides a blueprint for the City to mitigate risks from hazards like flooding, high winds, and extreme heat.

Plan Contents

For approval by FEMA, this plan must meet four sets of criteria as outlined by 44 CFR Part 201—Mitigation Planning, Interim Final Rule. Following is a list of the ways the City of Baltimore has fulfilled the four major components:

- ***Documentation of the Planning Process***: FEMA guidelines require the City of Baltimore to follow a planning process that allows for public input during the creation of the All Hazards Plan, to adopt the plan, and to have it approved by the Maryland Emergency Management Agency (MEMA) and FEMA. The planning process must allow for public comment on the All-Hazards Plan prior to plan approval. The process must also include a review of existing studies, plans, and technical information.

  During development of the All Hazards Plan, staff of the City of Baltimore Department of Planning led the planning process and worked with the Local Emergency Planning Committee (LEPC). LEPCs have broad public participation as mandated by the Federal Government. Citizens, business representatives, community representatives, government agency representatives from the City, surrounding jurisdictions, the State of Maryland and the federal government, local colleges and universities, and a host of non-profit organizations serve on the LEPC, working to prevent emergencies and minimize their harm. Department of Planning staff involved the LEPC through presentations and facilitated discussions of the All-Hazards Plan at meetings in October 2003, and in February and November 2004. A list of LEPC members is found in Appendix B.

In November 2004, the City of Baltimore Planning Commission held its regular hearing in which adoption of the All Hazards Plan was an agenda item. The Commissioners and public were privy to a PowerPoint presentation that provided highlights of the All Hazards Plan, and the public was allowed an opportunity to comment on the plan at the hearing. There were no comments; the All Hazards Plan was adopted by the City of Baltimore Planning Commission and submitted to MEMA in February 2005. This revised plan represents an update to the adopted plan, incorporating changes suggested by MEMA during a preliminary, informal review. Every five years following its first adoption, Baltimore City's All Hazards Plan must go before the Planning Commission for review and approval, with any appropriate updates or changes. Details about the Planning Commission hearing are found in Appendix A.

In development of this All Hazards Plan, several existing studies, plans, and technical information were consulted. While there were many sources of information (these are cited at the end of each hazard profile or vulnerability assessment), the planning team relied on some texts more than others, specifically:

- The draft *Baltimore City Multi-Objective Floodplain Management Plan*, 2000, prepared by the City of Baltimore Department of Planning, the State of Maryland Department of Natural Resources, the National Oceanic and Atmospheric Administration, and MEMA.
- The *Flood Insurance Study, City of Baltimore Maryland, Independent City*, 1988, FEMA.
- The *Multi-Hazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy*, 1997, FEMA.
- The *State of Maryland Hazard Mitigation Plan*, September 2004, MEMA.

More details about the process used to develop the risk assessment are provided in the Chapters Two and Three.

- ***Risk Assessment***: FEMA guidelines require that the plan must identify hazards, profile hazards that affect the jurisdiction, and describe the jurisdiction's vulnerability to hazards that are a threat. The plan should also assess vulnerability by identifying susceptible structures, estimate potential losses to the extent possible, and analyze development trends.

  Chapter Two identifies the hazards that threaten the City of Baltimore and provides profiles of hazards that may occur in Baltimore. Chapter Three assesses the City's vulnerability to hazards of particular concern by identifying susceptible structures when possible and analyzing development trends. The draft *State of Maryland Hazard Mitigation Plan* supplies much of the hazard profiling and some of the vulnerability assessment information.

- ***Development of Mitigation Strategies***: FEMA guidelines require that local jurisdictions provide a blueprint for reducing potential losses to hazards. The strategy should list goals and a comprehensive range of mitigation actions for each hazard identified.

  Chapter Four explains the long-term mitigation goals, specific strategies for hazards of particular concern for the City of Baltimore, and an action plan for prioritizing and implementing the strategies. Strategies include practices already in place, recommendations for refining or expanding them, and suggestions for new ways to address harm from natural hazards.

- ***Plan Maintenance***: FEMA guidelines require that local mitigation plans describe how elements of the plan will be monitored, evaluated, and updated the mitigation plan within a five-year cycle.

  Chapter Five of the All Hazards Plan provides details about how the plan will be monitored, evaluated, and updated, including ways in which mitigation strategy elements will be incorporated into other planning mechanisms and ways the public will continued to be involved in the plan.

About the City of Baltimore

The City of Baltimore, Maryland is located on the eastern seaboard of the mid-Atlantic. Baltimore has a temperate climate and experiences all four seasons. The City is primarily urbanized, but has important natural assets including the Patapsco River, Gwynns Falls, Jones Falls, and other small streams, all of which are tributaries to the Chesapeake Bay. The City also has an excellent park system with protected, naturalized forests and habitat areas.

Figure 1: Baltimore's Inner Harbor, Downtown

The current population of Baltimore stands at approximately 651,000. Since the 1960's, Baltimore has lost about one-third of its population due to the urban ills that have affected many large cities. However, recent redevelopment activities focused on Baltimore's Inner Harbor have turned the trend. The City's economic activity has largely centered on waterfront development and redevelopment. Baltimore's waterfront includes a wide variety of land uses, including industrial, commercial, recreational, and residential development.

Figure 2: Historic Charles Village rowhouses

Baltimore has a rich historic fabric, and the City prides itself on being a national leader in historic preservation. In fact, Baltimore has 71 local and national historic preservation districts, comprised of 56,000 structures. These represent 20% of Baltimore's built environment--the highest number and largest percentage of historic structures of any city in the United States.

As Baltimore endeavors to expand its population, create a healthy economic environment, and preserve its natural assets and historic fabric, the City must also strive to protect its assets from the harmful effects of natural hazards.

Chapter Two: Natural Hazards in Baltimore City

Chapter Two profiles the natural hazards that may impact Baltimore City. The planning team explored the list of hazards used by FEMA and States to determine which of the following hazards may affect the City of Baltimore and whether the hazard will be included in the All Hazard Plan. The following table identifies whether the hazard will be covered in this Plan. Clearly, hazards that have occurred and have had significant impact in Baltimore City needed no further investigation and are included in the plan.

Table 1: Preliminary Investigation

Identified Hazard	Comments	Treatment in Plan
Avalanche	Lack of mountainous terrain makes hazard improbable in Baltimore City.	Not included in the plan
Coastal Erosion	Interview with the City's critical area program manager indicated that coastal erosion is not a problem. Much of the city's shorelines have been bulkheaded or do not have the wave action that lead to erosion.	Not included in the plan
Coastal Storm	Past experience has shown the hazard is a threat to Baltimore City.	Addressed in "Hurricane" hazard profile
Dam Failure	Baltimore City has several dams.	Addressed in "Flooding" hazard profile
Drought	Baltimore City has had recent experiences with drought.	Addressed in "Drought and Extreme Heat" hazard profile
Earthquake	Interview with Maryland Geological Survey indicated that hazard may affect Baltimore City.	Addressed in "Landslides and Earthquake" hazard profile
Expansive Soils	Interview with Maryland Geological Survey indicated that hazard does not significantly affect Baltimore City.	Not included in the plan
Extreme Heat	Past experience has shown the hazard may significantly affect Baltimore City.	Addressed in "Drought and Extreme Heat" hazard profile
Flood	Past experience has shown the hazard may significantly affect Baltimore City.	Addressed in "Flooding" hazard profile
Hailstorm	Past experience has shown the hazard may significantly affect Baltimore City.	Addressed in "Severe Thunderstorm" hazard profile
Hurricane	Past experience has shown the hazard may significantly affect Baltimore City.	Addressed in "Hurricane" hazard profile
Land Subsidence	Interview with Maryland Geological Survey indicated that hazard does not significantly affect Baltimore City.	Not included in the plan
Landslide/Land Slump	Interview with Maryland Geological Survey indicates that land slump may affect Baltimore City.	Addressed in Landslides and Earthquake section
Severe Winter Storm	Past experience has shown the hazard may significantly affect Baltimore City.	Addressed in "Severe Winter Storm" hazard profile

Table 1: Preliminary Investigation		
Identified Hazard	**Comments**	**Treatment in Plan**
Tornado	Past experience has shown the hazard may significantly affect Baltimore City.	Addressed in "Severe Thunderstorm" hazard profile
Tsunami	According to the FEMA publication *Understanding Your Risks,* tsunamis are not of great concern along the East Coast of the United States.	Not included in the plan
Volcano	Interview with Maryland Geological Survey indicated that hazard does not significantly affect Baltimore City	Not included in the plan
Wildfire	While Baltimore has some forests, they are not huge, uninterrupted tracts of wildland. Baltimore also does not have other elements that generate or spread wildfires, like arid climate, softwood/conifer trees, large expanses of steep slopes (>40%), or prolonged drought.	Not included in the plan
Windstorm	Past experience has shown the hazard may significantly affect Baltimore City.	Addressed in "Severe Thunderstorm" hazard profile

This All Hazards Plan will address the following natural hazards by analysis of impacts on Baltimore City and recommendations for mitigation strategies:

- Flooding (including Dam Failure and Sea Level Rise)
- Hurricanes and Tropical Storms
- Severe Thunderstorms (including Tornadoes, Severe Wind, and Hailstorms)
- Winter Storms
- Extreme Heat
- Drought
- Landslides and Earthquake

The federal government grants Presidential disaster declarations when hazard events overwhelm normal local and state resources to respond to them. Table 2 following lists the Presidential disaster declarations for natural hazard events that have occurred in the City of Baltimore.

Table 2: Federal Disaster Declarations for the City of Baltimore			
Type of Disaster	**Date**	**Type of Assistance**	**Federal Disaster Number**
Severe Storms and Flooding	1971-Aug-17	IA/PA	309
Tropical Storm Agnes	1972-Jun-23	IA/PA	341
Heavy Rains and Flooding	1975-Oct-04	IA/PA	489
Severe Storms, Tornadoes and Flooding	1979-Sep-14	IA/PA	601
Blizzard of 96	1996-Jan-11	PA	1081
Severe Winter Storm	2000-Apr-10	PA	1324
Severe Snowfall	2003-Mar-14	PA	3179

The table reveals that floods and winter storms have been the primary trigger of disaster declarations. However, hazard events can have harmful consequences whether or not they involve a federal declaration. These events can disrupt government and businesses; generate insurance payments for repair of structures, as well as for personal injury or loss of life; or can have substantial consequences for specific types of individuals or places within Baltimore – without the possibility of assistance from the federal government in the form of grants or loans for recovery.

Flood Hazard Profile

Flooding occurs when rivers, creeks, streams, ditches, or other water bodies receive too much water from rain or snowmelt. The excess water flows over adjacent banks into the adjacent floodplain (FEMA, *Managing Floodplain Development*, 6). As many as 85% of the natural hazard disasters across the United States have been attributed to flooding. In the City of Baltimore, flood origins include riverine flooding along stream tributaries to the Patapsco River, including the Gwynns Falls, the Jones Falls, and their tributaries, and tidal flooding in the Northwest Harbor and Middle Branch of the Patapsco River (FEMA, *Flood Insurance Study, City of Baltimore Maryland, Independent City*, 2).

Map Insert 1, Baltimore City Floodplain, depicts the 100- and 500-year floodplains within Baltimore City, as designated by the FEMA. The 100-year flood is a flood which has a 1.0% chance of being equaled or exceeded in equaled or exceeded in any given year; the 500-year flood relates to a flood with an approximate 0.2% chance of being equaled or exceeded (MDE, *Maryland Floodplain Manager's Handbook*). According to the *Flood Insurance Study*, riverine flooding in Baltimore City can be attributed to urbanization, which creates runoff from impervious areas and sharper flood peaks; stream channel encroachments, like structures in the floodplain, and undersized railroad and roadway bridges; inadequate storm sewer drainage; and along the City's waterfront, high tides that enhance high water events. Tidal flooding in Baltimore usually occurs as a result of nor'easters and hurricanes (see the Hurricane Hazard Profile, page 9). The flood maps indicate that some areas of tidal flooding also have high velocity flooding where floodwaters can move faster than 5 feet per second. High velocity flooding can exacerbate flood damage.

The City of Baltimore has had numerous incidents of flooding. While most incidents are the result of flash flooding from sudden, short-lived rainstorms and localized flooding resulting from poor drainage and stormwater management issues, the City has suffered several significant floods that have led to loss of life and significant damage. The *Flood Insurance Study* indicates that past major flood events occurred in 1817, 1837, 1863, 1868, 1933, 1955, 1972, and 1975. These floods have caused loss of life, damage to dwellings, industries, and infrastructure. In August 1817, flooding along the Jones Falls swept away houses, bridges, horses, and cattle. Floodwaters were reportedly between 12 and 20 feet above normal levels (*FIS*, 5). The flood of July 1868 caused the Jones Fall to rise 20 feet, claimed more than 50 lives, and caused millions in damages, hitting downtown Baltimore the hardest. A July 1923 storm caused even more damage than the 1868, and the flood of 1966 caused 39 fatalities ("Baltimore City Multi-Objective Floodplain Management Plan", 24).

Hurricanes and tropical storms have been sources of significant flood events. The storm of 1933 caused tides of 8.33 feet at Fort McHenry, inundating the downtown. Flooding from Tropical Storm Agnes in June 1972 stands as one of Maryland's greatest natural disasters. Flood peaks were in some areas twice the 100-year recurrence interval (Water Supply Paper 2375, National Water Summary 1988-89--Floods and Droughts: MARYLAND AND THE DISTRICT OF COLUMBIA, http://md.water.usgs.gov/publications/wsp-2375/md-dc/). Statewide, Agnes caused 43 million dollars in damages to public infrastructure and 66 million dollars damage to private property. Baltimore alone suffered 33.9 million dollars in losses (Baltimore City Multi-Objective Floodplain Management Plan, 25).

Figure 3: Lancaster Street, Fells Point after Hurricane Isabel, 2003

In the Fall of 2003, Hurricane Isabel hit Baltimore and produced what some have called the "perfect" 100 year flood, meaning that floodwaters reached depths predicted for 100 year floods. Because of Baltimore City's freeboard requirements, buildings with first floors at or above the 1' freeboard elevations did not sustain flooding, and only 16 flood insurance claims were filed.

Dam Failure

Dams are water storage, control, or diversion barriers that impound water upstream in reservoirs. Dam failure is a collapse or breach of the structure. While most dams have storage volumes small enough that failures have little or no repercussions, dams with large storage volumes can cause significant flooding.

Dam failures can result from any one or a combination of the following causes:

- Prolonged periods of rainfall and flooding, which cause most failures of dams in the U.S.
- Inadequate spillway capacity, resulting in excess overtopping flows.
- Internal erosion caused by embankment or foundation leakage or piping.
- Improper maintenance, including failure to remove trees, repair internal seepage problems, replace lost material from the cross section of the dam and abutments, or maintain gates, valves, and other operational components.
- Improper design, including the use of improper construction materials and construction practices.
- Negligent operation, including the failure to remove or open gates or valves during high flow periods.
- Failure of upstream dams in the same drainage basin.
- Landslides into reservoirs, which cause surges that result in overtopping.
- High winds, which can cause significant wave action and result in substantial erosion.
- Earthquakes, which typically cause longitudinal cracks at the tops of the embankments, leading to structural failure (see Earthquake Hazard Profile) (Multi-Hazard Identification and Risk Assessment).

The City of Baltimore Department of Public Works owns and maintains the seven public works dams around the City. All dams are earthen (one earthen with rockfill) and all but one are off-stream dams. The National Inventory of Dams, a database maintained by the U.S. Army Corps of Engineers, classifies one of these dams as low hazard, one as significant hazard, and five as high hazard dams. Low hazard potential dams are those where failure or improper operation would result in no probable loss of human life and low economic or environmental losses. Significant hazard potential dams are those where failure or improper would result in no probable loss of human life, but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns. High hazard potential dams are dams where failure or improper operation will likely cause loss of human life. Table 3 following details the dam names, related waterways, and hazard potential classification for dams found in Baltimore City.

Table 3: Baltimore City Dams by Waterway and Hazard Potential			
Dam Name	**Other Dam Name**	**Waterway**	**Hazard Potential Classification**
Peck s Branch Dam (Ashburton)	Wastewater Lake	Offstream-Gwynns Run	H
Montebello Waste Water Lake	Dam No. 1	Offstream-TR-Herring Run	L
Guilford Reservoir		Offstream-Stony Run	H
Lake Montebello		Offstream-Herring Run	S
Lake Ashburton		Gwynns Run	H
Druid Hill Lake		Offstream-Jones Falls	H
Hillen Road Water Supply Lake	Montebello Plant No. 2 Finished Water Reservoir	Offstream-Herring Run	H
National Inventory of Dams, http://crunch.tec.army.mil/nid/webpages/nid.cfm			

Stanford University maintains the National Performance of Dams Program database which documents dam incidents. Incidents are defined as events that affect the structural and functional integrity of dams, though not necessarily causing failure, and not including ordinary maintenance and repair, vandalism, acts of war, recreational accidents, or sabotage. The database has no record of dam incidents for dams in the City of Baltimore.

Sea Level Rise

Related to flooding is sea level rise. For many reasons worldwide, including the controversial "global warming," the level of water in oceans and seas has been rising. In the past 100 years, documentation exists that sea level in Baltimore has risen one foot. Recent research suggests that in the next 50 years sea levels in the Baltimore region could experience another foot of sea level rise.

Conclusion

Baltimore's extensive flood history and the existence of floodplains show that flooding is a significant hazard. Therefore, this plan will assess Baltimore's vulnerability to flooding in Chapter Three: Vulnerability Assessment.

Hurricanes

Figure __: Hurricane Isabel approaching the mid-Atlantic States

Hurricanes and tropical storms are types of large, intense storms called tropical cyclones—cyclonic, low-pressure systems originating over tropical or sub-tropical waters. Tropical cyclones with maximum sustained winds of more than 39 mph are considered tropical storms. Hurricanes have sustained winds of 74 mph or more.

As hurricanes and tropical storms near land, they bring torrential rains, high winds, storm surge inundation, coastal flooding, inland flooding, and sometimes, tornadoes. In Baltimore, hurricanes and tropical storms cause wind damage cause riverine flooding along tributaries, and inundate shorelines and harbors with storm surge. Storm surge is one of the most damaging features of hurricanes and tropical storms. Storm surges are large waves of ocean water that are pushed by strong winds across coastlines where a storm makes landfall. Storm surges are so damaging because they combine large amounts of water with movement and velocity.

Table 4 details the Saffir-Simpson Scale which categorizes the intensities of hurricanes based on their wind speed and expected storm surge in feet about normal sea level. The table demonstrates that the more intense the storm, the greater are the height of the surge and the damage to the shoreline and land. Map Insert 2, North Atlantic Tropical Storm and Hurricane Trajectories show the paths of hurricanes that have come near or affected the City of Baltimore.

Table 4: Saffir-Simpson Scale

Category	Wind Speed	Storm Surge	Expected Damage
1	74-95 mph	4-5 ft.	**Minimal**: Damage is done primarily to shrubbery and trees, unanchored mobile homes are damaged, some signs are damaged, no real damage is done to structures.
2	96-110 mph	6-8 ft.	**Moderate**: Some trees are toppled, some roof coverings are damaged, major damage is done to mobile homes.
3	111-130 mph	9-12 ft.	**Extensive**: Large trees are toppled, some structural damage is done to roofs, mobile homes are destroyed, structural damage is done to small homes and utility buildings.
4	131-155 mph	13-18 ft.	**Extreme**: Extensive damage is done to roofs, windows, and doors; roof systems on small buildings completely fail; some curtain walls fail.
5	>155 mph	>18 ft.	**Catastrophic**: Roof damage is considerable and widespread, window and door damage is severe, there are extensive glass failures, and entire buildings could fail.

Understanding Your Risks, FEMA 386-2, 2-23

Usually, significant hurricanes of Categories 3-5 subside as they reach the Mid-Atlantic, making extensive damage from very strong winds and storm surge unlikely. However, these storms often bring extreme amounts of rainfall which causes riverine and tidal flooding.

Table 5 depicts the tropical storms and hurricanes that have passed within 200 nautical miles of Baltimore City since 1950. Because hurricanes are sometimes hundreds of miles across, their effects can be felt far away. Hurricane Agnes in 1972 did not pass directly over Baltimore, but it is considered to be one of the most damaging hurricanes in Baltimore history.

Table 5: Tropical Storms and Hurricanes within 200 Nautical Miles of Baltimore City

Year	Month	Day	Storm Name	Wind Speed (KTS)	Category
1952	9	1	Able	35-40	Tropical Storm
1953	8	14	Barbara	65-70	Hurricane, Cat. 1
1954	8	31	Carol	85	Hurricane, Cat. 2
1954	10	15	Hazel	110	Hurricane, Cat. 3
1955	8	12	Connie	35-65	Hurricane, Cat. 1
1955	8	18	Diane	40-60	Tropical Storm
1955	9	19	Ione	60-65	Hurricane, Cat. 1
1959	7	10	Cindy	35-40	Tropical Storm
1960	7	30	Brenda	45-50	Tropical Storm
1960	9	12	Donna	90-95	Hurricane, Cat. 2
1961	9	14	Notnamed	35	Tropical Storm
1964	9	1	Cleo	35	Tropical Storm
1967	9	16	Doria	45-70	Hurricane, Cat. 1
1972	6	22	Agnes	45-60	Tropical Storm
1976	8	9	Belle	80-90	Hurricane, Cat. 2
1979	9	5	David	40	Tropical Storm
1979	9	14	Frederic	35	Tropical Storm
1981	6	30	Bret	50-60	Tropical Storm
1983	9	30	Dean	40-55	Tropical Storm
1985	9	27	Gloria	85-90	Hurricane, Cat. 2
1985	9	23	Henri	35-45	Tropical Storm
1986	8	18	Charley	60-70	Hurricane, Cat. 1
1991	8	19	Bob	100	Hurricane, Cat. 3
1992	9	25	Danielle	35-55	Tropical Storm
1996	7	13	Bertha	60-65	Hurricane, Cat. 1
1996	9	6	Fran	40	Tropical Storm
1997	7	24	Danny	40	Tropical Storm
1998	8	28	Bonnie	65-75	Hurricane, Cat. 1
1999	9	16	Floyd	50-70	Hurricane, Cat. 1
2000	9	23	Helene	35-45	Tropical Storm
2003	9	18	Isabel	50-85	Hurricane, Cat. 2

Table 5: Tropical Storms and Hurricanes within 200 Nautical Miles of Baltimore City					
Year	**Month**	**Day**	**Storm Name**	**Wind Speed (KTS)**	**Category**
2004	8	14	Charley	60	Tropical Storm
2004	8	31	Gaston	35	Tropical Storm
Historical Hurricane Tracks, Coastal Services Center, NOAA, http://hurricane.csc.noaa.gov/hurricanes/					

In the past 55 years, 33 hurricanes and tropical storms have passed within 200 nautical miles of Baltimore, an annual frequency of 0.6 cyclonic storms. In this time period, Baltimore did not suffer a direct hit by storms greater than a Category 1 hurricane. However, as noted in the Flooding section, storms like Hazel, Agnes, and Isabel have caused great amounts of flooding and damage.

Conclusion

Baltimore's extensive hurricane history and mapped hurricane inundation areas show that hurricanes are a significant hazard. Therefore, this plan will assess Baltimore's vulnerability to hurricanes in the flooding and high winds sections of Chapter Three: Vulnerability Assessment.

Severe Thunderstorms

Severe thunderstorms have many varied characteristics and may cause a wide range of damage. Severe thunderstorms hazards may include lightning, high winds and tornadoes, torrential rainfall, hail, and, in winter, snow and ice. Thunderstorms, and lightning associated with them, pose a regular hazard in Baltimore. Lightning strikes have killed and /or injured Baltimoreans and caused property damage throughout the years. In fact, a Department of Planning employee, Carl Ruskin, sadly was killed by a lightning strike while taking refuge in a former church structure at Leakin Park during a heavy thunderstorm.

While most thunderstorms are not notable and do not cause severe damage, three types or elements of severe thunderstorms cause particular concern in Baltimore—tornadoes, windstorms, and hailstorms.

Tornadoes

A tornado is a violent atmospheric disturbance characterized by one or more twisting and funnel-shaped clouds. Spawned by powerful thunderstorms or hurricanes, tornadoes are produced when a southwesterly flow of warm, moist air combines with both northwesterly and southwesterly flows of cool, dry air, forcing the warm air to rise rapidly. Most damage results from high wind velocity and wind-blown debris.

Tornado season is generally March through August, although tornadoes can occur at any time of the year. More than 80 percent of tornado strikes are between noon and midnight. Depending on the intensity and size of the tornado, damage can range from broken tree limbs and downed power lines to the destruction of houses, businesses and life. Tornadoes account for an average of 70 fatalities and 1500 injuries nationwide each year.

Tornadoes are measured according to their wind speed on the Fujita scale, shown in Table 6. These precise wind speed numbers are actually hypothesized and have never been scientifically verified. Different wind speeds may cause similar-looking damage from place to place or even from building to building. Without a thorough engineering analysis of tornado damage in any event, the actual wind speeds needed to cause that damage are unknown.

Tornado winds can uproot trees, carry debris, damage buildings, destroy roadways and bridges, cause power outages, contaminate water supplies, cause structure fires, disrupt delivery of essential services, and prevent rescue personnel from reaching injured people in a timely manner (New York City Draft All-Hazards Mitigation Plan).

Table 6: Fujita Tornado Intensity Scale

Category	Wind Speed	Examples of Possible Damage
F0	Gale Tornado (40 – 72 mph)	**Light damage**. Some damage to chimneys; break branches off trees; push over shallow-rooted trees; damage to sign boards.
F1	Moderate Tornado (73 – 112 mph)	Moderate damage. The lower limit is the beginning of hurricane wind speed; peel surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads.
F2	Significant Tornado (113 – 157 mph)	**Considerable damage**. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
F3	Severe Tornado (158 – 206 mph)	**Severe damage**. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; cars lifted off ground and thrown.
F4	Devastating Tornado (207 – 260 mph)	**Devastating damage**. Well-constructed houses leveled; structure with weak foundation blown off some distance; cars thrown and large missiles generated.
F5	Incredible Tornado (261 – 318 mph)	**Incredible damage**. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile-sized missiles fly through the air in excess of 100 yards; trees debarked; incredible phenomena will occur.

FEMA, *Understanding Your Risks: Identifying Hazards and Estimating Losses*, 2-21

Baltimore has had a number of tornado incidents:

- May 6, 1937 at 1245 hours EST, a F1 tornado struck along Northern Parkway in Hamilton in Northeast Baltimore. The tornado was observed. It unroofed a building and ripped slate from another. It blew down a large trellis. Damage was less than $1000.

No one was injured. The damage path 0.2 miles long and 35 yards wide (Lat./Long. = …)

- May 26, 1937 at 1620 hours EST, a F1 tornado struck Baltimore damaging trees in Clifton and Patterson Parks. The funnel cloud was observed. It unroofed and damaged homes, unroofed two water towers, demolished sheds, damaged cars, and blew down utility poles. Damage was estimated at $53,000. No one was injured. (Lat./Long. = 38.°N/76.°W)
- August 26, 1946 at 1528 hours EST, a F0 tornado/waterspout was observed 4-6 miles southeast of the Weather Bureau Office in Baltimore. The tornado moved inland a short distance from the Harbor doing slight damage to East Baltimore and dissipated as it approached Dundalk. Damages were less than $1,000. (Lat./Long. = unavailable)
- June 16, 1973 at 1650 hours EST, a F2 tornado struck the Towson area. Its track details are unknown at this time. The tornado tore off an apartment roof, overturned cars and uprooted trees. Funnels were also seen in Gamber and DC on that day. There were no fatalities, but four people were injured. Damage amounts were estimated at $50,000. (Lat./Long. = 39.20/76.35)
- June 8, 1990 at 1735 EST, a F0 tornado struck. Its path was 0.3 miles long and 40 yards wide. No one was injured. No details at this time. Damages were estimated at $3, 000. (Lat./Long. = 39.35/76.37)
- October 18, 1990 at 1530 hours EST, a F2 tornado struck the Reisterstown area. The damage path was 0.1 miles long and 100 yards wide. It was the fourth tornado spawned by the same thunderstorm that moved northeast out of Virginia. No one was killed but 59 people were injured, mostly at an apartment complex in Reisterstown where the roof was torn off along with some of the facing damaging 150 units. Cars were overturned and an additional 52 homes sustained damage. Total losses were estimated at $9.5 million. (Lat./Long. = 39.28/76.49)
- October 18, 1990 at 1549 hours EST, a F1 tornado was spawned by the same storm. The damage path was 0.1 miles long and 30 yards wide. There were no injuries. No details at this time. Damages were estimated at $100,000. (Lat./Long. = 39.32/76.39)
- November 1, 1994 at 1415 hours EST, a F1 tornado struck the center of Baltimore just west of I-83 and north of Camden Yards. The damage path was 1.5 miles long and 220 yards wide. There were no injuries. Damage occurred to rowhouses and trees. The tornado clipped one school with only minor damage. Damage amounts were estimated at $500,000. (Lat./Long. = 39.27/76.38)
- November 1, 1994 at 1420 hours EST, a second F1 tornado struck the center of Baltimore east of the first one. It touched down east of I-83 and north of the Harbor. The damage path was 0.7 miles long and 210 yards wide. There were no injuries. Tornadoes were spawned by a bow-echo thunderstorm. Damage occurred to rowhouses and trees. Damage amounts were estimated at $1,000,000. (Lat./Long. = 39.27/76.37)
- July 19, 1996 at 1530 hours EST, a F0 tornado touched down twice in Baltimore City. Each touch down was brief producing a swirl of dust, dirt, trash, etc. One was in the

north central part of the city and the other in the east central part. The touch downs were observed and the funnels were caught on film. No mentionable damage was reported with them. This was the tail end of a tornadic outbreak from this supercell. (Lat./Long. = unavailable)

Baltimore's tornadic history suggests that on average, the Baltimore region experiences 0.1 tornado incident per year.

Windstorms

In the mainland United States, the mean annual wind speed is reported to be 8 – 12 mph, with frequent speeds of 50 mph and occasional wind speeds of greater than 70 mph. In coastal areas from Texas to Maine, tropical cyclone winds may exceed 100 mph. In the mid-Atlantic, high wind speeds are generally produced by severe thunderstorms and tropical storms/hurricanes. The most severe windstorms may produce tornadoes (FEMA, *Multi-Hazard Identification and Risk Assessment*,).

According to the National Climatic Data Center, there have been 64 incidents of thunderstorm and high wind events reported from 1950 through May 2005 in Baltimore City. Of those events for which wind speed was reported, the average wind magnitude was 56.7 knots, or 65.3 miles per hour. Damage for these events was generally less than $20,000, although an August 3, 2002 event stands out with property damage estimated at $100,000. In this storm, downed trees toppled power lines and one tree fell on a car. Minor structural damage (shingles and gutters) was also sustained to some houses in the Patterson Park area.

Wind hazards also occur in the form of other natural events described in this plan, most notably, hurricanes (see Hurricane Hazard Profile, p. 9).

Hail

Hail is a large frozen raindrop produced by intense thunderstorms, where snow and rain can coexist in the central updraft. As the snowflakes fall, liquid water freezes onto them forming ice pellets that will continue to grow as more and more droplets are accumulated. Upon reaching the bottom of the cloud, some of the ice pellets are carried by the updraft back up to the top of the storm. As the ice pellets once again fall through the cloud, another layer of ice is added and the hail stone grows even larger. Typically the stronger the updraft, the more times a hail stone repeats this cycle and consequently, the larger it grows. Once the hail stone becomes too heavy to be supported by the updraft, it falls out of the cloud toward the surface. The hail stone reaches the ground as ice since it is not in the warm air below the thunderstorm long enough to melt before reaching the ground (University of Illinois WW2010 Project, http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/cld/prcp/rnhl.rxml)

Winter Storms

Winter storms are large storms occurring during the cold, winter months. Winter storms may be characterized by a number of hazardous conditions, including extreme cold, heavy snow, freezing rain, sleet, high winds, and sometimes lightning. Blizzards are intense winter storms that combine high winds, heavy snowfall, ice storms, and extreme cold. While winter storms are expected, annual events and the City of Baltimore budgets for and prepares for snow removal activities each year, winter storms are sometimes of such magnitude as to overwhelm City resources to respond to them. In severe storms, ice-coated powerlines may cause power outages, icy and snow-covered streets lead to numerous auto accidents, and people may suffer severe injuries from falls on slippery sidewalk and pavement. Winters with several winter storms or extreme cold can also tax the energy supply, making heating bills very expensive. In short, winter storms may significantly disrupt the ability for the City and its residents to carry on regular activities. For many vulnerable populations in Baltimore, snow and ice pose a particular hazard. Inability to access vital medical services such as dialysis treatment; heart attacks from overwork when clearing a sidewalk; and being or feeling trapped indoors by those who are less mobile, have chronic illnesses or age-related limitations on meeting their personal needs during times of winter storms.

Over the past decade, Baltimore City has had several strong winter storms that have disrupted regular activities, caused innumerable auto accidents, and caused power outages. Normally, Baltimore receives approximately 21.1 inches of snowfall on average annually. In many of the storms listed below in Table 7, which shows significant winter storms, the region received more than the annual snowfall in one storm event.

Table 7: Significant Winter Storms in Baltimore MD, 1892-2003

Date	Inches of Snow and Ice
March 15-18, 1892	16.0 inches
February 11-14, 1899	21.4 inches
February 16-18, 1900	12.0 inches
January 27-29, 1922	26.5 inches
March 29-30, 1942	22.0 inches
February 15-16, 1958	15.5 inches
December 11-12, 1960	14.1 inches
March 5-7, 1962	13.0 inches
January 30-31, 1966	12.1 inches
February 18-19, 1979	20.0 inches
February 11-12, 1983	22.8 inches
January 22, 1987	12.3 inches
January 7-8, 1996	22.5 inches
January 25, 2000	14.9 inches
February 15-18, 2003	28.2 inches

National Weather Service, www.nws.noaa.gov/er/lwx/winter/storm%2Dpr.htm

In the winter storm of 2003, more than 26 inches of snow fell on the City of Baltimore. Snow and debris removal cost the city about $3 million. The City of Baltimore received Presidential disaster declarations for storms in 1996, 2000, and 2003.

Conclusion

Baltimore has had many experiences with winter storm. However, because winter storms have a broad impact, determining the costs of damage and response activities is difficult. Therefore, winter storms will be covered briefly in Chapter Three: Vulnerability Assessment.

Extreme Heat

Summers in Baltimore are known for their frequent high temperatures joined on too many occasions by high humidity. Extreme heat in areas with dense development as is typical of Baltimore City poses a threat to life and even, on occasion, damage to transportation and other infrastructure. While air conditioning in buildings is far more common today than in past years, Baltimore has residents who cannot afford to air condition their homes or choose not to do so (or to provide effective alternate means of cooling their homes). Baltimore's prototype row house can become extremely hot during times of 90+ degree days and nights. Older residents remember sleeping out on rooftops or in City parks to obtain relief from the heat. Today these options are seen by most residents in most of Baltimore as unsafe. Workers may also be forced to toil in areas with high temperatures either outside or not relieved inside buildings.

Central Baltimore is highly urbanized, with few large expanses of green spaces and trees to help cool the environment. As a result of these large, uninterrupted stretches of hardscape (sidewalks, buildings, streets, etc.) the temperature in Baltimore City is sometimes several degrees hotter than surrounding areas and particularly hot in central Baltimore.

Conclusion

Nearly every summer Baltimore has an extreme heat event, meaning that extreme heat is a significant hazard in Baltimore. Therefore, this plan will assess Baltimore's vulnerability to extreme heat in Chapter Three: Vulnerability Assessment.

Droughts

Droughts simply are extended periods of dry weather. Drought is a normal part of virtually all climatic regimes, including areas with high or low average rainfall. Drought is the consequence of a natural reduction in the amount of precipitation over an extended period of time, usually a season or more in length. They may differ greatly in their extent, duration, severity, and impact. These differences make quantitative analyses and comparisons among droughts difficult. A drought can affect many states and last 10-15 years. However, a drought affecting one or two counties and lasting 3-6 months may be more devastating locally. Droughts may be classified as meteorological, hydrologic, agricultural, and socioeconomic. Table 8 presents definitions for these different types of droughts:

Table 8: Drought Classification Definitions	
Term	**Definition**
Meteorological Drought	The degree of dryness or departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.
Hydrologic Drought	The effects of precipitation shortfalls on streamflows and reservoir, lake, and groundwater levels.
Agricultural Drought	Soil moisture deficiencies relative to water demands of plant life, usually crops
Socioeconomic Drought	The effect of demands for water exceeding the supply as a result of a weather-related supply shortfall.
Multi-Hazard Identification and Risk Assessment, FEMA	

While occurring less frequently in Baltimore City than in some other jurisdictions across Maryland, meteorological and hydrologic droughts are natural hazards that pose major issues for the City and regional water supply. Such droughts may lead to socioeconomic droughts in which the City's ability to deliver water to the residents, businesses, and other concerns that depend upon them is affected. Baltimore provides public water to areas outside the City's boundaries; therefore the impact of drought may greatly limit available water supplies to the City and surrounding counties. Only once in recent years has City government been forced to impose water rationing requirements on households; limits on car washing and other commercial/ institutional uses have been imposed more often. Agriculture is generally the first and hardest hit of industries in droughts; however, Baltimore does not have an agriculture industry to support.

A drought analysis summary for Maryland is presented in Table 9.The table also indicates for each dry period the recurrence interval -- the average interval of time within which streamflow will be less than a particular value. The U.S. Geological Survey (USGS) determined annual departures from average streamflow and assigned recurrence intervals to droughts by using data from gaging stations. The USGS found four droughts of significant extent and duration: 1953-56, 1958-71, 1980-83, and 1984-88. The 1930-32 drought was likely the most severe agriculture drought ever recorded in Maryland. Rainfall during that period was about 40 percent less than average. The year 1930 was the driest year since 1869. Crop losses for 1930 were estimated at $40 million (U.S. Weather Bureau, 1930, v. 35, no.13).

Table 9. Chronology of major and other memorable droughts in Maryland, 1889-1988.				
Drought	**Date**	**Area affected**	**Recurrence interval in years**	**Remarks**
Drought	1930-32	Statewide.	>25	Regional drought. Estimated crop losses in 1930, $40 million.
Drought	1953-56	Statewide.	10 to >25	Regional.
Drought	1958-71	Statewide	>25	Regional.
Drought	1980-83	Statewide, except for western	10 to 25	Multistate.
Drought	1984-88	Monocacy River basin, east of Baltimore, and Chesapeake Bay	10 to 25	Estimated agricultural losses for 1986-88, $302 million.
U.S. Geological Survey Water-Supply Paper 2375; *National Water Summary 1988-89--Floods and Droughts: MARYLAND AND THE DISTRICT OF COLUMBIA*; http://md.water.usgs.gov/publications/wsp-2375/md-dc/				

Droughts have occurred about once every 10 years since 1930 but differed in severity and duration. The 1953-56 drought had recurrence intervals of 10-25 years, except for the area north and east of Baltimore where recurrence intervals were less than 10 years.

From 1958 through 1971, a regional drought having recurrence intervals greater than 25 years caused streamflow deficiencies throughout Maryland. This drought persisted the longest of the four droughts and was the most severe in terms of annual departure from average streamflow.

Conclusion

While droughts can disrupt residents', businesses', and governments' normal activities, droughts do not have the economic impact in urban areas as in agricultural areas. Determining the costs of reducing water consumption and other drought-response activities is very difficult. For these reasons, drought will not be addressed in the vulnerability assessment in Chapter Three.

Earthquake and Land Movement

Earthquakes are sudden movements or trembling of the earth caused by an abrupt release of accumulated strain on the tectonic plates that comprise the Earth's crust. As tectonic place move, they bump, slide, catch, and hold against each other. Eventually, faults along or near plate boundaries slip abruptly when the stress exceeds the elastic limit of the rock, and an earthquake occurs. The motion creates surface faulting, ground failure, and along coasts, tsunamis.

Table 10 below shows one measure of earthquake intensity, the Modified Mercalli Intensity (MMI)scale. Map Insert 3, Earthquakes in the State of Maryland, displays the locations of earthquake epicenters by Modified Mercalli Intensity through December 2002 in Maryland. While none occurred in the City of Baltimore, strong earthquakes are capable of being felt sometimes hundreds of miles away. The strongest earthquake in the Baltimore region measured five on the MMI scale. At this level earthquakes are felt by nearly everyone within 30 miles; many people are frightened enough to run outdoors. Also, some heavy furniture may be moved, plaster may fall, and chimneys may be damaged.

TABLE 10. The Modified Mercalli Intensity Scale of 1931 (abridged).

Intensity	Experience
I	Not felt except by very few people under especially favorable conditions.
II	Felt by a few people, especially those on upper floors of buildings. Suspended objects may swing.
III	Felt quite noticeably indoors. Many do not recognize it as an earthquake. Standing motorcars may rock slightly.
IV	Felt by many who are indoors; felt by a few outdoors. At night, some awakened. Dishes, windows and doors rattle.
V	Felt by nearly everyone; many awakened. Some dishes and windows broken; some cracked plaster; unstable objects overturned.
VI	Felt by everyone; many frightened and run outdoors. Some heavy furniture moved; some fallen plaster or damaged chimneys.
VII	Most people alarmed and run outside. Damage negligible in well constructed buildings; considerable damage in poorly constructed buildings.
VIII	Damage slight in special designed structures; considerable in ordinary buildings; great in poorly built structures. Heavy furniture overturned. Chimneys, monuments, etc. may topple.
IX	Damage considerable in specially designed structures. Buildings shift from foundations and collapse. Ground cracked. Underground pipes broken.
X	Some well-built wooden structures destroyed. Most masonry structures destroyed. Ground badly cracked. Landslides on steep slopes.
XI	Few, if any, masonry structures remain standing. Railroad rails bent; bridges destroyed. Broad fissure in ground.
XII	Virtually total destruction. Waves seen on ground;objects thrown into the air.
Earthquake Fact Sheet, MGS, www.mgs.md.gov/esic/brochures/earthquake.html,	

Compared to other parts of the United States, the Baltimore region has relatively low probability of strong earthquakes. Figure 5 following shows the expected maximum horizontal ground acceleration (%g) or ground shaking with a 2% chance of being exceeded in 50 years. The Baltimore region has an expected peak acceleration of 8%g. At this level, according to Table 11, any potential damage is expected to be very light (Earthquake Fact Sheet, MGS, www.mgs.md.gov/esic/brochures/earthquake.html, www.mgs.md.gov/esic/fs/fs13.html).

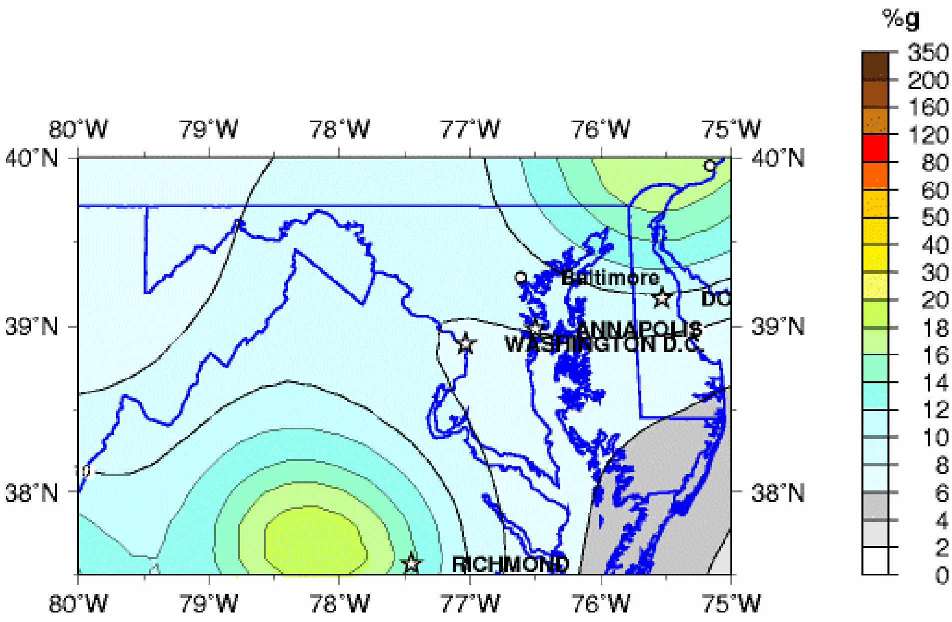


Figure 5: Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years, National Seismic Hazard Mapping Project; cited in Earthquake Fact Sheet, MGS, www.mgs.md.gov/esic/brochures/earthquake.html, www.mgs.md.gov/esic/fs/fs13.html

Table 11: Approximate relationships among earthquake magnitude, intensity, worldwide occurrence, and area affected

General Description	Richter Magnitude	MMI	Expected Annual Incidence	Distance Felt (miles)
Microearthquake	below 2.0	--	600,000	--
Perceptible	2.0-2.9	I--II	300,000	--
Felt generally	3.0-3.9	II-III	49,000	15
Minor	4.0-4.9	IV-V	6,000	30
Moderate	5.0-5.9	VI-VII	1,000	70
Large (Strong)	6.0-6.9	VII-VIII	120	125
Major (Severe)	7.0-7.9	IX-X	18	250
Great	8.0-8.9	XI-XII	1.1	450

The phenomena of landslides and land slumping can be factors that exacerbate the occurrence of earthquakes. Land slides and slumping most often involve steep slopes, karst terrain, or otherwise unstable land. Landslides occur when steep slopes greater than 15% become unstable due to a combination of unstable soil or rock, lack of vegetation, rain, or earthquake. The Maryland Geological Survey does not consider Baltimore to have a significant risk of landslide because of the lack of mountainous areas. While there are some steep slopes, particularly near streams, these slopes are usually vegetated and stable and unlikely to be factors in the minor earthquakes that occur in the Baltimore region.

The Maryland Geological Survey does caution, however, that land slumping could be a significant hazard in Baltimore in the event of a major earthquake. Downtown Baltimore is constructed upon a considerable amount of artificial fill, deposited there as a way to dispose of debris after the Great Fire of 1904. Scientists at MGS theorize that were a severe earthquake to occur in or near Baltimore, many structures located on the fill could suffer significant damage. The MGS has partnered with FEMA to map the fill in Baltimore and determine the potential risk to the built environment. The results of the study are not yet available.

Conclusion

While the MGS and FEMA are studying Baltimore's risk to land slump and earthquake, past experiences and existing research show that Baltimore has not had and is not expected to have significant damage from land movement or earthquake events. For this reason, land movement and earthquake will not be addressed in Chapter Three: Vulnerability Assessment.

Chapter Three: Vulnerability Assessment

Chapter Three provides descriptions of how the hazards profiled in Chapter Two may affect the City of Baltimore, and when possible, provides estimates of structures, critical facilities, or vulnerable populations threatened by hazards. For hazards with a geographic extent, a series of GIS maps will illustrate the potential vulnerability.

Flooding Vulnerability Assessment

Flooding is by far Baltimore's most problematic hazard. Not only have 100-year and greater floods caused millions of dollars in damages over the years, but also localized flooding have caused damage and disrupted lives. Following is an estimate of the number of structures vulnerable to 100-year flooding. These structures exist in the 100-year floodplain which is regulated by federal, state, and local laws. The following tables provide details of the numbers of properties by land use in the 100-year floodplain and floodways (floodplain counts are inclusive of floodway properties).

Table 12: Parcels in the Floodplain by Land Use and Year of Improvement			
Land Use	**Total**	**Before or in 1988**	**After 1988**
Business/Industrial Park	9	9	0
Cemetery	5	5	0
General Commercial	232	213	19
Shopping Center	11	11	0
High Density Mixed Use	48	45	3
Moderate Density Mixed Use	19	18	1
Industrial	268	257	11
Maritime Industrial	146	131	15
High Density: Residential	42	42	0
Medium Density: Garden Apts.	51	51	0
Medium Density: Traditional	512	400	112
Low Density: Residential	334	330	4
Parks/Recreation	208	206	2
Private/Institutional Facilities	140	138	2
Public/Institutional Facilities	113	98	15
Railroad	76	74	2
Transportation ROW	78	77	1
Undeveloped	121	119	2
Total	**2413**	**2224**	**189**

Table 13: Parcels in the Floodway by Land Use and Year of Improvement			
Land Use	**Total**	**Before or in 1988**	**Built after 1988**
Business/Industrial Park	5	5	0
Cemetery	4	4	0
General Commercial	40	38	2
Shopping Center	0	n/a	n/a
High Density Mixed Use	0	n/a	n/a
Moderate Density Mixed Use	0	n/a	n/a
Industrial	72	68	4
Maritime Industrial	0	n/a	n/a
High Density: Residential	2	2	0
Medium Density: Garden Apts.	31	31	0
Medium Density: Traditional	70	70	0

Table 13: Parcels in the Floodway by Land Use and Year of Improvement			
Land Use	**Total**	**Before or in 1988**	**Built after 1988**
Low Density: Residential	188	187	1
Parks/Recreation	130	128	2
Private/Institutional Facilities	33	33	0
Public/Institutional Facilities	10	10	0
Railroad	33	32	1
Transportation ROW	41	40	1
Undeveloped	77	75	2
TOTAL	**736**	**723**	**13**

Map Inserts 4 and 5 outline Baltimore City's 100-year floodplains and floodways and the land uses within each. The maps were created using FEMA's Q3 digitized floodplain maps and Baltimore City's base maps using GIS. The historic City of Baltimore has a great number of parcels in the floodplain and floodway. Most of these parcels, in such historic neighborhoods as Fells Point, Canton, Inner Harbor, and Woodberry, have structures built before floodplain regulations went into effect. Citywide, about 2% of parcels are located in the floodplain. Industrial and commercial uses in the floodplain also suggest the possibility of hazardous materials being stored in the floodplain.

Table 12, Parcels in the Floodplain by Land Use and Year of Improvement, shows that the vast majority of properties in the floodplain and floodway were improved in 1988 or before (this category includes properties for which there is no construction date). One hundred eighty-nine properties in the floodplain have construction dates since 1988, the date of the FEMA's Flood Insurance Rate Maps (FIRMs). When determining vulnerability to flood loss, it is assumed that structures built after 1988 have less susceptibility to flooding since first flood elevations will have been constructed above the base flood elevation. Furthermore, Baltimore has a one-foot freeboard requirement in effect, further protecting these structures from flood damage.

Table 13, Parcels in the Floodway by Land Use and Year of Improvemen,t shows that there are seven properties in the floodway. The National Flood Insurance Program (NFIP) regulations prohibit structures being constructed in the floodway. Because of the inaccuracy of Q3 geographic information systems (GIS) layers (FEMA advises that they should only be used for planning purposes) and the fact that these represent parcels, not primary building locations about which the NFIP is mainly concerned, it cannot be determined whether these structures are truly in the floodway. The Baltimore City Department of Planning is developing Digital Flood Insurance Maps (DFIRMs) which, when complete, will provide a more accurate picture of vulnerability in the floodplain and floodway.

In order to conduct an accurate dollar loss estimate for flooding, it is necessary to know for each structure the first floor elevation and replacement costs, calculated with such information as construction materials and square footage. Because such specific information about the properties identified in the tables above is not available, it is impossible to develop an accurate loss estimation. However, using very broad assumptions suggested by FEMA's risk assessment guide *Understanding Your Risks: Identifying Hazards and Estimating Losses* about replacement costs and local knowledge about the size of structures, and assumed depth of flooding, it is possible to develop a general idea about the magnitude of potential losses within the 100-year floodplain. Loss estimates will not be generated for the following land uses: cemeteries, parks/recreation, railroad, transportation right-of-way, and undeveloped land.

The following tables detail the potential losses to structures built before 1988 in the floodplain (excepting those in the floodway) and in the floodway. The analysis assumes that no floodproofing methods are in place, that there is a two-foot flood depth for structures in the floodplain and a four-foot flood depth for structures in the floodway.

Table 14: Estimate of Losses to Structures Built before 1988 in the 100-Year Floodplain

Land Use (Number of Parcels)	# parcels	Assumed sq. ft.	Assumed Building Type	Replacement cost/sq. ft.	Total Replace-ment Cost	% Loss	Total Losses
Business/ Industrial Park	4	200,000	2 stories, no basement	$87	$69,600,000	13%	$9,048,000
General Commercial	175	12,000	1 story, no basement	$87	$182,700,000	22%	$40,194,000
Shopping Center	11	150,000	1 story, no basement	$67	$110,550,000	22%	$24,321,000
High Density Mixed Use	45	250,000	several stories	$90	$1,012,500,000	1%	$10,125,000
Moderate Density Mixed Use	18	100,000	2 stories, no basement	$90	$162,000,000	13%	$21,060,000
Industrial	189	50,000	2 stories, no basement	$69	$652,050,000	13%	$84,766,500
Maritime Industrial	131	150,000	2 stories, no basement	$69	$1,355,850,000	13%	$176,260,500
High Density: Residential	40	250,000	several stories	$98	$980,000,000	1%	$9,800,000
Medium Density: Garden Apts.	20	100,000	1 or 2 stories, with basement	$98	$196,000,000	20%	$39,200,000
Medium Density: Traditional	330	1,200	1 or 2 stories, with basement	$77	$30,492,000	20%	$6,098,400

Low Density: Residential	143	2,000	1 or 2 stories, with basement	$77	$22,022,000	20%	$4,404,400
Private/Institutional Facilities	105	500,000	several stories	$145	$7,612,500,000	1%	$76,125,000
Public/Institutional Facilities	88	150,000	1 or 2 stories, with basement	$88	$1,161,600,000	20%	$232,320,000
Total							**$733,722,800**

Table 15: Estimate of Losses to Structures Built before 1988 in the Floodway

Floodway Disaster Area (Number of Parcels)	# parcels	Assumed sq. ft.	Assumed Building Type	Replacement cost/sq. ft.	Total Replacement Cost	% Loss	Total Losses
Business/ Industrial Park	5	200,000	2 stories, no basement	$87	$87,000,000	20%	$17,400,000
General Commercial	38	12,000	1 story, no basement	$87	$39,672,000	29%	$11,504,880
Shopping Center	0	150,000	1 story, no basement	$67	$0	29%	$0
High Density Mixed Use	0	250,000	several stories	$90	$0	2%	$0
Moderate Density Mixed Use	0	100,000	2 stories, no basement	$90	$0	20%	$0
Industrial	68	50,000	2 stories, no basement	$69	$234,600,000	20%	$46,920,000
Maritime Industrial	0	150,000	2 stories, no basement	$69	$0	20%	$0
High Density: Residential	2	250,000	several stories	$98	$49,000,000	2%	$980,000
Medium Density: Garden Apts.	31	100,000	1 or 2 stories, with basement	$98	$303,800,000	28%	$85,064,000
Medium Density: Traditional	70	1,200	1 or 2 stories, with basement	$77	$6,468,000	28%	$1,811,040
Low Density: Residential	187	2,000	1 or 2 stories, with basement	$77	$28,798,000	28%	$8,063,440
Private/ Institutional Facilities	33	500,000	several stories	$145	$2,392,500,000	2%	$47,850,000
Public/Institutional Facilities	10	150,000	1 or 2 stories, with basement	$88	$132,000,000	28%	$36,960,000

Total							$256,553,360

The tables above do not estimate other essential elements of flood loss estimates, like loss to contents, displacement costs or functional downtime costs. For all parcels in the floodplain and floodway, potential losses are nearly $1 billion. While the tables provide a very broad illustration of potential losses, they do demonstrate the seriousness of a wide-spread 100-year flood event. Furthermore, dam failure could also cause or exacerbate flooding to nearby developed areas, and future sea level rise could increase flood depths, thereby increasing losses.

Map Insert 6 shows the hurricane inundation areas for Baltimore City by land use. The map shows that a Category 4 hurricane has the potential to inundate a significant portion of harbors. Baltimore's harbors are the life-blood of the City, where industrial, commercial, and residential development has increased in recent years. Below is a table of the parcels by land use that fall within predicted hurricane inundation areas.

Table 16: Parcels within Hurricane Inundation Zones

	Category 1			Category 2			Category 3			Category 4		
Hurricane Inundation by Land Use (Number of Parcels)	**Total**	**Built in 1988 and before or no date**	**Built after 1988**	**Total**	**Built in 1988 and before or no date**	**Built after 1988**	**Total**	**Built in 1988 and before or no date**	**Built after 1988**	**Total**	**Built in 1988 and before or no date**	**Built after 1988**
Business/Industrial Park	0	0	0	0	0	0	0	0	0	13	4	2
General Commercial	90	80	10	233	214	19	233	214	19	401	345	23
Shopping Center	12	9	3	12	9	3	12	9	3	22	10	6
High Density Mixed Use	17	16	1	40	38	2	40	38	2	113	41	3
Moderate Density Mixed Use	13	13	0	18	17	1	18	17	1	19	18	1
Industrial	68	63	5	158	149	9	166	157	9	395	277	19
Maritime Industrial	121	108	13	174	157	17	193	176	17	420	245	24
High Density: Residential	25	25	0	32	32	0	32	32	0	45	34	0

Table 16: Parcels within Hurricane Inundation Zones												
	Category 1			Category 2			Category 3			Category 4		
Hurricane Inundation by Land Use (Number of Parcels)	**Total**	**Built in 1988 and before or no date**	**Built after 1988**	**Total**	**Built in 1988 and before or no date**	**Built after 1988**	**Total**	**Built in 1988 and before or no date**	**Built after 1988**	**Total**	**Built in 1988 and before or no date**	**Built after 1988**
Medium Density: Garden Apts.	3	3	0	3	3	0	3	3	0	8	6	0
Medium Density: Traditional	253	154	99	713	577	136	713	577	136	2031	1616	257
Low Density: Residential	0	0	0	0	0	0	0	0	0	8	6	0
Parks/Recreation	67	67	0	88	88	0	90	90	0	146	110	3
Private/Institutional Facilities	24	24	0	48	47	1	48	47	1	113	81	4
Public/Institutional Facilities	88	73	15	99	84	15	99	84	15	150	107	15
Railroad	8	7	1	12	10	2	14	12	2	85	34	4
Transportation ROW	10	10	0	29	29	0	31	31	0	65	39	1
Undeveloped	34	33	1	49	48	1	49	48	1	81	56	2
Total	833	685	148	1708	1502	206	1741	1535	206	4115	3029	364

Based on hurricane history in Baltimore, a Category 4 storm would be very unlikely. Table 16 shows that, were a Category 4 to occur, however, it would significantly impact Baltimore with over 4000 properties affected[*].

After Hurricane Isabel which produced a 100-year flood, only 16 flood insurance claims were filed, while upwards of 400 were filed in neighboring Baltimore County. One reason for the low number of claims could the durability of existing buildings in the harbor flood zones. Reportedly no structure needed to be condemned as a result of damage from Hurricane Isabel, according

[*] Because the FEMA-determined 100-year floodplain takes hurricane events into account, an analysis of losses for hurricane inundation will not be attempted here. Please see Flooding Hazard Profile for more information.

to the Department of Housing and Community Development (also known as Baltimore Housing). Also, much of the harbor has been bulkheaded and filled. Another reason may be the application of floodplain development regulations in the new development that is expanding residential and mixed use development to the areas around Baltimore's harbor. Damage in existing structures related not to the structures but rather to contents stored below floodplain levels and cars left at curb parking spaces.

Critical Facilities are those we need to continue operation through hazard events. Table 17 and Map Insert 7 show that six critical facilities fall within the 100-year floodplain and hurricane inundation areas. In addition to critical facilities, an analysis by MEMA and Towson University of vulnerable populations showed that 3% of Baltimore's elderly population live in the floodplain, concentrated primarily near or in floodplains for Western Run and the Jones Falls. Also, five child care centers exist in the 100-year floodplain.

Table 17: Critical Facilities in the 100-Year Floodplain and Hurricane Inundation Areas

Agency	Name	Address	Hazard Area
Fire	Fire Dept. - Communications	601 E Fayette St	Floodplain, Hurricane - Catergory 4
Fire	Fire Dept. - FB-1 FRB-1	2601 Leahy St	Floodplain, Hurricane - Catergory 4
Police	Downtown Precinct	500 E Baltimore St	Hurricane - Category 4
Police	Downtown Precinct	601 E Fayette St	Floodplain, Hurricane - Catergory 4
School	Sharp-Leadenhall	150 W West St	Hurricane - Category 4
School	Cross Country Elementary	6100 Cross Country Blvd	Floodplain
School	Baltimore City Community College	50 Market Pl	Floodplain, Hurricane - Catergory 2

Flood vulnerability is particularly problematic for Baltimore since waterfront development in recent years has been Baltimore's economic engine. The pressure to expand mixed use and residential uses with waterfront views, on piers, or in 100-year floodplains continues. Construction in Baltimore's floodplain will likely continue, especially in its harbor areas subject to tidal flooding. Riverine floodplains will also be a focus of development. Recent examples of Riverine floodplain redevelopment include the multi-million dollar residential and commercial rehabilitation of historic Clipper Mill and Mt. Washington Mill.

High Wind Vulnerability Assessment

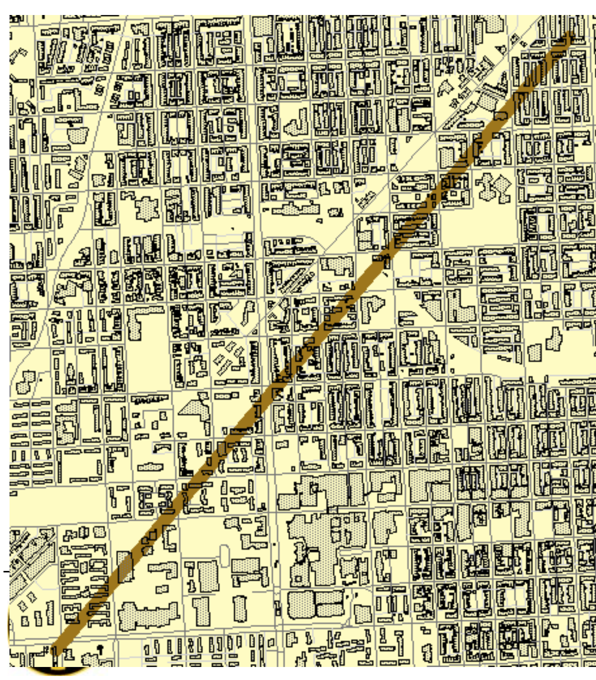
The construction of Baltimore City's structures places it in a reasonably good position to weather a moderate tornadic or wind event with little damage. The bulk of the City's structures were built in the 19th or early 20th century, and are built solidly, primarily out of heavy brick or stone. The wood frame structures built in the mid 20th century were also built from heavy materials, and according to Baltimore's building inspection professionals, are believed to be able to handle a significant wind load. Baltimore's newer buildings, while not built with materials of the same density of the older building stock, have been subject to the International Building Code which dictates construction has a wind resistance to 160 mph.

However, two primary building groups stand out as potentially vulnerable structures in the event of a tornado or high wind event. These structures include:

- **Dilapidated structures:** While well-maintained older properties are expected to fare reasonably well in the event of a tornado or windstorm, there are numerous dilapidated structures in Baltimore City that would likely sustain heavy damage in a wind event. Areas where there are significant numbers of dilapidated structures can be approximated by noting concentrations of vacant buildings on the map below. These areas are primarily in the inner city to the immediate east, northeast, west and northwest of downtown and in the Park Heights area of northwest Baltimore City.
- **Gable-roofed structures:** Gable-roofed structures are primarily found in Baltimore City's low-density residential neighborhoods, as most of Baltimore City's medium- and high-density areas consist of flat-roofed structures. While most of these areas are fairly well-maintained and residents should have little reason to expect significant damage, the physical nature of gabled roofs make them more susceptible to damage such as deshingling or, at worst, deroofing in case of a significant wind event. These low-density residential areas are primarily in the northern and western extremes of the City, with some smaller areas elsewhere.

Map Insert 8 depicts locations of vacant housing notices (code enforcement citations for structures vacant six months or longer) and areas with low density residential land use. While these comprise significant portions of the city, they do not coincide with areas of highest density or intense development.

In order to estimate the potential dollar losses for a high wind event, planners designed two scenarios demonstrating the potential effect of a tornado. Tornadoes, by their nature, are randomly occurring events, and no particular region within a localized area such as Baltimore City is more or less at risk of a tornado occurrence. However, the damage that a tornado could potentially wreak on structures in a particular area varies significantly, based on the quality and density of structures within it.



Scenario 1: An F2 tornado touches down in a depressed area of East Baltimore, leaving a typical tornado damage path (1.5 miles long, 50 yards wide). Due to the dilapidated nature of many of the houses in this area, heavy damage to the building stock is sustained. Overall, the building stock is damaged by approximately 50%.

Loss = (Total value of improvements) x 0.50
$5,436,725 = $10,873,450 x 0.50
In this scenario, damage is estimated at **$5,436,725**.

Abandoned or vacant properties would likely not be insured and consequently, would not be rebuilt. In such a scenario, the City simply would likely demolish these structures, leaving vacant lots or “gap-tooth” housing. Gap-tooth housing, a characteristic usually found in blighted neighborhoods, is an example of the secondary negative effects of hazard events.

Scenario 2: A tornado similar to the one in Scenario 1 touches down in a wealthy North Baltimore neighborhood. The housing stock here is fairly sturdy, and most structures are unharmed aside from some shingle loss and a downed gutter here and there. A few houses had some significant roof damage or busted windows due to tree branches that were blown into their houses. Overall, damage was estimated at 10%.

Loss = (Total value of improvements) x 0.10

$4,436,056 = $44,360,560 x 0.10

In this scenario, damage is estimated at **$4,436,056**.

Losses in this area would likely be insured. Costs to the City would include tree and debris removal.

Police, fire, school, and major hospital facilities in the City are constructed of heavy materials such as brick and stone and do not have gable-end roofs. Thus, no critical facilities are expected to have vulnerability to high winds.

Winter Storm Vulnerability Assessment

Winter storms can damage buildings, household plumbing, municipal utilities, and power lines. Freezing rain and ice can weigh down power lines, cause branches to break, and cause trees to break or become uprooted. Downed trees and power lines may disrupt traffic, hinder emergency response vehicles, and necessitate costly clean-up and disposal of debris.

One aspect of winter storms with particular peril for Baltimore City is heavy snowfall that may exceed the snow load capacity of roofs. One famous example is the roof collapse of the B&O Railroad Museum, a historic structure and repository of irreplaceable railroad industry artifacts and antique equipment. Baltimore has several thousand rowhouses with flat roofs which may be susceptible to collapse in the event of heavy snowfall. Recent experience has shown that a few roofs collapse in very heavy winter storms. Unfortunately, the City does not maintain data on roof types; therefore, this analysis cannot estimate the number nor the likely dollar losses of susceptible structures.

Extreme Heat Vulnerability Assessment

Extended periods with extreme heat can tax the energy delivery system, leading to high cooling costs, and rarely, blackouts or brownouts. But usually, extreme heat does not adversely affect the integrity of structures or infrastructure; the costs of extreme heat are primarily human. During Baltimore's hottest and most humid days, elderly residents in rowhouse neighborhoods with little tree cover are most likely to suffer. The top ten neighborhoods with the lowest percentage of tree cover appear in Table 18 below along with the number of elderly citizens residing in each. Tables showing the number of elderly by neighborhood and tree canopy percentages are found in Appendix C.

Table 18: Low Tree Canopy Neighborhoods and Elderly Residents

Neighborhood	Percent Tree Canopy	# ≥ 65
Highlandtown	0.38%	500
Fells Point	0.72%	350
Patterson Pk N&E	0.95%	75
Madison/East End	1.35%	170
Jonestown/Oldtown	1.42%	280
Inner Harbor/Federal Hill	1.44%	300
Downtown/Seton Hill	1.48%	170
Perkins/Middle East	1.93%	680
Upton/Druid Hts	2.94%	1250
Clifton-Berea	2.96%	925

The neighborhoods of Canton, Sandtown-Winchester, Harlem Park, Fulton Heights, Oliver, Middle East, and Broadway East are some of the neighborhoods located in central Baltimore that have significantly less tree cover than other neighborhoods. These neighborhoods all have significant numbers of elderly residents.

Hazard Priorities

Based on the hazard profiles and vulnerability assessments, hazards included in this plan can be assigned the following priorities:

High
- Flooding (including hurricane inundation)

Medium
- High Winds (including hurricane, tornado, thunderstorm, and other wind events)
- Winter Storm
- Extreme Heat

Low
- Drought
- Earthquake and Land Movement

Chapter Four: Mitigation Strategies

A primary goal for an All Hazards Plan to achieve is to offer and recommend practical solutions that can be implemented by local governments, including in partnerships with businesses, non-profit organizations, community groups, other levels of government, and volunteers. These are known as mitigation strategies. This plan presents for Baltimore a series of recommendations from the simple to the more complex and long-term. They will form an Action Plan to address the vulnerabilities and potential harm that can come from Natural Hazards.

Chapter Four presents goals, objectives, and mitigation strategies to address the hazards that have been shown to threaten the City of Baltimore. Each strategy will identify the parties responsible for implementing the item, and a general time-frame for implementation. Timeframes are listed as ongoing for items that have been started, but not yet completed; short-term for items that can be implemented within one-year; mid-term for items that can be implemented in one to two years, and long-term for items that will likely take three or more years to implement. This chapter will also prioritize the listed strategies.

Hazard Mitigation Goals

Goals reflect the broad vision for hazard mitigation of the developers of this plan. The hazard mitigation goals for the City of Baltimore include:

- Protecting the health and safety of Baltimore City residents.
- Preventing damage to structures, infrastructure, and critical facilities.
- Developing public understanding about the effects of hazards and the need for mitigation.
- Integrating disaster prevention into complementary City initiatives.

Objectives and Strategies

Objective: Develop up-to-date research about hazards.

- **Flooding**
  - Restudy Jones Falls floodplain.
    Responsible Party: Department of Public Works
    Possible Funding Source: Pre-Disaster Mitigation Grant Program, Capital Improvement Program
    Timeframe: Ongoing; completion delayed due to cost overruns.
  - Develop D-FIRMS for more accurate determination of flood-prone structures.
    Responsible Party: Department of Planning
    Possible Funding Source: Pre-Disaster Mitigation Grant Program, staff time
    Timeframe: Ongoing; completion expected in Spring 2006.
  - Study the threat and possible mitigation and policy changes for sea level rise.
    Responsible Party: Baltimore City Department of Planning—possible partnership with MEMA, NOAA, or USACE
    Possible Funding Source: Staff time initially, however a detailed study will likely require an additional funding source
    Timeframe: Mid-term
- **Earthquakes and Land Movement**
  - Develop map of artificial fill in Baltimore's harbor and downtown to help assess risk from earthquake and land slump.
    Responsible Parties: Maryland Geological Survey and the Federal Emergency Management Agency
    Possible Funding Source: N/A
    Timeframe: Ongoing; completion date uncertain.

Objective: Maintain City infrastructure and improve operations.

- **Flooding**
  - Improve water/waste water infrastructure to prevent flooding from overflows.
    Responsible Party: Baltimore City Department of Public Works
    Possible Funding Source: Capital Improvement Program
    Timeframe: Ongoing; Moore's Run is among the first to undergo improvements.

- o Develop stream maintenance program to clear trash, debris and vegetation that block stream flow. Reinstitute Stream Cleaning and Maintenance program as an operating budget item on an on-going basis for areas considered highest priority.
  Responsible Parties: Baltimore City Department of Public Works and non-profit/volunteer groups
  Possible Funding Source: Capital Improvement Program
  Comment: DPW, which would likely have primary responsibility for implementing this strategy, is a large City agency with a system of operations that is difficult to adjust to new responsibilities or operations swiftly. Non-profit groups and volunteers are able to help with this strategy in the short-term; some programs already exist. The Baltimore Multi-Objective Floodplain Management Plan suggested reinstituting the Stream Cleaning and Maintenance program in 2000.
  Timeframe: Mid-term.

- o After D-FIRMs are completed, update permitting database to flag all structures in the floodplain.
  Responsible Parties: Baltimore City Department of Planning, Baltimore Housing Office of Permits and Code Enforcement
  Possible Funding Source: Staff time
  Timeframe: Mid-term

- o Train all code enforcement and building inspectors about floodproofing techniques and the local floodplain ordinance.
  Responsible Parties: Baltimore City Department of Planning and the Office of Permits and Code Enforcement; Emergency Management Institute
  Possible Funding Source: Staff time
  Timeframe: Short-term

Objective: Enhance and protect City's natural assets where such assets can aid hazard mitigation objectives.

- **Extreme Heat**

  - o Expand tree planting program to provide tree cover in central Baltimore neighborhoods.
    Responsible Parties: Baltimore City Departments of Recreation and Parks and Public Works
    Possible Funding Source: Unknown
    Timeframe: Ongoing; however, consistent underfunding of this program hinders effectiveness.

- Adjust policies on size of tree pits in sidewalks to allow for better establishment and growth of street trees.
  Responsible Parties: Baltimore City Departments of Public Works, Recreation and Parks, and Planning
  Possible Funding Source: Staff time
  Timeframe: Short-term

- **Flooding**

  - Develop stream maintenance program to clear trash, debris and vegetation that block stream flow. Reinstitute Stream Cleaning and Maintenance program as an operating budget item on an on-going basis for high priority areas.
    Responsible Parties: Baltimore City Department of Public Works and non-profit/volunteer groups
    Possible Funding Source: Capital Improvement Program
    Comment: DPW, which would likely have primary responsibility for implementing this strategy, is a large City agency with a system of operations that is difficult to adjust to new responsibilities or operations swiftly. Non-profit groups and volunteers are able to help with this strategy in the short-term; some programs already exist.
    Timeframe: Mid-term.

Objective: Develop programs, regulations, and codes that integrate disaster prevention.

The City of Baltimore already has in place a number of codes, regulations, and programs that integrate disaster prevention, namely:

- Critical Area Program which mandates or encourages environmentally-sensitive construction within 1000 feet of waterways, including a 100 foot non-buildable buffer.
- Floodplain Management Ordinance which implements NFIP regulations and mandates a one-foot freeboard requirement for new construction.
- Site Plan Review and construction plans review to ensure flood protection measures and tree planting techniques.
- Forest Conservation Program which requires replacement of trees when new construction displaces existing trees.
- Weatherization Assistance Program, Maryland Energy Assistance Program, and Electric Universal Service Program to aid low-income residents with paying their heating/cooling bills, minimize heating crises, and make energy costs more affordable.
- Maryland Building Performance Standards/October 2001
- International Building Code/2000 which provides for snow loads of 30 psf and wind loads up to 160 mph.
- National Electrical Code/1999

- National Fuel Gas Code/1999 International Mechanical Code/2000
- National Standard Plumbing Code/2001
- International Property Maintenance Code/2000
- International Fire Code/2000
- International Energy Conservation Code/2000

- **Extreme Heat**

  - Develop landscape ordinance to "green" Baltimore and provide parameters for healthy maintenance of vegetation.
    Responsible Party: Baltimore City Department of Planning
    Possible Funding Source: Staff time
    Timeframe: Short-term

- **Flooding**

  - Update zoning code to restrict some uses in the floodplain.
    Responsible Party: Baltimore City Department of Planning
    Possible Funding Source: Staff time
    Timeframe: Short-term

  - Explore possibility of raising freeboard requirement to two or three feet.
    Responsible Party: Baltimore City Department of Planning
    Possible Funding Source: Staff time
    Timeframe: Short-term

  - **Drought**

    - Encourage partnerships and the use of creative water conservation methods like rain barrels.
      Responsible Parties: Non-profit groups like Herring Run Watershed Association and Parks and People; Baltimore City Departments of Planning, Housing, and Public Works
      Possible Funding Source: Various non-profit grants for neighborhood greening, environmental enhancement, and Chesapeake Bay watershed-related activities
      Timeframe: Short-term

Objective: Prevent damage to existing structures.

- **Flooding**

  - Assess opportunities to acquire properties in the floodway.
    Responsible Parties: Baltimore City Departments of Planning, Housing, and Baltimore Development Corporation
    Possible Funding Source: Staff time; Pre-Disaster Mitigation Grant Program
    Comment: In one Southeast industrial community, comprehensive planning efforts can meet multiple objectives of acquiring existing structures in the floodway, providing economic development incentives and opportunities for existing industrial businesses, solve local truck traffic problems, and enhancing habitat area. The Department of Planning will seek other opportunities to provide a comprehensive solution to flood and other issues. A comprehensive strategy will also provide a wider-range of funding opportunities.
    Timeframe: Mid-term

  - Encourage purchase of flood insurance by lowering premium costs by becoming a Community Rating System community.
    Responsible Party: Baltimore City Department of Planning
    Possible Funding Source: Staff time
    Timeframe: Short-term

- **High Winds, Extreme Heat, and Winter Storms**

  - Revise existing rowhouse redevelopment manual to provide advice about shoring up roofs to withstand snow loads and high winds, building green roofs, and using white or reflective paint to reflect heat.
    Possible Funding Source: Staff time
    Responsible Party: Baltimore City Department of Planning
    Timeframe: Short-term

  - Continue to enforce City codes to see that currently existing structures sustain minimal damage in the event of a wind disaster.
    Responsible Party: Office of Permits and Code Enforcement
    Possible Funding Source: Staff time
    Timeframe: Ongoing

  - Continue to cite vacant landlords for poor building maintenance practices.
    Responsible Party: Office of Permits and Code Enforcement
    Possible Funding Source: Staff time
    Timeframe: Ongoing

Objective: Educate residents about the existence of hazard, mitigation programs, and incentives.

- **Flooding**
  - Following development of DFIRMS, conduct floodplain determinations, and notify residents and businesses in the floodplain of their floodplain status.
    Responsible Party: Department of Planning
    Possible Funding Source: Staff time
    Timeframe: Mid-Term
  - Develop annual newsletter to inform and remind owners of property in the floodplain about flood insurance and floodproofing activities they may undertake.
    Responsible Party: Department of Planning
    Possible Funding Source: Staff time; Pre-Disaster Mitigation Program
    Timeframe: Mid-term
- **Extreme Heat and Winter Storm**
  - Develop outreach program to inform low-income and seniors about the existence of weatherization and energy assistance programs.
    Responsible Party: Commission on Aging and Retirement Education
    Possible Funding Source: Staff time
    Timeframe: Short-term
- **Multi-Hazard**
  - Post emergency planning tips on the Baltimore City website to educate the public on the proper course of action in the event of a severe weather event. For example, impress the importance of finding a stable place such as a school or recreation center in which to seek shelter in the event of a tornado.
    Possible Funding Source: Staff time
    Responsible Party: Office of Emergency Management
    Timeframe: Short-term

Objective: Provide direct assistance to low-income individuals, seniors, and others who need it.

- Extreme Heat
  - Distribute fans to seniors and low-income households.
    Responsible Parties: Mayor's Office of Neighborhoods, Commission on Aging

and Retirement Education
Possible Funding Source: Mayor's Office of Neighborhoods discretionary funds
Timeframe: Short-term

Mitigation Strategy Priorities

The following attempts to prioritize the mitigation actions listed in the previous section. Prioritization is based on conformity with hazard mitigation goals, whether the action refers to a high priority hazard or has multiple hazard applications, and whether the action is politically or financially feasible. For each criteria, each strategy will receive a 3 for "fully aligns with criteria;" a 2 for "somewhat aligns with criteria;" or a 1 for "minimally aligns with criteria/does not align with criteria."

Table 19: Mitigation Strategies and Criteria

	Protecting the health and safety of Baltimore City residents.	Preventing damage to structures, infrastructure, and critical facilities.	Developing public understanding about the effects of hazards and the need for mitigation.	Integrating disaster prevention into complementary City initiatives.	Priority Hazard or multiple hazards	Politically Feasible	Financially Feasible	SCORE
Restudy Jones Falls floodplain.	2	2	3	1	3	3	2	16
Develop D-FIRMS for more accurate determination of flood-prone structures.	3	2	3	1	3	3	2	17
Study the threat and possible mitigation and policy changes for sea level rise.	2	3	3	1	3	2	2	16
Develop map of artificial fill in Baltimore's harbor and downtown to help assess risk from earthquake and land slump.	2	2	3	1	1	2	3	14
Improve water/waste water infrastructure to prevent flooding from overflows.	3	3	1	3	3	2	3	18

Table 19: Mitigation Strategies and Criteria								
	Protecting the health and safety of Baltimore City residents.	Preventing damage to structures, infrastructure, and critical facilities.	Developing public understanding about the effects of hazards and the need for mitigation.	Integrating disaster prevention into complementary City initiatives.	Priority Hazard or multiple hazards	Politically Feasible	Financially Feasible	SCORE
Develop stream maintenance program to clear trash, debris and vegetation that block stream flow. Reinstitute Stream Cleaning and Maintenance program as an operating budget item on an on-going basis for areas considered highest priority.	3	3	1	3	3	1	2	16
After D-FIRMs are completed, update permitting database to flag all structures in the floodplain.	3	3	2	1	3	2	3	17
Train all code enforcement and building inspectors about floodproofing techniques and the local floodplain ordinance.	3	3	1	1	3	3	3	17
Expand tree planting program to provide tree cover in central Baltimore neighborhoods.	3	2	1	3	2	3	3	17
Adjust policies on size of tree pits in sidewalks to allow for better establishment and growth of street trees.	2	3	1	3	2	2	3	16
Develop landscape ordinance to “green” Baltimore and provide parameters for healthy maintenance of vegetation.	2	1	2	3	2	3	3	16
Update zoning code to restrict some uses in the floodplain.	3	3	1	3	3	2	3	18
Explore possibility of raising freeboard requirement to two or three feet.	3	3	1	1	3	1	3	15
Encourage partnerships and the use of creative water conservation	1	1	3	3	1	3	3	15

Table 19: Mitigation Strategies and Criteria								
	Protecting the health and safety of Baltimore City residents.	Preventing damage to structures, infrastructure, and critical facilities.	Developing public understanding about the effects of hazards and the need for mitigation.	Integrating disaster prevention into complementary City initiatives.	Priority Hazard or multiple hazards	Politically Feasible	Financially Feasible	SCORE
methods like rain barrels.								
Assess opportunities to acquire properties in the floodway.	3	3	1	3	3	2	3	18
Encourage purchase of flood insurance by lowering premium costs by becoming a Community Rating System community.	3	3	3	3	3	3	3	21
Revise existing rowhouse redevelopment manual to provide advice about shoring up roofs to withstand snow loads and high winds, building green roofs, and using white or reflective paint to reflect heat.	3	3	3	3	3	3	3	21
Continue to enforce City codes to see that currently existing structures sustain minimal damage in the event of a wind disaster.	3	3	2	3	2	3	3	19
Continue to cite vacant landlords for poor building maintenance practices.	3	3	2	3	2	3	3	19
Following development of DFIRMS, conduct floodplain determinations, and notify residents and businesses in the floodplain of their floodplain status.	3	2	3	1	3	1	3	16
Develop annual newsletter to inform and remind owners of property in the floodplain about flood insurance and floodproofing activities they may undertake.	3	3	3	1	3	3	3	19
Develop outreach program to inform low-income and seniors about the existence of weatherization and	3	2	3	3	2	3	2	18

Table 19: Mitigation Strategies and Criteria	Protecting the health and safety of Baltimore City residents.	Preventing damage to structures, infrastructure, and critical facilities.	Developing public understanding about the effects of hazards and the need for mitigation.	Integrating disaster prevention into complementary City initiatives.	Priority Hazard or multiple hazards	Politically Feasible	Financially Feasible	SCORE
energy assistance programs.								
Post emergency planning tips on the Baltimore City website to educate the public on the proper course of action in the event of a severe weather event	3	1	3	1	2	3	3	16
Distribute fans to seniors and low-income households.	3	1	3	2	2	3	2	16

The resulting list of hazard mitigation priorities is as follows:

Table 20: Hazard Mitigation Priorities

Hazard Priority	Strategy	Score
Primary	Encourage purchase of flood insurance by lowering premium costs by becoming a Community Rating System community.	21
	Revise existing rowhouse redevelopment manual to provide advice about shoring up roofs to withstand snow loads and high winds, building green roofs, and using white or reflective paint to reflect heat.	21
	Continue to enforce City codes to see that currently existing structures sustain minimal damage in the event of a wind disaster.	19
	Continue to cite vacant landlords for poor building maintenance practices.	19
	Develop annual newsletter to inform and remind owners of property in the floodplain about flood insurance and floodproofing activities they may undertake.	19
Secondary	Improve water/waste water infrastructure to prevent flooding from overflows.	18
	Update zoning code to restrict some uses in the floodplain.	18
	Assess opportunities to acquire properties in the floodway.	18
	Develop outreach program to inform low-income and seniors about the existence of weatherization and energy assistance programs.	18

Table 20: Hazard Mitigation Priorities		
Hazard Priority	**Strategy**	**Score**
	Develop D-FIRMS for more accurate determination of flood-prone structures.	17
	After D-FIRMs are completed, update permitting database to flag all structures in the floodplain.	17
	Train all code enforcement and building inspectors about floodproofing techniques and the local floodplain ordinance.	17
	Expand tree planting program to provide tree cover in central Baltimore neighborhoods.	17
	Restudy Jones Falls floodplain.	16
	Study the threat and possible mitigation and policy changes for sea level rise.	16
	Develop stream maintenance program to clear trash, debris and vegetation that block stream flow. Reinstitute Stream Cleaning and Maintenance program as an operating budget item on an on-going basis for areas considered highest priority.	16
	Adjust policies on size of tree pits in sidewalks to allow for better establishment and growth of street trees.	16
	Develop landscape ordinance to “green” Baltimore and provide parameters for healthy maintenance of vegetation.	16
	Following development of DFIRMS, conduct floodplain determinations, and notify residents and businesses in the floodplain of their floodplain status.	16
	Post emergency planning tips on the Baltimore City website to educate the public on the proper course of action in the event of a severe weather event	16
	Distribute fans to seniors and low-income households.	16
Tertiary	Explore possibility of raising freeboard requirement to two or three feet.	15
	Encourage partnerships and the use of creative water conservation methods like rain barrels.	15
	Develop map of artificial fill in Baltimore’s harbor and downtown to help assess risk from earthquake and land slump.	14

Chapter Five: Monitoring and Evaluation

Chapter Five outlines an Action Plan for Mitigation Strategies that can be readily applied to following up on the Planning Commission's Adoption of the All Hazards Plan as a Master Plan for Baltimore City.

Recommended Actions to Follow Up, Monitor, Implement Strategies, and Include the Content of the All Hazards Plan in other Master Plans, the Capital Improvement Plan, and Baltimore's Comprehensive Plan:

1. In Year One following Planning Commission's November 11, 2004 adoption of the All Hazards Plan (to December 31, 2005), review recommendations for those that can be implemented easily and quickly; integrate content of the plan into the Comprehensive Plan, integrate the All Hazards Plan into any other Master Plan being developed, review implementation of existing strategies for possible refinement such as permit review. Continue to participate in continuing education for the Floodplain Coordinator and staff from the Planning Department and other agencies. Establish links with the Capital Improvement Planning process to ensure integration of All Hazard Plan recommendations. Monitor possible funding sources for capital projects, additional studies, etc.

2. In Year Two (Calendar Year 2006), stress proposals for changes to the City's Zoning Ordinance as the Department of Planning commences its Comprehensive Zoning Review to follow adoption of Baltimore's new Comprehensive Plan by December 31, 2005. Apply for appropriate grants to implement mitigation provisions. Review CIP provisions related to floodplains and other natural hazards and provide input to take advantage of the City's construction projects to improve mitigation.

   Emphasize passage of desired changes in laws, rules, and regulations beyond changes to the Zoning Code, as is possible and needed to implement recommended mitigation strategies. Explore funding sources for additional acquisitions of vulnerable properties and relocation of land uses out of floodplains, or at least to locations where they can meet floodplain development regulations not now met.

3. Year Three (Calendar Year 2007), stress evaluation of processes to improve mitigation strategies for natural hazards. Update information on vulnerable populations, Critical Facilities, etc.

4. In Year Five (by November 11, 2009), complete the evaluation of the first five years of Baltimore's All Hazards Plan with recommendations for changes to the plan as

appropriate for approval by the Planning Commission on or before November 11, 2009. Approval is in the form of a renewal of approval for the plan with any changes the Planning Commission approves. Institutionalize monitoring, evaluation, implementation and review of the All Hazards Plan in Baltimore on a five-year cycle as called for in this adopted plan.

Appendices

Appendix A: Documentation of Adoption of the All-Hazards Plan by the Baltimore City Planning Commission

Chapter Seven documents the adoption of the All Hazards Plan by the Baltimore City Planning Commission on November 11, 2004.

Documents include the Department of Planning staff report, a Power Point Presentation that accompanied the presentation of the Plan at the Planning Commission public hearing on November 11th, and the transcript of proceedings from the Planning Commission that report the approval of the All Hazards Plan for Baltimore.

Appendix B: Members of the Local Emergency Planning Committee

Appendix C: Elderly Residents and Tree Canopy

Appendix A:
Documentation of Adoption of the All-Hazards Plan by the Baltimore City Planning Commission

Appendix B:
Baltimore City
Local Emergency Planning Committee (Lepc)

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Appendix C:
Elderly Residents and Tree Canopy

Percentage and Number of Elderly Population by Neighborhood		
Neighborhood	**%≥ 65**	**# ≥ 65**
ABELL	2.51	25
ALLENDALE	23.78	995
ARCADIA	9.98	125
ARLINGTON	15.82	480
ARMISTEAD GARDENS	17.47	550
ASHBURTON	30.06	755
BALTIMORE HIGHLANDS	14.25	330
BALTIMORE-LINWOOD	10.50	625
BARCLAY	12.20	335
BARRE CIRCLE	4.50	15
BEECHFIELD	6.25	235
BELAIR-EDISON	8.87	1466
BELAIR-PA KSIDE	12.95	65
BELLONA-GITTINGS	18.82	115
BEREA	20.44	925
BETTER WAVERLY	7.93	240
BEVERLY HILLS	10.61	85
BIDDLE STREET	17.98	265
BLYTHEWOOD		0
BOLTON HILL	15.50	820
BOOTH-BOYD	4.06	40
BREWERS HILL	15.73	235
BRIDGEVIEW/GREENLAWN	18.18	420
BROADWAY EAST	13.24	905
BROENING MANOR	15.27	255
BROOKLYN	9.91	905
BURLEITH-LEIGHTON	22.73	160
BUT HER'S HILL	5.56	105
CALLAWAY-GARRISON	16.05	315
CAMERON VILLAGE	7.53	120
CANTON	16.17	1760
CANTON INDUSTRIAL AREA		0
CARROLL - CAMDEN INDUSTRIAL AREA		0
CARROLL PARK		0
CARROLL-SOUTH HILTON	16.43	255
CARROLLTON RIDGE	10.67	515
CEDARCROFT	21.22	125
CEDMONT	16.66	430
CEDONIA	7.68	275
CENTRAL FOREST PARK	16.79	250
CENTRAL PARK HEIGHTS	8.15	645

Percentage and Number of Elderly Population by Neighborhood		
Neighborhood	**%≥ 65**	**# ≥ 65**
CHARLES NORTH	33.57	335
CHARLES VILLAGE		0
CHERRY HILL	9.52	740
CHESWOLDE	23.13	1485
CHINQUAPIN PARK-BELVEDERE	5.92	125
CHRISTOPHER	11.66	140
CLAREMONT-FREEDOM	10.94	160
CLIFTON PARK		0
COLDSPRING	21.59	190
COLDSTREAM HOMESTEAD MONTEBELLO	10.87	950
CONCERNED CITIZENS OF FOREST PARK	12.78	170
COPPIN HEIGHTS/ASH-CO-EAST	16.91	525
CROSS COUNTRY	27.59	1135
CROSS KEYS	48.31	41
CURTIS BAY	11.30	450
CURTIS AY INDUSTRIAL		0
CYLBURN	11.21	290
DARLEY PARK	13.21	205
DICKEYVILLE		0
DOLFIELD	14.94	335
DORCHESTER	12.38	225
DOWNTOWN	7.27	135
DRUID HEIGHTS	14.22	270
DRUID HILL PARK		0
DUNBAR-BROADWAY	9.76	115
DUNDALK MARINE TERMINAL		0
EAST ARLINGTON	15.05	370
EAST BALTIMORE MIDWAY	14.38	595
EASTERWOOD	14.70	255
EASTWOOD	27.73	150
E MONDSON VILLAGE	14.52	1030
EDNOR GARDENS-LAKESIDE	10.36	525
ELLWOOD PARK/MONUMENT	5.13	180
EVERGREEN	11.06	45
EVERGREEN LAWN	16.76	205

Percentage and Number of Elderly Population by Neighborhood

Neighborhood	%≥ 65	# ≥ 65
FAIRFIELD AREA		0
FAIRMONT	23.44	90
FALLSTAFF	17.53	685
FEDERAL HILL	9.16	220
FELLS POINT	11.47	350
FOREST PARK	19.04	325
FOREST PARK GOLF COURSE	16.62	55
FOUR BY FOUR	6.77	110
FRANKFORD	9.32	1565
FRANKLIN SQ ARE	8.59	305
FRANKLINTOWN	0.72	10
FRANKLINTOWN ROAD	20.51	485
GARWYN OAKS	11.75	185
GAY STREET	11.31	235
GLEN	19.45	1685
GLEN OAKS	8.70	255
GLENHAM-BELFORD	16.01	975
GRACELAND PARK	23.85	410
GREEKTOWN	17.30	570
GREENMOUNT CEMETARY		0
GREENMOUNT WEST	9.15	120
GREENSPRING	14.38	575
GROVE PARK	15.40	0
GUILFORD	15.97	335
GWYNN FALLS	13.10	155
GWYNNS FALLS/LEAKIN PARK		0
HAMPDEN	17.69	1320
HANLON-LONGWOOD	16.36	440
HARFORD-ECHODALE/PERRING PARKWAY	9.44	810
HARLEM PARK	13.14	620
HARWOOD	9.81	175
HAWKINS POINT		0
HERITAGE CROSSING	5.00	20
HERRING RUN PARK		0
HIGHLANDTOWN	17.72	500
HILLEN	9.17	245
HOES HEIGHTS	15.52	145
HOLABIRD INDUSTRIAL PARK		0
HOLLINS MARKET	6.59	135
HOMELAND	11.82	365
HOPKINS BAYVIEW	0.00	0
HOWARD PARK	18.06	1105
HUNTING RIDGE	14.94	175

Percentage and Number of Elderly Population by Neighborhood

Neighborhood	%≥ 65	# ≥ 65
IDLEWOOD	8.49	230
INNER HARBOR	10.50	80
IRVINGTON	8.63	380
JOHNS HOPKINS HOMEWOOD	0.00	0
JOHNSTON SQUARE	11.94	325
JONES FALLS AREA		0
JONESTOWN	0.00	0
JOSEPH LEE	23.44	510
KENILWORTH PARK	20.62	285
KERNEWOOD	3.82	20
KESWICK	21.63	135
KRESSON	7.56	30
LAKE EVESHAM	9.32	45
LAKE WALKER	15.35	320
LAKELAND	7.94	340
LANGSTON HUGHES	6.85	80
LAURAVILLE	11.89	520
LEVINDALE	23.00	285
LIBERTY SQUARE	9.86	75
LITTLE ITALY	17.18	95
LOCH RAVEN	15.34	925
LOCUST POINT	15.55	300
LOCUST POINT INDUSTRIAL AREA		0
LOWER HERRING RUN PARK		0
LOYOLA/NOTRE DAME	4.22	165
LUC LLE PARK	1.94	10
MADISON PARK	8.88	190
MADISON-EASTEND	7.10	170
MAYFIELD		0
MCELDERRY PARK	4.71	210
MEDFIELD	14.13	390
MEDFORD	16.48	195
MID-GOVANS	10.32	245
MID-TOWN BELVEDERE	11.11	355
MIDDLE BRANCH/REEDBIRD PARKS		0
MIDDLE EAST	10.71	580
MIDTOWN-EDMONDSON	17.40	405
MILLHILL	17.30	320
MILTON-MONTFORD	8.71	140
MONDAWMIN	17.44	620
MONTEBELLO		0
MORAVIA-WALTHER	12.06	130
MORGAN PARK		0

Percentage and Number of Elderly Population by Neighborhood		
Neighborhood	%≥ 65	# ≥ 65
MORGAN STATE UNIVERSITY		0
MORRELL PARK	15.56	725
MOSHER	13.19	265
NEW SOUTHWEST/MOUNT CLARE		0
MOUNT HOLLY	7.23	120
MOUNT VERNON	15.16	685
MOUNT WASHINGTON	12.98	500
MOUNT WINANS	7.28	75
MT PLEASANT PARK		0
NEW NORTHWOOD	7.43	52
NORTH HARFORD ROAD	16.61	460
NORTH R LAND PARK/POPLAR HILL	19.94	250
NORTHWEST COMMUNITY ACTION	16.83	350
O'DONNELL HEIGHTS	5.06	105
OAKENSHAWE	8.34	90
OAKLEE	13.28	100
OLDTOWN	7.91	280
OLIVER	12.97	710
ORANGEVILLE		0
ORANGEVILLE INDUSTRIAL AREA		0
ORIGINAL NORTHWOOD	8.06	100
OTTERBEIN	26.97	600
OVERLEA	16.17	115
PANWAY/BRADDISH AVENUE	30.60	380
PARK CIRCLE	13.83	530
PARKLANE	12.45	265
P RKSIDE	6.67	170
PARKVIEW/WOODBROOK		0
PATTERSON PARK		0
PATTERSON PLACE	6.12	75
PEN LUCY	11.34	370
PENN NORTH	9.18	215
PENN-FALLSWAY	0.00	0
PENROSE/FAYETTE STREET OUTREACH		0
PERKINS HOMES	6.44	100
PERRING LOCH	12.81	400
PIMLICO GOOD NEIGHBORS	26.52	310
PLEASANT VIEW GARDENS	24.62	240
POPPLETON	9.54	310
PORT COVINGTON		0

Percentage and Number of Elderly Population by Neighborhood		
Neighborhood	%≥ 65	# ≥ 65
PULASKI IND STRIAL AREA		0
PURNELL	0.00	0
RADNOR-WINSTON	9.95	60
RAMBLEWOOD	10.40	210
REISTERSTOWN STATION	13.06	260
REMINGTON	11.30	260
RESERVOIR HILL	10.07	695
RICHNOR SPRINGS	23.52	155
RIDGELY'S DELIGHT	2.16	20
RIVERSIDE	13.74	750
ROGNEL HEIGHTS	16.02	345
ROLAND PARK	13.95	655
ROSEBANK	11.34	50
ROSEMONT	16.58	0
ROSEMONT EAST	19.05	360
ROSEM NT HOMEOWNERS/TENANTS	15.48	270
SABINA-MATTFELDT		0
SAINT AGNES	29.41	185
SAINT HELENA	6.48	35
SAINT JOSEPHS	16.97	385
SAINT PAUL		0
SANDTOWN-WINCHESTER	8.75	810
SBIC	11.05	430
SETON BUSINESS PARK		0
SETON HILL	1.63	35
SHARP-LEADENHALL	10.15	80
SHIPLEY HILL	14.67	360
SOUTH CLIFTON PARK	12.33	150
SPRING GARDEN INDUSTRIAL AREA		0
STADIUM AREA		0
STONEWOOD-PENTWOOD-WINSTON	12.35	105
TAYLOR HEIGHTS	21.60	70
TEN HILLS	11.29	180
THE ORCHARDS	10.85	50
TOWANDA-GRANTLEY	13.12	185
TREMONT	6.03	60
TUSCANY-CANTERBURY	20.16	695
UNION SQUARE	5.28	70
UNIVERSITY OF MARYLAND	0.00	0
UPLANDS	10.70	270
UPPER FELLS POINT	10.86	455
UPTON	15.50	980
VILLAGES OF HOMELAND	24.33	100
VIOLETVILLE	21.85	585

Percentage and Number of Elderly Population by Neighborhood

Neighborhood	%≥ 65	# ≥ 65
WAKEFIELD	13.92	270
WALBROOK	16.37	460
WALTHERSON	11.77	695
WASHINGTON HILL	6.80	130
WASHINGTON VILLAGE	10.35	560
WATER		0
WAVERLY	6.14	195
WEST ARLINGTON	10.00	225
WEST FOREST PARK	15.01	380
WEST HILLS	10.89	235
WESTFIELD	15.42	495
WESTGATE	4.87	140
WESTPORT	7.55	165
WILSON HEIGHTS	12.21	110

Percentage and Number of Elderly Population by Neighborhood

Neighborhood	%≥ 65	# ≥ 65
WILSON PARK	15.49	210
WINCHESTER	22.30	345
WINDSOR HILLS	21.90	405
WINSTON-GOVANS	10.32	150
WOODBERRY	8.10	90
WOODBOURNE HEIGHTS	7.20	130
WOODBOURNE-MCCABE	7.44	80
WOODMERE	13.02	300
WOODRING	19.14	480
WYMAN PARK	17.61	215
WYNDHURST	15.59	125
YALE HEIGHTS	6.40	185

Percent Tree Canopy by Neighborhood

Community	Percent Forest Canopy
Allendale/Irvington/S. Hilton	26.26%
Beechfield/Ten Hills/West Hills	40.44%
Belair-Edison	12.60%
Brooklyn/Curtis Bay/Hawkins Pt	15.14%
Canton	3.50%
Cedonia/Frankford	21.98%
Cherry Hill	13.29%
Chinquapin Pk/Belvedere	28.92%
Claremont/Armistead	25.10%
Clifton-Berea	2.96%
Cross-Country/Cheswolde	34.78%
Dickeyville/Franklintown	65.34%
Dorchester/Ashburton	17.86%
Downtown/Seton Hill	1.48%
Edmonson Village	44.42%
Fells Point	0.72%
Forest Pk/Walbrook	41.59%
Glen-Falstaff	17.98%
Greater Charles Vill./Barclay	11.72%
Greater Govans	22.14%
Greater Mondawmin	12.70%
Greater Roland Pk/Poplar	42.98%

Percent Tree Canopy by Neighborhood

Community	Percent Forest Canopy
Greater Rosemont	14.61%
Greenmount East	5.52%
Hamilton	23.85%
Harford/Echodale	21.62%
Highlandtown	0.38%
Howard Pk/W.Arlington	32.67%
Inner Harbor/Federal Hill	1.44%
Jonestown/Oldtown	1.42%
Lauraville	28.87%
Loch Raven	26.59%
Madison/East End	1.35%
Medfield/Hampden/Woodberry/ Remington	23.65%
Midtown	3.22%
Midway/Coldstream	3.19%
Morrell Pk/Violetville	18.04%
Mt Washington/Coldspring	54.07%
North Balto./Guilford/Homeland	37.31%
Northwood	21.12%
Orangeville/E. Highlandtown	7.57%
Patterson Pk N&E	0.95%
Penn North/Reservoir Hill	31.99%

Percent Tree Canopy by Neighborhood	
Community	**Percent Forest Canopy**
Perkins/Middle East	1.93%
Pimlico/Arlington/Hilltop	13.60%
Poppleton/The Terraces/Hollins Mkt	3.03%
Sandtown-Winchester/Harlem Pk	5.02%
South Baltimore	1.95%
Southeastern	1.67%
Southern Park Heights	16.77%

Percent Tree Canopy by Neighborhood	
Community	**Percent Forest Canopy**
Southwest Baltimore	6.05%
The Waverlies	9.19%
Unassigned--Jail	0.09%
Upton/Druid Hts	2.94%
Washington Village	6.30%
Westport/Mt Winans/Lakeland	14.96%
City-Wide Total	19.86%