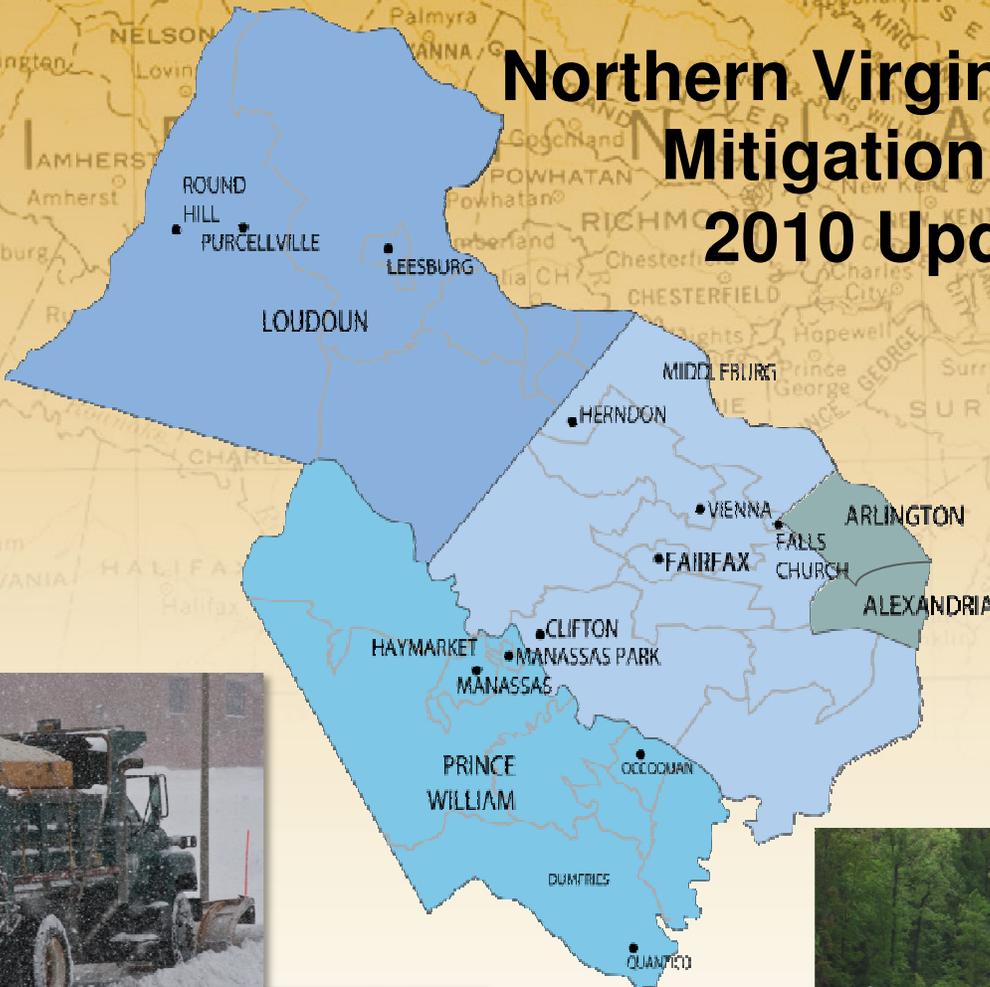


Northern Virginia Hazard Mitigation Plan 2010 Update





Executive Summary1

Chapter 1: Introduction4

 I. Background4

 A. Disaster Mitigation Act of 2000.....5

 II. Overview of Hazard Mitigation Planning.....6

 III. Purpose of Plan.....7

 IV. Authority7

 V. Summary of Plan Contents8

Chapter 2: Planning Process10

 I. Mitigation Advisory Committee11

 II. Public Involvement and Citizen Input12

 III. Incorporation of Existing Plans and Studies14

Chapter 3: Regional Information15

 I. Northern Virginia Overview15

 A. Planning Region15

 1. County Profiles17

 2. City Profiles.....19

 3. Town Profiles21

 B. Geography, Hydrology, and Climate.....24

 1. Geography24

 2. Hydrology.....26

 3. Climate27

 C. Demographics, Population & Economic Growth.....30

 1. Projected Economic Growth.....32

 2. Population.....34

 3. Housing36

 D. Land Use, Development & Zoning36

 1. Land Use36

 2. Development Trends.....40

 3. Zoning41

Chapter 4: Regional Hazard Identification and Risk Assessment (HIRA)47

 I. Introduction47

 II. Data Availability and Limitations48

Local Critical Facility and Building Data.....48

HAZUS^{MH} MR4.....56

Data62

 III. Hazard Identification64

Federally Declared Disasters65

NCDC Storm Events Database67

NCDC Normalizing Data.....70

NCDC Inflation Computation71

NCDC Annualizing Data71

NCDC Data Compilation.....72

 IV. Ranking and Analysis Methodologies74

HAZUS^{MH} Methodology.....74

Supplemental Annualized Loss Estimate Methodology75



Critical Facility and Building Risk.....75
2006 Ranking Methodology76
2010 Ranking Methodology78
Ranking Methodology.....78
Population Vulnerability and Density79
Geographic Extent.....80
Annualizing the Data for Analysis.....82
Annualized Deaths and Injuries82
Annualized Crop and Property Damage83
Annualized Events83
Overall Hazard Ranking84
Comparison of Methodologies84
Additional Risk Assessments Completed for the Northern Virginia Region.....84
November 2008 NCR SHIELD.....86
September 2005 CIP MCR RBFRS.....86

V. Flood87
 A. Hazard Profile87
 Sea Level Rise.....88
 Erosion.....91
 B. Risk Assessment.....103

VI. Winter Storm (with extreme cold).....123
 A. Hazard Profile123
 B. Risk Assessment.....128

VII. High Wind/ Severe Storms136
 A. Hazard Profile136
 C. Risk Assessment.....143
 D. Hurricanes and Tropical Storms.....145
 E. Risk Assessment.....157

VIII. Tornadoes.....172
 A. Hazard Profile172
 B. Risk Assessment.....181

IX. Drought (and extreme heat)186
 A. Hazard Profile186
 B. Risk Assessment.....191

X. Earthquake195
 A. Hazard Profile195
 B. Risk Assessment.....202

XI. Landslides215
 A. Hazard Profile215
 B. Risk Assessment.....219

XII. Wildfire227
 A. Hazard Profile227
 B. Risk Assessment.....230

XIII. Sinkholes / Karst / Land Subsidence242
 A. Hazard Profile242
 B. Risk Assessment.....246



XIV. Dam Failure.....	254
A. Hazard Profile	254
B. Risk Assessment.....	257
XV. Overall Hazard Results	260
Chapter 5: Capability Assessment	269
I. Introduction	269
II. Conducting the Capability Assessment	270
III. Capability Assessment Findings	270
A. Administrative and Technical Capability	270
B. Planning and Regulatory Capability.....	277
C. Fiscal Capability.....	285
Chapter 6: Mitigation Strategies	288
II. Planning Process for Setting Mitigation Goals	288
III. Considering Mitigation Alternatives	289
A. Identification and Analysis of Mitigation Techniques	289
B. Prioritizing Alternatives.....	291
IV. Identifying Objectives and Strategies.....	293
A. Goals and Strategies	293
Chapter 7: Jurisdiction Executive Summaries.....	298
I. Alexandria.....	298
II. Arlington County.....	305
III. Fairfax County.....	318
IV. Loudoun County.....	331
V. Prince William County	339
VI. City of Fairfax	346
VII. City of Falls Church	352
VIII. City of Manassas	359
IX. City of Manassas Park	364
X. Town of Clifton.....	371
XI. Town of Dumfries	376
XII. Town of Haymarket.....	381
XIII. Town of Herndon	387
XIV. Town of Leesburg.....	392
XV. Town of Middleburg.....	401
XVI. Town of Occoquan	405
XVII. Town of Purcellville	410
XVIII. Town of Quantico	415
XIX. Town of Round Hill.....	419
XX. Town of Vienna.....	425
Chapter 8: Plan Maintenance.....	430
I. Implementation.....	430
II. Monitoring, Evaluation and Enhancement	431
III. Continued Public Involvement.....	434



Executive Summary

Mitigation is commonly defined as sustained actions taken to reduce or eliminate long-term risk to people and property from hazards and their effects. Hazard mitigation focuses attention and resources on community policies and actions that will produce successive benefits over time. A mitigation plan states the aspirations and specific courses of action that a community intends to follow to reduce vulnerability and exposure to future hazard events. These plans are formulated through a systematic process centered on the participation of citizens, businesses, public officials, and other community stakeholders.

The area covered by this plan includes:

Participating Communities	
Counties	Towns
Arlington County	Town of Clifton
Fairfax County	Town of Dumfries
Loudoun County	Town of Haymarket
Prince William County	Town of Herndon
	Town of Leesburg
	Town of Middleburg
	Town of Purcellville
	Town of Occoquan
	Town of Quantico
	Town of Round Hill
	Town of Vienna

Cities
City of Alexandria
City of Fairfax
City of Falls Church
City of Manassas
City of Manassas Park

The additional contents of this Plan are designed and organized to be as reader-friendly and functional as possible. While significant background information is included on the processes used and studies completed (e.g., risk assessment, capability assessment), this information is separated from the more meaningful planning outcomes or actions (e.g., mitigation strategy, mitigation action plans).

Chapter 2, Planning Process, provides a complete narrative description of the process used to prepare the Plan. This includes the identification of who was involved, who participated on the planning team, and how the public and other stakeholders were involved. It also includes a detailed summary for each of the key meetings held along with any associated outcomes.

Chapter 3, Regional Information, describes the general makeup of the Northern Virginia region, including prevalent geographic, demographic, and economic characteristics. In addition, transportation, housing, and land-use patterns are discussed. This baseline information provides a snapshot of the regional planning area and thereby assists county and municipal officials to recognize those social, environmental, and economic factors that ultimately play a role in determining community vulnerability to natural hazards.



The Regional Hazard Identification and Risk Assessment (HIRA) is presented in Chapter 4. This section serves to identify, analyze, and assess the Northern Virginia region’s overall risk to natural hazards. The risk assessment also attempts to define any hazard risks that may uniquely or exclusively affect the individual municipal jurisdictions.

The Risk Assessment builds on available historical data from past hazard occurrences, establishes detailed profiles for each hazard, and culminates in a hazard risk ranking based on conclusions about the frequency of occurrence, spatial extent, and potential impact of each hazard. FEMA’s HAZUS^{MH} loss estimation methodology was also used in evaluating known hazard risks by their relative long-term cost in expected damages. In essence, the information generated through the risk assessment serves a critical function as communities seek to determine the most appropriate mitigation actions to pursue and implement — enabling communities to prioritize and focus their efforts on those hazards of greatest concern and those structures or planning areas facing the greatest risk(s). The hazards analyzed in this plan include: Flood, High Wind, Tornadoes, Winter Storms, Drought, Earthquakes, Landslides, Wildfire, Sinkholes, and Dam Failure.

The Capability Assessment, found in Chapter 5, provides a comprehensive examination of each participating jurisdiction’s capacity to implement meaningful mitigation strategies and identifies existing opportunities to increase and enhance that capacity. Specific capabilities addressed in this section include planning and regulatory capability, staff and organizational (administrative) capability, technical capability, fiscal capability, and political capability. Information was obtained through the use of detailed survey questionnaires for local officials and an inventory and analysis of existing plans, ordinances, and relevant documents. The purpose of this assessment is to identify any existing gaps, weaknesses, or conflicts in programs or activities that may hinder mitigation efforts, and to identify those activities that should be built upon to establish a successful and sustainable regional hazard mitigation program.

The Regional Information, Risk Assessment, and Capability Assessment sections collectively serve as a basis for determining the goals for the Hazard Mitigation Plan; each contributing to the development, adoption, and implementation of a meaningful Mitigation Strategy that is based on accurate background information.

The Mitigation Strategy, found in Chapter 6, consists of broad regional goal statements as well as specific mitigation actions for each local government jurisdiction participating in the planning process. The strategy provides the foundation for detailed jurisdictional Mitigation Action Plans, found in Chapter 7, that link specific mitigation actions for each jurisdiction to locally-assigned implementation mechanisms and target completion dates. Together, these sections are designed to make the Plan both strategic (through the identification of long-term goals), but also functional through the identification of short-term and immediate actions that will guide day-to-day decision-making and project implementation.

In addition to the identification and prioritization of possible mitigation projects, emphasis is placed on the use of program and policy alternatives to help make the communities of the Northern Virginia region less vulnerable to the damaging forces of nature while improving the economic, social, and environmental health of the community. The concept of multi-objective



planning was emphasized throughout the planning process, particularly in identifying ways to link hazard mitigation policies and programs with complimentary community goals related to housing, economic development, downtown revitalization, recreational opportunities, transportation improvements, environmental quality, land development, and public health and safety.

The Plan Maintenance Procedures, found in Chapter 8, include the measures that the Northern Virginia Regional Commission and participating jurisdictions will take to ensure the Plan's continuous long-term implementation. The procedures also include the manner in which the Plan will be regularly evaluated and updated to remain a current and meaningful planning document.



Chapter 1: Introduction

Mitigation is commonly defined as sustained actions taken to reduce or eliminate long-term risk to people and property from hazards and their effects. Hazard mitigation focuses attention and resources on community policies and actions that will produce successive benefits over time. A mitigation plan states the aspirations and specific courses of action that a community intends to follow to reduce vulnerability and exposure to future hazard events. These plans are formulated through a systematic process centered on the participation of citizens, businesses, public officials, and other community stakeholders.

A local mitigation plan is the physical representation of a jurisdiction’s commitment to reduce risks from natural hazards. Local officials can refer to the plan in their day-to-day activities and in decisions regarding regulations and ordinances, granting permits, and in funding capital improvements and other community initiatives. Additionally, these local plans will serve as the basis for States to prioritize future grant funding as it becomes available.

It is hoped that the Northern Virginia Hazard Mitigation Plan will be a useful tool for all community stakeholders by increasing public awareness about local hazards and risks, while at the same time providing information about options and resources available to reduce those risks. Teaching the public about potential hazards will help each of the area’s jurisdictions protect itself against the effects of the hazards, and will enable informed decision making on where to live, purchase property, or locate businesses.

The areas covered by this plan include:

Table 1.1. Participating Communities	
Counties	Towns
Arlington County	Town of Clifton
Fairfax County	Town of Dumfries
Loudoun County	Town of Haymarket
Prince William County	Town of Herndon
	Town of Leesburg
	Town of Middleburg
	Town of Purcellville
	Town of Occoquan
	Town of Quantico
	Town of Round Hill
	Town of Vienna

I. Background

Natural hazards, such as floods, tornadoes, and severe winter storms are a part of the world around us. Their occurrence is natural and inevitable, and there is little we can do to control their force and intensity.



The Northern Virginia region is vulnerable to a wide range of natural hazards, including flooding, tornadoes, hurricanes, and winter storms. These hazards threaten the safety of residents and have the potential to damage or destroy both public and private property, disrupt the local economy, and impact the overall quality of life of individuals who live, work, and play in the Northern Virginia region.

While we cannot eliminate natural hazards, there is much we can do to lessen their potential impacts upon our community and our citizens. The effective reduction of a hazard’s impact can decrease the likelihood that such events will result in a disaster. The concept and practice of reducing risks to people and property from known hazards is generally referred to as hazard mitigation.

Hazard mitigation techniques include both structural measures, such as strengthening or protecting buildings and infrastructure from the destructive forces of potential hazards; and non-structural measures, such as the adoption of sound land-use policies or the creation of public awareness programs. Some of the most effective mitigation measures are implemented at the local government level where decisions on the regulation and control of development are made. A comprehensive mitigation strategy addresses hazard vulnerabilities that exist today and in the foreseeable future. Therefore it is essential that projected patterns of development are evaluated and considered in terms of how that growth will increase or decrease a community’s overall hazard vulnerability. Land use is a particularly important topic in the Northern Virginia region, where many communities are facing increasing growth rates. Now is the time to effectively guide development away from identified hazard areas and environmentally sensitive locations, before unsound development patterns emerge and people and property are placed in harm’s way.

One of the most effective tools a community can use to reduce hazard vulnerability is to develop, adopt, and update as needed, a local hazard mitigation plan. A hazard mitigation plan establishes the broad community vision and guiding principles for addressing hazard risk, including the development of specific mitigation actions designed to eliminate or reduce identified vulnerabilities. The Northern Virginia Regional Hazard Mitigation Plan (hereinafter “Hazard Mitigation Plan” or “Plan”) is a logical first step toward incorporating hazard mitigation principles and practices into the routine activities and functions of local government within the Northern Virginia region.

The mitigation actions noted in this Plan go beyond recommending structural solutions to reduce existing vulnerability. Local policies addressing community growth, incentives to protect natural resources, and public awareness and outreach campaigns are examples of other measures that can be used to reduce the future vulnerability of the Northern Virginia region to identified hazards. The Plan has been designed to be a living document, with implementation and evaluation procedures included to help achieve meaningful objectives and successful outcomes.

A. Disaster Mitigation Act of 2000

In an effort to reduce the Nation's mounting natural disaster losses, the U.S. Congress passed the Disaster Mitigation Act of 2000 (DMA 2000) in order to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act. Section 322 of DMA 2000 emphasizes the need for State and local government entities to closely coordinate on mitigation planning activities, and makes



the development of a hazard mitigation plan a specific eligibility requirement for any local government applying for Federal mitigation grant funds. These funds include the Hazard Mitigation Grant Program (HMGP) and the newly-created Pre-Disaster Mitigation (PDM) program, both of which are administered by the Federal Emergency Management Agency (FEMA) under the Department of Homeland Security. Communities with an adopted and federally-approved hazard mitigation plan thereby become pre-positioned and more apt to receive available mitigation funds before and after the next disaster strikes.

The Plan has been prepared in coordination with FEMA Region III and the Virginia Division of Emergency Management (VDEM) to ensure that the Plan meets all applicable DMA 2000 and State requirements. A Local Mitigation Plan Crosswalk, found in Appendix A, provides a summary of Federal and State minimum standards and notes the location where each requirement is met within the Plan.

II. Overview of Hazard Mitigation Planning

Local hazard mitigation planning is the process of organizing community resources, identifying and assessing hazard risks, and determining how to best minimize or manage those risks. This process results in a hazard mitigation plan that identifies specific mitigation actions, each designed to achieve both short-term planning objectives and a long-term community vision. To ensure the functionality of each mitigation action, responsibility is assigned to a specific individual, department, or agency along with a schedule for its implementation. Plan maintenance procedures are established for the routine monitoring of implementation progress, as well as the evaluation and enhancement of the mitigation plan itself. These plan maintenance procedures ensure that the plan remains a current, dynamic, and effective planning document over time.

Mitigation planning offers many benefits, including:

- saving lives and property;
- saving money;
- speeding recovery following disasters;
- reducing future vulnerability through wise development and post-disaster recovery and reconstruction;
- expediting the receipt of pre-disaster and post-disaster grant funding; and
- demonstrating a firm commitment to improving community health and safety.

Typically, mitigation planning is described as having the potential to produce long-term and recurring benefits by breaking the repetitive cycle of disaster loss. A core assumption of hazard mitigation is that pre-disaster investments will significantly reduce the demand for post-disaster assistance by lessening the need for emergency response, repair, recovery, and reconstruction. Furthermore, mitigation practices will enable local residents, businesses, and industries to re-establish themselves in the wake of a disaster, getting the community economy back on track sooner and with less interruption.



The benefits of mitigation planning go beyond solely reducing hazard vulnerability. Measures such as the acquisition or regulation of land in known hazard areas can help achieve multiple community goals, such as preserving open space, maintaining environmental health, and enhancing recreational opportunities. Thus, it is vitally important that any local mitigation planning process be integrated with other concurrent local planning efforts, and any proposed mitigation strategies must take into account other existing community goals or initiatives that will help complement or hinder their future implementation.

III. Purpose of Plan

The purpose of the Plan is to:

- Protect life, safety, and property by reducing the potential for future damages and economic losses that result from **natural** hazards;
- Make communities safer places to live, work, and play;
- Qualify for grant funding in both the pre-disaster and post-disaster environment;
- Speed recovery and redevelopment following future disaster events;
- Demonstrate a firm local commitment to hazard mitigation principles; and
- Comply with State and Federal legislative requirements for local multi-jurisdictional hazard mitigation plans.

IV. Authority

Following conditional approval of the plan by both VDEM and FEMA, the plan will be brought forth to each participating jurisdiction to be formally adopted.

The Plan, developed in accordance with current State and Federal rules and regulations governing local hazard mitigation plans, will be adopted by the four counties, five cities, and 11 participating municipalities in accordance with the authority and police powers granted to counties, cities, and municipalities under §15.2-2223 through §15.2-2231 of the Virginia State Code. Copies of local adoption resolutions are provided in Appendix B (to be completed after adoption). The Plan shall be routinely monitored and revised to maintain compliance with the following provisions, rules, and legislation:

- Section 322, Mitigation Planning, of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as enacted by Section 104 of the Disaster Mitigation Act of 2000 (P.L. 106-390); and
- FEMA's Interim Final Rule published in the Federal Register on February 26, 2002, at 44 CFR Part 201.



V. Summary of Plan Contents

The additional contents of this Plan are designed and organized to be as reader-friendly and functional as possible. While significant background information is included on the processes used and studies completed (e.g., risk assessment, capability assessment), this information is separated from the more meaningful planning outcomes or actions (e.g., mitigation strategy, mitigation action plans).

Chapter 2, Planning Process, provides a complete narrative description of the process used to prepare the Plan. This includes the identification of who was involved, who participated on the planning team, and how the public and other stakeholders were involved. It also includes a detailed summary for each of the key meetings held along with any associated outcomes.

The Regional Information section, located in Chapter 3, describes the general makeup of the Northern Virginia region, including prevalent geographic, demographic and economic characteristics. In addition, transportation, housing and land use patterns are discussed. This baseline information provides a snapshot of the regional planning area and thereby assists county and municipal officials to recognize those social, environmental, and economic factors that ultimately play a role in determining community vulnerability to natural hazards.

The Regional HIRA is presented in Chapter 4. This section serves to identify, analyze, and assess the Northern Virginia region's overall risk to natural hazards. The risk assessment also attempts to define any hazard risks that may uniquely or exclusively affect the individual municipal jurisdictions.

The Risk Assessment builds on available historical data from past hazard occurrences, establishes detailed profiles for each hazard, and culminates in a hazard risk ranking based on conclusions about the frequency of occurrence, spatial extent, and potential impact of each hazard. FEMA's HAZUS^{MH} loss estimation methodology was also used in evaluating known hazard risks by their relative long-term cost in expected damages. In essence, the information generated through the risk assessment serves a critical function as communities seek to determine the most appropriate mitigation actions to pursue and implement — enabling communities to prioritize and focus their efforts on those hazards of greatest concern and those structures or planning areas facing the greatest risk(s).

The Capability Assessment, found in Chapter 5, provides a comprehensive examination of each participating jurisdiction's capacity to implement meaningful mitigation strategies and identifies existing opportunities to increase and enhance that capacity. Specific capabilities addressed in this section include planning and regulatory capability, staff and organizational (administrative) capability, technical capability, fiscal capability, and political capability. Information was obtained through the use of detailed survey questionnaires for local officials and an inventory and analysis of existing plans, ordinances and relevant documents. The purpose of this assessment is to identify any existing gaps, weaknesses, or conflicts in programs or activities that may hinder mitigation efforts, and to identify those activities that should be built upon in establishing a successful and sustainable regional hazard mitigation program.



The Regional Information, Risk Assessment, and Capability Assessment sections collectively serve as a basis for determining the goals for the Hazard Mitigation Plan, each contributing to the development, adoption, and implementation of a meaningful Mitigation Strategy that is based on accurate background information.

The Mitigation Strategy, found in Chapter 6, consists of broad regional goal statements as well as specific mitigation actions for each local government jurisdiction participating in the planning process. The strategy provides the foundation for detailed jurisdictional Mitigation Action Plans, found in Chapter 7, that link specific mitigation actions for each jurisdiction to locally-assigned implementation mechanisms and target completion dates. Together, these sections are designed to make the Plan both strategic (through the identification of long-term goals) but also functional through the identification of short-term and immediate actions that will guide day-to-day decision-making and project implementation.

In addition to the identification and prioritization of possible mitigation projects, emphasis is placed on the use of program and policy alternatives to help make the communities of the Northern Virginia region less vulnerable to the damaging forces of nature, while improving the economic, social, and environmental health of the community. The concept of multi-objective planning was emphasized throughout the planning process, particularly in identifying ways to link hazard mitigation policies and programs with complimentary community goals related to housing, economic development, downtown revitalization, recreational opportunities, transportation improvements, environmental quality, land development, and public health and safety.

The Plan Maintenance Procedures, found in Chapter 8, include the measures that the Northern Virginia Regional Commission and participating jurisdictions will take to ensure the Plan's continuous long-term implementation. The procedures also include the manner in which the Plan will be regularly evaluated and updated to remain a current and meaningful planning document.



Chapter 2: Planning Process

For the 2010 plan update, the Mitigation Advisory Committee (MAC) held six in-person meetings and multiple conference calls during the plan update process. The dates and the description of the activities at these in-person meetings are below, and each meeting was organized and facilitated by the contractor, Dewberry, LLC. Meeting sign-in sheets are located in Appendix C.

Date	Meeting Purpose
December 4, 2009	Project Kickoff Meeting
January 15, 2010	Hazard Identification and Risk Assessment Phase I
July 12, 2010	Hazard Identification and Risk Assessment Results and Capability Assessment Briefing
August – September (Jurisdictional Visits)	Mitigation Strategies
October 18, 2010	Mitigation Actions Meeting
January 27, 2010	Draft Plan Conference Call

Kickoff Meeting

The update of the 2006 Northern Virginia Hazard Mitigation plan began with data collection. A kick-off meeting was held on December 4, 2009, with representatives from various counties and cities in the planning region in attendance. A list of participants for each committee meeting can be found in Appendix C. At the kickoff meeting, the planning process was discussed in detail, along with the proposed schedule of deliverables. Additionally, the committee was asked to review the list of hazards in the 2006 plan and determine if the list should carry over as-is to the 2010 plan, or if changes were necessary.

Following the kickoff meeting, community, county, State, and Federal resources were identified and contacted to collect pertinent policy and regulatory information from each of the jurisdictions. This information included comprehensive plans, zoning ordinances, development ordinances, and building codes. Dewberry collected information about natural hazards including past occurrences and projected frequencies of future occurrence and the anticipated risk, where available.

Hazard Identification and Risk Assessment Meeting

A second meeting was held on January 15, 2010, to discuss the goals and vision of the plan's HIRA section. The HIRA process involved analyzing the region's greatest hazard threats and determining its most significant vulnerabilities with respect to natural hazards. Risk was determined by looking at the total threat and vulnerability for all of the jurisdictions for each hazard identified by the MAC. The HIRA was performed in large part using GIS data from the participating jurisdictions, HAZUS^{MH} (a GIS-based FEMA loss estimation software), and State sources. At the HIRA results meeting in July 2010, the MAC reviewed the draft HIRA.



Hazard Identification and Risk Assessment Results Meeting

The hazards initially identified in the 2006 plan were discussed and re-prioritized at the July meeting. Using the new prioritization, updates were made to the HIRA.

Simultaneous to conducting the HIRA, Dewberry also assessed the mitigation capabilities of the jurisdictions in the planning region. A capability assessment was performed whereby the existing programs and policies addressing natural hazards were reviewed. A thorough analysis of the adequacy of existing measures was performed, and potential changes and improvements were identified. The committee reviewed the capability assessment at the second HIRA meeting conducted July 12, 2010.

August – September Jurisdictional Meetings

Following the HIRA Results meeting on July 12, each county and city held a meeting to develop jurisdiction-specific mitigation actions. The attendees of these meetings included county and city department representatives and town representatives at the county meetings where appropriate. The first part of each meeting included an overview of the HIRA results, followed by the development of mitigation actions.

Mitigation Actions Meeting

Next, the committee worked to identify and develop potential regional mitigation actions for implementation at the October 18, 2010, Strategies meeting. The MAC considered issues related to potential damage from hazard events within the region and evaluated the 2006 projects and helped draft an action plan that specifies recommended projects, who is responsible for implementing the projects, and when they are to be completed.

Draft Plan Meeting

A draft plan conference call meeting was held on January 27, 2011, where the MAC discussed the draft plan in its entirety and the changes they thought should be made prior to the final draft plan submission to VDEM. Additionally, the committee discussed the public outreach methods being explored and executed within the various jurisdictions. For a detailed explanation of the public outreach methods, see Section II below.

The region will continue to implement the plan and perform periodic reviews and revisions through on-going MAC reviews and revisions. The Arlington County Office of Emergency Management will organize an annual planning review of the mitigation plan, and public meetings will be held during the five-year review/update period.

I. Mitigation Advisory Committee

The planning region convened an advisory committee comprised of representatives from various participating jurisdictions. The MAC worked with the Dewberry team and provided input at key stages of the process. Efforts to involve municipal, city, and county departments and community organizations that might have a role in the implementation of the mitigation actions or policies included invitations to attend meetings and serve on the MAC, access to the project website, e-mail updates, strategy development workshops, plus opportunities for input and comment on all draft deliverables.



The following members were a part of the MAC and were chosen by their respective jurisdictions to participate in the development of this plan:

Member	Jurisdiction
David Morrison	Arlington County
Joanne Hughes	Arlington County
Charlie McRorie	City of Alexandria
Ken Rudnicki	City of Fairfax
Walter English	City of Fairfax
Dan Ellis	City of Falls Church
John O’Neal	City of Manassas Park
Elizabeth McKinney	Fairfax County
Kevin Johnson	Loudoun County
Alexa Hussar	Prince William County
Pat Collins	Prince William County
Beth Brown	Virginia Department of Emergency Management
Amy Howard, Debbie Messmer	Virginia Department of Emergency Management

II. Public Involvement and Citizen Input

An important component of this planning process is the opportunity for the general public to provide input. Individual citizen and community-based input provided the planning team with a greater understanding of local concerns and increased the likelihood of successfully implementing mitigation actions by developing community “buy-in” from those directly affected by the decisions of public officials. As citizens become more involved in decisions that affect their safety, they are more likely to gain a greater appreciation of the natural hazards present in their community and take the steps necessary to reduce their impact. Public awareness is a key component of any community’s overall mitigation strategy aimed at making a home, neighborhood, school, business, or city safer from the potential effects of natural hazards. This public outreach effort was also an opportunity for neighboring jurisdictions, agencies, businesses, academia, nonprofits, and other interested parties to be involved in the planning process. Local jurisdictions included Community Emergency Response Teams (CERTs), the American Red Cross, and Citizen Corp groups in planning meetings and presentations for this plan update. A complete list of public outreach initiatives can be found below; however, it should be noted that many jurisdictions chose to have public outreach meetings following conditional approval of this plan.



The following lists include an explanation of the public outreach efforts accomplished by each participating jurisdiction. This section is considered a work-in-progress and will be completed by formal adoption.

Arlington County

- The Plan has been posted for review and comment on the county's website.
- The Plan project has been presented to the county commission which addresses emergency management issues

Fairfax County (including the Towns of Clifton, Herndon, and Vienna)

- The County and Towns posted the draft plan at www.fairfaxcounty.gov for public comment and review. Please see Appendix H for a screenshot example.
- The County also posted a link to the Plan on their Twitter and Facebook pages, advertising that public review and comments were welcome.
- Fairfax County additionally sent out a newsletter to a group of businesses and non-profits that are part of the Emergency Support Function-15 Council of Governments group, advertising that the Plan was being updated and it could be accessed on the county website.
- The Office of Emergency Management (OEM) also included the link to the Plan in a monthly newsletter that is distributed to all county agencies and partner agencies.
- OEM's Outreach Coordinator also included the Plan update information in a monthly newsletter which is distributed to groups such as Fairfax County Citizen Corp Groups.
- Lastly, the County also utilized its daily newsletter "Newswire," which is circulated to all county employees, elected officials, and partner agencies, and the Tyson's Corner Security Officers Association.

Loudoun County (Including the Towns of Leesburg, Middleburg, Purcellville, and Round Hill)

- A link to the draft plan will be posted to the OEM website, which is www.loudoun.gov/oem, in the summer of 2011.
- OEM will coordinate the set-up of our display board at the government center depicting the hazard maps, vulnerability analysis, and opportunity for the public to provide input. A "do you want to know more?" tag line routing citizens to the website will be added.
- OEM will coordinate with the Loudoun County Public Information Office to distribute messages on Twitter and Facebook announcing the project and directing residents to the website.

Prince William County (including the Towns of Dumfries, Haymarket, Occoquan, and Quantico)

- A link to the draft plan will be posted on the county website for review and comment by the public during the summer of 2011.
- The County posted information about the plan being available for review by the public on their local cable channel.

City of Alexandria

- The City will post a link to the draft plan on their Emergency Management website, requesting that the public review and comment on the plan during the summer of 2011.



- The City printed a hard copy of the plan and displayed it at the Beatley Central Library on 5005 Duke Street for the public to review and comment.

City of Fairfax

- On January 5, 2011, the City of Fairfax OEM presented an overview of the draft 2010 Northern Virginia Hazard Mitigation Plan to its Community Emergency Response Team. A copy of this presentation can be found in Appendix H.
- The City posted a link to the draft plan on their Emergency Management website, requesting that the public review and comment on the plan. A screenshot can be found in Appendix H.

City of Falls Church

- Upon receiving the final document the City will provide public outreach via the City website, Facebook, and eFocus (newsletter).
- Upon receiving the final document the City will provide public outreach via eFocus (newsletter).

City of Manassas

- The City intends to post the Plan to the City website during the summer of 2011. Contacts have been made with television media to promote the plan through a news story.

City of Manassas Park

- The City posted the plan on its website on February 16, 2011. A screenshot of this website can be found in Appendix H.
- The Plan will be featured on the City's cable channel.
- Presentations were made to the Citizen Corps organizations within the city, as well as CERT.

III. Incorporation of Existing Plans and Studies

The Plan incorporates information from a number of other previously produced plans, studies, and reports. These documents include:

- Commonwealth of Virginia Hazard Mitigation Plan, 2010
- Critical Infrastructure Protection in the National Capital Region, 2005
- National Capital Region Hazard Identification and Risk Assessment, 2007
- National Capital Region Strategic Hazard Identification and Evaluation for Leadership Decisions (NCR SHIELD), 2008.



Chapter 3: Regional Information

I. Northern Virginia Overview

A. Planning Region

The Northern Virginia planning region includes Arlington, Fairfax, Loudoun, and Prince William counties, as well as the cities and towns located within these counties (20 jurisdictions). The communities participating in the 2010 hazard mitigation plan update plan are summarized in Table 3.1 and graphically in Figure 3.1.

The 2006 Hazard Mitigation Plan grouped the Northern Virginia region into four distinct planning areas within the Northern Virginia region to aggregate and summarize historical hazard events and damage figures (Table 3.1). During the kick-off meeting for the plan update it was decided that each jurisdiction should be represented individually; if no information is available it has been noted in the risk assessment.

Table 3.1. 2006 Planning Regions.	
Planning Area	Jurisdictions Included
1	Arlington County
2	Fairfax County City of Alexandria City of Fairfax City of Falls Church Town of Clifton Town of Herndon Town of Vienna
3	Loudoun County Town of Leesburg Town of Purcellville Town of Round Hill Town of Middleburg
4	Prince William County City of Manassas City of Manassas Park Town of Dumfries Town of Occoquan Town of Quantico Town of Haymarket

Fourteen jurisdictions participated in the 2006 Hazard Mitigation Plan. For this update, the six towns have joined the planning process and include Clifton, Middleburg, Round Hill, Haymarket, Occoquan, and Quantico.

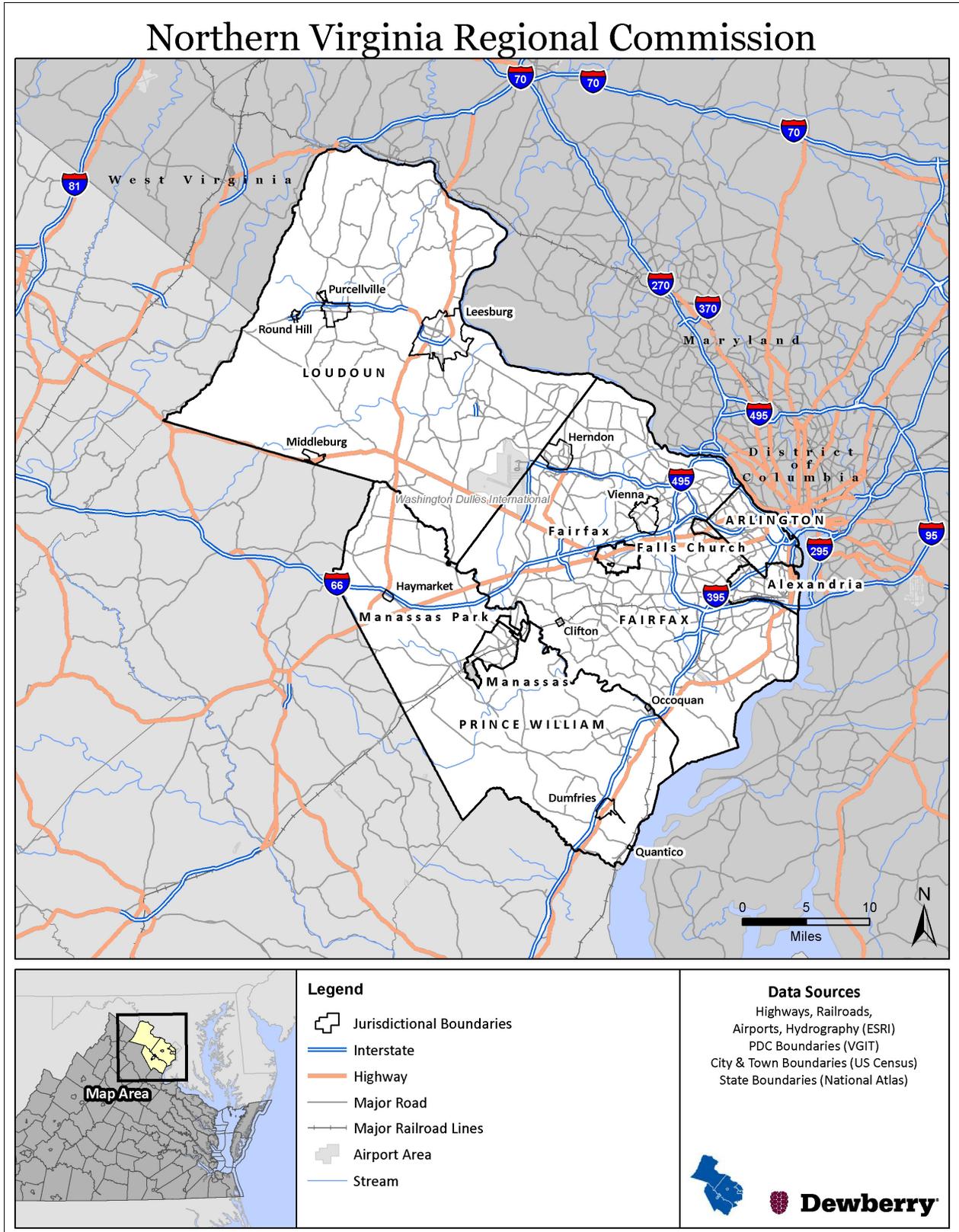


Figure 3.1. Northern Virginia 2010 Hazard Mitigation Plan Update Region



1. County Profiles

Arlington County

The area that encompasses present-day Arlington County was first settled as part of the British Colony of Virginia in the late 1690s. In 1791, George Washington surveyed the area in what was to become the District of Columbia. Congress returned the area to the Commonwealth of Virginia in 1842 as the County of Alexandria. In 1870, the City of Alexandria became



independent of Alexandria County, and the county portion was officially renamed Arlington County in 1920. The 2009 census estimate for the county is 212,038, an approximately 12% increase during the past decade.

Arlington is an urban county of about 26 square miles located directly across the Potomac River from Washington DC. Arlington's central location in the Washington DC metropolitan area, its ease of access by car and public transportation, and its highly skilled labor force have attracted an increasingly varied residential and commercial mix. Arlington is one of the most densely populated communities in the nation with more than 7,315 persons per square mile.

Arlington's high population density and its location along the banks of the Potomac River, increase the city's vulnerability to a variety of hazards, most notably flooding. In addition to snow melt and rain-related river flooding episodes, Arlington is also subjected to tidal and storm surge flooding. As sea levels rise, permanent inundation of low lying areas along and near the river shoreline is also a threat. Additionally, winter storms pose significant threats, as evidenced during the 2009 – 2010 winter season.

Fairfax County

The land that is now Fairfax County was part of the Northern Neck Proprietary granted by King Charles II in 1660 and inherited by Thomas Fairfax, Sixth Lord Fairfax of Cameron, in 1719. The county itself was formed in 1742 from Prince William County. The 2009 census population estimate for the county is 1,036,473, an approximately 7% increase during the past decade.



Fairfax County comprises about 407 square miles located directly across the Potomac River from Washington, DC. The county's location in the Washington metropolitan area, its ease of access by car and public transportation, and its highly skilled labor force have attracted an increasingly varied residential and commercial mix. Most commercial development is centered around Tysons Corner, which is the 12th largest central business district in the nation.

Due to its situation on both the Virginia piedmont and the Atlantic coastal plain, the County experiences a variety of weather. The diversity of Fairfax County's landscape increases the County's vulnerability to a variety of hazards, most notably flooding and severe storms. In addition to snow melt and rain-related river flooding episodes, low-lying areas of Fairfax County along the Potomac River are also subject to tidal and storm surge flooding. As sea levels rise,



permanent inundation of low lying areas along and near the river shoreline is also a threat. Additionally, winter storms pose significant threats, as evidenced during the 2009 – 2010 winter season.

Loudoun County

Loudoun County was established in 1757 and was formerly part of Fairfax County. It was named after John Campbell, Fourth Earl of Loudoun and past Governor of the Commonwealth of Virginia. It was the most populous Virginia county during the time of the American Revolution. Since 1757, the county seat has always been the Town of Leesburg. In 2010, Loudoun County was ranked by Forbes as America’s wealthiest county. The County has a total area of 521 square miles, of which one square mile is water. As of the 2000 Census, it has a population density of 272 per square mile. The population was estimated to be approximately 298,113 in 2009 by the U.S. Census Bureau, a nearly 76% increase over the 2000 population of 169,599.



Geographically, Loudoun County is bounded to the North by the Potomac River, to the south are Prince William and Fauquier counties, and on the west by the watershed of the Blue Ridge Mountains. The Bull Run Mountains and Catoclin Mountain run through the County. There are seven incorporated and 60 unincorporated towns within the County.

Risk factors for the county are in part due to its proximity to the Nation’s capital and its growth rate. The county has a risk of flooding due to low lying areas surrounding the Potomac River and other natural hazards and risks, such as storm damage and winter weather. Winter storms pose significant threats, as evidenced during the 2009 – 2010 winter season.

Prince William County

Prince William County was formed in 1730, and was named by the Virginia General Assembly to honor the son of King George II. The county seat is the City of Manassas. Prince William County has a total area of 338 square miles, of which 11 square miles are water. It has a population density of 819 per square mile. In 2009, the population was estimated at 386,934, an approximately 38% increase over the 2000 census. It was the fourth fastest growing county in the United States during that period.



Prince William County has grown more than 200% over a 20-year period. This is because of its central location to the Washington, DC metropolitan area. The population growth rate poses a risk; as open land is developed flood management must be addressed with the increasing amounts of impervious surfaces. Its flood risk is also due to low lying areas surrounding the Potomac River. Other natural hazards and risks are storm damage and winter weather. Winter storms pose significant threats, as evidenced during the 2009 – 2010 winter season.



2. City Profiles

City of Alexandria

What is now the City of Alexandria was first settled as part of the British Colony of Virginia in the late 1690s. In 1791, George Washington included portions of the City of Alexandria in what was to become the District of Columbia. That portion was given back to Virginia in 1846 and the City of Alexandria was re-chartered in 1852. In 1870, the City of Alexandria became independent of Alexandria County, with the remainder of the County changing its name to Arlington County in 1920. The population of the city was 128,283 per the 2000 Census and was estimated to be 141,738 in 2009.



Alexandria's high population density and its location along the banks of the Potomac River, increase the city's vulnerability to a variety of hazards, most notably flooding. In addition to snow melt and rain-related river flooding episodes, Alexandria is also subjected to tidal and storm surge flooding. As sea levels rise, permanent inundation of low lying areas along and near the river shoreline is also a concern. Winter weather and high wind events also pose a significant threat to the city as the 2009 – 2010 winter and summer seasons have proven.

City of Fairfax

Named after Thomas Fairfax, Sixth Lord Fairfax of Cameron, what is now known as the City of Fairfax became an independent city in 1961. This occurred only after having been previously known as Earp's Corner, then Town of Providence, and eventually Town of Fairfax. Its population was 21,498 as of the 2000 Census and was estimated by the Census Bureau to be 24,702 in 2009.



The city's location on the eastern edge of the Virginia Piedmont make it susceptible to natural hazards and risks, such as storm damage and winter weather, as evidenced during the 2009 – 2010 winter season.

City of Falls Church

It is believed that the area was first settled by Europeans in 1699. The city takes its name from what was coined The Falls Church, a building that was built in 1757. The population of the city was 10,377 as of the 2000 Census and was estimated by the Census Bureau to be 11,711 in 2009.



The City of Falls Church comprises about 2.2 square miles located approximately 10 miles west of Washington, DC. The City's proximity to the Washington metropolitan area and its ease of access by car and public transportation have allowed increasingly-varied residential and



commercial development. Falls Church is densely populated with more than 5,077 persons per square mile.

The City of Falls Church experiences significant flood threats due to the presence of Four Mile Run and Tripps Run. The City's location on the eastern edge of the Virginia Piedmont make it susceptible to other natural hazards and risks, such as damage from severe storms and winter weather, as evidenced during the 2009 – 2010 winter and summer seasons.

City of Manassas

The City of Manassas played an important role during the American Civil War. The First Battle of Bull Run (also called First Battle of Manassas) was fought in the vicinity in 1861. It was the first land battle of the Civil War. The Second Battle of Bull Run took place August 28-30, 1862. The Town of Manassas was



incorporated in 1873 and became an independent city in 1975. The population of the city was 35,135 as of the 2000 Census and was estimated by the Census Bureau to be 36,213 in 2009.

Manassas is subject to high wind events, winter weather, and flooding. Winter storms pose significant threats, as evidenced during the 2009 – 2010 winter season.

City of Manassas Park

The City of Manassas Park was incorporated in 1957 and became an independent city in 1975. It was the last town in Virginia to become a city before a moratorium was placed on other towns achieving similar status. The population of the city was 10,290 as of the 2000 Census and was estimated by the Census Bureau to be 14,026 in 2009.





3. Town Profiles

Town of Dumfries

Dumfries was chartered on May 11, 1749, and is Virginia's oldest continuously chartered town. John Graham gave the land on which the town was founded and is named after his birthplace, Dumfrieshire, Scotland. The population of the town was 4,937 as of the 2000 Census and was estimated by the Census Bureau to be 4,954 in 2009.



Town of Herndon



Incorporated in 1879, the area on which the town was built was originally granted to Thomas Culpeper by King Charles II of England in 1688. Much of the downtown was destroyed on March 22, 1917, by a fire but was rebuilt with brick instead of wood. The population of the town was 21,655 as of the 2000 Census and was estimated by the Census Bureau to be 22,579 in 2009.

Town of Leesburg

Steeped in history, Leesburg is the county seat of Loudoun County. Leesburg was established in 1758, and formally became a town by signed act of the Virginia General Assembly on February 18, 1813. It is located just over 30 miles west-northwest of Washington, DC, at the base of Catoctin Mountain and adjacent to the Potomac River. The principal drainage for the town is Tuscarora Creek and its northern "Town Branch," which empties into Goose Creek to the east of town.



European settlement began in the late 1730s. After its founding, it was the location of the post office and regional courthouse. The town was originally established on 60 acres of land. The population of the town was 28,311 as of the 2000 Census and was estimated by the Census Bureau to be 40,927 in 2009.

Town of Vienna

Originally called Ayr Hill, the village agreed in the 1850s to change its name to Vienna at the request of William Hendrick, a medical doctor who grew up in Vienna, New York. Vienna was incorporated as a town in 1890. The population of the town was 14,453 as of the 2000 Census and was estimated by the Census Bureau to be 15,215 in 2009.



Town of Purcellville



Settled in the mid 1700s, the village was first known as Purcell’s Store. The village renamed to Purcellville on July 9, 1852, and was incorporated in 1908. Many present structures in the town reflect the Victorian architecture of the turn of the century. Located in the western portion of Loudoun County, the town has a total area of 2.6 square miles. Wine production is a thriving industry in this area, with approximately 30 wineries in the region. The Blue Ridge Mountains are just to the west and in good weather are usually visible from town. Recreation includes the WO&D bike trail, the western portion of which ends here. The population of the town was 3,584 as of the 2000 Census and was estimated by the Census Bureau to be 5,309 in 2009.

Town of Clifton

Formerly known as Devereux Station, Clifton became the first town in Fairfax County when it incorporated on March 9, 1902. The population of the town was 185 as of the 2000 Census and was estimated by the Census Bureau to be 216 in 2009.

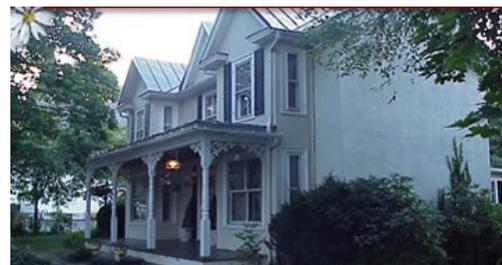


Town of Middleburg

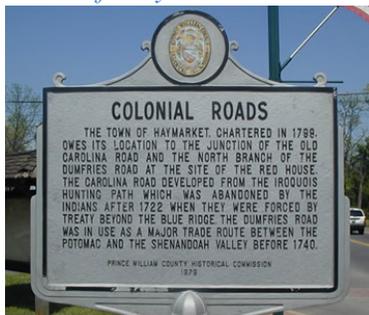
The population of the Town was 632 as of the 2000 Census and was estimated by the Census Bureau to be 976 in 2009. Middleburg is located in Loudoun County and covers approximately 0.6 square miles of land. The population density of the town is 1,083 people per square mile.

Town of Round Hill

Named after the 910 foot hill located just southwest of the town center, and part of the foothills of the Blue Ridge Mountains, Round Hill was incorporated in 1900. The population of the town was 500 as of the 2000 Census and was estimated by the Census Bureau to be 759 in 2009.



Town of Haymarket



Chartered in 1799 by the Virginia General Assembly, the Town of Haymarket was incorporated in 1882. The population of the town was 879 as of the 2000 Census and was estimated by the Census Bureau to be 1,252 in 2009.

Since the 1900s it has been popular for fox hunting and steeple chasing and is also known for its wineries. The town covers 0.5 square miles of land and is located in Prince William County.



Town of Occoquan

Derived from a Dogue Indian word meaning ‘at the end of the water,’ Occoquan was divided into lots and streets were laid out in 1804 by Nathaniel Ellicott, James Campbell, and Luke Wheeler. The population of the town was 759 as of the 2000 Census and was estimated by the Census Bureau to be 834 in 2009.



Town of Quantico

Located in Prince William County and surrounded by the Marine Corps Base Quantico, the population of the town was 561 as of the 2000 Census and was estimated by the Census Bureau to be 607 in 2009.



B. Geography, Hydrology, and Climate

1. Geography

The Northern Virginia planning region is located at the north-east corner of the Commonwealth of Virginia, lies across the Potomac River from the Nation's Capital, Washington, DC, and is part of the Washington, DC-Maryland-Virginia-West Virginia Primary Metropolitan Statistical Area. Figure 3.1 above is an overview map for the Northern Virginia region including all counties, cities, and towns within the region.

Northern Virginia is made up of the counties of Arlington, Fairfax, Loudoun, and Prince William; the independent cities of Alexandria, Falls Church, Fairfax, Manassas, and Manassas Park; the major towns of Dumfries (Prince William County), Herndon and Vienna (Fairfax County), and Leesburg and Purcellville (Loudoun County); and the smaller towns of Clifton (Fairfax County), Middleburg and Round Hill (Loudoun County), and Haymarket, Occoquan, and Quantico (Prince William County). Figure 3.2 is a base map overview of the Northern Virginia region including all participating county, city, and town jurisdictions, as well as the identification of interstate highways, major roads, major water bodies, and lands outside the authority of participating jurisdictions such as Dulles Airport and U.S. government property.

Northern Virginia is home to numerous Federal government facilities such as the Pentagon, CIA, and U.S. Geological Survey. Historic and cultural resources include George Washington's historic home on the Potomac, Mount Vernon; Arlington National Cemetery; and the Udvar-Hazy Center of the Smithsonian Institution's National Air and Space Museum at Washington-Dulles International Airport.

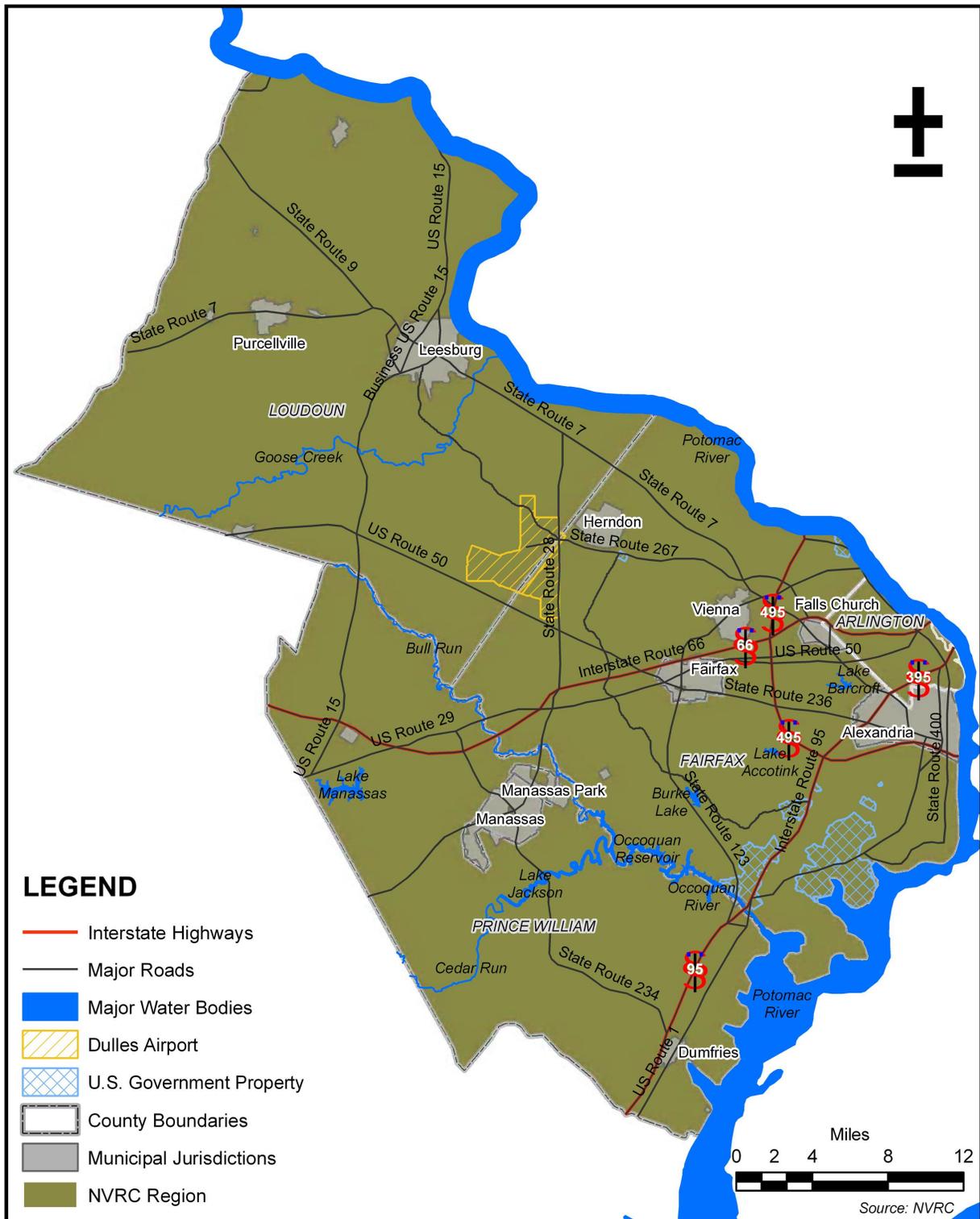


Figure 3.2. Major Features in Northern Virginia
Source: 2006 Northern VA HIRA from Northern Virginia Regional Commission & PBS&J



2. Hydrology

The Northern Virginia Planning District is divided by three physiographic provinces of Virginia: the Coastal Plain, the Northern Piedmont, and the Blue Ridge (Figure 3.3). The Coastal Plain lies roughly east of Interstate 95/395 including the eastern portions of the City of Alexandria, and Fairfax and Prince William Counties. The Northern Piedmont province lies roughly between I-95 and US Highway 15 in central Loudoun and western Prince William counties. It is bounded by the Blue Ridge Mountains on the west with ridges, foothills, and hollows rolling down to the Potomac River to the east. Elevations range from more than 1,950 feet above sea level in the Blue Ridge Mountains in western Loudoun County to sea level in eastern Prince William County on the Potomac River. The total land area is 1,304 square miles.

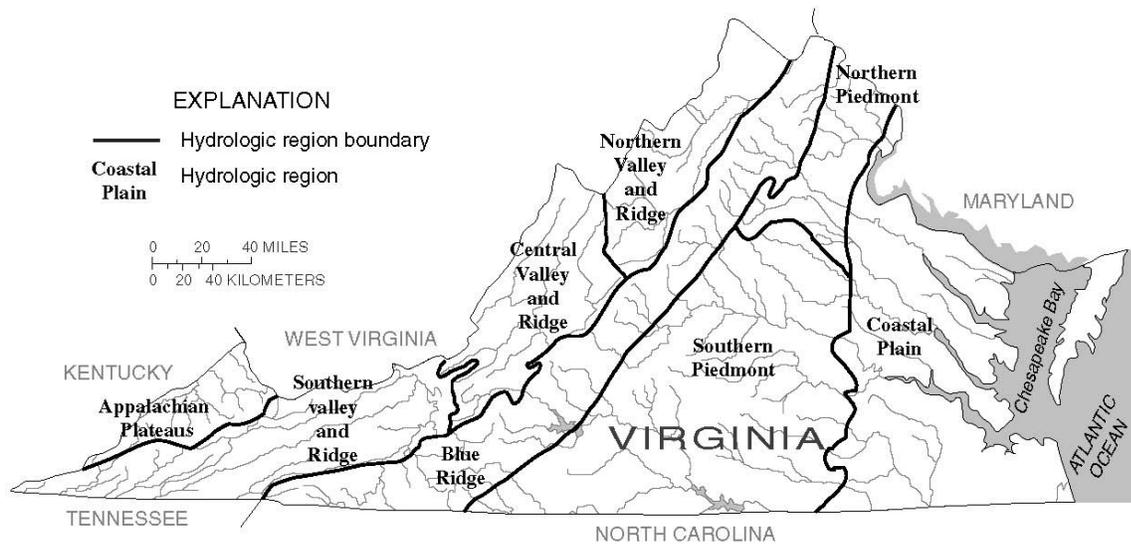


Figure 3.3 Hydrologic Regions of Virginia

Source: U.S. Department of the Interior, U.S. Geological Survey, Fact Sheet 023-01

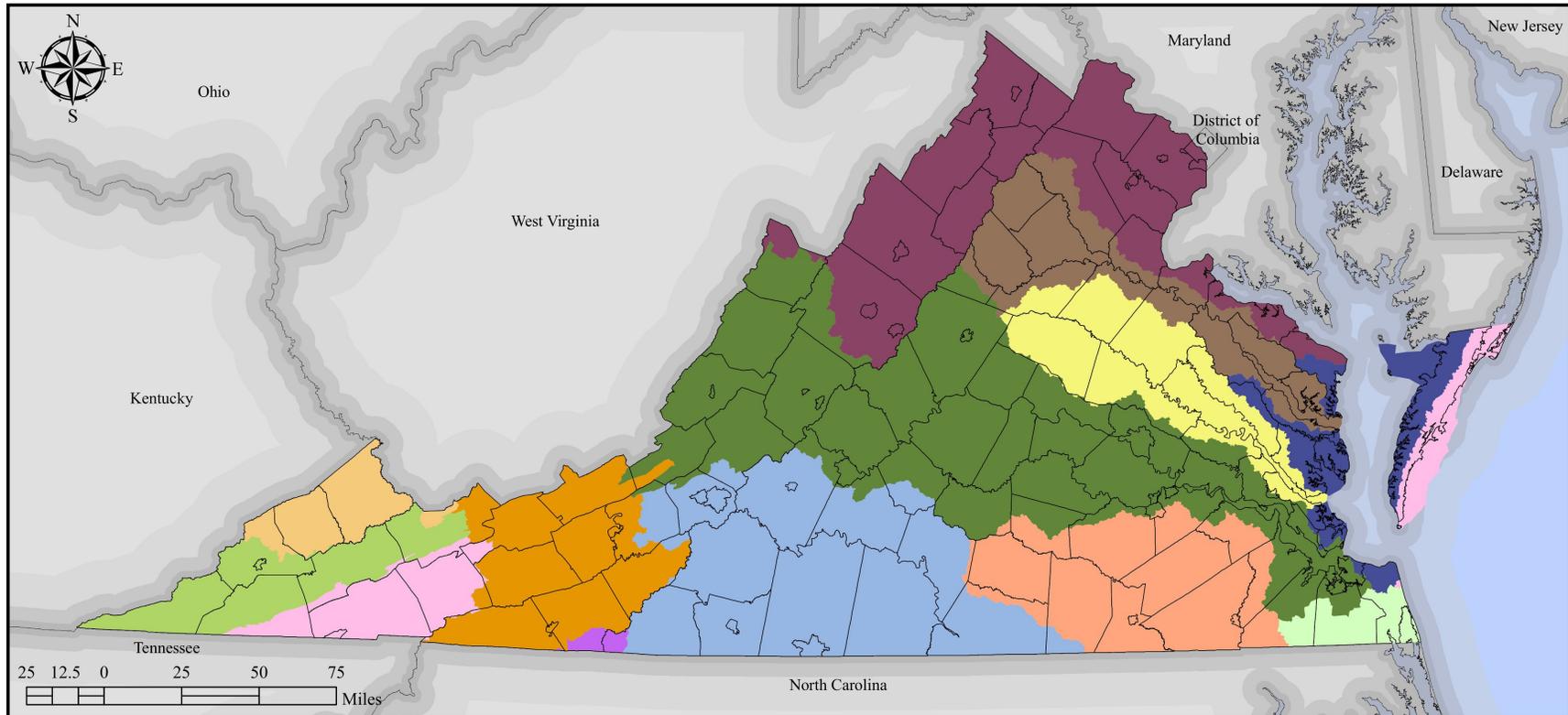
Northern Virginia lies entirely within the Potomac River watershed. After passing Harper's Ferry, WV, the Potomac forms the border between Maryland and Virginia, flowing in a southeasterly direction. Figure 3.4 provides a general overview of the watersheds in Virginia. The topography of the upper reaches of the basin is characterized by gently sloping hills and valleys. At Great Falls, the stream elevation rapidly descends from over 200 feet to sea level. Eastward of Great Falls, the Basin enters into the Coastal Plain physiographic province. Figure 3.5 illustrates the major physiographic features of Virginia..



3. Climate

The area has a moderate climate. Average temperatures are approximately 50 degrees, and range from January lows in the mid-20s to July highs in the high-80s. Annual rainfall averages above 40 inches and is supplemented with approximately 14 inches of snow.

Climate change is both a present threat and a slow-onset disaster. It acts as an amplifier of existing hazards. Extreme weather events have become more frequent over the past 40 to 50 years and this trend is projected to continue.¹ Rising sea levels, coupled with potentially higher hurricane wind speeds, rainfall intensity, and storm surges are expected to have a significant impact on coastal communities, including those in northern Virginia. (see Sea Level Rise Case Study in the Flood section of the HIRA) More intense heat waves may mean more heat-related illnesses, droughts, and wildfires. As climate science evolves and improves, future updates to this plan might consider including climate change as a parameter in the ranking or scoring of natural hazards.



DATA SOURCES:

DCR/NRCS Hydrologic Units
 VGIN Jurisdictional Boundaries
 ESRI State Boundaries

LEGEND:

- | | | |
|--------------|------------------------|--------------|
| River Basins | Albemarle & Coastal | James |
| | Atlantic Ocean Coastal | New |
| | Big Sandy | Potomac |
| | Chesapeake Bay Coastal | Rappahannock |
| | Chowan | Roanoke |
| | Clinch-Powell | Yadkin |
| | Holston | York |

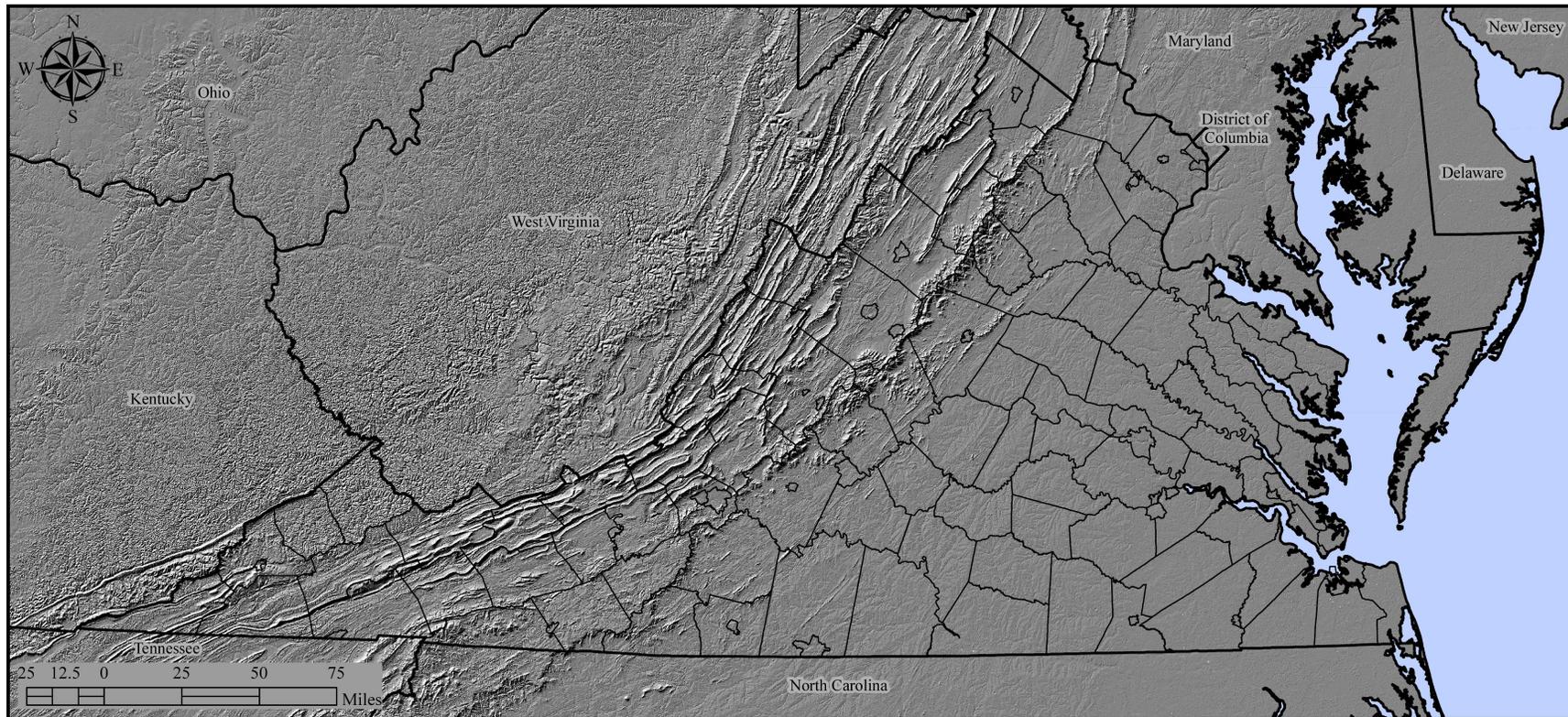
HAZARD IDENTIFICATION:

DCR's soil and water conservation program USDA-NRCS delineated detailed sixth order hydrologic units for Virginia in 1990 and again in 1995 following the issuance of new hydrologic unit delineation standards in 1992. The HU have been merged together to show the 14 major river basins of Virginia.

Commonwealth of Virginia Enhanced Hazard Mitigation Plan 2010
 Section 3.2 Page 4

DISCLAIMER: Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards. In order to identify potential risk in the Commonwealth available data has been used beyond the original intent.

Figure 3.4. Watersheds of Virginia (Source: Commonwealth of Virginia Emergency Operations Plan HIRA Figure 3.2-2)



DATA SOURCES:
USGS National Map Seamless Server
Shuttle Radar Topography Mission
VGIN Jurisdictional Boundaries
ESRI State Boundaries

LEGEND:
SRTM Hillshade
Mountains
Valleys

HAZARD IDENTIFICATION:

The Shuttle Radar Topography Mission (SRTM) is a joint project between NASA and NGA (National Geospatial-Intelligence Agency) to map the world in three dimensions. SRTM data is being used to generate a digital topographic map of the Earth's land surface with data points spaced every 1 arc second for the United States of latitude and longitude (approximately 30 meters).

DISCLAIMER: Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards. In order to identify potential risk in the Commonwealth available data has been used beyond the original intent.

Figure 3.5. Shaded Relief of Virginia
(Source: Commonwealth of Virginia Emergency Operations Plan HIRA Figure 3.2-1.)



C. Demographics, Population & Economic Growth

The Washington metropolitan area is projected to experience substantial growth in population, employment, and output over the next 20 years. Proximity to the Nation's capital has been fueling population growth in Northern Virginia for more than 60 years. Since the mid-1930s, when large numbers of Federal workers moved to Washington, DC, during the New Deal and began spilling out into adjoining suburbs, people have been moving into Northern Virginia at an accelerated rate. Like a water faucet turned on and left running, the flow of people has remained vigorous and constant for most of the post-war period.

Today, Northern Virginia is home to over 2 million people. As seen in Table 3.2, demographers are projecting on average, nearly 30,000 newcomers per year through the end of this decade, and approximately 28,000 per year the decade after. By 2020, the population will approach 2.5 million.

Table 3.2 Projected Population Growth in Northern Virginia, 2004-2020 (in millions)				
Jurisdiction	2004	2010	2020	2004-2020
Alexandria	134.2	143.9	152.6	18.4
Arlington County	193.2	212.2	233.1	39.9
City of Fairfax	23.3	23.9	26.0	2.7
Fairfax County	1,007.4	1,133.0	1,193.4	186.0
Falls Church	11.2	12.3	14.7	3.5
Loudoun County	241.8	318.1	422.9	181.1
Manassas	37.0	38.0	40.2	3.2
Manassas Park	12.4	15.0	16.5	4.1
Prince William County	344.0	415.3	488.2	144.2
Northern Virginia	2,004.5	2,311.7	2,587.6	583.1

Source: Metropolitan Washington Council of Governments, Cooperative Forecasts

The locus of population growth, inexorably pushing outward, is now sweeping across the broad expanse of the outer rim of the Northern Virginia region. This is where the pressure to absorb new metropolitan growth is most intense, and where it will remain concentrated for decades to come. More than 60% of the more than three-quarter million projected newcomers (2000 to 2020) will settle in Prince William and Loudoun Counties.

At the beginning of the 1960s, Northern Virginia was a suburban bedroom community of predominantly middle-class families with children, not dissimilar demographically from hundreds of other places. By the end of the century, it had evolved into a complex blend of urban and suburban influences, an intricate demographic composite formed by the economic growth, transformation, and prosperity of the Washington metropolitan economy, by a rising tide of immigration, aging of the baby boom generation, and other powerful agents of social and demographic change.



A second salient feature of Northern Virginia’s demography is the degree of urbanization etched in locality profiles. In many ways, American suburbs have become more urban, as traffic congestion, overcrowding, immigrants, and more diverse homes and lifestyles work their way into suburbia. But urban pressures and forms, while present everywhere, have not impacted suburbia equally. The pressures are more intense, as a general rule, in neighborhoods settled by the first wave of post-war suburbanization, as they age and become part of an expanding urban core.

In Northern Virginia, impacts of urbanization can be observed in the contrasting demographic profiles of close-in and outer-fringe localities. The differences can be traced, primarily, to variations in the affordability, age, and composition of local housing inventories. As types of housing are unevenly distributed across regional and local landscapes, so too is the flow of different population streams as they seek a home in a location and at a price range suitable to their lifestyle, thereby stamping sections of the region with a distinctive demographic coloration. Listed below are some of the major demographic differences found in the close-in and outer-ring suburbs of Northern Virginia.

Northern Virginia Suburbs closest to Washington, DC:

(Primarily in Alexandria, Arlington County, and some inside-the-beltway Fairfax neighborhoods)

- are communities that have changed during the past three decades from conventional family-centered suburbs into new-urban enclaves that, demographically, have become similar to downtown Manhattan, San Francisco, and other U.S. cities
- have become “first-stop” immigrant gateways
- are approaching minority-majority status
- are distinctive and stand out nationally for their high percentage of non-family households, single-person households, childless households, renters, and multi-unit apartment and hi-rise housing (of 50 or more units)
- have among the smallest percentage of school age children, and among the largest percentage of young adults (20 to 35 year old), found anywhere in the U.S.
- average household sizes also are among the smallest in the country
- have high population turnover, people continually moving in and out, with about half of the population replaced every five years
- exhibit evidence of a widening gap between have and have-nots with large numbers at the high end of the income ladder; and large numbers, mainly immigrants and minorities, at the low with very few in the middle.

Outer-ring suburbs of Northern Virginia:

(Primarily in Prince William and Loudoun Counties and parts of Fairfax County)

- are communities that are more traditionally suburban in character
- dominated by families with school-age children, and homeowners who are living in detached single-family houses and townhouses
- have large average household sizes
- have growing foreign-born populations but with socio-economic backgrounds different from those pouring into the inner core. Outer suburban immigrants, generally, have lived



in the U.S. longer, are better educated, are more affluent, and are more likely to live in homes they own

- have fewer poor people, less evidence of a have, have-not divide; many affluent, well educated homes and people; with some pockets of lower income communities but less prevalent than the jurisdictions closer to Washington, DC.

1. Projected Economic Growth

With a gross regional product of nearly \$288 billion dollars, the Greater Washington economy is the fourth largest metro market in the United States, and the seventeenth largest in the world. While still relatively strong, the recent downturn has had significant impact on the area's economy. The Department of Labor Statistics reported an unemployment rate of 6.6% for the region in February 2010, as compared to 5.8% in February 2009. Even with the slumping economy, the region's unemployment rate remains considerably lower than the national rate of 9.7%. Looking further ahead, the region is expected to experience continued economic growth. George Mason University's Center for Regional Analysis projects the Washington Metropolitan Area economy (Gross Regional Product) to grow from \$352.1 billion in 2010 to \$683.7 billion in 2030. The rate of economic growth is nearly double that forecast for New York City or Chicago, but lower than that expected for Dallas-Fort Worth².

A few quick facts underscore the strength, performance, and unique structure of its economy, of which Northern Virginia is an important sub-component. Greater Washington:

- is home to the Federal government, the largest purchaser of goods and services in the world. The total value of Federal procurement outlays received by businesses in the National Capital region during fiscal year 2004 was \$42.2 billion, up from \$12.5 billion in 1990.
- leads the Nation in job growth over the past 20 years, averaging 52,000 new jobs per year, with job growth over the past five years substantially surpassing numbers achieved by other metropolitan areas in the United States. During this time period, the Washington area generated a total of 305,000 new jobs. The next closest metro was Las Vegas, NV, with 150,000 new jobs (about the same number added in Northern Virginia).
- has been significantly outperforming the national economy on most basic indicators of economic activity, (i.e., GRP growth, job growth, unemployment rates).
- has one of the lowest unemployment rates in the country (3.1% in 2004). In 2009, its monthly unemployment rate was the lowest in the Nation, among metro areas, for 11 of 12 months
- is the Nation's third-largest center of bio-science companies; is home to 5,367 associations, the largest concentration in the Nation; and employs more people in technology occupations (76,000) than any other location
- is a top U.S. tourist destination, serving as host to 18.6 million domestic and international visitors in 2002
- is home to a growing list of industries and advanced technologies on the vanguard of innovation. Many of the people and companies building the global communications network, for example, are located here, such as America ONLINE, UUNET Technologies Inc., PSINet Inc, Lockheed Martin, SPRINT, Comsat, Intelsat, GTE Spacenet, and others.



Northern Virginia is a strong sub-regional component of the larger Washington economy, as are suburban Maryland and the District of Columbia. While all of the sub-regional markets are experiencing job growth, Northern Virginia is significantly outpacing the other two. During the 1990s, for each new job added in Suburban Maryland, Northern Virginia gained two. This decade, the ratio has widened to 2.3 to one. Major employers for manufacturing and non-manufacturing jobs in the Northern Virginia region are shown in Table 3.3.

Table 3.3. Major Employers in Northern Virginia. Source: Virginia Economic Development Partnership (VEDP).		
Manufacturing		
<i>Company</i>	<i>Product/Service</i>	<i>Estimated Employment</i>
BAE Systems	Aerospace electronic systems	100 - 299
Gannett Company, Inc.	Printing & publishing	1,500 - 2,499
Lockheed Martin Corporation	Electronic components	5,000 - 9,999
Non-Manufacturing		
AOL, LLC	Internet service	2,500 - 4,999
Booz, Allen & Hamilton	Management & technology consulting	10,000+
CACI, Inc.	Computer services	2,500 - 4,999
Computer Sciences Corporation	Information technology services	10,000+
Department of Defense	National security	10,000+
ExxonMobil Corporation	Petroleum products	1,500 - 2,499
Federal Home Loan Mortgage Corp.	Financial services	2,500 - 4,999
General Dynamics Information System	Technology solutions	2,500 - 4,999
George Mason University	Higher education	2,500 - 4,999
INOVA Health System	Health care	10,000+
Northrop Grumman	Professional, scientific, and technical services	5,000 - 9,999
Science Applications International Corp. (SAIC)	Information technology services	5,000 - 9,999
SRA International	Technology solutions	1,000 - 1,499
Verizon Service Corp	Telecommunications	1,000 - 1,499
Wal-Mart Stores, Inc.	Discount retail	2,500 - 4,999
Washington Metro Area Transit Authority	Transit system	1,500 - 2,499



2. Population

According to the U.S. Census Bureau, the population of the Northern Virginia region in 2000 was approximately 1.8 million. The average number of persons per square mile was 1,380, making the region one of the most densely populated in the United States. Table 3.4 shows the total population and population density per square mile, by jurisdiction. As can be seen in the table, the City of Alexandria is the densest jurisdiction while Loudoun County is the least dense. However, when the land comprising Arlington National Cemetery and Regan National Airport are considered, Arlington County is even denser than Alexandria. Figure 3.6 illustrates the distribution of population density, using 2005 estimates, across the region according to census tracts.

Table 3.4. Population Statistics in the Northern Virginia Region, by Jurisdiction (2000)

Source: U.S. Census Bureau

Jurisdiction	2000 Total Population (April 1, 2000)	2000 Population Density (Square Mile)	2005 Population Estimate	2005 Population Density (Square Mile)	2007 Census Population Estimate	2007 Population Density (Square Mile)
Arlington County	189,453	7,315	197,806	7,573	204,568	7,838
Fairfax County	969,749	2,413	1,036,578	2,550	1,010,241	2,485
Loudoun County	169,599	272	257,240	494	278,797	535
Prince William County	280,813	819	354,039	1,016	360,411	1,034
City of Alexandria	128,283	8,385	138,004	8,955	140,024	9,092
City of Fairfax	21,498	3,467	23,059	3,626	23,349	3,706
City of Falls Church	10,377	5,189	10,648	5,324	10,948	5,474
City of Manassas	35,135	3,514	37,423	3,742	35,412	3,541
City of Manassas Park	10,290	5,717	12,561	5,106	11,426	4,570
Northern Virginia Total	1,815,197	1,357	2,067,358	1,545	2,075,176	1,551

Development Trends, described in the following section, summarize population change for the region. The Risk Assessment Methodology section summarizes the population parameters used in ranking the hazards presented in this report.

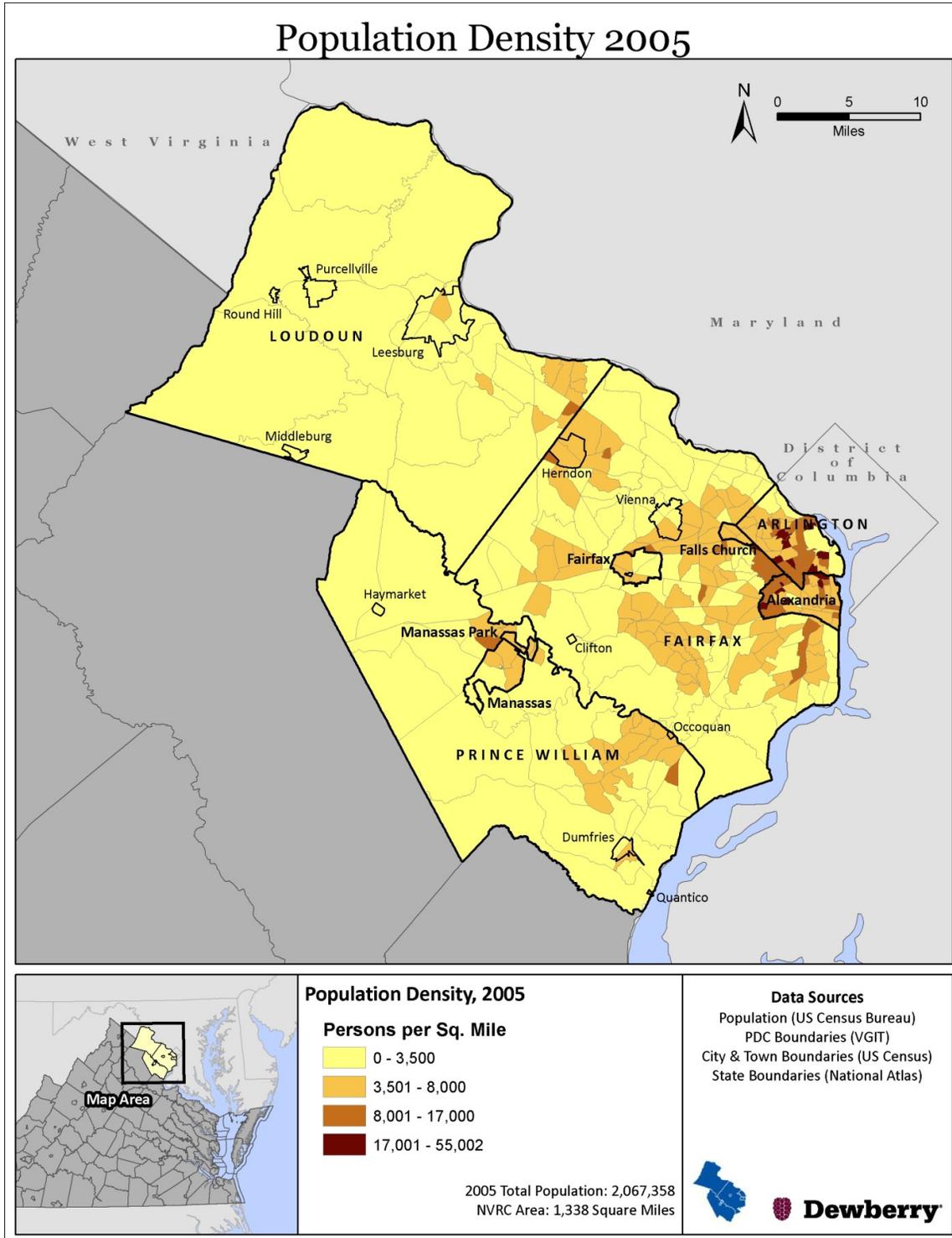


Figure 3.6 Population Density (2005).



3. Housing

A general market inventory of housing in Northern Virginia shows that there is a continual demand for affordable housing, with low vacancy rates throughout the region. Housing demand is being propelled by the highest job growth in the United States.

As tracked by COG, the median sales price of housing has increased 59 percent over the past six years, from \$166,548 in 1997 to \$265,047 in 2003. Incomes have not been keeping pace with rising housing prices. Between 1998 and 2003, incomes increased by only 17 percent, compared with a housing sales price increase of 59 percent. The Urban Institute estimates that one-quarter of the region's households are carrying unaffordable housing cost burdens. Housing construction has been pushed to outer-ring suburban jurisdictions, where prices still remain somewhat affordable, but savings are counterbalanced to some extent by the increased cost and time of commutes.

D. Land Use, Development, & Zoning

1. Land Use

FEMA requires that State and local mitigation plans evaluate land use and development trends so that mitigation options can be considered in future land-use decisions. Changes in urban and agricultural land cover may help to highlight areas within the State that should be considered in long-term comprehensive plans.

To identify these areas, land cover change was assessed using the National Land Cover Dataset. This dataset is produced by the Multi-Resolution Land Characteristics Consortium (MRLC), a collection of Federal agencies that pool resources to map land cover across the Nation. Using satellite imagery, the MRLC produced datasets for 1992 and 2001 that include 16 land cover classes for various types of urban, agricultural, forested, and other natural areas. It is important to note that the MRLC revised the classification system for 2001. In order to assess change consistently, the 1992 land cover classes were cross referenced to 2001 according to the MRLC 1992-2001 Retrofit Change Product.

The majority of change in Northern Virginia has occurred in forested lands, shown in Table 3.5. From 1992 through 2001, forest land cover has decreased across the region. Each of the four counties experienced decreases, with Fairfax County showing the largest decrease of 23%. Urban land has also decreased in the region, especially in Fairfax County. Loudoun County, however, has witnessed the most urban growth, increasing by 9,838 acres. Agricultural land cover has increased in Fairfax and Prince William Counties, 54% and 17% respectively; while Loudoun County has shown a small decrease of 5%. Figures 3.7 and 3.8 show the distribution of land cover for Northern Virginia.



Table 3.5. National Land Cover Changes 1992 to 2001.				
Jurisdiction	Urban Change (Acres)	Forest Change (Acres)	Agricultural Change (Acres)	Wetland Change (Acres)
Arlington County	-628.49	-1,693.09	385.19	146.34
Fairfax County	-16,529.25	-27,808.21	13,700.61	-1,425.55
Town of Herndon	-84.73	-228.18	-72.06	-28.91
Town of Vienna	-688.53	-274.21	111.2	9.56
Town of Clifton	-43.59	-12.23	24.24	1.33
Loudoun County	9,838.96	-17,791.12	-8,349.58	72.95
Town of Leesburg	1,596.13	-1,517.62	-1,259.64	-15.12
Town of Purcellville	215.95	-160.57	-489.49	0
Town of Middleburg	-27.8	-37.14	-52.93	0
Town of Round Hill	22.68	-38.25	-56.49	-3.11
Prince William	-1,350.38	-16,364.01	8,406.07	840.43
Town of Dumfries	-65.61	14.9	12.45	-41.37
Town of Haymarket	-44.92	4.67	-45.59	3.78
Town of Occoquan	-17.57	-4.23	-4.89	1.56
Town of Quantico	-2.67	-2.22	6.23	-3.78
Alexandria	-211.27	-695.65	-62.49	-39.14
Fairfax City	-555.1	-640.05	245.75	23.57
Falls Church	-288.89	-48.93	20.02	-0.44
Manassas	-231.29	-294.45	-328.03	10.01
Manassas Park	-121.65	-86.73	31.36	-1.33
Total	-9,218.03	-67,677.32	12,221.91	-449.24

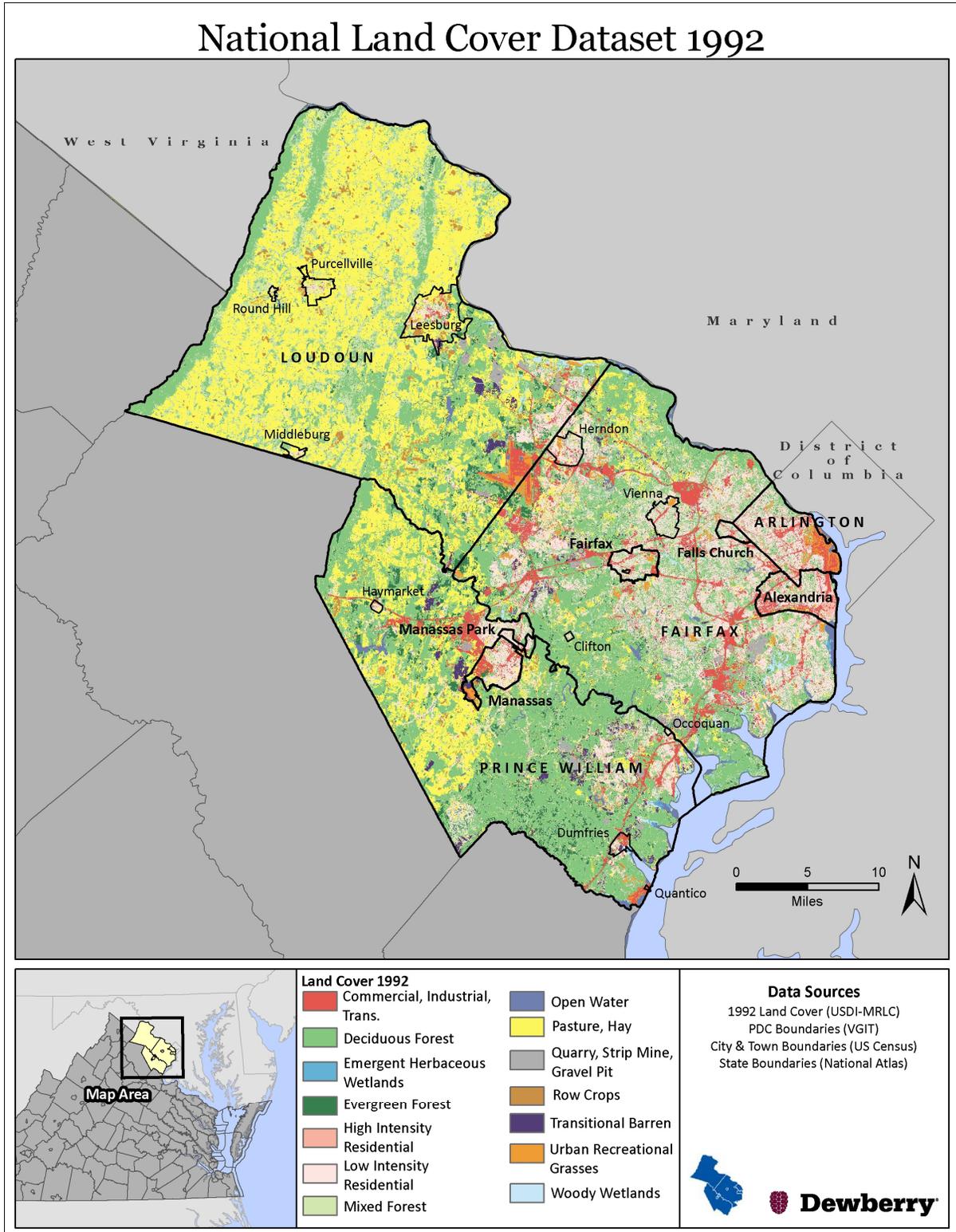


Figure 3.7. 1992 Land Cover categories.

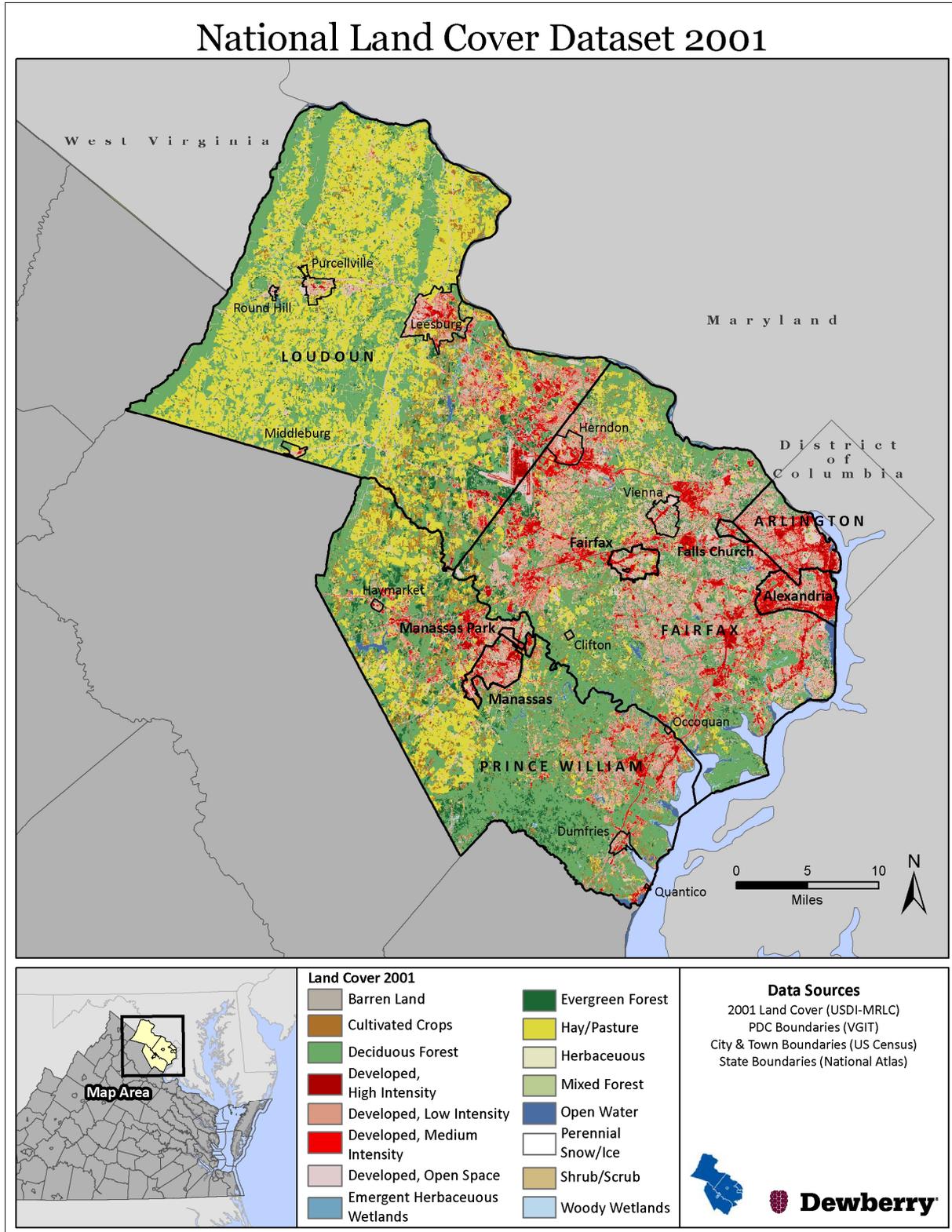


Figure 3.8. 2001 Land Cover categories.



2. Development Trends

A general analysis of land uses, development trends, and zoning within the planning area is an important factor in formulating mitigation options that influence future land use and development decisions. In many cases, local development policies greatly influence the degree of future vulnerability in communities across the region. The vulnerability of future buildings, infrastructure, and critical facilities is a great concern to community leaders across the Northern Virginia region and, as discussed in the Capability Assessment section, many of the day-to-day activities in local governments in the region are designed to deal with these challenges.

One of the most critical indicators to review in considering local development trends is population growth. The average rate of population change in the Northern Virginia region from 2000 to 2009 was 24.6 percent, which is significantly higher than the average growth rate for the State of Virginia during this same time period (11.4 percent). Table 3.6 shows the breakdown of population growth rates, by jurisdiction. As can be seen in the table, Fairfax County has the highest population in the region (1,036,473 people) while Loudoun County experienced the highest growth rate based upon percent change (75.78%). The region as a whole has experienced a 19% growth in the past nine years and accounts for over a quarter of the Commonwealth’s total population.

Total population and population density have been used in the risk assessment ranking methodology. Refer to the Risk Assessment and Methodology section for more details on these ranking parameters.

Table 3.6. Northern Virginia Population Change (2000 – 2009).			
Jurisdiction*	2000 Census (April 1, 2000)**	Provisional 2009	Percent Change
Arlington County	189,453	212,038	11.92%
Fairfax County	969,749	1,036,473	6.88%
Town of Herndon	21,655	22,579	4.27%
Town of Vienna	14,453	15,215	5.27%
Town of Clifton	185	216	16.76%
Loudoun County	169,599	298,113	75.78%
Town of Leesburg	28,311	40,927	44.56%
Town of Purcellville	3,584	5,309	48.13%
Town of Middleburg	632	976	54.43%
Town of Round Hill	500	759	51.80%
Prince William County	280,813	386,934	37.79%
Town of Dumfries	4,937	4,954	0.34%
Town of Haymarket	879	1,252	42.43%
Town of Occoquan	759	834	9.88%
Town of Quantico	561	607	8.20%



Table 3.6. Northern Virginia Population Change (2000 – 2009).

Jurisdiction*	2000 Census (April 1, 2000)**	Provisional 2009	Percent Change
City of Alexandria	128,283	141,738	10.49%
City of Fairfax	21,498	24,702	14.90%
City of Falls Church	10,377	11,711	12.86%
City of Manassas	35,135	36,213	3.07%
City of Manassas Park	10,290	14,026	36.31%
Northern Virginia Total	1,815,197	2,161,948	19.10%
VIRGINIA TOTAL	7,079,030	7,882,590	11.35%

*Town estimates are accounted for in County Totals. Town estimates are from the US Census Bureau June 2010

**Included all official corrections to the 2000 Census counts.

Source: Weldon Cooper Center for Public Service www.coopercenter.org/demographics

3. Zoning

Zoning is also a critical indicator to review in considering local development trends. Zoning Geographic Information Systems (GIS) data was provided by the majority of the jurisdictions participating in the plan update. The following section summarizes the results of this data. In some cases, zoning generalizations were made in order to compare the jurisdictions to each other. In all of the jurisdictions, residential zoning is by far the largest classification, often followed by commercial.

Fairfax County has five zoning categories; residential zoning occupies approximately 82% of the total area of the county followed by planned units (12%). Commercial and Industrial make up 6% of the county land area.

Arlington County has 28 zoning classifications. Close to 44% of the land area zones are considered One-Family Dwelling Districts, and 30% is in the Special District. In order to compare to the other jurisdictions, the classifications were grouped into commercial, industrial, residential, and other. This resulted in 61% residential, 31% other, 7% commercial, and less than 1% is industrial based on land area.

The City of Alexandria has 32 zoning classifications. The residential single family zone on an 8,000 square foot lot represents the largest category with over 14% of the land area of the city. The coordinated development district represents almost 12% of the land area. In order to compare to the other jurisdictions, the classifications were grouped into commercial, industrial, residential, and other. This resulted in 58% residential, 24% commercial, 15% other, and less than 3% industrial based on land area.

The City of Falls Church has 13 zoning classifications; low density residential represents the largest category with 48% of the land area of the city and medium density residential represents 18% of the land area. In order to compare to the other jurisdictions, the classifications were



grouped into commercial, industrial, residential, and other. This resulted in 76% residential, 14% commercial, 8% industry, and less than 3% other (or transitional) based on land area.

The City of Fairfax has 16 existing zoning classifications; residential single detached represents the largest category with 45% of the land area of the city, and open space recreation and historic presents 11% of the land area. In order to compare to the other jurisdictions, the classifications were grouped into commercial, industrial, residential, institutional, and other. This resulted in 55% residential, 14% commercial, 19% other, 9% institutional, and approximately 3% other based on land area.

The City of Fairfax also provided Future Zoning categories. Based on this information, the city has 14 future zoning classifications; residential low is the largest category with 34% of the land area of the city; business commercial represents 12% of the land area. In order to compare to the other jurisdictions (and existing zoning of the city), the classifications were grouped into commercial, industrial, residential, institutional, and other. This resulted in 55% residential, 12% commercial, 8% institutional and approximately 3 percent other based on land area. It appears that the future zoning for the city will result in a slight decrease in the commercial and institutional categories.

4. Transportation

Northern Virginia and the Washington, DC, metropolitan area is served by an extensive transportation network. There are 12 interstates and 42 highways in the Northern Virginia region. Transportation within the Northern Virginia region is primarily dependent upon a network of major highways (VA Rt. 7, I-66, US50, US29/211, I-95/395, and US1) that radiate out from the urban core (Washington, DC, Arlington, and Alexandria); one major circumferential highway (I-495/95, the Capital Beltway); and other primary cross-county roads such as the Fairfax County Parkway and the Prince William Parkway. Figure 3.1 above provides the major overview of the highways and interstates in the planning region.

The Washington Area's Metro primarily serves the inner localities with 11 stations in Arlington County, four stations in the City of Alexandria, and five stations in Fairfax County. The Virginia Railway Express (VRE) commuter rail system serves communities to the west, cutting through central Fairfax County to the cities of Manassas and Manassas Park, and to the south in eastern Prince William County continuing to the City of Fredericksburg. Several bus systems (Metrobus, Alexandria's DASH, Arlington's ART, Falls Church's George, Fairfax County's Connector, Fairfax City's CUE, and Prince William's PRTC/Omniride) provide service throughout the region.

Commercial air service includes the Ronald Reagan Washington National Airport and Washington Dulles International Airport. Figure 3.2 shows the location of the airports in the planning region.

Nevertheless, these transportation systems are being strained by the growing population, housing, and employment patterns. From 1982 to 1997, population increased by 28.3%, but vehicle miles traveled grew by 81.5%, according to the Texas Transportation Institute. Between 1990 and 2000, the length of the average one-way, home-to-work commute increased from 28.2



minutes to 31.7 minutes, and this number has risen further since 2000. Workers are leaving home earlier and coming home later to make up the time that it takes to get where they need to go.

The Texas Transportation Institute 2005 Urban Mobility Report shows the Metropolitan Washington region ranks as follows:

- Number 3 in average hours lost sitting in traffic (69 – 3 hours more than previous year).
- Number 3 in congestion cost per commuter (\$1,669 – \$80 more than previous year).
- Number 4 in excess fuel consumed per commuter due to congestion (42 gallons/year – 2 gallons more than previous year).
- Number 5 in total excess gallons of fuel consumed due to congestion (88 million gallons – 4 million more than previous year)
- Number 7 total regional congestion cost (\$2.465 billion/year – \$209 million more than previous year).
- Number 7 in total delay due to congestion (145 million hours/year – 9 million more than previous year). Total Delay due to congestion rank changed from #8 to #7 - worsened.

Transportation systems are key in providing effective emergency response, but can also influence the impact of natural disasters. This can be a particularly crucial issue in Northern Virginia due to the high levels of traffic congestion. In addition to more immediate needs, businesses and employees suffer economic consequences when roads are closed due to natural disasters.

Day to day traffic reports frequently report accidents or simply high volume levels that may bring a particular highway to a standstill. The attack on the Pentagon on September 11, 2001, Hurricane Isabel in 2004, and normal winter storms bring the regional highway system to a stop and taxes the transit system to the limits.

Northern Virginia, the Commonwealth of Virginia, and the metropolitan area as a whole are actively addressing transportation through significant updates in regional plans; expansion of transit to areas such as Tysons Corner, Reston, and Dulles Airport; and introduction of operational measures such as HOT lanes (charging tolls on high occupancy vehicle lanes) to address congestion. However, under present development scenarios, Northern Virginia is expected to experience funding shortages for its transportation needs in the tens of billions of dollars in the next 25 years.

E. Northern Virginia Populations at Risk

In the context of hazard mitigation and emergency management, when assessing populations at risk, a group's "vulnerability" is broadly defined as the potential for increased harm or loss by the emergency or disaster. This applies to people, property, and land area. Risk to people is termed 'social vulnerability' by one of the most highly respected models for risk assessment, the Social Vulnerability Index created by Cutter et al (2003). It describes pre-event population vulnerability based on the characteristics and geographic location of people grouped using U.S. Census demographic categories and measurement units (tracts and blocks). Using a method such as the Social Vulnerability Index used during the Northern Virginia Hazard Mitigation planning process allows emergency managers a "first look" at populations at the highest risk due to characteristics that amplify their risk. Following further examination of population trends and



specific community needs, local emergency management departments can then direct appropriate preparedness, response, recovery, and mitigation planning and program delivery to specific communities to help them better prepare for and recover from disaster.

Over the past decade, members of academia have researched and validated how to quantify and measure risk, or “social vulnerability,” which can prove difficult as most of the variables that factor into risk assessment applied to segments of society are qualitative rather than quantitative. Such an analysis can help a community increase communication approaches to different members of the community through the most appropriate communication networks.

The analysis used in the 2010 Northern Virginia Hazard Mitigation Plan update closely follows a national model and method presented in the peer-reviewed and published article Cutter et al (2003)³, a groundbreaking study that defined and quantified the measures of social vulnerability. The Social Vulnerability Index has been slightly altered for the Northern Virginia analysis to accommodate available data. The analysis was conducted using data from the 2000 Census as the best available data for this study. *It should be noted, it was necessary to rely upon the 2000 Census because the plan is regional, and updated, consistent population data across all metrics was not uniformly available for each of the 20 participating jurisdictions within the Northern Virginia planning region. Changes in population numbers since that time should be considered when analyzing the results.*

Dewberry performed this analysis to confirm that the rich diversity of Northern Virginia presented differing challenges. This analysis is meant to provide the first regional assessment of population demographics viewed in terms of specific Census-defined groups and their relative risk to natural and human-caused hazards due to various comparative societal factors. The results must be viewed through a sharper interpretive lens by the Northern Virginia Emergency Managers who have intimate knowledge of their jurisdiction. This information is provided to begin the conversation about populations at risk; it is recommended that resources be obtained to continue a more detailed assessment once the 2010 Census data, American Community Survey, and updated U.S. Department of Agriculture (USDA) Land-Use Cover Data set becomes available in 2011. An understanding of local conditions must be applied when interpreting the results of the analysis.

The Northern Virginia analysis was performed at the Census tract level to provide insight into regional population trends. A total of 330 tracts were included in the analysis. It should be noted, the 2010 U.S. Census and American Community Survey categories will not change from those used in the 2000 Census available for this analysis. Census questionnaire answers are “self-determined” by each respondent, so they can be biased due to a variety of factors.

There were eight major factors that influenced social vulnerability when analyzing the 30 Social Vulnerability variables for Northern Virginia, as determined by the Cutter et al article. It is important to understand that to the extent that areas in Northern Virginia have social vulnerability, these were the factors that influenced that vulnerability through the analysis. It is also important to note that most factors are largely influenced by multiple variables and that the name assigned to each factor is not necessarily reflective of one single variable, but rather the most dominant variables listed.



The eight factors were:

1. Socio-economic status;
2. Wealth;
3. Elderly populations;
4. Female heads of Large Households in densely populated areas;
5. Rural areas;
6. Female labor force;
7. Asian Population (as defined by the U.S. Census Bureau); and
8. Households living in Manufactured Housing.

The Region at a Glance

The main contributors to the region's vulnerability score provided a lens through which to begin to understand statistically-based indicators of factors which contribute to public risk. However, analysis of 2010 Census data overlaid with local knowledge of communities and societal groups is necessary to more precisely identify those most vulnerable to emergencies, hazard events, or disasters. However, the analysis did provide some interesting and relevant trends that guided the Northern Virginia MAC and participating jurisdictions in creating new mitigation strategies, such as:

- Assess growth and land use during the 2000 – 2010 decade to determine whether rapid suburban expansion in the Sterling to Purcellville and Manassas corridors has challenged emergency preparedness, response, and mitigation communication in specific demographic terms for new residents – immigrant, elderly (Leisure World complex east of Leesburg), and others.
- Expand code requirements to require redundant mechanical systems, especially in communities targeted at retirees.
- Design and build new schools to serve as community shelters.
- Assess if an under-assessed Hispanic service and farm labor force is at risk due to limited communication pathways.
- Determine whether school systems that rapidly expanded during the past 20 years have adequate natural hazard monitoring systems (tornado, winter storm, severe storm); are plans in place and exercised to ensure appropriate school closures or sheltering-in-place.
- Consider new multi-household housing units, especially for elderly, to have on-site generators for power redundancy.
- Work with Cooperative Extensive Service/USDA agencies and Loudoun and Prince William Soil and Water Conservation Districts to determine if agricultural land owners have special hazard mitigation challenges regarding power outages and livestock feeding, access, etc.
- Determine most effective emergency management and hazard mitigation notification communication networks to reach military and immigrant communities who are not familiar with the area.
- Verify that targeted elderly populations can be reached through redundant communication networks.
- Work with advocates for elderly populations to consider education and outreach for seniors to facilitate personal disaster preparedness plans.



- Develop and distribute homeowner hazard mitigation tool kits to property owners that focus on easy mitigation actions homeowners can take.
- Provide multi-language hazard mitigation tool kits through community churches and other organizations.
- Work with landlords to distribute multi-cultural hazard mitigation information to renters, as appropriate, regarding renter's insurance, what to do in an emergency, etc.

Analysis Challenges

One of the great challenges in emergency management and all government support services to residents in the Northern Virginia region that is not fully captured by this vulnerability analysis, is the richness of the immigrant population. For example, children in Arlington County schools speak more than 120 languages and come from homes where English is the secondary language. While the Asian population, which includes many of Middle Eastern and Indian origin (as defined by the U.S. Census), is significant, the communication and cultural understanding challenges are the same for someone of any non-American origin.

Another significant challenge in this analysis is the use of 2000 Census data. It is obvious that the region has experienced great socio-economic, population, and land-use changes during the period from 2000-2010 which are not reflected in this analysis. This analysis used the 2000 Census tract data because more recent data was not uniformly available for each jurisdiction in the region. Further demographic and cultural analysis should be considered once 2010 data sets are available to provide a more current snapshot of the region. However, the trends shown in this analysis are worth consideration in planning emergency management communication, emergency sheltering, and other support programs.

It is vitally important to realize that the Census is determined by how those who responded characterized themselves. It is highly probable that someone from India or of Indian descent did categorize themselves as Native American Indian. Also, it is impossible to fully characterize the richness of the Northern Virginia area in the relatively narrow terms of the U.S. Census, so someone that is characterized as Caucasian may be a recent immigrant with multiple challenges in terms of being prepared for disasters or knowing how to mitigate against natural or human-caused hazards. However, since "Asians" did show as an indicator of populations at risk for this particular region, the term can be used as a placeholder for multiple immigrant communities as the challenges are not exclusive to just residents of Asian origin or descent.

As Census 2010 and other data sets emerge, it will become increasingly apparent that Northern Virginia is experiencing change based on factors which attract thousands of new residents to the area annually. Many of the desirable factors that attract businesses and people to the area present the greatest challenges to Northern Virginia Emergency Managers and cause significant hazard mitigation challenges including: growth, dense populations, over-taxed transportation routes, communication, and knowledge of how to mitigate vulnerable buildings and prepare for disasters.