



**U.S. Department of Housing and Urban Development
Climate Change Adaptation Plan**

June, 2012

FINAL DRAFT for Public Comment

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Executive Summary

Background

This report was developed in response to Executive Order 13514, Federal Leadership in Environmental, Energy, and Economic Performance, which establishes an integrated strategy for sustainability within the Federal Government.¹ Under the Executive Order, each agency is required to evaluate their climate change risks and vulnerabilities to manage the effects of climate change on the agency's mission and operations in both the short- and long-term.² As a federal cabinet agency focused on improving the built environment, on strengthening both metropolitan areas and rural communities, and on expanding opportunity for all Americans, the U.S. Department of Housing and Urban Development (HUD) recognizes the need for action. Through the process outlined in this document, HUD has begun to identify how climate change is likely to affect its ability to achieve its mission, operate its facilities, and meet its policy and program objectives.

Climate change adaptation refers to the adjustment of our built environment, infrastructure and social systems in response to actual or expected climatic events or their effects.³ Adaptation planning is predicated on the identification of risks and vulnerabilities linked to a changing climate and the development of strategies to minimize associated impacts. Conversely, mitigation generally encompasses activities designed to reduce the amount of greenhouse gases in the atmosphere and thus slow the rate of climate change. Most of the benefits of mitigation are not realized immediately, but rather after some decades; therefore, adaptation is required to address current and near-future impacts. Yet without mitigation, eventually the increasing magnitude of climate change impacts would significantly diminish the effectiveness of adaptation. Therefore, both mitigation and adaptation are necessary to respond to the effects of a changing climate.⁴

This report is the culmination of a year-long process initiated by the HUD's Climate Change Adaptation Task Force (Task Force). This committee, chaired by the Deputy Secretary, was formed to oversee and coordinate department-wide climate change adaptation planning. Representation is provided from each program office, as appropriate, to ensure alignment with relevant policies and initiatives. Once the document is finalized, the Task Force will coordinate the implementation of the climate change adaptation actions specified within.

HUD's 2012 Climate Change Adaptation Plan

The climate change adaptation plan described in this document is divided into four sections. The Introduction places HUD's mission and vision into the context of climate adaptation and describes linkages to HUD's 2010 – 2015 strategic plan. The Risk and Vulnerability Assessment section summarizes a high-level overview of specific climate change effects, their impacts to communities and the built environment, and HUD's programs and operations. Opportunities and Actions follows; this section contains responses to the risks and vulnerabilities described in the previous section and outlines

potential areas for integrating climate change perspectives in the future. In addition, this section highlights some of the current activities that address climate change within the Agency. Finally, the Implementation section describes how HUD, through the activities of the Climate Change Adaptation Task Force, will implement and monitor progress towards the aforementioned climate change actions.

Current climate projections show steadily increasing average temperatures over the next century, with most, if not all, of the U.S. experiencing the effects of a warmer atmosphere. Cities and their urban surroundings will bear the effects of extreme heat, predominantly in the form of more frequent and longer lasting heat waves. These higher temperatures will result in changes to precipitation regimes across the country. Many areas, especially in the northern regions, will receive more precipitation. However, much of this increased precipitation is forecast to fall during fewer, yet more intense, rain events. Areas already at-risk to flooding will be more vulnerable to this risk. Conversely, those areas that currently receive less-than-normal precipitation will generally continue to see less, resulting in an increased prevalence of drought. Areas along the coastal margins will be impacted by rising sea levels, with certain areas experiencing increased rates of inundation due to the local geomorphology. Many of these same areas, especially along the Atlantic and Gulf coasts, will experience more powerful coastal storms.

The impacts of a changing climate will have a significant effect on HUD and the communities it serves. Extreme heat will disproportionately affect those populations that are already vulnerable, including the young, the old, and the impoverished. Inundation from an increased incidence of intense precipitation and sea level rise will result in structural damage and loss to public and assisted housing. An increased frequency of extreme events (e.g. floods, coastal storms, and drought) will place a strain on the resources of the Agency to effectively respond while carrying out its intended mission.

Fortunately, HUD is well-positioned to plan for the impacts of climate change. Recently implemented programs and policies in the areas of disaster recovery and preparedness, sustainability planning, and energy efficiency / green building provide local communities with strategies to reduce their exposure to the effects of a changing climate. In addition, new opportunities for integrating climate change adaptation principles into other existing programs and policies will be investigated as part of the adaptation planning process outlined in this report.

Introduction

The mission of the U.S. Department of Housing and Urban Development (HUD) is to create strong, sustainable, inclusive communities and quality affordable homes for all. HUD's activities in support of this vital mission touch virtually every American family, from low-income families living in public and Indian housing to families purchasing their dream home. Across the Nation, our communities are beginning to experience impacts from a changing climate, such as higher average temperatures, more extreme weather events, and rising sea levels. While the severity and pace of future climate change impacts are difficult to predict, it is clear that already occurring and potential future changes will have important impacts on the ability of HUD to fulfill its mission.

HUD's role in shaping communities recognizes that success is dependent on partnerships among federal, state, and local entities across the public, nonprofit, and private sectors. Each brings unique skills, knowledge, and perspective, so HUD envisions a relationship that fosters collaboration and innovation in meeting community development needs. For HUD, this means striking the right balance between various roles (policymaker, funder, capacity builder, and regulator). This especially holds true in the context of climate change. The spatial diversity of climate impacts demands a place-based approach that is rooted in the development of working relationships at various scales.

Linkages to Strategic Plan and Environmental Justice Strategy

Climate change adaptation planning relates to both HUD's mission statement and to HUD's strategic plan. HUD's mission is to create strong, sustainable, inclusive communities and quality, affordable homes for all. HUD's strategic plan emphasizes its role in building sustainable communities and in promoting energy-efficient buildings and location-efficient communities, as well as its role in facilitating disaster preparedness. The strategic plan also emphasizes the opportunity to use housing to improve quality of life, including improvement in health outcomes. The following is a summary of relevant strategic goals and the potential impacts of a changing climate on HUD's ability to meet these goals:

- **Strengthen housing market to bolster economy and protect consumers (Strategic Goal 1):** Changes in frequency, intensity, and duration of extreme weather events (i.e. floods, droughts, windstorms, and wildfires) will significantly impact HUD's ability to strengthen the housing market to bolster the economy and protect consumers.⁵ Extreme weather events have the potential to damage or destroy existing housing stock across the country. Loss or damage to existing housing may put additional strain on the housing market, the U.S. economy, and consumers.
- **Meet need for quality affordable rental homes (Strategic Goal 2):** Accelerated sea level rise and lake level changes will impact HUD's ability to meet the need for quality affordable rental homes.⁶ Higher sea and lake levels will cause the loss of coastal land and threaten the safety of

residents in existing buildings. This may result in a shortage in available land and other potential challenges related to the provision of replacement housing for displaced residents.

- **Utilize housing as a platform for improving quality of life (Strategic Goal 3):** Climate change also could affect the indoor environments, which in turn could significantly affect human health, learning, and productivity.⁷ Effects of climate change on indoor environmental quality are likely to vary depending on the region and the age and condition of the structures in that region, but could include increased indoor concentrations of pollutants or increased dampness and associated fungal and bacterial growth or off-gassing of chemicals due to building decay.⁸ However, research indicates that opportunities exist to improve public health while mitigating or adapting to alterations in indoor environmental quality induced by climate change.⁹
- **Build inclusive and sustainable communities free from discrimination (Strategic Goal 4):** Increased temperatures may challenge HUD's ability to build inclusive and sustainable communities free from discrimination.¹⁰ Low-income, often minority, families are frequently most at risk from the effects of extreme heat that will become more frequent due to climate change.¹¹ They may be unable to afford the high cost of utilities in these conditions or invest in the cooling equipment needed to mitigate these effects.¹²
- **Transform the way HUD does business (Strategic Goal 5):** In the Department's strategic plan for FY 2010-2015,¹³ HUD identified sub-goals and strategies that will enable the Department to better consider and address climate change adaptation concerns. Sub-goals that support climate change adaptation planning include the goal to build capacity to create a flexible and high-performing learning organization with a motivated, skilled workforce, and to focus on results to create an empowered organization that is customer centered, place based, collaborative, and responsive to employee and stakeholder feedback. Relevant supporting strategies include collaboration across programs to develop place-based decisions, and to incorporate field and regional staff knowledge and customer input into policy decisions and implementation strategies. Working across programs and regions will be especially helpful in addressing a multi-dimensional problem like climate change that has different effects across regions. Finally, HUD identified other relevant implementation measures including a plan to increase the energy performance of the HUD headquarters building and to increase HUD operations that support HUD sustainability Principles.¹⁴

The considerations and actions discussed in this document are also relevant to implementing HUD's Environmental Justice Strategy (77 FR 22599, published April 16, 2012). HUD's Environmental Justice Vision Statement explains that "For HUD, EJ means equal access to safe and healthy housing for all; mitigating risks to communities in disaster-prone areas; providing access to affordable, accessible, quality housing free of hazards to residents' health; and working to achieve inclusive, sustainable communities free from discrimination" (emphasis added).¹⁵ By helping HUD offices, programs, and partners respond and adapt to a changing climate, HUD will be furthering its vision for environmental justice.

Climate Change Risk and Vulnerability Analysis

HUD's analysis of its risk and vulnerabilities to climate change focuses upon four key effects: (1) extreme heat, (2) changes in precipitation, (3) climate-related extreme events, and (4) sea level rise. As local communities seek HUD's guidance to plan for future growth and development, HUD must help them develop place-based adaptation strategies in response to a changing climate. HUD believes that the four key effects identified are the most immediate to American homes and communities and thus by extension to American families.

Each section of the analysis begins with a discussion on the broad impacts of each expected effect of climate change to housing and communities. Next, the sections highlight the potential risks and vulnerabilities to HUD operations and programs. In order to ensure a thorough analysis of HUD's risk and vulnerabilities to its various program areas, this analysis was prepared with input from staff across the agency.

The impacts of climate change are expected to be spatially variable across the Nation. As a result, each section includes the results of a high-level spatial analysis of field office, public housing, and multifamily locations (HUD-assisted and -insured). The analysis and related criteria were used to determine the total risk from climate change effects via the following equation:

$$\text{Total Risk} = \text{Likelihood} \times \text{Vulnerability} \times \text{Exposure}$$

- The **Likelihood** of impact from selected climate change effects is based on the location of each property relative to specific climate change indicators. The total range of values for each indicator was determined and values of High, Moderate, and Low likelihood were assigned.
- The **Vulnerability** of each location is based on the magnitude of the following demographic indicators within the surrounding census block group (obtained from 2010 census data):
 - Percent of population < 5 years of age
 - Percent of population > 65 years of age
 - Percent population in poverty

The total range of values for each indicator was determined and values of High, Moderate, and Low were assigned based on relative value. Figure 1 shows the distribution of the combined demographic vulnerability values for the continental U.S.

- The level of **Exposure** was determined for public housing and multifamily locations by classifying each property based on the total number of units (below average, average, and above average).

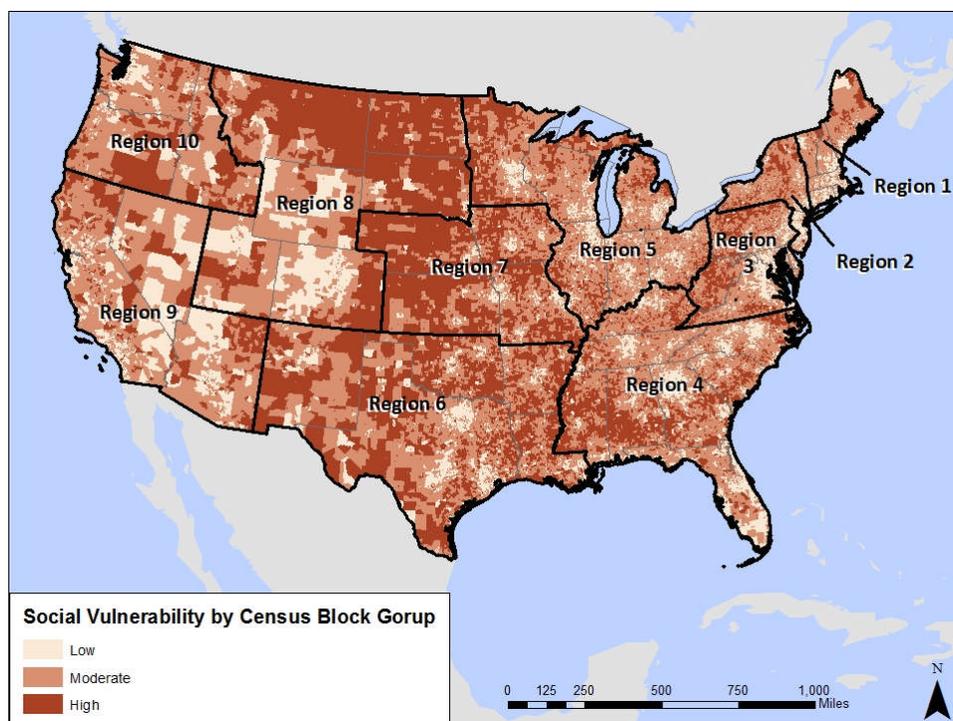


Figure 1 – Vulnerability by Census block group (Source: U.S. Census Bureau)

This analysis provides a summary-level assessment of climate change and its potential impacts to HUD. It is not intended to be comprehensive, but serve as a starting point using freely available data sources that are easily accessible. For example, an analysis of extreme heat risk is provided, while the seasonal effects of higher temperatures in winter are not included at this time. Over the next year, HUD will work internally, and with partners at the federal, state, and local levels to dig deeper into the effects of a changing climate on housing and communities and determine the appropriate actions to respond.

Extreme Heat

Observed and Expected Climate Change Effects

Over the last century, the average global temperature has risen by about 1.5°F. In an effort to predict future temperature trends, climate scientists use a suite of models based on scenarios that predict population and economic growth parameters resulting in higher- or lower-than-expected greenhouse gas emissions. Based on these models, the average global temperature is expected to rise 2-11.5°F by 2100.¹⁶ In the United States, this projected average temperature increase is expected to result in a higher number of days above 90°F, with certain regions experiencing far more days at or above this high temperature.¹⁷ For example, if higher emissions continue, parts of the South that currently experience temperatures over 90°F about 60 days per year are projected to experience 150 or more days a year above 90°F by the end of this century.¹⁸ Coincident with this phenomenon will be an increase in the

frequency and duration of heat waves. Air quality will be directly affected by higher-than-normal temperatures, with extreme heat events contributing to high ozone levels.

Impacts to Communities and the Built Environment

From a public health standpoint, many of the residents within the communities HUD serves are highly vulnerable to the effects of extreme heat. Elderly and very young populations and the chronically ill are particularly vulnerable to thermal stress, also called hyperthermia¹⁹. The elderly are also more likely to have preexisting medical conditions, including cardiovascular and respiratory illnesses, which may put them at greater risk of exacerbated illness by climate-related events or conditions²⁰. Extreme temperatures have a direct linkage to atmospheric ozone concentrations, which results in poorer air quality²¹. Poor access to health care, low levels of education, and racial/ethnic composition, all characteristics of low income populations, are likely to affect vulnerability to poor air quality. Within the built environment, an increase in the number of days above 90°F will result in higher energy demands for cooling.²²

HUD Risks and Vulnerabilities

Several of HUD's major programs are vulnerable to the effects of extreme heat events, especially those programs that serve low-income families and special needs populations, such as the elderly, persons who are homeless or who present risks of homelessness, and those with disabilities, including persons with HIV/AIDS. A number of HUD's major housing assistance programs, including Housing Choice Vouchers, Public and Indian Housing, Continuum of Care/Homeless Assistance Grants and Housing Opportunities for Persons with AIDS (HOPWA), have portfolios that are concentrated in urban areas that involve persons with vulnerabilities. Urban areas generally are more susceptible to extreme heat events because of the heat island effect. The term "heat island" describes a built up area that is hotter than nearby less developed or rural areas, an effect which can alter peak energy demands and heat-related illness and mortality.²³

As demand for energy increases, so do the operating costs within HUD's housing portfolios. HUD's partners spent an estimated \$7.1 billion on utility costs (water and energy) in 2010. Much of HUD's portfolio of public and assisted housing was built before the advent of energy codes, creating both environmental and affordability challenges for building owners, residents, and the federal government. Since allowances for tenant-paid utilities in HUD-assisted units are typically based on historical, regional averages, they may not be sufficient to cover higher energy costs in especially inefficient units, or spikes in energy costs due to extreme heat.²⁴

The expected spatial variability of higher projected temperatures shows that Regions V, VI, VII, and VIII will experience some of the highest temperature increases (Figure 2). In an assessment of climate change risk and vulnerability as it relates to regional and field offices, multifamily housing properties, and public housing structures, the following indicators were used to determine the likelihood of extreme heat events at each location:

- Projected temperature change by the 2080s
 - **Source:** Downscaled 12km translations of contemporary climate projections over the contiguous United States. The original projections are from the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project phase 3 (CMIP3) multi-model dataset, which was referenced in the Intergovernmental Panel on Climate Change Fourth Assessment Report. The data was obtained from the Climate Wizard application (<http://www.climatewizard.org>). The projected temperature data represents an average of all global circulation models, with a high emission scenario(A2)
 - **Categories:** Below Average (Low), Average (Moderate), and Above Average (High) relative to projected mean temperature rise

- Percent impervious surface (Used to identify locations that are more likely to experience the urban “heat-island” effect. Areas with higher impervious surface contain materials that absorb heat and do not allow it to dissipate.)
 - **Source:** National Land Cover Database (NLCD), 2001
 - **Categories:** < 33% (Low); 33%-66% (Moderate); > 66% (High)

- Percent tree canopy (Also used to identify locations that are more likely to experience the “heat-island” effect. Areas with low percentages of tree canopy have a lower incidence of shade, which lowers ambient air temperature.)
 - **Source:** National Land Cover Database (NLCD), 2001
 - **Categories:** > 66% (Low); 66%-33% (Moderate); < 33% (High)

- Population density (by block group)
 - **Source:** U.S. Census Bureau, 2010
 - **Categories:** < 1,000 persons / sq. mi (Low); 1,000 – 5,000 persons / sq. mi. (Moderate); > 5,000 persons / sq. mi. (High)

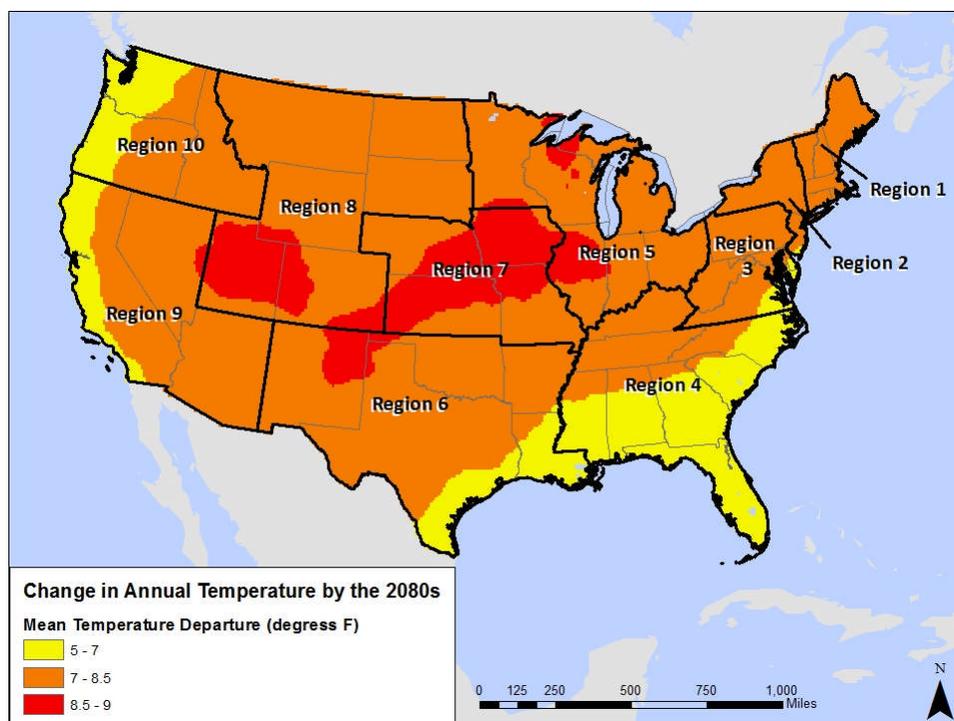


Figure 2 – Projected annual temperature change by the 2080s (*Source: WCRP CMIP3 multi-model dataset*)

For HUD’s regional and field office locations, likelihood values were derived by assigning a score to each indicator value (Low – 0; Moderate – 1; High – 2). Next, these indicator scores were added together, giving a total possible score of 8 for each location. Table 1 shows the regional / field office locations with the five highest extreme heat likelihood scores.

Office Location	Region	Category	Extreme Heat Likelihood (Max Possible = 8)
Springfield, IL	V	Field	7
St. Louis, MO	VII	Field	7
Kansas City, KS	VII	Regional	7
Omaha, NE	VII	Field	7
Boston, MA	I	Regional	7

Table 1 – HUD regional and field office locations with the highest extreme heat likelihood scores.

For multifamily properties and public housing structures, once the extreme heat likelihood score was derived, it was multiplied by the vulnerability score and exposure value for each location to obtain the

total extreme heat risk value. Next, the range of values was divided into quintiles, with the top 20% of values within each range designated as falling within a high risk category. Table 2 shows the percent of high risk properties within each region.

Region	Percent of Multifamily Properties with High Heat Risk	Percent of Public Housing Properties with High Heat Risk
I	18%	33%
II	31%	46%
III	22%	21%
IV	8%	7%
V	18%	21%
VI	14%	8%
VII	16%	11%
VIII	9%	11%
IX	17%	14%
X	4%	7%

Table 2 – The percent of multifamily and public housing properties with high heat risk scores by HUD region.

The resultant extreme heat risk scores were summarized by city and normalized to fall within a range of 1 to 100. Table 3 shows the cities with the highest heat risk scores.

City	Highest Heat Risk Score for Public Housing and Multifamily Properties
Atlantic City, NJ	100
Baltimore, MD	100
Detroit, MI	100
Ferndale, MI	100
Harrisburg, PA	100

Table 3 – Cities with the highest heat risk scores for public housing and multifamily properties.

Changes in Precipitation

Observed and Expected Climate Change Effects

Rising average temperatures will have effects on the Earth's water cycle. One of the clearest precipitation trends in the United States is the increasing frequency and intensity of heavy downpours. This increase was responsible for most of the observed increase in overall precipitation during the last 50 years.²⁵ In fact, there has been little change or a decrease in the frequency of light and moderate precipitation during the past 30 years, while heavy precipitation has increased. In addition, while total average precipitation over the nation as a whole increased by about 7 percent over the past century, the amount of precipitation falling in the heaviest 1 percent of rain events increased nearly 20 percent. In the U.S., warming is expected to cause a northward shift in storm tracks, resulting in decreases in precipitation in areas such as the Southwest, but increases in many areas to the north and east. The Southwest region is expected to experience increasing drought as changes in atmospheric circulation patterns cause the dry zone just outside the tropics to expand farther northward into the United States.

Impacts to Communities and the Built Environment

An analysis by HUD's Office of Healthy Homes and Lead Hazard Control (OHHLHC) shows that increased precipitation (particularly flooding) causes greater water leakage through building envelopes, which in turn can amplify the level of mold and other biological contaminants in indoor air. Poor indoor air quality significantly affects health as Americans spend the majority of their lives in indoor environments. A further concern is that low-income families have the fewest resources to fix water leaks and replace water-damaged and mold-prone building materials and personal items.

Similar to the effects of extreme heat, the effects of increased high intensity precipitation and associated flooding will fall disproportionately on the poor, the young, and the elderly. Many of vulnerable populations are served by HUD programs, and as such, further analysis of specific health-oriented effects will be undertaken in the near future to better identify potential response strategies.

Water scarcity is an emerging issue in the Southwest which will be exacerbated by climate change. This will also have a tremendous impact on water supply availability for housing development. In 2012, the Arkansas Project sued the Texas Council on Environmental Quality's water resources management system for failure to provide adequate water which resulted in the deaths of 23 endangered whooping cranes which occurred during the extreme drought. Controversies such as this involve trade-offs in water use in a water-scarce environment and have implications for water availability for municipal and rural domestic water uses.

HUD Risks and Vulnerabilities

Many of the same programs that are vulnerable to the effects of extreme heat events are also vulnerable to the effects of changing precipitation regimes and the secondary impacts of flooding and drought. Increases in the frequency of heavy precipitation events will result in a higher risk to those HUD

owned and managed properties that are already at risk to damage from inundation. Table 4 illustrates the results of a spatial analysis that summarizes HUD properties residing within a FEMA-designated flood zone. Structures within the “High” category reside within the 100-year flood zone, structures within the “Moderate” category reside within the 500-year flood zone, and structures within the “Low” category do not reside within a FEMA-designated flood zone.²⁶ Structures within the “Unknown” category lie within areas that are not currently covered by FEMA flood maps. It is important to note that some of these areas reside in tribal reservations that contain populations served by HUD’s Indian housing programs. The spatial extent of these zones is shown in Figure 3.

	Structures within Flooding Likelihood Category							
	High		Moderate		Low		Unknown	
	#	%	#	%	#	%	#	%
Field Office	3	4%	8	10%	69	85%	1	1%
Multifamily Housing	1,759	5%	1,653	5%	29,046	86%	1,157	4%
Public Housing	17,877	7%	15,522	6%	213,342	83%	9,774	4%

Table 4 – The exposure of selected HUD properties to flooding based on their location relative to FEMA-designated flood zones

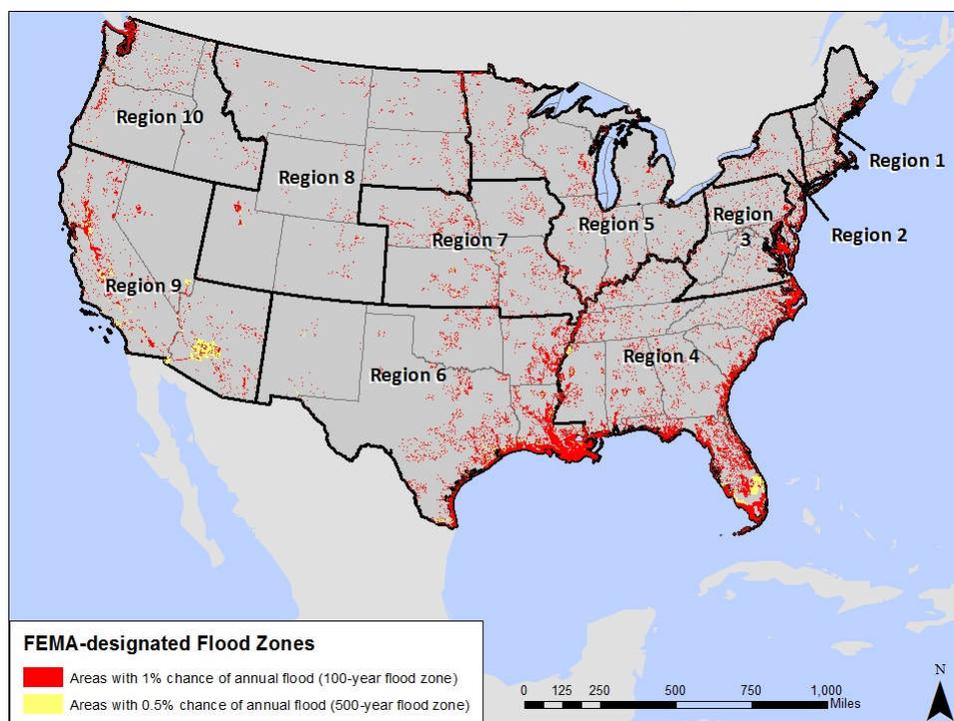


Figure 3 – Areas within FEMA-designated 100-year and 500-year flood zones. (Source: FEMA)

The spatial variability of changing precipitation regimes shows that Regions I, II, III, and V will experience increases in precipitation relative to the period from 1975 – 2005 (Figure 4). Conversely, Regions VI, VIII, and IX will see a decrease in precipitation relative to the same period.

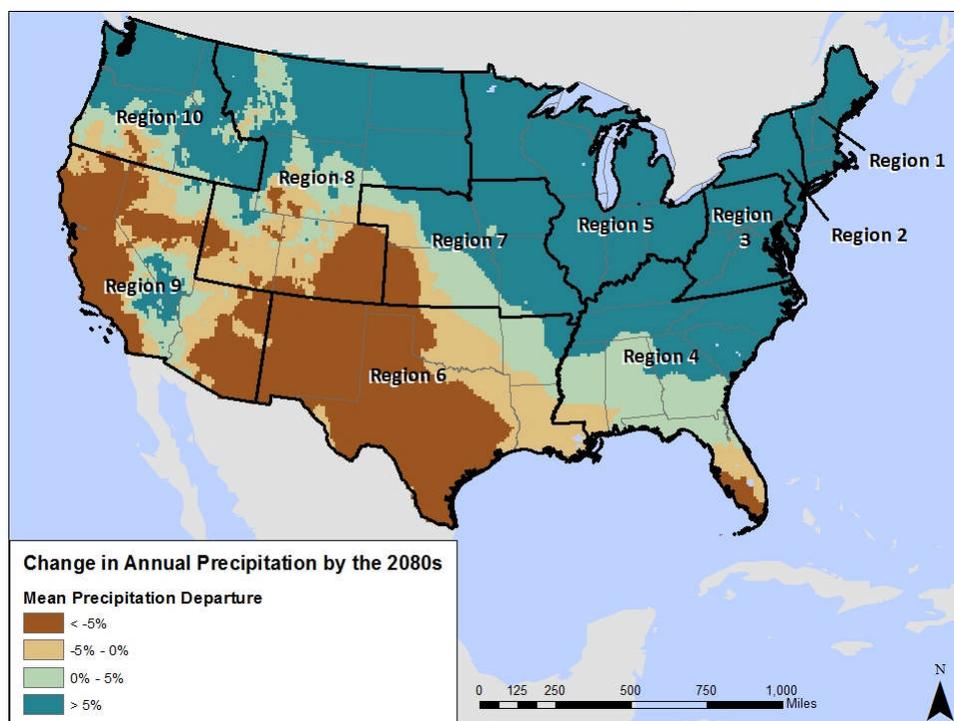


Figure 4 – Projected annual precipitation change by the 2080s. (Source: WCRP CMIP3 multimodal dataset)

In an assessment of climate change risk and vulnerability as it relates to HUD’s regional and field offices, multifamily housing properties, and public housing structures, the following indicators were used to determine the likelihood of flooding events at each location:

- Projected precipitation change by the 2080s
 - **Source:** Downscaled 12km translations of contemporary climate projections over the contiguous United States. The original projections are from the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project phase 3 (CMIP3) multi-model dataset, which was referenced in the Intergovernmental Panel on Climate Change Fourth Assessment Report. The data was obtained from the Climate Wizard application (<http://www.climatewizard.org>). The projected precipitation data represents an average of all global circulation models, with a high emission scenario(A2)
 - **Categories:** Below Average (Low), Average (Moderate), and Above Average (High) relative to projected mean precipitation change
- Location within a FEMA-designated flood zone
 - **Source:** FEMA Digital Flood Insurance Rate Maps (DFIRM) and Q3 data.

- **Categories:** Outside of a FEMA-designated flood zone (Low); Within a FEMA-designated 500-year (0.5% annual chance) flood zone (Moderate); and within a FEMA-designated 100-year (1% annual chance) flood zone (High)

For HUD’s regional and field office locations, likelihood values were derived by assigning a score to each indicator value (Low – 0; Moderate – 1; High – 2). Next, these indicator scores were added together, giving a total possible score of 4 for each location. Table 5 shows the regional / field office locations with the five highest flooding likelihood scores.

Office	Region	Category	Flooding Likelihood (Max Possible = 4)
Providence, RI	I	Field	3
Charleston, WV	III	Field	3
Nashville, TN	IV	Field	3
Boise, ID	X	Field	3
Grand Rapids, MI	V	Field	2

Table 5 – HUD regional and field office locations with the highest flooding likelihood scores.

For multifamily properties and public housing structures, once the flooding likelihood score was derived, it was multiplied by the vulnerability score and exposure value for each location to obtain the total flooding risk value. Next, the range of values were divided into quintiles, with the top 20% of values within each range designated as falling within a high risk category. Table 6 shows the percent of high risk properties within each region.

Region	Percent of Multifamily Properties with High Flood Risk	Percent of Public Housing Properties with High Flood Risk
I	17%	26%
II	29%	43%
III	26%	22%
IV	11%	10%
V	19%	18%
VI	3%	2%
VII	15%	9%
VIII	3%	3%

Region	Percent of Multifamily Properties with High Flood Risk	Percent of Public Housing Properties with High Flood Risk
IX	2%	1%
X	6%	10%

Table 6 – The percent of multifamily and public housing properties with high flood risk scores by HUD region.

The resultant flood risk scores were summarized by city and normalized to fall within a range of 1 to 100. Table 7 shows the cities with the highest flood risk scores.

City	Highest Flood Risk Score for Public Housing and Multifamily Properties
Atlantic City, NJ	100
Columbus, OH	100
Yonkers, NY	100
Fayetteville, NC	96
Lumberton, NC	92

Table 7 – Cities with the highest flood risk scores for public housing and multifamily properties.

Extreme Events

Observed and Expected Climate Change Effects

Global climate change is likely to increase the occurrence of weather-related natural disasters and to disrupt patterns of occurrence in terms of geography. This not only means that communities will face a greater number of hurricanes and severe storms; it also means that communities that never faced such disasters in the past will face them in the future. Over the last three decades, annual sea surface temperatures in the main Atlantic hurricane development region increased nearly 2°F.²⁷ This warming coincided with an increase in the destructive energy of Atlantic tropical storms and hurricanes. The strongest hurricanes have, in particular, increased in intensity. Analyses of model simulations suggest that for each 1.8°F increase in tropical sea surface temperatures, core rainfall rates will increase by 6 to 18 percent and the surface wind speeds of the strongest hurricanes will increase by about 1 to 8 percent. Regarding severe thunderstorms and tornadoes, reports of these destructive phenomena have

increased over the last half-century. However, this increase can be attributed to advances in observational early-warning technologies, as opposed to a changing climate.²⁸ While some of the primary ingredients for severe weather events, such as increased atmospheric heat and moisture content, are predicted to increase over the next century, other elements, such as wind shear, are expected to decrease. As a result, it is difficult to predict how climate change may affect the presence and magnitude of severe weather events.

Impacts to Communities and the Built Environment

Extreme events, such as tropical storms / hurricanes and severe weather / tornadoes, have the capability to inflict enormous physical and emotional tolls on communities. Moreover, low-income families, racial and ethnic minorities, homeless individuals and families, and those with disabilities are disproportionately affected by the aftermath of a disaster. In addition to potential structural damage to housing, these events can also cause major disruptions to transportation, power transmission, and water supply infrastructures. Flooding from heavy precipitation events or storm surge, coupled with wind damage, can result in poor indoor air quality from mold and mildew. In response to the most extreme events, municipalities may need to develop recovery planning strategies that contemplate relocation of at-risk structures or mitigation measures such as elevation that protect human lives and investments in homes and infrastructure.

HUD Risks and Vulnerabilities

Climate- and weather-related disasters severely affect HUD's ability to fulfill its mission. The Department has learned valuable lessons from its experiences responding to housing needs in times of crisis, such as Hurricanes Katrina and Rita and the recent flooding throughout the Midwest. Following these and other major disasters, HUD has learned that its efforts to assist short-term and long-term recovery in response to natural disasters poses significant burdens with regard to staff time and meeting day to day needs in the context of limited resources. Vulnerabilities to HUD's mission are present both in terms of where and how HUD encourages development and in terms of how HUD aids those most in need. In other words, each of HUD's programs has its own vulnerabilities. For instance, the Office of Public and Indian Housing recognizes that Public Housing Agencies have developments in areas at risk of increased climate-related disasters. The Office of Community Planning and Development is examining a FEMA grant standard that requires new construction of critical actions²⁹ to be elevated to the 500-year base flood elevation, which is the standard proposed by the U.S. Water Resources Council. While many communities that HUD supports are at risk, it is important to remember that parts of these communities are more at risk than others.

The likelihood of tropical storms is used to illustrate the spatial variability of extreme events for the purposes of this document. It should be noted that current models cannot accurately predict the future behavior or location of smaller scale events such as severe storms and tornadoes as a response to climate change. As such, these phenomena were not included in this analysis. An examination of the number of direct hits from a tropical system, by county, during the period of 1851 to 2005 shows that

those areas along the Southeast and Gulf Coasts (Regions I, III, IV, and VI) have the highest likelihood (Figure 5). In an assessment of climate change risk and vulnerability as it relates to HUD regional and field offices, multifamily housing properties, and public housing structures, the following indicators were used to determine the likelihood of extreme events at each location:

- Location within a FEMA-designated coastal flood zone
 - **Source:** FEMA Digital Flood Insurance Rate Maps (DFIRM) and Q3 data.
 - **Categories:** Outside of a FEMA-designated coastal flood zone (Low); Within a FEMA-designated 500-year (0.5% annual chance) coastal flood zone (Moderate); and within a FEMA-designated 100-year (1% annual chance) coastal flood zone (High)
- Number of Tropical Storm Hits (Based on number of tropical storms making direct hit on a U.S. county, 1851 - 2005)
 - **Source:** NOAA Coastal Services Center’s Historical Hurricanes Tracking Tool
 - **Categories:** 0 – 5 (Low); 5 – 15 (Moderate); > 15 (High)

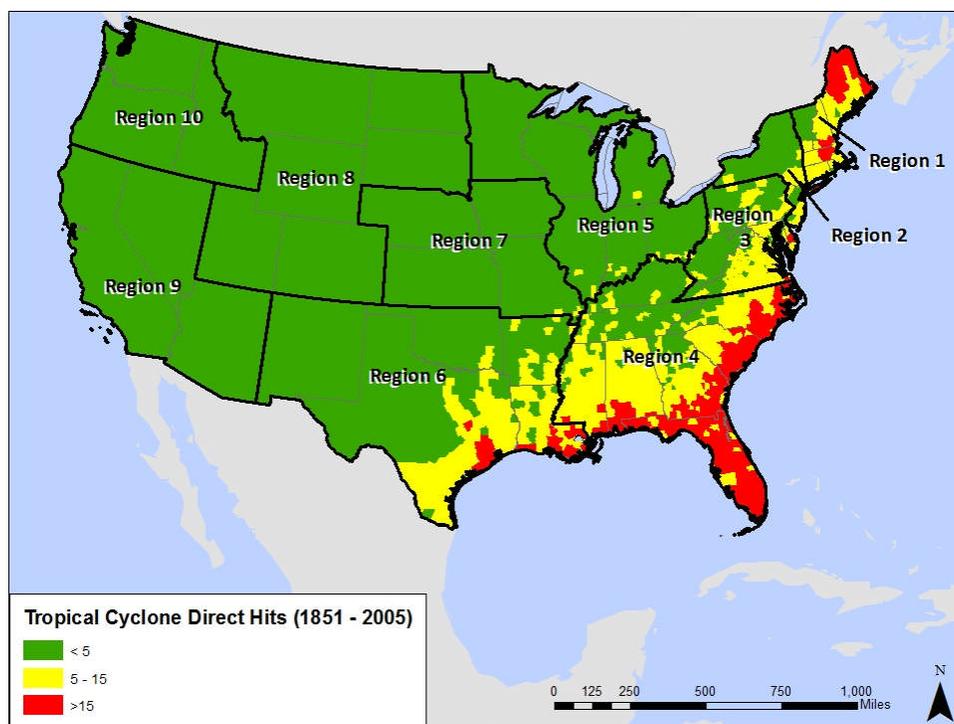


Figure 5 – Tropical Storm Direct Hits, 1851 – 2005. (Source: NOAA)

For regional and field office locations, likelihood values were derived by assigning a score to each indicator value (Low – 0; Moderate – 1; High – 2). Next, these indicator scores were added together,

giving a total possible score of 4 for each location. Table 8 shows the regional / field office locations with the five highest coastal storm likelihood scores.

Office	Region	Category	Coastal Storm Likelihood (Max Possible = 4)
Miami, FL	IV	Field	4
New Orleans, LA	VI	Field	2
Orlando, FL	IV	Field	2
Houston, TX	VI	Field	2
Tampa, FL	IV	Field	2

Table 8 – HUD regional and field office locations with the highest coastal storm likelihood scores

For multifamily properties and public housing structures, once the coastal storm likelihood score was derived, it was multiplied by the vulnerability score and exposure value for each location to obtain the total coastal storm risk value. Next, the range of values were divided into quintiles, with the top 20% of values within each range designated as falling within a high risk category. Table 9 shows the percent of high risk properties within each region.

Region	Percent of Multifamily Properties with High Coastal Storm Risk	Percent of Public Housing Properties with High Coastal Storm Risk
I	11%	27%
II	6%	14%
III	33%	6%
IV	2%	14%
V	<1%	<1%
VI	12%	8%
VII	0%	<1%
VIII	0%	0%
IX	1%	<1%
X	<1%	<1%

Table 9 – The percent of multifamily and public housing properties with high coastal storm risk scores by region.

The resultant coastal storm risk scores were summarized by city and normalized to fall within a range of 1 to 100. Table 10 shows the cities with the highest coastal storm risk scores.

City	Highest Coastal Storm Risk Score for Public Housing and Multifamily Properties
Biloxi, MS	100
New Bern, NC	92
Galveston, TX	88
Brunswick, GA	83
Miami, FL	83

Table 10 – Cities with the highest coastal storm risk scores for public housing and multifamily properties

Sea Level Rise

Observed and Expected Climate Change Effects

During the last century, the sea level rose by more than the global average along the Mid-Atlantic and Gulf Coasts.³⁰ These communities may be threatened by sea levels inundating wetlands, eroding beaches, intensifying flooding, and increasing the salinity of rivers, bays, and elevating groundwater tables (impacting freshwater supplies and affecting drainage and septic systems).³¹ The rate of inundation is not expected to be uniform along the U.S. coast. Some areas, such as the Chesapeake Bay and Louisiana coasts, will see a much higher rate due to land subsidence. Other areas, such as the Great Lakes, will actually see water levels fall, in response to the relative uplift of the surrounding areas.

Impacts to Communities and the Built Environment

Compared to other climate change effects, such as more frequent extreme events, sea level rise produces longer-term impacts. In 1991, FEMA estimated that a one-foot rise in sea level by 2100 would increase annual flood damage to insured property by 36-58 percent and a three-foot rise would increase annual damage by 102-200 percent. Recent estimates indicate that a sea level rise of nearly 20 inches by 2100 would cause \$23-170 billion in damage to U.S. coastal property.³² However, it is important to note that even small changes to sea levels can have profound effects in the short term when compounded by inundation from higher-than-normal tides and storm surge.

The effects from rising sea levels are similar to the effects of increased flooding from changes in precipitation regimes, just on a much longer time frame. Coastal communities will see fragmented barrier islands, and potential impacts to existing homes, business, and infrastructure³³. In addition, sea-level rise is expected to increase saltwater intrusion into coastal freshwater aquifers, making some sources of drinking water unusable without desalination³⁴.

HUD Risks and Vulnerabilities

HUD's strategy to fulfill its mission in terms of at-risk communities is to encourage development that can withstand sea level rise. HUD's primary vehicle for accomplishing this is the restrictions that HUD places upon its funding to grantees. Currently, several of HUD's program offices are considering restricting their grant funding to areas that can withstand sea level rise. For instance, CPD has proposed a rule to prohibit the construction of new structures in Coastal High Hazard Areas, mirroring FEMA's grant standard. Changing the funding structure of HUD's programs can help communities become more resilient to sea level rise in the long run; this is an area for HUD to explore in terms of cross-program collaboration.

The spatial variability of sea level rise shows that Regions III, IV, VI, IX, and X are most vulnerable to sea level rise (Figure 6). This is based on the Coastal Vulnerability Index (CVI) product from the U.S. Geological Survey (USGS). CVI combines a coastal system's susceptibility to change with its natural ability to adapt to changing environmental conditions, and yields a relative measure of the system's natural vulnerability to the effects of sea-level rise.³⁵ In an assessment of climate change risk and vulnerability as it relates to regional and field offices, multifamily housing properties, and public housing structures, the following indicators were used to determine the likelihood of sea level rise at each location:

- Location within a FEMA-designated coastal flood zone
 - **Source:** FEMA Digital Flood Insurance Rate Maps (DFIRM) and Q3 data.
 - **Categories:** Outside of a FEMA-designated coastal flood zone (Low); Within a FEMA-designated 500-year (0.5% annual chance) coastal flood zone (Moderate); and within a FEMA-designated 100-year (1% annual chance) coastal flood zone (High)
- Location within 1 mile of a shoreline rated as having a high or very high coastal vulnerability to sea level rise
 - **Source:** USGS Coastal Vulnerability Index, 1999
 - **Categories:** Outside of an area defined by a 1-mile distance from a CVI shoreline rated high or very high (Low); within an area defined by a 1-mile distance from a CVI shoreline rated high (Moderate); and within an area defined by a 1-mile distance from a CVI shoreline rated high (High)

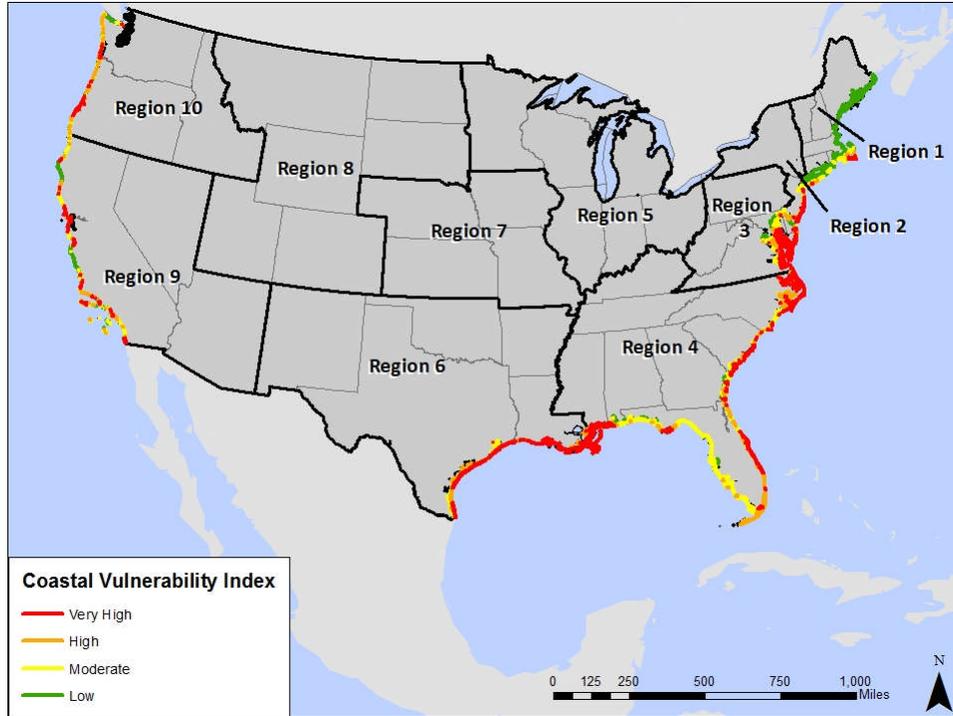


Figure 6 – Coastal Vulnerability to Sea Level Rise. (Source: USGS)

For regional and field office locations, likelihood values were derived by assigning a score to each indicator value (Low – 0; Moderate – 1; High – 2). Next, these indicator scores were added together, giving a total possible score of 4 for each location. Table 11 shows the regional / field office locations with the three highest sea level rise likelihood scores.

Office	Region	Category	Sea Level Rise Likelihood (Max Possible = 4)
Miami, FL	IV	Field	3
New Orleans, LA	VI	Field	1
Providence, RI	I	Field	1

Table 11– HUD regional and field office locations with the highest sea level rise likelihood scores.

For multifamily properties and public housing structures, once the sea level rise likelihood score was derived, it was multiplied by the vulnerability score and exposure value for each location to obtain the total sea level rise risk value. Next, the range of values were divided into quintiles, with the top 20% of

values within each range designated as falling within a high risk category. Table 12 shows the percent of high risk properties within each region.

Region	Percent of Multifamily Properties with High SLR Risk	Percent of Public Housing Properties with High SLR Risk
I	<1%	<1%
II	2%	3%
III	1%	2%
IV	2%	1%
V	0%	0%
VI	1%	1%
VII	0%	0%
VIII	0%	0%
IX	<1%	<1%
X	<1%	<1%

Table 12– The percent of multifamily and public housing properties with high SLR risk scores by region.

The resultant sea level rise risk scores were summarized by city and normalized to fall within a range of 1 to 100. Table 13 shows the cities with the highest sea level rise risk scores.

City	Highest Sea Level Rise Risk Score for Public Housing and Multifamily Properties
Biloxi, MS	100
Galveston, TX	88
Atlantic City, NJ	75
Norfolk, VA	71
New Bern, NC	69

Table 13 – Cities with the highest sea level rise risk scores for public housing and multifamily properties.

Opportunities and Actions

As evidenced by the discussion above, HUD's operations and programs will face many challenges resulting from projected climate change. HUD will address these challenges through existing HUD programs and activities which support adaptation, and through future actions that are already proposed or will be considered in the future. These future actions represent further opportunities to explore adaptation at the agency and community level.

The HUD Climate Change Adaptation Taskforce will work with HUD's program and regional offices to align proposed actions with current activities in an effort to "mainstream" climate change perspectives in a manner that maximizes current resources.

In this section of the adaptation planning document, the Task Force has outlined current HUD frameworks and programs that support climate change adaptation, followed by an outline of future proposed actions that will future enhance existing climate change efforts.

Current HUD Frameworks and Programs that Support Climate Change Adaptation

In fulfilling its mission, HUD has in place a number of programs, resources, and strategies that support the climate change adaptation process. The following represents an overview of activities in which HUD is actively working with communities to better prepare for, and respond to, the effects of a changing climate. These examples include the HUD environmental review process, disaster recovery and preparedness, sustainability planning and other planning efforts, and energy efficiency and green building.

HUD Environmental Review Process

Several statutes, regulations, and guidance documents that are relevant to adaptation planning are utilized during the environmental review process. The National Environmental Policy Act (NEPA)³⁶ establishes national environmental policy and goals for the protection, maintenance, and enhancement of the environment and provides a process for implementing these goals within the federal agencies. The Act also establishes the Council on Environmental Quality (CEQ) and assigns CEQ the task of ensuring that federal agencies meet their obligations under the Act. To carry out this charge, the CEQ set forth regulations and guidance documents to assist Federal agencies in implementing NEPA during the planning phase of any Federal action.³⁷ HUD regulations found at 24 CFR Part 50 and 24 CFR Part 58 further implement NEPA and other environmental review requirements for HUD-assisted activities. As part of the NEPA environmental review process, impacts to the environment are considered. The environmental analysis and documents produced in the NEPA process may provide the decision maker with relevant and timely information about the environmental effects of his or her decision as they relate to climate change and reasonable alternatives to mitigate those impacts. HUD regulations also reference additional required environmental review processes. Those especially applicable to climate

change mitigation are the rules and regulations regarding Coastal Zone Management,³⁸ Floodplain Management,³⁹ Flood Insurance,⁴⁰ and Wetlands Protection.⁴¹ Compliance with these environmental laws and authorities advance climate adaptation planning by considering the risk of water resource impacts to projects before a project site is approved.

Disaster Recovery / Preparedness

In a recent report to HUD, the Institute for Sustainable Communities (ISC) commented, “It is widely recognized that climate change is a ‘game changer’ that will require much greater attention to disaster risk reduction and preparedness.” ISC’s report summarizes the challenges and recommendations captured on January 12, 2010, during a meeting HUD hosted with the support of the Rockefeller Foundation and in cooperation with the U.S. Department of Homeland Security (DHS). The meeting convened leading experts to discuss the integration of sustainability and resilience into federal long-term disaster recovery efforts. Climate adaptation was one of four topics discussed to inform HUD and other members of the Interagency Long-Term Disaster Recovery Working Group. ISC also reported to HUD that “the federal government, along with researchers, the disaster response community and other stakeholders, can help create better prepared and more resilient communities in the face of the anticipated impacts of climate change.”⁴²

In anticipation of increased frequency and severity of major disasters likely to result from climate change, HUD is working with the Federal Emergency Management Agency (FEMA) of DHS and other federal agencies to invest in disaster recovery coordination and preparedness. This preparation builds on HUD’s experience partnering with states, tribes, and local governments to lead long-term recovery after catastrophic events such as Hurricane Katrina and the attacks of September 11, 2001.

HUD has made changes in its operational structure to enable the Department to better respond to disaster recovery needs. These actions, described in more detail below, are designed to layer seamlessly with current programs while providing a flexible and scalable structure that would enable HUD to respond quickly to implement new statutory mandates or disaster recovery appropriations as Congress may direct from time to time. These recent actions and investments are also consistent with Goal 4 of HUD’s FY 2010-2015 Strategic Plan. Under Subgoal 4D, HUD aims to facilitate disaster preparedness, recovery, and resilience. The following strategies and implementation measures identified under Goal 4 will assist HUD in adapting to new and changing disaster recovery needs due to climate change.

- Promote the use of climate-resilient and disaster-resistant development patterns, building siting, design, and construction.
- Integrate and coordinate assistance across federal programs to help create disaster-resilient and sustainable communities and facilitate the delivery of post-disaster resources for recovery.
- Reduce losses to businesses, community organizations, and public infrastructure from reoccurring disasters in high-risk areas.

- Increase the proportion of Consolidated Plans that incorporate disaster-resiliency and sustainability principles and that are linked to Federal Emergency Management Agency hazard mitigation plans.⁴³

Office of Disaster Management and National Security (ODMNS)

HUD is also in the process of standing-up an Office of Disaster Management and National Security (ODMNS) that advises the Secretary, Deputy Secretary, and departmental leadership on disaster management and national security preparedness, response, and recovery. The Office was established in 2010 through a change in the Department's operating plan to serve as a focal point and improve coordination of the Department's response and recovery activities.⁴⁴ ODMNS works with others in the department to identify and mitigate national risks to HUD's clients and programs, public resources, and critical infrastructure. The office will ensure that HUD's security and disaster management programs support national objectives and the security of the United States, while supporting HUD's primary mission of creating strong, sustainable, inclusive communities and quality affordable housing.

National Disaster Recovery Framework (NDRF) & Housing Recovery Support Function

In September 2009, President Barack Obama charged DHS and HUD with establishing a Long-Term Disaster Recovery Working Group (the Working Group). Composed of more than 20 Federal departments, agencies and offices, the Working Group was asked to develop operational guidance for recovery organizations, and to make recommendations for improving the Nation's approach to disaster recovery.⁴⁵

This effort resulted in the National Disaster Recovery Framework (NDRF), a guide to promote effective recovery, particularly for those incidents that are large-scale or catastrophic. It focuses on how best to restore, redevelop and revitalize the health, social, economic, natural and environmental fabric of the community and build a more resilient Nation. During the period of recovery, the NDRF applies to all Presidentially-declared major disasters (those declared under the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act)). It defines various Recovery Support Functions (RSFs) and identifies the federal agencies responsible for coordinating, leading, and supporting these functions.

The NDRF complements the National Response Framework (NRF), which provides the overarching interagency initial response coordination structure for major disasters and for non-Stafford Act incidents. Consistent with the National Disaster Housing Strategy (NDHS), under the NRF FEMA maintains lead responsibility as Coordinating Agency for sheltering and interim housing with interim housing support from HUD and other agencies and organizations.

From the interim period following a disaster through long-term recovery, HUD is the Coordinating Agency for the Housing RSF under the NDRF, which addresses disaster-related housing issues. The NDRF defines core recovery principles, roles and responsibilities of recovery coordinators and other stakeholders, and an overarching interagency coordinating structure for all stakeholders for the recovery phase. Elements of the NDRF may also be used for significant non-Stafford Act incidents.

Various HUD offices, particularly ODMNS, the Office of Public and Indian Housing, the Office of Field Policy and Management, the Office of Community Planning and Development, and regional and field offices in the disaster-affected area work closely with FEMA, other federal agencies that administer housing programs and State Housing Agencies in affected areas to address housing needs. The Housing RSF is designed to allow HUD and other member agencies to scale efforts based on the resources available, and rapidly scale up efforts if Congress makes special appropriations for recovery or grants special statutory authority in response to catastrophic events. For example, Division B of the Department of Defense Emergency Supplemental Appropriations to address Hurricanes in the Gulf of Mexico and Pandemic Influenza Act, 2006 (Section 901 of Public Law No. 109-148, enacted on December 30, 2005), authorized PHAs in federally declared disaster areas as a result of Hurricanes Katrina and Rita to combine assistance under sections 8(o) (Housing Choice Voucher Funds) and 9(d) and (e) (public housing Operating and Capital Funds) of the U.S. Housing Act of 1937 for the purpose of assisting families that were receiving assistance under those programs before the hurricanes and displaced after the hurricanes. Section 901 flexibility permitted a handful of Louisiana and Mississippi PHAs to use funds to repair damaged public housing, develop new affordable rental and homeownership housing, institute self-sufficiency programs, upgrade housing search capacities, implement re-occupancy programs, offer home purchase buy-downs, and offer other assistance to formerly assisted and displaced families. HUD can draw from its experience in administering past supplemental appropriations and authorities to implement the Housing RSF.

The NDRF also provides guidance for pre- and post-disaster recovery planning and sets forth the process by which communities can capitalize on opportunities to rebuild stronger, smarter and safer. The Housing RSF, through HUD and the RSF's other member departments and agencies, works toward addressing disaster housing issues pre-disaster, focusing on solutions that are implementable, sustainable and resilient. Using available resources, Housing RSF works with local, State, and Tribal governments, organizations and others in coordination with the National Disaster Housing Task Force's Joint Housing Solutions group to identify strategies and options that address a broad range of disaster housing issues. In addition to considering issues such as planning, zoning, design, production, logistics, codes, and financing, the Housing RSF incorporates accessibility, sustainability and resilience, and mitigation, into identified housing recovery strategies.

HUD used an approach similar to the NDRF Framework to coordinate action after the multiple-vortex EF5 tornado struck Joplin, Missouri in May 2011. After that disaster struck, HUD's Joplin Tornado Field Working Group began assessing the damage to HUD properties and clients and showing HUD's support. They met with the local public housing authority director, checked on homeless grantees and their clients, and looked firsthand at multifamily properties that had been decimated by the storm. The Joplin Tornado Field Working Group has made several visits to the city and forged a strong partnership between HUD, the city, and other federal agencies to help rebuild Joplin. Since that initial visit, the Field Working Group has worked tirelessly to help get public and multifamily housing units back online, secure disaster funding for the city, meet with city management to offer edits on Joplin's proposed use

of the funding, and has helped celebrate the reopening of a multifamily property for seniors that was heavily damaged.

The success of this cross-program collaboration in Joplin has changed the way the regional office and offices nationwide approach HUD's role in disaster recovery after similarly scaled disasters. Storms that hit the Plains in February 2012 solidified this approach, immediately bringing together managers from across the region to discuss what HUD's response would be and how HUD could quickly help families.

Community Planning and Building Capacity to Respond to Major Disasters

In addition to its role as Coordinating Agency under the Housing RSF of the National Disaster Recovery Framework (NDRF), HUD is a supporting organization under the Community Planning and Capacity Building RSF. This RSF unifies expertise and assistance programs from across the Federal Government to aid in restoring and improving the ability of Tribes, States and local governments to organize, plan, manage and implement recovery, develop a pre- and post-disaster system of support for communities, and integrate hazard mitigation. To this end, HUD is identifying and implementing methods for improved community planning and capacity building. The improvements to the consolidated planning process, described in more detail below, are an example of how HUD is using existing authorities to support community planning efforts. The RSF also serves as a forum for helping to integrate the nongovernmental and private sector resources into public sector recovery planning processes.⁴⁶

Community Development Block Grant Disaster Recovery Assistance

When disasters occur, Congress may appropriate additional funding for the Community Development Block Grant (CDBG) program as Disaster Recovery grants to rebuild the affected areas and bring crucial seed money to stimulate the recovery process. Because these recovery funds may assist a broader range of recovery activities than most other federal programs, CDBG Disaster Recovery assistance helps communities and neighborhoods that otherwise might not recover due to limits on other resources.

Generally, CDBG Disaster Recovery funds go to states and local governments in places that have been designated by the President of the United States as major disaster areas. Eligible activities under the program assist grantees in meeting long-term recovery disaster. In meeting these needs, grantees are encouraged to incorporate sustainability principles and hazard mitigation elements when rebuilding from the impacts of the covered disaster.

HUD has previously encouraged the investment in reducing risk from future disasters by establishing an incentive fund within the supplemental CDBG disaster recovery appropriation responding to the disasters of 2008. The Disaster Recovery Enhancement Fund (DREF) set-aside approximately \$311 million of the approximately \$6.1 billion appropriated under P.L. 110-329. Grantees that invested their initial disaster recovery allocations in activities that reduced risk and promoted resiliency were eligible for a one-for-one match from the DREF on a pro-rata basis, depending on the amount dedicated toward certain qualifying activities. Qualifying activities to receive matching funds from the DREF included:

- Development of a forward-thinking land-use plan that will guide the use of long-term recovery and subsequent land-use decisions and that reduces existing or future development in high-risk areas;
- Buyout programs within floodplains, critical fire areas, or seismic hazard areas under an optional relocation plan that includes incentives so that families and private-sector employers move out of high-risk areas;
- Individual mitigation measures to improve residential properties and make them less prone to damage; as well as implementation of modern disaster resistant building codes.

Sustainability Planning and Other Planning Efforts

Communities throughout the country are realizing that planning for their future development includes recognizing and incorporating the impacts of a changing climate. The possibility of facing more frequent and intense heat waves, changed precipitation patterns and rising sea levels forces communities to plan for climate change adaptation, or adjust natural and human systems to moderate these negative effects.

Sustainable Communities Regional Grant Program

HUD's Office of Sustainable Housing Communities (OSHC) introduced the Sustainable Communities Regional Grant Program in Fiscal Year 2010 to support metropolitan and multi-jurisdictional planning efforts that integrate housing, land use, economic and workforce development, transportation, and infrastructure investments. The impacts of these grants will in many cases lower greenhouse gas emissions – through siting new jobs near transit or new housing near jobs reducing miles driven, through enabling communities to rewrite zoning code to allow for local renewable energy development, or by improving bicycling, walking and transit infrastructure to allow for fewer auto-based trips. Climate adaptation planning is an eligible activity. A number of grant recipients of the Sustainable Regional Planning Grants from the Office of Sustainable Housing and Communities have recognized the unavoidable impacts of climate change and are directly addressing adaptation into their long-range planning efforts:

- The Consortium in southeast Florida is already seeing impacts of sea level rise as saltwater intrudes inland areas and rising water tables cause increased flooding. They are developing a regional climate resiliency strategy to better understand the likely impacts of climate change including the likely extent of sea level rise impacts and then formulating a coordinated regional adaptation plan to protect natural, built and human communities.
- In the Boston metro region, the Metropolitan Area Planning Commission is leading the effort to study likely impacts of climate change: hazards such as increased temperatures and more frequent and intense storms and long-term effects like rising sea levels. The region will come up with a set of recommendations to local governments on how to minimize vulnerability to these climate change impacts.

- New York City’s Regional Plan Association will develop tools to improve resilience to severe storms and coastal flooding in areas most vulnerable to the effects of projected climate change and sea level rise. They will focus specifically on protecting critical infrastructure such as power plants and water treatment facilities, as well as identifying design implications for flood protection on buildings’ ground-floor, the pedestrian environment, and building accessibility.
- The Pioneer Valley region of western Massachusetts will develop a Climate Action Plan including a detailed Climate Action Toolbox, to assist communities and regional groups to address both the sources of greenhouse gas emissions and adaptation strategies for climate change impacts. Strategies such as zoning to allow local renewable energy installations, imposition of carbon fees for large development, and building retrofit programs will be explored.
- The Des Moines region is already facing increased flooding events from the heavily polluted Raccoon River which are expected to become more prevalent with expected climate changes. Their planning process will study current infrastructure and assess potential future scenarios for adapting to these flood events.

The aforementioned grantees are explicitly developing adaptation measures to deal with the effects of climate change in their regions and communities. . The following communities are engaging in activities that are not explicitly tied to adaptation, but demonstrate the potential to identify adaptation co-benefits from climate mitigation measures:

- Cincinnati and Pittsburgh are exploring environmentally and economically sustainable alternatives to wholesale infrastructure overhaul to separate combined sewer overflows to better manage rainfall in large storm events.
- Houston-Galveston region is building on experience in planning for disaster and coastal resiliency. One consortium member, a nonprofit environmental partner, is working on using green infrastructure to address the region’s water quality and flooding issues.

Consolidated Planning Enhancement Initiative

The Office of Community Planning and Development has undertaken the Consolidated Planning Enhancement Initiative. CPD Maps, a newly released online tool that will assist communities in developing their consolidated plans, includes data layers of the 100-year floodplain and the 500-year floodplain that can be overlaid on maps of neighborhoods. This information is critical to helping communities assess where they may be at-risk to inundation hazards related to climate change. As a result, this initiative improves climate change adaptation planning at the state and local government levels by encouraging the incorporation of adaptation issues into community needs assessments and funding priorities.

Energy Efficiency/Green Building

Energy efficiency is central to HUD's mission because more energy efficient homes, when combined with green building practices, are also likely to be more durable, comfortable, and healthy. Energy efficient homes also have important environmental benefits: they require less energy use and generate fewer greenhouse gas emissions. Energy efficient housing not only lowers greenhouse gas emissions that contribute to climate change, but is better prepared to deal with infrastructure shocks, social impacts, and resource impacts that a changing climate may deliver.

Federal leadership in improving energy efficiency is particularly important because new state and local building codes and green building standards, while providing an important means for reducing energy consumption and promoting sustainability in new buildings, generally do not address energy performance in existing buildings. This is particularly significant because over half of the buildings that will be standing in 30 years already exist today, and HUD's inventory of assisted housing is largely built out with a significant portion of assisted properties built before 1980.

HUD has taken unprecedented action in the past two years to increase energy efficiency in affordable housing:

- HUD established a two-year goal (FY 2010-2011) for energy efficient, healthy retrofits and new construction of 159,000 affordable units - and exceeded this goal, with over 201,000 units reported through the 4th Quarter, FY 2011. In addition, HUD has set a new goal of completing cost-effective energy retrofits and energy-efficient new construction of an estimated 159,000 units during FY2012-2013.
- Through HUD's core programs, including formula and grant programs, mortgage loan insurance and public and Indian housing investments, HUD has expanded financing, increased technical assistance, and strengthened basic energy requirements to advance greater energy efficiency.
- Through a partnership with the Department of Energy (DOE), HUD-assisted multifamily housing increased access to funding under DOE's Weatherization Assistance Program, which received an historic \$5 billion appropriation under the Recovery Act.
- HUD has launched the Power Saver pilot program to provide FHA-insured loans for homeowners to invest in home energy improvements, as well as the multifamily Energy Innovation Fund to spur innovation in the multifamily sector.
- HUD has begun developing the Safe and Healthy Homes Investment Partnerships (SHHIP) certification, which acknowledges communities which have successfully braided federal and private funds to integrate energy and health retrofits of the local housing stock. This incentivizes local communities to improve their community's organizational resilience while making their physical structures more adaptive.

HUD works with EPA, DOE and USDA on issues related to green building, utility and energy consumption, water management (including consumption, and site issues for controlling runoff and flooding, etc) - all designed to make properties with HUD involvement better and safer environments, and the reduce those properties' impact on their neighborhoods and a changing climate.

Proposed Future Actions to Enhance HUD's Current Climate Change Adaptation Efforts

HUD is considering future actions to address climate change adaptation that will be undertaken by program offices, field and regional offices, and the Climate Change Task Force. These future actions fall into two major categories: 1) actions to better understand risks from climate change; and 2) actions to better address climate change.

HUD anticipates that the Task Force will work with the offices within the Department to refine, update, and implement these actions going forward.

Actions to Better Understand Climate Change Risks and Opportunities

The following actions will inform the work of HUD staff and grantee operations related to the potential impacts of a changing climate on HUD programs and operations:

Action: HUD will encourage environmental field staff to stay informed of different regional climate change initiatives, in whatever capacity they have the resources for, such as by attending climate change-related trainings and meetings, subscribing to mailing lists, etc. This type of information exchange can help inform HUD environmental staff's technical assistance, compliance, and monitoring functions vis-à-vis the National Environmental Policy Act (NEPA) and HUD environmental review regulations.

Action: HUD's Climate Change Adaptation Task Force (Task Force) will explore the opportunity to work with Federal and external partners to gather information and develop standards, policies and programs on climate change adaptation.

Action: HUD will look for opportunities to strengthen education/training, enforcement, and compliance with existing floodplain and wetland regulations.

Action: HUD will explore opportunities to incorporate climate change considerations in updates to current HUD environmental guidance and website materials.

Action: The Task Force will continue to work with existing in-reach mechanisms, such as the monthly Office of the Chief Information Officer (OCIO) Learning Sessions, to provide or collaborate on presentations and discussions with other federal agencies on climate change topics.

Actions to Better Address Climate Change Risks and Opportunities

HUD has proposed the following actions and will consider other actions that can be accomplished over the coming year.

Action: The Multifamily Accelerated Processing (MAP) Guide states that “[w]here a site does not appear to be located in the floodplain on official FEMA maps, but shows evidence of flooding, HUD is not precluded from qualitatively evaluating the acceptability of the site.”⁴⁷ Utilizing this provision, HUD’s Office of Multifamily Housing will consider seeking to work with FEMA to assess areas which have high potential for future flood hazard impacts based on climate change, and then using this information to evaluate sites.

Action: The Task Force will investigate how to best promote climate change adaptation strategies among HUD grantees. The Task Force will explore strategies such as incorporating adaptation-related policy priorities in the Department’s competitive funding cycle, offering technical assistance, or other methods to encourage grantees to adapt existing HUD-funded projects and plans to also consider effects of climate change.

- For the HUD programs that work on a point system, the Task Force will explore with program offices the feasibility of awarding points to a project based on its incorporation of climate change adaptation measures.

Action: The MAP Guide states that, “Hubs/PCs may adopt additional requirements to address unique local concerns, but, if any local requirement is mandated, the Hub/PC must inform the Deputy Assistant Secretary for Multifamily Housing and the HUD Headquarters Housing Environmental Clearance Officer of the requirement and its rationale”.⁴⁸ As such, HUD Multifamily field offices may consider exploring the implementation of environmental review policies which take into account their unique climate-related issues.

Action: HUD will investigate options for modifying program construction standards to address climate change impacts. For example, the Office of Healthcare Programs serves elderly populations who are vulnerable to changes in temperature. Construction standards could be changed to include white roofing to reflect heat and therapeutic roof gardens as part of heat island reduction initiatives, increasing building’s efficiency, treating patients and decreasing air pollution. Also, the Office of Healthcare Programs will work with the Task Force to officially incorporate its Sustainability Policies for Retrofit Facilities and continue to seek out funding support for its Transformational Initiative: Energy Conservation Program for Hospitals.

Action: In anticipation of future disasters, HUD will work with FEMA and other partners to explore how best to assist in meeting housing needs during the initial and interim responses to a disaster. HUD will examine how the Department can best leverage its existing statutory authority and established protocols to meet housing needs within the initial response framework of the NRF and the recovery framework of the NDRF. Establishing protocols within steady state (non-disaster) times will ensure HUD is prepared and able to respond immediately in the face of a catastrophic event or major disaster. For example, the following protocols are in place and HUD will explore these options as soon as possible following a major disaster in order to meet housing needs:

- **Use of existing authority to provide temporary housing until permanent housing is restored:** HUD has established Section 8 Pass Through protocols located in Housing Handbook 4350.1 REV-1 CHG-2, Chapter 38 (Multifamily Emergency/Disaster Guidance), Section 38-32C. By following these protocols, when disaster makes a building under a project-based Section 8 contract uninhabitable, the building owner may temporarily lease a unit in another building, which is habitable; to house the displaced Section 8 resident until the resident’s permanent unit has been restored.
- **Use of existing authority for transfer of budget authority from one Section 8 contract to another:** Section 8(bb) of the United States Housing Act of 1937 directs that when a contract for project-based assistance is terminated or expired and not renewed and there is remaining budget authority under the ending contract, the Secretary shall (under terms prescribed by the Secretary) transfer remaining budget authority for a project-based Section 8 HAP contract to another contract in order to provide continued assistance to eligible families. Following a disaster, HUD can look for opportunities to fund dwelling units that are already in existence and ready for occupancy at a new project if the units at the original project are no longer habitable and the contract on the uninhabitable project is terminated or expired and not renewed. HUD also can consider how best to use its discretion under this statutory authority to best meet post-disaster housing needs (by splitting contracts or prescribing new terms to the extent allowable).

Action: When the NDRF is activated for future disasters, HUD will coordinate and facilitate the delivery of Federal resources and activities to assist local, State and Tribal governments in the rehabilitation and reconstruction of destroyed and damaged housing, whenever feasible, and development of other new accessible, permanent housing options.⁴⁹ HUD will also use its own resources to get individuals into permanent housing options as soon as possible. For example, HUD will continue to make the following rapidly available to meet housing needs whenever possible:

- **National Housing Locator System:** HUD established and maintains a National Housing Locator System (NHL) that complements HUD’s housing and emergency disaster voucher programs. NHL is designed to be a single, web-based clearinghouse that will assist individuals and families in finding rental housing in a Presidential-declared or local disaster area. It allows HUD and its business partners, in particular State Housing Authorities, Public Housing Authorities, Federal Agencies and other critical First Responders, to identify rental housing and available government-owned single family homes for sale during an emergency.
- **Mortgage Insurance for Disaster Victims (Section 203(h)):** Under Section 203(h) of the National Housing Act (12 U.S.C. 1709(h)), any person whose home has been destroyed or severely damaged in a presidentially declared disaster area is eligible to apply for FHA mortgage insurance, even if they were renting the property. The borrower’s application for mortgage insurance must be submitted to an FHA-approved lending institution within one year of the President’s declaration of the disaster. Similar to the section 203(b) program (FHA’s basic

mortgage insurance program), the program provides mortgage insurance to protect lenders against the risk of default on loans to qualified disaster victims.

Action: In implementing current Community Development Block Grant (CDBG) disaster recovery grants and any future CDBG disaster recovery funds, the Office of Community Planning and Development will continue to educate grantees on eligible activities that respond to impacts of the current disaster in ways that will lessen impacts of future disasters. Examples of eligible activities include:

- Buying damaged properties in a flood plain and relocating residents to safer areas;
- Floodplain mapping and land-use planning that guides recovery efforts;
- When rebuilding damaged properties, elevating, flood-proofing, outfitting with roof straps, storm shutters, using stronger materials, installing tornado warning systems, basements, safe rooms, etc.

Implementation

Programmatic Activities

Consistent with the *Climate Change Adaptation Guiding Principles* identified by the Interagency Climate Change Adaptation Task Force,⁵⁰ HUD's approach to implementing the actions specified within this document will not result in the development of a new organizational structure within the department. Rather, adaptation planning activities will be integrated into existing program areas.

Coordination of these activities across HUD will be the responsibility of the HUD Climate Change Adaptation Task Force. This committee is chaired by the Deputy Secretary and includes representation from each program, as appropriate. During the implementation phase of this plan, the Task Force will meet monthly to review progress made towards existing actions and identify new actions as new information becomes available. Members of this committee will continue to participate in the Climate Change Adaptation Community of Practice, a CEQ-led working group of climate change planners from across the federal government, which will facilitate collaboration with other Federal entities. In addition, the HUD Climate Change Adaptation Task Force will look for opportunities to convene other agencies involved in the built environment (e.g. GSA, DHS) in an effort to share best practices. Interactions with regional, state, and local adaptation planning efforts will be facilitated through HUD's existing network of Regional Sustainability Officers located within its regional and field office locations.

Reporting and Accountability

To conform to the *Implementing Instructions for Federal Agency Climate Change Adaptation Planning*,⁵¹ HUD will post this document on its public website upon approval from the Office of Management and Budget.

Also in accordance with the *Implementing Instructions*, beginning in 2012, HUD will ensure that meaningful opportunities exist for the public to submit comments and recommendations relating to the agency's Climate Change Adaptation Plan.

¹ Executive Order No. 13514, 74 Fed. Reg. 52117 (Oct. 8, 2009).

² Federal Facilities Environmental Stewardship and Compliance Assistance Center., Climate Change Adaptation <http://www.fedcenter.gov/programs/climate/> (last visited June 15, 2012) (detailing how federal agencies implement climate change adaptation requirements of Executive Order 13514).

³ INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: IMPACTS, ADAPTATION AND VULNERABILITY CONTRIBUTION OF WORKING GROUP II TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 6 (Martin .L. Parry et al. eds., 2007), *available at* http://www.ipcc.ch/publications_and_data/ar4/wg2/en/contents.html.

⁴ PATRICIA ROMERO LANKAO, URBAN AREAS AND CLIMATE CHANGE: REVIEW OF CURRENT ISSUES AND TRENDS ISSUES PAPER FOR THE 2011 GLOBAL REPORT ON HUMAN SETTLEMENTS 84 (2008), *available at* http://www.ral.ucar.edu/staff/prlankao/GRHS_2011_IssuesPaperfinal.pdf.

⁵ COUNCIL ON ENVIRONMENTAL QUALITY, IMPLEMENTING CLIMATE CHANGE ADAPTATION PLANNING IN ACCORDANCE WITH EXECUTIVE ORDER 13514 "FUTURE LEADERSHIP IN ENVIRONMENTAL, ENERGY, AND ECONOMIC PERFORMANCE" FEDERAL AGENCY CLIMATE CHANGE ADAPTATION PLANNING SUPPORT DOCUMENT APP F, 41-44 (2011), *available at* http://www.fedcenter.gov/_kd/go.cfm?destination=ShowItem&Item_ID=17354.

⁶ *Id.*

⁷ INSTITUTE OF MEDICINE OF THE NATIONAL ACADEMY OF SCIENCES, CLIMATE CHANGE, THE INDOOR ENVIRONMENT, AND HEALTH 3 (2011), *available at* https://download.nap.edu/catalog.php?record_id=13115.

⁸ *Id.* at 3-7.

⁹ *Id.* at 8.

¹⁰ IMPLEMENTING CLIMATE CHANGE ADAPTATION PLANNING IN ACCORDANCE WITH EXECUTIVE ORDER 13514, *supra*, at 41–44.

¹¹ *A Rational Discussion of Climate Change: the Science, the Evidence, the Response*, Statement to the House, Committee on Science and Technology, Subcommittee on Energy and Environment, 111th Congress 3 (2010) (statement of James C. Lopez, Senior Advisor to the Deputy Secretary, U.S. Dept. of Housing and Urban Development), *available at* <http://gop.science.house.gov/Media/hearings/energy10/nov17/Lopez.pdf>.

¹² *Id.*

¹³ U.S. DEPT. OF HOUSING AND URBAN DEVELOPMENT., HUD STRATEGIC PLAN FY 2010-2015 (2010), *available at* http://portal.hud.gov/hudportal/documents/huddoc?id=DOC_4436.pdf.

¹⁴ *Id.* at 40–44, 62.

¹⁵ U.S. DEPT. OF HOUSING AND URBAN DEVELOPMENT, 2012 – 2015 ENVIRONMENTAL JUSTICE STRATEGY 4 (2012), *available at* <http://portal.hud.gov/hudportal/documents/huddoc?id=envjustice.pdf>.

¹⁶ U.S. GLOBAL CHANGE RESEARCH PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES 9 (2009), *available at* <http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/full-report>.

¹⁷ *Id.* at 34.

¹⁸ *Id.*

¹⁹ CCSP, 2008: Analyses of the effects of global change on human health and welfare and human systems. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. [Gamble, J.L. (ed.), K.L. Ebi, F.G. Sussman, T.J. Wilbanks, (Authors)]. U.S. Environmental Protection Agency, Washington, DC, USA. at 7.

²⁰ *Id.* at 63

²¹ *Id.* at 7.

²² LARISSA LARSEN, ET.AL., UNIVERSITY OF MICHIGAN & U.S. GREEN BUILDING COUNCIL, GREEN BUILDING AND CLIMATE RESILIENCE: UNDERSTANDING IMPACTS AND PREPARING FOR CHANGING CONDITIONS 29(2011), *available at* <https://www.usgbc.org/ShowFile.aspx?DocumentID=18496>.

²³ U.S. ENVIRONMENTAL PROTECTION AGENCY, REDUCING URBAN HEAT ISLANDS: COMPENDIUM OF STRATEGIES, 1, 13–14 (2008), *available at* <http://www.epa.gov/hiri/resources/compendium.htm>.

²⁴ U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT, HUD FISCAL YEARS 2012-2013 ANNUAL PERFORMANCE PLAN 35 (2012), *available at* <http://portal.hud.gov/hudportal/documents/huddoc?id=FY12-FY13APP.pdf>.

²⁵ U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra*, at 32.

²⁶ Federal Emergency Mgmt Agency, U.S. Dept. of Homeland Security, Floodplain Management, Flood Zones, http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/flood_zones.shtml (last visited June 22, 2012).

²⁷ U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra*, at 35.

²⁸ *Id.* at 38.

²⁹ Under HUD’s Floodplain Management regulation, a critical action is “any activity for which even a slight chance of flooding would be too great, because such flooding might result in loss of life, injury to persons, or damage to property.” 24 C.F.R. § 55.2(b)(2)(i) (2011). Examples include emergency operations centers including fire and police stations, hospitals, nursing homes, and places producing, using or storing highly volatile, flammable, explosive, toxic or water-reactive materials. *Id.*

³⁰ U.S. Environmental Protection Agency, Climate Change, Coastal Areas Impacts and Adaptation, <http://epa.gov/climatechange/effects/coastal/index.html> (last visited June 22, 2012).

³¹ U.S. CLIMATE CHANGE SCI. PROGRAM AND THE SUBCOMMITTEE ON GLOBAL CHANGE RESEARCH, COASTAL SENSITIVITY TO SEA-LEVEL RISE: A FOCUS ON THE MID-ATLANTIC REGION 2, 174 (2009), *available at* <http://www.climatescience.gov/Library/sap/sap4-1/final-report/sap4-1-final-report-all.pdf>.

³² RUTH, M., D. COELHO, AND D. KARETNIKOV, UNIVERSITY OF MARYLAND, CENTER FOR INTEGRATIVE ENVIRONMENTAL RESEARCH, THE U.S. ECONOMIC IMPACTS OF CLIMATE CHANGE AND THE COSTS OF INACTION 6 (2007), *available at*

<http://www.cier.umd.edu/documents/US%20Economic%20Impacts%20of%20Climate%20Change%20and%20the%20Costs%20of%20Inaction.pdf>.

³³ U.S. GLOBAL CHANGE RESEARCH PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES 9 (2009), *available at* <http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/full-report>. at 150.

³⁴ *Id.* at 47.

³⁵ U.S. Geological Survey, National Assessment of Coastal Vulnerability to Sea-Level Rise, <http://woodshole.er.usgs.gov/project-pages/cvi/> (last visited June 22, 2012).

³⁶ National Environmental Policy Act of 1969, 42 USC § 4321-4370e (2006).

³⁷ *See* 40 C.F.R. parts 1500-1508 (2011).

³⁸ Coastal Zone Management Act of 1972, 16 USC §§ 1451-1464, 1456(c)-(d) (section 307(c)-(d)) (2006).

³⁹ Executive Order No. 11988, 3 C.F.R. 117 (1977); 24 C.F.R. part 55 (2011).

⁴⁰ Flood Disaster Protection Act of 1973, 42 USC §§ 4001-4128 (2006), as amended.

⁴¹ Executive Order No. 11990, 3 C.F.R. 121 (1977).

⁴² INSTITUTE FOR SUSTAINABLE COMMUNITIES, SUSTAINABLE DEVELOPMENT AND LONG-TERM DISASTER RECOVERY: A CONVENING OF EXPERTS TO INFORM AND SUPPORT THE DELIBERATIONS OF THE LONG-TERM DISASTER RECOVERY WORKING GROUP 4 (2011), *available at* http://www.iscvt.org/resources/documents/isc_report_to_hud.pdf.

⁴³ HUD STRATEGIC PLAN FY 2010-2015, *supra*, at 61.

⁴⁴ *What HUD Services and Resources are Available for Disaster Relief and Recovery in FY 2012?*, Statement to the Senate Committee on Appropriations, Subcommittee. on Homeland Sec., 111th Congress 3 (2010) (written testimony of Fred Tombar, Senior Advisor for Disaster Programs, Office of the Secretary, U.S. Dept. of Housing and Urban Development), *available at* <http://www.appropriations.senate.gov/ht-homeland-security.cfm?method=hearings.download&id=e1e7eb23-26c7-4cf9-bf0a-e0116f05ed62>.

⁴⁵ FEDERAL EMERGENCY MGMT AGENCY, U.S. DEPT. OF HOMELAND SECURITY, NATIONAL DISASTER RECOVERY FRAMEWORK 3 (2011), *available at* <http://www.fema.gov/pdf/recoveryframework/ndrf.pdf>

⁴⁶ *Id.* at 45.

⁴⁷ U.S. Dept. of Housing and Urban Development, Multifamily Accelerated Processing (MAP) Guide 4430.G REV-1 § 9.5.D.6. (2011), *available at* <http://portal.hud.gov/hudportal/documents/huddoc?id=4430GHSGG-bm.pdf>.

⁴⁸ *Id.* at § 9.5.O.5.

⁴⁹ FEDERAL EMERGENCY MANAGEMENT AGENCY, U.S. DEPARTMENT. OF HOMELAND SECURITY, NATIONAL DISASTER RECOVERY FRAMEWORK 55 (2011).

⁵⁰Federal Facilities Environmental Stewardship and Compliance Assistance Center., Climate Change Adaptation Guiding Principles, <http://www.fedcenter.gov/programs/climate/guidingprinciples/> (last visited June 22, 2012).

⁵¹ Council on Environmental Quality, Instructions for Implementing Climate Change Adaptation Planning in Accordance with Executive Order 13514 “Federal Leadership in Environmental Energy, and Economic Performance:” Federal Agency Climate Change Adaptation Planning Implementing Instructions § I.D.3 (2011), *available at* http://www.whitehouse.gov/sites/default/files/microsites/ceq/adaptation_final_implementing_instructions_3_3.pdf.