INTRODUCTION

The first section of the Regional Implementation Plan provides an initial assessment of the implications of climate change for EPA Region 2's programs and objectives. This regional vulnerability assessment builds on the preliminary agency-wide vulnerability assessment contained in EPA's Climate Change Adaptation Plan (draft released Feb 2013[1]) and was developed in concert with vulnerability assessments developed by EPA's national program offices.

This Assessment is divided into three main sections: Background on projected climate change effects; EPA Region 2's Vulnerability Assessment based on programmatic expertise; and an attached Summary Table analyzing the range of vulnerabilities. The information on climate change impacts in the Background section comes from peer-reviewed scientific literature, including the major climate assessments produced by the U.S. Global Change Research Program. The Vulnerability Assessment section sets forth the Region's preliminary judgment regarding the risks that those climate change impacts pose to the programs that Region 2 implements and to our facilities, assets and day-to-day operations. Finally, the Summary Table follows a common format put forth for all the Regions and Program Offices, and presents a broad picture of how climate change impacts may affect programs in Region 2.

This assessment of our programmatic risks and vulnerabilities should be viewed as a living document that will be updated as needed and when possible, to account for new knowledge, data and scientific evidence. As in the agency-wide Climate Change Adaptation Plan, our assessment of regional programmatic vulnerabilities is organized around EPA's strategic goals.

BACKGROUND: REGION 2'S KNOWN VULNERABILITIES TO CLIMATE CHANGE IMPACTS

In order to determine our region-specific vulnerabilities, EPA Region 2 began with a research effort to understand the current science and modeling on climate change effects. This section summarizes the state of the science for known or expected vulnerabilities for the region.

OUR STATES & TERRITORIES & INDIAN NATIONS: NEW YORK, NEW JERSEY, PUERTO RICO & THE U.S. VIRGIN ISLANDS

Climate change, interacting with changes in land use and demographics, will affect important human facets in the United States, especially those related to human health, communities, and welfare. The challenges presented by population growth, an aging population, migration patterns, and urban and coastal development will be affected by changes in temperature, precipitation, and extreme climate-related events. According to the International Panel on Climate Change (IPCC), global average temperature over the 21st century is expected to increase by between 3.5 and 7°F. The large range is due to uncertainties both in future GHG concentrations and the sensitivity of the climate system to GHG emissions. The greatest warming is expected over land and in the

[1] http://epa.gov/climatechange/impacts-adaptation/fed-programs.html

high altitudes of the northern hemisphere where local warming may exceed 15° F. In these regions, winter warming is expected to be greatest (NPCC 2010). Hurricane wind speeds, rainfall intensity, and storm surge levels are likely to increase. Other changes include measurable sea level rise and increases in the occurrence of coastal and riverine flooding (NYSERDA 2011). Given the diverse geography covered by Region 2 and the varied environmental programs that EPA implements in this region, climate change presents a broad array of risks to the achievement of our mission. The risks vary somewhat between the continental states (NY/NJ) and the tropical region where Puerto Rico and the Virgin Islands are located, but the theme of coastal concerns is common for the Region as a whole.

PRECIPITATION AND INLAND EFFECTS

Nearly all climate models are predicting changes in precipitation patterns. In New York and New Jersey, precipitation will fall in heavier events with hotter and drier periods in between. Similarly, the Caribbean may see less frequent but heavier storm events, with more severe drought periods. Severe storms are also predicted to increase, with 100-year storms likely to occur every 80 years by the end of the century (USGCRP 2009, NYSERDA 2011). In the New York area, average precipitation is projected to increase up to 5% by 2020, up to 10% by 2050, and as much as 15% by 2080. Much of this increase is projected to fall in the winter months (NYSERDA 2011), and more likely to fall as rain instead of snow. In upstate New York, the changing balance between rain and snow has already reduced snowpack and, in addition, many areas have already seen flooding from extreme rainfall events like Hurricane Irene. Warming temperatures have led to decreases in ice cover on lakes and rivers. By the end of this century, the length of the winter snow season in northern New York is predicted to be reduced by half (USGCRP 2009).

In the Great Lakes region, which includes portions of upstate NY, reduction in ice cover will lead to cold air moving over open water that would have otherwise been frozen. This will increase evaporation, leading to heavier and more frequent lake effect snow. Rising atmospheric temperatures will cause annual spring runoff due to snowmelt to occur up to two weeks earlier in the year. This change will decrease water from runoff later in the year, stressing ecosystems that depend on the availability of water in the summer (USGCRP 2009). Studies also predict a decrease in the Great Lakes water levels due to increased evaporation and decreased runoff from snowmelt. This has implications for energy generation and downstream ecosystems (NYSERDA 2011). Rising air temperatures also increase water temperatures. In lakes and reservoirs, warmer surface waters reduce the frequency of turnover with

cooler bottom waters, resulting in increased periods of stratification (USGCRP 2009). Increased stratification isolates layers of warm water, which is less capable of holding dissolved oxygen (DO), which is critical to supporting aquatic ecosystems (NYSERDA 2011).

SEA LEVEL AND OCEANS

Climate change also has impacts on marine resources and coastal regions. Currently, sea levels are rising an average of 0.86 to 1.5 inches per decade, as measured by tide gauges, with an average of 1.2 inches per decade since 1900. Before the Industrial Revolution, the rate of increase had been approximately 0.34 to 0.43 inches per decade, mostly as a result of land subsidence (NPCC 2010). For the Long Island and New York City shorelines, models predict a rise of 7-12 inches by 2050 and 19-29 inches by 2080. Under a rapid ice melt scenario in the arctic, sea levels could rise by as much as 55 inches by 2080 (NYSERDA 2011). Freshwaters and marine waters alike are expected to see increases in temperature with higher air temperatures. Models predict an ocean temperature increase of 1.8 – 2.5^{o}F for near-shore waters by 2050, depending on the model used (NYSERDA 2011).

When atmospheric CO_2 increases, more CO_2 is dissolved in the ocean, decreasing the pH of the water and creating an acidic environment that dissolves the hard shells of corals, shellfish and smaller organisms. This process, called ocean acidification, also decreases the availability of calcium carbonate ($CaCO_3$), a building block for the shells and exoskeletons of many marine organisms. Although dissolution of CO_2 in oceans is a natural process, the current rate of ocean CO_2 dissolution is unprecedented, with serious implications for the marine food chain and ocean ecosystems.

Puerto Rico (PR) and the United States Virgin Islands (USVI) are especially vulnerable to the impacts of climate change due to their smaller land size (and therefore diminished resources, population mobility, infrastructure and resilience), limited water resources, vulnerable ecosystems, susceptibility to natural hazards and the location of large urban centers near the coastline (e.g. San Juan, Charlotte-Amalie). Threats of climate change to this portion of the Caribbean include the potential increase in sea level of at least 15.7 inches based on a linear trend of observed sea level rise (PRCCC 2012), increase in average annual temperature between 3.5 - 5 °F, (USGCRP 2009) and decrease in precipitation between 5 to 20% by the end of the century (USGCRP 2009). Other impacts include the formation of more intense hurricanes and increase in ocean temperature and acidity (USGCRP 2008). These threats will cause myriad adverse effects to PR and the USVI including: increases in coastal inundation, storm surge, erosion and increased water pollution as a result of coastal flooding, threatening vital infrastructure, settlements and facilities that support the livelihood of near shore and low lying communities; compromised water resources in PR and USVI islands; heavy impacts on coral reefs in PR and the USVI; and changes in fisheries and other marine-based resources.

HUMAN HEALTH

Climate change is very likely to accentuate the disparities already evident in the American health care system. Many of the expected health effects are likely to fall disproportionately on the poor, the elderly, the disabled, and the uninsured. The most important adaptation to ameliorate health effects from climate change is to support and maintain the United States' public health infrastructure (USGCRP

2008). Urban areas are especially prone to increased morbidity and mortality due to heat waves and poor air quality that results from higher temperatures and dry conditions. In addition to air pollution and heat-related impacts on health, extreme weather events due to climate change will likely increase risk for injuries such as those from debris during storm events where high winds and fast moving flood waters are involved. In Region 2, recent severe storm events have also caused unexpectedly high incidences of drowning. Moreover, flood waters can expose people to harmful environmental contaminants, especially if the flooding affects people who live nearby industrial sites or facilities that store or contain hazardous materials. For coastal and waterfront communities, heavy storms can cause storm surges that overwhelm or damage wastewater and drinking water treatment systems with high water volumes or salt water. The result is that communities are inundated with sewage- and industrial waste-contaminated waters, the health impacts of which could be severe gastrointestinal and respiratory illnesses. In PR and the USVI, potential adverse human health impacts are expected due to these previously discussed concerns, as well as increased incidence of vector-borne diseases and more frequent dust storms.

The National Research Council 2011 report, *Climate Change, the Indoor Environment, and Health* addresses the impacts that climate change may have on the indoor environment and the resulting health effects. The report points to extensive research on how climate change affects the outdoor environment, how the outdoor environment affects indoor environments under different climate conditions, and how indoor environments affect occupant health, among other related topics. The impacts on the indoor environment include poor indoor air quality, for example, due to changing indoor concentrations of pollutants from increased outdoor concentrations of those pollutants caused by alterations in atmospheric chemistry or atmospheric circulation. Other indoor impacts include: moisture and mold, flooding, infectious agents and pests, and thermal stress (NRC 2011).

VULNERABLE COMMUNITIES

OVERBURDENED COMMUNITIES

Certain parts of the population, such as children, the elderly, minority persons, persons of low income, persons with underlying medical conditions and disabilities, persons with limited access to information (such as those with low English proficiency), and tribal and indigenous populations, can be especially vulnerable to the impacts of climate change. Also, certain geographic locations and communities are particularly vulnerable, such as those located in low-lying coastal areas. One of the principles guiding EPA's efforts to integrate climate adaptation into its programs, policies and rules calls for its adaptation plans to prioritize helping people, places and infrastructure that are most vulnerable to climate impacts, and to be designed and implemented with meaningful involvement from all parts of society.

This Implementation Plan identifies key programmatic vulnerabilities and the priority actions that will be taken to address those vulnerabilities over time. As the work called for in this Plan is conducted, the communities and demographic groups most vulnerable to the impacts of climate change will be identified. The Agency will then work in partnership with these communities to increase their adaptive

capacity and resilience to climate change impacts. These efforts will be informed by experiences with previous extreme weather events (e.g., Superstorm Sandy) and the subsequent recovery efforts.

As noted in the agency-wide Climate Adaptation Plan, the populations most vulnerable to climate change often include children, elderly, poor, persons with underlying medical conditions and disabilities, and tribal and indigenous populations, and this applies in Region 2. The primary concerns are extreme storm events, sea level rise, and extreme high temperatures. Without strong adaptation measures, climate related health impacts may become more prevalent as the frequency and severity of extreme climate events such as heat waves, flooding, and severe storms increase .

According to the U.S. Census, the U.S. population is aging; the percent of the population over age 65 is projected to be 13 percent by 2010 and 20 percent by 2030, at which time NY and NJ alone will be home to over 7.8 million seniors over age 65. Older adults, very young children, persons with underlying medical conditions such as some disabilities or compromised immune functions are vulnerable to temperature extremes. Heat-related mortality affects low-income and minority populations disproportionately, because they are generally concentrated in highly developed urban environments that suffer from heat island effects (USGCRP 2008). For the past decade, Region 2 communities from the Caribbean to the northeast have faced summers with increasing numbers of days over 90^{o} F. For example, between 2010 and 2011, San Juan, Puerto Rico experienced 100 days of temperatures over 90 degrees; the same number of days with such extreme temperatures was experienced between 1900 to 1949 – a span of nearly 50 years (PRCCC 2012). Low-income seniors are at highest risk for heat-related health impacts. According to estimates from the New York City Department of Aging, 55% of people hospitalized for heat-related illness were over 65 years of age; most of these were

CASE STUDY: SUPERSTORM SANDY

Superstorm Sandy, which struck the east coast in late October 2012, starkly illustrated the special vulnerability that low-income, elderly and people with serious medical conditions face from extreme storms and flooding. While Sandy was not necessarily a result of, or exacerbated by, climate change, it was an example of the extreme weather events that are expected to become increasingly frequent in the NY/NJ region over time, due to climate change. The extended deprivations wrought by Superstorm Sandy and the associated flooding (e.g. loss of power and heat for days or weeks; difficulty in obtaining food and supplies, medical care, transportation) were felt particularly by vulnerable populations, who in many cases lacked some of the resources or options available to others -- such as the ability to stay with friends or family or at hotels located outside of the affected area.

Of the more than 100 people in NY and NJ who lost their lives due to Superstorm Sandy, the majority were seniors. Many of the buildings that had to be evacuated in New York City as the storm approached (because of their location in low-lying areas) were public housing for low-income residents. It was reported that one week after the storm, 174 of the 402 public housing buildings that were impacted by the storm still lacked heat and hot water; 114 of them lacked power. The lack of heat meant enduring near-freezing temperatures with no heat and no hot water for bathing. Lacking power meant they had no lights or water for ordinary household uses because water needs to be pumped up to their homes. Because of the significant damage incurred by many of these buildings during the storm, many of the residents needed to remain in shelters or temporary housing for an extended period.

low-income seniors. Fortunately, air conditioning is an effective intervention in preserving heat health and reducing risk of heat-related death. However, as the EPA Climate Adaptation Action Plan acknowledges, economic constraints prevent some low-income households from using air conditioning for relief against extreme heat. For example, a family may not have access to an air conditioning unit, or choose not to use one so as to cut down on energy costs. Air conditioning may also not be a good solution in some heavily industrialized urban communities because high usage encourages power producers to run highly polluting "peaker plants" (e.g., older, high-emission power plants that are put into service to meet periods of peak energy demands) or puts the community at risk for power outages, which creates other hardships. Warming temperatures will also likely increase ozone concentrations. Increased ozone concentrations could in turn contribute to increased morbidity and mortality due to cardiovascular and pulmonary illnesses, including exacerbation of asthma and chronic obstructive pulmonary disorder (COPD) if current regulatory standards are not attained. If the projections for increased drought risk and lower precipitation in summer months prove correct, ozone health impacts will become a major issue for the respiratory health of residents in our region.

With sea level rise and the projected increase in the frequency and intensity of storms, low lying communities in our region will also likely see more health issues related to exposure to mold and mildew, which have been known to trigger asthma and allergic reaction as well as more severe respiratory symptoms. In areas where flooding can damage electrical systems necessitating the use of residential generators, we also expect to see more health problems related to carbon monoxide poisoning, especially when residents do not know to ensure proper ventilation when such equipment are in use. Flooding of industrial and environmental infrastructure also presents unique challenges to vulnerable communities. For example, during and after Superstorm Sandy, Indian nation communities like the Shinnecock people who live in the lowlands along the coast of Long Island Sound were faced with potential loss of drinking water because floodwaters infiltrated the private wells on which they rely for drinking water. Similarly, the low-income community of the Ironbound section in Newark, New Jersey, was inundated with flood waters that carried raw sewage and treatment chemicals from the nearby sewage treatment plant and industrial operations.

INDIAN NATIONS

EPA values its unique government-to-government relationship with Indian nations in planning and decision making. This trust responsibility has been established over time and is further expressed in the 1984 EPA Policy for the Administration of Environmental Programs on Indian Reservations and the 2011 Policy on Consultation and Coordination with Indian nations. These policies recognize and support the sovereign decision-making authority of tribal governments.

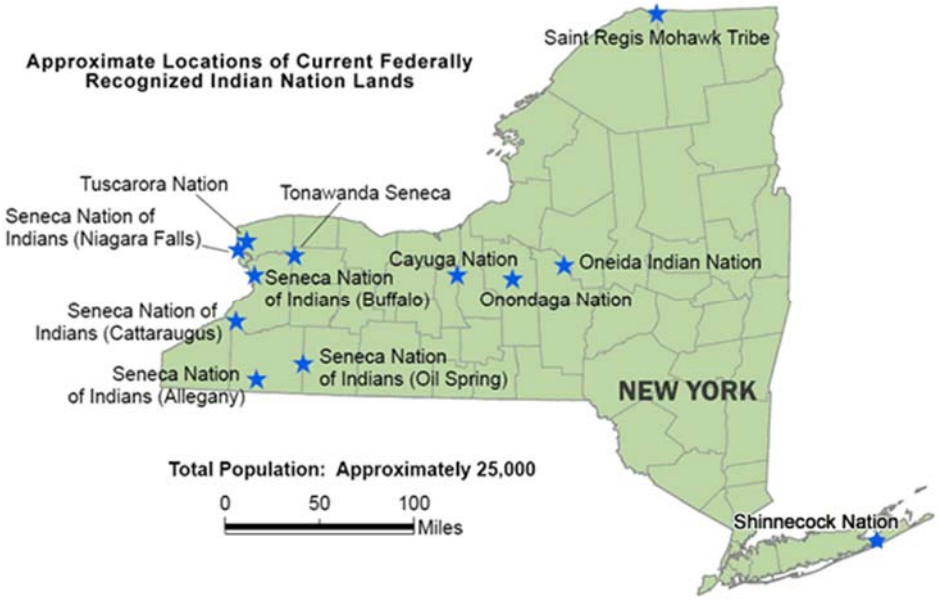
Supporting the development of adaptive capacity among nations is a priority for the EPA. Nations are particularly vulnerable to the impacts of climate change due to the integral nature of the environment within their traditional lifeways and culture. There is a strong need to develop adaptation strategies that promote sustainability and reduce the impact of climate change on Indian nations.

EPA engaged nations through a formal consultation process in the development of the Agency's Climate Change Adaptation Plan. Nations identified some of the most pressing issues as erosion, temperature change, drought and various changes in access to and quality of water. Nations recommended a number of tools and strategies to address these issues, including improving access to data and information; supporting baseline research to better track the effects of climate change; developing community-level education and awareness materials; and providing financial and technical support. At the same time, nations challenged EPA to coordinate climate change activities among federal agencies so that resources are better leveraged and administrative burdens are reduced.

This Implementation Plan identifies specific steps that will be taken to partner with tribal governments on an ongoing basis to increase their adaptive capacity and address their adaptation-related priorities. These collaborative efforts will benefit from the expertise provide by our tribal partners and the Traditional Ecological Knowledge (TEK) they possess. TEK is a valuable body of knowledge in assessing the current and future impacts of climate change and has been used by nations for millennia as a valuable tool to adapt to changing surroundings. Consistent with the principles in the 1984 Indian Policy, TEK is viewed as a complementary resource that can inform planning and decision-making.

Networks and partnerships already in place will be used to assist nations with climate change issues, including Regional Tribal Operations Committees, the Institute for Tribal Environmental Professionals and the Indian General Assistance Program (IGAP). Additionally, efforts will be made to coordinate with other Regional and Program Offices in EPA, since climate change has many impacts that transcend media and regional boundaries. Transparency and information sharing will be a focus, in order to leverage activities already taking place within EPA Offices and tribal governments.

Region 2 is also home to eight Federally-recognized Indian nation communities, all located in NY State. The nations in Region 2 are likely to be impacted by similar vulnerabilities discussed in other portions of this vulnerability assessment. In addition to those vulnerabilities mentioned throughout, nations in Region 2 have indicated that there are ecological as well as cultural activities that are vulnerable to the effects of climate change, directly affecting many of the cycles of the natural world.



The nations have noted a change in the composition of tree species in forests due to climate change. The change in forest tree species may not be moving at a rate as fast as that of climate change and therefore could lead to diminishing forest size. This

has resulted in an increased reliance on the planting by Indian nation communities of tree species that are more typically found in southern climates like the Carolina region of the U.S. Moreover, there is a growing concern that climate conditions are affecting many species of culturally significant trees such as the maple tree, causing an infestation of pests, insects, and fungi attacks.

The harvesting of culturally important crops such as maple syrup and wild strawberries as well as the undertaking of ceremonies to celebrate their harvest and medicinal purposes have also been affected by the changing climate. The traditional timing for harvesting crops depends largely upon the weather. If there is a cold winter with a lot of snow, the nations will have a good harvest of maple syrup in the spring. If there is a mild winter with limited precipitation, the maple syrup is not as plentiful and even in some cases, not available. In addition, the wild strawberry plant has unique nutritional and medicinal qualities that contribute to blood purifying and blood building. The berries, leaves and roots of the wild strawberry plant also contribute to a variety of women's health concerns and pregnancies. During the mid to late spring is traditionally the time that the wild strawberries come into being. But with changing climate, they now grow in the summer months, or are not as bountiful as previous years.

The undertaking of cultural activities such as ceremonies held in nations' longhouses have significantly been impacted with the unpredictable climate. For example, the Thunder Dance (or "Welcoming of our Grandfathers") is typically held two times per year with the first being held during the spring when one to three thunderstorms are heard and the second ceremony held during a dry period when rain is needed for crops. The nations thank the Thunderers or Grandfathers in the ceremony for returning again that year and for continuing to perform their responsibility of providing rain and fresh water, renewing the lakes, rivers, streams and wells. With the changing climate however, thunder is now common during rain and snow storms in the winter months (December thru February). Likewise, the ceremonies for the Strawberry, String Bean, and Green Corn are determined based upon the time for harvest, which more often depends upon the unpredictable climate conditions. Other cultural and economic activities such as fishing and hunting of wild game have also been impacted by changes in streams, other fishing waters, and natural habitats.

Climate change impacts for indigenous cultures are not expected to be clearly all positive or all negative. For example, increased air temperatures have the potential to lengthen the growing seasons of medicinal plants, higher CO_2 concentrations in the air can enhance plant growth, and in some areas, the availability of water resources may increase as rainfall patterns shift as a result of climate change. However, increased air temperatures may impair growth of certain species of traditional plants and cause them to migrate to zones outside Indian nation communities in our Region while allowing for a rise in invasive plant species, and water resources may be negatively impacted by extreme rainfall events that compromise drinking water supplies. While the extent and nature of climate related impacts are not clear, it is apparent to indigenous cultures that there will be climate related impacts that will impact their cultural heritage.

EPA REGION 2'S PROGRAMMATIC VULNERABILITIES TO CLIMATE CHANGE

This section focuses on those vulnerabilities that we believe, at this time, are most significant to EPA Region 2, and are presented in alignment with EPA's priorities where possible. A summary of program vulnerabilities to climate change is contained in the attached table.

1. TAKING ACTION ON CLIMATE CHANGE AND IMPROVING AIR QUALITY

TROPOSPHERIC OZONE POLLUTION

Various studies project that daily maximum ozone levels could increase between 2 and 5 parts per billion (current 8 hour ozone standard is 75 ppb) across the eastern U.S. between 2020 and 2080 due to climate change if no additional emissions controls for ozone precursors are implemented (Hogrefe 2004). The potential lengthening of the ozone season has also been projected, as reported in the 2007 IPCC Report and ClimAID. Region 2 States are located in the Ozone Transport Region[2], which indicates the sensitivity of the area to tropospheric ozone. The Jamestown, NY, NYC metro area and Philadelphia metro area currently violate the 2008 8-hr ozone National Ambient Air Quality Standard (NAAQS).

The projected ozone impacts of climate change may make it more difficult for New York and New Jersey to maintain compliance with existing ozone standards. Sources in or upwind of the Region may be required to implement additional control measures or emissions controls. EPA's air programs would oversee states' efforts to develop State Implementation Plan (SIP) revisions to address the issue.

PARTICULATE MATTER (PM)

WILDFIRES

Though wildfires are not common in Region 2, they have been known to occur in the Pinelands region of central/southern NJ, NJ Meadowlands and in Staten Island, NY. The risks of wildfire occurrences could be enhanced by climate change-induced effects such as higher temperatures, decreased soil moisture, and longer and more numerous periods of drought (IPCC 2007). All of these factors could increase the number, length, and size of wildfires.

The projected particulate impacts from wildfires could, but are not likely to, hinder areas in Region 2 from meeting or maintaining compliance with the PM NAAQS. Region 2's air program would oversee states' efforts to develop SIP revisions to address the issue if wildfire events lead to issues in complying with the PM NAAQS.

OTHER SOURCES OF PM AIR EMISSIONS

An increase in extreme weather events, which in the case of storms could include strong winds and/or heavy precipitation, increase the risk of disrupting energy delivery to many areas in Region 2. For

[2] See Clean Air Act §184(a) for list of states in the Ozone Transport Region.

example, electrical and natural gas distribution could be disrupted by downed trees and flooding. Extended periods with energy delivery disruption in cold seasons could lead to increased use of alternative heating fuels such as wood or backup generators. Residences which rarely use fireplaces could begin using them in a manner that does not reflect best practices. Using wood for heating that has not been seasoned properly or using fireplaces improperly increases the amount of wood smoke exhausted from wood burning devices, which can have negative impacts on human health and air quality. Occupants of indoor environments where wood is burned could be exposed to wood smoke. A major health threat from smoke comes from fine particles, also known as particle pollution (EPA). Particle pollution has been linked to premature death in people with heart or lung disease, nonfatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, and increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing (EPA). The increased PM could affect also an area's ability to comply with the PM NAAQS, which could have regional health impacts. In addition, weather events with high winds and storm surges such as those many areas in Region 2 have experienced, can generate a tremendous amount of debris from, among other things, destroyed buildings, displaced sand and felled trees. Efforts to remove construction debris (e.g., from buildings) could require months and involve a large number of vehicles which could generate combustion related emissions. Biomass removal could involve incineration which could also operate for months and adversely impact air quality. Region's 2 air program would be required to monitor clean-up efforts to assure compliance with the PM NAAQS.

INDOOR ENVIRONMENTS

INDOOR AIR QUALITY

One of the best sources of information on impacts on the indoor environment is *Climate Change, the Indoor Environment, and Health*. The following subsections provide findings from this report from the National Research Council. Indoor environments can be contaminated by chemical, organic, and particulate pollutants that migrate from outdoors. Indoor migration is likely to be of particular concern on high temperature days in residences without air conditioning. Indoor air can also be contaminated by gas stoves and other indoor emission sources, such as building materials, radon, wood stoves, and environmental tobacco smoke. Climate change can affect these factors in various ways. For example, changes in the outdoor concentrations of a pollutant due to alterations in atmospheric chemistry or atmospheric circulation will affect indoor concentrations. The expected increased use of air conditioning, if accompanied by reduced ventilation, could increase the concentrations of pollutants emitted from indoor sources. Additionally, power outages—caused by heat waves or other extreme weather events—could lead to the use of portable electricity generators that burn fossil fuels and emit poisonous carbon monoxide (NRC 2011).

DAMPNESS, MOISTURE, AND FLOODING

Extreme weather conditions associated with climate change may lead to more frequent breakdowns in building envelopes—the physical barrier between outdoor and indoor spaces—followed by infiltration of water into indoor spaces. Dampness and water intrusion create conditions that encourage the growth of fungi and bacteria and may cause building materials and furnishings to decay or corrode, leading in

turn to chemical emissions. Poorly designed or maintained heating, ventilation, and air conditioning systems may introduce moisture and create condensation on indoor surfaces. Humid conditions can, however, be improved by well-designed and properly operating systems. Mold growth prevention and remediation activities also may introduce fungicides and other agents into the indoor environment (NRC 2011).

PESTS AND INFECTIOUS AGENTS

Weather fluctuations and seasonal to annual climate variability influences the incidence of many infectious diseases which may affect the evolution of existing and emergence of new infectious diseases, for example, by affecting the geographic range of disease vectors. The ecological niches for pests will change in response to climate change, leading to changed patterns or routes of human exposure and potentially, increased use of pesticides in these locations. Climate change may also lead to shifting patterns of indoor exposure to pesticides as occupants and building owners respond to infestations of pests (e.g. termites) whose geographic ranges may have changed. Although decreases in pest populations in some locations may lower the incidence of allergic reactions to particular pests, the overall incidence of allergic disease may not go down, because those individuals with a predisposition to allergies may become sensitized to other regional airborne allergies (NRC, 2011).

THERMAL STRESS

Extreme heat and cold have several well-documented adverse health effects. High relative humidity exacerbates these effects in hot conditions. As increased frequency of extreme weather events may result in power outages, corresponding increased use of portable generators may expose occupants to potentially dangerous conditions indoors. Seniors, persons with medical conditions, persons of low-income, and residents of urban environments are more likely to be exposed to extreme temperature events. These vulnerable populations experience excessive temperatures almost exclusively in indoor environments. Increased temperatures will result in increased use of air conditioning. Air conditioning provides protection from heat but is associated with higher reported prevalence of some ailments, perhaps because of contaminants in HVAC systems (NRC, 2011).

BUILDING VENTILATION AND WEATHERIZATION

Leaky buildings are common and cause energy loss, moisture problems, and migration of contaminants from the outdoors (e.g. pests, chemical, volatile organic compounds, and particulates). Research indicates that poor ventilation is associated with occupant health problems and lower productivity in all populations, and is exacerbated in vulnerable populations such as children, seniors and persons with medical conditions (NRC 2011).

Residents may weatherize buildings to increase comfort and indoor environmental quality in addition to saving energy. Although in general these actions should be encouraged, this may lead to a reduction in ventilation and an increase in indoor environmental pollutants unless measures are taken to preserve or improve indoor air quality. EPA has developed practical guidance for improving or maintaining indoor environmental quality during home energy upgrades or remodeling in single-family homes and schools.

EPA's guidance and protocols may need to be revised to include state and local considerations for projected climatic changes. In addition, these programs may need to increase partnerships with other agencies to address training needs and workforce development for building owners, managers, and others, as well as develop new tracking mechanisms to assess the effectiveness of weatherization and remodeling techniques as they relate to indoor environmental quality.

INCREASED ENERGY DEMAND

Increased temperatures due to climate change could have a potential two-fold effect on energy consumption for heating and cooling. Energy used for heating is likely to decrease while energy used for cooling is likely to increase. Summer peak demand in the New York metro area could increase 7 to 17%. Increases in peak demand without changes to energy infrastructure could lead to increased brownouts (IPCC 2007, NYSERDA 2011) or operation of "peaker" electric generating units in order to meet the increased demand. During high energy demand days, peaker units operate and generally produce more emissions than the typical electric generating unit. Furthermore, increased energy use for cooling would occur in the summer, which would lead to increased emissions during the ozone season (unless there is an increase in the supply of renewable energy to match the increased energy demand). The emissions impacts from increased energy demand could hinder areas in Region 2 from meeting or maintaining compliance with the NAAQS (PM, O_3, NO_x). Sources in or upwind of the Region may be required to implement additional control measures or emissions controls. Region 2's air program would oversee states' efforts to develop SIP revisions to address the issue.

MOBILE SOURCE EMISSIONS

Warming due to climate change could lead to damages to transportation infrastructure. Increased frequency, intensity, and/or duration of heat events could lead to railway deformities, road softening, and traffic-related rutting due to the road softening (IPCC 2007). If damages to transportation infrastructure lead to increased congestion, traffic-related emissions could increase. If the costs of maintaining roads and rail lines in good repair divert limited funds from planned mass transit capital projects this could hinder work performed by the Region 2 states and EPA Region 2 in promoting and supporting mass transit projects to reduce transportation related emissions (NYMTC, FTA). Heavy precipitation events resulting from climate change can threaten travel routes on coastal and low lying roadways, lead to the closure of airports, and damage to shipping channels and ports (IPCC 2007). If these damages and closures lead to traffic congestion in other locations, this could cause increases in mobile source emissions. Extreme events experienced in Region 2, such as hurricanes, that hinder refinery operations or fuel transportation could require EPA to grant fuel waivers to allow more polluting fuels to be used for a short time period. Extended periods of congestion could arise in areas that are flooded, which could lead to increased transportation related emissions (USDOT, USDOE).

2. PROTECTING AMERICA'S WATERS

WATERSHEDS, AQUATIC ECOSYSTEMS AND WETLANDS

SEWERS AND WASTEWATER SYSTEMS

Variability in precipitation patterns and an increase in the intensity and severity of storms will lead to an increase in the number of sewer overflows and wastewater bypasses. Predicted increases in storm events and rainfall intensity, as well as sea level rise and storm surges, will contribute to the frequency and volumes of combined sewer overflow (CSO) discharges in heavily urbanized regions in New York and New Jersey. New York State has 76 CSO permit holders with 966 outfalls, and New Jersey has 25 CSO permit holders with 217 outfalls. These include the Region's largest cities, such as New York City, Albany, Binghamton, Rochester, Syracuse, Buffalo, Jersey City and Newark. Furthermore, increased heavy precipitation events could trigger increased sewer overflows and wastewater bypasses, especially in low-lying communities like those surrounding the Martín Peña Canal in San Juan, PR. These overflows contain not only stormwater but also pollutants such as untreated human and industrial waste, toxic materials, debris, and oil and grease. Consequences include an increased risks of waterborne diseases, greater loads of pollutants entering our waterways, aquatic habitat impairments, loss of recreational access to water bodies due to high bacteria levels, fish kills, fishing and shellfishing restrictions, and increased flows in streams and other conveyance channels that could be eroded. This reduces EPA's ability to ensure human health and safety and our goal to make waterbodies fishable and swimmable. Utilities will be challenged by the need to address uncertainties associated with severe storm events and frequency when they evaluate the costs and benefits of alternative approaches for capital infrastructure planning and outlays. Communities seeking to reduce sewer and wastewater overflows should coordinate with the state agency administering EPA's State Revolving Fund (SRF) for funding consideration. Climate change will lead to a need for greater investment provided by the SRF.

Increased precipitation may also result in additional pollutant loadings of nutrients, pesticides, and other chemicals, further challenging permittees' ability to meet water quality standards and permit requirements. For industrial dischargers and wastewater treatment plants, lower baseflows due to increased evapotranspiration and increased likelihood of drought conditions will make meeting permit requirements more challenging. This will have an impact on our watershed programs as well as our regulatory programs, including the NPDES[3] and TMDL[4] programs.

WATER QUALITY STANDARDS AND PERMITTING

Under section 303(d) of the Clean Water Act, states, territories and authorized tribes are required to develop lists of impaired waters (i.e., "the 303(d) list"). These are waters that are too polluted or otherwise degraded to meet the water quality standards set by states, territories, or authorized tribes after the implementation of effluent limitations or other pollution control requirements. For future TMDLs, models to evaluate impacts under a range of projected future climatic shifts, using the best information and tools available, will need to be used on a site-specific basis. For the NPDES program, there will be a need to incorporate greater uncertainty into permit calculations to reflect the uncertainty

[3] As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States.

[4] A Total Maximum Daily Load (TMDL) is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that load among the various sources of that pollutant.

in climate projections related to NPDES permitting (e.g., precipitation projections), revise low-flow stream estimates, and consider warmer surface waters when evaluating applications for variances from thermal effluent limitations.

WETLANDS AND WATER BODY ECOSYSTEMS

As sea level rises, barrier island configurations will change and coastal shorelines will retreat. Wetlands will be inundated and eroded, and low-lying areas will be inundated more frequently – some permanently – by the advancing sea. Freshwater wetlands will be subject to changes in hydrology, precipitation and temperatures impacting the ecological services that they provide. Since coastal areas are already well developed, there would be limited opportunity for wetlands to migrate upland. There will need to be a focus on wetland protection, restoration and capacity for resiliency in all wetland ecosystems. As sea level rises, temperature increases and rainfall patterns change the salinity of estuaries, coastal wetlands, and tidal rivers, which are likely to become more variable, further altering the composition and ecosystem function of existing wetlands. Furthermore, Mid-Atlantic tidal marshes, mangrove forests and other coastal ecosystems in the Caribbean which provide important services for shoreline protection, species habitat, and nutrient cycling in the environment will be vulnerable with sea level rise. Inland wetlands - which provide important services in flood protection, water quality, nutrient cycling and species habitat - will be vulnerable with changes in precipitation and groundwater recharge. EPA Region 2's wetland and mangrove protection and restoration efforts will face challenges due to uncertainty with regards to sea level rise and the wetland's ability to migrate and respond to changes in hydrology and precipitation.

Changing water flow to lakes and streams, increased evaporation, and changed precipitation in some areas will affect the size of wetlands and lakes. For example, water levels in the Great Lakes are expected to fall. Headwater streams will be increasingly dry during summer months as drought conditions occur more often and evapotranspiration increases. This will have an effect on aquatic ecosystems because species that are susceptible to higher temperatures or lower dissolved oxygen levels, such as freshwater trout fisheries in New York and New Jersey, will lose viable habitat.

Increasing sea surface temperatures and ocean acidification have the potential to reduce the stability of corals in Puerto Rico and the Virgin Islands, especially in the presence of stresses from the existing land-based sources of pollution and overuse of the reefs for fishing and recreation. In the Caribbean, already

stressed coral reef ecosystems will be highly compromised by the increasing sea surface temperature which will result in more chronic bleaching events and subsequent vulnerability to diseases associated with bleaching. Ocean acidification will reduce the capacity of reef corals to calcify and protect themselves against more frequent hurricanes (EPA 2012). The collapse of coral reef ecosystems will have a significant impact on greater ocean ecosystems, food supplies and recreation and tourism industries. This will make implementation of local stormwater runoff reduction and improved coral reef management efforts by EPA and its partner agencies much more critical for preserving current coral reef habitat.

DRINKING WATER, WASTEWATER AND STORMWATER INFRASTRUCTURE

WATER INFRASTRUCTURE CAPACITY

An increased number of flood events of greater intensity is impacting water infrastructure. Many water and wastewater treatment systems and pumping stations in New York and New Jersey were damaged due to Hurricane Irene and Superstorm Sandy in 2011 and 2012. For example, many of the wastewater facilities were flooded and/or shut down or lost power during these events, after which they only performed primary treatment for a period until the digester systems stabilized and discharged untreated or partially treated sewage to local waterbodies. Furthermore, providing emergency support to these facilities was complicated by flooding of low-lying access roads, damaged electrical supply systems or shortages of fuel for backup generators, and overstretched personnel. In New Jersey, the Passaic Valley Sewerage Authority facilities alone suffered $300 million dollars of damage due to Superstorm Sandy. This has required major financial resources to pay for the repair or replacement of damaged infrastructure or proactively retrofit existing infrastructure, including treatment plants, pumping stations and conveyance systems.

In June 2013, New York City presented a comprehensive coastal protection plan which articulates a diverse selection of coastal protection measures tailored to the specific geomorphology of and risks facing neighborhoods most in peril[1]; other local governments will likely develop similar plans as well. Dredged material management plans will need to be adjusted because a number of the coastal resiliency projects will use dredged sediments and also due to potentially greater sediment loadings entering our waterways and harbors from more intense storm events. While the Army Corps of Engineers is the primary permitting authority on dredged material management in the coastal zone, EPA and the states have oversight roles of dredged materials management activities and are involved in developing dredged materials management plans. Coastal protection measures may also have an impact on water quality in Region 2 coastal waters and in the New York and New Jersey Harbor and Estuary in particular.

General population growth combined with a loss of snowpack in the Northeast and declining surface and groundwater quality and quantity, particularly in the Caribbean, will increase competition for water among energy, agriculture sectors, public drinking water supply, and maintenance of ecological service.

[1] See “PlaNYC: A Stronger, More Resilient New York” - http://www.nyc.gov/html/sirr/html/report/report.shtml

This will have an impact on water supply and water use, along with the water body's ability to provide ecosystem services. An example is the stress placed on the cold-water trout fishery due to inadequate reservoir releases in the Pequannock River in New Jersey due to drinking water diversions which causes water temperatures to be elevated in the stream during the summer months.

Sea level rise in coastal areas puts fresh water supplies for all uses, particularly drinking water, at increased risk. Salt water intrusion into coastal aquifers is a problem in some areas where withdrawals are outstripping recharge; increased pressure head from a higher sea-level worsens this problem. As sea level rises, community drinking water intakes may end up in brackish waters as the salt front migrates up coastal rivers and streams. For example, sodium concentrations could increase at the drinking water intakes on the Delaware River that serve Camden, NJ, degrading the community's supply of drinking water.[5] The integrity of coastal water infrastructure systems could be put at increased risk because systems designed for current sea levels are likely to have to operate under conditions where the sea level is 2 to 5 feet greater than current levels. Wastewater outfalls will have reduced capacity and will have to be redesigned given increased water heights in receiving waters. Communities may need infrastructure improvements to become more resilient to sea level rise and more frequent storm events.

In Region 2, many low-income and/or minority communities are located within or near floodplains or in areas with older water infrastructure which may not be designed to handle increased water flows. Residents of these areas are vulnerable to flooding impacts from a variety of sources; a major concern in this regard is the incidence of wastewater and stormwater sewer systems back-ups that could cause localized flooding and water inflows into basements in urban areas. These flooding events are likely to increase in frequency and magnitude with more frequent heavy rainfall events under climate change (NYSERDA 2011). Unfortunately, communities most impacted by this flooding risk are also those least able to relocate from flood-prone areas, and therefore are more likely to be impacted by weather events that could disrupt the drinking water and electrical supply as well as damage plumbing and electrical systems at homes and businesses.

GROUNDWATER RECHARGE

Increased temperatures will lead to increased evapotranspiration, thereby reducing the amount of water available to recharge groundwater aquifers. In the Northeast more precipitation is forecast to occur as heavy downpours and in addition, the snowpack is expected to be reduced. Overall, this will result in increased surface runoff and reduced infiltration and groundwater recharge, particularly in upland areas. This will place strains on the use of groundwater for municipal, industrial, and agricultural water supply. For example, the Long Island Aquifer is a source of drinking water for 2.7 million people in New York State, and over 900 million gallons per day (mgd) of water is used (8% of total water use). Aquifers supply drinking water to New Jersey at the rate of 570 mgd (31% of total water use) and Puerto

Rico at the rate of 137 mgd[6]. In order to ensure adequate water supplies, the importance of groundwater protection from contamination will become more crucial in maintaining water supplies for the Region.

SEPTIC SYSTEMS

When there is flooding, or when soils are saturated for extended periods of time, septic systems cannot function properly. Proper septic system performance depends on having aerated conditions in the soil so that bacteria can properly treat wastewater by removing pathogens and other contaminants. Flooding events and rising groundwater tables due to sea level rise and increased precipitation saturate the soils and causes sewage backing up in buildings. Flooding also allows contaminants to enter ground and surface water, reducing water quality and recreational access. In Region 2, the major contaminants that could increase due to climate change are bacterial contamination, greater algal blooms due to increased nutrient loadings, and higher nitrate concentrations in groundwater. Additionally, certain areas such as Suffolk County, NY or some coastal areas of Puerto Rico rely primarily on cesspools and septic systems for sanitation; these areas are particularly threatened by impacts from climate change. EPA works with local officials and partner organizations to support onsite wastewater management and develops voluntary policies and guidance for onsite wastewater management programs.

QUALITY AND AVAILABILITY OF SAFE DRINKING WATER

Protecting public health from contaminants in drinking water will require adapting to the impacts of climate change. Warmer waters foster pathogen growth, which affects the reliability and the cost of drinking water disinfection. Increased precipitation, and in particular, more extreme rainfall events may result in additional pollutant loadings of nutrients, pesticides, and other chemicals, further challenging drinking water treatment. New York City's ability to continue to meet the criteria for the drinking water filtration avoidance, thereby reducing the need for water supply treatment, may be affected due to increased runoff and turbidity. Small water systems, such as non-PRASA (Puerto Rico Aqueduct and Sewer Authority) systems in Puerto Rico, are particularly vulnerable due to reduced water yields and/or poor water quality. Longer periods of drought are expected to occur and may produce an increase in the energy and costs associated with the production of drinking water.

New drinking water sources and/or enhanced treatment will be needed in some localities, including relocating water intakes and building desalinization plants. Rising sea levels cause intrusion of saltwater into the underground freshwater aquifer, contaminating the supply of usable groundwater and reducing the freshwater supply for the Caribbean islands, on Long Island, and in coastal sections of New Jersey. Desalination to treat marine or brackish water is becoming increasingly important in certain locations in the Virgin Islands and circumstances where demand is driven by population growth or drought. Wastewater or stormwater utilities could distribute reclaimed water from a centralized treatment

[6] http://www.ngwa.org, http://pubs.usgs.gov/circ/2004/circ1268/htdocs/table04.html

system for park irrigation or other uses, which may require additional treatment. EPA's drinking water and groundwater protection programs will be involved in permitting and monitoring the systems and providing technical support.

Aquifer Storage & Recovery (ASR) is a process of storing water underground to provide future domestic, industrial and agricultural water supplies. ASR is increasingly used where fresh water demand is beginning to or projected to exceed supply, and ASR is likely to increase in drought prone areas. When applied to stormwater, this practice can also reduce nonpoint source pollution of our lakes, streams and rivers. However, the infiltration or injection of polluted stormwater increases the risk of contamination of fresh water aquifers. In Region 2, the majority of ASR facilities are located in New Jersey. In light of increasing demand, EPA will need to ensure that groundwater quality and supply are maintained given greater use of this resource (EPA 2012).

3. CLEANING UP COMMUNITIES

RISK OF CONTAMINANT RELEASES

The prospect of more intense and more frequent storms and sea-level rise carries with it the risk of contaminant releases from RCRA Corrective Action sites, Superfund sites, Brownfield sites and landfills. As noted in EPA's Climate Change Adaptation Plan, inundation and flooding may lead to transport of contaminants through surface soils, groundwater, surface waters and/or coastal waters. Uncontrolled migration of contaminants may pose an increased risk of adverse health and environmental impacts. An example in Region 2 is American Cyanamid, a Superfund site on the banks of the Raritan River in Bridgewater Township, NJ. The site has two impoundments of harmful chemicals that release contamination during major flood events such as Hurricanes Floyd and Irene (1999 and 2011 respectively). There is currently no remedy selected for the impoundments area of the site, so future flood events will continue to release contamination on the site and into the river until a remedy is selected and implemented.

While this issue is, of course, most relevant to sites that have not yet been remediated, some sites where a containment remedy has been performed may also be vulnerable. For example, saltwater intrusion and increased groundwater salinity in coastal aquifers may increase the permeability of clay liners installed at waste sites, such as landfills, allowing contaminants to spread to nearby properties. Several landfills in Puerto Rico and the USVI are located at or near sea level. Many of these landfills are still operating and/or have been improperly closed. Rising sea level poses a significant risk of erosion to these landfills and the potential migration of contaminants towards nearby communities and ecosystems (i.e. coastal wetlands and coral reefs). Examples of these are the Culebra Island Landfill and the Rincón Municipal Landfill.

Severe storms, storm surge and sea level rise may also cause flooding of coastal or other riparian located facilities in Region 2 where chemicals, oil or other hazardous substances are present. Of notable concern are pesticide and chemical production or storage facilities, which are governed by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Toxics Substances Control Act (TSCA),

respectively. These facilities are also vulnerable to extreme weather events, possibly leading to the dispersal of such materials to nearby properties or surface waters and, in turn, creating risks to public health and the environment. This is an issue about which local Environmental Justice groups have raised concerns to EPA, as a number of such facilities in our Region are located near low-income minority communities. Releases of hazardous substances or other materials from such facilities could potentially lead to cleanup actions by EPA's Superfund program, the oil spill response program, or state or local government response programs to conduct cleanup actions.

ADVERSE EFFECTS ON CLEANUPS AND EMERGENCY RESPONSE

As noted in the Agency-wide Climate Change Adaptation Plan, changes in precipitation patterns and temperature as a result of climate change may adversely affect the performance of some site cleanup remedies and may require some remedies to be changed. In February 2012, EPA's Office of Solid Waste and Emergency Response (OSWER) released a report, *Adaptation of Superfund Remediation to Climate Change*, which identified vulnerabilities to site remedies nationwide. The assessment identified sites with on-site pump and treat or containment remedies within 100- and 500-year floodplains, as well as those within the modeled 5 ft. sea level rise zone. While the report concluded that there are multiple programmatic systems in place to address effects of climate change on Superfund sites, more evaluation is ongoing to look at more specifics regarding vulnerabilities during a site's lifecycle, as well as at sediment and other types of sites. The report also found that climate change effects could be accounted for within the remedy assessment criteria or the Five Year Review process, but site managers may need to be more aware of these opportunities for addressing adaptation issues. Other vulnerabilities include changes in site conditions and contaminant characterization of groundwater plumes as groundwater recharge may be affected by climate change. Flooding and storm surges are also likely to affect ongoing ecological redevelopment of sites, as well as oil tank storage.

4. ASSURING THE SAFETY OF CHEMICALS AND PREVENTING POLLUTION

USE OF TOXIC CHEMICALS

A changing climate will likely result in changes in the kind of agricultural crops planted in New York, New Jersey, and the Caribbean. For example, current cash crops in the Northeast such as apples, maple syrup, and cranberries will likely move further north into Canada while crops now grown in the Southeast will move into the region (USGCRP 2009). This in turn will affect the quantity, type, and timing of agricultural chemical use as well as the appropriate application method. These changes in chemical use and application could impact the appropriate risk management decisions made by EPA Region 2's Pesticides Program in determining what pesticides and geographic areas to focus our efforts to ensure compliance with the Federal Fungicide, Insecticide, and Rodenticide Act (FIFRA), particularly with regard to the protection of migrant farm workers and rural communities. For instance, soil fumigation as a method to apply pesticides is now rarely used in Region 2 but would be expected to become more common as crops move into the area that requires pest techniques that are associated with longer growing seasons and warmer winters (NYSERDA 2011). Soil fumigants are among the most hazardous of all pesticides and rapidly volatilize once in the soil. Once in gaseous form, the fumigant can disperse throughout the soil and contact target pests making them extremely effective. However, because of the

volatility of fumigants, people who live, visit, and/or work near fumigated fields may be exposed to these toxic emissions if the gases travel offsite either via wind aboveground or through wells, sewers, vaults and other underground pathways to the surface. Consequently, EPA Region 2's Pesticides Program would likely need to reevaluate its priorities if spray drift from fumigants becomes more common in Region 2.

Similarly, changes in temperature and precipitation levels are expected to result in increased cases of the West Nile Virus and other diseases carried by mosquitoes, some not usually found this far north. In fact, the migration of *Aedes albopicus* (Asian tiger mosquito) has resulted in increasing populations in more northern regions, especially Region 2 (Shope 1991). These mosquitoes have begun to take over areas previously inhabited by *the Culex species of mosquito* during the winter (i.e., NYC). The movement of this invasive species may increase the northward spread of Dengue. As the incidence and type of diseases carried by mosquitoes increases, EPA Region 2's Pesticides Program will likely need to broaden their knowledge of new types of pesticides and/or application methods to ensure compliance with FIFRA. EPA will also need to engage diverse stakeholders with disparate views on the merits of spraying pesticides. These activities will have resource implications for EPA Region 2 as will most of the programmatic impacts referenced in this Assessment.

EXPOSURE TO TOXIC CHEMICALS FROM INFRASTRUCTURE DAMAGE

The extreme weather events that are likely to occur as a result of climate change (e.g., high winds, heavy precipitation events) may damage community infrastructure (e.g., schools and child care facilities) and residential homes. As a result, there may be an increased risk of exposure to lead, asbestos and PCBs, when these buildings are initially damaged and when they are renovated/demolished as part of the recovery efforts. Children are particularly vulnerable to this risk, particularly those living in disadvantaged communities where buildings tend to be older and poorly maintained. Therefore, to mitigate/prevent such exposure and ensure compliance with the Toxic Substances Control Act (TSCA), EPA Region 2's Toxics Substances program will need to educate the affected communities about safeguarding themselves and provide technical assistance to debris removal companies and the construction/renovation industry. Depending on the extent of the communities impacted and the amount of damage resulting from these extreme weather events, the capacity of EPA Region 2 Toxic Substance program to provide such information/assistance in a timely manner, especially in a face-to-face format, could be sorely tested.

5. EPA REGION 2'S FACILITIES AND OPERATIONS

EPA Region 2's main office is in Lower Manhattan, with other facilities in Edison, NJ, and Guaynabo, PR, as well as small field offices in Hudson Falls and Buffalo, NY, Stamford, CT and in the U.S. Virgin Islands. Our Edison, NJ facility houses, among other things, our regional laboratory and EPA's Emergency Response Team. Overall, Region 2 currently has about 840 employees. The climate change impacts discussed in the above sections present a number of risks to Region 2's staff, facilities, assets, and day-to-day operations, as summarized below.

FACILITY OPERATIONS, SAFETY AND EMERGENCY COMMUNICATIONS

Extreme heat, bad air quality or other weather conditions exacerbated by climate change may increase the health risks of EPA Region 2 employees and contractors engaged in field work -- such as sampling, remediation and inspections -- or force them to delay such work. In addition, increased demands placed on electrical grids during heat waves could jeopardize the grids' integrity or force utility providers to institute rolling brownouts or blackouts. The occurrence of such outages would force EPA to use auxiliary power sources (generators, uninterrupted power supplies). Building lighting, HVAC systems and/or elevator service may have to be reduced or adjusted to compensate for the loss of power. EPA offices in the Caribbean could potentially close for short periods of time due to impacts of hurricane, tropical storms or other weather events and potential impacts on the facilities themselves and the employees' ability to safely travel to and from work. In addition, potential water shortages due to reduced water availability as a result of prolonged drought could disrupt day to day operations. Severe storms (for example, as seen during Superstorm Sandy) could also cripple public transportation systems, highways and roads, and/or result in significant gasoline shortages, thus preventing Region 2 employees from being able to come into work. We have prepared for such scenarios through our telework program, portable computing equipment for employees, and remote networking capabilities, but at a minimum, some impact on productivity can be expected. In addition, many regional staff conducts field-based work, such as site remediation and inspections. Instability of weather patterns (with more heavy snow and ice events in winter months) also impacts the safety of staff traveling to and from remote (and sometimes off-road) locations and increases the chance for automobile accidents with government vehicles.

EPA Operations & Superstorm Sandy

When Superstorm Sandy struck the east coast in October 2012, EPA Region 2's main office – located in lower Manhattan – lost its main power supply for five days and its heat supply longer, which forced the closure of the building for almost two weeks (9 business days). Closing the main office had a major impact on our operations, and due to the extent of impact – power outages, wireless and landline telephone service limitations – employees had limited ability to access their work virtually. The storm also knocked out the normal power supply for our Edison, NJ facility, forcing the facility (and the Region's command center for emergency response) to operate on emergency backup power. For nonessential Edison, NJ staff – including laboratory staff – the Edison facility was closed for five business days, creating a backlog in regular work while additional storm-related needs were developing. Edison's Regional Emergency Operations Center (REOC) ran on generator power from Monday through Saturday. Bottled water and dispensers had to be brought in to supply potable water for staff working at the REOC.

In addition to building operations, road and tunnel closures, hobbled public transportation (NYC subway, PATH, NJ Transit trains and light rail) and gasoline shortages created hardships mobilizing the workforce at both locations, whether bringing employees into the office or more importantly deploying employees to the field to assist other state and federal agencies.

Regardless of whether Superstorm Sandy can be directly attributed to climate change, the storm is illustrative of the sort of extreme weather events that are expected to occur in the Northeast with greater frequency in the future, as a result of climate change.

EPA Region 2 has Continuity of Operations Plans that are formulated to address an "all hazards" approach. Damages to EPA facilities and/or impacts to critical infrastructure due to extreme weather events could force Region 2 to implement those plans, or even Devolution of Operations Plans, in order for EPA to continue to execute Mission Essential Functions. The Region maintains a Continuity of Operations site in Edison, NJ that is capable of providing fully supported workspace for up to 200 emergency support personnel. The site has backup power and was constructed to withstand hurricane force winds and earthquake level forces.

Over time, climate change may result in EPA Region 2 personnel – including those working in our emergency response program or who collect or analyze environmental samples, as well as our contract support staff, public affairs staff, and others -- being increasingly drawn away from their normal day-to-day activities to respond to extreme weather events or emergencies. This, in turn, could lead to a reduced capacity to perform regular duties (e.g., monitoring compliance with and enforcing hazardous waste laws).

IMPACTS ON WATER SUPPLIES USED BY EPA REGION 2

As described previously, water availability, quality, and safety could be compromised by climate-influenced events. At all regional offices and the laboratory, the staff relies upon potable drinking water from municipalities. The availability of safe drinking water (as described in the Superstorm Sandy example) needs to be considered for all offices. Water supply issues could impact the Regional Lab at Edison, NJ and its ability to operate. In Edison, the ORD National Risk Management Research Laboratory conducts research on stormwater management practices and technologies. In-situ research requires copious amounts of water to mimic various storm intensities (and related overflows). Droughts can impact the Laboratory staff's ability to test technologies and conduct research because access to water could be limited through rationing/availability.

EPA developed a Water Conservation Strategy that identifies water conservation projects and approaches that reduce potable water use by 2% annually. This strategy applies to EPA-owned spaces, such as the Edison, NJ facility and laboratory that are owned and operated by the Regional office. Projects to ameliorate local water supply issues include gray water (rain water runoff and water condensation) capture for cooling. Increased drought intensity – and overall changes with the frequency and intensity of storm events – may reduce the availability of gray water over time.

In addition, water shortages could impact office operations of leased space in Puerto Rico, U.S. Virgin Islands, New York and New Jersey. Spaces leased from the U.S. General Services Administration (GSA) may be dependent upon water for consumption, cooling, landscaping, etc. However, GSA (directly or indirectly) is the responsible party for addressing water conservation and stormwater reduction. During extreme drought conditions, employees may be asked to conserve water such as limit watering plants, showering at the facility gym, etc. Long-term droughts and increased scarcity of water may cause local water rates to increase thereby increasing operational costs related to potable water use in office buildings and negotiated during lease renewal.

EPA REGION 2 PRIORITY ACTIONS

Adaptation planning efforts in Region 2 began with a vulnerability assessment of Regional programs to identify how climate impacts may affect our mission, program and operations. Region 2 focused on actions that would address the areas of highest likely risk and subsequently developed a preliminary list of action items to address the impacts identified in the vulnerability assessment. Next the group identified criteria to select the best actions from the preliminary list and developed a draft set of priority actions selected by applying the criteria. See the criteria listed below.

CRITERIA

- Action meets other regional/national objectives [Consider whether action is part of EPA's core or optional programs]
- Action must be implemented in order to enable other actions (sequencing)
- Region 2 is the best fit as implementer or co-implementer
- Action is achievable
- Action fills a gap
- Action reduces risk significantly
- We can measure benefits of the action
- There are resources available to do the action
- Action has short-term and long-term benefits
- Actions that address current impacts are more important than actions that address projected impacts
- The action avoids maladaptation
- Action addresses EJ communities and vulnerable areas/populations
- The law can provide an opportunity for the action; There is legal authority for the action
- The action is scalable and transferable
- Action advances sustainability
- Action has durability/stability/longevity

The following section lists priorities that represent regional actions to reduce the impacts of climate change to EPA Region 2 programs. Region 2 priority actions are categorized to demonstrate the region's short-term priorities, and long term priorities. The short-term priority action designation reflects the regional offices' assessment of appropriate resources and ability to implement the actions in the near-term while long-term priority actions are slated for the future and pending resource allocation. Additionally, the region identifies goals that are best suited for a headquarters or nationally-led initiative, due to factors such as scope, rulemaking authority, and resource requirements. Region 2 is committed to supporting the development of potential legal strategies underlying existing and new priority actions on adaptation and will more broadly consider options to improve the effective use of legal tools in the response and recovery phases following impacts from climate change. Such legal tools are relevant to consideration of a range of issues including but not limited to access issues, waivers, no-action assurances, and efforts to secure staging areas. Region 2 will also seek opportunities and develop options to increase resilience at entities regulated by environmental statutes and regulations by incorporating information and knowledge on vulnerabilities into permits, environmental reviews, injunctive relief portions of enforcement documents, and other EPA decisions and approvals, where appropriate.

Region 2 recognizes the iterative nature of adaptation planning and will use an adaptive management framework, or develop adaptation strategies based on assessments that are monitored, revisited, redesigned and adjusted over time, to implement these priority actions. An adaptive management framework will be particularly helpful given uncertainties about Regional climate change impacts and the effectiveness of our priority actions as well as changing resources and needs. Through an adaptation management framework, Region 2 will be able to more nimbly and effectively reprioritize and revise our actions.

SHORT TERM PRIORITIES

THE SHORT-TERM PRIORITY ACTION DESIGNATION REFLECTS THE REGIONAL OFFICES' ASSESSMENT OF APPROPRIATE RESOURCES AND ABILITY TO IMPLEMENT THE ACTIONS IN THE NEAR-TERM.

AIR

- Focus enforcement resources on emitters of tropospheric ozone precursors, volatile organic compounds (VOCs) and NOx, to reduce the impacts on air quality associated with projected temperature rise due to climate change.
- Increase outreach regarding the effects of emissions from emergency generators and wood smoke. Educate emergency generator purchasers about newer, cleaner, and more efficient generators. Promote best practices for using emergency generators and wood burning to reduce emissions associated with generating electricity and heat during extreme weather events which disrupt energy delivery. Enhance messaging on dangers from increased use of back-up electricity sources (e.g. generators) and heat sources (e.g. woodstoves, fireplaces) during power outages.

WATER

Region 2 contributed to the development and implementation of the National Water Program 2012 Strategy: Response to Climate Change[7] which identifies 19 Goals and 53 Strategic Actions that are being implemented nationally. The priority actions listed here include short-term priorities for which sufficient levels of funding and resources are available for implementation.

- Promote the Climate Ready Water Utilities program and the Climate Resilience Evaluation and Awareness Tool (CREAT) tool to water utilities and municipalities. Support utilities in modifying treatment plants to withstand future storm surges.
- Work with states to establish SRF criteria for building resistance to climate change impacts through infrastructure investment.
- Promote Green Infrastructure practices to state and municipal governments to help them better manage increased precipitation and flooding. Develop and finalize the regional Green Infrastructure Action Plan.

[7] http://water.epa.gov/scitech/climatechange/2012-National-Water-Program-Strategy.cfm

- Identify and assess public water supply systems that are close to streams or rivers that may be subject to climate impacts, including flooding and severe storm events.
- Implement the Coral Reef Protection Plan, which addresses climate impacts to corals such as ocean acidification and coral bleaching, as well as waste discharges, water quality criteria, and areas to be protected through a watershed management approach.
- Continue to support and incorporate climate change considerations into funding and support for coastal habitat restoration and monitoring activities.
- Engage with Regional National Estuary Programs (NEPs) to implement climate change priorities identified in NEP Action Plans and other key documents. Work with regional NEP programs to incorporate climate change considerations into funding and coastal habitat restoration activities, as appropriate.
- Improve coordination of Clean Water Act funding that supports wetland protection and monitoring to incorporate resilience of wetlands to climate change and sea level rise. Funding sources include CWA 104, 106, 319, and 320 grant programs.
- Collaborate with NOAA, US Fish & Wildlife, and FEMA to identify opportunities for coordination of wetland restoration funding. Identify duplicative actions and possibilities for collaboration to ensure more efficient use of federal funds. Streamlining restoration spending may free up funds that can be used for further restoration work, which can protect coastal communities from sea level rise, erosion and storm surge.
- Promote wetland conservation and restoration through Supplemental Environmental Projects (SEPs) in the Caribbean.

WASTE: SUPERFUND & RCRA

- Assess vulnerabilities of existing Superfund/Resource Conservation and Recovery Act (RCRA) sites, including proximity to flood zones, coastal or riverfront sites, etc. (National Priorities List or NPL, non-NPL, RCRA corrective action facilities, Formerly Utilized Site Remedial Action Program or FUSRAP sites) working with state and other federal agencies as appropriate. To be completed internally by site managers with a vulnerability checklist. Additional resources would be needed for a more complex vulnerability assessment, which may be more appropriate as a nationally-led report.
- Include consideration of potential climate change impacts in Five Year Reviews of NPL sites (e.g. flooding impacts to capped sites, changes to aquifers and plume migration, etc.).

EMERGENCY RESPONSE

Since Superstorm Sandy made landfall on the coast of New York and New Jersey the evening of Oct. 29, 2012, EPA Region 2 has been providing ongoing emergency response in our two northeastern states. In addition to emergency response actions provided by our on-scene coordinators, Region 2 staff persons were stationed at the FEMA Joint Field Operations as part of the federal response to Superstorm Sandy in New York and New Jersey to develop Recovery Support Strategies. Region 2 continues to coordinate with other federal agencies on addressing climate risk in the rebuilding process. The region's immediate response work is not fully captured within the scope of this plan. Response work addresses a number of environmental and human health concerns including monitoring water quality, managing household hazardous waste and disaster debris in accordance with the National Response Framework. EPA Region 2 has been implementing recovery actions in accordance with the Superstorm Sandy Supplemental Appropriations bill. The bill provides funds for EPA in the following program areas: the drinking water and waste water State Revolving Loan Funds, Superfund sites, and monitoring environmental conditions.

The Region is working with state and federal partners to build climate resiliency into the recovery activities implemented by many federal and local organizations through the Superstorm Sandy Supplemental Appropriations bill. In the long-term, the Region will take into consideration lessons learned from recent climate events, including Superstorm Sandy response operations work, to address climate change in emergency response preparedness.

COMMUNITIES & VULNERABLE POPULATIONS

- Inspect regulated facilities in flood prone areas that store hazardous waste, chemicals, and oil to promote climate resilient practices. Design materials to distribute containing environmental assistance resources for regulated facilities in flood prone areas and distribute through inspections, meetings, and outreach events and in partnership with other technical assistance providers such as small business assistance programs. Make use of existing mapping applications with new climate data projections to identify regulated facilities in flood prone areas, especially in EJ areas.
- Identify areas of opportunity in hazard mitigation planning to integrate sustainability principles (including land use principles) into community planning documents to reduce further impacts and connect sustainability to long term recovery from extreme weather events. Expand partnership with research institutes, and FEMA to develop tools that planners can access.
- Develop and distribute resource materials for communities to conduct assessments of climate vulnerabilities and devise potential strategies for climate resilience.
- Use the EPA Environmental Justice Screening tool, EJSCREEN, to do an assessment of Superstorm Sandy-impacted communities. Support FEMA and the Federal Disaster Recovery Support Strategy to identify communities with potential areas of EJ concern for purposes of targeting and prioritizing technical support/assistance for local recovery efforts. Develop a plan for incorporating EJ in community development scenario planning protocols that will help communities rebuild sustainably.
- Incorporate climate adaptation concerns for communities and vulnerable populations into regional science priorities which prioritize future science and research funding.
- Use GIS-mapping and existing climate model information to assess vulnerabilities of public infrastructure (electric utilities, wastewater treatment plants, chemical storage facilities, public transport facilities, gasoline and oil storage locations).
- Create a regionally specific website to provide resources and information to stakeholders on preparing for the impacts of climate related events such as heat waves. Highlight priority actions as they are accomplished via press events, social media, and/or press releases.
- Address vulnerabilities regarding the water infrastructure and other industrial facilities with emphasis on low-income communities located near coastal water bodies in the Caribbean (e.g. Martín Peña and G-8 communities).
- Address climate change-related impacts in NEPA reviews, including consideration of options to reduce environmental consequences of climate change-related impacts on proposed federal actions.

INDIAN NATIONS

- Support Region 2 Nations in assessing impacts to tribal lands and cultural activities.
- Support tribal climate change information sharing amongst tribes in Region 2 and beyond. Region 2 will promote increased capacity for Indian nations to create and maintain adaptation plans for their

communities, and promote improved communications between EPA and Indian nation communities, and also tribal organizations, on climate change activities.

FACILITIES

- Update communication methods to staff during incidences of long and short term disruptions to wireless and phone capabilities. Address methods for communicating staff availability to other Regions, HQ, etc. during long and short term office and facility closures.
- Update disaster/emergency planning for operations, including protocols for asset management and tracking as well as the transition from normal operations to emergency status and vice versa.
- At our Guaynabo facility, promote use of WaterSense products.

LONG TERM PRIORITIES

LONG-TERM ACTIONS ARE SLATED FOR THE FUTURE AND PENDING RESOURCE ALLOCATION.

AIR

- Establish post-storm planning with multiple components to address air quality aspects of waste removal, including maximizing potential for re-use or composting of vegetative debris; removal of non-reusable debris *(e.g. asbestos); cleanest transportation options, e.g. marine, rail instead of trucks.
- Work with Headquarters to implement any necessary changes to air quality guidance and procedures to account for a changing climate (e.g., adjustments to waiver and waiver extension request procedures in response to more frequent or severe extreme weather impacts on facilities).
- Bring air pollution consequences of climate change impacts on transportation systems to the attention of state and local partners.

WATER-CARIBBEAN[8]

- Foster renewal of discussions about the implementation of source water protection programs in the Caribbean islands.
- Train Caribbean enforcement officers to increase awareness of the impact of climate change to regulated facilities and their activities. Give out information to public works personnel during Municipal Separate Storm Sewer Systems (MS4) inspections.
- Improve communications with Puerto Rico Department of Natural & Environmental Resources and U.S. Virgin Islands Department of Planning & Natural Resources and other state agencies for collaborations in the respective coastal zone management programs in the Caribbean to work together in addressing coastal vulnerabilities.
- Implement water conservation programs to address anticipated levels of reduced precipitation in the Caribbean. Promote more sustainable small water systems infrastructure, operation and maintenance for the Caribbean islands.

[8] New York and New Jersey long-term priority actions are identified in the “Moving Toward a Climate Resilient Region” Section.

- Outreach and implementation of water reuse/reclamation programs to address future water scarcity for the Caribbean islands.

WASTE: SUPERFUND & RCRA

- In the Caribbean, promote Climate Change Adaptation SEPs, in future enforcement orders, permits to CWA sites as well as RCRA Hazardous Waste sites.
- Promote more P2/Sustainable Practices in the Caribbean to prevent/minimize releases of hazardous material as a result of hurricanes, flooding, etc.

EMERGENCY RESPONSE

- Develop database/ for reuse and recycling of disaster debris. Simultaneously develop in-house expertise for debris management and conduct training for EPA staff through ICS exercises.
- Conduct outreach with states & municipalities to encourage development and implementation of disaster debris management plans.
- Conduct outreach with states and municipalities to improve management of household hazardous waste to prevent releases during extreme weather events. Increase awareness among federal, state and local agencies/first responders about the impacts of climate change in emergency situations in the Caribbean.
- Review CEPD's emergency response plan to ensure that the vulnerabilities of the new San Juan office location are considered.
- Improve communications with DNER/DPNR and other Caribbean state agencies for collaborations in the respective coastal zone management programs to mitigate impacts during emergencies.

COMMUNITIES & VULNERABLE POPULATIONS

- Increase number of communities that receive information about availability of technical assistance, such as Complete Streets, planning for older populations in communities.
- Promote more Pollution Prevention/Sustainable Practices in the Caribbean to prevent/minimize releases of hazardous material as a result of hurricanes, flooding, etc.
- Compile case studies that showcase implementation of climate adaptation and mitigation efforts to describe their effectiveness.
- Coordinate with states and local governments that are piloting and demonstrating use of climate information in research, planning and rebuilding efforts.
- Support economic development strategies for building communities with climate resiliency through job training, education and coordination.
- Develop outreach such as workshops, webinars, etc. on resilient buildings. Feature EPA Indoor airPLUS for building reconstruction and EPA's Healthy Indoor Environment Protocols for Home Energy Upgrades for building upgrades. Prepare information and recommendations regarding mold and indoor air quality issues for distribution to the public. Disseminate factsheets on re-entry to homes, schools, daycare centers, buildings, etc. Address energy efficiency impacts on indoor air quality for homes and schools to avoid maladaptation.

MOVING TOWARD A CLIMATE RESILIENT REGION

Like other regions and program offices in EPA, Region 2 faces significant constraints on funding and employee resources. Region 2's decision to segregate our priority actions into short-term and long-term actions in the preceding sections of this document recognizes those constraints. There are additional actions that EPA has not included in either the short-term or long-term actions, above, because the timing of those additional actions might not be clear or because this document is not seen as the vehicle to drive those actions. In addition to funding and employee resource constraints, these additional actions may require difficult policy or legal decisions before we can implement them. They might also require action by another party. For example, many of these actions must be addressed in partnership with states, territories, tribes and municipalities, all of which face serious budget restrictions and difficult policy choices of their own. In some cases, EPA is already implementing portions of additional actions through work driven by factors external to this Adaptation Plan. Below are some of the actions that fit into this additional category. EPA Region 2 will consider the appropriate timing of these additional actions in the context of the adaptive management framework.

Region 2 sees future opportunity to work with state regulators during the planning and permitting process, for the air and oil sector and sewage treatment plants, in accounting for climate change related issues. This could require considering the elevation of a facility, location of facility intakes, and location of emissions control equipment to account for project climate change impacts. In the Caribbean, we could explore the possibility of implementing green infrastructure and green energy in consent-decrees and orders (for both Safe Drinking Water Act and Clean Water Act).

In the area of watershed management, the regional water program supports continuing to work with state, territory, tribal, and local partners to further integrate climate change adaptation considerations into nonpoint source management plans and programs. For example, the New York City Drinking Water Program has a robust watershed protection program that integrates climate change concerns which was developed with the help of EPA Region 2 and other state partners. This collaboration with our partners could also entail enhancing the protection and creation of buffers to rivers, lakes, wetlands and other coastal resources to build resiliency and protect water quality. Region 2 could also work with partners to prepare for increased runoff by encouraging development of infiltration basins, providing soil structure to soils compacted by development, adoption of erosion and sediment controls, increases in culvert sizes and the adoption of other BMPs that mitigate runoff. These activities could be supported in part by leveraging state and federal resources, including Clean Water Act Section 319 grant funds. Finally, Region 2 could encourage states to incorporate climate change issues when updating their nonpoint source management plans and guidance documents.

In the ocean and coastal arena, the water program will continue to promote a sustainable balance between the use of soft shorelines, living shorelines and innovative shoreline development, and hardened shorelines. The region's ability to support on-the-ground projects as it has in the past is currently limited. The dredging program seeks to work with partners to better anticipate and plan for increased demand for dredged sediments to counter the effects of sea level rise and increased erosion.

As Superstorm Sandy demonstrated, drinking water and wastewater treatment plants in Region 2 are extremely vulnerable to sea level rise, storm surge and erosion. The water program supports further collaboration with

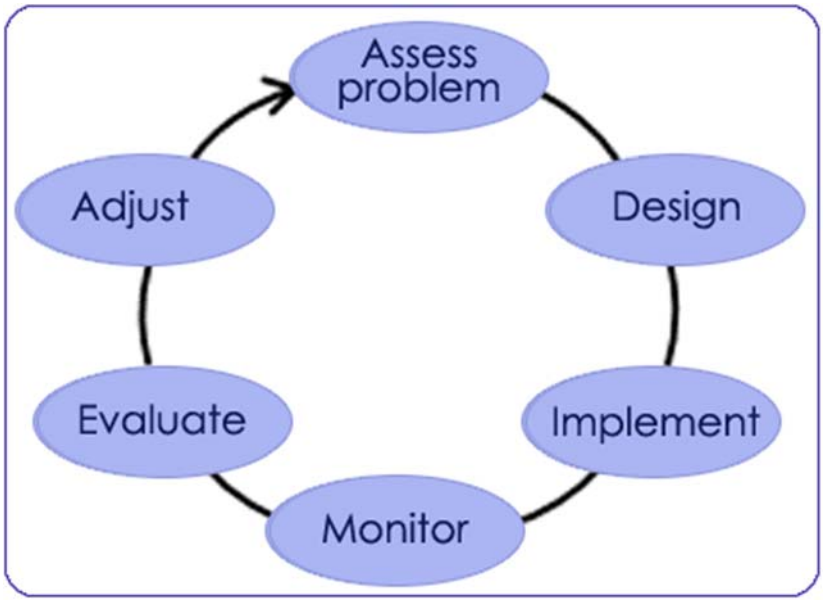
partners to support a watershed management approach to protecting source water. Activities could include introducing vegetation for flood control, increasing recharge to aquifers, including source water protection areas in local climate adaptation initiatives and identifying climate change threats to drinking water. The region plans to work more closely with facility operators and municipalities, which have a range of different capabilities and impacts of concern, to provide them with more support and better climate change information. Potential activities include training facility operators in the use of local climate projections, GIS (Geographic Information Systems) and LiDAR (Light Detection and Ranging) mapping of flood plains. The water program may be able to provide technical support to facilities and municipalities as they consider future audits, upgrades or new construction. Many communities in Region 2 rely on on-site systems like cesspools and septic systems instead of wastewater treatment plants. To support these communities, the water program intends to support state and local partners in conducting an analysis of the susceptibility of septic systems and cesspools to climate change as resources permit. To reduce the strain on facilities and on-site systems, the region seeks to expand its existing green infrastructure program to better support residential and community green infrastructure programs by promoting rain gardens, green roofs, downspouts and other tools. Finally, the water program seeks to improve climate readiness of coastal communities by supporting vulnerability assessments, hazard mitigation, pre-disaster planning and (if applicable), recovery efforts.

These additional actions will help us move toward a climate resilient Region. While Region 2 is not prepared to set a schedule for these additional actions, they will be implemented at the appropriate time and in the appropriate manner in light of multiple factors such as resources, policy, law, actions of other parties, and relationship to other non-adaptation driven work. Some of these actions might be ripe for implementation very soon and others might not be appropriate for the foreseeable future. Region 2 will use the adaptive management framework to assist us in determining if and when to implement these additional actions.

TRACKING PROGRESS OVER TIME: MEASUREMENT & EVALUATION

Adapting to climate change impacts requires an approach that can adjust over time. There is uncertainty related to the global inputs of greenhouse gas emissions that we will experience in the future and related to the resulting local impacts from the range of emissions that could potentially be anticipated. As the region develops strategies to address climate impacts, these actions may need to shift to address changing environmental conditions or we may learn from initiatives and adjust them to seek greater results. EPA will continue to strengthen coordination among programs and with partners in this shifting context. A framework for understanding this approach is **adaptive management**, which calls for developing adaptation strategies based on assessments that are monitored, revisited, redesigned and adjusted over time. This adaptive management approach, employed by the Dept. of Interior, continually calibrates strategies to respond to shifting conditions meanwhile refining and improving the efficacy of strategies over time.

Adaptive Management Process



Source: Department of Interior, 2010

EPA's mission is to protect human health and the environment. In assessing climate hazards, and developing strategies to address them, the broad vision is to ensure that EPA persists in protecting human health and the environment as we experience and adapt to global climate change. In order to track our progress toward meeting the vision of a climate resilient mission for EPA, the following key summary goals have been identified for EPA Region 2 to measure and continue to evaluate over time.

Summary Goals

- Strengthen our emergency preparedness for anticipated climate events.

- Integrate climate impacts into public health information.
- Collaborate with other federal agencies on climate adaptation initiatives.
- Incorporate climate change considerations into appropriate funding activities.
- Conduct outreach on climate impacts and best practices to promote tools and support decision-makers.
- Work with states and Indian nations to integrate climate adaptation into EPA, state and tribal environmental programs.
- Develop assessments of vulnerable infrastructure and sites to increase knowledge of potential climate risks and inform responses.
- Integrate climate adaptation as appropriate into regional programs such as permitting, enforcement and environmental review.
- Partner with communities and other stakeholders to develop and implement climate adaptation strategies that address the climate vulnerabilities of our region.

As the region implements the adaptation plan, we will measure and evaluate progress toward achieving the above goals as part of the adaptive management framework. The region will assess the progress of our priority actions under each of these goals. The lessons learned in this process will inform the adjustment and development of our future strategies as we apply adaptive management to address the risks of climate change to our region.

CONCLUSION

Getting to resilience will require a coordinated effort by an intergovernmental partnership to leverage all the tools we have with our limited program resources. This adaptation plan begins to assess our vulnerabilities and define the starting point for addressing these vulnerabilities. Much of the work will be accomplished in a sustained effort over time.

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