

Response to Climate Change

| | |
|---|-----------|
| IV. Programmatic Visions, Goals, and Strategic Actions | 27 |
| A. Infrastructure | 28 |
| B. Watersheds and Wetlands | 36 |
| C. Coastal and Ocean Waters | 44 |
| D. Water Quality | 55 |
| E. Working With Tribes | 63 |



IV. Programmatic Visions, Goals, and Strategic Actions

THE NATIONAL WATER PROGRAM'S over-arching vision is:

Despite the ongoing effects of climate change, the National Water Program intends to continue to achieve its mission to protect and restore our waters so that that drinking water is safe; and aquatic ecosystems sustain fish, plants and wildlife, as well as economic, recreational, and subsistence activities.

To that end, the NWP Climate Change Workgroup identified five key programmatic areas in which to apply the principles articulated above. This chapter then, is divided into five sections, each of which is organized using a three-tier framework: Vision, Goals, and Strategic Actions. Each section articulates a Vision, for which EPA may be only one of many actors. EPA intends to work collaboratively with other federal, state, interstate, tribal, and local entities to achieve each Vision.

For each Vision, we identify Goals that also reflect a long-term timeframe. The Goals articulate EPA's mission and role in achieving each Vision, and describe *what* we are trying to achieve.

Each Goal entails several Strategic Actions, which are the program building blocks to achieve the Goal. The Strategic Actions describe *how* the NWP intends to work over the next three to eight years in pursuit of our longer term Goals and Visions.

EPA intends to incorporate annual objectives into the Agency's annual budget and planning process and reflect the availability of resources and priorities. We intend to describe progress toward achieving Goals and Strategic Actions in annual reports (see the section on *Tracking Progress and Measuring Outcomes* in Chapter VI).

It is important to underscore that neither this *2012 Strategy* nor its Visions, Goals, or Strategic Actions, impose any requirements on state, tribal, or local water programs, nor do they establish any regulatory obligations on permittees or others. Rather, the *2012 Strategy* provides a comprehensive discussion of how the NWP intends, over the long term, to incorporate climate change considerations into its day-to-day activities, as appropriate and consistent with applicable statutory and regulatory authority, and in accordance with best available science and information. This document identifies areas in which the NWP intends to work with stakeholders and partners to account for and respond to the potential and actual impacts of climate change.

The five sections of this chapter are:

- A. Infrastructure** – including centralized or decentralized technologies and practices for wastewater, drinking water, and stormwater management infrastructure; Climate Ready Water Utilities; energy use and co-generation; and water supply and demand management.
- B. Watersheds and Wetlands** – including landscape strategies to protect and restore watersheds, source water areas (including ground water), and wetlands; natural infrastructure; and low impact development (LID).
- C. Coastal and Ocean Waters** – including programs for coastal wetlands and estuaries; Climate Ready Estuaries (CRE); issues associated with coastal infrastructure and coastal drinking water (e.g., sea level rise, saline intrusion); and ocean water quality, ocean habitats, and marine life.
- D. Water Quality** – including policies and programs to protect human health and ecological integrity (e.g., Water Quality Standards [WQS], Total Maximum Daily Loads [TMDLs], National Pollutant Discharge Elimination System [NPDES] permits, green infrastructure (GI) for stormwater management, and underground injection control [UIC], wellhead protection).
- E. Working With Tribes** – including how the NWP intends to use “traditional knowledge” to help guide this *2012 Strategy* and long-term implementation of adaptation measures.

A. Infrastructure

VISION: In the face of a changing climate, resilient and adaptable drinking water, wastewater and stormwater utilities (i.e., the water utility sector) ensure clean and safe water to protect the nation’s public health and environment by making smart investment decisions to improve the sustainability of their infrastructure and operations, and the communities they serve, while reducing greenhouse gas emissions through greater energy efficiency.

The viability of drinking water and wastewater treatment and related infrastructure directly affects the protection of public and ecosystem health. Challenges driven by population growth, land-use change, aging infrastructure, availability of infrastructure funding, regulatory constraints, and various water quality stressors are already driving the water sector to take action. Climate change adds another dimension that will complicate these long-standing challenges for water sector operators and public officials. This chapter highlights how the NWP intends to continue assisting the water sector in achieving public

“Because the perception that climate fluctuates around a stationary mean is in conflict with recently observed climate dynamics, decision makers need an approach that is responsive to changes in the likelihood of extreme outcomes as well as changes in the “average” climate ... Rather than managing the resource to maintain its past condition and state, management may need to take steps to protect the resource ... or allow the resource to change as needed to adapt to climate change ... In other words the managers of these resources must work to incorporate the impact of climate change in their plans and operations.”

National Research Council, 2010d

Response to Climate Change

health and ecosystem objectives in light of climate change and these other challenges. The recently published *Principles for an Energy Water Future* (see Appendix A) underscores many of the concepts in this section.

Goal 1: The NWP works with the water utility sector to build the body of information and tools needed to incorporate climate change into planning and decision making to build the sector's adaptive capacity, reduce greenhouse gases, and deliver drinking water and clean water services.

This Goal highlights the objectives of the Climate Ready Water Utilities (CRWU) initiative to work with drinking water, wastewater, and stormwater utilities to advance their understanding of climate science and adaptation options. Through the CRWU program, the NWP intends to seek to expand the water sector's understanding of climate change risks and respond to the recommendations of the *Climate Ready Water Utilities: Final Report of the National Drinking Water Advisory Council* [NDWAC, 2010]. EPA's *Clean Water and Safe Drinking Water Infrastructure Sustainability Policy* [EPA, 2010c] also encourages water sector utilities to incorporate climate change considerations into their planning and operations, and supports the work of the CRWU initiative.

As recommended by the National Drinking Water Advisory Council (NDWAC) CRWU working group, climate change activities should be closely coordinated with other federal and state agencies, water sector associations, nongovernmental organizations, and tribes. CRWU activities also should be linked to other EPA programs, such as Climate Ready Estuaries (CRE) and Effective Utility Management (EUM). The EUM initiative is a collaborative partnership between EPA and major water sector associations and is based on a series of attributes of effectively managed utilities, including consideration of climate impacts. By coordinating with these and other programs, utilities can ensure that their climate change adaptation and mitigation approaches more readily address utility and community sustainability priorities through utilitywide planning, ongoing asset management and infrastructure repair and replacement, emergency response, and capacity development. Collaboration with the states through the State Revolving Fund (SRF) and other finance programs can also facilitate the consideration of climate change opportunities as states make infrastructure funding decisions.

Strategic Action 1: The CRWU program intends to work to improve access to vetted climate data and hydrological science, modeling and assessment tools. This action reflects the NWP's intent to incorporate climate change science and trend information into a major tool by 2015.

Water utility officials are struggling with the number and volume of climate change studies produced by federal and state agencies, water associations, universities, and others. Concurrent with utilities moving forward to address climate change challenges, there is a strong need for continued investment in advancing the understanding of climate impacts and strategies (NDWAC, 2010). The NWP intends to continue to work with federal and state partners to improve access to hydrologic science and tools, such as trend and risk assessment tools, downscaled climate modeling, and advanced planning support models and decision support tools.

CRWU intends to refine its Climate Resilience Education and Awareness Tool (CREAT) to assist water utilities with understanding potential climate change impacts and assess their risks. CREAT allows a utility to analyze how various adaptation strategies may help reduce climate risks, enabling them to prioritize the implementation of adaptation measures. CRWU also intends to improve a searchable toolbox of resources that support all stages of the decision process, from basic climate science through integration of mitigation and adaptation into long-term planning (EPA, 2011c).

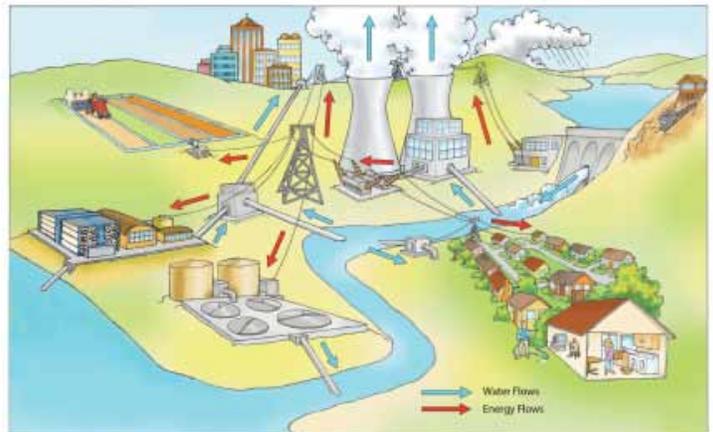
Strategic Action 2: The NWP intends to assist wastewater and drinking water treatment plants to reduce their greenhouse gas emissions and increase their long-term sustainability. The NWP intends to leverage programs such as effective utility management, sustainable asset management, and energy management, to encourage a combination of energy efficiency, co-generation and renewable energy resources.

About 80% of municipal water processing and distribution costs are for electricity, which comprises an estimated 3–4 % of national energy consumption; this percentage ranges up to 13% when residential water use is included (EPRI, 2002; EPA, 2011d). In addition, the Water Environment Research Foundation (WERF, 2010) reports that sewage typically contains 10 times the energy required to treat it, presenting an opportunity for using it as an energy source (co-generation). Becoming more energy efficient is a worthy goal for all water sector utilities and is an important step in reducing greenhouse gases and helping insulate utilities from energy costs or supply disruptions (Figure 6).

The NWP intends to continue encouraging water sector utilities to use its Energy Management Guidebook (EPA, 2008a), which uses a management systems approach to reduce energy use, along with other tools to develop sustainable energy management programs. As part of this effort, EPA intends to encourage utilities to document benefits from adopting energy management programs, such as lowering greenhouse gas emissions and operating costs. EPA has also developed a downloadable, Excel-based Energy Use Assessment Tool that can be used by small- to medium-sized systems to conduct a utility bill and equipment analysis to assess individual baseline energy use and costs (EPA, 2012b).

The NWP intends to continue to provide information on energy-efficient and co-generation technologies in consultation with other federal agencies—principally the Department of Energy (DOE)—and continue to collaborate with the EPA's Office of Air and Radiation and other

Figure 6: Water and Energy Nexus



Water and energy are intimately connected. Water is used by the power generation sector for cooling, and energy is used by the water sector for pumping, treatment, and heating. Without energy there would be limited water distribution, and without water, there would be limited energy production. Image credit: U.S. Global Change Research Program (www.globalchange.gov).

Response to Climate Change

partners to improve existing tools (e.g., ENERGY STAR's Portfolio Manager) and develop new energy benchmarking and auditing tools.

Strategic Action 3: The NWP intends to work with the states and public water systems, particularly small water systems, to identify and plan for climate change challenges to drinking water safety and to assist in meeting health based drinking water standards.

The NWP intends to continue working to enhance partnerships with states, interstates, tribes, and others to improve water sector understanding of climate change adaptation options and identify technical assistance activities to help water systems comply with National Primary Drinking Water Regulations (NPDWRs) under changing climate conditions.

CRWU intends to focus in particular on developing tools for smaller systems. While larger utilities tend to have the resources to engage technical experts for assistance with operations, management, and decision support for climate change, smaller utilities have fewer resources. Building capacity requires providing tools and assistance tailored to smaller utilities, including tools that will prepare them to adapt to the changing climate. CRWU climate change adaptation tools will augment the capacity development efforts of the EPA drinking water program to address small system challenges affecting sustainability, compliance, and day-to-day operations. The NWP also intends to encourage partnerships between water systems to ensure they are able to avoid disruptions and consistently provide safe drinking water to their customers.

Strategic Action 4: The NWP intends to collaborate with partners to promote sustainable design approaches to ensure the long-term sustainability of infrastructure and operations.

The NWP has completed *Planning for Sustainability: A Handbook for Water and Wastewater Utilities*, which provides a series of steps to help utilities voluntarily incorporate sustainability considerations into their planning. The Handbook focuses on key elements of planning, such as aligning utility sustainability goals with other community sustainability priorities in areas like housing and transportation; analyzing a range of infrastructure alternatives based on full life cycle costs, including green and natural systems; and ensuring that a financial strategy, including appropriate rate structures, is in place to fund, operate, maintain, and replace the alternatives chosen. Energy efficiency and impacts associated with climate change can be considered throughout the elements described in the handbook.

Recognizing that wastewater utilities are, in reality, resource recovery facilities, the NWP intends to work with the Water Environment Federation (WEF) and other partners to support development of an energy sustainability "roadmap." This roadmap will describe a path forward to help utilities conserve energy and become energy neutral over time. The NWP also intends to work with WEF, National Association of Clean Water Agencies, and other partners to increase public understanding of the value of biosolids as a renewable resource.

The NWP is also working with EPA's Office of Community Sustainability and three states (New York, Maryland, and California) to identify actions that can be taken to integrate the principles of the Housing and Urban Development-Department of Transportation-EPA Sustainable Communities Partnership into their Clean Water SRF programs. Options these states are consider-

ing include changes to intended use plans, project priority systems, and other funding guidance documents. Some of these changes could potentially provide incentives for projects that are energy efficient (that also help reduce greenhouse gas emissions) and/or that potentially reduce vulnerability to climate impacts. We intend to share information on the results of these pilots with other state Clean Water and Drinking Water Programs.

GOAL 2: EPA programs support IWRM in the water utility sector to sustainably manage water resources in the face of climate change.

Federal and state water resource management and protection agencies can encourage water sector utilities to establish partnerships with each other and the private sector (e.g., energy, agriculture) in the context of an IWRM framework (referred to as integrated water management in NDWAC, 2010). IWRM among water utilities and other partners can increase community resilience to climate change and expand opportunities for watershed-wide adaptive actions. The NWP, in consultation with other federal water agencies, states, interstates, and tribes, intends to consider how best to coordinate assistance to support IWRM.

Water supply management and water demand management are IWRM practices to consider, particularly where confidence in the future reliability of water supply quality or quantity is diminishing (e.g., in drought-prone, high growth, or coastal communities). The tools described below offer water sector utilities a range of methods—and there may be others—to extend their water supplies.

Many of the activities under the strategic actions for this goal can also be considered “no regrets” activities, in that they would provide benefits to utilities under current climate conditions as well as any future changes in climate.

Strategic Action 5: The NWP intends to seek opportunities to better understand and promote through technical assistance the use of water supply management strategies to increase hydrologic, ecologic, public health, and economic benefit.

Water supply management can help communities build resilience when water supplies are at risk. For example, Managed Aquifer Recharge can be used to store water in aquifers for

**Water Reuse and Recycling:
Examples of Inter-utility IWRM in the
Metropolitan Water District (MWD) of
Southern California**

- Orange County, California, recycles 70 million gallons per day (MGD) of sewage thru a \$481 million treatment plant (NY Times, 2007) as part of a Ground Water Replenishment System (Orange County Water District, 2008).
- The City of Hemet, California, in the Eastern Municipal Water District provides recycled water to supply public parks and golf courses throughout the southland (Metropolitan Water District of Southern California, 2008).
- The Hill Canyon Water Treatment Plant (WTP) releases recycled water for agricultural irrigation under an exchange agreement between Calleguas MWD and United Water Conservation District (MWDSC, 2008).
- The Thousand Oaks Tapia WTP supplies recycled water to two MWDs for municipal and agricultural irrigation (MWDSC, 2008).

Response to Climate Change

later use, and complements reuse of reclaimed wastewater to extend use, water loss control to preserve use of already treated water, and desalination to expand access to a useable resource.

Managed Aquifer Recharge: The NWP intends to work to foster research on Managed Aquifer Recharge practices that do not endanger underground sources of drinking water (USDWs). For example, Aquifer Storage and Recovery (ASR) is a process of storing water underground for future use if the injection does not endanger underground sources of drinking water. ASR is increasingly used where freshwater demand is beginning or projected to exceed supply, and use of ASR is likely to increase in drought prone areas, particularly those affected by climate change. When applied to stormwater, this practice can also reduce nonpoint source pollution of our lakes, streams, and rivers. However, the infiltration or injection of stormwater risks contamination of freshwater aquifers.

Reclamation and Reuse: The NWP intends to continue to encourage safe water reclamation and reuse. A wastewater or stormwater utility could, for example, distribute reclaimed water from a centralized treatment system for park irrigation or other uses, recognizing that additional treatment would be required for some applications. Onsite residential reuse of gray water for landscape vegetation reduces the volume of potable water delivered to the site and the volume of wastewater discharged from the centralized wastewater treatment facility. Since outdoor and non-potable water uses typically can account for more than half of all water use, this technique offers significant potential to preserve freshwater resources as well as to reduce treatment costs and energy use (EPA, 2004), and can help address increased frequency, severity, and duration of drought.

Water Loss Control: The NWP intends to provide technical assistance to reduce water loss from drinking water systems, building upon EPA's publication, *Control and Mitigation of Drinking Water Losses in Distribution Systems* (EPA, 2010d). Much of the estimated 880,000 miles of drinking water infrastructure in the United States has been in service for decades and can be a significant source of water loss. The American Water Works Association (AWWA) estimated in *Distribution System Inventory, Integrity and Water Quality* that there are close to 237,600 water line breaks per year in the United States, leading to about \$2.8 billion lost in yearly revenue (EPA, 2007).

Treated water that cannot be accounted for equates to lost revenue and requires more water to be treated, which requires more energy and chemical use, which drives up operating costs. A water loss control program improves infrastructure sustainability by reducing costs and maintaining or increasing revenue. A report by the California Public Utilities Commission (CA, 2011b) found after five years of research that repairing leaks in water distribution pipes offers the highest energy savings from nine water-related strategies assessed. Water loss control also protects public health by reducing potential distribution system entry points for pathogens (EPA, 2010c).

Desalination for Potable or Nonpotable Uses: Desalination to treat marine or brackish water is becoming increasingly important in certain locations and circumstances. Several coastal communities are piloting or using desalination plants to address increasing demand driven

by population growth or drought. These practices are increasing for inland sources for similar reasons or where water sources have been depleted. However, desalination is energy intensive, and there may be risks and costs associated with disposing of waste brines from the treatment. The NWP intends to monitor research developments to understand where efforts may be needed to ensure that the disposal of waste brines do not endanger underground sources of drinking water.

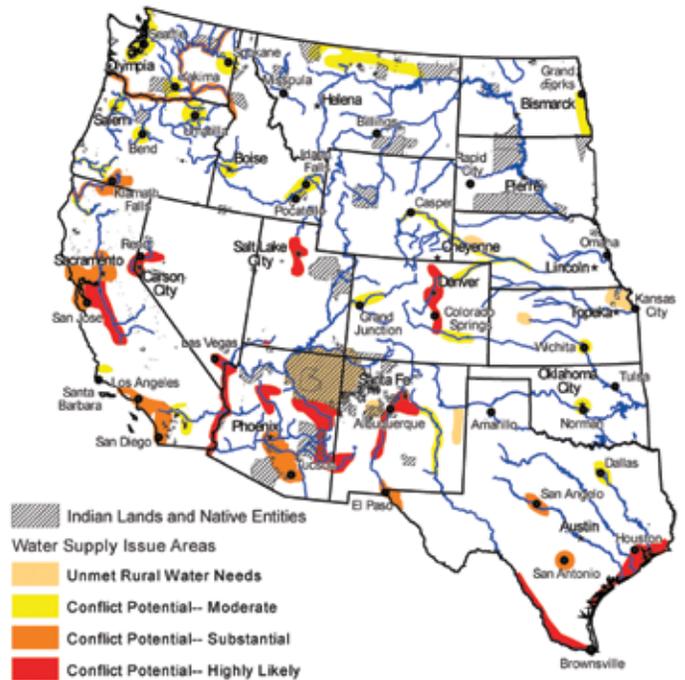
Strategic Action 6: The NWP intends to seek opportunities to evaluate, and provide technical assistance on, the use of water demand management strategies to increase hydrologic, ecologic, public health, and economic benefits.

Water demand management reduces consumption by providing information, technology, and incentives for consumers and industry to use less water. Water demand management calls for consumer education about the full cost of water services. To be sustainable, water utilities should be able to price water to reflect the full cost of treatment and delivery, as well as the cost of protecting water supplies. (Figure 7)

Metering and Metrics: The NWP intends to support the Water Workgroup of the ICCATF by working with other federal water agencies to develop sector-specific water-use efficiency metrics, and the NWP intends to continue seeking opportunities to assist water utilities in developing and deploying water metering technologies. Measuring water use enables development of conservation pricing as well as metrics for water-use efficiency. Service-connection metering informs customers about how much water they are using, and suppliers use metering to track water use and billing. It will also be of interest to see how the increasing use of real-time customer water use information changes customer behavior as it relates to water use.

Water Use Efficiency and WaterSense: WaterSense is an EPA-sponsored voluntary partnership to protect the future of our nation's water supply by bringing together local water utilities and governments, product manufacturers, retailers, consumers, and other stakeholders to decrease indoor and outdoor nonagricultural water use through more efficient products and practices. WaterSense helps consumers make water-efficient choices and encourages

Figure 7: Potential Water Supply Conflicts



USBR¹⁷¹

The map shows regions in the West where water supply conflicts are likely to occur by 2025 based on a combination of factors, including population trends and potential endangered species' needs for water. The red zones are where the conflicts are most likely to occur. This analysis does not factor in the effects of climate change, which is expected to exacerbate many of these already-identified issues.

Image credit: U.S. Bureau of Reclamation, 2005.

Response to Climate Change

innovation in manufacturing by standardizing rigorous certification criteria that ensure product efficiency, performance, and quality (EPA, 2011f). These savings at the consumer level translate to significant direct savings in operations and maintenance costs, and indirect savings in infrastructure replacement costs, for drinking water and wastewater utilities. EPA intends to continue to develop specifications for water-efficient products; encourage water efficiency in landscape design, building operations, and codes; and educate the public on the value of water use efficiency through its WaterSense program.

WaterSense has helped consumers save 287 billion gallons of water and \$4.7 billion in water and energy bills since 2006. By the end of 2011, WaterSense had partnered with more than 2,400 organizations and professionals, and more than 4,500 plumbing products had earned the WaterSense label (EPA, 2011e).

Water Pricing: The funding for daily operation and maintenance and long-term capital investments for drinking water and wastewater systems is typically generated through user fees. When measured as a percentage of household income, the United States pays less for water and wastewater bills than other developed countries. Because of this, there is a perception that water is readily available and water services are generally inexpensive. To meet our current and future infrastructure needs, public education on water sector system operations and costs, as well as private water conservation, is vital.

Pricing of water services should accurately reflect the true costs of providing high-quality water and wastewater services to consumers in order to both operate and maintain infrastructure and plan for upcoming repairs, rehabilitation, and replacement of that infrastructure. Drinking water and wastewater utilities should be able to price water services to reflect these costs, while also adjusting rates as needed to ensure that lower income communities can afford water and wastewater services.

There is an extensive body of knowledge on pricing water services and helping consumers learn about how pricing affects their community. EPA intends to continue to seek opportunities to work with our utility and state partners in identifying revenue templates that provide sufficient resources for infrastructure operations, maintenance, rehabilitation, and replacement, and send the right market signals about water use.

Strategic Action 7: The NWP intends to work to increase cross-sector knowledge of water supply climate challenges and develop watershed specific information to inform state, inter-state, tribal, and local decision making.

It is important that state and local governments and their constituents understand the nature and extent of the water challenges they face to make decisions to address them. The NWP intends to work with federal and state science agencies and academia to develop location-specific information about climate change impacts for different sectors in each watershed and aquifer. For example, EPA is participating with other federal and state water agencies and stakeholders in planning the Department of the Interior's (DOI's) National Water Census as well as its *WaterSMART* program to promote the efficient use of water (USBR, 2011). The NWP intends to also expand its effort to collaborate with the U.S. Army Corps of Engineers

as it fosters “collaborative relationships for a sustainable water resources future” (USACE, 2010a), including development of a Federal Support Toolbox to provide a common data portal to support IWRM (USACE, 2010b).

B. Watersheds and Wetlands

VISION: Watersheds are protected, maintained and restored to provide climate resilience and to preserve the ecological, social and economic benefits they provide; and the nation’s wetlands are maintained and improved using integrated approaches that recognize their inherent value as well as their role in reducing the impacts of climate change.

Healthy watersheds and wetlands will be critical to climate adaptation and mitigation. This section addresses how EPA intends to protect healthy watersheds, restore impaired watersheds to enhance climate resiliency, and preserve the important functions and ecosystem services provided by the nation’s wetlands, especially in the face of climate change.

Healthy watersheds and wetlands provide a host of ecological services, including water purification, ground water and surface flow regulation, wildlife habitat, flood and surge impact reduction, water temperature moderation, erosion control, and stream bank stabilization. In many cases, they also store carbon and sequester other greenhouse gases. These ecosystems already are threatened with a number of stressors, and climate change will exacerbate existing water quality and ecosystem management issues.

Protecting waters and watersheds inherently involves landscape-scale collaboration involving state, tribal, federal, and local partners. Such collaborations promote a holistic, systems approach, enabling partners to more cost-effectively reach shared goals that increase ecosystem resilience to climate change. In particular, the NWP intends to work to implement the National Fish, Wildlife and Plants Climate Adaptation Strategy (FWP, 2011), which lists seven goals (see Table 1).

Table 1: Draft National Fish, Wildlife and Plants Climate Adaptation Strategy

Goals:

- **Goal 1.** Conserve and Connect Habitat
- **Goal 2.** Manage Species & Habitats
- **Goal 3.** Enhance Management Capacity
- **Goal 4.** Support Adaptive Management
- **Goal 5.** Increase Knowledge & Information
- **Goal 6.** Increase Awareness & Motivate Action
- **Goal 7.** Reduce Non-Climate Stressors

FWP, 2011. Fish, Wildlife and Plants Climate Adaptation Workgroup www.wildlifeadaptationstrategy.gov

“The once seemingly separable types of aquatic ecosystems are, we now know, interrelated and interdependent. We cannot expect to preserve the remaining qualities of our water resources without providing appropriate protection for the entire resource.” *Tennessee Senator Howard Baker on the importance of the Clean Water Act on the Senate floor, 1977*

“I ask that your marvelous natural resources be handed on unimpaired to your posterity.”
Theodore Roosevelt, Sacramento, CA 1903

Response to Climate Change

The Goals and Strategic Actions in this section in particular reflect EPA's intention to implement the FWP Strategy.

GOAL 3: Identify, protect, and maintain a network of healthy watersheds and supportive habitat corridor networks across the country that provide resilience to climate change.

EPA, in partnership with others, is embarking on the Healthy Watersheds Initiative (HWI) to expand its efforts to protect healthy aquatic ecosystems using a strategic systems-based approach, prevent them from becoming impaired, and accelerate restoration (EPA, 2011g). This Initiative will greatly enhance our ability to meet the full intent and extent of the CWA 101(a) objective, "...to restore and maintain the chemical, physical, and biological integrity of the Nation's waters," and in doing so, will increase the climate resiliency of aquatic ecosystems and their watersheds. This goal would be difficult to achieve without working with our partners and their programs, such as the state-led National Fish Habitat Action Plan, the watershed protection and restoration programs of the U.S. Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), and the U.S. Forest Service (USFS), the full suite of conservation programs administered by U.S. Department of Agriculture, the U.S. Geological Survey's (USGS) Water Smart Initiative, the Nature Conservancy's Instream Flow and North America Freshwater Conservation Programs, the U.S. Army Corps of Engineers, and others.

The Healthy Watersheds approach is an important component of IWRM. IWRM offers a more holistic approach to water quality protection by addressing surface water and ground water quality and quantity as one hydrologic system. As implementation of the Healthy Watersheds approach increases our understanding of some of these relationships (e.g., hydrologic requirements of aquatic ecosystems), that knowledge will provide building blocks for the foundation of IWRM.

Strategic Action 8: The NWP intends to develop a national framework for a network of remaining healthy watersheds and aquatic ecosystems, including natural infrastructure for habitat corridors, and intends to support state and tribal efforts.

A national framework includes indicators to assess, identify, and track healthy watersheds and the success of protection measures. The NWP intends to support state and tribal efforts to conduct statewide and tribal lands integrated healthy watersheds assessments that include landscape condition (i.e., habitat corridor and floodplain connectivity and headwaters habitat intactness); hydrology; fluvial geomorphologic processes; and aquatic biology, habitat, and chemical condition. The NWP also intends to support state and tribal efforts to implement programs aimed at protecting and maintaining healthy, resilient watersheds and habitat.

Integrated Water Resources Management

Successful adaptation and mitigation of climate change impacts will require a coordinated effort among all levels of government, tribes, communities, nongovernmental groups, scientific entities and the private sector - that is, Integrated Water Resources Management. These voluntary partnerships will be essential to protecting and restoring watersheds, wetlands and coastal areas."

—Nancy Stoner, Acting Assistant Administrator,
EPA Office of Water, 2011

The NWP intends to work with partners to develop and pilot watershed projects and management practices that improve the resilience of healthy watersheds to climate change, including the demonstration of methods that preserve and protect natural hydrology, intact active river areas (TNC, 2008), aquatic habitat corridors, natural transport of sediment, and stream geomorphology. The NWP intends to provide technical decision support to local and regional planning commissions and governments for implementing programs to protect identified watersheds in the face of climate change, consistent with the IWRM objective of the ICCATF.

Strategic Action 9: The NWP intends to collaborate with federal and other partners who focus on terrestrial ecosystems and hydrology to promote consideration of potential effects of climate change on water quality and aquatic ecosystems.

Among the multitude of services derived from intact forests are protection of water resources and sequestration of carbon. The NWP intends to continue collaborating with partner agencies (including the ICCATF Fish, Wildlife and Plants Climate Adaptation Workgroup) to support their management objectives that maximize the adaptive capacity of ecosystems (e.g., through the protection of biodiversity, functional forest groups, and keystone species, and protection against invasive species) resulting in reduced vulnerability to disturbance and associated impacts to aquatic ecosystem integrity. In particular, the NWP intends to actively support and promote appropriate forest protection efforts, afforestation (new plantings) and reforestation (replanting of deforested areas) of non-forest lands, and promote and explore partnerships with working lands, land retirement, and forestry programs within other federal agencies such as those administered by the USFS and USDA's Natural Resources Conservation Service and Farm Service Agency.

For example, to date, EPA has been working directly with USFS staff in the State and Private Forestry program to promote the use of afforestation and reforestation as a component of GI, especially as it pertains to water quality protection and stormwater management. EPA has already co-developed a draft manual describing engineered approaches to afforestation and reforestation for stormwater management and has been working through the National Arbor Day Foundation to disseminate this information to arborists, local and state forestry officials, and tree planting volunteers. EPA intends to continue working with the USFS and partners such as the National Arbor Day Foundation to support these types of outreach efforts and broaden them to address the backlog of one million acres of national forests that the USFS has identified as needing replanting.

EPA has also contributed funds to USFS staff working in the EPA Chesapeake Bay Program Office in order to start up a Web-based forestry stewardship program targeting small landowners. A geo-referenced stewardship planning tool has been developed in partnership with the Pinchot Institute and is operational for three mid-Atlantic States. The tool allows private landowners to enter information characterizing landownership in order to obtain information about available federal and state programs that encourage afforestation and reforestation while providing economic benefits. Efforts are underway to expand the coverage of this tool nationwide.

Response to Climate Change

Strategic Action 10: The NWP intends to work to integrate protection of healthy watersheds throughout the NWP core programs.

Strategies that build resilience to climate change include incorporating healthy watershed protection priorities into states' continuing planning processes, promoting GI for managing stormwater, implementing the Section 404 wetlands compensatory mitigation rule, incorporating protection of healthy watersheds into funding and technical assistance programs, working with tribes, and strengthening strategic partnerships throughout EPA and the federal government, including smart growth strategies. EPA intends to encourage permitting authorities to use stormwater permits, as appropriate, to increase watershed resilience; for example, where increased use of GI or reductions in impervious cover can both address water quality issues and increase resilience to climate change. EPA intends to work with states to use the continuing planning process to develop and implement healthy watershed protection and restoration priorities.

Strategic Action 11: Increase public awareness of the role and importance of healthy watersheds in reducing the adverse impacts of climate change.

The critical ecological services watersheds and wetlands provide often go unrecognized by the public. Raising public awareness of the importance of protecting healthy watersheds will garner public support for actions needed to sustain these resources in the face of climate change.

The NWP intends to develop and implement public outreach programs emphasizing the importance of healthy watersheds, including the economic benefits of protecting and restoring watersheds, wetlands, floodplains, and riparian areas. To build support for action, the NWP intends to further articulate the climate-induced risks to aquatic ecosystems, and the associated need to enable ecosystem migration. (See for example EPA, 2011h.)

GOAL 4: Incorporate climate resilience into watershed restoration and floodplain management.

Watershed restoration and a watershed approach to floodplain management focus on re-establishing the composition, structure, pattern, and ecological processes of degraded or altered aquatic and riparian ecosystems necessary to make them sustainable, resilient, and healthy. Incorporating climate change factors into planning efforts will enable watershed strategies to be successful over the long term.

Strategic Action 12: The NWP intends to consider a means of accounting for climate change in EPA funded watershed restoration projects and encourage others funding restoration projects to take climate change and resiliency into consideration.

In partnership with other federal, state, interstate, and local water sector actors, the NWP intends to clarify and encourage implementation of existing investment flexibilities to support investments in climate resiliency in watershed restoration approaches, source water protection, GI, and joint partnerships, consistent with authorizing legislation. For example, CWA Section 319(h) grants can be used to implement nonpoint source management projects to

protect and restore watersheds, including those that are vulnerable to changing land use and/or climate change. The Section 319 grant guidance encourages partnering with other environmental programs with shared goals to leverage funding and strategically target efforts to maximize results. These partnerships are a key element to healthy watersheds protection and have the potential to be effective in meeting common goals of watershed protection across state and federal agencies.

Strategic Action 13: The NWP intends to work with federal, state, interstate, tribal, and local partners to protect and restore the natural resources and functions of riverine and coastal floodplains as a means of building resiliency and protecting water quality.

Floodplains are among the most valuable ecosystems to society, second only to estuaries. Despite representing less than 2% of Earth's terrestrial land surface area, floodplains provide approximately 25% of all terrestrial ecosystem service benefits (Opperman, 2010). Protecting and restoring the natural resources and functions of floodplains will provide numerous environmental as well as economic benefits, such as protecting water quality, enhancing ground water recharge, and ensuring base flow of streams. Buffer areas also provide for flood attenuation, allow potential shoreline and lateral stream movement, modulate water level fluctuations, and minimize impacts on infrastructure. The NWP intends to encourage sound floodplain management, including use of nonstructural measures such as GI and LID, and work with partners to enhance the use of buffers to reduce flood losses, protect riparian ecosystems, improve water quality, and build resilience. The NWP intends to discourage use of structural measures (e.g., stream channelization and levees) whenever possible.

GOAL 5: Watershed protection practices incorporate source water protection, and vice versa, to protect and preserve drinking water supplies from the effects of climate change.

Protecting public health from contaminants in drinking water will require adapting to the impacts of climate change, which poses multiple concerns for public water systems. Warmer waters foster pathogen growth, testing the reliability of drinking water disinfection and potentially increasing costs. Increased precipitation may result in additional pollutant loadings of nutrients, pesticides, and other chemicals, further challenging drinking water treatment. Sea level rise in coastal areas puts freshwater supplies for all uses, particularly drinking water, at increasing risk. Saltwater intrusion into coastal aquifers is a problem in some areas where ground water 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.

Strategic Action 14: The NWP intends to encourage states to consider updating their source water delineations, assessments or protection plans to address anticipated climate change impacts.

NWP program staff intend to continue working to assure that states include protecting drinking water supplies (ground water and surface water) in watershed planning and protection programs. States should consider the feasibility and value of periodically updating their source water protection areas and protection plans in concert with state watershed plan updates to address anticipated climate change impacts. EPA and its federal partners intend to

Response to Climate Change

explore opportunities for providing technical assistance to states as they update their source water delineations, assessments, and protection plans to address anticipated climate change impacts.

Strategic Action 15: The NWP intends to continue to collaborate with stakeholders to increase state and local awareness of source water protection needs and opportunities and encourage inclusion of source water protection areas in local climate change adaptation initiatives.

There are many players who influence the effectiveness of source water protection at the national, state, interstate, tribal, and local levels, such as water science and regulatory agencies, water sector utility operators, local decision-makers, and nongovernmental and private sector stakeholders. Acting individually, they may affect aspects of source water protection and preservation, but collaborating on the same watersheds and aquifers increases the potential to protect and preserve those resources. The NWP intends to work to foster increased collaboration to develop decision support tools to inform deliberations at the local and watershed or aquifer scale.

GOAL 6: EPA incorporates climate change considerations into its wetlands programs, including the CWA 404 program, as appropriate.

Since 1989, the federal government as a whole has embraced a policy goal of no net loss of wetlands under the CWA Section 404 regulatory program. In addition, the program operates under a goal of a net increase in the quality and quantity of the nation's wetlands. EPA's Wetlands Program fosters effective wetlands management through strategic partnerships with states, tribes, local governments, and other partners. Key to accomplishing these goals and actions is a watershed approach to aquatic resource protection.

Section 404 of the CWA establishes a program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands. Activities in waters of the United States typically regulated under this program include fill for development, water resource projects (e.g., dams and levees), infrastructure development (e.g., highways and airports), and mining projects. Section 404 requires either a permit from the U.S. Army Corps of Engineers (USACE) or an EPA-approved state program before dredged or fill material may be discharged into waters of the United States.

One basic requirement of the CWA Section 404 permitting program, as implemented by 404(b)(1) Guidelines, is that no discharge of dredged or fill material into wetlands may be permitted if a practicable alternative exists that is less damaging to the aquatic environment or if the nation's waters would be significantly degraded. Significant degradation is broadly defined in the 404(b)(1) Guidelines to include individual or cumulative impacts to human health and welfare; fish and wildlife; ecosystem diversity, productivity, and stability; and recreational, aesthetic, or economic values.

Strategic Action 16: The NWP intends to consider the effects of climate change as appropriate when making significant degradation determinations in the CWA Section 404 Wetlands Permitting and Enforcement Programs.

In light of the growing concerns regarding the adverse effects of climate change and the recognition that protecting the nation's wetlands and other aquatic resources can help mitigate these effects, EPA intends to coordinate with USACE to better understand how climate change may impact Section 404 sites and if/how the systematic consideration of climate change impacts could be incorporated into decision processes (including minimization and compensatory mitigation practices) in a scientifically and legally defensible way. EPA's Section 404 permit review process also includes determining if there would be a "substantial and unacceptable" impact to Aquatic Resources of National Importance (ARNI), as provided in Part IV of the 1992 CWA Section 404(q) Memorandum of Agreement between EPA and the Department of the Army, often called the elevation procedures. Criteria used for identifying an ARNI could potentially consider the chemical, physical, and biological importance, in light of climate change, of an aquatic resource proposed to be impacted. In partnership with USACE, the NWP also intends to consider how to incorporate the anticipated effects of climate change, as appropriate, when determining whether impacts are "unacceptable" (e.g., where discharges would result in harm to wetlands critical to storm surge reduction).

Strategic Action 17: The NWP intends to evaluate, in conjunction with relevant Federal Agencies when applicable, including USDA, USFWS, and the USACE, how wetland and stream compensation projects could be selected, designed, and sited to aid in reducing the effects of climate change.

Consistent with established regulatory policy, impacts must be compensated for "to the extent appropriate and practicable" after they are avoided and minimized to the greatest extent practicable. As an example, in order to offset permitted impacts, the Corps typically requires between 40,000 and 50,000 acres of compensatory mitigation annually. This compensation takes the form of restored, created, enhanced, and/or preserved complexes of wetlands and streams. EPA, in conjunction with the Corps, intends to consider how these wetland and stream compensation projects could be selected, designed, and sited to aid in reducing the impacts of climate change, with a focus on analyzing climate change and associated relative sea level change for coastal mitigation projects. For example, certain types of wetland mitigation projects might be encouraged in the future because of their scientifically assessed relative carbon sequestration benefits or because siting mitigation projects in coastal zones would facilitate wetland migration as sea level rises while also enhancing the natural lines of defense ("resilience") of the coastline and community and creating public green space that enhances the livability and sense of place of the community.

GOAL 7: EPA improves baseline information on wetland extent, condition, and performance to inform effective adaptation to climate change.

Baseline information on the location, extent, and quality of wetlands and aquatic resources will help to measure changes caused by climate change and other stressors. Ongoing monitoring will inform the development of predictive models and management strategies, including for climate change adaptation.

Strategic Action 18: The NWP intends to expand wetland mapping by supporting wetland mapping coalitions and training on use of the new Federal Wetland Mapping Standard.

Response to Climate Change

While Agency conclusions should be informed by detailed, accurate data sources, the existing National Wetland Inventory (NWI) mapping, managed by the USFWS, is a good initial guide about potential wetlands in an area/watershed and is used extensively, including to address the effects of climate change (e.g., modeling relative sea level rise). The NWI maps were innovative when first produced, but additional work is now needed to update these maps to make them current and to better satisfy the demands for sophisticated analysis that supports effective environmental planning. Hardcopy maps are available for approximately 4/5 of the nation, and approximately half of the NWI is available online for use in geographic information system (GIS) applications. However, a significant portion of the arid Western United States has not yet been mapped.

The modernized Wetlands Mapping Standard was developed by the interagency Federal Geographic Data Committee (FGDC), in collaboration with representatives of federal agencies, states, tribes, environmental organizations, and management associations, as well as local government associations from both the wetlands and geospatial communities. The Wetland Mapping Standard was developed to improve and standardize mapping data quality in order to accelerate the rate at which the national wetlands mapping is completed and to enable real-time updates of the national wetlands data layer in the future. Using the new Standard, other groups, such as states, tribes, local governments, and nongovernmental organizations, are able to collect and upload digitally mapped data to the NWI. EPA and other federal agencies intend to train and support a range of organizations to complete the national map.

Strategic Action 19: The NWP intends to produce a statistically valid, ecological condition assessment of the nation's wetlands.

The National Wetland Condition Assessment (NWCA) will be an integrated gauge of wetland condition nationwide, summarizing the cumulative effects of federal, state, interstate, tribal, and local government and private-party actions that either degrade wetlands or protect and restore their ecological condition. The NWCA will be repeated at the national scale every five years and will incorporate those indicators that EPA identifies as most meaningful to detecting and predicting the impacts of climate change on the condition of the nation's wetlands.

EPA worked closely with the USFWS Wetlands Status and Trends program to utilize its network of analysis plots as the sampling frame for the NWCA. When these efforts are paired, we will for the first time be able to measure progress toward the national goal to increase the quantity and quality of the nation's wetlands (Figure 8).

Figure 8: National Wetland Condition Assessment Site Locations



Approx. 1,000 randomly selected wetland sites sampled in 2011. National Wetland Condition Assessment, EPA, 2011n.

Wetland quality or condition speaks to how wetlands differ from their “natural” state, providing an assessment of the overall ecological integrity of the resource and the relative status of wetland processes, such as the ability of a wetland to absorb nutrients. In addition, the NWCA will identify the stressors most associated with degraded wetland condition because they provide insights into the causes of declining wetland quality.

“Wetlands are inextricably tied to water levels and changes in climatic conditions affecting water availability will greatly influence the nature and function of specific wetlands, including the type of plant and animal species within them.”

Secretary of the Interior Ken Salazar, announcing availability of the new wetland mapping standard.
August 18, 2009

Strategic Action 20: The NWP intends to work with partners and stakeholders to develop information and tools to support long term planning and priority setting for wetland restoration projects.

Wetlands have the potential to provide added benefits for climate change adaptation as well the potential to store and sequester carbon. The NWP intends to work with partners and stakeholders to share evolving

information and tools to encourage consideration of climate change in long term planning and priority setting for wetlands management strategies and sustainable restoration projects.

C. Coastal and Ocean Waters

VISION: Adverse effects of climate change along with collective stressors and unintended adverse consequences of responses to climate change have been successfully prevented or reduced in the ocean and coastal environment. Federal, tribal, state, and local agencies, organizations, and institutions are working cooperatively; and information necessary to integrate climate change considerations into ocean and coastal management is produced, readily available, and used.

Coastal and ocean environments are inextricably linked, both spatially and ecologically. This section borrows the concept of the “baseline” (a legal demarcation of ordinary low tide levels that also crosses river mouths, the opening of bays, and along the outer points of complex coastlines) to facilitate the discussion of strategies that may be more applicable to coastal environments (which we loosely define as being on the landward side of the baseline) or ocean environments (seaward of the baseline). The baseline may affect climate change strategies because of its jurisdictional implications relevant to governmental authority. However, although the terms “coastal” and “ocean” are used primarily to organize this discussion, we recognize that those domains grade into each other and that some strategies may be appropriate on both sides of the baseline.

As in other regions, coastal areas will face challenges to wetlands, watersheds, infrastructure, water quality, and drinking water. Some coastal problems, such as nonpoint source pollution and changing precipitation patterns, have the same causes and effects that are found in inland places.

Response to Climate Change

However, the ocean and coasts will experience unique impacts that the rest of the terrestrial United States will not. Sea level rise is already a multi-faceted problem that is worsening (Figure 9). Coastal wetlands and other estuarine habitats are being inundated or eroded, and many will not be able to sustain themselves as sea levels continue to rise. The potential for ocean acidification to damage the marine food chain, shellfish, and coral is another issue unique to the coastal and ocean environment. Coastal regions will also experience saltwater intrusion into ground water aquifers, the threats of rising seas to drinking water and wastewater infrastructure, and the effects of varying stream flow on estuarine salinity and ecology.

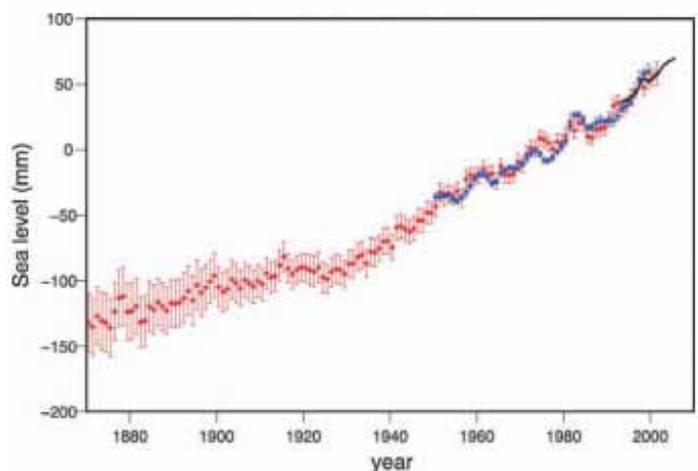
Scientific research over the last 10 years indicates that the adverse implications of ocean acidification (OA) for ocean and coastal marine ecosystems are potentially very serious because the ocean has a large capacity to absorb CO₂ from the atmosphere, and thus the resulting lowered pH levels in ocean waters can have serious cascading effects. In its 2010 report, *"Ocean Acidification: A National Strategy to Meet the Challenges of a Changing Ocean,"* the NRC (NRC, 2010f) concludes that ocean chemistry is changing at an unprecedented rate and magnitude due to human-made CO₂ emissions, and that there will be "ecological winners and losers." The report also states that "while the ultimate consequences are still unknown, there is a risk of ecosystem changes that threaten coral reefs, fisheries, protected species, and other natural resources of value to society".

Climate change impacts will in some respects be one more stressor that EPA's partners and programs will try to absorb or accommodate into their practices and portfolios. It will be important for EPA and the NWP to avert or resolve as many of the foreseeable climate adaptation problems as possible, while also preventing harm from responses to climate change that inadvertently increase vulnerability rather than reducing it.

However, in some parts of the country, such as parts of the Pacific Northwest, sea level rise is offset by coastal uplift. Such relative sea level decreases can offset absolute sea level rise and present benefits that enhance wetland preservation in coastal zones.

How others respond to the inevitable climate change impacts on coastal and ocean waters will have a large impact on EPA's ability to achieve or fulfill its mission. EPA intends to cooperate with other interested parties and work to enhance the adaptive capacity of our partners

Figure 9: Sea Level Rise



Annual, global mean sea level as determined by records of tide gauges (red and blue curves) and satellite altimetry (black curve) (NRC 2010c).

to effectively meet the coming 21st century environmental tests. We intend to work in close concert with local, state, tribal, and regional organizations and other federal partners through the wide range of existing programs and partnerships like the National Estuary Program (NEP), Large Aquatic Ecosystems (LAE), Great Waterbodies, and regional ocean groups. Working cooperatively with Canada and Mexico will also be critical if we are to be successful in near ocean environments.

Table 2: National Ocean Policy Implementation Plan Key Elements (NOC, 2011)

1. Ecosystem-based Management
2. Inform Decisions and Improve Understanding
3. Observations, Mapping, and Infrastructure
4. Coordinate and Support
5. Regional Ecosystem Protection and Restoration
6. Resiliency and Adaptation to Climate Change and Ocean Acidification
7. Water Quality and Sustainable Practices on Land
8. Changing Conditions in the Arctic
9. Coastal and Marine Spatial Planning

Similarly, the NOC has drafted an Implementation Plan for a new, comprehensive National Ocean Policy established by Executive Order 13547 on “Stewardship of the Ocean, Our Coasts, and the Great Lakes.” Following extensive stakeholder and expert input, the Plan is nearing completion in 2012. It describes a framework for federal agencies to work together to pursue common marine stewardship goals with cohesive actions, and to engage state, tribal, and local authorities; regional governance structures; nongovernmental organizations; the public; and the private sector. Table 2 lists the National Ocean Policy’s nine priorities, which include Resiliency and Adaptation to Climate Change and Ocean Acidification. Upon release, the Implementation Plan will identify specific Actions and milestones for each priority, in addition to

naming the federal agencies supporting those commitments. The Goals and Strategic Actions in this section reflect some of EPA’s intent to implement actions under Element 6, Resiliency and Adaptation to Climate Change and Ocean Acidification, as well as other parts of the plan.

GOAL 8: The NWP works collaboratively with partners so that the information and methodologies necessary to address climate change in ocean and coastal areas are collected or produced, analyzed or formatted, promoted, and easily available.

Protecting coastal and ocean environments from the adverse impacts of climate change will depend on policymakers and managers having the relevant information to make effective decisions. As the problems of climate change emerge and multiply, the need for knowledge will become even more pressing. Further, the NWP and our partners will need to know where to find the necessary information and tools. Agencies cannot afford to duplicate efforts and will need to work together to improve efficiency and leverage limited resources.

Strategic Action 21: To protect ocean and coastal areas, the NWP intends to collaborate within EPA and with other federal, tribal, and state agencies to ensure that synergy occurs whenever possible, lessons learned are transferred, federal efforts effectively help local communities and are not duplicative or working at cross-purposes.

Integrated Water Resources Management

As changing climates affect the decisions of water supply managers, coastal issues will be one more consideration. Managers are already balancing competing demands for in-stream ecological functions, water supply in reservoirs, water supply for downstream users, and power generation. Flows passing downstream have an effect on sediment delivery to coastal systems, the salinity structure of coastal estuaries, and how far upstream the salt front can push.

The management of coastal waters can benefit from an IWRM perspective. Issues may arise, for example, due to diversion of fresh surface water to recharge coastal aquifers, reducing flows needed for healthy coastal estuaries. Similarly, the disposal of residual brines where desalination is implemented to provide fresh water will also need attention.

Ensuring that lessons learned are transferred among the many partner federal agencies will maximize the utility and accessibility of new information and methodologies needed by tribal, state, and local communities to effectively prepare for climate change impacts.

Some federal agencies have already formalized cooperative mechanisms through written agreements. For example, EPA and NOAA have signed a Memorandum of Agreement to work together on climate adaptation, resilience, and smart growth efforts. In the New England region, a “Statement of Common Purpose” exists among federal agencies working together on climate change adaptation and mitigation and coastal and marine spatial planning. Similar agreements to coordinate with other federal agencies in the coastal zone, such as many DOI agencies (e.g., USGS, National Park Service, USFWS, Bureau of Ocean Energy Management), the Federal Emergency Management Agency (FEMA), USACE, DOT, and USDA (among others), would also be helpful.

Strategic Action 22: The NWP intends to work within EPA and with the U.S. Global Change Research Program and other federal, tribal, and state agencies to collect, produce, analyze, and format knowledge and information needed to protect ocean and coastal areas and make it easily available.

The NWP intends to work within EPA; with the USGCRP; and with other federal, tribal, and state agencies to produce relevant knowledge and information that informs decision-making, and to make it available in user-friendly formats through compendiums, websites, and clearinghouses. Information needed that is specific to coastal and ocean planning includes:

- Projections of relative sea level change at finer scales, including Light Detection and Ranging (LIDAR) land elevations.
- Information on ocean acidification and warming.
- Monitoring of environmental effects and system thresholds specific to the coastal and marine environments.
- Improvements in the ability to quantify real reductions of CO₂ due to salt marsh and coastal restoration.

EPA intends to continue to share similar information through portals such as ocean.data.gov and federal climate clearinghouses, such as the one under development by the USGCRP.

Please also see Strategic Action 44: Monitor climate change impacts to surface waters and ground water.

GOAL 9: Support and build networks of local, tribal, state, regional and federal collaboration partners that are knowledgeable about climate change effects and take effective adaptation measures for coastal and ocean environments through EPA's geographically targeted programs.

EPA's Large Aquatic Ecosystem Programs

- Chesapeake Bay Program
- Columbia River Basin
- Great Lakes
- Gulf of Mexico Program
- Lake Champlain Basin Program
- Long Island Sound Study
- Pacific Islands Office
- Puget Sound—Georgia Basin
- San Francisco Bay Delta Estuary
- South Florida Geographic Initiative

A primary role of the federal government will be to work within our existing networks to build adaptive capacity at the regional, state, tribal, and local levels.

Strategic Action 23: The NWP intends to work with the NWP's larger geographic programs to incorporate climate change considerations focusing on both the natural and built environments.

Geographically based programs in which EPA participates include 10 large aquatic ecosystems, Regional Ocean Partnerships, and regional planning bodies established under the National Ocean Council. The NWP intends to work to provide these key geographic programs with tools necessary to consider climate change effects in their plans and programs. EPA regional and geographic program offices and the Council of LAEs all intend to play key roles

addressing climate change impacts to both the natural and built environments when making policies or decisions, and intend to work to ensure that best practices and lessons learned from local projects are widely shared.

The NWP intends to continue working with Regional Ocean Partnerships that undertake planning for resiliency. According to the Coastal States Organization's website, "[t]here is an ever-growing recognition that multi-state, regional approaches are one of the most effective and efficient ways to address many of our ocean and coastal management challenges. To meet these challenges, governors around the country have voluntarily established Regional Ocean Partnerships and are working in collaboration with federal agencies, tribes, local governments, and nongovernmental and private sector stakeholders to identify shared priorities and coordinate ocean and coastal management on a regional basis. While each partnership is unique in terms of its region's issues and concerns, they all share a desire for more effective management of ocean and coastal resources. This includes balancing ecological and economic needs,

Regional Ocean and Great Lakes Partnerships

- Great Lakes Regional Collaboration
- Governors' South Atlantic Alliance
- Gulf of Mexico Alliance (GOMA)
- Mid-Atlantic Regional Council on the Ocean (MARCO)
- Northeast Regional Ocean Council (NROC)
- West Coast Governors' Agreement on Ocean Health

Response to Climate Change

and addressing climate change, through such approaches as ecosystem based management, and coastal and marine spatial planning.” [CSO, 2011]

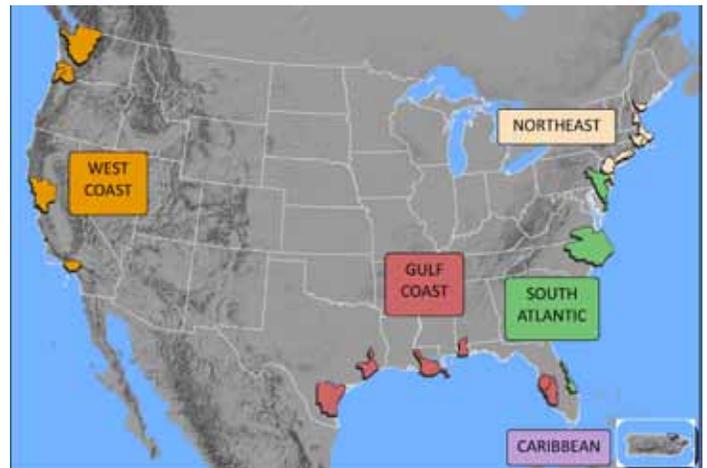
The NWP intends to also collaborate with the NOC’s Regional Planning Bodies established under the National Ocean Policy’s framework for effective Coastal and Marine Spatial Planning (CMSP) (see Executive Order 13547, *Stewardship of the Ocean, Our Coasts, and the Great Lakes*). The regional planning bodies implement the framework for CMSP, leading to the eventual development of regional, coastal, and marine spatial plans that will guide and inform Agency decision-making under existing statutory authority. The NWP intends to inform the CMSP process and the development of plans to implement two priority objectives: 1) Coastal and Marine Spatial Planning (which is driven in some areas by the demand for offshore renewable energy development), and 2) Resiliency and Adaptation to Climate Change and Ocean Acidification.

Strategic Action 24: Address climate change adaptation and build stakeholder capacity when implementing NEP Comprehensive Conservation and Management Plans and through the Climate Ready Estuaries Program. Each Program intends to build its stakeholders’ adaptive capacity through funding, technical assistance, and coordination.

The 28 NEPs around the country improve the quality of estuaries of national significance through community-based programs. NEPs are strategically positioned to build the adaptive capacity of stakeholders because they work directly with and within communities. In fact, many of the NEPs have specific goals in their Comprehensive Conservation and Management Plans (CCMPs) addressing climate change adaptation (Figure 10).

The Climate Ready Estuaries (CRE) program, which is jointly administered by EPA’s Office of Water and Office of Air and Radiation, provides funding or direct technical assistance to help NEPs complete climate change vulnerability assessments and to build their adaptive capacity to respond to climate change. CRE intends to continue to expand its information and guidance offerings and to develop and share the lessons learned from its sponsored projects. Incorporating CRE tools and methods into the NEP base programs by mainstreaming climate change adaptation into planning documents (e.g., CCMP or annual work plans) is expected to ensure that climate change is considered by all NEPs, and helps to prepare communities to respond to climate change impacts. Many other organizations also manage coastal and ocean resources in or near NEP watersheds, so CRE intends to work collaboratively with other EPA programs (e.g., CRWU), federal agencies (e.g., NOAA’s National Estuarine Research Reserves and Sea Grant,

Figure 10: NEP Study Areas



<http://water.epa.gov/type/oceb/nep/index.cf>

USDA's conservation planning activities), land trusts, and other nonprofit coastal organizations to build mutually supportive networks.

Strategic Action 25: The NWP intends to conduct outreach and education, and provide technical assistance to state and local watershed organizations and communities to build adaptive capacity in coastal areas outside the NEP and LAE programs.

All coastal areas, including regions outside NEP and LAE watersheds, should build their adaptive capacity to reduce adverse effects of climate change. The NWP can support the work of states and local watershed organizations by providing technical assistance or educational support that leverages the work of EPA's CRE and other geographic programs and partnerships. Communication will also help minimize the selection of responses to climate change that may work at cross-purposes, or have unintended adverse consequences.

GOAL 10: The NWP addresses climate driven environmental changes in coastal areas and provides that mitigation and adaptation responses to climate change are conducted in an environmentally responsible manner.

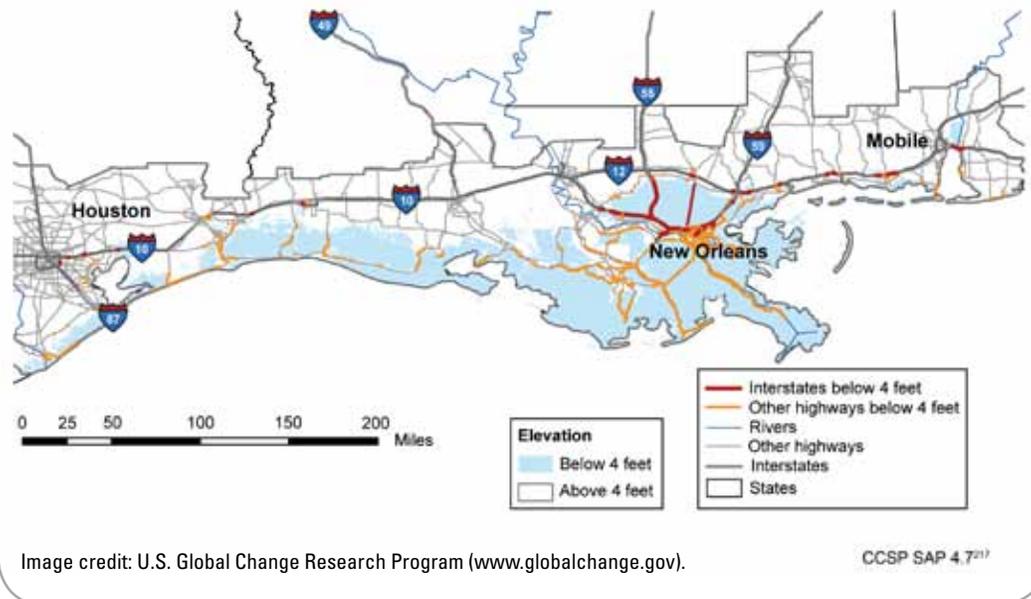
Impacts of climate change have greater consequences in coastal areas because so much of the country's population and economic infrastructure are located in those areas. Coastal areas will see greater demand for storm protection and erosion control. Strategies are needed to protect and enhance the natural environment while working toward a sustainable built environment that is prepared for climate impacts.

Coastal waters have the same potential problems with invasive species and water quality that all waters and watersheds have, in addition to marine-specific challenges such as ballast water discharges from commercial shipping. Changing precipitation patterns will affect runoff, nonpoint source pollution, and combined sewer systems, and warmer waters may foster increases in algal blooms and hypoxic conditions, decreasing the quality of waters for recreational uses such as swimming and other water sports that are extremely important in coastal areas. Warmer water will also likely worsen the already increasing occurrences of harmful algal blooms and other aspects of water quality, including the expansion in the range of many invasive species already present in U.S. waters, such as zebra mussels. Increasing temperatures in water bodies such as Lake Superior may allow organisms that have established in the other four Great Lakes to more easily establish in Superior's waters. Water bodies that were previously not receptive to invasion by many transoceanic invaders may become more habitable to those organisms.

Coastal wetlands, like all wetlands, are dependent on suitable hydrologic conditions. Climate change will severely challenge the resilience of coastal wetlands. Altered salinity from sea level rise and changing hydrometeorology will threaten coastal ecology. Geologic history and geomorphic research suggest that coastal wetlands will have a very hard time surviving at accelerated rates of sea level rise. Where salt marshes have limited sediment supplies, they will probably not be able to accrete enough material to stay above rising water level. As the intertidal zone shifts upward and landward, the area that can sustain salt marshes will shrink—in places where topography, coastal development, or insular layout prevents ecosystem shifts, marshes may disappear entirely. Some salt marshes may be able to become established

Response to Climate Change

Figure 11: Infrastructure Risk from Sea level Rise



upstream as the salinity changes; however, they are likely to replace freshwater tidal marshes, not to establish new wetland habitats. Both freshwater and salt marshes also are subject to changing temperature and precipitation that may affect the ability of existing species to continue to thrive.

Sea grasses are another very important aquatic resource that is vulnerable to climate change. Sea grass beds serve as critical habitat for juvenile life stages of many marine species. Most sea grass species live in a narrow strip of shallow coastal water and are extremely sensitive to changes in water clarity that control how much sunlight they receive. Warmer water, increased water depth, and turbidity from soil erosion caused by extreme precipitation and other storm events can all reduce water clarity and adversely impact the survival of sea grasses.

Strategic Action 26: The NWP intends to work collaboratively to support coastal wastewater, stormwater and drinking water infrastructure owners and operators in reducing climate risks and will encourage adaptation in coastal areas.

Impacts of climate change will threaten all types of coastal infrastructure, but the water sector is particularly at risk. Sea level rise and coastal subsidence, storms and storm surge, flooding and coastal erosion, saltwater intrusion into coastal aquifers, and increasing water temperatures all threaten wastewater and drinking water treatment facilities, conveyance systems, and utility operations (See Figure 11).

Stormsmartcoasts.org

...was established by the Gulf of Mexico Governor's Alliance with startup funding from NOAA and a 3-year EPA grant to expand it. Smartcoasts provides a platform for the open exchange of information among states, communities, counties, and others. A Community of Practice for Climate Change includes 100 members across the Gulf region from Sea Grant programs, NOAA, EPA, FEMA, the five Gulf of Mexico states, counties, parishes, communities, and universities.

National Water Program 2012 Strategy

EPA's CRWU and CRE programs intend to continue working together to provide coastal managers and infrastructure operators with planning support and technical assistance to help reduce climate risks and encourage adaptation. The NWP also intends to consider new approaches for ensuring that financial assistance to the water sector is used in ways that increase resiliency, reduce vulnerability, and avoid adverse unintended consequences.

Strategic Action 27: The NWP intends to work collaboratively to support climate readiness of coastal communities, including hazard mitigation, pre-disaster planning, preparedness, and recovery efforts.

Climate change impacts such as sea level rise and increased storm intensity will exacerbate existing coastal hazards. Flooding, wind, waves, and storm surge that damage coastal communities can directly affect water quality, as well as damage water infrastructure.

To avoid such problems and minimize the need for emergency response, the NWP intends to work within EPA and with other federal, tribal, and state agencies to provide technical assistance to coastal communities for hazard mitigation and pre-disaster planning. After a disaster, recovery and rebuilding efforts should avoid choices that reproduce previous vulnerabilities. EPA's CRWU, CRE, and Sustainable Communities programs intend to collaborate to provide local communities with planning tools to improve resiliency to natural hazards as well as to bring other economic, environmental, and quality of life benefits. FEMA is a critical federal partner; in 2010, EPA and FEMA signed a Memorandum of Agreement that will make it easier for the two agencies to collaborate to help communities recover from disasters and better plan for future resilience, including for climate change adaptation (EPA, 2011i). The NWP also intends to coordinate with NOAA's Storm Smart Coasts program to maximize efficiencies in delivering tools and other information to local communities. These programs will assist with vulnerability analyses and help to develop and implement hazard mitigation strategies.

Local projects supported by EPA grants may be affected by climate change impacts. EPA intends to provide advice on how funding recipients can include an assessment of adaptation and mitigation measures in their planning for federally funded projects.

Strategic Action 28: The NWP intends to support preparation and response planning for a diverse array of impacts to coastal aquatic environments.

The sea, the great unifier, is man's only hope. Now, as never before, the old phrase has a literal meaning: We are all in the same boat.

— Jacques Cousteau

Coastal upland, wetland, and aquatic ecosystems and resources have evolved over centuries and millennia. They are stressed by human uses and activities and invasive species, and now face further stress from a full range of climate change impacts, including threats such as sea level rise that are unique to coastal areas.

NWP base programs and initiatives will need to be cognizant of threats to coastal water quality. While extensive expertise in restoration planning resides within EPA and at other agencies and organizations, there is a need for decision support tools to help answer challenging questions about whether restoration is viable or whether alternative strategies should be pursued in certain places. Protecting water quality and aquatic habitats such as sea grass beds may

Response to Climate Change

require innovative actions like ensuring that the volume and quality of freshwater inflows into estuaries are maintained. In the context of coastal change and sea level rise, decisions about coastal marshes may need to consider long-term viability and replenishment costs. The NWP intends to use existing partnerships and networks, such as the Interagency Coastal Wetlands Workgroup, Coastal America, the National Dredging Team, and other interagency planning groups, to promote the consideration of sea level change and other climate change impacts in coastal habitat restoration planning. The National and Regional Dredging Teams intend to promote the beneficial use of suitable dredged material for maintaining and restoring coastal marshes and other habitats.

In addition, “Blue Carbon” is an emerging concept that refers to the ability of aquatic ecosystems to sequester CO₂. Should emissions trading practices take hold that include Blue Carbon, the use of external funding from private sector CO₂ emissions offsets might become a useful strategy for funding restoration or creation of sustainable coastal habitats. Care should be taken, however, to ensure that other ecosystem services do not suffer if some aquatic environments are managed strictly for their ability to sequester CO₂.

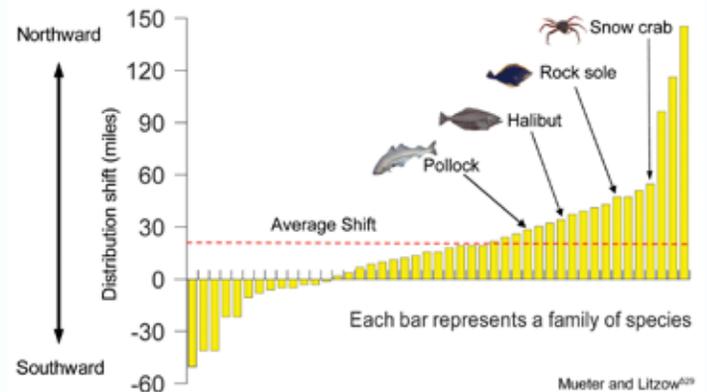
GOAL 11: Protect ocean environments by incorporating shifting environmental conditions and other emerging threats into EPA programs.

Protecting the ocean environment from adverse impacts of climate change is critical to human well-being because the ocean provides food, regulates our weather, and offers numerous opportunities for renewable energy, among many other benefits. Society will also be tempted to look to the oceans for seemingly simple solutions. It is important that strategies to reduce carbon dioxide levels in the atmosphere do not impose long-term costs on ocean waters, and that the many uses of marine spaces are responsibly balanced. (Figure 12)

Strategic Action 29: The NWP intends to consider climate change impacts and associated impacts (e.g., ocean acidification, nitrogen and phosphorus pollution) on marine water quality in its ocean management authorities, policies, and programs.

Climate change impacts to the ocean environment, including temperature increases, increased pollutant runoff, and hazardous algal blooms, as well as increases in ocean/coastal acidity, hazardous algal blooms, and spread of invasive species, add pressure to already stressed systems.

Figure 12: Observed Northward Shift of Marine Species in the Bering Sea Between the Years 1982 and 2006



As air and water temperatures rise, marine species are moving northward, affecting fisheries, ecosystems, and coastal communities that depend on the food source. On average, by 2006, the center of the range for the examined species moved 19 miles north of their 1982 locations.

The National Coastal Conditions Report that describes the ecological and environmental conditions in U.S. coastal waters will incorporate climate change impacts into its evaluation. EPA issued a Memorandum (EPA, 2010e) that recognized the seriousness of aquatic life impacts associated with ocean acidification and described how states can move forward, where ocean acidification information exists, to address it during the CWA 303(d) listing cycle using the current 303(d) Integrated Reporting (IR) framework. Additional guidance may be necessary as improved monitoring and assessment information becomes available. If other climate change impacts on ocean environments substantially affect water quality, such as dissolved oxygen and temperature, then the NWP intends to respond to them as well (USGCRP, 2008).

Strategic Action 30: The NWP intends to use available authorities and work with existing regional ocean governance structures, federal and state agencies, and other networks so that offshore renewable energy production does not adversely affect the marine environment.

Federal and state agencies are exploring offshore renewable energy production as a means to reduce the production of GHGs and increase energy independence. The NWP believes it is vital that the installation of renewable energy infrastructure (e.g., offshore wind turbines or wave energy systems, transmission cables, and shore-based facilities) be conducted in an environmentally responsible manner that does not result in unintended adverse consequences.

Relevant statutory authorities administered by the NWP include the National Environmental Policy Act (NEPA), the Marine Protection Research and Sanctuaries Act (MPRSA), and the CWA.

It will be particularly important to partner with and engage Regional Ocean Partnerships and EPA's geographic programs (e.g., Chesapeake Bay, Long Island Sound, Gulf of Mexico, NEPs), as well as other federal agencies, states, and tribes, and to participate in CMSP. CMSP is a comprehensive, adaptive, integrated, ecosystem-based, and transparent spatial planning process, based on sound science and intended to foster collaboration about how the ocean, coasts, and Great Lakes should be sustainably used and protected now and for future generations. Various sections of the CWA may apply to offshore energy facilities.

Strategic Action 31: The NWP intends to support the evaluation of sub-seabed sequestration of CO₂ and any proposals for ocean fertilization.

EPA intends to work with other agencies and the international community to provide technical assistance on sub-seabed carbon sequestration and coordinate with federal partners in addressing proposals for carbon sequestration in the sub-seabed or other proposals, such as potential fertilization of the ocean, including any applicable permitting that may be required under the MPRSA or the UIC program.

Carbon dioxide sequestration in sub-seabed geological formations, for example, involves separation of carbon dioxide from industrial and energy-related sources, transport to and injection into an offshore geological formation, and long-term isolation from the atmosphere. The NWP believes it is vital that the new technologies are responsibly deployed to protect the marine environment and avoid risks to coastal populations and habitats.

Response to Climate Change

Strategic Action 32: The NWP intends to participate in the interagency development and implementation of federal strategies through the National Ocean Council Strategic Action Plans and the ICCATF.

Many federal agencies manage or use coastal and ocean resources to support commerce, maintain national security, and ensure environmental sustainability. The NWP intends to participate in development and implementation of federal strategies so that coastal and ocean environments are protected and are prepared for climate change adaptation and mitigation, especially through the NOC. The National Ocean Policy identifies nine priority objectives, including to “strengthen resiliency of coastal communities and marine and Great Lakes environments and their abilities to adapt to climate change impacts and ocean acidification” and “increase knowledge to continually inform and improve management and policy decisions and the capacity to respond to change and challenges.” The NOC is developing a strategic action plan for this objective that will also serve as the National Action Plan (NAP) for Oceans and Coasts under the ICCATF. The NWP intends to continue to participate in writing and implementing this strategic action plan.

D. Water Quality

VISION: Our Nation’s surface water, drinking water, and ground water quality are protected, and the risks of climate change to human health and the environment are diminished, through a variety of adaptation and mitigation strategies.

This section focuses on the NWP’s strategy for responding to climate change impacts on water quality, using both regulatory and nonregulatory controls. Regulatory controls include WQS, TMDLs, and the NPDES, as well as drinking water regulations such as the UIC program. Nonregulatory controls include promotion of GI and LID strategies and other collaborative approaches. (Larger landscape strategies are covered in the Watersheds and Wetlands section). This section also discusses strategies for maintaining water quality while encouraging the adoption of alternative sources of energy and fuel technologies that reduce greenhouse gas emissions.

GOAL 12: The NWP protects waters of the United States and promotes management of sustainable surface water resources under changing climate conditions.

As detailed in the *2008 Strategy*, climate change is expected to impact surface waters in several ways, affecting both human health and ecological endpoints. For example, it is projected that warmer air temperatures in many locations will heat surface water temperatures to levels that will decrease the water’s ability to hold dissolved oxygen, leading to growth of harmful algal blooms and hypoxia. Warmer air temperatures may also lead to more evaporation, which could cause lower flows and higher salinity, as well as higher concentrations of other substances. Lower flows and greater salinity would likely cause an increase in impaired waters, even if actual pollutant loadings from dischargers do not increase. In many parts of the country, precipitation events are expected to become more extreme, increasing runoff with associated increases in pollutant loads, increasing variability of streamflow and associated sedimentation, and expanding flood risk.

Strategic Action 33: The NWP intends to encourage states and communities to incorporate climate change considerations into their water quality planning.

Sensitivity to impacts combined with adaptive capacity is a measure of vulnerability, and understanding vulnerability is necessary as the basis for adaptation planning. That is, the extent of climate change impacts on different ecosystems, regions, and sectors will depend not only on their sensitivity to climate change, but also on their adaptive capacity or resiliency. In order to facilitate adaptation of water programs and increase resiliency of water resources, states and tribes can use existing water quality and watershed planning programs and resources (e.g., CWA Sections 106, 604(b) and 319(h) planning funds) to conduct detailed assessments or develop plans to increase their adaptive capacity and prioritize adaptive responses. For example, agencies or local or interstate planning organizations can use section 604(b) funds to address climate change as part of comprehensive water quality planning efforts.⁵ In addition, the CWA Section 319(h) grant program can be an important resource to states for implementing

For more information on how NWP intends to work to protect the quality and resilience of watersheds, please see Goal 3, Strategic Action 10 in the Watersheds and Wetlands section, page 39.

Integrated Municipal Stormwater and Wastewater Plans

An integrated planning process can help define a critical path to achieving the objectives of the Clean Water Act by identifying efficiencies in implementing competing requirements that arise from separate wastewater and stormwater projects, including capital investments and operation and maintenance requirements. This approach can also lead to more sustainable and comprehensive solutions, such as green infrastructure, that improves water quality as well as supports other quality of life attributes that enhance the vitality of communities.

— EPA policy memo available at: <http://cfpub.epa.gov/npdes/integratedplans.cfm> (EPA, 2012d)

nonpoint source management projects that protect vulnerable priority waters and sources of drinking and that restore impaired waters.

Strategic Action 34: The NWP intends to encourage green infrastructure and low-impact development to protect water quality and to make watersheds more resilient.

Preserving the ability of the land to absorb water helps to preserve the natural function of wetlands and watersheds while also controlling pulses of stormwater. Both GI and LID incorporate approaches to managing stormwater in a way that will reduce runoff. GI and LID management approaches and technologies use infiltration, evapotranspiration, and capture and reuse of stormwater to maintain or restore natural hydrologies (EPA, 2011j). They employ principles such as preserving and re-creating natural landscape features and minimizing imperviousness to create functional and appealing site drainage that treats stormwater as a resource rather than a waste product (EPA, 2011k). EPA is actively promoting these kinds of practices through its Green Infrastructure

⁵ Section 604(b) of the CWA establishes a grant program to fund state, local, and interstate water quality planning efforts under CWA sections 205(j) and 303(e). This provision requires states to reserve 1% of their Clean Water State Revolving Fund allotment, or \$100,000, whichever is greater, for planning. Under section 205(j), many states pass through at least 40% of these funds to local or interstate planning organizations.

Response to Climate Change

Strategy (EPA, 2012c), available at <http://water.epa.gov/infrastructure/greeninfrastructure/index.cfm>.

The NWP intends to promote the use of GI and LID through tool development, stormwater permitting, outreach, and assistance programs to support states and permittees in evaluating benefits and co-benefits of GI and LID approaches. The NWP intends to consider focusing its regulatory and permitting efforts not only on new development, but also on redevelopment. This Strategic Action supports the Agency goal to incorporate climate change science and scenario information in five rulemaking processes by 2015.

Strategic Action 35: The NWP intends to promote the consideration of climate change impacts by NPDES permitting authorities.

As authorized by the CWA, the NPDES permit program reduces water pollution by regulating point sources that discharge pollutants into waters of the United States (EPA, 2009c). To help NPDES permit writers prepare for possible climate change impacts to surface waters, the NWP intends to evaluate and develop, as needed, technical tools for permit writers to improve their decision-making processes related to the impacts of climate change, such as use of precipitation and streamflow data and other data or models.

To promote water quality on a watershed scale, the NWP intends to continue to encourage the use of flexible watershed approaches, such as watershed-based permitting and water quality trading, for building surface water resiliency to climate change impacts. The NWP also intends to consider the need for, and appropriateness of, reflecting climate projections in NPDES permitting (e.g., precipitation projections).

The NWP intends to evaluate the anticipated effect of climate change on critical low-flow stream conditions, and encourage NPDES permitting authorities to incorporate revised low-flow stream estimates into NPDES permit effluent limit development where appropriate. The NWP also intends to continue to encourage NPDES permitting authorities to consider anticipated climate change impacts (e.g., warmer surface waters) when evaluating applications for 316(a) variances from thermal effluent limitations.

Strategic Action 36: The NWP intends to encourage water quality authorities to consider climate change impacts when developing wasteload and load allocations in TMDLs where appropriate.

Under Section 303(d) of the CWA, 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

The Chesapeake Bay TMDL and Climate Change

“EPA and USGS will work in conjunction with the states to conduct an analysis by 2017 to consider accounting for uncertainties of climate change in TMDL allocations. USGS has begun initial assessment of changes in pollution loads in the watershed under different climate and land-use scenarios. Initial results will be available in 2012 and be used to further plan assessments for TMDL allocations. Enhanced assessment will begin in 2016.”

— Chesapeake Executive Order Strategy, p. 41
[CBPO, 2010]

pollution control requirements. The law requires jurisdictions to develop TMDLs for these waters. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards (EPA, 2011).

The NWP intends to look for opportunities for states or EPA to consider potential climate change impacts when developing TMDLs. The NWP intends to explore the use of tools such as models to help states evaluate pollutant load impacts under a range of projected climatic shifts. This would be done in a way that takes into account the best available data as well as any uncertainties in the models or data.

TMDLs are developed and implemented using an adaptive management approach, in which adjustments can be made as environmental conditions, pollutant sources, or other factors change over time. Thus, as more information and tools become available, there will be opportunities to make adjustments in TMDLs to reflect climate change impacts.

Strategic Action 37: The NWP intends to identify and work to protect designated uses that are at risk from climate change impacts.

A designated use establishes the water quality goals for a specific water body and serves as the regulatory basis for establishing controls beyond technology-based requirements. The water quality standards regulations, implementing CWA section 303(c), require that states and authorized tribes specify appropriate water uses to be achieved and protected. These uses are identified by taking into consideration the use and value of the water body for public water supply; for protection and propagation of fish, shellfish, and wildlife; and for recreational, agricultural, industrial, and navigational purposes. In addition, the CWA places additional emphasis on achieving, wherever attainable, “water quality which provides for the protection and propagation of fish, shellfish, and wildlife and for recreation in and on the water” [Section 101(a)(2)]. EPA’s regulation interprets and implements these provisions through requirements that WQS protect the uses specified in Section 101(a)(2) of the Act unless those uses have been shown to be unattainable.

EPA’s regulations require that when removing a designated use, the state must provide an analysis (i.e., a Use Attainability Analysis [UAA]) to demonstrate that the designated use is not feasible to attain based on one of the established regulatory factors. Additionally, states are required to conduct a review of their WQS at least once every three years. As part of that triennial review, states examine whether any new information has become available for water bodies where water quality standards specify designated uses that do not include the uses specified in Section 101(a)(2) of the Act. If such new information indicates that the uses specified in Section 101(a)(2) are attainable, the state shall revise its WQS accordingly.

The water quality standards regulation specifies circumstances under which a designated use may or may not be removed or revised. If a designated use is an existing use for a particular water body, the designated use cannot be removed unless a use requiring more stringent criteria is added.

To target protective efforts, the NWP intends to identify designated uses that are important to states and tribes, necessary to meet the goals of the CWA, and vulnerable to climate change

Response to Climate Change

impacts. For example, recreational uses such as swimming, boating, and fishing may be affected by changes in precipitation levels, which may lead to increased impairments. Cold water fisheries may need particular consideration, since such uses may be particularly susceptible to changes in water temperature. To protect existing uses and water quality, the NWP intends to focus on implementation of antidegradation requirements, which, at a minimum, require maintenance and protection of existing uses and the level of water quality necessary to protect the existing uses.

The NWP also intends to work with stakeholders to better understand how a state could conduct Use Attainability Analysis (UAA), using the six attainability factors in EPA's current regulations, where climate change may be the primary cause of nonattainment and where impacts cannot be remedied.

Strategic Action 38: The NWP intends to clarify how states can update aquatic life water quality criteria on more regular intervals, using the best and most accurate science and data related to both changing climate conditions and how pollutants react.

Section 304(a)(1) of the CWA requires EPA to develop criteria for water quality that accurately reflect the latest scientific knowledge regarding pollutant concentrations and environmental or human health effects (EPA, 2011p). From time to time, these criteria are updated to account for advances in the science. States, tribes, and territories may adopt these criteria or other scientifically defensible criteria into their water quality standards. The NWP encourages states to update criteria using the best and most accurate science and data related to both the changing climate conditions and how pollutants react to the changing conditions on a pollutant by pollutant basis.

In addition, since climate changes will affect hydrologic conditions, the NWP intends to incorporate the best available science in an informational document to assist states and tribes that are interested in protecting aquatic life from these impacts.

GOAL 13: As the nation makes decisions to reduce greenhouse gas emissions and develop alternative sources of energy and fuel, the NWP intends to work to protect water resources from unintended adverse consequences.

Just as it takes energy to treat and distribute water supplies, it takes water to generate and produce energy and fuels. Well-designed or rehabilitated water infrastructure can reduce energy demand, and careful energy planning can reduce water demand. Using a systems approach, consolidated water infrastructure, energy, and transportation planning can directly and indirectly reduce the demand for both water and energy. While Goals 1 and 2 in the Infrastructure section of this *2012 Strategy* discuss improving the energy profile of water infrastructure, this goal identifies actions that may reduce the adverse effects of new energy technologies on water resources, consistent with the recently published *Principles for an Energy-Water Future* (see Appendix A).

Strategic Action 39: The NWP intends to continue to provide perspective on the water resource implications of new energy technologies.

Production of energy and fuel rely on access to water, and may in turn contribute to water quantity and quality problems. Further, while alternative sources of energy and fuel are important for reducing emissions of GHGs and offer a number of win-win energy choices, they too bring water resource challenges. As technologies evolve, the NWP intends to provide perspective on how the nation's energy choices affect water resources.

Strategic Action 40: EPA intends to provide assistance to states and permittees so that geologic sequestration of CO₂ is responsibly managed to protect and preserve underground sources of drinking water.

EPA finalized requirements for geologic sequestration in December 2010, under the authority of the SDWA's UIC Program (EPA, 2010e). These requirements are designed to protect underground sources of drinking water (USDWs). The rule builds on existing UIC Program requirements, with tailored requirements that address carbon dioxide injection for long-term storage to ensure that wells used for geologic sequestration are appropriately sited, constructed, tested, and monitored during and after injection (i.e., during a post injection site care period), and closed in a manner that ensures USDW protection. The NWP intends to focus on implementation of these requirements to protect USDWs.

Strategic Action 41: EPA will also continue to work with States to help them identify polluted waters, including those affected by biofuels production, and help them develop and implement Total Maximum Daily Loads (TMDLs) for those waters.

EPA finalized the Renewable Fuel Standard rulemaking in early 2010 (EPA, 2011m). The rulemaking implements a statutory provision that requires 36 billion gallons per year of biofuels be used by 2022. As the production and price of corn and other biofuel feedstocks increase, there may be impacts to both water quality and water quantity. Runoff from agricultural land carries contaminants such as fertilizers, pesticides, and sediment. More agriculture generally requires more irrigation, which increases the demand for water and the amount of water flowing directly off land and carrying pollutants into nearby water bodies. The degree to which fertilizers, pesticides, and sediment affect water quality depends on a variety of management factors, including nutrient and pesticide application rates and application methods, conservation practices and crop rotations, and acreage and intensity of tile drained lands.

Runoff from agricultural nonpoint sources is not directly controlled under the NPDES permit program. Nonpoint source pollution is addressed via state pollution control programs. These programs are supported with CWA Section 319 grant funding and include an array of regulatory and voluntary approaches depending on the state. In addition, water quality trading is a tool that can allow permitted point source facilities facing higher pollution control costs to meet their regulatory obligations by purchasing environmentally equivalent (or superior) pollution reduction credits from another source at lower cost. In some trading programs, nonpoint sources such as agricultural operations may be included in trading if pollution reductions can be sufficiently documented. EPA will also continue to work with states to help them identify

Response to Climate Change

polluted waters, including those affected by biofuels production, and help them develop and implement TMDLs for those waters.

Under the CWA, all point sources of pollution to a water of the United States, including ethanol plants, are required to have a permit to discharge to water bodies for both industrial process water and stormwater. NPDES permits for ethanol plants take into account the minerals, toxic pollutants, and biological oxygen demand resulting from the production process.

In order to adapt to the increased storage of biofuels, such as ethanol and biodiesel, in underground storage tanks (USTs), EPA is working with its partners to gain a better understanding of UST system materials compatibility; functionality of leak detection technologies; and the fate, transport, and remediation issues associated with biofuel releases. Unlike other fuel components, ethanol is corrosive and highly water soluble. As a result, special precautions must be taken to ensure that UST system components are both compatible and functional with ethanol blends (EPA, 2009a). EPA's ORD provides methods, models, and tools needed to remediate leaking UST sites and address fate and transport issues of leaking contaminants. EPA also proposed guidance (EPA, 2010f) that will clarify how UST owners and operators can comply with EPA's compatibility requirement, which states that owners and operators must use a system made of or lined with materials that are compatible with the substance stored in the UST system.

EPA will continue to explore these and other options for mitigation of risks related to the production and storage of biofuels, including ethanol-blended fuels, and possible impacts to water quality.

Strategic Action 42: EPA intends to provide informational materials for stakeholders to encourage consideration of alternative sources of energy and fuels that are water efficient and maintain water quality.

Alternative energy sources provide decreased reliance on fossil fuels. However, they still require access to water, and may still place added stress on water supplies. EPA intends to develop a website that consolidates EPA information on the energy/water nexus, as well as water and energy efficiency information for various sectors (forthcoming; includes EPA-OAR; EPA-R9, 2011). In order to reduce the possibility of adverse impacts to water quality and supply, EPA intends to seek opportunities and explore options to continue to develop and update outreach materials for stakeholders in concert with federal agencies such as DOE and its Renewable Energy Technology Program (DOE, 2012) and state water science agencies.

To learn more about how NWP plans to encourage energy efficiency for water utilities, please see Goal 1, Strategic Action 2 in the Infrastructure section.

Strategic Action 43: As climate change affects the operation or placement of reservoirs, the NWP intends to work with other federal agencies and EPA programs to understand the combined effects of climate change and hydropower on flows, water temperature, and water quality.

Hydropower generation is considered a renewable energy resource because the water supplying it is renewable. A hydroelectric power plant converts the downstream movement

of water into electricity by directing the water, often held at a dam or reservoir, through a hydraulic turbine that is connected to a generator. Although power plants are regulated by federal and state laws to protect human health and the environment, there are a wide variety of environmental impacts associated with power generation technologies. In addition, climate change is likely to affect the amount, timing, and temperature of water used for hydropower, creating competition for water supply, affecting operational decisions, and altering the background condition of the aquatic system. The NWP intends to work with other federal agencies and programs to understand and address these combined impacts. For example, NWP could work with the DOE Wind and Water Power Program (DOE, 2011, DOE 2012) as well as with the Department of the Interior and other signatories of the Federal Hydropower Memorandum of Understanding (BOR, DOE, USACE) to further coordination and integration of hydropower and other water resource uses (BOR, 2010).

GOAL 14: The NWP intends to work to make hydrological and climate data and projections for water resource management available, when needed, in collaboration with other EPA programs and federal, state, interstate, tribal, and other partners.

Many of the NWP's programs are currently faced with a lack of sufficient data to assess national program effectiveness. Whether the data don't exist or are just not easily or publicly available differs by program, but lack of access to current data and consolidated analyses is a fundamental problem. As more climate models and vulnerability assessment tools become available, the NWP intends to work with partners from inside and outside EPA to collect, assimilate, and disseminate historic and projected information from the best sources available. The strategies in this section aim to gather, enhance, and improve access to the data that the NWP and its partners need for water resource management under changing climate conditions.

Strategic Action 44: Monitor climate change impacts to surface waters and ground water.

In order to respond to effects resulting from a changing climate, the NWP intends to understand the impacts to inland and coastal surface and ground waters. The NWP intends to support interagency monitoring networks by coordinating and collaborating with the EPA/State National Aquatic Resource Surveys (EPA, 2011n) and other agencies' monitoring programs, as well as the Federal Advisory Committee on Water Information (ACWI), to encourage them to add the ability to track and evaluate changes to water resources availability and quality using historical, reliable, long-term monitoring networks. The NWP also intends to continue to contribute to ACWI's Subcommittee on Ground Water to establish and maintain a National Ground Water Monitoring Network to describe trends in interstate and regional changes in ground water quality and availability. Further, states should understand that funding is available to assist in water quality monitoring, including surface water and ground water, under Sections 106 and 319 of the Clean Water Act. See also Strategic Action 2.

Strategic Action 45: Develop new methods for use of updated precipitation, storm frequency, and observational streamflow data, as well as methods for evaluating projected changes in low flow conditions, in collaboration with other federal agencies.

Response to Climate Change

EPA intends to work to update hydrological data and methods in collaboration with federal consortia (e.g., ICCATF, the Office of Science and Technology Policy's Subcommittee on Water Availability and Quality [SWAQ], the USGCRP, the Climate Change and Water Working Group [CCAWWG], the Integrated Water Resources Science and Services [IWRSS]) and engage partners (e.g., ACWI, Water Environment Research Foundation [WERF], the Water Research Foundation [WRF]) and others to develop and standardize a process to revise precipitation, temperature, and storm event data nationwide to incorporate expected changes in commonly used data.

Of particular concern are the storm frequency, duration, and intensity estimates (e.g., 10-year, 24-hour storm events; 100-year, 24-hour storm events) and low-flow conditions in rivers and streams at the Hydrologic Unit Code 12 watershed level.

Updating precipitation records and statistical methods, and developing projections of future precipitation patterns, will enable a fundamental shift in modeling methods, which currently rely on historical data that may no longer be representative of current and future conditions. These efforts will fully consider the uncertainty inherent in predictions of the pace and magnitude of future climate-change related effects, especially at a local level.

Strategic Action 46: The NWP intends to work to enhance flow estimation using NHDPlus.

The NHDPlus is a comprehensive set of digital spatial data that encodes information about naturally occurring and constructed bodies of water, paths through which water flows, and related entities (USGS, 2011). It provides full characterization of the flow network, identification of unregulated and regulated gages and reaches, and network-based interpolation and adjustment of flows. In order to enhance flow estimates in the face of climate change, the NWP intends to support enhancements to NHDPlus as a cost-effective means of providing more accurate flow estimates for permitting, TMDLs, watershed planning, and other uses.

E. Working With Tribes

VISION: Tribes are able to preserve, adapt, and maintain the viability of their culture, traditions, natural resources, and economies in the face of a changing climate.



Native Americans have distinct cultural and spiritual connections to the water and land.

The collective wisdom of elders and ancestors has allowed them to carefully use and manage the land for centuries. Changes to the earth's climate provide a new set of challenges for tribes seeking to maintain and protect their resources and the safety and health of their people.

Indian tribes are involved in protecting and restoring tens of thousands of square miles of rivers, streams, and lakes, as well as ground water in over 110,000 square miles of Indian Country in the United States. Because tribes may be regulators for water programs and water resource managers for their communities, it is important that tribes are able to provide ongoing input and participate in NWP strategies and actions on climate change. It will be important

to understand and consider the impact of climate change on Native American communities and their traditional values and cultures, particularly as EPA invests in water management programs in Indian Country.

Tribes often express a holistic perspective in viewing and understanding the environment, and seek to achieve “sustainability” in their lifestyle choices, both environmentally and economically, recognizing that ultimately, it is the environment that sustains us all. Tribal recommendations to EPA include seeing the “big picture” and not compartmentalizing environmental programs into separate media to address threats from climate change.

Much of the work with tribes takes place within the EPA Regions, further described in Chapter V, Geographic Climate Regions. This section broadly describes the kinds of activities the NWP intends to pursue with tribes.

GOAL 15: The NWP incorporates climate change considerations in the implementation of its core programs for tribal nations, and collaborates with other EPA Offices and federal Agencies to work with tribes on climate change issues on a multi-media basis to build sustainability.

Strategic Action 47: Through formal consultation and other mechanisms, the NWP intends to ensure that the revised NWP Tribal Strategy and subsequent implementation of CWA, SDWA and other core programs incorporate climate change as a key consideration.

Principles to observe include:

- Tribes are involved in watershed-based strategies, integrated water resource management strategies, or other geographic strategies that affect tribal resources.
- Tribes participate in the development of EPA multimedia strategies for addressing climate change impacts in Indian Country.
- Actions taken are informed by and consistent with the EPA Tribal Science Council’s climate change priorities and research recommendations.

Strategic Action 48: The NWP intends to incorporate adaptation into tribal funding mechanisms, and will collaborate with other EPA and federal funding programs to support sustainability and adaptation in tribal communities, to the extent appropriate and allowable by law.

Examples of actions for the NWP to pursue include:

Working with Tribes Examples of EPA Adaptation Activities

Region 2 awarded a grant to the Saint Regis Mohawk Tribe to work together with all Region 2 tribal nations to discuss and design adaptation approaches during 2012.

In Region 5, the Great Lakes National Program Office is funding Great Lakes tribes to implement climate change adaptation projects and programs. Specifically, Lake Superior tribes and tribal organizations received Great Lakes Restoration Initiative (GLRI) funding through their tribal capacity grants to initiate priority climate change adaptation projects and initiatives; and tribes have been involved in the Lake Superior Sustainability Committee which is developing a Lake Superior climate change adaptation plan.

Response to Climate Change

- Provide information on the use of funding programs within the NWP to include mitigation and adaptation planning and implementation as eligible grant activities, as appropriate.
- Work with others in EPA to help clarify for tribes how funding mechanisms can be used for climate planning and implementation, such as the Tribal General Assistance Program managed by the American Indian Environmental Office (AIEO) and Community Action for a Renewed Environment (CARE).
- Work with federal partners to coordinate tribal adaptation planning and to conduct training and education for tribal members and environmental justice communities for building adaptive capacity.

GOAL 16: Tribes have access to information on climate change that they can use to inform and engage their communities for effective decision making.

Strategic Action 49: The NWP intends to collaborate to explore and develop climate change science, information and tools for tribes to understand local climate impacts and risks to inform adaptation solutions, and will incorporate local knowledge where possible.

Examples of information requested by tribes include:

- Information on environmental conditions and long-term trends.
- Risk assessment and management tools to help identify environmental risks and inform adaptation solutions.
- Assessments of watershed conditions and impacts using peer-reviewed summaries of empirical data specific to geographic areas and water resources, to inform local action.
- Perspectives of tribal elders with historic information to inform understanding and adaptation responses.
- Management options that consider climate change factors to protect watershed resources.
- Case studies of Tribal Environmental Knowledge (TEK) incorporated into program delivery, and guidelines for incorporating TEK into science products.
- Opportunities to leverage federal resources that can provide science information to tribes.

Strategic Action 50: The NWP intends to collaborate with others to develop communication materials relevant for tribal uses and tribal audiences.

Examples of materials requested by tribes include:

- Information tailored to different climate regions.
- Information linked to tribal culture and traditions.
- Information for use in elementary, high school, and tribal college and university curricula.

