

Next Steps for Managing Freshwater Resources in a Changing Climate:

A Report of the Water Resources Adaptation
to Climate Change Workgroup
to the
Advisory Committee on Water Information

April 10, 2014

WICP

Water Information Coordination Program

ACWI

Advisory Committee on Water Information



Prepared by:

Water Resources Adaptation to Climate Change Workgroup of the
Advisory Committee on Water Information

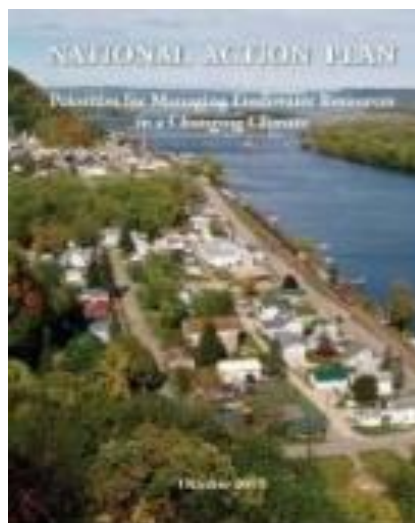
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Acronym List

NAME	ABBREVIATION
Advisory Committee on Water Information	ACWI
American Council for an Energy-Efficient Economy	ACEEE
American Planning Association	APA
American Water Works Association	AWWA
Appliance Standard Awareness Project	ASAP
Association of Metropolitan Water Agencies	AMWA
Council on Environmental Quality	CEQ
Federal Emergency Management Agency	FEMA
National Aeronautics and Space Administration	NASA
National Association of Counties	NACo
National Flood Insurance Program	NFIP
National Oceanic and Atmospheric Administration	NOAA
National Weather Service	NWS
Office of Management and Budget	OMB
U.S. Army Corps of Engineers	USACE
U.S. Centers for Disease Control and Prevention	CDC
U.S. Department of Agriculture	USDA
U.S. Department of Energy	DOE
U.S. Department of the Interior	DOI
U.S. Environmental Protection Agency	EPA
U.S. Fish and Wildlife Service	USFWS
U.S. Geological Survey	USGS
U.S. Global Change Research Program	USGCRP
University Corporation for Atmospheric Research	UCAR
Water Resources Adaptation to Climate Change	WRACC
Water Utility Climate Alliance	WUCA



INTRODUCTION

This report summarizes recommendations for next steps in implementing the *National Action Plan: Priorities for Managing Freshwater Resources in a Changing Climate*.

The report was developed by the Water Resources Adaptation to Climate Change (WRACC) Workgroup that supports the Advisory Committee on Water Information (ACWI). ACWI is a national Federal Advisory Committee made up of representatives of a diverse set of stakeholders and Federal agencies.

The WRACC Workgroup is one of several subgroups of ACWI and is made up of forty members, including members of ACWI and other organizations with an interest in the intersection between climate change and water resources. It was established in 2012 with the mission of advising Federal agencies on matters related to climate change and water resources, including implementation of the 2009 *National Action Plan*. More information about the WRACC Workgroup is available at: http://acwi.gov/climate_wkg/index.html.

In February 2014, the WRACC Workgroup convened for a two day meeting to review progress in responding to the challenges that a changing climate poses for water resources and to consider recommendations for next steps. A key purpose of this meeting was to respond to the request for input to the

development of a report required under section 3 of Executive Order 13653 “*Preparing the United States for the Impacts of Climate Change*” addressing actions that are:

“necessary to make the Nation’s watersheds, natural resources, and ecosystems, and the communities and economies that depend on them, more resilient in the face of a changing climate.”

The report required under section 3 of the Executive Order is to be completed in August of 2014 and is to:

“build on efforts already completed or underway as outlined in agencies’ Adaptation Plans, as discussed in section 5 of this order, as well as recent interagency climate adaptation strategies such as the *National Action Plan: Priorities for Managing Freshwater Resources in a Changing Climate...*”

The WRACC organized five subgroups based on the major topics of recommendations in the *National Action Plan*:

- Data and information for decision-making;
- Vulnerability assessment;
- Water use efficiency and conservation;
- Integrated water resource management; and
- Capacity building in training and outreach.

The subgroups were charged with identifying and describing a limited number of critical next steps that would complement and strengthen the actions now underway to implement the *National Action Plan*. Each of these subgroups has a Federal and non-Federal co-chair and met by conference call prior to the February meeting. Subgroups include persons who are representatives to the WRACC Workgroup as well as others from WRACC member organizations. Each subgroup worked to develop an initial assessment of next steps and then, at the February meeting, met in break-out sessions to refine ideas and report to the full group for feedback and discussion. The subgroups then prepared the

summary reports of their recommendations that are included in this report. These reports are the product of the subgroups and the general consensus of the WRACC Workgroup but are not formal positions of the agencies or organizations participating in the Workgroup. The subgroups deliberations were also informed by additional input and information from a private sector and nonprofit panel, as well as background information from panel presentations by Federal agency representatives.

In addition, several ideas and recommendations were discussed at the meeting more generally and are included in a closing section of this report.

A summary of the major recommendations provided in the report is provided as a preface to the more detailed subgroup reports.

This draft report will be submitted to the full ACWI for review and approval and forwarded to the Council on Environmental Quality and the Office of Management and Budget for their consideration in the development of the report required under section 3 of Executive Order 13653.

SUMMARY OF RECOMMENDATIONS

The next steps in implementing the *National Action Plan* identified by the WRACC Workgroup are presented in summary below and described in greater detail in the reports of the subgroups provided in the next section.

Water Data and Information Subgroup: This subgroup focused on the sufficiency and accessibility of data and information needed to make decisions related to preparedness for climate change.

Recommendation 1: Ensure continuity and viability of long-term hydro-climate observations and data management systems by establishing a coordinated process in which each Federal agency develops a plan and budget for its key observing system(s) showing how that agency will dedicate resources to evaluate data and information adequacy and then sustain and upgrade its system(s) to meet those needs.

Recommendation 2: Enhance data access and interoperability of data systems, including encouraging the Subcommittee on Water Availability and Quality (SWAQ) to develop and oversee implementation of a plan for improved water data access and interoperability across agency boundaries. This includes the development of an integrative tool to assist in the access to data and information from multiple sources.

Recommendation 3: Bolster critical data sets, including those related to groundwater, stream/river flow, health data (waterborne disease), water use, and paleoclimate reconstruction.

Assessment of Vulnerability Subgroup: This subgroup focused on evaluating the adequacy of infrastructure needed to adapt to changing climate and our abilities to make this assessment and/or plan and design for improvements.

Recommendation 1: Develop guidance for, and provide assistance to, communities and water utilities of all sizes on how to use existing climate

and extreme weather data, information, and tools in order to build capacity for assessing vulnerability and implementing responses to increase resilience.

Recommendation 2: Create a strategic plan for engagement and collaboration with non-Federal water institutions or partners to enhance messaging, improve the use of climate information, and cultivate a collaboration to inform and improve future climate tool development.

Water Use Efficiency Subgroup: This subgroup focused on a review of options to improve water use efficiency.

Recommendation 1: Agriculture should be prioritized for development of “nationally consistent metrics for water use efficiency,” a recommendation contained in the *National Action Plan*.

Recommendation 2: The Department of Energy should update Federal efficiency standards for showerheads, faucets, toilets, and urinals and consider incorporating a performance standard for products.

Recommendation 3: The Federal government should promote programs and legislation to develop a national funding program for water efficiency and reuse/reclamation that would mirror but not replace existing programs managed in western States by the Bureau of Reclamation.

Integrated Water Resources Management Subgroup: This subgroup considered issues and opportunities for improvements to water resources management.

Recommendation 1: Facilitate Federal agency coordination to achieve Integrated Water Resources Management and climate resiliency by:

- considering the reestablishment of an interagency Water Resources Council, such as authorized by the Water Resources Planning Act of 1965;

- creating a Federal Water Coordinator with authority at the Executive Office of the President; or
- creating regional Federal Agency Support Teams consisting of Federal agencies with water resources responsibilities to facilitate collaboration between the states and Federal government regarding water and climate issues, using the Western States Federal Agency Support Team (WestFAST) as a possible template and model.

Recommendation 2: Expand existing programs and create new incentives to empower State, interstate, local and tribal governments to assess and plan on a watershed or aquifer basis for preparedness and resilience of their water resources.

Recommendation 3: Incentivize use and protection of ecosystem services (i.e., natural capital) by expanding and coordinating existing efforts, including adapting or creating new funding programs to promote planning and implementation.

Training and Capacity Building Subgroup: This subgroup assessed ideas and options related to use of training and other educational tools to build capacity for adapting water resources management to a changing climate.

Recommendation 1: Identify the information sharing needs for *National Action Plan* actions, and develop mechanisms to facilitate sharing, such as expanding the role and resources of Water Resources Research Institutes at State Land Grant Colleges to include both research and capacity building for climate change adaptation.

Recommendation 2: Support education and training to build response capability, including expanding existing workforce training and college traineeships, requiring training of technical service providers, such as planners, engineers and consultants, and highlighting existing layperson training on climate change.

Additional Recommendations Derived from February Workgroup Meeting:

Several recommendations arose from general discussions at the meeting of the Workgroup.

Recommendation 1: Consider establishing a Natural Infrastructure State Revolving Loan Fund or other programs to enable State planning and investment in natural system infrastructure to adapt to more extreme weather and a changing climate.

Recommendation 2: Consider promoting “premium sharing” with local governments by the National Flood Insurance Program to strengthen community-wide, preventative actions to reduce flood risks and the economic and human costs of flooding.

Recommendation 3: Consider supporting a nonprofit organization to promote integrated water resources management professional training/accreditation and project recognition on a voluntary basis.

REPORTS OF SUBGROUPS

**Report of the Data and Information Subgroup
to the
Water Resources Adaptation to Climate Change Workgroup of the
Advisory Committee on Water Information**

Members of the Subgroup:

- Ron Hoffer; Environmental Protection Agency, co-chair
- Aris Georgakakos; National Water Research Institute, co-chair
- Joan Brunkard; Centers for Disease Control and Prevention
- Dave Fuller; National Tribal Council
- Noel Gollehon; US Department of Agriculture; Natural Resources Conservation Service
- Jeanine Jones; Western States Water Council
- Julie Kiang; US Geological Survey
- Chris Reimer; National Ground Water Association
- John Schmerfeld; Fish and Wildlife Service
- Troy Thomson; US Department of Agriculture; Forest Service
- Ernie Wells; National Oceanic and Atmospheric Administration; National Weather Service
- Dwayne Young; Environmental Protection Agency

Recommendation 1: Ensure continuity and viability of long-term hydro-climate observations and data management systems by directing each Federal agency to develop a plan and budget for its key observing system(s) showing how that agency will dedicate resources to evaluate data and information adequacy and then sustain and upgrade its system(s) to meet those needs.

Issue

The 2011 *National Action Plan* (NAP) makes priority recommendations for reducing climate change risk; an identified priority is to *improve water resources and climate change information for decision-making* through supporting actions including *strengthening data for understanding climate*

impacts on water resources. Multiple Federal agency monitoring programs cover various facets of the hydrologic cycle and provide fundamental data for managing the Nation's water resources, including:

- the National Weather Service cooperative observer program (precipitation) and weather satellites;
- USDA's Snotel program (snowpack);
- the USGS stream gaging and groundwater monitoring programs; and
- the NASA/USGS Landsat earth observing mission (water use).

Aging observing system infrastructure and Federal budget cuts threaten the continuity of long-term observing records, and a lack of Federal resources has limited efforts to upgrade and modernize existing networks to expand data collection to meet the needs of water resources adaptation to climate change.

Importance

Observations and data form the foundation upon which all water management is based – that which cannot be measured cannot be managed. Continuity and sustainability of long-term observations are essential for a broad spectrum of purposes including forecasting and managing extreme events (floods and droughts), tracking waterborne diseases, managing international treaties and interstate compacts, and complying with Federal public health and safety and environmental regulatory requirements. Response to expected impacts of climate change – extremes becoming more extreme, loss of mountain snowpack, shifts in timing of runoff – requires expansion of observing capabilities in key areas, including high-elevation snowpack monitoring and greater density of precipitation observations, especially in mountainous terrain.

As has been well recognized in the stakeholder community, the observing system most at risk of loss of continuity of long-term records is the NWS cooperative observer program. This relatively dense network of precipitation stations provides essential data for engineering design of many types of flood control and stormwater infrastructure.

Existing Federal Activities

The NAP calls for strengthening data to understand climate change impacts, but does not define what strengthening entails. The February 2014 working draft of NAP 2013 progress highlights and 2014 implementation plan is conspicuously silent on activities associated with maintaining and improving observing systems. Addressing the observing system issues will be neither quick nor easy in the current budget climate. Ongoing sustained action is needed, and a priority must be placed on this effort. The subgroup recommends that the NAP implementation plan include as a specific task that each Federal agency develop a plan for its key observing system(s) showing how that agency will dedicate resources to sustaining and upgrading its system(s).

Recommendation 2: Enhance data access and interoperability of data systems, including encouraging the Subcommittee on Water Availability and Quality (SWAQ) to develop and oversee implementation of a plan for improved water data access and interoperability across agency boundaries. This includes the development of an integrative tool to assist in the access to data and information from multiple sources.

Issue

While there are multiple Federal data systems that can be used for assessing climate risks and solutions, there are major gaps in communication between and across such systems. Data needs to be more easily accessible in a machine readable format in a way that will allow Federal data sets to be interoperable, using common open-source data standards and standard terminology. Federal agencies should develop this plan with the goal in mind of developing an integrated platform or portal that will enable the easy discovery of these datasets and their incorporation into models or other decision support tools for water resource managers. There are ongoing Federal efforts in this area but there remains a need to bring in more partners.

Federal data used by water resource managers is often available in very different formats from various sources. These data are also typically only available as a download from a web site, with only a few examples of these data

being available as a web service that can be incorporated into another application or model. Many of the data sets used by water resource managers are very similar in nature, in that they are measuring a given parameter, or set of parameters (i.e., flow or precipitation) at a given location, at set intervals of time. Because of this, the potential exists to use a common data format (or schema) and a common set of web services for all of these data sets.

Importance

On May 9, 2013, the President issued an Executive Order titled *“Making Open and Machine Readable the New Default for Government Information.”*

Specifically, this EO requires agencies to collect or create information in a way that supports downstream information processing and dissemination activities. This includes “using machine readable and open formats, data standards, and common core and extensible metadata for all new information creation and collection efforts.” Doing this would allow for third-party developers to develop applications that can consume data from sources in an automated fashion, thereby removing the need for a user to specifically go to each Federal web site, download the data of interest, format it into a common format, and use it in an application.

By providing automated access to the data, tools can be designed that can provide real-time information for decision makers, and allow for a more rapid adjustment to changes in events. It also will allow for a reduced cost for the users of Federal data.

A 2011 Report to Congress by the interagency Subcommittee on Water Availability and Quality (SWAQ) titled: *Strengthening the Scientific Understanding of Climate Change Impacts on Freshwater Resources of the United States* (available at: http://acwi.gov/9506_report_to_congress_aug2011_FINAL.pdf) had two significant findings related to data interoperability and integration, as follows:

- Finding 18: Interoperable Data Systems. Ready access to the full range of hydro-climatic data collected by government agencies and other interests is inadequate. Data are collected using a range of protocols, which are

not always documented, and are archived in a variety of ways, from modern relational databases to paper copies in files. There is much to be gained from use of consistent documentation standards and improvements in interoperability of data systems.

- Finding 19: Data and Decision-Making. In general, hydro-climatic data are insufficiently integrated (or readily integratable by the user community) to support important management decisions and hydro-climatic data are inadequately connected to information on issues of social relevance.

Existing Federal Activities

While there is a challenge to advance interoperability, there are ongoing efforts that form a good basis for forward motion, including:

- Integrated Water Resources Science and Services (IWRSS) – a collaborative effort of USGS, NOAA, and USACE to better share resources and expertise to help solve the nation’s water resource issues;
- the Federal Support Toolbox for Integrated Water Resources Management – an online clearinghouse for data, models, and tools related to water resources;
- the Water Quality Portal (USGS and EPA) – a collaborative effort between USGS, EPA, and the National Water Quality Monitoring Council to make water quality monitoring data available in a common format; and
- WaterML 2.0 – an example of a standard exchange format that could be used for many water datasets.

The USGS has been working with the Open Geospatial Consortium on development and testing of this standard.

To strengthen and coordinate this work, the existing Subcommittee on Water Availability and Quality (SWAQ) should be encouraged to develop and oversee implementation of a plan for improved water data access and interoperability.

Recommendation 3: Bolster critical data sets, including those related to groundwater, stream/river flow, health data (waterborne disease), water use, and paleoclimate reconstruction.

Issue

Issues 1 and 2 are “bigger picture” data and information matters, though it is also clear that certain critical data sets are not being gathered in sufficient depth and scope. Four of these are highlighted: groundwater, health data (waterborne disease), water use, and paleoclimate reconstruction.

Importance

Groundwater: Implementation of a comprehensive national groundwater monitoring program and information system able to characterize and attribute groundwater quantity and quality trends in major US aquifers, support reliable vulnerability assessments, and inform adaptation planning and management processes is greatly needed. The need for dependable and comprehensive groundwater data and information to support actionable resource assessments and adaptation strategies is becoming imperative in view of intensifying drought projections for many US regions (including the southwest, southeast, and the Great Plains), and anticipated sizable increases in agricultural water use in the same regions (2014 NCA, water chapter).

The combined stresses of water demand increases and declining recharge rates are expected to challenge the sustainability of many US aquifers. Coastal aquifers are facing additional threats due to sea level rise, sea water encroachment, and greater storm surges. Data and information are also necessary to assess the potential role of groundwater aquifers in climate adaptation strategies. For example, surface water and groundwater resources can be managed conjunctively, with higher reliance on surface water during wet climatic periods and groundwater during dry periods. Infiltration basins and injection wells may also enhance groundwater recharge at times of high flows. The current lack of data and information prevent reliable groundwater assessments and the formulation of suitable adaptation strategies. In response to this need, the ACWI Subcommittee on Ground Water has proposed the long-term operation and management of the National Groundwater Monitoring

Network (NGWMN) (see http://acwi.gov/sogw/NGWMN_InfoSheet_final.pdf). Work to date includes a Framework Document, data portal, and five successful pilot level demonstrations and this network should be implemented.

Health Data (Waterborne Disease): One of the potential health impacts of climate change is an increase in the prevalence of waterborne disease due to changes in the geographic distribution or range of waterborne pathogens and increased exposure to pathogens during extreme weather events if water and wastewater treatment systems are compromised or overwhelmed.

Surveillance data on waterborne disease outbreaks have been collected by State health departments and reported to CDC for approximately 40 years, while data on the most prevalent waterborne pathogens in the U.S., *Cryptosporidium* and *Giardia*, have been collected for two decades. Ensuring the continuity of public health surveillance systems and building public health capacity for reporting is essential to provide reliable, representative, long-term data and observations that can provide a baseline for evaluating future potential linkages between climate and weather variables and waterborne disease.

Further, additional data on emerging, climate-sensitive waterborne pathogens such as *Vibrios*, *Naegleria fowleri*, and harmful algal blooms, are needed to document, predict, and develop adaptive preventive measures to changing transmission routes and ranges of these pathogens. As water resources become increasingly scarce and water reuse applications increase, it is important to collect public health data on both the benefits and risks of water reuse and to include a public health perspective in developing guidance for best practices around water reuse applications with potential human exposures.

Water Use: Water use changes over time due to changes in population, land use practices, climate, and many other factors. Furthermore, the response of different water use sectors (for example, residential, industrial, or agricultural) may differ. While detailed information may be available to local water users, national compilations of water use are coarse in both temporal and spatial resolution. To understand the many factors affecting water use and to facilitate the creation of useful projections of water use into the future, more detailed

information on water use is needed. The USGS 5 year reports are critical to this need and should be reassessed to ensure that they are sufficiently rigorous.

Paleoclimate Reconstruction: Instrumental records of streamflow, aquifer levels, and other water-related variables are generally limited to the past 100–150 years. Other environmental indicators, such as tree-rings, flood deposits, and indicators of subsurface condition can be used to provide information on previous floods or droughts that were experienced before the instrumental record began. Such information can be tremendously helpful in putting more recent events into context, and to assist planners in preparing for events that were more extreme than those experienced in the instrumental record. The availability of such information is limited, and additional work to expand paleoclimate reconstructions of streamflow would be beneficial to water managers.

Existing Federal Activities

While there are Federal efforts underway in these selected areas, they require significant strengthening. Recommendation 2 of the *National Action Plan* (2011) includes Actions 3 and 4 for improving water resources and climate data. However, specific actions related to groundwater, water use, health and paleoclimate are either lacking, or progress in recent annual plans is unclear. Strengthening is also called for in parallel efforts. For example, the establishment of a national groundwater monitoring network and information system was called for by the ACWI Subcommittee on Ground Water. These recommendations outline a comprehensive groundwater monitoring framework to address key data gaps that are crucial for supporting adaptation planning and management decisions.

Report of the Assessment of Vulnerability Subgroup to the Water Resources Adaptation to Climate Change Workgroup of the Advisory Committee on Water Information

Members of the Subgroup:

- Judy Francis; National Association of County Planners; co-chair
- Nancy Beller-Simms; National Oceanic and Atmospheric Administration, co-chair
- Paul Fleming; City of Seattle
- Sasha Peterson; Society of Adaptation Professionals
- Doug Bellomo; Federal Emergency Management Agency
- Casey Brown; University of Massachusetts
- Cynthia Finley; National Association of Clean Water Agencies

Recommendation 1: Develop guidance for, and provide assistance to, communities and water utilities of all sizes on how to use existing climate and extreme weather data, information, and tools in order to build capacity for assessing vulnerability and implementing responses to increase resilience.

Issue and Existing Activities

As we have learned through our webinars and presentations, many Federal agencies and other organizations have developed a variety of vulnerability and risk assessment tools and disseminate data sets in various mediums. There is a wide breadth of applications of these products, but limited information available to guide potential users in making decisions about data interpretation and appropriate applications. This can result in confusion over findings and potentially flawed assessments.

Importance

The goal of this priority is to increase the usefulness of existing tools. This guidance will help clarify the context and appropriate uses of existing tools and leverage the previous Federal investment in creating the tools. Additional

development of some climate information can be useful, but there is enough information available that isn't being utilized effectively to inform climate risk (probability x magnitude) and vulnerability assessment (exposure & sensitivity).

Recommendation 2: Create a strategic plan for engagement and collaboration with non-Federal water institutions or partners to enhance messaging, improve the use of climate information, and cultivate a collaboration to inform and improve future climate tool development.

Issue and Existing Activities

Water infrastructure risk and vulnerability is an issue that encompasses a broad spectrum of potential stakeholders at all levels of government and both private and non-profit sectors. Each of these groups has functioning information dissemination systems, but they are not always effectively communicating outside their own spheres of influence. At the local level, decision-makers are most attentive to professional organizations such as the National Association of Counties, the League of Municipalities, and the American Planning Association. Similarly, the non-profit and private sectors have their own professional groups with extensive information exchange mechanisms. Agencies may provide cursory information to these groups, but opportunities for comprehensive interaction are lacking, and there is little or no feedback loop present to determine if a tool or data set has actually been useful in practical applications.

Importance

The goal of this recommendation is to build and enhance relationships among the Federal agencies (e.g. interagency working group on water) and key professional societies, regional entities, organizations, and existing entities in the water space. This will also diversify the set of "messengers" to deliver the information and increase use of the information. Example non-Federal partners include WUCA, AWWA, AMWA, NACo, APA, National League of Cities, U.S. Conference of Mayors, and state Leagues of Municipalities. These non-Federal partners are trusted "messengers" of information that could facilitate greater usage of existing tools and better inform the development of new and more effective tools. Such partnerships could also provide a forum for better communications between data managers and water resource practitioners.

As part of a strategic approach to development of tools, Federal agencies should coordinate with professional associations and organizations that develop and maintain model standards, regulations and data sets that are incorporated by reference by Federal, state and municipal authorities in their regulations, or are recognized as industry standards for designing infrastructure and other projects associated with land development to ensure these products reflect that the climate is transient.

**Report of the Water Use Efficiency Subgroup
to the
Water Resources Adaptation to Climate Change Workgroup of the
Advisory Committee on Water Information**

Members of the Subgroup:

- Veronica Blette; Environmental Protection Agency, co-chair
- Brandon Kernen; Association of State Drinking Water Administrators, co-chair
- Michael Block, National Ground Water Association
- Adam Carpenter; American Water Works Association
- Ben Chou; Natural Resources Defense Council
- Paul Wiegand; National Council for Air and Stream Improvement

Recommendation 1: Agriculture should be prioritized for development of “nationally consistent metrics for water use efficiency,” a recommendation contained in the *National Action Plan*.

Issue

Agriculture is the largest consumptive user of water in the U.S., accounting for 80 to 90 percent of all consumptive water use. The Federal government can provide leadership by further incentivizing soil management and irrigation practices that save water in Federal loan and insurance programs (e.g., the Federal Crop Insurance Program),¹ upgrading outdated infrastructure, encouraging metering of water deliveries to all agricultural districts, and implementing water pricing reforms for future contracts involving Federal water-wholesalers (e.g., using volumetric rates; ensuring rates adequately reflect construction, operation, and maintenance costs).²

¹ Claire O'Connor, *Soil Matters: How the Federal Crop Insurance Program should be reformed to encourage low-risk farming methods with high-reward environmental outcomes* (2013), NRDC, available at <http://www.nrdc.org/water/soil-matters/files/soil-matters-IP.pdf>.

² Juliet Christian-Smith and Chris Kaphiem, *Volumetric Water Pricing and Conjunctive Use: Alta Irrigation District* (2013), Pacific Institute, available at http://www.pacinst.org/wp-content/uploads/sites/21/2013/02/volumetric_water_pricing_and_conjunctive_use3.pdf.

Federal agencies should also engage with stakeholders from States, agricultural associations, researchers, and other groups to identify and implement additional actions that can reduce water withdrawals and improve agricultural water efficiency and promote the use of effluent. These actions can include the development and implementation of new technology, the use of financial incentives and technical assistance, and the identification and implementation of best practices in water efficiency and crop selection that can result in more sustainable practices, such as effluent reuse.

Importance

In 2005, agricultural irrigation accounted for 37 percent of all freshwater withdrawals and 62 percent of all freshwater withdrawals if thermoelectric withdrawals are excluded.³ Older, outdated irrigation systems also lose significant amounts of water to evaporation and seepage during conveyance—in some cases up to 20 percent.⁴ Of the nearly 55 million acres that were irrigated in 2008, 40 percent used surface gravity systems, 56 percent used sprinkler systems, and 7 percent used micro- or sub-irrigation systems.⁵ Micro-irrigation techniques are typically more water efficient than surface or sprinkler irrigation methods.⁶ A Pacific Institute study estimates that agricultural water efficiency improvements, ranging from modest crop shifting to various advanced irrigation techniques, could reduce consumption by 0.6 to 3.4 million acre-feet per year, in areas of California supplied by the Sacramento–San Joaquin Delta.⁷

³Joan F. Kenny, Nancy L. Barber, Susan S. Hutson, Kristin S. Linsey, John K. Lovelace, and Molly A. Maupin, *Estimated Use of Water in the United States in 2005* (2009), USGS, 4, available at <http://pubs.usgs.gov/circ/1344/>.

⁴ Glenn-Colusa Irrigation District, “GCID Landowner and Water User Meetings,” available at <http://www.gcid.t/Meetings/2014%20Water%20User%20Meeting%201-14-14.pdf>.

⁵ The total exceeds 100 percent because more than one irrigation method could be used. USDA, “Land Irrigated by Method of Water Distribution: 2008 and 2003,” *2008 Farm and Ranch Irrigation Survey* (2009), available at http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Farm_and_Ranch_Irrigation_Survey/fris08_1_04.pdf.

⁶ Terry A. Howell, “Irrigation Efficiency,” *Encyclopedia of Water Science* (2003), 468, available at <http://www.cprl.ars.usda.gov/pdfs/Howell-Irrig%20Efficiency-Ency%20Water%20Sci.pdf>.

⁷ Heather Cooley, Juliet Christian-Smith, Peter H. Gleick, *More With Less: Agricultural Water Conservation and Efficiency in California* (2008), Pacific Institute, available at http://www.pacinst.org/wp-content/uploads/2013/02/more_with_less3.pdf.

Existing Federal Activities

There are a variety of USDA conservation programs, such as the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program, that are used to fund water conservation and efficiency improvements. The Bureau of Reclamation also funds some water efficiency improvement projects. Additionally, USDA through the National Institute of Food and Agriculture (NIFA) also funds a nationwide system of cooperative extension offices to provide information, such as best practices for soil management and irrigation, to farmers and other agricultural stakeholders. The *President's Climate Action Plan* also included the development of USDA Regional Climate Hubs, which will help provide technical support and information to farmers on best management practices with a changing climate. However, there is no specific recommendation in the *National Action Plan* on improving agricultural water efficiency and reuse.

Recommendation 2: The Department of Energy should update Federal efficiency standards for showerheads, faucets, toilets, and urinals and consider incorporating a performance standard for products.

Issue

Minimum efficiency standards for plumbing products were established by the Energy Policy Act (EPA) of 1992. These standards were codified with a final DOE rulemaking in 1998 but have not been updated since then. Current Federal efficiency standards also do not take into account product performance as the EPA WaterSense program does.

Importance

These products are large consumers of indoor water use: toilets consume nearly 27 percent, showers nearly 17 percent, and faucets almost 16 percent.⁸ A study by ACEEE and ASAP estimates that if the WaterSense efficiency levels were adopted for consumer products, it would result in annual savings of more than 150 billion gallons of water in 2035 and substantial energy savings.

⁸ EPA, "Indoor Water Use in the United States," <http://www.epa.gov/WaterSense/pubs/indoor.html>.

Product	WaterSense Specification	Annual Water Savings (gal)	Annual Electricity Savings (TWh)	Annual Natural Gas Savings (Btu)
Faucets (residential lavatory) ⁹	1.5 gpm	48 billion	2.7	18 trillion
Toilets ¹⁰	1.28 gpf	92 billion	--	--
Urinals ¹¹	0.5 gpf	13.6 billion	--	--

Existing Federal Activities

The current law requires DOE to review efficiency standards for consumer products every six years,¹² but these standards have not been revised in fifteen years.¹³ The Appliance and Equipment Standards program within the DOE Buildings Technologies Office is responsible for setting minimum Federal efficiency standards for these consumer products, and historically, this has been viewed as a low priority for DOE. Enforcement of existing efficiency standards also remains a challenge.¹⁴ Manufacturers are required to certify that their products meet minimum Federal standards; however, DOE does not always verify that products do in fact meet the minimum standards.

There have been significant improvements in the efficiency of consumer products since these standards were adopted. At the time these Federal standards were established, they pre-empted existing State standards. In 2010, DOE officially waived preemption so that States (and local jurisdictions) could adopt more stringent standards. At least three States (California, Texas,

⁹ ACEEE and ASAP, *The Efficiency Boom: Cashing In on the Savings from Appliance Standards* (2012), 29, available at <http://www.appliance-standards.org/sites/default/files/The%20Efficiency%20Boom.pdf>.

¹⁰ ACEEE and ASAP 2012 at 32.

¹¹ ACEEE and ASAP 2012 at 41.

¹² Under 42 U.S.C. 6295(m)(1), within 6 years after issuance of any final rule establishing or amending a standard, DOE is required to publish a notice determining whether to amend such standards. If DOE determines that amendment is warranted, DOE must also issue a notice of proposed rulemaking including new proposed energy conservation standards by that same date.

¹³ The EPC Act minimum efficiency standards were codified in a final rule in 1998. Federal Register, FR 63 13308 (March 18, 1998)

¹⁴ See Office of the Inspector General, DOE, *Audit Report: The Department of Energy's Appliance and Equipment Standards Program* (2013), <http://energy.gov/sites/prod/files/2013/08/f2/OAS-M-13-05.pdf>.

and Georgia) and numerous cities, including New York City, Los Angeles, and San Francisco, have adopted more stringent standards.¹⁵ In 2011, DOE issued a request for information (RFI) on States and cities that have adopted more stringent efficiency standards since preemption was waived and information on new plumbing products that exceed Federal efficiency standards.¹⁶ In 2013, DOE finalized a rulemaking to amend the test procedure for these products.¹⁷

However, an update of the Federal efficiency standards for consumer plumbing products would not replace the need for EPA’s WaterSense program, which has encouraged manufacturers to improve product efficiency and helped consumers to make informed choices about products that save water and money without compromising performance. Since its inception, the WaterSense program has helped to save nearly 490 billion gallons of water and more than \$8.9 billion in water and energy bills.¹⁸

Recommendation 3: The Federal government should promote legislation to develop a national funding program for water efficiency and reuse/reclamation that would mirror but not replace existing programs managed in western States by the Bureau of Reclamation.

Issue

There is no nationwide source of Federal funding that has the specific goal of advancing water efficiency and water reuse/reclamation projects. Funding programs that are available for projects in western States have helped to advance the adoption of water efficiency and reuse projects in that part of the country. The absence of similar programs in the eastern half of the country hinders the ability of the Federal government to incentivize the adoption of similar projects which could improve the resiliency of water resources.

¹⁵ These standards generally follow the EPA WaterSense specifications: 1.28 gpf for toilet, 0.5 gpf for urinals, 1.5 gpm for private lavatories, and 2.0 gpm for showerheads.

¹⁶ “Faucets, Showerheads, Water Closets, and Urinals,” 76 *Federal Register* 163 (23 August 2011), pp. 52644-52646.

¹⁷ “Energy Conservation Program for Consumer Products and Certain Commercial and Industrial Equipment: Test Procedures for Showerheads, Faucets, Water Closets, Urinals, and Commercial Prerinse Spray Valves,” 78 *Federal Register* 205 (23 October 2013), pp. 62970-62988.

¹⁸ EPA, “WaterSense – Milestones,” http://www.epa.gov/WaterSense/about_us/milestones.html.

Importance

Availability of water resources is a growing concern in the country – whether due to drought or growing population – and these concerns can be expected to further grow in the future due to climate change. Historically, concerns about water scarcity have primarily been in the western part of the country and Federal programs have been initiated to address them. However, increasingly water shortages are observed in the eastern half of the country and similar funding programs do not exist to address them.

Existing Federal Programs

Funding is available for some types of water efficiency activities through the State Revolving Fund programs administered by States and overseen by EPA. However, this funding is primarily focused on the need to address aging infrastructure challenges faced by water and wastewater utilities.

Programs provided for by the Secure Water Act of 2009¹⁹ and earlier statutes authorize the Bureau of Reclamation to make grants to fund projects that improve water efficiency and reuse. This authority is specific to western States that are within the jurisdiction of the Bureau of Reclamation, and not available to States in the eastern half of the country (<http://www.usbr.gov/WaterSMART>).

- **Water and Energy Efficiency Grants** –These grants provide for projects to conserve and use water more efficiently, increase the use of renewable energy, improve energy efficiency, benefit endangered and threatened species, facilitate water markets, or carry out other activities to address climate-related impacts on water or prevent any water-related crisis or conflict. In 2012–2013, \$31 million in funding was provided for 76 projects that are expected to save 158,000 acre-feet annually, enough to serve more than 650,000.

¹⁹ From P.L. 111-11 Sec. 9504 “The Secretary may provide any grant to, or enter into an agreement with, any eligible applicant to assist the eligible applicant in planning, designing, or constructing any improvement— (A) to conserve water; (B) to increase water use efficiency; (C) to facilitate water markets; (D) to enhance water management, including increasing the use of renewable energy in the management and delivery of water; (E) to accelerate the adoption and use of advanced water treatment technologies to increase water supply;...” .

- **Title XVI Water Reclamation and Reuse Program** – Reclamation provides funding for projects that reclaim and reuse municipal, industrial, domestic or agricultural wastewater and naturally impaired ground or surface waters. Reclaimed water can be used for a variety of purposes, such as environmental restoration, fish and wildlife, groundwater recharge, municipal, domestic, industrial, agricultural, power generation or recreation. Water reuse is an essential tool in stretching limited water supplies.

Other Important Issues – Although they were not included as one of the three priority recommendations, the subgroup discussed two other issues that they believe warrant greater attention from the Federal government.

1. Develop Methods for Quantitative Cost/Benefit Assessment of Water

Efficiency Actions: Greater attention is needed to developing and sharing techniques for quantifying costs and benefits of actions undertaken to improve water efficiency in different sectors. Practices that act to foster increased conservation of water resources and improved efficiency of water use will be key elements in local adaptation strategies.

Implementing these strategies, however, must be considered in light of the full water and energy lifecycle which considers both related environmental tradeoffs (e.g., pollutant emissions resulting from increased energy consumption required to support water reuse, increased water and energy use required to utilize biofuels) and the value that will accrue to society by way of foresighted adaptation efforts. Unfortunately, techniques for quantifying and monetizing these costs and benefits in a manner that is relevant to local situations and comparable between locales or with national standards are not widely available. The Federal government should initiate the design of methods for monetizing these costs and benefits. Local governments making use of such methods would have enhanced powers to justify the incremental cost of adaptation efforts.

2. Create Incentives to Aggregate Energy and Water Efficiency Opportunities.

Clean water and air regulatory programs need to be modernized and

aligned to increase water and energy efficiency as a center piece to climate change mitigation and resiliency. Energy development, generation and consumption, and water production and use are directly interrelated throughout the entire water/energy lifecycle. For example, the production of most sources of energy involves water consumption, energy consumption, water quantity/quality impacts, and air quality impacts. The distribution of water involves energy consumption, water consumption, and air quality impacts. Energy and water efficiency is the least costly and most plentiful form of new energy and water sources available. However, efficiency opportunities are often disaggregated so mechanisms that provide a strong incentive for combining efficiency opportunities into substantial initiatives need to be developed in lieu of developing new sources of water or energy. Agency plans and regulatory structures should be modified and updated to align air and water regulatory programs to consider total environmental impacts holistically and to encourage, require or provide financial and/or regulatory incentives to significantly improve water and energy efficiency.

Report of the Integrated Water Resources Management Subgroup to the Water Resources Adaptation to Climate Change Workgroup of the Advisory Committee on Water Information

Subgroup members:

- Rolf Olsen; Army Corps of Engineers; co-chair
- Carol Collier; American Water Resources Association; co-chair
- Elizabeth Berger; US Forest Service
- Tamara McCandless; US Fish and Wildlife Service
- Mike Muse; Environmental Protection Agency
- Erica Brown; Association of metropolitan Water Agencies
- Dave Carlton; Association of State Floodplain Managers
- Gary Belan; American Rivers
- Ben Grumbles; US Water Alliance
- Brenna Mannion; National Association of Clean Water Agencies
- Patrick McCarthy; The Nature Conservancy
- David Berry; Sustainable Water Resources Roundtable

Recommendation 1: Facilitate Federal agency coordination to achieve Integrated Water Resources Management (IWRM) and climate resiliency.

Issue

To achieve resilience and preparedness for climate change in the management of freshwater resources we must work in an integrated, holistic way using watershed boundaries (IWRM). (Note that when the term “watershed” or “watershed management” is used this is not intended to include the interaction of both surface watershed and ground water aquifer.)

Responsibilities and authorities to manage and regulate water resources are spread across multiple Federal agencies. In order to achieve IWRM, the programs of these agencies need to be better coordinated.

Some possible mechanisms to better integrate Federal agencies in the assessment, planning, and management of water resources include the following:

- A Water Resources Council, such as authorized by the Water Resources Planning Act of 1965;
- A Federal Water Coordinator with authority at the Executive Office of the President; or
- Regional Federal Agency Support Teams consisting of Federal agencies with water resources responsibilities to facilitate collaboration between the states and Federal government regarding water and climate issues, using the Western States Federal Agency Support Team (WestFAST) as a possible template and model.

Importance

There are over 30 Federal Agencies that touch the issues of climate change and water resources. In order to apply focus on the critical issue of climate change and the likely impacts to water resources and the nation's economy, it is important to show a unified and coordinated approach by the Federal agencies. Also, in current time of limited budgets, a focused approach will provide a more efficient and cost effective way to develop strategies, work with other levels of government, and implement solutions.

Existing Federal Activities

The Water Resources Planning Act of 1965 established the U.S. Water Resources Council (WRC) to coordinate Federal water programs and policy. During the early 1980s, the Reagan Administration thought States should play a primary role in water management, so the WRC was disbanded in 1983. The Water Resources Planning Act was never repealed and the WRC remains authorized, but no funding has been appropriated since FY1983 for the WRC.

A more recent action to improve Federal agency coordination was the creation of the Western States Federal Agency Support Team (WestFAST). WestFAST was established at the request of the Western Governors to support the Western Governors Association and the Western States Water Council in coordinating Federal efforts regarding water resources in the West. Twelve Federal agencies

participate in WestFAST and a Federal Liaison is stationed in the Council's Salt Lake City, Utah offices to facilitate coordination between WestFAST and the western states.

Another Federal interagency collaboration is the National Integrated Drought Information System (NIDIS) led by NOAA. NIDIS objectives include drought monitoring, forecasting, and early warning. There have also been a number of recent studies and action plans developed by individual agencies or multiple agencies, organized by CEQ.

Recommendation 2: Expand existing programs and create new incentives to empower State, interstate, local and tribal governments to assess and plan on a watershed or aquifer basis for preparedness and resilience of their water resources.

Issue

There is a need to include all levels of government in watershed assessment, planning, and management. Responsibility for water resources management is divided among Federal, State, interstate, local, tribal, and private interests, and these entities need to work together to achieve IWRM.

Some specific mechanisms to improve the Federal support to State, interstate, local and Tribal governments include the following:

- Appoint an Ombudsman for State/Federal Coordination;
- Develop more programs like Silver Jackets and the USDA Forest Service Watershed Condition Framework (watershed restoration action plans);
- EPA and OMB, in coordination with State agencies, should continue to modernize the infrastructure needs surveys conducted under the Clean Water Act and Safe Drinking Water Act to capture the costs for preparedness and resilience as accurately as possible;
- Expand the SECURE Water Act, a law that authorizes Federal water and science agencies to work together with State and local water managers to plan for climate change and the other threats to our water supplies, and take action to secure our water resources for the communities, economies, and the ecosystems they support;

- The Department of Interior’s WaterSMART grant program, which was authorized in SECURE, provides support for IWRM planning and implementation by local, State and regional water providers and users in collaboration with Federal water and science agencies;
- Develop and fund River Basin Commissions;
- Include requirements in All Hazards Mitigation Plans for planning for climate resiliency;
- Require funding and grant programs to include IWRM watershed assessments including climate resiliency as a first step to funding; and
- Provide tools (models, monitoring, and assessment methods) and/or funding to State, interstate, local and tribal governments to support IWRM.

The Federal government could encourage IWRM by developing or expanding incentive programs that are revenue neutral or have minimal budget impact. For instance:

- Allow a faster track for permits for communities with watershed plans;
- Reduce local cost share for USACE Feasibility Studies and construction projects;
- Implement sliding cost share that depends on how well a community implements risk reduction and supports ecosystem services;
- Programs like FEMA’s Community Rating System (reduced insurance rates).

Federal, State, interstate, local and tribal agencies can work with partner organizations to facilitate implementation of IWRM. These organizations could include professional associations, water sector-based organizations, and organizations of local governments, such as the APA, the NGA, and the National League of Cities, and WUCA.

Importance

While planning and development of action plans are best conducted at regional/watershed scales, much of the implementation occurs at the local level. Federal agencies often best serve a support role to the other levels of government. With the uncertainty associated with water resource impacts due

to climate change, Federal agencies will play a very important role in assistance to other government levels.

Existing Federal Activities

The Silver Jackets is a program that brings together Federal agencies with State agencies to support improved flood risk management. A similar program for integrated water resources management in general could be developed.

The National Flood Insurance Program's (NFIP) Community Rating System (CRS) is an example of an incentive program to encourage community floodplain management activities that exceed the minimum NFIP requirements.

Communities can qualify for reduced flood insurance rates. The USACE Federal Support Toolbox was developed to facilitate assistance to State and interstate governments by Federal agencies.

Recommendation 3: Incentivize use and protection of ecosystem services (i.e., natural capital) by expanding and coordinating existing efforts, including adapting or creating new funding programs to promote planning and implementation.

Issue

Natural solutions are often more resilient to extreme weather and other forces of climate change than the use of solely gray infrastructure. The use and protection of ecosystem services should be incentivized.

Importance

Natural systems provide many services that should be part of an integrated water resources management framework. Healthy upstream watersheds have terrestrial, riparian, and aquatic ecosystems that capture, store, and release water, sediment, and nutrients. Healthy watersheds can sustain terrestrial, riparian, aquatic, and wetland habitats that are capable of supporting diverse populations of riparian and aquatic species. Floods are a natural occurrence and floodplains will periodically be flooded. Recognizing the natural and beneficial uses and functions of floodplains and wetlands and restoring or

protecting floodplains and wetlands will reduce the risk of future flood damages.

Existing Federal Activities

Many Federal agencies use or consider ecosystem services in their policies and management decisions.

- EPA, NOAA, USACE, USDA, and DOI have policies related to ecosystem services.
- The Federal Resource Management and Ecosystem Services (FRMES) project brings together Federal agencies and outside expertise to share ideas and build a consistent approach to integrating ecosystem services into Federal resource management and planning processes.
- FEMA is taking steps to build ecosystem services into its cost-benefit analyses for new projects.
- The National Science and Technology Council (NSTC) has a Subcommittee on Ecological Systems that coordinates some Federal activities.
- The USGS Science and Decision Center is starting an effort to understand the role of ecosystem services in climate adaptation. The Forest Service, USACE, and the USGCRP are participating in this effort.
- New policies adopted by USACE, FEMA and other Federal agencies recognize the multiple benefits of reducing flood risk and restoring ecosystems.
- USACE projects, especially those developed through the agency's Sustainable Rivers Project, are increasingly considering and implementing nonstructural measures, including structure removal and floodplain ecosystem restoration.
- CEQ's 2013 report: "[Principles and Requirements for Federal Investments in Water Resources](#)", calls for ecosystem services to be incorporated into water resources investment decisions by Federal agencies, including USACE, EPA, FEMA, DOI, and USDA.

**Report of the Training and Capacity Building Subgroup
to the
Water Resources Adaptation to Climate Change Workgroup of the
Advisory Committee on Water Information**

Subgroup members are:

- Levi Brekke; Bureau of Reclamation; co-chair
- Jeff Manning; Association of Clean Water Administrators; co-chair
- Peg Bostick; Association of State Wetland Managers
- Peter Evans; Interstate Council on Water Policy
- Chitra Kumar; Council on Environmental Quality
- Deirdre Mason; Association of State Groundwater Administrators
- Nancy Turyk; North American Lake Management Society

Recommendation 1: Identify the information sharing needs for *National Action Plan* actions, and develop mechanisms to facilitate sharing, such as expanding the role and resources of Water Resources Research Institutes (WRRI) at State Land Grant Colleges to include both research and capacity building for climate change adaptation.

Issue

One of the goals Stated in the E.O. *Preparing the United States for the Impacts of Climate Change* is to “(ii) reform policies and Federal funding programs that may, perhaps unintentionally, increase the vulnerability of natural or built systems, economic sectors, natural resources, or communities to climate change related risks;”

In order to accomplish this goal, government resource managers need to work hand-in-hand with counterparts across sectors and disciplines to share tools, data, information and resources developed for freshwater climate change adaptation and provide user support for diverse audiences in order to have better, more holistic decision-making. Ways to achieve this outcome include work with existing climate knowledge hubs (e.g., WRRI, State Associations) to facilitate cross-discipline knowledge-sharing networks (e.g., water resource

managers and ecosystem service planners); and increased connections to non-traditional, non-professional networks (e.g., NGOs, community organizations). Many of the Freshwater NAP actions involve the need for development of information that would be useful to share, but other tools and resources may exist as well. Sustainable delivery mechanisms need to be identified.

Importance

Information sharing is an important part of capacity building because it enables effective decision-making, thereby ultimately reducing vulnerability of communities to impacts from climate change. Additionally, the absence of coordination and facilitation for information sharing on climate change data and information topics across sectors, disciplines, and user types can lead to inefficient or inaccurate decision-making. Local decision-makers have gained increasing access to data and tools in recent years but still lack guidance on how to connect them to planning at the local level (e.g., at the river basin level where planners wish to prepare for drought under future climate variability rather than under climate “stationarity”). Information sharing could make use of knowledge networks, communication/outreach, and tailoring of information products to specific audiences.

There is a need for capacity in this area. Cross-sector awareness would help to develop decision-makers’ capacity to account for ecological and social benefits and consider trade-offs during climate resilience planning. Decision-making capabilities would be further enhanced by increasing knowledge of information-sharing methods that best mobilize public support for the tough decisions that will inevitably need to be made in a resource-constrained future with climate change.

In particular, there is a need for water resource management agencies to be aware of and responsive to the data and information needs of communities most vulnerable to the impacts of climate change so that consequences do not fall disproportionately on any particular economic sectors or communities. For example, lack of information about variable emergency response capabilities and aging water infrastructure across neighborhoods has led to inadequate response in low income areas during extreme weather events. By increasing

networking with organizations representing the most vulnerable communities, water resource professionals would be better prepared to integrate these considerations into their decision-making.

Existing Federal Activities

While some level of capacity has been developed at the Federal level, it should be used to enhance and expand capacity at the State and local level. Part of information sharing involves issuance of user manuals and guidance documents that accompany data sets and tools, such as those on www.climatedata.gov.

Recommendation

While NAP “Action #23 under Rec #6 – Engage Water Resources Research Institutes at land grant colleges in climate change adaptation was focused on research, we recommend expanding the charge to include capacity building for climate change. The WRRRI is a very logical location hub for climate information and resources for dispersing information, opportunities for knowledge sharing, and educational training for States municipal staff, and the next entry level workforce. Information sharing by WRRIs and Extension can help to frame climate change impacts from regional perspectives, providing local relevance to climate change response and application of management tools. The WRRRI can maintain and refine tools and information, and develop regionally relevant information, and include other disciplines, such as ecosystem service managers, when necessary. Other examples of work to accomplish this include identifying the particular water stakeholders that certain tools and information would be most useful to – beginning with the resource listing that was prepared by the ACWI Climate Workgroup.

Recommendation 2: Support education and training to build response capability, including expanding existing workforce training and college traineeships, requiring training of technical service providers such as planners, engineers and consultants, and highlighting existing layperson training on climate change.

Issue

To support effective water resources adaptation under climate change, we need to improve workforce expertise on integrating climate change information into decision-support and enhance stakeholder and community understanding of climate science, impacts, and adaptation.

Importance

Executive Order 13653 calls on Federal, State, local, tribal, and non-government entities to mainstream climate change considerations into their water resources planning and management. Education and training are essential building blocks for achieving this goal. This includes technical education for water resources professionals who must integrate climate change information into decision-support and layperson training for the stakeholder community on climate science, impacts, and adaptation. Expertise is currently concentrated in the research community and some agencies, but is not well distributed across the water resources community where adaptation occurs. While education and training needs are evident, shrinking budgets make it difficult for agencies to respond.

Existing Federal Activities

This priority follows from Recommendation #6 from the Freshwater NAP (2011), and particularly Actions 21 (“Establish a core training program on climate change science for local, Tribal, and State water resources managers”).

Considerable progress has been made under this action. For example, pilot technical courses for water resources professionals have been developed and delivered through collaboration between the Federal Climate Change Adaptation Working Group (CCAWWG) and the UCAR COMET program (see *Developing Climate Change Training Capacity* in NAP Highlights 2013). Additionally, tool-specific training has been delivered via webinars hosted by EPA (*Carrying out Climate Ready Water Utilities Webinars*, NAP Highlights 2013). Also, climate change adaptation courses oriented towards ecosystem professionals have been offered through the USFWS National Conservation Training Center (NCTC).

While the outcomes of Action 21 activities are substantial, they do not fully address the recommendation #6 pertaining to workforce education. For example, the CCAWWG and UCAR COMET technical courses were delivered only as one-time pilots to a small number of Federal and non-Federal students. Future delivery of these courses, as well as those developed by EPA, USFWS NCTC and others, requires developing a business model where course delivery and refreshers are mostly likely funded by tuition fees, given agency funding limitations. This triggers the need to establish education demand among professionals, which can occur by agencies adopting planning requirements that require integration of climate change information into decision-support. Lastly, Action 21 activities were also focused on workforce education, and do not address the need for layperson training for stakeholders.

Recommendations

- Action 21 implementing agencies should continue to develop and pilot—the delivery of workforce-oriented education, but complement this business model development that aims for sustained future delivery reaching the larger professional workforce.
- Federal and non-Federal agencies should compel their technical service providers to seek educational opportunities, perhaps through adoption of planning requirements requiring integration of climate change information into decision-support, or inclusion of education requirements for adaptation grants/contracts recipients.
- The NAP Freshwater Impacts group should increase stakeholder community access to layperson training; perhaps through cataloging of resources that already exist and partnering with information sharing networks on delivery (see Priority 1).

Other Needs

Socio-Economically Vulnerable Communities

Socio-economically and environmentally vulnerable communities present unique challenges for climate change planners. Especially during major events (e.g. floods, droughts, etc.), underserved populations may be overshadowed unless agencies are able to adjust priorities and procedures. Further, in order

to compel widespread support for implementation of climate change plans, there is a need for communities most vulnerable to the impacts of climate change to have greater capacity to engage in technical planning discussions. By increasing networking with organizations representing the most vulnerable communities, water resource professionals would be better prepared to integrate unique emergency response, infrastructure vulnerabilities, toxic migration, and other community-specific considerations into their resilience planning decisions, such that historic disparities are not perpetuated. Engaging a more general audience in capacity building activities would require forging new pathways and alliances at the local level. Though a sorely needed area of investment, mechanisms for capacity-building in vulnerable communities are probably better considered by State and local actors at this time.

Strengthening Connection between Water Resources and Ecosystem Adaptation Communities

Additional attention to the sharing of information among sectors is needed to integrate ecosystem services while avoiding unacceptable degradation of natural systems which will require expertise and resources outside of some agencies' priorities. Preparedness and response to changing climatic conditions will require nimble and collaborative responses by agencies and institutions to ensure that the interest of all freshwater-related needs are identified and considered in the decision-making process.

Given that the priorities of each agency are frequently tied to regulatory mandates and funding sources, differences among agencies may create barriers to working collaboratively on new challenges posed by climate change. Mandates, funding, and strategic planning for management of water supplies and water quality differ significantly from established priorities for the management of fish and wildlife habitat and protection of natural resources, but climate change may demand increased flexibility and coordination among these interests to maximize beneficial actions. Climate change can result in events and circumstances which may not have been anticipated at the time priorities were identified and funding was allocated; therefore, flexibility is necessary to allow agencies to reprioritize tasks, if necessary.

- Example: The Quileute Indian Tribe’s reservation is located on the Olympic Peninsula adjacent to Olympic National Park in Washington. Although there have been ongoing boundary disputes, sea level rise necessitated the adjustment of wilderness boundaries and park land to ensure that the tribe had sufficient high ground to relocate their schools, housing, and administrative buildings. Providing access to traditional fishing and hunting lands while ensuring access to the land by non-tribal members were also important considerations. HR1162 sought to provide the Quileute Indian Tribe tsunami and flood protection by shifting boundaries of the park and wilderness area. This sort of adjustment is highly unusual and provides an example of the flexibility which may be needed to address climate change challenges.

Complex changing conditions may not be anticipated or may involve solving challenges that have not previously been experienced in the United States or a region of the country. Collaboration across sectors and levels of government that include a variety of perspectives will result in the generation of better solutions to complex situations and a coordinated effort can result in the most efficient use of resources and expertise, but only if collaborators have the flexibility to respond.

ADDITIONAL RECOMMENDATIONS DERIVED FROM FEBRUARY WORKGROUP MEETING

This report is organized around the reports of subgroups addressing the five key subjects described in the *National Action Plan: Priorities for Managing Freshwater Resources in a Changing Climate*. Although these five topics provided a useful framework for discussions, some ideas and proposals did not fit this structure or were identified and developed as a result of subsequent discussions. Three such ideas are presented as recommendations in this section.

Recommendation 1: Consider establishing a Natural Infrastructure State Revolving Loan Fund or other programs to enable State planning and investment in natural system infrastructure to adapt to more extreme weather and a changing climate.

Issue

Building the adaptive capacity of the Nation's water resources to a changing climate will require long term commitments to investing in the natural infrastructure needed to strengthen watershed resilience to flooding and drought and help fish, animals, and plants adapt to changing climatic conditions over the long-term. States can play an important role in leading the planning and investments in natural infrastructure. Most States, however, have not developed natural infrastructure plans or investment programs.

Importance

Examples of natural infrastructure a State might invest in to build resilience to a changing climate include:

- dune systems providing storm surge buffers;
- wetlands to build flood and drought resilience in a watershed;
- corridors that allow fish, animals, and plants to migrate as the climate changes; and

- conventional infrastructure that allows for continuity of corridors across obstacles such as highways (e.g.; a tunnel under a highway or fish passage/obstacle removal).

Existing Federal Activities

State Clean Water and Drinking Water State Revolving Funds (SRFs) currently offer financing to municipal water utilities to build conventional water treatment facilities. A new Natural Infrastructure State Revolving Loan Fund program would give a State the option of working with the Federal government and private investors to create a portfolio of investments that enhance the natural infrastructure of the State and strengthen climate resilience. Federal agencies should work with States and interested organizations to evaluate this concept and consider whether and how a State Revolving Fund model, or similar model, could contribute to meeting climate adaptation needs.

States opting to establish a Natural Infrastructure SRF could work with State agencies, Federal agencies, and other stakeholders to develop a State Natural Infrastructure Intended Use Plan comparable to the existing water infrastructure Intended Use Plans.

States would implement Intended Use Plans by making investments in natural resources including critical land acquisition, easements, and infrastructure to strengthen functions of natural resources. States could hold natural infrastructure investments for ten years without repayment to the SRF but could sell the investment with a permanent, binding commitment or easement to protect the natural features of the property in perpetuity. Transactions could be facilitated by a market at the State or national level. Buyers for the investments might include local organizations, parties seeking carbon credits, investors seeking to use available capital for social benefit, internet based “crowd-source” financing, and parties needing to meet compensation obligations (e.g., supplemental environmental projects under an enforcement action). Funds from the sale of the investments would be returned to the SRFs.

Recommendation 2: Consider promoting “premium sharing” with local governments by the National Flood Insurance Program to strengthen community-wide, preventative actions to reduce flood risks and the economic and human costs of flooding.

Issue

Flooding, as a result of extreme weather and rising sea levels, poses a significant risk to many communities across the country. Many of these communities are not well prepared for managing flood events that are expected to occur with greater frequency in the future and lack the resources to develop and implement plans to reduce flood risks.

Importance

Flooding is a major cause of economic and human loss. The 30-year flood averages \$8.17 billion in damages and 89 deaths per year. Without improved flood prevention efforts, these economic and human costs are likely to rise as extreme weather events caused by climate change become more common, and as rising sea levels increase the vulnerability of coastal communities to inundation. Flooding also has significant consequences for the health of aquatic ecosystems including reduced water quality and potential interruption in drinking water and wastewater services.

Existing Federal Activities

The National flood Insurance Program (NFIP) provides homeowners with the option to buy flood insurance to recover from major flood damages. The Community Rating System (CRS) program provides a small reduction in flood insurance premiums paid by homeowners in communities where specific community flood prevention measures are implemented. Although the CRS program provides incentives for communities to take flood prevention actions, the financial benefits of the actions accrue to the homeowner rather than the community. Many communities lack the financial resources to implement CRS flood prevention measures or additional actions to improve retention and infiltration of floodwaters across a watershed. Reduced premiums can also encourage development within a floodplain.

The CRS program might be expanded to offer communities the option of “premium sharing” under the NFIP. A municipal government or regional authority that develops an approved flood risk reduction program on a community or watershed basis would be eligible to share with the Federal government some portion of the annual premiums (e.g.; 10 percent) being paid by home owners in that community to the national flood insurance fund. These funds would be available prior to a flood event and could be used to implement both upgrades to infrastructure and changes to policies and programs to improve flood prevention and reduce flood losses. Although “premium sharing” would slightly reduce the total value of the NFIP rebuilding fund, the investments by communities in flood prevention measures would reduce long-term claims on the fund by homeowners and provide more comprehensive and effective flood risk reduction for the community as a whole.

Recommendation 3: Consider supporting a nonprofit organization to promote integrated water resources management professional training/accreditation and project recognition on a voluntary basis.

Issue

Water resource management demands complex, long-term investments in built infrastructure including drinking water systems, irrigation systems, and ports and waterways. Engineering and design professionals in the public and private sectors play a central role in translating general plans into detailed blueprints. Many engineering professionals are interested in increasing the sustainability of the infrastructure they design and building climate resiliency but they lack commonly recognized standards and practices for this work. In addition, there is presently no mechanism to provide standardized recognition for water infrastructure projects that meet key sustainability thresholds and support integrated water resources management.

Importance

Individual water infrastructure projects often involve unique challenges that may not be a good fit with standardized “top down” requirements for sustainable design. An alternate, “bottom-up” approach is to develop throughout the water engineering community the training that professionals

need to define sustainable solutions to project design challenges that support an integrated approach to water resources management. A certification program related to sustainability for water design professionals would encourage professionals to take sustainability training. A corollary program to provide recognition of projects that meet clearly established sustainability thresholds would provide professionals with an incentive to implement sustainable design principles in water project plans. Emphasizing sustainability early in the design process will more likely lead to success, rather than attempting to add it on at a later date.

Existing Federal Activities

The Federal government has several policies and programs to promote design and execution of sustainable, climate-resilient water projects but does not provide water engineering professionals with sustainability training or certification and does not have common thresholds for recognizing the sustainable characteristics of water projects.

An existing program that could provide a model for the water infrastructure sector is the Leadership in Energy and Environmental Design (LEED) program now in place for the design of buildings. The LEED program provides sustainability training and certification to a diverse array of architects and other design professionals, and this certification is increasingly recognized as a necessary skill set for professional advancement and marketing. The LEED program also provides clear guidelines for project design features that result in a variable sustainability rating (e.g.; silver, gold, platinum) for a building.

Rather than operating a sustainability certification and recognition program for water infrastructure directly, the Federal government might provide start-up seed funding on a competitive basis to an existing non-profit organization with the capacity to implement the program. Once the certification and recognition process was established, it is likely to be financially self-sustaining without Federal funding by drawing on fees for training and other services. The economic and societal benefits of designing water infrastructure projects to be more sustainable are likely to outweigh the start-up and operating costs of the program.

APPENDIX

**Members of the Water Resources Adaptation to Climate Change
Workgroup**

Federal Agencies	Representative	Alternate
Army Corps of Engineers, Institute for Water Resources	Rolf Olsen	
Centers for Disease Control and Prevention	Joan Brunkard	
Council on Environmental Quality	Chitra Kumar	
Department of Agriculture, Natural Resources Conservation Service	Noel Gollehon	
Department of Agriculture, Forest Service	Chris Carlson	Elizabeth Berger Troy Thompson
Department of Energy	Craig Zamuda	
Department of Homeland Security, Federal Emergency Management Agency	Doug Bellomo	Mark Crowell Paul Huang
Department of Interior, U.S. Geological Survey	Jerad Bales	Bill Werkheiser
Department of Interior, Bureau of Reclamation	Levi Brekke	
Department of Interior, U.S. Fish and Wildlife Service	John Schmerfeld	Tamara McCandless
Environmental Protection Agency	Jeff Peterson Federal Co-Chair	Ron Hoffer
National Oceanic and Atmospheric Administration; National Weather Service	Ernie Wells	Chris Bunner
National Oceanic and Atmospheric Administration; Climate Program Office	Nancy Beller-Simms	
Office of Science and Technology Policy	Peter Colohan	

State, Tribal, and Local Government Organizations	Representative	Alternate
Association of Clean Water Administrators	Jeff Manning	
Association of Metropolitan Water Agencies	Erica Brown	
Association of State Drinking Water Administrators	Brandon Kernen	Deirdre Mason
Association of State Floodplain Managers	Dave Carlton	
Association of State Wetland Managers	Peg Bostwick	Jeanne Christie
Groundwater Protection Council	Mike Paque	Mary Musick
Interstate Council on Water Policy	Peter Evans	
National Association of Clean Water Agencies	Peter Ruffier	Cynthia A. Finley, Ph.D.
National Association of County Planners	Judy Francis, AICP	
National Congress of American Indians	Brian Howard	
National Tribal Water Council	Dave Fuller	
Water Utility Climate Alliance	Paul Fleming	
Western States Water Council	Jeanine Jones	Nathan Bracken

Public and Academic Organizations	Representative	Alternate
American Rivers	Gary Belan	Fay Augustyn
American Society of Civil Engineers	Casey Brown	
American Water Resources Association	Carol R. Collier	Richard A. Engberg
American Water Works Association	Adam Carpenter	
American Society of Adaptation Professionals	Sascha Petersen	
National Council for Air and Stream Improvement	Paul Wiegand	Douglas McLaughlin
National Ground Water Association	Michael Block	Paul Gruber
Natural Resources Defense Council	Ben H. Chou	
National Institutes for Water Research	Dr. Aris Georgakakos	Dr. Reagan Waskom
North American Lake Management Society	Nancy Turyk	Dennis McCauley
The Nature Conservancy	Patrick McCarthy	
U.S. Water Alliance	Ben Grumbles	
Water Environment Federation	Paul L. Freedman, Non-Federal Co-Chair	

Water Resources Adaptation to Climate Change Workgroup of the
Advisory Committee on Water Information
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WICP Water Information Coordination Program

ACWI Advisory Committee on Water Information