AUTHENTICATED
U.S. GOVERNMENT
INFORMATION
GPO

S. HRG. 112–268

DOMESTIC AND GLOBAL WATER SUPPY ISSUES

HEARING

BEFORE THE

SUBCOMMITTEE ON WATER AND POWER

OF THE

COMMITTEE ON
ENERGY AND NATURAL RESOURCES
UNITED STATES SENATE

ONE HUNDRED TWELFTH CONGRESS

FIRST SESSION

TO

HEAR TESTIMONY ON OPPORTUNITIES AND CHALLENGES TO ADDRESS DOMESTIC AND GLOBAL WATER SUPPLY ISSUES

DECEMBER 8, 2011

Printed for the use of the
Committee on Energy and Natural Resources

U.S. GOVERNMENT PRINTING OFFICE

72–894 PDF WASHINGTON : 2012

For sale by the Superintendent of Documents, U.S. Government Printing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512–1800; DC area (202) 512–1800
Fax: (202) 512–2104 Mail: Stop IDCC, Washington, DC 20402–0001

COMMITTEE ON ENERGY AND NATURAL RESOURCES

JEFF BINGAMAN, New Mexico, *Chairman*

RON WYDEN, Oregon
TIM JOHNSON, South Dakota
MARY L. LANDRIEU, Louisiana
MARIA CANTWELL, Washington
BERNARD SANDERS, Vermont
DEBBIE STABENOW, Michigan
MARK UDALL, Colorado
JEANNE SHAHEEN, New Hampshire
AL FRANKEN, Minnesota
JOE MANCHIN, III, West Virginia
CHRISTOPHER A. COONS, Delaware

LISA MURKOWSKI, Alaska
JOHN BARRASSO, Wyoming
JAMES E. RISCH, Idaho
MIKE LEE, Utah
RAND PAUL, Kentucky
DANIEL COATS, Indiana
ROB PORTMAN, Ohio
JOHN HOEVEN, North Dakota
DEAN HELLER, Nevada
BOB CORKER, Tennessee

ROBERT M. SIMON, *Staff Director*
SAM E. FOWLER, *Chief Counsel*
MCKIE CAMPBELL, *Republican Staff Director*
KAREN K. BILLUPS, *Republican Chief Counsel*

SUBCOMMITTEE ON WATER AND POWER

JEANNE SHAHEEN, New Hampshire, *Chairman*

RON WYDEN, Oregon
TIM JOHNSON, South Dakota
MARIA CANTWELL, Washington
BERNARD SANDERS, Vermont
DEBBIE STABENOW, Michigan
JOE MANCHIN, III, West Virginia

MIKE LEE, Utah, *Ranking*
JAMES E. RISCH, Idaho
DANIEL COATS, Indiana
JOHN HOEVEN, North Dakota
DEAN HELLER, Nevada
BOB CORKER, Tennessee

JEFF BINGAMAN and LISA MURKOWSKI are Ex Officio Members of the Subcommittee

CONTENTS

STATEMENTS

	Page
Castle, Anne, Assistant Secretary of Water and Science, Department of the Interior	4
Gleick, Peter H., President, Pacific Institute, Oakland, CA	26
Hansen, L. Jerry, Principal Deputy Assistant Secretary for Installations, Energy, and Environment, U.S. Army	11
Keppen, Dan, Executive Director, Family Farm Alliance	66
Lee, Hon. Mike, U.S. Senator From Utah	1
Meeker, Melissa L., Executive Director, South Florida Water Management District, West Palm Beach, FL	49
Salzberg, Aaron, Special Coordinator on Water Resources, Bureau of Oceans and International Environmental and Scientific Affairs, Department of State	16
Shaheen, Hon. Jeanne, U.S. Senator From New Hampshire	1
Stanley, Thomas, Chief Technology Officer, GE Power and Water, Water and Process Technologies, Trevose, PA	38
Stewart, Harry T., Director, Water Division, New Hampshire Department of Environmental Services, Concord, NH	55
Willardson, Anthony, Executive Director, Western States Water Council, Murray, UT	42

APPENDIX I

Responses to additional questions	67

DOMESTIC AND GLOBAL WATER SUPPY ISSUES

THURSDAY, DECEMBER 8, 2011

U.S. SENATE,
SUBCOMMITTEE ON WATER AND POWER,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The subcommittee met, pursuant to notice, at 3:10 p.m. in room SD–366, Dirksen Senate Office Building, Hon. Jeanne Shaheen presiding.

OPENING STATEMENT OF HON. JEANNE SHAHEEN, U.S. SENATOR FROM NEW HAMPSHIRE

Senator SHAHEEN. Good afternoon, everyone. I apologize for starting late. I knew if we had a subcommittee hearing today, we would have both at the same time. So, I should have expected that.

Let me begin by thanking our panelists for being here. I'm going to also recognize Senator Bingaman, who chairs the full Energy and Natural Resources Committee. We're delighted to have him here for however long he can stay. Senator Lee has another engagement and has to leave. So, what I would like to do, Senator Lee, is ask you to go ahead and make your opening remarks, and then I will make mine, and introduce the panelists.

So, if the panelists are OK with that, Senator Lee.

STATEMENT OF HON. MIKE LEE, U.S. SENATOR FROM UTAH

Senator LEE. Thank you so much, Senator Shaheen. I appreciate your accommodating my schedule. I also want to thank our witnesses for joining us today.

I've been looking forward to this hearing and the different perspectives and opportunities before us as we look at our domestic and our global water supplies. I'm encouraged that our committee's looking at opportunities to further ensure that we have continued access to clean and reliable sources of water.

It's my intent, it has been my intent, as we've been approaching this meeting, to address a myriad of issues in connection with this hearing, to ensure that we've got these water resources for the next century, and to ensure that we respect the primacy of the States and their role, their historic and constitutional role in the allocation of water.

Although the allocation of water is and long has been a State-driven process, the Federal Government has been involved in the development of water for more than a century, particularly in the West. Projects have been built to store and to manage water, to

produce power, and reduce the impacts of floods, provide for navigation, and to help develop irrigation.

Most of these Federal projects were built with the support of local communities under the prevailing State water laws. The regulation and appropriation of water resources are and should remain within the purview of a State-driven process. As we proceed with this hearing, I want to be clear, the allocation of water is a State responsibility, fundamentally, and not a Federal one. I believe every State in this Nation faces similar challenges relating to the supply and the quality of water resources.

First, with limited fresh water supplies, how can we assure and ensure that we have an adequate and safe water supply for urban and rural communities? How do we develop affordable options to treat and further develop our finite supplies of water? I hope that our witnesses today can describe some options that are available to address these 2 questions.

Water, as it has served for the last century, will continue to be the backbone of our economy in many respects. Safe, reliable, and cost-effective supplies for water will continue to be a critical driver of all sectors of the American economy, including agriculture, industry, recreation, and that water that's used for domestic and culinary purposes.

I encourage our witnesses today to think outside the box on options to expand our water supply through new resources and through conservation efforts. In so doing, I'd also encourage our witnesses to think outside the box on how the Federal Government can best assist the States with meeting their water supply challenges.

So, I look forward to the extent that I'm able to remain for the next few minutes to hearing some of these, and—and will follow-up with my own questions in—in writing inasmuch as I'll be unable to remain for the duration of the meeting.

I want to recognize and thank Tony Willardson, who is the Executive Director of the Western States Water Council. He's from my home State of Utah, from Salt Lake City. I want to thank him especially for being here.

Finally, in closing, I want to acknowledge that—I understand that the EPA is embarking on the preparation of a report to address the value of water to the U.S. economy. I'll be following up with some questions in writing on—on how various entities that we'll be discussing today may have contributed to this study or be involved in it, and how we can follow up on that. So, with that, I'll turn it back to you, Senator Shaheen. Thank you again for accommodating my schedule.

Senator SHAHEEN. Thank you very much, Senator Lee.

As Senator Lee suggested, we're here today to explore the opportunities and challenges facing domestic and global water supplies. It is a very broad topic, but it's also one that deserves our ongoing attention, because water is critical. Yet, most of us really don't pay very much attention to the water that we use, where it comes from, where it goes after we finish using it.

Many of us in the United States take water for granted, but globally, 800 million people do not have access to safe drinking water. The figures on water use are astounding. The U.S. Geological Sur-

vey estimates that Americans use about 100 gallons of water per day. The majority of our daily water use helps generate electricity at our country's power plants, with over 200 billion gallons of water used in this sector alone.

Globally, agricultural water use accounts for nearly 70 percent of all water withdrawals. When we consider that the world's population is expected to grow from 7 billion to 10 billion people by 2050, we quickly realize the—the successful management of our water resources is critical. The State Department reports that in just 2 decades the world's demand for fresh water is expected to exceed supply by 40 percent.

There's increasing recognition that water scarcity raises tensions between Nations and may be a driver of armed conflict. Coupled with our changing climate, the future of our water supplies, both here in the U.S. and around the world, is a cause for grave concern.

In my home State of New Hampshire, the fastest growing of all the New England States, we're projected to add 260,000 new residents by 2030. While we're fortunate in New Hampshire to have abundant water supplies, we face our own challenges from increased flooding and aging infrastructure.

I'm very pleased to be able to acknowledge Harry Stewart, who is from New Hampshire, and is joining us from New Hampshire's Department of Environmental Services, where he heads the Water Resources Division, to provide the perspective from not only New Hampshire, but from the Northeastern States.

While we've seen great strides in technology to overcome water challenges, including desalinization, we don't yet have a silver bullet to overcome water scarcity. At the same time, there are innovative ways to reduce water consumption, using existing technologies. Our Armed Forces have often been trailblazers in figuring out how to do more with less. The Army's Net Zero Initiative for water is an impressive example from which we can all learn. Mr. Hansen, we're all very anxious to hear what you have to tell us.

I'm pleased to welcome our witnesses today, and look forward to hearing from them about the state of the existing technologies, the future of technological innovation, and what else we can do as a society to ensure we have adequate supplies of water for future generations.

I want to recognize our first panel, the Honorable Anne Castle, who is Assistant Secretary for Water and Science, with the Department of the Interior. Thank you for being here. Mr. Jerry Hansen, who's the Principal Deputy Assistant Secretary for Installation, Energy, and Environment, with the U.S. Army. Good afternoon. Mr. Aaron Salzberg, who's the Special Coordinator for Water Resources with the U.S. Department of State.

Before I turn it over to Ms. Castle, let me just ask Chairman Bingaman if he would like to make any remarks at the start.

The CHAIRMAN. I really didn't have any opening statement. I'm very glad to be here to learn what I can from these witnesses. I think it's a very important issue, and one that we need to understand much better. Thank you for having the hearing.

Senator SHAHEEN. Thank you.

Ms. CASTLE.

STATEMENT OF ANNE CASTLE, ASSISTANT SECRETARY OF WATER AND SCIENCE, DEPARTMENT OF THE INTERIOR

Ms. CASTLE. Thank you, Chairman Shaheen, Senator Bingaman. Thank you very much for inviting me to be here today to talk to you about the Department of the Interior's undertakings and accomplishments with respect to water scarcity, both domestically and globally.

I'll be talking specifically about the Bureau of Reclamation and the U.S. Geological Survey, the 2 agencies that I work most closely with. While it is States that allocate water supplies and control administration of use, the Federal Government has a very important role to play in leading the way to sustainability of water resources, and providing the tools that we need to get there.

The USGS is best known in the world of water for the over 7,000 stream gauges that it operates, deployed all across the country. Those stream gauges provide us with real-time stream flow information that is accessible to anyone who goes online. That information is really essential to the National Weather Service, to FEMA, to the Army Corps of Engineers, and to just about any water manager.

USGS also helps us with water imbalances, by telling us exactly how and where water is being used across the country. Every 5 years, USGS produces a report on the overall water use in the United States, and tells us what water withdrawals are used for, and what volume of water is being used for those purposes.

USGS is also drilling down on particular watersheds, and doing very detailed supply and demand inventories in existing river basins. For example, Senator Shaheen, as you know, I'm sure, USGS recently completed 2 reports on water supply and demand in the seacoast area in New Hampshire. One was looking at current and future surface water demand, based on growing population and climate change. The other was a groundwater model that was looking at projected groundwater depletions, based on both withdrawals and climate change as well.

Reclamation also has a very key role to play. It's the largest wholesaler of water in the United States, and the second largest producer of hydroelectric power. We provide drinking water to over 31 million people, and irrigation water supplies to 10 million acres of land.

Reclamation's role has really evolved over the years from being solely a constructor and operator of dams and reservoirs to being one of the co-managers of the ecosystems in which those reservoirs exist. We now know that we have to pay attention to downstream resources if we're going to fulfill our mission of providing reliable supplies of water and power.

Interior's signature initiative to lead the way toward sustainability of water supplies is our WaterSMART program. Reclamation is a key player in WaterSMART. We know that we need to develop better strategies for managing our own water supplies, but we also recognize that we have a role to play in facilitating new technology, in incentivizing conservation and reuse, and encouraging innovation for all types of water users.

One of the ways that WaterSMART does that is providing cost-share grants to help fund water conservation and reuse measures

and to incentivize technological breakthroughs. A great example of a WaterSMART grant is in Senator Lee's State, a grant that we made to the Uinta Water Conservancy District, $300,000 to fully automate its water delivery system. That's going to enable water savings of over 1,800 acre feet, and also contribute to better water sustainability in the important energy resource development of the Uinta basin of eastern Utah.

Another example of information that we provide to assist in water supply management is through USGS's earth-observing satellite system, the Landsat series of satellites. Landsat gives us remotely sensed land imagery over the entire globe, but it also allows us to very accurately estimate consumptive use of water from vegetation and crops. So, it gives us a better tool for more quickly and inexpensively estimating water use through evapotranspiration. That's a very important component of water balance.

My written testimony describes our other work, our international work in the Middle East and North Africa. It also describes our efforts to estimate the impacts of climate change on water supplies, and assess how to improve that information.

Finally, I've described our incubation of new technologies for accessing unconventional supplies of water, like seawater, or brackish groundwater, or other impaired sources, so that we can actually increase the availability of water.

As water scarcity increases, which we have every reason to believe that it will, we're trying to use a multipronged approach to create the platforms and the tools that water managers and planners need to adapt to changing conditions, and to create security for the future.

I look forward to talking with you further about this important question and to answer any of your questions. Thank you.

[The prepared statement of Ms. Castle follows:]

PREPARED STATEMENT OF ANNE CASTLE, ASSISTANT SECRETARY OF WATER AND SCIENCE, DEPARTMENT OF THE INTERIOR

Chairwoman Shaheen, Ranking Member Lee and Members of the Subcommittee, I am Anne Castle, Assistant Secretary of Water and Science at the Department of the Interior (Department). I am pleased to report on the Bureau of Reclamation's (Reclamation) and the U. S. Geological Survey's (USGS) accomplishments as they relate to the opportunities and challenges to address domestic and global water supply issues. These are areas of priority and special study at the Department and I appreciate the opportunity to share with you information on the many activities we have underway.

The USGS and Reclamation play key roles with respect to meeting our Nation's water supply challenges. Water is one of six science mission areas of the USGS and has been an essential part of the USGS mission for more than 120 years. USGS is known throughout the country for its operation of our national system of stream gauges. The USGS installed its first stream gauge in Embudo, New Mexico in 1889 and today, a network of more than 7,000 stream gauges operated in cooperation with local, state, and Federal agencies, provides real-time data important to the National Weather Service, FEMA, the U.S. Army Corps of Engineers and other Tribal, state, and local partners. Streamflow information is used for interstate and international transfers, river forecasting, water budgets, and other purposes. Stream gauge information is essential to effective and sustainable water management, as it provides necessary data to make decisions concerning the water supply.

Founded in 1879, the USGS is the Nation's largest water, earth, and biological science and civilian mapping agency. The USGS collects, monitors, analyzes, and provides scientific understanding about natural resource conditions, issues, and problems. The USGS provides impartial scientific information on the health of our ecosystems and environment, the natural hazards that threaten us, the natural re-

sources we rely on, the impacts of climate and land-use changes, and the core science systems that help us provide timely, relevant, and useable information. With a diversity of scientific expertise, the USGS carries out large-scale, multi-disciplinary investigations and provides scientific information to resource managers, planners, and other customers.

Reclamation owns and operates water projects that promote and sustain economic development within the 17 western States. The mission of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public. Since it was established in 1902, Reclamation has constructed more than 600 dams and reservoirs including Hoover Dam on the Colorado River and Grand Coulee on the Columbia River. Reclamation is the largest wholesaler of water in the country, delivering water to more than 31 million people, and providing one out of five western farmers with irrigation water for 10 million acres of farmland across the United States. Reclamation is also the second largest producer of hydroelectric power in the United States, and provides significant amounts of renewable energy to customers throughout the West.

The Department's WaterSMART Program Contributes to Water Supply Security

On February 10, 2010, Secretary Ken Salazar signed a Secretarial order establishing the Department 's WaterSMART Initiative. The "SMART" in WaterSMART stands for "Sustain and Manage America's Resources for Tomorrow." The WaterSMART Program includes WaterSMART cost share grants (Water and Energy Efficiency Grants, System Optimization Review Grants, Advanced Water Treatment and Pilot and Demonstration Project Grants, and Grants to Develop Climate Analysis Tools), Reclamation's Basin Studies, Landscape Conservation Cooperatives, West-Wide Climate Risk Assessments, the Title XVI Water Reclamation and Recycling program, the Cooperative Watershed Management Program, the Water Conservation Field Service Program, USGS's Water Availability and Use Assessments, and the WaterSMART Clearinghouse. Through the WaterSMART Program, the Department works with states, tribes, local governments, and non-governmental organizations to secure and stretch water supplies for use by existing and future generations to benefit people, the economy, and the environment and will identify measures needed to address climate change and future demands.

Rapid population growth, depletion of groundwater resources, impaired water quality, water needed for human and environmental uses, and climate variability all play a role in determining the amount of fresh water available at any given place and time. Water shortage and water-use conflicts have increasingly become commonplace in many areas of the United States. As competition for water resources grows—for irrigation of crops, growing cities and communities, energy production, and the environment—the need for information, tools, and technology to aid water resource managers also grows.

Through the Basin Study Program, Reclamation and its partners are conducting studies of the supply and demand for water in 12 basins throughout the West, including the Colorado River Basin, the Yakima River Basin, and the St. Mary and Milk River Basins. Subsequent West-Wide Climate Risk Assessments will provide hydrologic projections that water managers can utilize to adapt to climate change and other resource management challenges.

Reclamation's Title XVI Program provides opportunities to reclaim and reuse wastewater and naturally impaired ground and surface water in the 17 western States and Hawaii, providing flexibility during water shortages by reusing water typically available during drought periods. Recent examples of Title XVI projects that use technology to create new drought resistant sources of water include the Santa Clara Valley Water District's South Bay Advanced Water Treatment Plant. The plant will use microfiltration, reverse osmosis, and ultra violet disinfection techniques to produce up to 10 million gallons per day of recycled water from wastewater to help meet the Silicon Valley's future water demands. Similarly, the Long Beach Water Department is using the Title XVI Program to develop and test a new double-pass nanofiltration system to desalinate seawater to drinking water quality. The demonstration phase has been completed, and the process has been shown to result in energy savings when compared to reverse osmosis processes.

USGS's WaterSMART program includes the ongoing Water Census Program which is designed to provide a comprehensive examination of water availability in the United States. An initial Water Census pilot project for the Great Lakes Basin was completed in 2011 (http://water.usgs.gov/wateravailability/greatlakes/). The pilot provides an indication of the detailed information that will be generated through the Program. In general, USGS's water programs provide information designed to quan-

tify water availability, understand ecological needs for water, and improve the ability to accurately measure consumptive uses.

The Department's Actions to Address Water Supply Uncertainties Relating to a Changing Climate

The Department has released two reports this year as called for by Sections 9503 and 9506 of the SECURE Water Act, P.L. 111-11, which was enacted to develop tools to help resource managers secure adequate and safe supplies of water. Reclamation's Section 9503 Report synthesized existing peer-reviewed literature on climate change and included an original assessment of climate change implications for snowpack and natural hydrology in eight major Reclamation river basins (http://www.usbr.gov/climate/SECURE/docs/SECUREWaterReport.pdf). Projections of future precipitation indicate that the northern and north-central portions of the United States may gradually become wetter while the southwestern and south-central portions may gradually become drier. Projections also suggest that warming and associated loss of snowpack will persist over much of the western United States. This loss of snowpack storage is expected to result in a decrease in the amount of reliable water supply in areas where snow has been a major component of the hydrologic system.

The Section 9506 report, titled Strengthening the Scientific Understanding of Climate Change Impacts on Freshwater Resources of the United States, was prepared by a Federal interagency panel led by the USGS and developed in concert with the Council on Environmental Quality, the National Oceanic and Atmospheric Administration, and the Office of Science and Technology Policy. The report reviews the state of existing science and identifies strategies for improving systems to collect climate-related data and water monitoring information. The recommendations are intended to help water managers predict, respond and adapt to the effects of climate change on the Nation's freshwater supplies so that they can help ensure adequate water quantity and quality. Recommendations include a need to strengthen the Nation's water monitoring systems, including both ground-and space-based systems.[1]

The Department's River Restoration Activities and Species Recovery Programs Enhance Water Supply Security

In addition to developing tools to address uncertain climatic conditions, an important aspect of Reclamation's mission is to ensure reliability of water supplies through its river restoration programs. In order to continue to deliver water and generate power, Reclamation must address the environmental effects associated with its projects. These ongoing restoration efforts provide certainty to water users, enhancement to the environment, and economic benefits to the surrounding communities. A 2009 economic report prepared for the Department concludes that every one million dollars we invest in ecosystem restoration yields approximately 30 jobs.[2]

USGS provides scientific expertise and support to restoration and species recovery programs and is an active participant in major ecosystem restoration programs that protect drinking water supplies, irrigation and industrial water uses, and maintain a healthy environment. USGS conducts research and monitoring to develop and convey a fundamental understanding of ecosystem function and distributions, and to evaluate the physical and biological components of freshwater, terrestrial, and marine ecosystems and the human and biotic communities they support.

Landsat Imagery Contributes to Our Understanding of Water Use and Availability

An additional example of technology that assists water supply management is USGS's Earth-observing satellite, called Landsat, which has been providing sustained remotely-sensed land data for the entire planet since 1972. One of the many valuable uses of Landsat is to enable water managers to "see" evapotranspiration and estimate consumptive water use from irrigation. The States of Idaho and Arizona use this satellite data for this purpose, which has proven to be much cheaper than traditional methods of measuring consumptive use.

One thing that makes Landsat unique is its temporal resolution, which is a measurement of how often it takes an image of each square meter of the Earth's surface. Until recently, Landsat captured an image about once every 8 days which is useful for evaluating the ongoing changes to the western landscape and patterns of water use. In November of this year however, one of the two Landsat satellites (Landsat 5) became inoperative after breaking records for longevity, and the temporal resolution was cut in half. An eighth Landsat is scheduled to launch in early 2013 and

[1] http://www.doi.gov/news/pressreleases/loader.cfm?csModule=security/getfile&pageid=260567
[2] http://www.doi.gov/news/pressreleases/loader.cfm?csModule=security/getfile&PageID=22612

critical steps are being taken to plan for the next satellite. Maintaining the continuity of the data is essential to water managers that rely on it.

Research and Development Activities Help Develop Tools to Address Water Supply Challenges

In addition to recognizing the importance of gathering information and developing strategies to better manage water supplies, the Department recognizes that technology, efficiency, and innovation will be central to maximizing water supplies in the years ahead. Federal investments in the research, development and demonstration of water conservation and reuse technologies can be catalysts in the creation of U.S. jobs, and can strengthen the competitiveness of U.S. industries in a global economy. Federal investments in research, development and demonstration projects can lead to breakthroughs in science and engineering, which can create foundations for new industries, new companies and new jobs. For example, Reclamation has been engaged in funding research, development and demonstration technologies to address water shortages which have been instrumental in facilitating the expansion of the U.S. market for water conservation technologies. Through its Desalination and Water Purification Research and Development Program, Reclamation has provided grant money to a consortium of U.S. membrane manufacturers to evaluate a "standard" diameter for large reverse osmosis elements. The consortium developed a 16-inch standard diameter element that has been adopted for large capacity plants such as Singapore's 2.6 million gallon per day Power Seraya project and the new 108.5 million gallon per day desalination project in Sorek, Israel, which may also be used elsewhere.

Similarly, Reclamation's Advanced Water Treatment grants Program for strategic, targeted water management improvements, encourages the use of innovative technologies that address water supply sustainability. Loving County, Texas is using WaterSMART Grant funding this year to begin a field-installed pilot project to evaluate the viability of using wind powered vapor compression technology to treat brackish groundwater. In California, the Richvale Irrigation District is implementing an online Geographic Information System and irrigation flow-event recording system using WaterSMART Grant funding. The project will enable the district to improve flow management, reduce leaks and spills, and conserve water by providing continuous feedback on water consumption to growers and is projected to save 11,500 acre-feet of water annually.

The Department has a history of supporting research and development efforts to create and improve water purification technologies to encourage new water supplies, including highly purified brackish water, seawater, and wastewater. The Department recognizes the growing importance of unconventional water sources and that research and development must be a priority now in order to make these options more certain and sustainable for the future. The USGS's Water mission are includes the National Research Program which develops technology and insights regarding varied and complex hydrologic and ecological processes that are important for protecting and enhancing the Nation's water resources and the ecosystems they support. USGS scientists are conducting a wide variety of research and development activities to study water scarcity. A few examples are discussed below.

- Purification of water using solar energy—An example of new technology that directly addresses water scarcity is the solar distillation loop (US Patent No. 7,108,769). This invention provides a low-energy, inexpensive process for water purification and is designed to help solve the complex problems associated with water scarcity, increasing water conveyance costs, and regional accumulation of salts in soils resulting from irrigation.
- Changes in snowpack runoff—The western United States depends heavily on runoff from snowpack melt to store wintertime precipitation into the drier spring and summer months. USGS scientists have been conducting research to document the shift towards earlier runoff that is caused by (1) more precipitation falling as rain instead of snow and (2) earlier or faster snowmelt. Results of this work will impact the manner in which water is managed in the West.
- Water sustainability in the Southwest United States—The USGS has investigated the potential effects of specific levels of climate warming on streamflow in the Colorado 6 River basin using a water-balance model. This work supports both WaterSMART activities, as well as Reclamation's Colorado River Basin Study.
- Drought—Climate, droughts and streamflow patterns are all interdependent. USGS research is documenting regional, national, and global spatial patterns of drought. Coping with a prolonged drought is anticipated to be difficult, particularly in the arid and semi-arid West, where water demand has increased significantly and water supplies are likely to be insufficient for demand. Severe

drought conditions have also affected the East in recent years. Understanding drought frequency, duration, and severity are key to meeting water demands.

Reclamation conducts research and development of technologies such as membranes and advanced treatment for water reuse and desalination represents innovation in an area that may be one of our best opportunities to create 'new' water supplies that benefit both inland and coastal areas here in the U.S. and around the world. In 2008, the National Academy of Sciences released a two-year study, sponsored by Reclamation and the Environmental Protection Agency, which looked at the role of desalination in contributing to the Nation's water supply. The study resulted in recommendations for two overarching goals: 1) to understand the environmental impacts of desalination and develop approaches to minimize these impacts relative to other water supply alternatives; and 2) develop approaches to lower the financial costs of desalination so that it is an attractive option relative to other alternatives in locations where traditional sources of water are inadequate. The recommendations form the basis for Reclamation's advanced water treatment technology initiatives.

Reclamation has a number of initiatives that develop and apply advanced water treatment technologies in water scarce regions with involvement that ranges from funding and partnerships for laboratory studies, to prototyping new concepts, to assisting other federal agencies and organizations around the world. One Reclamation project that incorporates advanced water treatment and technology research is the Yuma Desalting Plant in Arizona and its adjoining Water Quality Improvement Center.

The Yuma Desalting Plant was constructed under the authority of the Colorado River Basin Salinity Control Act of 1974 to recover agricultural return flows that bypass the Colorado River. Due to budget constraints as well as sufficient water supplies on the lower Colorado River prior to the current drought, the plant has been maintained, but not operated except for brief periods. Working with the Metropolitan Water District of Southern California (MWD), Southern Nevada Water Authority (SNWA), and Central Arizona Water Conservation District (CAWCD), the Colorado River Basin states and other parties, in March 2011 Reclamation concluded a successful pilot run of the plant under budget and ahead of schedule to recycle approximately 30,000 AF of irrigation return flow water that was used to help meet the U.S.'s 1944 Water Treaty to deliver Colorado River water to Mexico and to provide flows for the Ciénega de Santa Clara (Ciénega), a wetland in Mexico. The Ciénega is now home to more than 350 bird species and habitat for thousands of migratory and resident birds—an accomplishment that has set the stage for future collaboration with Mexico.

In October 2011, Reclamation announced a number of awards under its Desalination and Water Purification Research Program, using $1.5 million of Federal funds to support nearly $2.8 million for use in research projects, including five new projects and two projects that are receiving continuing funding for their second phase. The projects help to reduce environmental impacts, integrate renewable energy, reduce long-term costs, expand scientific understanding, and test pilot and demonstration-scale projects. Examples include a project to design and test a pressure regulation subsystem for a wave-driven desalination system being carried out by a company in Boston, Massachusetts. This system will be used in conjunction with a seawater reverse osmosis system powered by ocean wave energy to create a clean and cost-effective alternative to diesel-driven desalination systems.

A number of projects are also being carried out at Reclamation's Brackish Groundwater National Desalination Research Facility in Alamogordo, New Mexico. New Mexico State University with the Office of Naval Research is funding students and faculty to work with General Electric and their researchers on electrodialysis, to develop a more affordable desalination system for small users. Additionally, the University of Texas at El Paso with Veolia Water Systems received a second year of demonstration funding to continue the commercialization of a brackish desalination system that would recover approximately 98% of the brackish water rather than the conventional 70%.

Addressing the Energy/Water Nexus

There is no dispute that water shortages can affect energy production and energy production can impact water supplies. Through the WaterSMART Program, the Department is committed to integrating energy and water policies to promote the sustainable use of all resources, including incorporating water conservation criteria and the water/energy nexus into the Department's planning efforts. WaterSMART specifically recognizes that water and energy are inextricably linked and that water conservation can yield significant energy conservation benefits too. For example, Reclamation's Water and Energy Efficiency grant program recognizes the connection

and has prioritized funding for projects that include energy savings in addition to water savings. The most recent grant awards included 25 projects that included energy savings in addition to water savings.

USGS plays an integral role with respect to understanding the constraints and impacts involved in the relationship between energy and water. For example, USGS evaluates water consumption of thermoelectric power plants as part of its water use assessments and is working with industry and the U.S. Energy Information Administration to evaluate the water uses associated with different technologies. USGS expects to have a report completed in 2012 regarding classifications of various cooling technologies and methodologies for estimating consumptive uses. USGS also conducts water quality and quantity monitoring in connection with oil and gas development. This subcommittee recently heard testimony from USGS relating to shale gas production and water resources in the eastern United States. USGS is currently coordinating with other agencies, including the Department of Energy and the Environmental Protection Agency to address human and environmental health and safety concerns in the development of shale gas resources. In the West, USGS is working with the Bureau of Land Management (BLM) on groundwater and surface water monitoring in oil and gas development areas in Colorado and Wyoming. USGS is also working with BLM on evaluating impacts relating to renewable energy development such as solar power in the southwest to ensure that development plans address water supply constraints.

Efforts to Address International Water Supply Issues

Though Reclamation's efforts are primarily focused in the 17 western states, what is learned in one part of the world is rapidly transferred to other regions with similar needs. As one example of Reclamation's international efforts, in coordination with the Department of State, Reclamation worked toward the creation and operation of the Middle East Desalination Research Center (MEDRC) in Muscat, Oman as a tangible part of the Middle East Peace Process. This year, Reclamation participated with the State of Israel in an audit of MEDRC policies and procedures. Reclamation recently updated an Interagency Agreement with the Department of State to provide technical assistance to MEDRC as well as to provide technical assistance as 'new' water infrastructure is developed by the Palestinians, Jordanians, and Israelis utilizing desalination and water reuse. Through the same agreement, Reclamation has been providing preliminary advice on the Red Sea Dead Sea mega desalination and energy project.

USGS works with the Department of State and the Department of Defense in many countries, including Afghanistan, Ethiopia, Haiti, India, Iraq, Pakistan, and Sudan, to support local and national efforts to better understand and manage water resources. USGS's international efforts include a focus on the ability to exchange water data across nations and to interpret the data with common protocols. A summary of USGS's International Water Resources Branch activities is found at: http://water.usgs.gov/international/. USGS is actively participating in the work of the Open Geospatial Consortium jointly with the World Meteorology Organization to develop and apply standards for describing and distributing water data from any database (whether local, national or International) such as those of the USGS National Water Information System. In 2010, the USGS released the results of a collaborative effort with the Afghanistan Geological Survey and the Afghanistan Ministry of Energy and Water, and supported by the United States Agency for International Development, to study water resources in the Kabul Basin. Because of the decades-long gap in the record of hydrologic and climatic observations due to war and civil strife, the investigation made use of remotely sensed data and satellite imagery, including glacier and climatic data, in addition to recent geologic investigations, analysis of streamflow data, groundwater-level analysis, surface-water-and groundwater-quality data, and estimates of public-supply and agricultural water uses.

Other international examples include work in Iraq, where the USGS recently provided training on groundwater assessment methodologies and helped to develop basin wide water availability methodologies using remote sensing techniques. In addition, since 1988 the USGS, at the request of the U. S Embassy, has been partnering with the National Drilling Company of the Abu Dhabi Emirate to collect information on the ground-water resources of the Emirate, to conduct research on the hydrology of the arid environment, to provide training in water-resources investigations, and to document the results of the cooperative work in scientific publications.

Conclusion

In conclusion, as water scarcity increases throughout the world, the Department of the Interior's efforts to create and utilize new technologies are helping to firm

up water supplies for agricultural, municipal, industrial, and environmental needs. State governments administer water use within their borders and state law determines allocations and allowable uses. But the Federal government has a responsibility to provide leadership and tools to address the challenges of imbalance between supply and demand. We can provide incentives to encourage water conservation and reuse, leadership in new technology to increase usable supplies, and assistance for ecosystem restoration efforts that increase the certainty of water supplies for the future. All of these efforts depend on partnerships with local utilities, states, tribes, and foreign allies. The Department aims to continue generating positive, concrete results from these efforts and to help communities in managing opportunities and challenges for a secure water future.

I would be pleased to answer any questions the Subcommittee may have.

Senator SHAHEEN. Thank you very much.

Mr. HANSEN.

STATEMENT OF L. JERRY HANSEN, PRINCIPAL DEPUTY ASSISTANT SECRETARY FOR INSTALLATIONS, ENERGY, AND ENVIRONMENT, U.S. ARMY

Mr. HANSEN. Thank you, ma'am.

Madam Chairwoman, Senator Bingaman, it's a pleasure today to appear to discuss water scarcity and how the Army's water-related programs, and particularly our efforts to create net zero installations and reduce water requirements in contingency operations that are part of the solution. We're especially grateful for this committee's interest in the Army's energy and water reduction programs. We believe the committee's ongoing efforts, coupled with the President's vision for sustainability, will help our installations accomplish their worldwide missions now and into the future without disruption.

The Army faces significant manmade and natural threats to our energy and water supply requirements, both at home and abroad. Just this past year, Army installations have faced a tsunami, earthquake in Japan, tornadoes in the South, and droughts in the West. We must address these threats and work to ensure that the Army of tomorrow has the same access to resources as the Army of today.

Addressing sustainability is operationally necessary, financially prudent, and essential to mission accomplishment. We are creating a culture that recognizes the value of sustainability, measured not just in terms of financial benefits, but benefits to maintaining mission capability, quality of life, relationships with local communities, and the preservation of options for the Army's future.

The Army's proud to lead the way in meeting water intensity reductions in the Energy Policy Act of 2005. Our installation of water intensity has dropped from 57.6 gallons per gross square foot in 2007 to 48.8 in 2010.

The centerpiece of our program, to appropriately manage our natural resources, is our net zero program. A net zero water installation limits the consumption of fresh water resources and returns water back to the same watershed, so as not to deplete the groundwater and surface water resources of that region in quantity and quality over the course of a year. We have pilot installations identified and net zero energy and net zero waste, as well as net zero water.

The net zero water strategy balances water availability and use to ensure a sustainable water supply for years to come. This con-

cept is of increasing importance, and scarcity of clean potable water is quickly becoming a serious issue in many areas.

The continued drawdown of major aquifers results in significant problems for—for our future. Strategies such as harvesting rainwater and recycling discharge water for reuse will reduce our need for municipal water and also reduce our discharges of storm water or treated wastewater.

In addition to the net zero initiative, our water security mission makes water a consideration in all Army activities. To increase efficiency, reduce demand, seek alternative sources, and create a culture of water accountability, while sustaining or enhancing operational capabilities.

For example, Installation Management Command will be holding users accountable to modernize facilities, install new technologies, and leverage partnerships that can provide an increased level of water security. This will lead to increased sustainability, a more resilient water-related infrastructure, and enhance mission assurance.

The Army has identified 8 installations as net zero water pilot sites. Let me highlight just 2 examples of interest to committee members. First, is Camp Rilea, Oregon. This 281,000-acre installation is striving to reach net zero water by successfully redesigning their water supply and wastewater capability, so that they can operate independent of the existing municipal supply, if needed, to keep the North Coast Energy Operation Center operable 24/7.

Camp Rilea also recently installed several rapid infiltration basins to simultaneously supplement their existing reclaimed water reuse capabilities, and comply with regulatory requirements for wastewater discharge.

Second, Joint Base Lewis-McChord, in Washington. Joint Base Lewis-McChord has requested funding for replacing an aging and obsolete wastewater treatment plant at their installation. The proposed new plant will generate class A reclaimed water, which can then be reused as part of the net zero initiative. The project is designed to reduce or eliminate storm water discharges into a creek and reuse it. Joint Base Lewis McChord is including storm water in its net zero goals. The installation has been meeting the EO—Executive Order 135104 required water use reduction of 2 percent per year, mostly through water conservation projects, reducing the amount of water used for irrigation.

In parallel to net zero water, the—the Army is also implementing solutions to reduce water use in our contingency operations. Reducing water use directly decreases the threats to our convoys, because 70 to 80 percent of our resupply weight or convoy weight is fuel and water.

Less water means fewer convoys, which means fewer soldiers are placed at risk. Deploying technology at our contingency bases, such as the Shallow Water Reuse System, makes the Army more efficient and directly enhances the mission. The magnitude of water savings associated with the Shower Water Reuse System deployed at a 600–man force provider tent city are pretty impressive. In many cases, the system produces a simple economic payback for less than a week of use. From the net zero water pilots and contingency base initiatives, we'll be collecting best management prac-

tices and lessons learned, and we will share these as widely as possible.

Madam Chairwoman, this completes my statement. Thank you again for the opportunity to appear before you today. I'll look forward to your questions. I also have an Army vision for net zero folder, 2 pages, that I'll be happy to provide for the record, if you'd like.

[The prepared statement of Mr. Hansen follows:]

PREPARED STATEMENT OF L. JERRY HANSEN, PRINCINPAL DEPUTY ASSISTANT SECRETARY FOR INSTALLATIONS, ENERGY, AND ENVIRONMENT, U.S. ARMY

INTRODUCTION

Madam Chairwoman and members of the Committee, it is a pleasure to appear before you to discuss the Army's water related programs, particularly our efforts to create net zero installations. We are especially grateful for this Committee's continued support for the Army's energy and water reduction programs. The Committee's on-going efforts, coupled with the President's vision for sustainability, marked by increased energy and water efficiencies, and reductions in the generation of solid waste, will ensure that our installations are able to accomplish their world-wide missions now and into the future without disruption.

BACKGROUND

The Army's vision is to appropriately manage our natural resources with a goal of net zero installations. Today, the Army faces significant threats to our energy and water supply requirements both at home and abroad. Addressing sustainability is operationally necessary, financially prudent, and essential to mission accomplishment. The goal is to manage our installations not only for water efficiency, but also energy efficiency, and solid waste reduction. We are creating a culture that recognizes the value of sustainability measured not just in terms of financial benefits, but benefits to maintaining mission capability, quality of life, relationships with local communities, and the preservation of options for the Army's future. The Army is making investments on our installations by improving efficiencies in energy, water, and reducing waste for the benefit of the Nation and, provide current and future Soldiers with the maximum amount of flexibility possible to address the Nation's security needs.

ARMY INSTALLATION WATER PROGRAM

In addition to our installation to become net zero initiative, our water security mission makes water a consideration in all Army activities in an effort to increase efficiency, reduce demand, seek alternative sources, and create a culture of water accountability while sustaining or enhancing operational capabilities. For example, in the Installation Management Command, which manages the majority of Army installations one of their strategic goals is to maintain water efficiency by holding users accountable to modernize facilities, install new technologies, and leverage partnerships that can provide an increased level of water security. This will lead to increased sustainability, a more resilient water-related infrastructure, and enhanced mission assurance. The trend in our installation water intensity (Gallons/Gross Square Foot), 2007—57.6, 2008—54.0, 2009—58.2, and 2010—48.8, has decreased over the last four years for which data are available. The Army is a leader amongst all Federal Agencies in regards to meeting the water intensity reductions in the Energy Policy Act of 2005. In fact, based on data from the Federal Energy Management Program, were it not for the Army's superior performance with water intensity reductions in the last two years, the Federal Government as a whole would not have met its Congressionally mandated water intensity targets.

To meet the challenges of limited and stressed potable water sources, we will continue to plan and implement, particularly net zero, that recognize water as a strategic resource. Enhancing water conservation and management, and creating awareness are basic responsibilities of every Army Soldier and civilian. Success depends on individual and organizational accountability for improved performance through implementation of solutions to meet current and future water security challenges. Changing our behavior in how we view and use water is central to our continued success.

NET ZERO WATER

Earlier this year, we asked for nominations from throughout the Army for installations that were interested in being becoming net zero energy, water, and/or waste pilot. We received applications from 60 installations. For net zero water, we evaluated 23 applications from across the U.S. and across multiple Army commands. A total of eight installations were identified as net zero water pilots including Aberdeen Providing Ground, Maryland; Camp Rilea, Oregon; Fort Buchannan, Puerto Rico; Fort Riley Kansas; Joint Base Lewis McChord, Washington; Tobyhanna Army Depot, Pennsylvania; Fort Carson, Colorado; and Fort Bliss, Texas and New Mexico. While each installation is unique and has specific needs based on their location and function, the net zero water pilot initiative brings them together to share information and strategies, and will provide a model for other installations that are working on their own sustainability efforts.

The net zero water strategy balances water availability and use to ensure a sustainable water supply for years to come. This concept is of increasing importance since scarcity of clean potable water is quickly becoming a serious issue in many areas. The continued draw-down of major aquifers results in significant problems for our future. Strategies such as harvesting rain water and recycling discharge water for reuse is reducing the need for municipal water, exported sewage, or storm water.

To achieve a net zero water installation, efforts begin with conservation followed by efficiency in use and improved integrity of distribution systems. Water is repurposed by using gray water generated from sources such as showers, sinks, and laundries and by capturing precipitation and storm water runoff for on-site use. Wastewater can be treated and reclaimed for other uses or recharged into groundwater aquifers. Several Army installations are already well down the path to reaching net zero water goals.

MULTI-AGENCY COLLABROATION

While the Army possess a significant amount of in-house expertise in water, including offices within the U.S. Army Corps of Engineers that we are working with including the Construction Engineering Research Laboratory in Champaign, Illinois, and the U.S. Army Engineering and Support Center in Huntsville, Alabama, there is considerable expertise elsewhere in the federal government that we are also drawing on.

We have reached out to the federal Environmental Protection Agency's Office of Research and Development to assist the Army with the net zero initiative. Ms. Katherine Hammack, the ASA(IE&E) and Dr. Paul Anastas, the EPA's Assistant Administrator for Research and Development, and the Science Advisor to the Administrator, signed a Memorandum of Understanding on 28 November 2011 to formalize the collaboration. We will work jointly to advance the development of new applications and technologies that can be used as we strive towards net zero energy, water, and waste. We will explore technologies and approaches that (1) increase efficiency and recovery of energy, water, and materials, (2) incorporate design and use of Green Infrastructure, (3) address the energy/water nexus, (4) addresses social and behavioral components, (5) aid in our understanding of water, energy, and material flows and interactions, and (6) incorporate water and energy security and climate-ready solutions.

We are also working with the Department of Energy's Pacific Northwest National Laboratory (PNNL) within the context of the Department of Defense and Department of Energy's Memorandum of Understanding to draw on PNNL's expertise in water efficiency. PNNL will begin by performing a water balance assessment for each of the net zero water pilots. A water balance (Figure 1*) compares the total water supplied to the installation to the actual water consumed by equipment and processes such as industrial, landscaping, and residential use. The water balance will identify the largest water consumers and assist in identifying problem areas such as high leak rates in the water distribution system.

Background information will be collected on an installation's overall water supply, wastewater discharge, and building inventory. This information provides historic installation water use trends and specific trends in water use at the building level. Following the background information collection, building and process walk-through audits will be conducted to provide information to estimate water use by end-use. These data are then used to develop the water balance providing an estimate of water use by major end-use category.

---

*All figures have been retained in subcommittee files.

Based on results from the water balance, a strategic project road map will be created (Figure 2). The road map will identify net zero water projects that will have the greatest affect on overall water demand reduction and will move the installation towards net zero. Projects will include a mix of efficient technologies and projects that target alternate water sources, such as gray water, that will replace the use of freshwater resources, such as those that draw raw water from rivers or lakes. There will be an emphasis on demand reduction and then alternate water source projects. After completion of the economic analysis of the net zero water projects, the road map will provide a list of projects to be programmed into the Army budgets and will assist in identifying other possible funding sources. Each installation's master planning activity will be part of the creation of the road map so that the installations current master plans are well integrated into their net zero water program.

CONTINGENCY BASE WATER

In parallel to the net zero water pilot initiative, the Army is also examining ways to reduce water use in contingency operations. Reducing water use directly decreases the threats to our convoys because 70 to 80 percent of our resupply weight or convoy weight is fuel and water. Less water means, fewer convoys which means fewer Soldiers are placed at risk. As with our U.S. based installations, we know that our budgets are going to be coming down and we are strategizing how to do more with less. Deploying technology at our contingency bases that makes the Army more efficient, such as the Shower Water Reuse System (SWRS), demonstrates our commitment to use resources more efficiently and directly enhances the mission. The SWRS works by taking waste or graywater and recycling it for future use. To accomplish this, the SWRS takes the soiled shower water and runs it through a series of filters, membranes, and chemicals. The water distributed from this system is within potable quality standards, although while technically potable, the Surgeon General has only approved it for reuse within the shower.

The SWRS can treat up to 12,000 gallons of water per day and returns 75 percent of it for reuse. When the system is used at full capacity, 9,000 gallons of water are saved per day. Spread over an entire year, the Army could recognize a potential savings of more than 3.2 million gallons of water in just one shower facility.

Most contingency bases are not near accessible water supplies and need to be constantly resupplied. The cost of water per gallon in a war zone is extremely high. Once all factors are added up, one gallon of water delivered to a base in Afghanistan can cost anywhere from $5 to $30. This is what makes the SWRS such a force multiplier. By drastically reducing the amount of water needed to be resupplied, it returns more Soldiers to the field and lessens the burden on combat forces due to the coming drawdown.

The SWRS is currently undergoing additional field testing at the Army's recently opened Base Camp System Integration Laboratory (SIL) at Fort Devens, Massachusetts. The SIL is designed to enable the Army and the joint services to evaluate future technologies in a live Soldier environment, providing solutions to reduce the energy and water demand and logistical burden on base camps in Afghanistan.

The four-acre SIL is fully instrumented to measure water, fuel, and power use, forging the path for increased energy efficiency and base camp commonality. While the SWRS has already undergone two years of mission testing, evaluation at the SIL will be slightly different. We are currently working with Pennsylvania State University to create a way to filter laundry water in the same water reuse unit. If successful, the laundry water filter will be added on to the SWRS in the field. By Spring 2012, 54 SWRSs will be fielded to units in Afghanistan. Each SWRS system costs roughly $170,000. If used at its full capacity, the Army could realize a potential savings of millions of dollars per unit each year. It is this type of innovation that the Army is implementing to enhance capability and do more with less.

CONCLUSION

Through our installation water goals, the net zero initiative, and technologies such as the Shower Water Reuse System, the Army is researching innovative technological solutions coupled with changes in culture to achieve greater efficiencies in water. Thus, throughout the Army, we are focused on identifying ways to decrease the Army's water footprint across its entire global mission. From the net zero water pilots and contingency basing initiatives, we will be collecting best management practices and lessons learned throughout and will seek to share these across the Army, other Services, other federal agencies, and any other organizations that might find these practices useful for their own sustainability programs.

Madam Chairwoman, this concludes my statement. Thank you again for the opportunity to appear before you today. I look forward to your questions.

Senator SHAHEEN. Thank you very much. We would like that very much for the record. Thank you, Mr. Hansen.

Mr. SALZBERG.

STATEMENT OF AARON SALZBERG, SPECIAL COORDINATOR ON WATER RESOURCES, BUREAU OF OCEANS AND INTERNATIONAL ENVIRONMENTAL AND SCIENTIFIC AFFAIRS, DEPARTMENT OF STATE

Mr. SALZBERG. Thank you, Madam Chair, Senator Bingaman. I, too, appreciate the opportunity to appear before you today.

As Secretary Clinton has noted, perhaps there's no 2 issues are more important to human health, economic growth, and peace and security than access to basic sanitation and sustainable supplies of water. Yet, as you pointed out, today, over 884 million people lack access to safe drinking water, and over 2-1/2 billion people lack access to basic sanitation. Each day, nearly 4,000 people, most children under 5, die from preventable diarrheal diseases caused by contaminated water. Not surprisingly, women and girls are most affected.

In addition to the health impacts, water will affect our ability to protect the environment, achieve food and energy security, and respond to climate change. Competition for water and the lack of access to basic water and sanitation services may become a source of conflict and a contributing factor to State fragility and failure.

While these statistics are grim, there is hope. In most places, there is enough water to meet demands. What's lacking is a commitment to sound water resources management and to meeting the basic water and sanitation needs of the people. To address these challenges, the United States is working internationally to help countries achieve water security. This means ensuring that people have reliable and sustainable access to the water they need, when they need it, where they need it, while reducing the risks from extreme hydrological events.

To achieve this goal, the United States is working to increase access to safe drinking water and sanitation, improve water resources management, and mitigate the tensions associated with shared waters.

Last year, Secretary Clinton outlined 5 primary areas of action for our work on water. First, to build and strengthen institutional and human capacity at the local, and national, and regional levels. Countries and communities must take the lead in securing their own water future. We need to help build their capacity so they can do so.

Second, increase and better coordinate our diplomatic efforts. We need to work to raise international awareness, to encourage developing countries, to prioritize water and sanitation, and national plans and budgets, and to integrate water into global food security, health, and climate change initiatives.

Third, mobilize financial support. This is going to require resources. In many cases, there is capital within developing countries. We need to work to mobilize these resources toward water and sanitation infrastructure by strengthening local capital markets, providing credit enhancements, and exploring other avenues for support.

Fourth, promote science and technology. Madam Chair, you're right, there is no silver bullet. That said, science and technology can have a huge impact. We need to work hard to incentivize the development of technologies that can make a difference at scale, and to share U.S. experience and knowledge with the rest of the world.

Finally, fifth, build and sustain partnerships. We, the U.S. Government—we cannot solve this problem alone. As you've already heard, there's a great deal of knowledge and experience that lies within the U.S. technical agencies, the private sector, the U.S.-based non-profit community. We need a whole-of-government, a whole-of-America approach, and stronger partnerships with the non- governmental community.

I'll stop here, but I'll leave you with a quote from Secretary Clinton. She said, "It's not every day that you find an issue where effective diplomacy and development will allow you to save millions of lives, feed the hungry, empower women, advance our national security interests, protect the environment, and demonstrate to billions of people that the United States cares, cares about you and your welfare. Water is that issue."

We look forward to continuing our work with the members of the subcommittee, USAID, other U.S. Government agencies, and interested stakeholders to improve water resources management and to get safe water and basic sanitation to the billions of people who are currently without.

Madam Chair, with your permission, I would like to submit my full remarks for the record, and thank you again for the opportunity to testify on behalf of the Department of State.

[The prepared statement of Mr. Salzberg follows:]

PREPARED STATEMENT OF AARON SALZBERG, SPECIAL COORDINATOR ON WATER RESOURCES, BUREAU OF OCEANS AND INTERNATIONAL ENVIRONMENTAL AND SCIENTIFIC, DEPARTMENT OF STATE

Chairperson Shaheen and other Members of the Water and Power Subcommittee, I appreciate the opportunity to appear before you today to discuss the global water challenge. As Secretary Clinton has noted, perhaps no two issues are more important to human health, economic growth and peace and security than basic sanitation and access to sustainable supplies of water.

The Challenge of Water

Both at home and abroad, water security is becoming one of the great challenges of our time. Today, an estimated 884 million people lack access to an ″improved″ drinking water source. (Improved drinking water sources include piped water, a borehole, or a protected dug well. We don't know how many people lack access to "safe" water—drinking water quality is not measured globally.) More than two and a half billion people lack access to basic sanitation. While we are making some progress—particularly in increasing access to improved drinking water sources - over 1 billion people still defecate in the open. Each day, nearly 4,000 people die from diarrheal diseases which remain the second leading cause of death in children under five worldwide. Many of these deaths are preventable: increased access to safe drinking water, sanitation and hygiene (WASH) can reduce diarrheal disease by 30-40%. These interventions can also reduce or eliminate morbidity associated with water-related neglected tropical diseases such as Guinea worm disease, trachoma, and schistosomiasis.

Women and children are disproportionately impacted by these issues. Women and girls often bear the primary responsibility for meeting the water needs of the family—they often spend hours every day collecting water, with the consequence of foregoing other economic and educational opportunities. Similarly, the burden of tending to family members sickened by diarrheal diseases falls primarily on women. In some areas, collecting water consumes up to five hours per day and involves walking

more than two miles carrying over 40 pounds of water. Collecting water can often involve walking through isolated, unsafe areas that expose women and girls to health and safety risks. Girls are also more likely to stop attending school when appropriate sanitation facilities are not available.

Water will have a great impact on food security. On a worldwide basis, more than 70% of the water used globally goes towards agriculture; in some developing countries, it's over 90%. As demand for food increases and countries shift to foodstuffs that require more water—such as beef—already scarce water resources will be under greater pressure. To expand food production we will need to improve the productivity of water (our ability to get more "crop per drop") and work to ensure reliable access. This means expanding irrigated agriculture, using new technologies to reduce the water used in certain applications such as drip irrigation and drought-tolerant crop varieties. It means using natural and man-made systems to store and manage supplies. We will also have to take steps to protect our freshwater and coastal ecosystems. Fish are a significant source of protein for more than two and a half billion people in developing countries. Overfishing, pollution and poor management have led to a decline in many freshwater fish species and will undermine food security. Finally, children who suffer from chronic diarrhea have difficulties absorbing the nutrients they need and are therefore more likely to be malnourished.

Water will also play a key role in achieving energy security. Water needs to be brought to its point-of-use, and it is heavy. The pumping and transport of water can, in many cases, be one of the leading consumers of energy. Conversely, water can be a source of clean, renewable, energy. Dams can play a key role in meeting future energy needs and along with natural infrastructure can be critical to managing and mitigating the impacts of floods and droughts. But dams can also have an impact on people and the environment. Stakeholder involvement and sound management will be essential to ensuring the interests of people and the environments are protected. We also need to be sensitive to the impacts of new energy development on existing water resources.

Water is becoming an increasing threat to peace and security. Within countries, water availability and access to basic drinking water and sanitation services may be a source of local conflict and a contributing factor to state fragility or failure. Among countries that share water, tensions are likely to rise as demands grow. Today, over 40% of the world's population lives in river basins shared by two or more countries. Disagreements are inevitable. The key is to keep these disagreements from escalating into violent conflict. At the same time, water can be unifying. Water can provide a platform for building trust and cooperation between countries. Water user groups, and increased transparency and accountability between the people and service providers, can both increase access and advance democratic values. While history is not necessarily a good predictor of our future, it is true that water is more often a source of cooperation than it is of conflict.

Climate change will exacerbate many of these challenges. In many regions, wet regions may get wetter; dry regions may get drier; glaciers will recede; and sea levels will rise. Greater variability in rainfall will increase the likelihood of floods and droughts in some regions. Rising sea levels, storm surges, flood damage, and saltwater intrusion will threaten freshwater supplies in many areas. Extreme weather (floods and droughts) is likely to increase in certain places - threatening both people and economies. Greater water run-off from more frequent and more intense precipitation events is likely to carry more pollutants into water systems. All these will put greater pressure on our ability to manage water holistically across a broad range of competing needs.

In sum, by 2025, experts predict that nearly two-thirds of the world's population will be living under water stressed conditions, including roughly a billion people that will face absolute water scarcity (a level that threatens economic development as well as human health). Water scarcity and poor water quality will increase disease, undermine economic growth, limit food production, and become an increasing threat to peace and security.

There is hope. Some regions are truly water scarce. In those cases, countries will have to work hard to reduce demand and better manage supplies through proper pricing, improved water storage, conservation, and water reuse. But in most places, there is enough water to meet demands. What is lacking is a commitment to sound water resources management and to meeting the basic water and sanitation needs of the people.

The U.S. Approach

The goal of U.S. efforts on water internationally is to help countries achieve water security. This means that people have reliable and sustainable access to the water they need, when they need it, where they need it, while reducing the risks from ex-

treme hydrological events. To achieve this goal, the United States is working to increase access to safe drinking water and sanitation, improve water resources management, increase the productivity of water resources, and mitigate tensions associated with shared waters. We are also working to better integrate water and sanitation considerations into our efforts on food security, climate, and health. In other words, we cannot have food programs failing because the sustainability of the water resources was not considered; we cannot undermine children's health or education by failing to ensure they have safe water to drink or appropriate sanitation facilities; and we need to improve the management of water if we are going to effectively manage the projected impacts of climate change.

Secretary Clinton has outlined five primary areas of action for our efforts on water:

- Build and strengthen institutional and human capacity at the local, national and regional levels—Countries and communities must take the lead in securing their own water futures. We need to help them build capacity at all levels so as to better enable communities and countries to understand and respond to water and sanitation challenges. This includes strengthening regional cooperative mechanisms for managing shared water resources.
- Increase and better coordinate our diplomatic efforts—We need to work with donor countries and international organizations to raise international awareness and to address critical needs; to encourage developing countries to prioritize water and sanitation in national plans and budgets; and to integrate water into global food security, health, and climate change initiatives. We need to help countries establish a precedent for early action rather than letting the issue grow until it can no longer be ignored. Perhaps the greatest impediment we face is the lack of political will. The fact that countries themselves fail to prioritize meeting the basic water and sanitation needs of their own people is a major impediment to moving forward. We have seen a number of cases where, with the right political leadership, a country has turned itself around and made significant progress in meeting the water and sanitation needs of their people.
- Mobilize financial support—Managing water issues requires resources. Even if all of the world's official development assistance were directed towards water and sanitation it would still not be enough to meet developing country needs. In many cases, there is significant capital within developing countries to fund water projects. We need to focus our support on mobilizing those resources by strengthening local capital markets, providing credit enhancements, and exploring other avenues for support.
- Promote science and technology—There is no technological silver bullet. That said, science and technology can make a huge impact. We need to work harder to incentivize innovation on technologies that can make an impact in the water sector and to share U.S. expertise and knowledge with the rest of the world.
- Build and sustain partnerships—We cannot solve this problem on our own. There is a great deal of knowledge and experience that lies within the U.S. technical agencies, the private sector, and the U.S.-based non-profit community. We need a whole-of-government approach and stronger partnerships with the non-governmental community.

The United States remains one of the largest bilateral donors to water and sanitation efforts. Together, the United States Agency for International Development, the Millennium Challenge Corporation and the U.S. Army Corps of Engineers invested over $950 million in fiscal year 2010 (the last year for which we have complete data) for all water sector and sanitation-related activities in developing countries. Of this amount, USAID and MCC invested over $898 million in drinking water, sanitation and hygiene activities. As a result of USAID's activities, some 2.8 million people received improved access to safe drinking water and 2.9 million received improved access to sanitation in 2010. You can find additional details in our 2011 Report to Congress on the implementation of the Senator Paul Simon Water for the Poor Act (www.state.gov/g/oes/water).

We contribute annually to UN organizations and multilateral development banks through our dues and through special multi-donor trust funds related to water projects. More than twenty U.S. government agencies are engaged on international water challenges sharing their knowledge and expertise with developing country partners to help build international capacity to address the global water challenge. The United States also remains active in a number of transboundary water basins throughout the world including the Nile and Mekong river basins.

As Secretary Clinton said, "It's not every day you find an issue where effective diplomacy and development will allow you to save millions of lives, feed the hungry, empower women, advance our national security interests, protect the environment,

and demonstrate to billions of people that the United States cares, cares about you and your welfare. Water is that issue." We look forward to continuing our work with Members of the Committee, USAID, other U.S. government agencies, and other interested stakeholders to improve water resources management and get safe water and basic sanitation to the billions who are currently without.

Thank you again for this opportunity to testify before this subcommittee on behalf of the Department of State.

Senator SHAHEEN. Thank you very much.

Let me begin with you, Ms. Castle, because Senator Lee talked about this in his statement, about the fact that currently States control much of the regulation policy around water. I certainly know that, as a former Governor.

But, should we do more at the national level to address water supply issues in this country? Do we need a national water policy, or do we have one, and we just don't know about it?

Ms. CASTLE. I don't think we have one—sorry. I don't think we have one and don't know about it. I think that the best thing that we can do at the Federal level is to more fully integrate and coordinate—as Mr. Salzberg said, take advantage of all the expertise that exists in individual agencies, and to make sure that we're maximizing our use of resources. Because I do think there's a very important Federal role in providing leadership and providing the tools to get to water sustainability.

But, I also think that, not just because the States control water allocation and use, but also because water issues are so regional and local. They're different in every watershed. The best solutions are those that come from the ground up. It's the kind of thing that the Cooperative Watershed Management Program was designed to facilitate. Getting people together in the community is developing sustainable water plans, rolling those up into river basins, and into State plans. I think that is the best mechanism that we have to create solutions that are going to last. Because solutions to watershed conflict have to have widespread support. They cannot be top down, in my opinion.

So, the concept of Federal-level water planning, I don't think is one that is best designed to succeed. I think, rather, it should come from the ground up.

Senator SHAHEEN. Thank you. You mentioned technology and the importance of technology. I think you all actually mentioned that, in some respects. But, given that we haven't seen any real major technological leaps in the recent past, are there more R&D efforts that we ought to be engaging in and promoting through Federal policy, to encourage those kinds of technological breakthroughs?

Ms. CASTLE. Senator Shaheen, I think that there has been good progress made in advancing technology with respect to making new sources of water available. Desalination technology has advanced. A very significant problem with desalinization has been the energy requirements. Those have actually come down significantly over the past 20, 25 years. So, we're seeing some successes there.

Some of the kinds of advance technologies that Reclamation is funding, both through its desalinization research program and through the WaterSMART grants, is in the category of using renewable energy to power desalinization processes. Wind, solar, even wave energy. I think that's a very significant avenue for additional research and development.

I do think we have to concentrate on R&D. I think that's an area where Federal coordination would be really welcome, because there are a lot of different agencies who are putting effort into those kinds of projects. I also think we can learn from countries around the world, like Israel and Australia, who have made significant leaps forward in desalinization and use of impaired water sources.

Senator SHAHEEN. In the 25 seconds that I have left, can you just describe one of the projects that's been funded through the water and energy efficiency grant program, and how it's been effective?

Ms. CASTLE. I can. You know, we've made probably close to 60 or 70 grants under the water and energy efficiency program. This past year, we had $24 million available that was spread over about 52 projects. Of those, 24 had energy efficiency, energy savings incorporated into the water conservation project. I can give you a specific example that's representative.

In Oregon, the Three Sister's Irrigation District had a project to line an irrigation canal to reduce seepage and reduce the diversion requirement from the river. When you encase the irrigation canal, that gives you the opportunity to put hydropower generation on the conduit. That's what they did.

So, the project included generation of hydroelectric power that they could then use for their own power needs, and had enough left over to sell power into the grid to partially pay for the conservation project.

We've seen several projects like that, with the enclosure of formerly unlined canals, and hydroelectric power generation tacked onto it. It's a really good system. It's very sustainable and low impact environmentally.

Senator SHAHEEN. Great. Thank you. Senator Bingaman.

The CHAIRMAN. Thank you all for your testimony. I guess each of us approaches this problem based on where we're from and in our own experience. The State I represent is an arid State. New Mexico. In our State, I believe I'm right, that by far the largest use of water is agriculture. Accordingly, the largest opportunity for reducing water use is agriculture. It strikes me that all of the things you're talking about are useful, but we do not do enough to assist, and incentivize, and require that agriculture be more sensitive to water use and waste in this country.

I don't know if any of you have views on that, but I don't know the extent to which the Department of Agriculture has focused on this as a priority in their work with farmers who are dependent upon large amounts of waters for the crops they grow.

Particularly, this is an issue in my State, because the water that is being used by agriculture in many cases is groundwater, and it is being depleted. We are not going to have it 10, 20, 30 years from now to use. So, if any of you have comments on that. Ms. Castle, maybe you'd want to start, to give any thoughts you have on that.

Ms. CASTLE. Senator Bingaman, the way in which the Bureau of Reclamation gets involved in agricultural efficiencies is primarily in the delivery systems. I mentioned to Senator Shaheen kinds of projects where we're facilitating the lining or enclosure of formerly unlined canals. We also provide WaterSMART grant funding for automation of delivery systems to avoid spills and over deliveries, and again, cutting down on the need for diversions.

We do less in the area of actual consumptive use by crops. It's my understanding that the Department of Agriculture and the Natural Resource Conservation Service does quite a bit of work in that area, and provides information on best practices, with respect to drip irrigation systems, and control technologies that allow testing of the soil moisture, so that you're not over applying the irrigation water supply. I know less about that area, though.

The CHAIRMAN. Mr. Salzberg, did you want to make a comment?

Mr. SALZBERG. Sure. Just quickly, Senator. You know, you're exactly right. This is certainly one of the most pressing issues that we face internationally. Many developing countries around the world dedicate well over 70 percent of their water for irrigation purposes. In fact, I was looking at one country this morning where over 99 percent of its water goes for agricultural purposes, an almost impossible figure. So, any gains that we can make in that sector is important to our being able to use water for other purposes in those countries.

So, there's no question that our trying to focus on moving a country away from flood irrigation toward those technologies, like drip irrigation, that can minimize the water applied to the crops, land management practices that can help retain moisture, both on the field, but also in adjacent areas, that can hopefully offer long-term support and drought protection, low-water consuming crops, and crops that can grow on brackish water are things that we need to be thinking about.

Of course, management and policy changes that incentivize sound water use. So, even the pricing of water in some cases, establishing water user groups that can help ensure that farmers understand that these things are do have a cost to them, and that they need to be—manage them wisely. This is a critically important area for us to work on.

The CHAIRMAN. Let me ask about one other issue. In the West, historically, control of water and management of water has been a State issue, and the Federal Government has assisted. But, in the case where we've got rivers running across different States, from one State to another, the States have dealt with that issue by entering into compacts.

Where we have 2 States sharing an underground aquifer, that hasn't happened. We've got the circumstance, which has been a long-term source of irritation in Eastern New Mexico, that we share the Ogalala Aquifer with a lot of States, but particularly with West Texas. They have a very, what I would characterize as a very irresponsible set of water laws in Texas, which basically allows you to pump and use as much water as you've got equipment for, whereas in our State, we have tried to limit water use make it much more orderly. But, the frustration, of course, on our side is that the water level in the aquifer continues to drop because of the excessive water use on the Texas side of the border. As I say, we've got 2 straws in one aquifer that is straddling the State line.

Is there any idea as to how the Federal Government could try to play a more constructive role in this? The problem is, there's no incentive on the part of Texas to do anything other than what they're doing until they run out of water, in which case they're going to have to move out of West Texas into other parts of Texas,

I guess. But Ms. Castle, maybe you have some thoughts on how we solve this problem.

Ms. CASTLE. That's a tough problem, Senator Bingaman. I would first say that one of the best weapons in any sort of groundwater dispute is good information, and that's sometimes lacking, in groundwater, particularly. So, I know that USGS has been doing some work to characterize that aquifer and to look at rates of depletion, and the stresses on the aquifer. I think that that's going to be a necessary component of any solution.

You know, frequently, I think these interstate groundwater disputes get dealt with in the form of the surface water compacts that they're attached to. But when that doesn't exist, it poses a more difficult problem. But I can see ultimately that there would need to be a groundwater compact between New Mexico and Texas, with allocation and safe withdrawal rates. You're absolutely right, when one State has the rule of capture, and the other one doesn't, it doesn't create equal footing as a basis for negotiations.

I do think the Federal Government's role can be to supply good information. I need to give some additional thought to what else we might be able to do.

The CHAIRMAN. Thank you very much. Thank you.

Senator SHAHEEN. Thank you. Mr. Hansen, one of the things that has impressed me about the efforts that have been undertaken by the Army, but I think by the Navy as well, and the military, in general, has been the effort not just to address water, but also energy. I wonder if you could talk about how you, the Army, looks at those 2 issues, and the nexus between the 2, and why—and thinking about how to address them, you decided that it needed to be a joint effort.

Mr. HANSEN. Yes, ma'am. Part of it was that we were both looking at the same challenges at the same time, and that was a marriage of convenience. But we also are connected to the joint bases and have connections there that drove us in that direction. We've also shared some personnel and personnel turnover, which we shared between the 2 agencies. So, that's further cooperation.

But we are going for net zero energy, as well as water, as I mentioned. With net zero energy, meaning that we're attempting at an installation level to produce as much energy at the installation as we consume. This is over s period of a year. So, for instance, with solar, we may be producing more than we need during the day, and drawing from the grid at night, but—and then, certain seasons are—so that would be more so than others.

But we also recognize for every energy project that there's a water component. So, for instance, with solar, if we're using PV, there is a certain amount of water, and we predict—project that out to about a third of year timeframe to makes sure that we have a sufficient amount. That's considered in our NEPA work as well.

If we want to use a—a more efficient concentrated solar solution, for instance, it's going to require more water. So, that becomes more of a challenge. So that is—that could be a limiting factor in—in using certain types of technologies.

So, the 2 are very interrelated, and we think that they're equal challenges to our sustainability for the future and they're—we're

really joined at the hip with those 2, and that's why we manage them out of the same office.

Senator SHAHEEN. Can you talk a little bit about how you are coordinating with other Federal agencies, to the extent that you are, and how that's working.

Mr. HANSEN. Yes, ma'am. As you know, the Department of Defense and Department of Energy have an MOU that we're very involved with the DOE labs. We currently have a senior executive from the Department of Energy that's helping us with our renewable energy initiatives, the partnership initiatives. We're using Pacific Northwest National Lab, for instance, to do our water survey audits at installations that help us map out what we're currently using, establishing a baseline for that.

We've also recently established an MOU with the EPA, and are working closely with them in a number of areas. We are involved in interagency land use coordinating committee, with the Department of Interior and other agencies that are looking at withdraw lands issues and others, particularly in the West, where there are a number of challenges to long-term leases and other types of energy projects that we might want to enter into with the private sector.

So, we really are trying to partner with everyone who's interested in the same topic. We've reached out, and a lot of them have reached out to us. I think that's continuing to grow.

Senator SHAHEEN. Good. That's encouraging. I also—you were talking about some of the efforts to look at how—how much water individuals are using. I remember one time, when I was in college, we had a water shortage for a while, and so we were all instructed to make sure we turned off the faucets as we were brushing our teeth, you know, limit showers, all of those sort of very easy standard kinds of things. But are there lessons that you think you have learned, as you're looking at personal habits and how we change those personal habits around water usage? Because clearly, that's a place where we in the United States have not been very careful about our water use.

Mr. HANSEN. Yes, ma'am. I think changing the culture for water is similar to changing the culture for energy. Both are very definitely needed, and we're approaching that at installation level by metering, and by getting feedback, whether it's through a mock bill or an actual bill to the family housing areas, to make people more aware and more visible of what their use actually is.

We're encouraging the use of filters for the water to reduce the pressure to a reasonable level, and limit the amount of usage. That's not an official policy yet, but we've got a lot of discussions on how we can change habits that have really lead to inefficient use of both energy and water over the years, and which really have to be changed.

We find that the younger generation is very much more akin to this, and do some of those things more naturally than some of us that are the older cohorts. We're attacking that at all levels of our education systems, too. For instance, the West Point, the United States Military Academy is very involved in a number of these projects, and—and passing that along. We're sharing all of our best practices with all our installations. I think that while culture

change is not an overnight phenomena, that I'm very encouraged by the amount of change I've seen just in the last year or so.

Senator SHAHEEN. That's encouraging. Mr. Salzberg, you mentioned the impact, globally, of water use on women, in particular. It's something that I hadn't really thought about until I started going through the briefing for this hearing, and recognizing that empowering women and girls in other countries around the world has been very important to stability, to economic prosperity. Can you talk about what the impact of water scarcity is on women and girls, and if it's not addressed, what the prospects are for the future?

Mr. SALZBERG. It's a very important question, of course. You know, we see in some places, if you look at Sub-Saharan Africa, there are women that spend 6 hours a day collecting the water for their families. So, you can imagine that they have to forego other economic-generating opportunities, other things that they might be doing for the family and for the community.

At the same time, the lack of safe water, and in particular, sanitation in schools is a reason why girls, when they reach a certain age, become very uncomfortable in attending some of these schools, and is accountable for some of the dropping out that we see in many schools internationally. So, it's important for a whole bunch of reasons.

Women are also responsible, of course, often for taking care of members of the family who are sick or ill. Diarrheal disease being the leading illness among children would be a main reason for women having to stay home, and, again, not being able to engage in other economic opportunities. So, it really does affect women and girls at all levels of development.

Senator SHAHEEN. As we're looking at the effects of climate change, particularly in Africa, Sub-Saharan Africa, but seeing some of those effects here, are there ways that we're looking at planning for the water effects of climate change globally? Is that—have there been discussions about this in Durban this week that you've been following?

Mr. SALZBERG. Start with the last question first. Yes, water is the subject that's certainly be discussed out in Durban. I know that there's many events on the margins of the major meetings, talking about these kinds of issues.

First is collecting data. It's just trying to get an understanding of the resources that we have, and how they'll be impacted by some of these changes. Ms. Castle pointed out to a number of activities that we're doing domestically. The same exact kinds of things that we need to be doing internationally.

We then need to translate that data into some sort of useable form for consumers. We need to generate information that will be meaningful to our consumers. That means both those people who can help generate some of the solutions to these challenges, but also those people who will be most impacted by these kinds of challenges. So, we have a data management issue there.

Then from an action standpoint, we really do need to focus our work on building flexible structures. In other words, infrastructure that can be altered, and respond, and adapt to changing conditions over time. Flexible institution——

Senator SHAHEEN. Like, give me an example.

Mr. SALZBERG. When we start thinking about dams, large-scale infrastructure. How do we ensure that we can operate those under a wide range of different conditions. If we know that we have glaciers upstream that will be melting, and so, it will be changing the timing of seasonal flows down a particular river, then how do we ensure that we've got infrastructure that will be able to change and manage those changes over the next 30–100 years. Because that's how long we hope that this infrastructure will be in service for. So, it's a large, large issue in many places throughout the world.

How do we build flexible institutions, and flexible contractual agreements, and legal agreements? When you look across the world, when you have legal agreements, they're based on country X gets this amount of water, country Y gets this amount of water. If the amount of water is going to be changing over time, you can imagine it's going to be very difficult to enforce those types of agreements. So, we need to build very robust institutions that allow the countries to work together, to—on an annual, 5–year, 10–year, whatever's appropriate basis, to reevaluate the data, and to re-optimize the management of shared resources for the benefit of all the people within the basin.

So, the key really is going to be building in flexibility into many of the institutions and arrangements that we have.

Senator SHAHEEN. Thank you. I feel like this is a conversation that we're just beginning here at this hearing, but because we have another panel to present, I'm going to thank the 3 of you very much for your testimony. We will have some questions, I think, submitted for the record, which we may ask you to respond to. Hopefully, from this hearing, we will generate some additional actions and continue this conversation. So, thank you all very much. I'm going to ask the second panel if they would come forward.

While they're doing that, I will just point out that the Senate is out for the weekend, so some of the Senators who might have come today have—obviously are getting on earlier flights. But I view this as just more time for me to ask questions. So again, I want to thank each of our panelists for joining us this afternoon. I will introduce you briefly. We will then begin.

Dr. Peter Gleick is President of the Pacific Institute, in Oakland, California. Thank you for joining us. Mr. Thomas Stanley is the Chief Technology Officer for General Electric. Tony Willardson is the Executive Director of the Western States Water Council. Melissa Meeker is the Executive Director of South Florida Water Management District, in West Palm Beach. Harry Stewart is the Director of the New Hampshire Department of Environmental Services, Water Division. So again, thank you all very much for being here. Dr. Gleick, I'm going to start with you.

STATEMENT OF PETER H. GLEICK, PRESIDENT, PACIFIC INSTITUTE, OAKLAND, CA

Mr. GLEICK. Madam Chairwoman, thank you very much for the opportunity to come and speak to the committee and the subcommittee about opportunities and threats on national and global fresh water issues. My written testimony has been submitted for the record. It's far more detailed in both the issue of threats facing

us and some of the solutions and opportunities that I'll be able to talk about today. But it's there for the record.

Theodore Roosevelt said a hundred years ago, quote, The Nation behaves well if it treats the natural resources as assets, which it turns over to the next generation increased and not impaired in value, end of quote. I would just start by noting that we're failing to do that for water. We are not turning over our water resources in a better condition than we found them.

There are a wide range of global and national water challenges, as you've heard already partly from the previous panel. I would say they fall into 2 basic categories. The first is challenges over water availability and use. The second is challenges over the quality of water resources. I might add a third that is, perhaps, challenges with the way we manage water, and with the institutions that we create to deal with water.

My written testimony addresses a wide range of challenges. I'll just mention a few of them. Some have already been touched on. Our water quality is threatened with new contaminants, with old contaminants that we failed to remove. We are failing to invest adequately in maintaining and upgrading our water infrastructure, precisely at a time when governments are cutting back on all sorts of expenditures.

Water disputes are growing over the allocation and use of water. Senator Lee made the comment at the beginning that States typically have the responsibility for allocating water. That's not entirely correct, of course. In fact, Utah and Nevada have a challenge over groundwater resources, as Senator Bingaman noted, that has not adequately addressed, and may not be adequately addressed at the State level. Often when States have a challenge that they can't resolve among themselves, they require the Federal Government to step in.

The health of natural ecosystems is degrading. The natural ecosystems that use the same water that humans use. Water and energy links are very strong. They're typically ignored in policy. We don't think about the water required to produce energy. We don't think about the energy required to produce water. The whole issue of fracking these days is an example of a desire to solve an energy problem without, perhaps, adequately thinking about some of the water-related challenges. They're food and water links. We grow a tremendous amount of food for the United States and for the rest of the world, and yet, we don't manage that agriculture water use particularly well.

Finally, on the challenges side, Federal coordination over water is lacking. There are very important serious Federal responsibilities for water. They're not well coordinated. They're not well managed. It's a difficult challenge, but it needs to be improved. So, it's time for what I would describe as a 21st century U.S. water policy, and there are a series of recommendations in my written testimony. I'd just like to touch on a couple of them.

First of all, we need to better coordinate among the Federal agencies that have different responsibilities for water, and energy, and agriculture, and water quality, and all of the different water-related issues. We might consider a national water commission. We haven't had one that's reported to the President and the Congress

since the early 1970's. We might reinstate basin water commissions that have been very effective at managing water resources.

Second, the Nation lacks and must develop an adequate understanding of water supply use and flows. It's sort of remarkable, but we do not have adequate data on the way we use water, on the water that's available, on the variability of that water resources. Ms. Castle talked about the USGS's responsibility in this area, but it needs to be widely expanded. The Secure Water Act, Public Law 111-11, recommended a national census for water. It's not been adequately funded.

We need better strategies for pricing water and for marketing water. There's a serious Federal responsibility for the way much of the western water is priced and allocated. We've subsidized water extensively. There were good reasons for doing that, but not all subsidies that we put in place a century ago, or 50 years ago, or 30 years ago still make sense.

Water policies and infrastructure need to be designed for climate change. Climate change is a real problem. It's already happening. We see clear evidence of it, and some of the most significant impacts of climate change will be on our water resources, because the hydrologic cycle is the climate cycle.

There are some other recommendations in my written testimony. I just want to point out one figure from that testimony. It's figure 3, if you have it available. We, at the Pacific Institute, put out a report on energy and water in the intermountain West a few weeks ago. One of the conclusions of that report was a tremendous amount of water currently used to produce energy in the United States could be saved if we moved to a combination of renewable energy systems and smart advanced cooling systems on existing technology. We could reduce the amount of water required for cooling very substantially with modern technology in the energy area.

Then finally, I'd like to note there is some good news. The United States uses less water today for everything than we used 30 years ago. Figure 4 in that—in my written testimony shows this. Our water use has leveled off. On a per capita basis, our water use has dropped dramatically. That's a result of changes in the structure of our economy, and in particular, it's a result of tremendous improvements in the efficiency with which we use water. We're growing more food with the same amount of water. We're producing more industrial, and commercial, and domestic products with the same amount of water.

It is possible to have a healthy growing economy and population with a significantly potentially decreased use of water. So, there are lots of opportunities to do better the things we're already doing.

Thank you very much. I'd be happy to answer questions.

[The prepared statement of Mr. Gleick follows:]

PREPARED STATEMENT OF PETER H. GLEICK[1] PRESIDENT, PACIFIC INSTITUTE, OAKLAND, CA

Madame Chairman, Senators: I would like to thank the Committee for the opportunity to address threats and opportunities facing the Nation's freshwater resources and to offer specific recommendations for a 21st century U.S. water policy.

The water crisis around the nation and around the world is growing, presenting new threats to our economy and environment, but also offering new opportunities for better and coordinated responses. We have long known that we need coordinated federal planning for water; but such coordination remains an elusive goal. And the nation faces new water challenges such as climate change, new pollutants, and decaying infrastructure.

My written and oral testimony will address two broad issues:

1. The kinds of water challenges we face at the national and international levels, and
2. The kinds of responses we need at the federal level.

Global and National Water Challenges

There is a wide range of water challenges, but they fall into two basic categories: challenges over water availability and use, and problems associated with water quality and contamination.

Basic Human Needs for Water Services are Unmet

Globally, the most significant and unresolved water problem is the failure to meet basic human needs for safe water and adequate sanitation for billions of people. This is the greatest development disaster of the 20th century and has been explicitly acknowledged by this body with the bipartisan passage of the Paul Simon Water for the Poor Act of 2005 and the Paul Simon Water for the World Act of 2009, which has expanded U.S. development assistance for water and sanitation. The failure to meet these basic needs means that millions of people, mostly young children, still die annually—and unnecessarily—from preventable water-related diseases. This problem is getting worse, not better. Figure 1* shows that deaths from water-related diseases worldwide are rising, not falling.

We are not immune to this problem. Despite the fact that the U.S. has built one of the most sophisticated and complete municipal tap water system in the world, millions of people here, mostly in rural communities, are inadequately protected from water contamination or are drinking water with unacceptable levels of pollutants. For example, a recent assessment released by the Pacific Institute reported that between 2005 and 2008, 92 drinking water systems in California's San Joaquin Valley alone had groundwater wells with nitrate levels over the legal limit, potentially affecting the water quality of over 1.3 million residents. Far too many people in small, poor, rural agricultural communities in California's Central Valley have no option but to drink contaminated water despite more than a decade of efforts to address this problem. Indeed, many of the nation's most pressing environmental justice concerns revolve around access to safe water, or disproportionate exposure to water pollution.

A second global water challenge is climate change, and the increasingly apparent and severe impacts that climate changes will have on our water resources.[2] The natural hydrological cycle of evaporation, condensation, precipitation, runoff, and reevaporation is a fundamental component of the Earth's climate. The scientific community, as represented by the National Academies of Science of every major nation on Earth, every major professional scientific organization, and nearly 100% of the

---

[1] Dr. Gleick is President and co-founder of the Pacific Institute, Oakland, California and a member of the U.S. National Academy of Science. His comments reflect his own opinion and the recommendations of the Pacific Institute, Oakland, California. (Phone: 510-251-1600)

* All Figures have been retained in subcommittee files.

[2] See, for example, the following Senate and House testimonies and briefings: H. S. Cooley. 2009. Testimony of Heather S. Cooley to the United States Congress Select Committee on Energy Independence and Global Warming. For the Hearing on Global Warming Effects on Extreme Weather. July 10, 2008. http://www.pacinst.org/publications/testimony/cooley___extremeevents___7___10___08.pdf

P.H. Gleick, 2010. Testimony of Dr. Peter H. Gleick for The Congressional Select Committee on Energy Independence & Global Warming Hearing, "Not Going Away: America's Energy Security, Jobs and Climate Challenges." December 1, 2010. http://www.pacinst.org/publications/testimony/gleick___testimony___climate___strategies.pdf

P.H. Gleick, 2011. "The Vulnerability of U.S. Water Resources to Climate Change." American Meteorological Society/American Association for the Advancement of Science (AMS/AAAS) Briefing, Capitol Hill, Washington DC. May 9, 2011. http://www.pacinst.org/publications/testimony/vulnerability___to___climate___change.pdf.

world's climatologists, agree that humans are changing the climate in fundamental ways (see Table 1). These climate changes are increasingly threatening water systems and water resources everywhere. While the scientific facts about climate change have so far failed to lead to an adequate political response at either the national or international level, the political and policy disputes do not change the fundamental scientific reality of the threats of climate change, particularly to our water resources.

Table 1. Position Statements on Human-Induced Climate Change

The following international Scientific Academies and Professional Societies have published official organizational statements on the issue of climate change and human influence. This list is not complete, but indicates the comprehensive and strong nature of the scientific understanding about human-caused climate change.

American Academy of Pediatrics
American Association for the Advancement of Science (AAAS)
American Chemical Society
American College of Preventive Medicine
American Geophysical Union
American Institute of Biological Sciences
American Institute of Physics
American Medical Association
American Meteorological Society
American Physical Society
American Public Health Association
American Quaternary Association
American Society for Microbiology
Australian Coral Reef Society
Australian Medical Association
Australian Meteorological and Oceanographic Society
Canadian Foundation for Climate and Atmospheric Sciences
Canadian Meteorological and Oceanographic Society
Ecological Society of America
European Academy of Sciences and Arts
European Federation of Geologists
European Geosciences Union
European Physical Society
European Science Foundation
Federation of Australian Scientific and Technological Societies
Geological Society of America
Geological Society of Australia
Geological Society of London
Institute of Biology (UK)
Institute of Professional Engineers New Zealand
Institution of Engineers Australia
InterAcademy Council
International Association for Great Lakes Research
International Council of Academies of Engineering and Technological Sciences
International Union for Quaternary Research
International Union of Geodesy and Geophysics
National Academies of—Australia, Belgium, Brazil, Cameroon Royal Society of Canada, the Caribbean, China, Institut de France, Ghana, Leopoldina of Germany, of Indonesia, Ireland, Accademia nazionale delle scienze of Italy, India, Japan, Kenya, Madagascar, Malaysia, Mexico, Nigeria, Poland, Royal Society of New Zealand, Russian Academy of Sciences, Senegal, South Africa, Sudan, Royal Swedish Academy of Sciences, Tanzania, Turkey, Uganda, The Royal Society of the United Kingdom, the United States, Zambia, and Zimbabwe.
National Association of Geoscience Teachers
Network of African Science Academies (The science academies of Cameroon, Ghana, Kenya, Madagascar, Nigeria, Senegal, South Africa, Sudan, Tanzania, Uganda, Zambia, Zimbabwe, as well as the African Academy of Sciences)
Royal Meteorological Society (UK)
World Federation of Public Health Associations
World Meteorological Organization

A third major global water challenge is the growing risk to national and international security associated with increasing competition and disputes about the allocation, use, and quality of freshwater. The U.S. intelligence community and military are increasingly concerned about the ways that water shortage, the control of internationally shared rivers, and water contamination will affect U.S. military and dip-

lomatic policy and strategy. We know that water has played a role in political and violent conflicts in the Middle East, the Sudan, India, China, the Horn of Africa, and elsewhere.[3] The Secretaries of State for at least the past four presidential administrations have publicly addressed international water issues in one form or another.

Here in the United States, we also face a broad and growing set of freshwater challenges including growing scarcity, disputes over water allocation and use among neighboring states, unmitigated water contamination from both known and new pollutants, threats to our energy production, a clear and present danger associated with climate change, inadequate investment in critical water infrastructure and data collection systems, and, as mentioned above, threats to national security associated with water problems outside of our own borders. I describe each in more detail, below.

Water Quality is Threatened

New water contaminants are finding their way into our waterways; and many known contaminants are not adequately removed, especially from "non-point sources" such as the runoff of agricultural chemicals such as fertilizers and pesticides. Insufficient investment in technologies and infrastructure to monitor water quality and quantity, inadequate federal regulations and weak enforcement of existing water quality regulations permit unnecessary, costly, and dangerous water contamination to go unchecked.

The reality is that many communities and tribes lack access to safe water. Lack of access to clean, safe drinking water can be caused by contamination in the water, by a lack of adequate drinking water and wastewater infrastructure, such as old or nonexistent plumbing, and by outdated Federal water-quality laws that no longer reflect best available technology or information.

Investment in Maintaining and Upgrading Water Infrastructure is Inadequate

Municipalities and communities trying to provide safe tap water and reliable wastewater services are faced with billions of dollars of infrastructure needs precisely at the same time that government funding for public systems is being crippled. Farmers cannot afford to upgrade irrigation infrastructure to reduce losses and cut waste. Insufficient investment in monitoring equipment, or new piping, or water purification technologies is leading to a deterioration of national water quality and availability. Other witnesses will provide detail on national water infrastructure needs, but these needs lie at the core of national strength.

Water Disputes over Allocations and Use are Growing

Disputes over allocations of shared rivers once limited to the arid western states are now increasingly appearing in the southern and eastern U.S. Tensions between cities and farmers over water rights are rising. An example is the ongoing and unresolved dispute over the Apalachicola-Chattahoochee-Flint river systems shared by Florida, Alabama, and Georgia. Severe drought in Texas, worsened by rising global temperatures, is leading to new (or worsening existing) groundwater disputes and concerns about uncontrolled water withdrawals. The vast majority of States are now expected to have water shortages in coming years according to the General Accountability Office.[4]

Degraded Natural Ecosystems are Worsening

Natural ecosystems such as the Everglades, the Sacramento-San Joaquin Delta, the coastal and inland wetlands of the Gulf States, delicate desert water systems, and even the fisheries of the Great Lakes are under growing threats. One of the original impetuses for the national water quality laws passed over three decades ago was the sight of Lake Erie dying and the Cuyahoga River burning on national television. Tremendous progress was made in cleaning up Lake Erie, but that progress is now being lost. The fisheries of Lake Erie and other water bodies are again threatened by the lack of federal action to protect national waterways from contamination.

Water and Energy Links Are Strong but Ignored

Water use and energy use are closely linked: Energy production uses and pollutes water; water use requires significant amounts of energy. And the reality of climate change affects national policies in both areas. Limits to the availability of both en-

---

[3] See the Water Conflict Chronology, at www.worldwater.org, for a comprehensive list of water-related conflicts.

[4] General Accountability Office. 2003. http://www.gao.gov/new.items/d03514.pdf. "Freshwater Supplies: States' views." GAO-03-514, Washington DC.

ergy and water are beginning to affect the other, and these limits have direct implications for US economic and security interests. Yet energy and water issues are rarely integrated in policy. Considering them together offers substantial economic and environmental benefits.

As we enter the 21st century, pressures on both our national water and energy resources are growing. Alternative energy sources are raising new questions about the associated water risks. Producing biofuels, for examples, is water-intensive, and chemicals used to grow these crops threaten our nation's water quality. Hydraulic fracturing (fracking) of shale gas formations has the potential to greatly increase domestic production of natural gas, a cleaner-burning fossil fuel than dirty coal, and less politically costly than imported Middle Eastern oil. Yet fracking also has the potential to damage or destroy vast groundwater resources or pollute surface water, and federal oversight of these risks has fallen far behind industry efforts to expand fracking operations.

Similarly, there are growing risks that energy and electricity production will be adversely affected by limited water resources. In just the past few years, several power plants have been temporarily closed or derated (i.e., had their energy production reduced) due to drought, lack of reliable water supply, or temperature limits on rivers. New power plants have been opposed because of water scarcity concerns. Table 2 presents some recent headlines from around the U.S. of these problems. The failure to link these issues will inevitably lead to disruptions in the supply of both water and power.

Table 2—Some recent headlines from around the nation show the links between water and energy.

Drought Could Force Nuke-Plant Shutdowns—The Associated Press, January 2008
Sinking Water and Rising Tensions—EnergyBiz Insider, December 2007
Stricter Standards Apply to Coal Plant, Judge Rules; Activists Want Cooling Towers for Oak Creek— Milwaukee Journal Sentinel, November 2007
Journal-Constitution Opposes Coal-Based Plant, Citing Water Shortage—The Atlanta Journal-Constitution, October 2007
Maryland County denies cooling water to proposed power plant—E-Water News Weekly, October 2007
Water woes loom as thirsty generators face climate change—Greenwire, September 2007

Water and Food Links

The vast majority of water consumed in the United States (and worldwide) goes to grow food. As demands for water from cities, energy systems, and environmental restoration increase, pressure is growing on the nation's farmers to relinquish water that they have been using, often for decades. Given the limited ability to expand supplies of water, especially in the Great Plains and California where much of the nation's food is grown, this leaves only three options:

1. Take land out of production, decreasing the amount of food and fiber we produce;
2. Change the types of crops we grow away from water-intensive irrigated crops to more water-efficient crops that can flourish, at least partly, on rainfed lands; or
3. Increase the productivity of agriculture by improving water-use efficiency and reducing waste.

While farmers always weigh these three options when making decisions, the last approach is the most attractive: it permits farmers in increase yields and income while maintaining or even decreasing total water use. But improvements in water-use productivity in agriculture will require new federal policies to eliminate subsidies for some kinds of crops, raise the price of water delivered from federal irrigation systems to encourage efficiency, or provide financial assistance to farmers to invest in shifting irrigation technologies to modern systems for monitoring and delivering water.

The good news is that progress is being made in increasing water-use productivity in agriculture, and implementation of new federal policies can expand on this progress. Figure 2 shows that farmers in California have steadily increased their production of field and seed crops per unit water used. Measured another way, farmers are exploring strategies for producing more food and money with less water. Policies that encourage these strategies and innovations should be supported.

Federal Coordination over Water is Lacking

Responsibility for water is spread out over many federal agencies and departments, operating with little overall coordination. Over 30 federal agencies, boards,

and commissions in the United States have water-related programs and responsibilities. The nation's complex legal and institutional framework for water management has evolved over two centuries, and has never undergone comprehensive review and integration. The result is an incomplete and often inefficient approach to water management at the federal level that has been noted by numerous past commissions, advisory boards, and councils.

It is Time for a 21st Century U.S. Water Policy

The role of the federal government in solving our water problems is rightly limited: Many of our water problems are local, and must be resolved at the local and regional level. But the responsibility to develop and implement appropriate national policies is not being adequately fulfilled by the diverse federal agencies responsible for them. Part of the problem is confusion over authority. Part of the problem is the failure of executive branch in recent years to request sufficient funds to protect and manage our water resources, or of the legislative branch to appropriate and allocate those funds. Part of the problem is old water legislation that has not been updated to account for the realities of the 21st century and for recent advances in our scientific and technical understanding of both water problems and solutions. I offer here several specific recommendations for developing a 21st century United States water policy, recently produced from research conducted over the past several years with colleagues at the Pacific Institute.[5]

Recommendation 1—Federal water-related agencies and programs are fragmented and require better coordination

The persistent and emerging challenges of the twenty-first century demand an integrated and comprehensive approach to national water policy. One possibility is to reconstitute a National Water Commission to provide up-to-date advice to the executive and legislative branches. The United States has not had a comprehensive water commission in place for 30 years, since the 1968 National Water Commission reported to the President and Congress in 1973. Moreover, we have never had a water commission with the authority and responsibility to review and recommend policies for the role of the U.S. in addressing international water issues. Nor has such a commission ever addressed the new challenges of climate change. Such a commission could be very valuable.

We recommend the following actions to move toward better integration of federal water programs:

- Congress should re-evaluate the jurisdiction over water management, funding, and protection in Congressional committees. Current jurisdiction is split among different committees, often with competing or contradictory objectives.
- The Office of Science, Technology, and Policy's Committee on Environment, Natural Resources, and Sustainability should develop a national strategy for water protection. Such a strategy would:
  - —Develop a National Water Council or Roundtable on Water, similar to the existing National Ocean Council and Roundtable on Climate Information and Services,
  - —Define how to assess existing pressures and potential threats to interstate surface and groundwater, and
  - —Recommend amendments, or new legislation, to bring interstate groundwater basins under the EPA's regulatory authority.
- U.S. river basin commissions should be re-instituted as a more rational locus for organizing water-management responsibilities and should be tasked with developing river-basin management plans that become a gateway for federal funding. For example, grants for improved water management that are now dispersed through separate agencies and programs, e.g., the Farm Service Agency, the Environmental Protection Agency (such as the State Revolving Loans), the U.S. Bureau of Reclamation's grant program, and others, could instead include scoring criteria that prioritizes projects developed through the comprehensive river basin management plans.
- A national water commission or council comprised of diverse non-federal experts and including leaders of the environmental justice movement should be formed to recommend policies and principles for sustainable water management in the 21st century. The commission's first task should be to develop guidance docu-

[5] See, J. Christian-Smith and P.H. Gleick (editors), 2012, A 21st Century U.S. Water Policy (in press, Oxford University Press, New York), and J. Christian Smith, P.H. Gleick, and H. Cooley, 2011, "U.S. Water Policy Reform," in P.H. Gleick (editor) The World's Water, Volume 7 (Island Press, Washington D.C.), pp. 143-155.

ments for the river basin commissions in terms of creating scientifically rigorous, participatory river basin management plans. In addition, a national water commission could make recommendations for reducing the risks of international tensions over shared water resources, including how to resolve concerns with Mexico and Canada over shared water systems. These recommendations would be valuable in other international river basins where U.S. experience, international stature, and expertise can be effective.

Recommendation 2—The nation lacks, and must develop, an adequate understanding of water supply, use, and flows

In 1889, the U.S. Geological Survey (USGS) began measuring the flow in the nation's rivers and continues to play a leading role in data collection, analysis, and management. Other federal agencies, such as NOAA and NASA, collect data critical for protecting the nation from extreme weather events, including flooding and droughts. Unfortunately, a vast amount of water data are still not collected, and large numbers of existing data collection systems are being lost. In 2009 alone, nearly 100 long-term stream gages were discontinued due to budgetary constraints and Congress has failed to adequately support funding for some vital satellite systems, such as the Joint Polar Satellite System (JPSS), raising the specter of a loss of advance warning for extreme weather events. This represents a direct threat to health and safety of U.S. citizens and the economy. It is critical for Congress to provide consistent funding for comprehensive water data collection programs.

We recommend full appropriation for the Secure Water Act (P.L. 111-11) to conduct an urgently needed national water census. A national water census will deliver information nationwide on water availability and water use throughout the country, including water used for vital food production and thermoelectric power generation. The Act authorized $20 million for the national water census effort but the money has never been fully appropriated. This is a key priority not only for improving the nation's data collection but also to provide valuable information to states about water availability and water use.

Recommendation 3—More appropriate economic strategies can create more sustainable water-use patterns

Water pricing is often thought of as a local or state concern, and indeed, most financing of water systems is and should remain local. However, as the largest wholesaler of water in the west, federal agencies such as the U.S. Bureau of Reclamation also play an important role in setting water rates. Forty years ago, the last National Water Commission recommended discontinuing the subsidization of new irrigation projects, writing:

> Direct beneficiaries of Federal irrigation developments should pay in full the costs of new projects allocated to irrigation.

Nearly four decades later, this recommendation has largely been ignored. The U.S. should reform pricing policies that subsidize the inefficient use of water and continue to cost the taxpayers money. The Central Valley Project Improvement Act passed by Congress in 1992, required the Bureau of Reclamation to institute tiered water rates to encourage conservation, but their current rate structure is ineffective. It should be reformed, and this requirement for conservation pricing should be extended to other federal projects in a way that provides incentives for improving water-use practices.

We recommend new federal financing strategies to improve the administration of water-related laws. Rather than simply expanding federal investment, we recommend a three-pronged approach: (1) encourage more local investment through continued funding at or above current levels for state revolving funds; (2) encourage the adoption of marginal cost pricing by water utilities, and (3) raise fees on polluters to be re-invested in agencies that regulate water pollution. Similar economic tools are increasingly being used worldwide to discourage unsustainable water practices. In order to ensure that all people have access to water to meet their basic needs at an affordable price we suggest the creation of a Low Income Home Water Assistance Program within State Revolving Loan programs.

Recommendation 4—Water policies and infrastructure should be designed to evolve with changing climatic conditions

There is a well acknowledged need to evaluate both the implications of climate change for the nation's water resources and appropriate technologies and water management strategies for coping with unavoidable impacts of climate change. In 2009, the Government Accountability Office (GAO) reports that although many federal resource managers understand that climate change impacts are important to the resources that they manage, they have not yet incorporated climate change pro-

jections, mitigation, or adaptation efforts into planning.[6] While there has been increased collaboration on improving data collection and information dissemination in regard to the impacts of climate change on water supply, there is still a lack of a coordinated national strategy.

The passage of the Secure Water Act (2009) calls for the establishment of a Climate Change and Water Intra-governmental Panel, which primarily focuses on downscaling climate data and conducting individual basin studies (beginning with the Colorado, Yakima, and the Milk/St. Mary River basins). This is critical in terms of enhancing our scientific understanding of climate change impacts, but such mitigation and adaptation efforts should be accelerated and expanded. The Council on Environmental Quality's Interagency Climate Change Adaptation Task Force finds that "there still are significant gaps in the U.S. government's approach to climate change adaptation and building resilience." The federal government should develop national strategy for climate change adaptation to now-unavoidable impacts. Such a strategy would:

- Define a protocol to analyze the climate resiliency of federal agency actions.
- Conduct a national inventory to identify the most promising opportunities to modify federal dam operations in the United States in light of climate change.
- Require agencies to integrate energy and water efficiency efforts (also addressed below).
- Identify priority areas for coordinated government response.

Recommendation 5—Existing Federal water laws should be updated and adequately enforced

Congress must modernize the antiquated Clean Water Act and Safe Drinking Water Act—two foundational pieces of federal legislation passed originally with bipartisan support, and immensely popular with the American people.

Once modernized, federal regulations must be enforced. There is an overwhelming assumption that safe, affordable water for drinking and household use is available to all residents in the US. This is false. Violations of our nation's water laws have become routine—a recent survey of national water quality data found that more than 50% of regulated facilities violated the Clean Water Act, but enforcement actions against polluters were infrequent.[7] Clear and immediate action is needed to expand enforcement efforts against violations of established water law.

We recommend the following changes to the Clean Water Act and the Safe Drinking Water Act to improve the protection of public health:

- Tighten controls on point sources to better reflect the Clean Water Act's goal of zero discharge of pollutants.
- Update technology standards to reflect current best available technologies and encourage innovation.
- Create stricter penalties for violating NPDES permits, levying fines that are sufficiently large to make polluting no longer a viable cost of doing business and by rescinding or denying renewal of permits of repeat violators. Update the Safe Drinking Water Act's standard-setting regulations to make them more protective of human health. Despite continued emergence of new contaminants in drinking water, regulations have barely changed and have not incorporated the risks of synergistic impacts. Standards should be updated to include the additive effects of common mixtures of chemicals.
- Bring bottled water quality standards and enforcement under the authority of the EPA rather than the FDA and make the standards consistent with tap water standards.
- Integrate implementation and enforcement of the Clean Water Act and Safe Drinking Water Act to make most efficient use of resources.
- Expanding the authority and administration of the Clean Water Act to regulate non-point source pollution and groundwater quality.
- Restoring the traditionally broad scope of the Clean Water Act to bring water bodies such as ephemeral streams and wetlands with no "nexus" to a navigable water body back under its jurisdiction.
- Integrating equality of access to safe drinking water into the Safe Drinking Water Act's mandate.

---

[6] Government Accountability Office (GAO). 2009. Climate Change Adaptation: Strategic Federal Planning Could Help Government Officials Make More Informed Decisions. GAO-10-113. http://www.gao.gov/products/GAO-10-113.

[7] K. Russell and C. Duhigg. 2009. "Clean Water Act Violations: The Enforcement Record." The New York Times, September 13, 2009.

In addition, many of the nation's waterworks and regulations were created before we fully understood the extent and value of the ecological services provided by intact river systems. New legislation is needed to ensure that these benefits (and the water required to sustain them) be given equal consideration with other project purposes, similar to the 1986 amendments to the Federal Power Act that gave habitat conservation goals "equal consideration" with power and development interests.

Recommendation 6—Twenty-first century water management must encompass decentralized solutions such as water demand management, stormwater capture, recycled water, greywater, and other nontraditional approaches

There are several other key actions Congress can take to ensure that national water policy is far more comprehensive, modern, effective, and efficient.

- Increase efforts to promote the use of water-efficient technologies and practices through updated federal standards for appliances and fixtures, along with expanded education and technical assistance. Federal water-efficiency standards were created by the EPA over two decades ago; these standards should be more frequently updated to reflect advances in technology.
- Technical assistance programs to landowners, such as the Farm Service Agency should be specifically targeted at accelerating the adoption of water conservation and efficiency practices in priority agricultural areas.
- Federal agencies should support community-based organizations that play a central role in ensuring the involvement of affected residents by increasing programs to technical assistance providers working on critical water issues, such as EPA's program to support small water systems and the NRCS' Watershed Protection and Flood Prevention Program.
- Target federal spending through State Revolving Loans and other programs on demand management and infrastructure that increases the productive use of water.

Recommendation 7—Federal water policies must be integrated with other policies, including energy, agriculture, and climate change

As noted earlier, there are strong links between the water sector and other sectors, including energy and food production. The water sector is a major energy consumer and future trends suggest that this demand could grow due to more energy-intensive water supplies and treatment technologies, e.g. desalination.

Conversely, smart national policies can help address both water and energy challenges. For example, as shown in Figure 3, strategies that promote renewable energy and alternative cooling systems in the western United States can, over the next two decades, reduce water withdrawals for energy production by far more than 50%—a tremendous improvement in water efficiency. In particular, the Pacific Institute research recommends that federal water policy:

- Phase out irrigation, energy, and crop subsidies that promote wasteful use of water and energy.
- Pursue new appliance standards and smart labeling of water efficient appliances that save money, water, and energy.
- Promote research and development that will help traditional energy sources reduce water withdrawals and consumption.
- Promote research and development for renewable energy sources that use little to no water.
- Use alternative water sources such as reclaimed or saline water for power plant cooling.

The National Academy of Sciences should be asked to conduct an in-depth analysis of the impact of energy development and production on the water resources of the United States. The Secretary of the Interior and the Administrator of the Environmental Protection Agency should work together to identify the best available technologies to maximize water and energy efficiency in the production of electricity and other energy resources, including evaluating the energy used in water storage and delivery operations in major Reclamation projects.

Recommendation 8—Fully incorporate environmental justice principles into federal water policy

Many federal agencies, including EPA and Department of the Interior, already have the statutory ability to address the concerns raised by environmental justice communities in permitting, project review and construction, and financing activities. Through the work of the National Environmental Justice Advisory and other efforts of the Office of Environmental Justice, there are many documents providing guidance on how to achieve this in a variety of agencies. However, a renewed effort must

be made to fully integrate environmental justice into federal water policy, which would use benchmarks of measurable progress towards eliminating water-related disproportionate impacts in low-income communities and communities of color and have a clear system of evaluation and accountability. Some of the key elements of such an effort include, but are not limited to:

- Hiring staff explicitly charged with environmental justice assessments of policies and projects and providing training for other policy staff, such as permit writers;
- Assessing disproportionate impacts in any proposed project, policy, or permit, ranging from NPDES permits to Bureau of Reclamation dam operations, and modify or cancel proposed projects, policies, or permits if disproportionate burdens cannot be reduced;
- Ensuring water quality permits and programs, such as the Underground Injection and the Total Maximum Daily Load programs, are based on numeric standard that are protective of the most sensitive populations.
- Prioritizing grants for environmental justice communities within existing water-related funding programs. Programs such as the Clean Water State Revolving Fund, the Safe Drinking Water Revolving Fund, and the USDA Rural Loan and Grant program should prioritize funding and expand current program specifically for low-income communities and communities of color to fund critical water supply, water quality, and wastewater projects.
- Conducting an environmental justice review of federal water-related funding programs. Entities receiving federal funding should be required to demonstrate collaboration with affected communities and ongoing efforts to address disproportionate impacts in order to continue receiving funding. This would apply to programs to both grant and loan programs such as US Department of Agriculture's Environmental Quality Incentives Program, State Revolving Funds, but also Bureau of Reclamation agricultural water delivery programs such as California's Central Valley Project.
- Addressing long-standing tribal water claims.

Recommendation 9—Other important federal government actions: The federal government must lead by example. The federal government should lead by example, establishing new rules and targets for its own operations. We recommend that:

- All federally managed buildings must meet or exceed WaterSense standards for fixtures and appliances.
- The federal government should set a target encouraging half of federally managed buildings to utilize recycled water, storm water, or greywater sources by 2025.
- All federal water projects should evaluate the risks of climate change and develop plans for modifying physical infrastructure or operating procedures to reduce these risks.

Some Good News

The assumption that a growing economy and growing population must, inevitably, demand more and more water without limit now turns out to be wrong. In the past several decades in the United States, quietly and without fanfare, the nation has been improving the productivity of water use, growing more food and producing more goods and services without increasing the demand for water.

Figure 4 shows this remarkable change, plotting gross domestic product with total water withdrawals over the past century. In the late 1970s and early 1980s, demand for water began to level off and even decline; on a per-person basis, the nation uses far less water today per person than in 1980. This is a tremendous increase in water "productivity" as shown in Figure 5, which plots total economic value per unit water. This measure of productivity has grown tremendously in the past two decades, showing that limits to water availability do not mean economic hardship or suffering. Indeed, additional investment in physical infrastructure of water treatment and delivery systems has the potential to create hundreds of thousands of new jobs nationwide.

Conclusions

The 21st century brings with it both persistent and new water challenges, including growing human populations and demands for water, unacceptable water quality in many areas, weak or inadequate water data collection and regulation, and growing threats to the timing and reliability of water supply from climate change. Several countries have reformed their water policies to better address these challenges. While the political and cultural contexts of these reforms have varied, water reforms offer the potential to meet economic demands for water with less water through so-

lutions that focus on "soft path" water solutions including water conservation and efficiency, smarter water pricing, new technology, and more participatory water management.

The United States has not followed suit and continues to rely on fragmented and outdated water policies based on a patchwork of old laws, competing institutions, and aging infrastructure. This testimony offers specific recommendations for Congress drawing on the unique characteristics of the United States water system together with insights drawn from experience around the world, in an effort to help identify a more effective and sustainable approach to federal water management.

I congratulate you for considering this vital issue and for helping to raise national attention on the need to re-evaluate and re-focus efforts on sustainably managing the nation's precious freshwater resources.

Thank you for your attention.

BIOGRAPHY FOR DR. PETER H. GLEICK

Dr. Peter H. Gleick is co-founder and President of the Pacific Institute in Oakland, California. The Institute is one of the world's leading non-partisan policy research groups addressing global environment and development problems, especially in the area of freshwater resources. Dr. Gleick was described by the San Francisco Chronicle in 2009 as "arguably the world's leading expert on water." His research and writing address the hydrologic impacts of climate change, sustainable water use, water privatization, and international conflicts over water resources. His work on sustainable management and use of water led to him being named by the BBC as a "visionary on the environment" in its Essential Guide to the 21st Century. In 2008, Wired Magazine called him "one of 15 People the Next President Should Listen To."

Dr. Peter H. Gleick produced some of the first research on the implications of climate change for water resources. He has also played a leading role in highlighting the risks to national and international security from conflicts over shared water resources. He produced some of the earliest assessments of the connections between water and political disputes and has briefed major international policymakers ranging from the Vice President and Secretary of State of the United States to the Prime Minister of Jordan on these issues. He also has testified regularly for the U.S. Senate, House of Representatives, and state legislatures, and briefed international governments and policymakers.

Dr. Gleick received a B.S. from Yale University and an M.S. and Ph.D. from the University of California, Berkeley. In 2003 he received a MacArthur Foundation Fellowship for his work on global freshwater issues. In 2006 he was elected to the U.S. National Academy of Sciences, Washington, D.C. and his public service includes work with a wide range of science advisory boards, editorial boards, and other organizations. Gleick is the author of more than 80 peer-reviewed papers and book chapters, and nine books, including the biennial water report The World's Water published by Island Press (Washington, D.C.).

Senator SHAHEEN. Thank you.

Mr. STANLEY.

STATEMENT OF THOMAS STANLEY, CHIEF TECHNOLOGY OFFICER, GENERAL ELECTRIC POWER AND WATER, WATER AND PROCESS TECHNOLOGIES, TREVOSE, PA

Mr. STANLEY. Senator Shaheen, it's a privilege to share with you today GE's thoughts on addressing domestic and global water supply issues.

As the Chief Technology Officer for GE's global water business, it's my responsibility to effectively manage the about $100 million a year that GE invests in clean water research and development. So, I welcome this opportunity to outline for you GE's research and development efforts in this very critical area.

So, I work for GE Power and Water, which is part of GE Energy. GE Energy has more than 100,000 global employees, and generates about $40 million in revenues annually. GE Energy provides integrated product and service solutions in all areas of energy and

water—water industries, including conventional and renewable technologies.

Our water business, that I have responsibility for, has more than 8,000 employees in 130 countries around the world. That includes 400 scientists and engineers located in 10 major technical centers, who are dedicated to developing solutions in collaboration with our customers to address issues associated with water purity and water scarcity.

We also have access to GE's network of global research centers. GE research, as that is called, is one of the world's largest and most diversified industrial research labs. Today, GE research has a dedicated team and a world-class team of scientists and engineers partnering with my team in—in our business to develop the next generation of solutions, making water more accessible and more affordable for our customers in this time, as all have commented about, at a time of increasing water challenge. So, our business has identified several themes that are very important to our customers. My team has aligned our research activities with these important themes.

The first is to develop the capability to treat increasingly impure water sources. The second is to develop the ability to reuse or recycle a higher percentage of treated water. The third is to reduce the cost and the energy consumption required to treat water. Last, is to develop solutions for our customers to meet increasingly stringent requirements and regulations on the discharge of—of water.

In my written testimony, I took the time to elaborate on 3 examples that illustrate these themes. The first of these was our ability to now take—or get very high recovery of usable water from salty or brackish rivers and streams. We are now evaluating this new technology with a number of beverage manufacturers, who are required to use these brackish water sources, and have to have a—and have a high premium on a high yield of useable water.

The second is the treatment and recycle, at low cost, of the water that's produced in the conjunction with the production of oil.

The third is to capture exceedingly low concentrations of mercury in waste water effluent from coal-fired power plants, allowing these plants to meet these increasingly stringent requirements.

So, just a few examples, but representative examples for the kinds of things that my team works on on a daily basis to address these issues.

There's an important role that the Federal—Federal funding can play in R&D to leverage the investments of key stakeholders, including foundations, and universities, and communities, as well as industry, in addressing water scarcity and quality issues.

Chairman Shaheen, it's been my pleasure. I thank you for your time. It's been a pleasure to talk about these topics.

[The prepared statement of Mr. Stanley follows:]

PREPARED STATEMENT OF THOMAS STANLEY, CHIEF TECHNOLOGY OFFICER, GE POWER AND WATER, WATER AND PROCESS TECHNOLOGIES, TREVOSE, PA

Introduction

Chairman Shaheen and members of the Subcommittee, it is privilege to share with you GE's thoughts on the opportunities and challenges to address domestic and global water supply issues. As the Chief Technology Officer for GE Power & Water, Water & Process Technologies, it is my responsibility to effectively manage the ap-

proximately $100 million that GE invests in clean water research and development every year, and it is these complex issues that my team and I strive to address each and every day. I welcome this opportunity to outline for you GE's research and development efforts in critical areas including treating impure sources of water; increasing reuse/recycling of treated water; reducing cost and energy consumption required to treat water; and meeting increasingly stringent regulatory requirements for discharged water.

Background

GE is a diversified global company that provides a wide array of products to meet the world's essential needs. From energy, water, and transportation to healthcare and security, we deliver advanced technology solutions through a broad business portfolio to promote cleaner, more efficient energy alternatives; provide more efficient aircraft engines and locomotives; increase the availability of clean, safe water; and improve access to quality healthcare.

The businesses that comprise GE Energy—GE Power & Water, GE Energy Management and GE Oil & Gas—have more than 100,000 global employees and generate annual revenues of about $40 billion. GE Energy provides integrated product and service solutions in all areas of the energy industry including coal, oil, natural gas and nuclear energy; renewable resources such as water, wind, solar and biogas; as well as other alternative fuels and new grid modernization technologies to meet 21st century energy needs.

GE has long recognized the connection between energy and water. In 2008 GE integrated its water and power generation businesses to better meet customer needs and address significant global challenges, creating GE Power & Water. With a broad array of power generation and energy delivery technologies, GE works in all areas of the energy industry-including gas and steam turbines; renewables such as wind and solar; alternative fuels, including biofuels, coal gasification and liquefaction; and nuclear energy. Our Power & Water team also develops advanced technologies to help solve the world's most complex challenges related to water availability and quality. Numerous products are qualified under ecomagination, GE's initiative to aggressively bring to market new technologies that will help customers meet pressing environmental challenges. The following chart* outlines the wide array of technologies encompassed by GE Power & Water.

The roots of the GE's Water & Process Technologies business date back to 1925 and became a GE business in 1999, evolving from a series of acquisitions over the last 12 years. This business currently employs nearly 8,000, including 400 scientists and engineers located in 10 major technical centers around the globe who are dedicated to developing solutions in collaboration with our customers, addressing problems associated with water purity and recovery.

This team also has access to GE's network of Global Research Centers (GRC), which are located around the globe. The GE GRC is one of the world's largest and most diversified industrial research labs, creating true breakthrough technologies for GE's businesses over the last 100 years. Today, GE Research has a world-class team of scientists and engineers partnering with the technical team in our Water & Process Technologies business to develop the next generation of solutions, making water more accessible and more affordable for our customers, in a time of increasing water challenges.

R&D Focus

Our business has identified several themes of importance to our customers, and my team has aligned its research and development activities with these important themes. These themes are to: 1) develop capability to treat increasingly impure sources of water; 2) develop ability to reuse or recycle a higher percentage of treated water; 3) reduce cost and energy consumption required to treat water; and 4) develop solutions for customers to meet increasingly stringent regulations on impurities in discharged water.

Following are a few specific examples of new technologies we are developing to help customers meet these challenges.

Improved Recovery from 'Brackish' Water Sources

We are working to reduce the cost and improve the recovery of water extracted from relatively salty and impure rivers and lakes. These sources are typically referred to as 'brackish' water. Today, using state-of-the-art technology, when pure water is produced from brackish sources, about 80% of the water is recovered as clean water. The remaining 20%, which contains all the salts and many of the impu-

* GE Power & Water chart has been retained in subcommittee files.

rities that were present in the feed water, must be discharged. GE Water and Process Technologies is developing a new technology that will allow recovery to exceed 99% in a process that will require only modest capital investment and will be very efficient to operate. This technology, called the Non-Thermal Brine Concentrator, will provide a much more efficient way to extract very pure water from brackish feed water sources. The impact of this new technology is illustrated in Figure 1*, below.

We are validating and demonstrating this technology with several beverage manufacturers, all of whom use brackish water sources and require high water recoveries because of water scarcity and water cost in their regions.

Maximizing Oil Recovery and Water Recycling

Much has been made in recent years of the energy-water nexus. One example of this is the use of increasing amounts of water in the production of oil. In many of today's producing oil fields, water or steam must be used to force the oil through the field so that it can be extracted. When oil is recovered this way, much more water than oil is produced—as much as 10 times more water than oil. Once out of the ground, the oil is separated from the water and the oil is sent to a refinery. The so-called 'produced water' remains. It is very dirty, containing small amounts of oil that could not be separated, as well as dissolved salts and a host of other impurities. Figure 2* shows a sample of produced water recovered from a Canadian oil sands site which uses steam to extract the oil. Cleaning this water is a tremendous challenge.

We are working with our customers to improve methodologies for treating this water so that it can be safely recycled back into the field to further facilitate oil recovery. We are establishing demonstration facilities for new de-oiling technology followed by more robust membrane devices that, if successful, will allow water recycling in equipment that will require about 20% less capital investment than current state-of-the-art technologies, and run with 30% less operating cost due to improved energy efficiency. In addition it may be possible to recycle more of the produced water back into the field. These are very significant improvements in capability and efficiency.

Managing Mercury Emissions in Water

Here is a last example of new technologies we are developing, and this is another example where water is tied closely to energy production. Water is used to scrub the emissions from coal fired power plants to capture impurities. The effluent from the scrubbers goes to a wastewater treatment plant where it is treated before discharge. Often times, this wastewater contains trace quantities of mercury originally coming from the coal. Regulations on mercury emissions in water are increasingly tight, in many cases limited to less than 10 parts per trillion, an exceedingly low concentration. Conventional wastewater treatment technology cannot meet these requirements.

We have designed specialty polymers which dissolve in the wastewater and selectively adsorb mercury. These polymers can be used in conjunction with conventional wastewater treatment methodologies to improve mercury removal. In addition we can use very fine filters, called ultra-filters, to recover tiny particulates containing mercury. We are working now with a number of U.S.-based power companies to optimize these technologies, used alone or in tandem as required for their operating conditions, to meet these challenging mercury emissions targets.

In Conclusion

Today, I've discussed just three examples of new technologies that GE Water and Process Technologies is developing that illustrate how we help customers solve water challenges related to higher water recovery; increased water recycling; lower cost and more energy efficient processes; and adherence to regulatory requirements.

At GE, we're working closely with our customers and global thought leaders to ensure that advanced technology development continues so that together we can overcome water quality and scarcity challenges.

There is also an important role for Federal funding for water R&D to leverage the investments of key stakeholders, including foundations, universities, communities, and industry, in addressing water scarcity and quality issues.

Chairman Shaheen and members of the Subcommittee, thank you for your time and the opportunity to provide our comments on these important issues.

Senator SHAHEEN. Thank you very much, Mr. Stanley.

---

*All figures have been retained in subcommittee files.

Mr. WILLARDSON.

STATEMENT OF ANTHONY WILLARDSON, EXECUTIVE DIRECTOR, WESTERN STATES WATER COUNCIL, MURRAY, UT

Mr. WILLARDSON. Madam Chairman, the Western States Water Council was created in 1965 by a resolution of the Western Governors, and we represent 18 States, of the reclamation States and the State of Alaska. Our members are appointed by the Governors. We're closely affiliated with the Western Governors Association.

The water resources in the West are in distress, given our population growth, as well as changing water needs and values. There are an increasing number of conflicts between users and uses.

States are primarily responsible for ensuring that their own water resources are sustainable, but Federal support is essential, given its Federal trust responsibilities and regulatory mandates. Water must be given a higher priority at all levels of government as an essential element of a sustainable economy and sound environment. Adequate supplies of clean water are essential to creating and maintaining jobs.

An integrated and collaborative approach, beginning at the local watershed, is important to effectively conserve, protect, develop, and manage our water resources. We must recognize and respect national, regional, State, local, and tribal differences, their values, and support decision-making and problem solving at the lowest practical level.

In 2006, the Council and Western Governors Association worked together, working with our Federal partners to address uncertainties related to growth, better define our water supplies, uses, and needs, improve our infrastructure, resolve any water rights claims, and deal with environmental demands, particularly related to endangered aquatic species, as well as climate uncertainties.

We very much appreciate the leadership of the subcommittee and the committee in enactment of the Secure Water Act, in support of USGS stream gauging and Landsat programs, with the Indian water rights settlements that have been adopted, now 27. Also, we are working on related funding issues, and the committee's work on energy and water integration.

I'd like to highlight the work of our Western Federal agency support team, created at a request of the Western Governors, and helps us in implementing the water needs and strategies for sustainable future reports, and which provide a number of recommendations.

Eleven Federal agencies have named representatives to work with us on those recommendations. That includes the Army Corps of Engineers, the Bureau of Reclamation, and the U.S. Geological Survey. Together they have dedicated a Federal liaison, who is detailed in our offices. That person is an EPA employee. DOE has also expressed interest in participating.

In addition to the support of the council on WGA initiatives, WestFAST helps to coordinate other water-related Federal efforts, and has identified the numerous Federal water resource studies that are going on in the Colorado river basin, and also has compiled a summary of Federal climate-related programs. We view WestFAST as a model for other Federal-State partnerships, and

further opportunities for leveraging limited resources to address priority water problems.

I'd like to highlight just a few examples of our collaborative efforts. One of the challenges that we face is a lack of adequate information related to our existing water uses as a region. We have outlined steps to create a water data exchange to compile and share water use information between States and Federal agencies. We're working with the Department of Energy to first identify uses related to energy demands. We're also participating with USGS and the national water census.

We continue to work with the Department of Interior and the Native American Rights Fund to better define and settle Indian water rights claims, and as I said, to fund those implementation of the settlements that Congress has approved.

Water in the West is moving from agricultural to other uses, and we're exploring innovative ways of conserving water, allowing water transfers, and encouraging sharing in a manner that avoids and mitigates negative impacts on agricultural communities and the environment.

Federal water transfer policies will be an important part of this effort, as well as an examination of Federal regulatory requirements. Defined water rights and regulatory processes are important to encouraging appropriate opportunities to voluntarily move water between existing and future needs. In this regard, the Landsat thermal infrared imager is important in helping us to archive and measure consumptive water use, and improve water management and water rights administration. Requested USGS funding is essential to maintain this capability.

Last, I'd mentioned with respect to the aging infrastructure, that it is a major concern. We're addressing opportunities to prioritize and refine our necessary improvements, and finance those, and also opportunities to stretch and augment existing supplies through innovative conservation, water reuse, desalination, and even weather modification strategies, as well as water banking and opportunities for interstate, interregional, and international cooperation.

We appreciate the opportunity to testify.

[The prepared statement of Mr. Willardson follows:]

PREPARED STATEMENT OF ANTHONY WILLARDSON, EXECUTIVE DIRECTOR, WESTERN STATES WATER COUNCIL, MURRAY, UT

I. Introduction

Madame Chair, and members of the Subcommittee, my name is Tony Willardson, and I am the Executive Director of the Western States Water Council (WSWC). We appreciate the opportunity to testify on the water resources challenges facing the West and the Nation. Thank you all for your leadership in addressing the serious water-related needs of the West and the Nation.

Our members are appointed by the Governors of eighteen states. We are a nonpartisan advisory body on water policy issues closely affiliated with the Western Governors' Association (WGA). My testimony is based on official reports, statements and positions taken by both organizations, as well as our recent and continuing efforts to define and refine a vision and principles for effective water management strategies to help ensure a prosperous and sustainable future. I will emphasize just a few of our interests and concerns, while attaching the most recent WGA policy resolution on Water Resources Management in the West (No. 11-7) and highlighting selected sections in my testimony.

Water in the West (and elsewhere) is an increasingly scarce and precious resource, given population growth and an expanding range of often competing eco-

nomic and ecological demands, as well as changing social values. Surface and ground water supplies in many areas are stressed, resulting in a growing number of conflicts among users and uses. A secure and sustainable future is increasingly uncertain given our climate, aging and often inadequate water infrastructure, limited knowledge regarding available supplies and existing and future needs and uses, and competing and sometimes un-defined or ill-defined water rights. Effectively addressing these challenges requires a collaborative, cooperative effort among federal, state, tribal and local governments and stakeholders that transcends political and geographic boundaries. The following principles are keys to effectively managing our challenges.

- State primacy is fundamental to a sustainable water future. Water planning, policy, development, protection, and management must recognize, defer to, and support state laws, plans, and processes. The federal government should streamline regulatory burdens and support implementation of state water plans and state water management strategies.
- Given the importance of the resource to our public health, economy, food security, and environment, water must be given a high public policy priority at all levels.
- An integrated and collaborative approach to water resources management is critical to the environmentally sound and efficient use of our water resources. States, tribes, and local communities should work together to resolve water issues. A grassroots approach should be utilized in identifying problems and developing optimal solutions.
- Any approach to water resource management and development should accommodate sustainable economic growth, which is enhanced by the protection and restoration of significant aquatic ecosystems, and will promote economic and environmental security and quality of life.
- There must be cooperation among stakeholders at all levels and agencies of government that recognizes and respects national, regional, state, local and tribal differences in values related to water resources and that supports decision-making at the lowest practicable level.

In June 2006, the WGA unanimously adopted as WGA policy a report prepared by the WSWC entitled, "Water Needs and Strategies for a Sustainable Future," and similarly endorsed a follow up "Next Steps" report in 2008. A 2010 "Progress Report" was accepted by the governors, and we are now preparing a 2012 WGA Water Policy Report, refining our vision, values and recommendations regarding opportunities or strategies for further addressing present and future challenges.

The 2006 WGA report included 28 recommendations and the 2008 "Next Steps" report contained 42 recommendations for action in six different areas, focused on challenges related to growth and meeting future water-related demands, watershed planning and basic water data gathering, present and future water infrastructure needs, the resolution of Indian water rights claims, protecting aquatic endangered species, and climate adaptation. WGA policy resolution 11-7 on Water Resources Management in the West reaffirms many of the recommendations in the 2006 and 2008 reports.

I want to stress that one common aspect of our water-related challenges and opportunities for developing successful management is the uncertainty surrounding our present uses and future needs. The importance of basic information regarding our water resources for sound decision-making cannot be over emphasized.

II. Water Information and Data

"Western Governors encourage continued investment in the Nation's water measurement and monitoring data networks and the development of information services that promote collaboration between the research and management communities to ensure relevant information is developed and shared with decision-makers. Basic information on the status, trends and projections of our water resources is essential to sound water management." (WGA Policy Resolution 11-7, p. 1)

The 2006 WGA Report called for " . . . a state-by-state and westwide summary of existing water uses . . . , current ground and surface water supplies, and anticipated water demands, .[that] should address both consumptive and non-consumptive uses and demands." The 2008 WGA Report recommended, "State and federal water resource agencies should work together to provide universal access to the water-related data collected by all state, local and federal agencies, as well as tools and models that better enable the synthesis, visualization and evaluation of water-related data . . . " It also called for " . . . an accurate assessment of the Nation's water availability and water demands, with the goal of integrating the information into state water resources planning, recognizing that a truly national assessment must

begin at the state and local level with appropriate technical and financial support from the federal government."

In September 2007, the National Science and Technology Council's Committee on Environment and Natural Resources, Subcommittee on Water Availability and Quality (SWAQ), released a report entitled: "A Strategy for Federal Science and Technology to Support Water Availability and Quality in the United States." In part the report reads: "In 2006, the Nation supported 300 million citizens and the population was growing at a rate of almost 1 percent per year. Several regions and major metropolitan areas are growing at double-digit rates. Attempts to address the science and technology needs of the water community will require special consideration of areas with extreme growth in population or water consumption. In addition, trends in water use in the agricultural and energy sectors are major drivers of water resource needs. Other primary factors that influence the future availability of water include climate change and variability, pollution, and increased conflicts over water allocation among different users. Abundant supplies of clean, fresh water can no longer be taken for granted." (p. 7)

The SWAQ report continues, "Many effective programs are underway to measure aspects of our water resources. However, simply stated, quantitative knowledge of U.S. water supply is currently inadequate (U.S. Government Accountability Office, 2005; National Research Council, 2004). The United States should measure water resources more strategically and efficiently. A robust process for measuring the quantity and quality of the Nation's water resources requires a systems approach. Surface water, ground water, rainfall, and snowpack all represent quantities of water to be assessed and managed—from the perspectives of quantity, quality, timing, and location. A comprehensive assessment of U.S. water resources should build upon significant monitoring programs by water management authorities, States, and Federal government agencies to ensure that regional and national water resources are measured accurately. Data and information about the Nation's water supply should be widely available, should integrate physical and social sciences, and should be relevant to decisionmakers, from the individual homeowner to regional water managers. Without an adequate assessment of water supplies on a watershed or aquifer basis, optimal water management cannot be achieved. Improved knowledge of the size and distribution of the water supply and how it changes over time will allow more efficient and equitable allocation of this precious resource and will minimize over-allocation of limited supplies . . . To manage water effectively, we should know our present and future demands for water in individual homes, businesses, farms, industries, and power plants, as well as water needed for sustainable ecosystems." (pp. 7-8)

"Western Governors support several federal programs that are particularly critical.. Western Governors are concerned about declines in federal spending for.programs that provide important water supply information and believe that such programs should be fully funded by Congress." (WGA Policy Resolution 11-7, p. 2)

We urge Congress to continue to support the U.S. Geological Survey (USGS) and its National Water Availability and Use Assessment, authorized by the SECURE Water Act, as well the National Streamflow Information Program and Cooperative Water Program, all of which are critical to providing a sound basis for improving water management and decision-making. We continue to join with scores of other government entities and stakeholders in calling on Congress to fully fund NSIP and re-balance the federal CWP cost-share to a 50-50 match, in order to reverse the loss of long-term streamgages and restore data that is critical to assessing our needs related to water supplies, drought and floods, emergency warning and management systems, infrastructure design, climate, interstate water compacts, international treaties and tribal trust responsibilities, as well myriad other federal, state and local government water planning, management and decision-making purposes.

We also strongly support NASA's Landsat Data Continuity Mission (LDCM), with its thermal infrared sensor (TIRS) and imaging capability (that many western states are using to monitor and manage consumptive water uses, particularly agricultural uses). Further, we recognize the need for and importance of providing sufficient appropriations for USGS to complete and operate the necessary ground operations systems without having to take funds from other USGS programs. This is a priority for WGA and the WSWC, and hopefully for this Congress, given the impending failure of Landsat 5 and the need to launch Landsat 8 as planned and keep LDCM on schedule, so we do not lose this important thermal data which more and more states rely on to measure and monitor consumptive uses.

We are also very concerned about potential cuts to USDA's Snow Survey and Water Supply Forecasting Program, which is presently operating on a "shoe string." Western water managers depend on this vital information for water supply planning and decision-making. Any funding cuts will likely lead to the suspension of snow

course readings, stop conversions of snow courses to automated SNOTEL (Snow Telemetry) sites, and ultimately result in the loss of data due to the failure of equipment that has to be actively maintained. Many snow courses and SNOTEL sites have been operating for decades, and the potential loss of such long continuous records is particularly troubling and problematic due to the impact on modeling and forecasting.

"Western Governors support federal efforts to coordinate water data gathering and information programs across multiple agencies . . . Western Governors encourage federal agencies to partner with States in the gathering, coordination and effective dissemination of water-related data . . . Western Governors call on the federal government to work with Western States to develop tools and models that better enable the synthesis, visualization and evaluation of water-related data." (WGA Policy Resolution 11-7, p.2)

The WGA, WSWC and our member states are working closely with a number of federal agencies on various efforts to further our water related knowledge, including but not limited to the WaterSMART Assessment/Census and Basin Studies, Interior's Landscape Conservation Cooperatives, the National Integrated Drought Information System (NIDIS) Upper Colorado River Basin Pilot, climate and extreme event workshops, and energy and water demand studies.

Of particular note, the WGA and WSWC are working with the Department of Energy and National Laboratories to develop water demand projection and water availability models as a basis for estimating and evaluating water needs for electric power generation and other energy uses. We are also evaluating the impact of those demands on other water use sectors. The WSWC is providing expert advice and state generated data, and will be preparing information on state institutions, statutes, policies and processes that govern water rights and control the allocation and use of water in the West.

We have also developed a project plan for a Water Use Data Exchange, collaborating with state and federal agencies, to make data available in a format that can be synthesized to support federal, state and local decision-making and improve water resources planning and management. Our initial efforts are focused on water for energy demands, but our intent is also to be able to better understand our capabilities and limitations related to estimating water use and prepare a foundation upon which to build better water budgets and demand projections through close collaboration between state and federal agencies.

III. Water Infrastructure

"Western Governors support investment in water supply and water quality infrastructure. Infrastructure investments are essential to our nation's continued economic prosperity and environmental improvements, and they assist state and local entities in meeting federally mandated standards. Infrastructure investment is particularly critical now, as much of the water infrastructure that has served the West for decades is aging and in dire need of repair." (WGA Policy Resolution 11-7, p.4)

In November 2010, the WGA, WSWC and Texas Water Development Board (TWDB) sponsored a Symposium entitled, "Western Water Resources Infrastructure Needs and Strategies" in San Antonio, Texas. Patrick Natale, Executive Director of the American Society for Civil Engineers (ASCE), spoke and said: "The estimated five-year investment need for all infrastructure repairs and rehabilitation is $2.2 trillion." The most recent ASCE Report Card gave the Nation's drinking and wastewater infrastructure a D-grade, its dams a D, and its levees and inland waterways a D-. Steve Stockton, Director of Civil Works, U.S. Army Corps of Engineers, reported, "The present value of the capital stock portfolio of the USACE has declined from a peak value of $250 billion in 1983 to $165 billion today, with $60 billion in authorized projects and an annual investment of $2 billion. Roughly $100 billion is needed to repair levee systems, while $125 billion is required to replace the current navigation lock system." Steve Allbee, EPA Gap Analysis Program Director, added, "State and local governments have spend $1.1 trillion since the 1960s on water and wastewater infrastructure, with an additional $140 billion federal investment, but EPA's 2002 analysis identifies a current need of $540 billion."

Separately, estimates of the Bureau of Reclamation's 2010 backlog total some $6.6 billion for major rehabilitation and replacement of aging infrastructure ($930 million), authorized Title XVI water recycling and reuse projects ($600 million), authorized construction and operation of rural water projects ($1.2 billion), authorized environmental restoration programs ($2 billion), and then authorized and pending Indian water rights settlements ($1.9 billion). By comparison, Congress appropriated $951.2 million in FY 2010 for Reclamation's Water & Related Resources Account.

Construction related federal Stimulus spending totaled some $135 billion, with $22 billion for water and wastewater projects according to Ken Simonson, Associ-

ated General Contractors of America. Total construction spending is down 10% in the last five years, and private non-residential building is down 25%, said Perry Fowler, Texas Associated General Contractors.

Of note, a report by the Texas 2000 Commission entitled, "Texas Past and Future," concluded: "Capital financing requirements to meet demands from municipal and industrial water and wastewater treatment during the next quarter century represent an outlay more than double the existing debt of the state and all of its political subdivisions." TWDB has spent $12.4 billion on water and waste-water projects, including $1.5 billion in 2010 alone.

According to Stephen Fuller, George Mason University, every $1 billion spent on water-related infrastructure produces 28,500 jobs, growth in personal earning of $1.1 billion, and the gross domestic product (GNP) grows by $3.4 billion. Infrastructure investments are an investment in our future.

In the West, our population is growing and water demands have changed since much of our infrastructure was built. Symposium participants identified a need to redefine and re-evaluate our water infrastructure needs based on standard criteria that include risks to: (a) health and human safety; (b) economic growth; and (c) the environment. We also need to evaluate risks to our existing infrastructure, and improve asset management and system operations.

There is a great need for stable or increasing funding of infrastructure, especially in small and rural communities, that must be addressed. While states recognize that they cannot depend on the federal government in Washington, D.C. to solve all their infrastructure problems, there is a legitimate continuing federal role related to federal landownership, tribal trust responsibilities and federal regulatory mandates. Federal financial incentives and technical assistance may also be appropriate to assist state and local governments, where they can't reasonably meet their own needs. There is a need, and there are opportunities, to improve collaboration and leadership at all levels of government in addressing our water-related infrastructure needs. Moreover, it is important to make investment decisions based on long-term capital budgeting efficiencies, and move away from "annual incremental choices." Inconsistent, inadequate and untimely funding leads to project delays and ultimate higher costs.

Financing is the principal challenge to meeting our present and future infrastructure needs, particularly given important concerns over the national debt and federal spending. Infrastructure can be viewed either as a critical investment or "pork barrel" spending. We must differentiate between "good" and "bad" debt, and between projects we need and projects we would like to have. We must adequately weigh project costs and benefits, using planning and prioritization tools to set clear priorities. That being said, the project with the highest benefit-cost ration or return on the federal investment is not necessarily the best project. State and local collaboration and appropriate cost sharing are important tools. Federal capitalization of State Revolving Funds for water and wastewater projects have been an effective and successful partnership, and have been especially critical to meeting the needs of small systems and small communities. Similar partnership mechanisms that rely on state operations and decision-making should be considered, such as federal loan guarantees, water-related private activity bond tax exemptions, and an infrastructure bank or water trust fund.

A 1964 compilation of papers on the economics of public policy in water resources development observed, "A reduction in the federal share of the costs of water resources projects should not be regarded necessarily as a desirable end in itself. Rather, requirements should be established to serve more specific objectives as achieving optimum resource development and use—and promoting desired incidence, distribution and stabilization policies." (Economics and Public Policy in Water Resource Development, Stephen Smith & Emery Castle editors, Iowa State University Press, 1964).

A 1984 WSWC report on federal water project financing and cost sharing concluded: "The present Administration seems to be proposing further withdrawal of federal financing participation in national water resource development in order to reduce federal spending. While the urgent need to balance the federal budget may appear to necessitate a decreasing federal role, reduced federal appropriations for water projects will do very little, if anything, to solve our economic problems. The size of the national debt has mainly been caused by direct income transfers and national defense spending.. While western states have previously endorsed the concept of cost sharing, they have not, and cannot support federal abdication of responsibility. where an appropriate federal interest is involved." The same might be said today. (State/Federal Financing and Western Water Resource Development, 1984, pp. 13-14)

Public Private Partnerships may help reduce overall public risk and capital investment requirements, as well as improve efficiencies and cost effectiveness. Governments can remove unnecessary obstacles to alternative infrastructure delivery methods, and provide a supportive statutory and political environment. We must also recognize that private risk capital is profit driven, and investors are intolerant of bureaucratic processes and litigation. Opportunities exist to minimize regulatory compliance costs and avoid unnecessary project delays by better defining reasonable and necessary protections, streamlining and coordinating regulations at all levels of government, and removing unnecessary regulatory obstacles. We need to promote both public and private accountability.

In the West, Congress provided the means to finance federal water resources investments through the Reclamation Act of 1902. Western Governors continue to urge the Congress to increase appropriation from the Reclamation Fund for authorized purposes to match average annual fund receipts.

In the end, there is no "silver bullet." Resolving our infrastructure challenges will require real cash to service real debt. There has to be a revenue stream. However, despite budget pressures, now is a good time to invest in order to take advantage of opportunities related to both low material and capital costs.

IV. Indian Water Rights Settlements

"Western Governors support negotiated settlements of Indian land and water rights disputes in order to meet the nation's obligations to tribes while providing increased certainty for all Western water users." (WGA Policy Resolution 11-7, p. 5)

The WGA and WSWC are long-standing advocates of Indian water rights settlements, and we applaud Congress for passing the Aamodt, Crow, Taos, and White Mountain Apache settlement agreements last December as part of the Claims Resolution Act of 2010. "Western Governors urge the Administration to support a strong federal commitment to meaningful federal contributions that recognize the trust obligations of the United States government. Congress should also ensure that any land or water settlement, once authorized and approved by the President, will be funded and implemented in a timely manner without a corresponding offset to some other tribe or essential Interior program." Settlements and related infrastructure investments are bringing economic development, environmental protection and peace to many valleys in the West—yet more needs to be done. "Negotiated settlements are flexible, promote sound management practices, provide a basis for partnerships between Indian and non-Indian communities, and save millions of dollars by avoiding prolonged and costly litigation." (WGA Policy Resolution 11-7, p. 5)

V. Water Transfers

"Western Governors recognize the potential benefits of market-based water transfers, and that the predominant water use in the West is agriculture, but they are concerned about maintaining the important cultural, economic, and environmental benefits of agricultural lands and food production." (WGA Policy Resolution 11-7, p. 5)

With support from the Walton Family Foundation, the WGA and WSWC are carrying out a year-long project to identify and promote innovative water sharing strategies to allow temporary or permanent water transfers between different uses (including agriculture, urban, energy and environmental uses), while avoiding or mitigating damages to environmental values, agricultural economies and rural communities. Specifically, the WGA and WSWC are focusing on state-level programs, institutional arrangements, and administrative practices that can facilitate smart water sharing. The project is engaging state water managers and a broad stakeholder community of agricultural water users, municipal providers, energy/industrial developers, and the environmental community. Products will include a toolbox of innovative strategies, options for new programs or administrative practices, and potential policy recommendations for the Western Governors—with a focus on activities that can be implemented at the state level to address our growing and changing water needs.

Further, Western Governors encourage adoption of strategies to make existing water supplies go further, including water conservation and reductions in per capita water use. They also support investment in research into promising water-saving strategies. Moreover, Western Governors encourage the use of alternative water supplies (of appropriate quality for designated uses) through water reuse and recycling, desalination and reclamation of brackish waters.

VI. State-Federal Collaboration: WestFAST

"Western Governors recognize the important role of federal agencies in supporting sound water resource management in the Western states. Governors appreciate the

efforts of federal agencies to coordinate water-related activities with the Western states through the 'Western States Federal Agency Support Team' (WestFAST) and recommend the continuation of this key state-federal partnership." (WGA Policy Resolution 11-7, p. 4)

Lastly, on behalf of the WGA and WSWC, we would like to recognize and applaud the collaborative efforts of eleven federal agencies, including the U.S. Army Corps of Engineers, U.S. Bureau of Reclamation and U.S. Geological Survey, in joining us in signing a Letter of Cooperation to work together for the sustainable and efficient use of western water resources. The WestFAST partnership is a continuing commitment on the part of federal and state agencies—working with local, tribal and other public and private stakeholders—to improve the effectiveness of collaboration in seeking grassroots, watershed solutions to water issues in the West. It emphasizes proactive, voluntary, participatory and incentive-based approaches to water resource management and conservation assistance programs. Each agency has designated a WestFAST member to represent them, and together support a federal liaison officer detailed to our office. We believe WestFAST represents a model for other collaborative federal-state partnerships.

VII. Conclusion

We appreciate the invitation to testify on these important matters and look forward to continuing to work with the Subcommittee, Committee and Congress on opportunities to address our present and future water supply challenges.

Senator SHAHEEN. Thank you.

Ms. MEEKER.

STATEMENT OF MELISSA L. MEEKER, EXECUTIVE DIRECTOR, SOUTH FLORIDA WATER MANAGEMENT DISTRICT, WEST PALM BEACH, FL

Ms. MEEKER. Madam Chair, thank you for the opportunity to appear before you. My name is Melissa Meeker, and I am the Executive Director of the South Florida Water Management District. This agency is 1 of 5 regional agencies created to ensure a sustainable supply of water for Florida citizens, environment, and economy.

In South Florida, this responsibility includes operating 1 of the world's largest flood-controlled systems, which protects 7.7 million people and delivers 1.4 billion gallons of water each day to support urban and agricultural users.

Florida's water challenge is not necessarily a lack of water. Nearly two-thirds of our fresh water is supplied by vast underground aquifers, and Florida receives 53 inches of rainfall each year, making it one of the wettest States in the Nation.

But we do have water challenges, which are 3-fold. First and foremost is storage. Florida is a flat landscape, and that means that we have an inability to really capture and store rainwater for future use. It's extremely limited. As a result, an average of 1.7 billion gallons are discharged daily through our canal systems to tide.

Our second challenge is weather extremes. Florida is affected by tropical storms and hurricanes, as well as extensive droughts and water shortages. Just this year, the region emerged from a 4-year rainfall deficit. Because Florida is largely surrounded by saltwater, our drought conditions bring the risk of saltwater intrusion in our underground fresh water supplies.

Our third challenge is demand and competing uses. Statewide, Floridians use an average of 6.7 billion gallons a day. The projection for the year 2030 is 8.1 billion gallons per day. That means in the next 20 years, another 1.4 billion gallons a day must be identified and developed. Planning for a growing population must

also be imbalanced—must also be balanced with ensuring water is available for our natural systems.

Water in the State of Florida is a public resource. So, strategies that expand our water supply must be in the public interest. We use a variety of tools to achieve this, including sound planning and predictable permitting programs based and embedded firmly in our State law, demand reductions, development of alternative water sources, and in South Florida, restoring the Everglades, which will result in more water from environmental, urban, and agricultural users.

In 2004—in 2005, excuse me, the Florida legislature recognized the importance of developing alternative water supplies, and adopted the Water Protection and Sustainability Program. More than $550 million in State funding have helped to construct 327 projects, which will create an estimated 760 million gallons a day of new water. This is more than 50 percent of the additional water demands I previously described.

To date, more than 60 percent of those funded programs are for reclaimed water. This underscores the value of wastewater as a critical water resource, rather than a disposal challenge, as historically viewed. Reclaimed water can safely be used for irrigation, groundwater recharge, saltwater intrusion barriers, environmental enhancement, and other beneficial uses.

Florida is a leader in water reuse. The State's total reuse capacity has increased more than 300 percent since 1986. Statewide, there are more than 480 facilities collectively reusing 660 million gallons a day of reclaimed water. This is supplementing our water supplies by the billions.

Florida's efforts go even further. Three years ago State lawmakers directed the elimination of ocean outfalls by 2025. Preventing this discharge of wastewater to the oceans will generate an estimated 178 million gallons of reclaimed water that can be used in some of our most highly populated areas in Southeast Florida.

We cannot talk about water in South Florida without talking about environmental restoration. They're intrinsically linked. The largest of our efforts is a State-Federal partnership to restore America's Everglades. The Comprehensive Everglades Restoration Plan is constructing large public works, like storage reservoirs and treatment wetlands, to improve water delivery to the Everglades' inter-coastal ecosystems.

New water resulting from construction of these projects will be set aside for the environment first, and then made available for other purposes. While restoration is underway, Federal agency coordination, Congressional authorizations for shovel-ready projects, and continued Federal and State funding are critical to maintaining our momentum.

In summary, Florida's water managers are successfully using a variety of tools to address current and future water needs. But to maintain progress we must commit to financial and political investments that support community infrastructure improvements, innovative technologies, enhanced agency coordination, especially in the face of budgetary challenges, and partnerships like the Comprehensive Everglades Restoration Plan. The long-term benefits, particu-

larly that of a healthy and sustainable economy, truly outweigh the costs.

Chairman, thank you again for convening this hearing. I appreciate the invitation to share Florida's perspective, and we look forward to a national dialog on these issues. Thank you.

[The prepared statement of Ms. Meeker follows:]

PREPARED STATEMENT OF MELISSA L. MEEKER, EXECUTIVE DIRECTOR, SOUTH FLORIDA WATER MANAGEMENT DISTRICT, WEST PALM BEACH, FL

Introduction

Thank you for the opportunity to provide testimony to the Subcommittee on Water and Power of the Senate Committee on Energy and Natural Resources. We appreciate Chairman Jeanne Shaheen's heightened focus on the critical issue of water supply challenges and opportunities. My name is Melissa L. Meeker, and I appear before the subcommittee in my capacity as Executive Director of the South Florida Water Management District.

Headquartered in West Palm Beach, the South Florida Water Management District is one of Florida's five regional water management districts created to oversee and manage the state's water resources. Operating for the past forty years, these public agencies are charged with four broad mission responsibilities: flood control, water supply, natural systems and water quality. With general oversight and guidance provided by the Florida Department of Environmental Protection, the water management districts utilize a variety of tools and technologies to help ensure a reliable and sustainable supply of water for Florida's citizens, environment and economy, both for today and for our future.

The South Florida Water Management District has two additional responsibilities unique to South Florida. The first is managing and operating the Central and Southern Florida Project, one of the world's largest public works projects. This extensive infrastructure of canals, levees and structures was built by the U.S. Army Corps of Engineers fifty years ago to provide flood control and water supply benefits to an estimated population of 2 million. Today that system is supporting a population of 7.7 million-nearly four times the number of people it was designed for. At the same time, operation of this complex system of water management structures is capable of delivering nearly 1.4 billion gallons per day-or 500 billion gallons annually-to support the water supply needs of urban areas and the agricultural industry.

The agency's second unique responsibility is implementing the federal-state partnership to restore America's Everglades, the largest ecosystem restoration initiative in North America. The Comprehensive Everglades Restoration Plan is focused specifically on "getting the water right".in quantity, quality, timing and distribution. Successful restoration will capture, store, treat and deliver water to revitalize the natural system, improve wildlife habitat and recharge the underground aquifer to ensure a reliable and sustainable supply of water for the Everglades and South Florida. This effort is a critical component of our overall water management strategy.

Overview: Where Does Florida's Water Come From?

Florida is a rainfall-dependent state. Average annual rainfall is 53 inches, making it one of the wettest states in the nation. Unlike other parts of the country, nearly two-thirds of Florida's freshwater use is pumped from underground aquifers. These include the deep Floridan Aquifer and the shallower Biscayne Aquifer, which is highly dependent on rainfall for replenishment. The state's remaining fresh water is supplied from surface waters, including lakes and rivers, which are also dependent on rainfall. In South Florida, approximately 90 percent of the water used in homes and businesses comes from groundwater sources, with only 10 percent from surface waters.

At the center of South Florida sits the 730-square-mile Lake Okeechobee-the liquid heart of the greater Everglades ecosystem. It serves as both a direct source of public water supply and provides a supplemental source of irrigation water to more than 700,000 acres in agricultural production. In addition, the 'big lake' serves as the backup water supply for more than five million residents.

America's Everglades are a vital part of South Florida's water story. Dubbed the River of Grass for the sawgrass that flourished throughout the marsh, the Everglades is a mosaic of freshwater ponds, prairies and forested uplands that is home to dozens of federally threatened and endangered species, including the Florida panther, American crocodile, snail kite and wood stork. These vast, shallow wetlands,

which once covered almost 11,000 square miles, help to recharge the region's underground water supplies. But because of efforts to drain the marshland for urban development, agriculture and flood control, the Everglades is today half the size it was a century ago.

Florida's Water Supply Challenges

Florida's water supply challenges are three-fold: the need for storage, unpredictable weather extremes and a growing demand coupled with competing uses.

Storage—Florida's flat landscape creates one of our most significant water supply challenges: lack of storage. Although rainfall recharges underground supplies, the ability to capture and store the rainwater for future use is extremely limited. When floods threaten-which occurs even during water shortage situations-the South Florida Water Management District's top priority is channeling excess water away from homes and businesses as quickly as possible. To lower the levels in coastal canals and accommodate direct rainfall and stormwater runoff for flood protection, fresh water must oftentimes be released to the Atlantic Ocean or the Gulf of Mexico.

Effective management of the Central and Southern Florida Project provides for the delivery of nearly 1.4 billion gallons per day to meet South Florida's water supply needs. But because of limited surface water storage and an infrastructure designed for flood control, it is estimated that a staggering 1.7 billion gallons of water per day, on average, is diverted through the extensive canal system and discharged to tide.

Weather Extremes—Despite the abundance of rainfall, the state's climate types yield significant rainfall variability from region to region and from year to year. In South Florida, most of the rain falls during just four summer months. In addition, a significant amount of rainfall is lost through evapotranspiration or-because of the flat landscape and lack of regional storage-channeled out to tide for flood protection.

Florida is also prone to prolonged droughts and water shortages. Just this year, the region emerged from a multi-year period of rainfall deficit. Lake Okeechobee reached an all-time low of 8.82 feet above sea level in the summer of 2007, and from October 2010 to June 2011, the region experienced its driest dry season since recordkeeping began 80 years ago. In some areas, the rainfall deficit grew to more than 20 inches, with Lake Okeechobee, a water body with an average depth of only 9 feet, dropping more than 3.5 feet below normal. In essence, the Sunshine State is a state of meteorological extremes, where extended dry spells and big rain days are considered the norm.

And because Florida is largely surrounded by salt water, drought conditions require a constant vigil to monitor and combat the intrusion of heavier seawater into the state's underground freshwater supplies.

Demands and Competing Uses—During the past half-century, Florida's water demands have risen exponentially-and they are projected to continue increasing. Statewide, Floridians used an average of 6.7 billion gallons a day in 2010; the projection for 2030 is 8.1 billion gallons a day. That means that in the next 20 years, another 1.4 billion gallons a day must be identified and planned for. Planning and developing water for a growing population must also be balanced with ensuring water is available for our natural systems.

What makes Florida unique is its diversity of environmental features: beaches, rivers, lakes, bays, estuaries and wetlands, including the vast Everglades ecosystem. The vast interconnected Everglades system, which historically stretched from Orlando in the central part of the state down to Florida Bay, today encompasses 2.4 million acres and is the focus of a thirty-year, multi-billion dollar state-federal restoration effort.

The health of this ecosystem depends on delivering the right quality of water to the right places in the right amounts and at the right time. Successful restoration requires capturing, storing, treating and delivering water to revitalize the natural system. When complete, Everglades restoration has the very real potential to achieve both our environmental and economic water supply needs.

Florida's Water Supply Solutions

To meet Florida's future demands, the state's water management districts are diversifying the water supply portfolio to maximize traditional sources, while at the same time tapping into alternative sources. Strategies include sound planning and permitting; demand reduction through water conservation; development of alternative water sources such as surface waters, reuse and desalinization; and in South Florida, restoring the Everglades, which will result in more water overall for environmental, urban and agricultural users.

Planning and Permitting—Water in the State of Florida is a public resource. Its use, as determined by state statutes, is guided by the diverse programs imple-

mented by the water management districts (Chapter 373, Florida Statutes). The cornerstone of effective water supply management is sound planning and regulatory certainty.

To address future water needs, Florida's water management districts work with utilities, agriculture and other stakeholders to develop region-specific water supply plans. These plans use a 20-year planning horizon to evaluate water needs and identify strategies for meeting future demands. Developed through a collaborative effort with local governments and other stakeholders, each plan includes water demand estimates and projections; an evaluation of existing regional water resources; identification of water supply-related issues and options; water resource and water supply development components, including funding strategies; and recommendations for meeting projected demands.

In South Florida, the regional plans completed to-date have concluded that the use of traditional fresh water sources have been maximized. In 2010, urban and agricultural users in South Florida used an estimated 3.5 billion gallons per day of water. Over the next 20 years, water needs in the region are projected to increase by almost 1 billion gallons a day.

Regulatory programs also play an important a role in water supply management. When applied fairly and consistently, they aid in advancing water use efficiency, promoting water conservation, sustaining limited supplies and protecting the natural environment. Permit applications for water use are evaluated by Florida's water management districts under a "three-pronged test": the proposed use must be reasonable-beneficial, it must not interfere with any presently existing legal use of water, and it must be consistent with the public interest.

Additional rules are in place for protecting Florida's water bodies, especially wetlands, from harm that could result from water supply over-pumping. In addition, the state's Water Reservations authority allow for water to be set aside in an ecosystem for the protection of fish and wildlife. This has become an important tool in Everglades restoration.

Furthermore, in South Florida it is no longer an option for utilities or businesses to address future demands by requesting increased withdrawals from certain regions. Restricted Allocation Area rules prevent water users from tapping the famed River of Grass for new or additional supplies. "New" water from the Everglades is now restricted for environmental restoration purposes only. A similar rule is in effect that limits withdrawals from Lake Okeechobee to current levels.

Alternative Water Supplies—Diversifying water supply sources is important to Florida's future and ensures communities are less susceptible to the effects of drought. In 2005, the Florida Legislature recognized this and enacted the Water Protection and Sustainability Program. Through funding, this precedent-setting program encourages cooperation between municipalities, counties, the state and the five water management districts to protect and develop water supplies in a sustainable manner. Examples of alternative water supplies that meet this objective include: treatment of saltwater and brackish water; water reuse; stormwater/surface water captured during heavy rainfalls; and sources made available through the addition of new storage capacity.

Since 2005, more than $551 million in state funding assistance has been provided toward 327 projects, about 15 percent of the $3.8 billion estimated total construction costs. When constructed, these alternative water supply projects will create a combined 761 million gallons a day of "new water".more than 50 percent of the additional 1.4 billion gallons a day needed to meet the projected growth in demand.

In South Florida alone, funding has been provided in support of local alternative water supply projects since 1997. To-date, a total of $204 million in grants has been directed toward 474 alternative water supply projects that produced 429 million gallons of water per day. Funded projects have included reuse, use of brackish and seawater sources and aquifer storage and recovery.

The reuse of reclaimed water is a key component of the new "water pie." To date, more than 60 percent of the alternative water supply projects funded are for reclaimed water. This underscores the value of wastewater as a critical water resource rather than a disposal challenge. It is no longer acceptable to use water just once and then dispose of it. Water reuse is an excellent opportunity to integrate wastewater management and water supply. Reclaimed water can safely be used for irrigation, groundwater recharge, saltwater intrusion barriers, environmental enhancement and other beneficial uses.

Florida is today a leader in water reuse. The state's total reuse capacity has increased 331 percent between 1986 and 2010. Statewide today, there are more than 480 facilities in operation—collectively reusing 659 million gallons a day of reclaimed water that is estimated to have avoided the use of more than 121 billion

gallons of potable quality water. This also adds more than 80 billion gallons back to available groundwater supplies.

To further increase the use of treated wastewater, the Florida Legislature in 2008 authorized the elimination of six ocean outfalls remaining in the state. This legislation requires utilities currently using ocean outfalls as a wastewater disposal method to go to advanced wastewater treatment by 2018; to eliminate discharges (except for wet weather) by 2025; and to achieve, at a minimum, 60 percent reuse of the facility's actual annual flow by December 31, 2025.

The elimination of the state's ocean outfalls—all of which are located within the South Florida Water Management District's boundaries—will generate an estimated 178 million gallons per day of reclaimed water for use within some of the most heavily-populated areas of South Florida. Water supply development projects that support the reuse of treated wastewater are included in regional water supply plans and its beneficial use is encouraged in consumptive use permits. The challenge we face is in retrofitting our communities to accommodate reclaimed water infrastructure and the public perceptions associated with this valuable resource.

I recently had the opportunity to talk to a national audience about Florida's leadership and commitment to increasing water reuse in the state at the "2011 Potable Reuse Conference" sponsored by the WateReuse Association. A copy of that presentation is included here as part of my written testimony. See attachment*.

Realizing Everglades Restoration—Together with traditional water supply augmentation and demand management strategies, efforts are also under way to capture, conserve and more effectively utilize water for the natural system through environmental restoration.

Today, the South Florida Water Management District and the State of Florida, along with the U.S. Army Corps of Engineers and other partner agencies, are working to undo the environmental damage inadvertently caused by the construction of the Central and Southern Florida Project and a century of drainage. The overarching goal is to capture the 1.7 billion gallons per day of fresh water that now flows unused to the ocean and the gulf and redirect it to storage for natural areas that need it most for restoration purposes. Returning a more historic flow of water to the remnant River of Grass will not only revive the native habitat for 68 threatened and endangered species, it will also naturally replenish the underground aquifers that supply drinking water to the population.

Authorized in the Water Resources Development Act of 2000, the joint state-federal Comprehensive Everglades Restoration Plan (CERP) partnership provides a framework to restore, protect and preserve the water resources of central and southern Florida, including the Everglades. CERP includes more than 60 elements. Any new water resulting from the construction of restoration projects will, first and foremost, be directed to environmental restoration and then will be made available for other purposes. Major components include surface water storage reservoirs; water preserve areas; management of Lake Okeechobee as an ecological resource; improved water deliveries to coastal estuaries; underground water storage; treatment wetlands; improved water deliveries to the Everglades; removal of barriers to the natural sheetflow of water; storage of water in existing quarries; reuse of wastewater and improved water conservation.

Approximately 60 percent of the nearly 400,000 acres of lands needed to move forward with Everglades restoration are in public ownership. Design and/or construction of projects to increase storage, improve water quality and reestablish more historic flow patterns and hydrologic characteristics are under way. Federal agency coordination and authorizations of projects ready-to-go, along with continued federal and state funding, is crucial to maintaining restoration progress.

Conclusion

Just as rainfall is linked to water supplies, the availability of an affordable water supply is also tied to the economy. The economic downturn has been painful across the country, and the combination of a weak economy with recent record drought conditions has made it a challenge for many communities and businesses. That connection underscores the importance of planning for and developing adequate water supply for economic sustainability. Adequate, affordable water is needed to achieve economic growth; attract new industries and provide cooling water for new and existing utilities; sustain agriculture; and to maintain a healthy environment. These—and numerous other water-dependent businesses—all have the potential to create jobs. No one wants water scarcity or availability to be a limiting factor in any aspect of our state or nation's economic future.

---

*A copy of the presentation has been retained in subcommittee files.

Finding and implementing workable, cost-effective solutions to environmental, water resource protection and water supply availability issues requires a concerted and collaborative approach—a combination of public works projects and private participation that can yield mutually beneficial dividends. We must employ a variety of resource management tools to address our challenges, and we must commit to financial and political investments in water conservation, water resource development and alternative water supplies to ensure that future water needs will be met-not at the expense of our natural systems but as a result of innovative and cooperative solutions.

Federal support and investment in the Comprehensive Everglades Restoration Plan, community infrastructure improvements and new technologies are vital to helping local communities-and our nation-meet its water supply needs. The long-term benefits, particularly that of a healthy and sustainable economy, truly outweigh the costs. Chairman Shaheen, the South Florida Water Management District would like to thank you for convening this hearing and for stimulating thoughtful dialogue that can lead to collaborative and productive solutions to the nation's water supply challenges. We appreciate the invitation extended to the State of Florida to provide input and our perspective on this important issue.

Senator SHAHEEN. Thank you very much.

Harry. I'm not going to call you Mr. Stewart. I know you well enough to call you Harry.

STATEMENT OF HARRY T. STEWART, DIRECTOR, WATER DIVISION, NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES, CONCORD, NH

Mr. STEWART. The last time we met it was in a smaller room than this, I believe——

Senator SHAHEEN. That's right.

Mr. STEWART [continuing]. Senator. Thank you for the opportunity, Madam Chair, to be here and talk about water resource issues with you.

To me, sustainability, in terms of public water supplies, is a matter for water resource itself, the infrastructure that conveys, stores, and treats that water. The financial resources have to be in place, and also the management capability. Those are all very important issues.

New Hampshire, as you indicated, is the rapid—the most rapidly growing State in New England. In fact, the State has doubled in population in 50 years, and is projected to increase another 20 percent, or 260,000 people in the next 20 years. So, that certainly presents a challenge for us, in terms of our—our water resources.

About 36 percent of the population is supplied water at—at its—at residences by private individual wells. Those aren't really a topic, in terms of the sustainability issue probably, but they are an issue in New Hampshire and other States.

For example, in New Hampshire, 20 percent of those wells, we know, have arsenic exceedances. They're unregulated. We have education outreach to those folks, but it certainly is a public health issue in New Hampshire and other States.

The community public water supplies in New Hampshire, the 721 of them, 100 or so are municipal systems. Those have been pretty much fixed. Then there are older systems. Some go back 150, 160 years. It's been 10 or 15 years since I've heard of a piece of wooden pipe coming out of the ground, but we do have wooden pipe, actually, still in the ground. Those systems are—are old. They're in pretty good shape, in terms of compliance with the Safe Drinking Water Act, but there are quantity issues, supply issues,

going forward, and infrastructure, more broadly, infrastructure issues that need to be addressed.

The other 600 or so our community supplies that have grown up like mushrooms across the State during the growth spurts that have occurred over the last 50 years. The older of those are undermanaged, underfinanced. They have trouble with compliance with the Safe Drinking Water Act. When they are upgraded, the affordability is a major issue for the community, particularly if it's a low-income community. So, those are a major concern in the broadest sustainability context.

We know in New Hampshire that there's 1.7 billion in infrastructure needs for drinking water supply. We did a need survey this past year to—to feed information into a sustainability commission. That's a very substantial figure.

Other water infrastructure needs for wastewater, municipal, and State-owned dams, and storm water infrastructure are comparable, in the $1.5 billion range, cumulatively. So, we have a lot of issues with regards to the infrastructure.

Our climate change is affecting our drinking water supplies, and—and it is a real issue. For example, over the last 5 years, the Lamprey River, near where you live, Senator, 7 of the 15 highest flows on record have occurred. The record is a 100 old. So, we're very clearly seeing more volatility with regard to our precipitation events and how they affect river flows.

Going forward, New Hampshire has a number of initiatives that are trying to address the sustainability question. The Governor, this year, Governor Lynch, commissioned a commission to develop a water sustainability plan for the State of New Hampshire. This is in its early throes. But the focus is on the long-term and how to make sure that we're prepared for the future, in terms of water resource sustainability.

We also have a commission that's working on the infrastructure sustainability, in the context of funding. This is a—a legislative commission. We hope that coming out of 2012 they'll have—there'll be a direction, in terms of some funding source to—to help with the question of affordability for the—for the community water supplies, and the wastewater plants, in particular.

We also have 2 other initiatives—initiatives. Excuse me. Since 1998, when you were Governor, we've had a large groundwater withdrawal permitting program. This has evolved over time. It's a very transparent program. So, when withdrawals occur, there's 2 public hearings.

Considerations, in terms of approvals, include the long-term right of replenishment of the aquifer, if that's going to be affected. If there's effects on wetlands or surface water flows that could cause a violation of the Clean Water Act, the spread of groundwater contamination. All these factors, as well as impacts on other users, are considered.

This is a very sophisticated program. It's certainly state-of-the-art nationally. Our aquifers are different than in Texas. They're more localized. But it's a very effective program.

We also have a—an in-stream flow protection pilot program going on. This is supposed to last 5 years. It's taken 10. It's going to end this—in 2012. To look at how to build a consensus on—on

water use in a river basin, and balance the interests of diverse users, along with the environmental considerations, to make sure that the environment is reasonably protected, also.

So, I think New Hampshire is moving forward. We've made good progress toward a sustainable water supply over the long term. We have a long way to go. I think it's important to note that Federal funding is integral to this. We need the Federal dollars for the—in terms of drinking water State revolving fund, the clean water State revolving fund, and other moneys for our research and planning that have been available historically. Some are at risk at the moment. Those are very important and critical to us and the other States, going forward.

Thank you for this opportunity.

[The prepared statement of Mr. Stewart follows:]

PREPARED STATEMENT OF HARRY T. STEWART, DIRECTOR, WATER DIVISION, NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES, CONCORD, NH

I am here today to present the State of New Hampshire's views on the challenges that we face as a northeastern state to address water supply issues, as well as some of our successes and opportunities to ensure sustainable water resources into the future. Thank you for this opportunity.

WATER SUPPLY CHALLENGES

The focus of this hearing is "water sustainability". For public water supplies, sustainability means the availability of adequate water resources; adequate infrastructure to convey, treat and store the available water; adequate management capacity to manage the water system and the financial resources to support the operation, maintenance and capital investment in the water infrastructure for the long term. I have summarized below a number of water supply challenges for New Hampshire in the context of these criteria.

Population growth—New Hampshire's population is currently just over 1.3 million people, over double the population that existed in 1960. This growth has generally occurred in multi-year surges of 5 to 10 years over the last 50 years, predominately in the southern tier of the state. New Hampshire is also predicted to continue to be the fastest growing state in New England going forward to 2030, with an expected population increase of between 130,000 to 260,000 people. As a result, since 1960, the water use has also doubled with the population to an estimated 100 million gallons per day and is expected to continue to increase and, therefore, will continue to be a challenge for the state. In the national context, while there are some separate industrial and agriculture consumptive water users, the use by public water supplies are predominate as compared with other states. Water supply for new residential development is supplied by a combination of municipal water supply extensions, small community water supplies and private residential wells. About 36% of the state's population is served by private residential wells and about 64% by community public water supplies. New Hampshire is also generally perceived to be relatively "water rich", which is partially true, but there are also some watersheds, especially in the southern tier near the seacoast where water resources are increasingly stressed due to increasing demands caused by population growth.

Private residential wells—While private residential wells are not the primary topic of my testimony, it is worth noting that these wells, which serve over 400,000 individuals in New Hampshire, are a challenge in New Hampshire and nationally. New Hampshire has basic regulations that control well locations for sanitary protection and well capacity. However, many of these wells have been drilled into deep bedrock to tap into bedrock fractures through which water can flow. This deep bedrock contains natural contaminants. Around 20% of these wells have exceedances of the arsenic drinking water standard 0f 0.010 mg/l, while numerous others have problems with radon, other radionuclides, fluoride, iron, manganese and other natural contaminants. These wells also may contain volatile organic compounds, such as methyl tertiary butyl ether (MtBE) or other contaminants from gasoline or other spills or releases from leaks. New Hampshire has an active education and outreach program to address water quality in these wells.

Community public water supplies—Groundwater and surface water are equally important water supply sources in New Hampshire. New Hampshire has a total of

721 community public water supplies regulated under the Safe Drinking Water Act. The water supply sources for the population served are

- 38% groundwater only
- 39% surface water only
- 23% surface water plus groundwater

There are also over 600 very small public water systems serving less than 500 people, most supplied by groundwater wells. The abundance of small systems poses a very significant management challenge. Most are under-managed and under-financed. And, the older systems typically have inadequate piping and storage infrastructure. In addition, since most of these systems are supplied by deep bedrock wells, many of these systems also have the water quality issues mentioned before for private residential wells. Compliance with the water quality and operating requirements of the Safe Drinking Water Act are a challenge for these systems in New Hampshire and nationally. In addition, the cost per user of compliance is higher than for larger systems making affordability for users, especially in low income areas, a significant issue when these systems are upgraded to current standards.

New Hampshire has around 100 municipal or major private utility public water systems. The systems tend to be relatively small on a national scale, with only two serving over 50,000 people. Significant progress has been made over the years to achieve compliance with the Safe Drinking Water Act. However, delayed investment in water infrastructure is a significant issue and challenge going forward.

Water supply infrastructure needs for sustainability—In 2011, to provide more accurate and current information to a legislative study commission, the Commission to Study Water Infrastructure Sustainability Funding (discussed further below), DES contracted for a detailed needs survey to identify 20-year funding needs by polling the public water supply systems. This resulted in identification of a the 20-year need of $1.7 billion ($85 million/year) in the following broad categories;

- 51% ($878.5 million) for water delivery,
- 39% (668.3 million) for water treatment,
- 6% ($94.7 million) for water storage and
- 4% ($71.5 million) for water supply source development.

The upgrade of this infrastructure is critical to provide safe, potable water to New Hampshire's citizens and to the long term health of New Hampshire's economy. A combination of local, state and national funding ultimately is needed to keep these investments affordable for ratepayers.

Other water infrastructure needs—The provision of water supply is an obvious dominant factor when considering how to achieve water resource sustainability in New Hampshire. Other factors include the identification and protection of significant lands for water supply source protection, management of development patterns, and the state of other existing water infrastructure, specifically wastewater collection and treatment systems, stormwater systems, and dams. These components of water infrastructure also have very substantial investment needs to provide for long term sustainability due to regulatory requirements and aging infrastructure. DES has estimated the following needs in these areas for the next 20-years:

- Wastewater infrastructure upgrades ($1,300 million)
- Municipal and state-owned dams ($60 million)
- Stormwater infrastructure to meet federal permitting requirements ($100 million)

Overall watershed management and investment in all types of water infrastructure are keys to water supply sustainability and the economic health of New Hampshire. It is also important to note that, from a municipal perspective this is all "one check book." Many municipalities could pay a large, and potentially unaffordable, price for delayed investment to address upgrade requirements across this wide array of municipal water infrastructure. This is also reflective of the undervaluation of water infrastructure and investment needs in water rates to support this infrastructure. "Full cost pricing" in the long term is also key to the sustainability of this suite of infrastructure.

Climate change—The impacts of climate change on New Hampshire's water resources provide a significant future challenge for water supplies. There is strong evidence that these impacts exist right now. For example, over the last 5 years, consistent with predictions of volatility, New Hampshire has experienced 7 of the 15 highest flows of record in the Lamprey River on New Hampshire's Seacoast. The effects of climate change, including the potential reduction in snow pack from warming coupled with increased storm intensity and, conversely, drought conditions, are

likely to cause diminished surface water and groundwater storage thus availability for drinking water supply over the long term.

OPPORTUNITIES AND SUCCESSES

New Hampshire is fortunate to have a relative abundance of high quality water resources from a global and national perspective. This provides opportunity and potential advantage if our water resources are used and managed wisely which can be fully realized only if measures are implemented that include:

- Ensuring that consumptive withdrawals are sustainable through the right management techniques and regulatory structures.
- Water infrastructure investments to address identified deficiencies, and then ensure sustainable investment in the long term as well as compliance with federal requirements. This is our greatest challenge.
- Maximizing energy efficiency for the water supply withdrawal, treatment and pumping and the pumping and treatment of wastewater. We know that this area presents "low hanging fruit" that is gradually being realized "one system at a time" as funding allows.
- Management of watershed lands with a focus on protection and preservation of important water resources such as drinking water supply aquifers and reservoirs.
- Water conservation to preserve vital water resources and also as a means to make water use more efficient. Operation and investment costs less when less water is used to achieve the same objectives. This is an area where New Hampshire can apply lessons learned in other states where water resources are already stressed.

New Hampshire has several ongoing commissions that are evaluating these and other water resource issues:

- Governor's Commission to Develop a Water Sustainability Plan for the State of New Hampshire—This is an active commission established by Governor Lynch to broadly evaluate the issue of water sustainability.
- Commission to Study Water Infrastructure Sustainability Funding—This commission was established by the Legislature in 2009 and renewed in 2011 to evaluate infrastructure funding needs and funding options. This is a critical concern especially in light of the needs expressed above coupled with the risk of federal funding reductions and recent reductions of state funding for water supply and wastewater state aid grants and the elimination of a state matching grant program that provided incentive to purchase sensitive drinking water source water protection lands.

These commissions, in combination, are focused on developing a statewide consensus on how to improve our water resources management and funding for the long term and should help us ultimately to move towards the sustainability goal.

New Hampshire also has two state-based programs that are in implementation to help us to better manage our water resources: a large groundwater withdrawal permitting program (which Senator Shaheen requested that I discuss) and an instream flow pilot program. Collectively, when fully implemented, these programs will go a long way towards clearly establishing a state regulatory framework for the management of both groundwater and surface water that balances the needs of all users in a sustainable manner (in conjunction with the federal Clean Water Act).

Large Groundwater Withdrawal Permitting Program

This program is fully implemented. We know from discussions and inquiries from other states that this program is the "state of the art" for permitting large groundwater withdrawals to ensure no impacts to surrounding users and resources. Since 1998, all new groundwater withdrawals with a proposed use of at least 57,600 gallons per day require a permit from the New Hampshire Department of Environmental Services. This permitting process has been since improved by several statutory changes developed by a longstanding Commission to Study Groundwater Withdrawals, which was established by the state legislature principally to address concerns raised by the public about proposed large commercial groundwater withdrawals. The permitting process generally consists of an application, two public hearings (before and after withdrawal testing) to ensure municipal and public participation, development of technical information including a long term groundwater withdrawal test. Permitting decisions are based on consideration of a comprehensive list of potential "adverse impacts", any of which could be a basis for denial:

- Reduction of the withdrawal capacity of other water users or surface water levels or flows that cause a violation of surface water quality standards;

- A net loss of values for wetlands;
- Causing a permitted surface water or groundwater discharges to fail to meet permit conditions;
- Causing the spread of existing groundwater contamination, or
- Causing the long-term rate of replenishment of the aquifer to be exceeded. Conservation plans are required for all new permitted withdrawals to better ensure the efficient use of water resources. Conservation requirements were also instituted at the same time for surface water withdrawals.

Instream Flow Protection Pilot Program (for Surface Water Flow Management)

This pilot program will be completed in 2012. The goal is to develop a strong scientific and regulatory basis to balance the diverse interests for uses of rivers through a consensus building process. These diverse uses include public water supply, wastewater assimilation, hydropower production, navigation, recreation, fishing, conservation, maintenance and enhancement of aquatic life, fish and wildlife habitat. There are two ongoing pilot studies to address these issues for the Souhegan River (state funded) and the Lamprey River (federal-funded). These pilot programs will serve as a model for how to reasonably balance potentially competing interests to ensure water resource sustainability.

Conclusion

In conclusion, New Hampshire has made good progress towards ensuring a sustainable water supply over the long term and has a clear sense of the primary actions that need to be accomplished to further this objective. However, we have a long way to go.

It is also important to recognize how important federal funding is to the states and local communities to promote these efforts, especially in this period of shrinking resources at all levels of government. At the national level, the Drinking Water State Revolving Fund Program, the Clean Water State Revolving Fund Program, other water-related programs and research efforts must be adequately funded for the states and local communities to meet the water supply challenges of the 21st century.

Thank you again for this opportunity to testify before your committee.

Senator SHAHEEN. Thank you very much.

We have at least 3 major regions of the country represented, I think, on the panel today. Four, if we count you, Dr. Gleick, as being part of the Pacific Coast. I think most of you—I'll put you in a separate category, Mr. Stanley, because you're really representing industry.

But I think you've all said in different ways what Mr. Willardson put so well when you said that we need a higher public priority on water use in this country. So, I'd like to ask you all to go back to that question: How do we get more public attention to water use in this country, and attention to address the kinds of challenges that each of you are really working on to address water use, and both the scarce resources and the technologies that are available to make sure we have the water that we need in this country?

So, Mr. Willardson, would you like to go first on that, since you put it so well?

Mr. WILLARDSON. We can credit drought with getting a lot of public attention in Texas right now. They are looking at their water management. In fact, I think intermittent shortages have always been a catalyst to try and change policies. I think at this point, we have—we've talked about the need for a national water policy. We think that should not be equated with a Federal command and control structure that's pushed down from the top, but really, would have to be built on local watersheds and also State policies, and using those as building blocks toward a national policy. We think that can be used to—in support. The Federal programs should be used in support of those efforts.

I think there is a need for public education, and a realization of the value of water, and the fact that we pay a lot more for our cell phone bills, generally, than we do for our water bills. What's more important to us?

Senator SHAHEEN. Dr. Gleick, you also talked about the need for a national policy on water, which I think can be defined in different ways. Mr. Willardson pointed out that we're not talking about a command and control, a regulatory regime, per se, but more a national strategy. Would you agree with that, or do you think we're looking at something else?

Mr. GLEICK. I would. Let me make 2 comments. First, as—as Mr. Willardson said, and as Ben Franklin said many, many years ago, we learn the worth of water when the well runs dry. We tend to forget it when the well fills up again. That's—that's part of our problem. But there is a growing awareness about water issues. Despite difference of—differences of opinion about environmental issues, the American public considers water to be the most important environmental challenge, and has consistently for many, many years. People care about water.

You asked the first panel, do we have a national water policy. We do have a national water policy. Maybe we don't think we do, but there's a de facto national water policy in the combination of Federal laws that we've passed around water quality and water management, around the strategies of the different agencies. There are Federal responsibilities. The challenge going forward is going to be to better integrate and manage those Federal responsibilities, to leave the local issues to local agencies, State issues to State agencies, to help at the Federal level, when help is appropriate, but there are important Federal responsibilities. That's what an integrated national water policy could look like. My written testimony goes into more detail.

Senator SHAHEEN. Right.

Mr. GLEICK. Let me just say one specific thing. It's time to rewrite the Clean Water Act and the Safe Drinking Water Act. Those are foundational Federal laws about water. They were great. They're important. They're out of date. They need to be rewritten. It's this body that needs to do it.

Senator SHAHEEN. We could spend the next—the next 3—3 weeks talking about that. But do you want to talk a little more specifically? As you say, we need to rewrite them, because they're out of date. Are there any particular areas in mind that you want to refer to when you say that?

Mr. GLEICK. Sure. Two in particular. For the Clean Water Act, we've done a pretty good job of dealing with what we call point sources of pollution. We could do a better job at enforcement, but—but a pretty good job. We've done a very bad job at dealing with non-point source pollution. Many of the remaining serious water quality problems in our rivers and lakes are non-point sources. Nitrates. Phosphates. A whole series of things that you're aware of. We need to deal with that.

On the safe drinking water side, we have a remarkable tap water system in this country. A tap water system much of the rest of the—of the world wishes they had. But it's not as good as it could be. It's not as good as it should be.

There's new technology. General Electric has developed a lot of it, and many other companies have developed it. To produce any quality tap water we want, from any quality wastewater we might produce, we can restore the tap water system of this country. It's an investment worth making. It's an investment that we're going to be sorry we didn't make, if we don't move forward on it.

Senator SHAHEEN. Thank you. Ms. Meeker or Harry, would either of you like to add to those comments?

Mr. STEWART. I agree with Dr. Gleick on the—on the non-point source question. The Clean Water Act does not address that well. We see that in Great Bay, in New Hampshire, where permits for municipalities are going to get ratcheted up for nitrogen removal. Without the non-point source improvements, that's not going to matter to Great Bay. So, I think that's a very important point.

The Clean Water Act, we've talked about it for years. It needs to be overhauled eventually.

Senator SHAHEEN. Ms. Meeker.

Ms. MEEKER. Thank you. Just a comment on a national dialog. I'm not sure if I would go so far to say we need a policy, but in terms of the national dialog, 2 key areas where I think we could use additional coordination, and public education was one of those that's mentioned.

As we further technologies, it's very difficult to explain some of those technologies to the public. They need to understand them in order to support their governmental entities and utilities moving forward with those technologies. So, that's the first.

The second——

Senator SHAHEEN. Give me an example of what you're talking about.

Ms. MEEKER. You know, he just talked about wastewater creating—I mean you can do that whole wastewater, treat it to the point where it's actually drinkable. There are—that's the 2 extremes. We have many areas in between, and without that public education and—and public involvement and understanding treatment technologies, getting them to understand those issues is very difficult. So, that's some—an area, I think, where our Federal agencies could really help us.

The second is in the technology development. You know, research is one. An individual utility can't necessarily go out and research something on their own. But having the Federal agencies work with either their own agencies or other not-for-profits who specialize in those types of things is exactly the type of area where I think you could—you could certainly help us.

Senator SHAHEEN. Thank you. Mr. Stanley, do you see, as you're looking at the work that GE is doing, are there any breakthrough technologies that are going to make a dramatic difference as we're looking at some of the challenges we face to address clean water?

Mr. STANLEY. Breakthrough technologies in the eye of the beholder. You asked the question earlier about have we made any significant advances, and I thought Ms. Castle gave a nice answer, in that reverse osmosis is a technology that's been around for a lot of years, but when you look at the details, in fact, we have made quite a number of improvements. Many of those have—have made

by GE, some other advances by competitors. But the net result is that—that there's been significant advances there.

We continue—I have a team that's dedicated to reverse osmosis. Looking for improvements in the membrane technology, and the module design, et cetera, to try and improve that. So, whether you would characterize that as a—as a breakthrough technology, or a more incremental or transformational improvement of the technology, we are looking at all of the devices that we sell, the chemical treatments that we provide, how we integrate those into solutions, and we see tremendous progress as we look at our development efforts as we go forward.

So, yes, I'm very bullish on the opportunity for technology to continue to make improvements and provide solutions for customers.

Senator SHAHEEN. Good. Are there areas, either in the United States or around the world, where you're working with governments to address specific water challenges, where you've seen success?

Mr. STEWART. We—in the U.S., we have an arrangement with the University of New Mexico, that's a government-funded program, looking at brackish water reclamation there. That's a very ongoing program that so far has been very successful, and we look forward to continue that program.

We work with the government of Singapore. Very progressive. I think others mentioned how progressive Singapore is——

Senator SHAHEEN. Right.

Mr. STEWART [continuing]. With their water programs. We have a new research center. We have a collaboration with the National University of Singapore, and activities with the public utility board in Singapore. So, very aggressive there. We also have a number of activities in Israel. We're on the boards of incubators there, and we work with small companies in Israel. So, we have a number of activities around the world.

Senator SHAHEEN. Good. Ms. Meeker, I want to go back to your testimony, where one of the things you talked about was the restoration of the Florida Everglades. Are there lessons there that have been learned that you think can apply to other restoration projects, either in the U.S. or around the world? One of the things that there's been a lot of attention to has been what's happened in Louisiana at the mouth of the Mississippi, where so much destruction of the Delta there has increased the impact from hurricanes and storms. Have you learned anything in the Everglades that has application there or other places?

Ms. MEEKER. Do you have a couple days?

Senator SHAHEEN. I know. We're getting short on time here.

Ms. MEEKER. Yes. Excellent question. Certainly could take up a lot of time. I'll say simply yes, I think we've learned a lot. At the top of the list of our lessons learned is interagency coordination. The Federal, regional, State, local partnerships that have been formed, so that it's not a single entity that has to keep the ball rolling, I think is critical. I think that—that fits with any issue, any technological issue, or any major challenge which we are trying to face. It's about establishing those relationships, working together, trusting each other, and seeing what the end goal is, and focusing on that. It's not always easy to do, but certainly our top priority.

Senator SHAHEEN. Good. Thank you. Harry, you mentioned, and as did Dr. Gleick, the non-point source pollution and ways to address that. Can you talk about some—some of the ways that pollution has effectively been addressed? Perhaps, Dr. Gleick, you could also respond, or anyone else who has been looking at those kinds of challenges, and has found successful ways to address them.

I have a personal stake at this, because I live in the area that Mr. Stewart was talking about. I'm in one of those communities where we have septic systems and no community water supply. So the pollution is affecting not only the groundwater, but the Great Bay that comes in from the ocean.

Mr. STEWART. There are some opportunities. The University of New Hampshire Storm Water Center is one area that has been doing a lot of research in this area. Basically, there are ways to—to treat storm water to improve its quality, and also to reduce the flow of storm water into surface waters by technologies, such as pervious pavement, and the like, to reduce the impact of storm water onto surface water.

So, we don't have all the answers at this point. I think nationally, it's a problem and a challenge, but there are these relatively low technology solutions that are developing and evolving to address these issues.

Senator SHAHEEN. Dr. Gleick.

Mr. GLEICK. Yes. I would add, there are lots of successes out there. The Pacific Institute, actually, today released a series of agricultural farm success stories from the Western U.S., some of which look at the issue of water quality improvements. We can improve water quality and reduce ag runoff, for example, by improving the efficiency of water use in agriculture. You apply less water, and less water runs off.

You can put in place policies to reduce the application of chemicals, and that reduces the chemical runoff that results. Dealing with CAFOs, the combined animal feeding operations, which this country has moved toward in the agricultural area. That's a very serious water quality challenge. It's a—it's, to some degree, becoming a point source, if you will, but they're not adequately regulated.

I just point out, we talk about the—the hundreds and hundreds of millions of people worldwide without access to safe drinking water. There are people without access to safe drinking water in the United States. It's largely, as you know, Senator, people in rural communities, with a dependence on local wells, where those wells are not monitored, they're not protected, they're vulnerable to the kinds of non-point source problems that we've been talking about. It's another example of where modifications of Federal laws could improve public health, improve public safety, improve the quality of water, and reduce some of these challenges.

Senator SHAHEEN. Thank you. One of the things that many of you have mentioned is the effect of climate change and these increasing weather emergencies on our water systems and our water supply. Are any of you working in—on planning to address those additional emergencies? I think, Ms. Meeker, you talked a little bit about that. But what kind of planning are you doing to address those challenges, and how do you get the public brought in to the efforts that you're looking at? Dr. Gleick, you want to answer that

first? Then maybe I could ask the other panel members if they could respond.

Mr. GLEICK. We do a lot of work on the impacts of climate change on water resources and on how to adapt to—to unavoidable impacts of climate change in the water area. There are more and more examples of water agencies taking responsibility for designing new infrastructure, not for yesterday's climate, but for future climate.

There was an interesting story about rebuilding the rail line north of New York City washed out by an extreme event, a hurricane, and doing it to a different standard, to take into account both future sea level rise and a higher risk of severe storms.

There is a realization that our water systems are both vulnerable, but also can be protected, if we think about rebuilding them and redesigning them now, rather than waiting for the future. We're thinking about re-operating reservoirs in California, because we're losing snowpack, which is a very important storage, natural storage. That's happening in the Rocky Mountains area as well.

There are lots of examples, but it's a very slow process. It's—we're way behind the curve. Water agenciesare just trying to now figure out what the most effective things to do might be.

Senator SHAHEEN. Mr. Stanley, are you working on that anywhere in the world, as you——

Mr. STANLEY. Not—not directly. You know, obviously, as climate change happens, as water becomes scarce and—and more problematic in regions, we try and develop products that will be, you know, useful and helpful for—for customers. But that—that's our response really.

Senator SHAHEEN. Thank you. Mr. Willardson.

Mr. WILLARDSON. I would just mention that climate is just one of the uncertainties that we face.

Senator SHAHEEN. Sure.

Mr. WILLARDSON. In mentioning both droughts and—and the flooding that we've seen in the West are a product of natural variability, and we've had to deal with that. You do have, by diversifying your supplies, by conserving water, trying to manage demands, and taking what really are no-regret strategies, water management tools that make sense anyway.

Senator SHAHEEN. Thank you. Ms. Meeker.

Ms. MEEKER. The 2 areas where we have focused on have been in our infrastructure improvements for our coastal structures, where at one time they were gravity structures. You could just open them and let the water flow off the land. As sea level has inched up, literally, we have—when we refurbished those structures, they now become mechanical structures to force the water out. So, that's the first one.

The second is, as we see that sea level rise, you know, we see a higher tendency or a possibility for saltwater intrusion in our groundwater wells. So, that's a key area that we watch very closely, working with, you know, USGS and the sampling, and everything else, and the utilities to watch the saltwater levels in those wells.

We have moved wells away from the coastal area. We use our coastal structures to keep water levels in the canals higher, to re-

charge the aquifers, to—to, you know, create a head, to keep that saltwater out. So, we continue to work with that literally every day.

Senator SHAHEEN. A number of people have mentioned the importance of data, as you're trying to make these decisions. Do you feel like you have adequate data? Do you also have adequate ways to either regulate or incentivize compliance with those——

Ms. MEEKER. Absolutely.

Senator SHAHEEN [continuing]. Needs?

Ms. MEEKER. Yes. We have an extensive sampling program throughout South Florida, both in groundwater and surface water, and look at, you know, every—every bit of information you can imagine, we're collecting it. We also have a very active regulatory program, which includes compliance. So, 2 very key areas that we focus on to ensure that we have the right information to make the right decisions.

Senator SHAHEEN. Thank you. Harry.

Mr. STEWART. From a—from a data perspective, our screen gauge network is shrinking, when it should be expanding, due to funding. That's a combination in New Hampshire of the gradual Federal attrition, but also State match for stream gauges. So—and that—as we get these tropical storms and hurricanes, such as Irene, that came up the coast, you know, we have people that are looking real-time at what's going on in the State, and we need those stream gauges for that purpose.

As far as other changes in our programs, we have changed our criteria for culvert design. So, new culverts are being designed to a higher standard, to a 100-year storm event, which is probably no longer a 100-year storm event.

The other thing that's happening in New Hampshire is that it's something that the engineers and scientists have known, but I think that there's a shift in the—in the population, where there's finally a recognition that we can't keep building in floodplains, because they do flood.

Senator SHAHEEN. Thank you. Again, I know several of you have planes to catch. While we could go on much longer, and because it's a fascinating topic, and obviously, one that we need to pay more attention to. I want to thank you all very much for your testimony, for being here, and as I said, I think it's a topic that we will come back to, because obviously, there is a lot more work to do.

So, again, thank you very much. This hearing is closed.

[Whereupon, at 4:55 p.m., the hearing was adjourned.]

[The following statement was received for the record.]

Hon. JEAN SHAHEEN,
Chairwoman, Senate Committee on Energy and Natural Resources, Water and Power Subcommittee, 304 Dirksen Senate Building, Washington, DC.

Hon. MIKE LEE,
Ranking Member, Senate Committee on Energy and Natural Resources, Water and Power Subcommittee, 304 Dirksen Senate Building, Washington, DC.

DEAR CHAIRWOMAN SHAHEEN, RANKING MEMBER LEE AND MEMBERS OF THE SUBCOMMITTEE: My name is Dan Keppen, and I serve as the Executive Director of the Family Farm Alliance (Alliance). The Alliance is a grassroots organization of family farmers, ranchers, irrigation districts and allied industries in 16 Western states. The Alliance is focused on one mission: To ensure the availability of reliable, affordable irrigation water supplies to Western farmers and ranchers. We are also com-

mitted to the fundamental proposition that Western irrigated agriculture must be preserved and protected for a host of economic, sociological, environmental and national security reasons—many of which are often overlooked in the context of other national policy decisions.

We appreciate the attention your subcommittee is placing on the critical need to address domestic and global water supply issues. However, we were disappointed that no representatives of agriculture—the largest user of water in America and the world, according to Assistant Interior Secretary Anne Castle's own testimony at your hearing—were invited to participate in the December 8 event. Within the Interior Department, the Bureau of Reclamation (Reclamation) is the single largest wholesaler of water in the country, providing water for 10 million acres of irrigated agriculture, and drinking water for 31 million Westerners. The Family Farm Alliance has a long history of collaboration with our partners at Reclamation, and we generally agree with Assistant Secretary Castle's assessment that the a proper role for the federal government on water matters is to focus on research and development; more fully integrate, coordinate and maximize use of resources; and encourage planning from the "ground up". We also have a wellestablished relationship with Congress, with 33 invitations to testify before Congressional committees on Western agriculture, water and environmental matters since 2005.

This testimony will provide some key observation that underscore the importance of providing reliable and affordable water to Western agricultural irrigators, address some concerns we heard with testimony provided at the December 8 hearing, and provide specific policy recommendations that we believe lay the foundation for effectively addressing current and future water challenges in the Western United States.

KEY OBSERVATIONS

We are in danger of losing a generation of farmers

Nationally, the median age of active farmers in America has never been higher, with the percentage of farmers under 50-years-old continuing to plummet. More than half of today's farmers are aged between 45 and 64, and only 6% of our farmers are younger than 35.

The number of farms is declining throughout the West

According to the U.S. Department of Agriculture (USDA), the total number of farms nationally is 2.08 million, a 0.6% drop from a year ago. Nationally 930.9 million acres are in farmland, a 1.5 million-acre drop from a year ago (USDA National Agricultural Statistic Service). For example, at the start of 2008 in Oregon, California, Idaho and Washington, there were 170,800 farms, a decline of 2% compared to the previous year. California, Oregon and Washington each lost 1,000 farms since the previous USDA annual report on farm numbers. There are 500 fewer farms in Idaho, according to the USDA report. In the West, Oregon, California and Idaho each lost 100,000 acres compared to the previous year. USDA attributes the decline in the number of farms and land in farms to a continuing consolidation in farming operations and diversion of agricultural land to nonagricultural uses.

Americans pay a substantially lower amount of disposable income on food

According to the World Bank, families in 28 other high-income countries pay 10.2% of their disposable income on food compared to 6.2% for families living in the United States. For the average American that's a difference of $3,820 per year and represents real dollars that are available to purchase consumer goods other than food. A 2011 report by Cardno-ENTRIX examined the relative affordability of food in the U.S. as compared to 28 other high-income countries. Data was derived from a report published by the World Bank titled "Global Purchasing Power, Parities and Real Expenditures." The results were weighted for each country by its total GDP so to ensure comparability with the U.S. On a percentage basis, other highincome countries spend about 64% more in disposable income on food and non-alcoholic beverages compared to the U.S. The full food cost report is available at: www.farmwater.org/food____cost____results.pdf

At a time when average Americans are feeling the pinch in their pocket books, the foundation of our country's ability to provide safe and affordable food and fiber is at risk. Ironically, it is because Western irrigated agriculture has been so adaptive and successful at providing plentiful, safe and affordable food that it is now jeopardized—nobody believes there can be a problem. The last Americans to experience food shortages are members of the Greatest Generation and their parents. For the most part, they have left us, taking with them the memories of empty supermarket shelves. When the issue has never been personalized, it's easy to be complacent.

Agriculture holds the most senior water rights in the West and is considered a likely source of water to meet growing municipal and environmental demands

The Family Farm Alliance is part of a work group of diverse interests—agricultural, environmental, and urban—that has been funded by the Walton Foundation to seek the most effective and innovative ways water can be shared for mutual benefit, without damaging agriculture or rural communities; to pinpoint obstacles to sharing; and to develop strategies to alleviate obstacles. To that end, the Colorado River Ag/Urban/Enviro Working Group has investigated transfers throughout the West in an attempt to uncover best ideas for the Colorado River Basin, and beyond. The Group has developed recommendations for the Western States Water Council (WSWC) in the context of toolbox strategies to increase the chance that WSWC might get the Western governors behind at least some of our recommendations. We want to get the governors to enable local solutions to sharing water more effectively, to give governors more latitude to do what's right in their states instead of being tied by federal restrictions. Our message to the governors is that changes shouldn't be pushed from the top down. We hope they can get behind the idea of empowering interjurisdictional solutions.

Several observations were gleaned from the Colorado River Basin Forum:

- Better management of the resource can always be part of the solution. Management requires flexibility (and trial and error.) More regulation usually reduces flexibility. Competing demand interests on water have not done a very good job of creating the opportunity for flexible management.
- More storage is still a critical piece of the answer. Finding the dollars within the states for creation of new storage for water for the environment could be a very helpful way to level the field.
- We need to be concerned that our demand does not get so hardened that a drought can devastate our society. The environment and agriculture can both recover from a temporary insufficient supply easier than homes and businesses.

As we look to the future, we can tie that fact to Mother Nature's expected long term drought cycles. We need to find ways to implement interruptible supply and lease agreements between cities and agriculture, and cities and the environment. For multiple reasons, water transfers that result in the permanent fallowing of agricultural land may be detrimental to all sectors. Regulatory costs and insufficient infrastructure are significant barriers to temporary water transactions that might be used in lieu of permanent fallowing. We should encourage temporary transactions with incentives, potential mandates and pilot programs.

The only large potential for moving water from agriculture to other uses will come from fallowing large swaths of farmland

We often see bold general statements of water transfer proponents about the potential for agricultural water use efficiency to free up water that can be used for in-stream flows. However, those statements are usually followed up by a list of the factors that make it a difficult proposition. Those include re-use deficiencies when water is removed upstream in the system, water rights that protect water users from water being taken away if they conserve water, and transactions that move water between presumably willing buyers and willing sellers, but have the effect of taking land out of production. All of those issues are dealt with directly in a major California report released last month by the Center for Irrigation Technology (CIT) at Fresno State. The report, "Agricultural Water Use in California: A 2011 Update", which refutes some long-standing beliefs about agricultural water usage and confirms others. The full report is available at http://www.californiawater.org. The CIT report and others have reached a similar conclusion: the only large potential for moving water from agriculture to other uses will come from fallowing large swaths of farmland.

Growing domestic and global food security and scarcity concerns must be considered as federal water policies are developed and implemented

The U.S. needs a stable domestic food supply, just as it needs a stable energy supply. The post 9/11 world of terrorist threats makes the stability of domestic food supply even more pressing. Outgoing Secretary of Health and Human Services Tommy Thompson put it bluntly when he said, "I cannot understand why the terrorists have not attacked our food supply, because it is so easy to do." Further, Thompson said he worries "every single night" about threats to the American food supply.

This isn't just a matter of domestic security; it's also a global concern. Earlier this year, the Global Harvest Initiative (GHI) released its Global Agricultural Productivity (GAP) Report, which measures ongoing progress in achieving the goal of sustainably doubling agricultural output by 2050. For the first time, the GAP Re-

port quantifies the difference between the current rate of agricultural productivity growth and the pace required to meet future world food needs. The report predicts that doubling agricultural output by 2050 requires increasing the rate of productivity growth to at least 1.75% annually from the current 1.4% growth rate, a 25% annual increase.

Other signs point to the hard truth of a very real food crisis in the world today. The Food and Agriculture Organization of the United Nations (FAO) in June 2009 reported that over 1 billion people world-wide go hungry every day. And the problem will only get worse. The world's population is growing by 79 million people each year. The FAO estimates that the world needs to produce 70% more food by 2050 to keep pace with population growth and increased demand for calories.

G-8 agricultural ministers at a summit last year committed to increase international assistance for agricultural development to $20 billion over the next three years. Actions of this type will surely give the world's hungry a reason for hope by tackling food security with a renewed commitment to agricultural development in other countries. However, similar focus must be placed closer to home, where less than two percent of the nation's population produces food for our country and the world.

We need policies that encourage agricultural producers to work together in a strategic, coordinated fashion. Rebuilding is required of parts of the institutional structure now in place, so that water resources can be managed specifically, not generically. We must get a handle on changing weather patterns and assess how the agricultural landscape and water security will be impacted due to a changing climate. And we must develop a clear understanding of the resulting limitations on our ability to feed the world is impacted when we take domestic agricultural lands out of production as water tied to those lands is transferred elsewhere.

CONCERNS

As you know, Peter Gleick of the Pacific Institute for Studies in Development, Environment and Security testified at the December 8 hearing. The Family Farm Alliance and our members have worked with Dr. Gleick in a variety of forums, and his December 8 testimony featured points where we agreed and disagreed. For example, we agree with Dr. Gleick's statement that "Farmers cannot afford to upgrade irrigation infrastructure to reduce losses and cut waste," which is consistent with our findings, further outlined in Policy #5, below. However, his push for new federal policies to "eliminate subsidies for some kinds of crops, raise the price of water delivered from federal irrigation systems to encourage efficiency, or provide financial assistance to farmers to invest in shifting irrigation technologies to modern systems for monitoring and delivering water" need to be addressed.

Western farmers and ranchers have long taken a progressive approach to water management. Farmers are already investing in upgraded irrigation systems. For example, between 2003 and 2010 San Joaquin Valley farmers invested almost $2.2 billion in upgraded irrigation systems on over 1.8 million acres of farmland. Those investments helped improve water use efficiency and food production and helped fuel portions of the rural economy at a time when water supply cuts were increasing unemployment. And, these sorts of efficient farm practices have led to increased economic value and production. A report by the California Department of Water Resources[1] shows that the value of California farm products doubled during the 40-year period from 1967 and 2007 while at the same time, applied water decreased by 14%. Other research by the California Farm Water Coalition showed that the volume of farm production between 1967 and 2000 rose approximately 89% with only a two percent increase in applied water per acre. These indicators support assertions that farmers in general are improving water use efficiency in significant ways over time.

Dr. Gleick and others often bring up arguments regarding the need to address "antiquated" Western water policy. "Part of the problem," says Dr. Gleick, "is old water legislation that has not been updated to account for the realities of the 21st century and for recent advances in our scientific and technical understanding of both water problems and solutions." We need to resist any attempts at rewriting our basic system of water rights, something affirmed recently by the Delta Stewardship Council in California. We offer additional recommendations to address this concern in Policy #6, below.

Dr. Gleick and the Pacific Institute recommend that we "phase out irrigation, energy, and crop subsidies that promote wasteful use of water and energy." This rec-

[1] The DWR report is available at 222.farmwater.org/DWR__Econ__Efficiency.pdf

ommendation begs the question, who decides what is an efficient water use in agriculture?

Finally, Dr. Gleick's testimony closes with optimistic graphs that demonstrate progress in terms of water use efficiency since 1975. Based on those figures, it is difficult to see where we need to make changes, unless Pacific Institute's goals are something other than increasing efficiency.

POLICY RECOMMENDATIONS

Western water supplies are already inadequate to the demands of agriculture, urban growth, environmental enhancement and power generation. Global climate change, we're told, will further reduce those supplies. So how will we meet the ever-increasing demand for water in the West in an era when there will be an ever-decreasing supply? Improved conservation, water reuse and efficiency by urban and agricultural water users are certainly parts of the solution, but only a part. Resolving these issues without destroying what we worked so hard to achieve is the challenge that we all face. To be successful, we must face them together. No resolution will be found unless we find a way to balance all competing needs. We believe that within the policies outlined in this testimony lay the foundation upon which to build for the future. It will be a foundation that allows for resolution of significant conflicts in a way that supports continued growth of irrigated agriculture.

Policy 1.—The U.S. must adopt an overriding national goal of remaining self-sufficient in food production. Food security is homeland security. Policy decisions on a wide range of issues should then be evaluated to be sure they are consistent with that goal

Remarkably absent from the newly-ignited dialogue about fuel and food costs and food safety is recognition of the importance of a secure and sustainable domestic food supply. Politicians from both parties now routinely urge us to end our reliance on foreign energy sources, but nobody is talking about food independence. A national response should include as one of its goals selfsufficiency in food production. It is time for our national leaders to stand up and focus on improving the security, stability, and economic aspects of domestic food production so that our food remains readily available, ample, affordable, and safe. An obvious solution to address this alarming development would be to increase agricultural productivity and output. In our own country, that means finding ways to keep farmers and ranchers doing what they do best, and to further encourage young farmers to follow in their footsteps.

Europeans aggressively protect their farms and food production capability because they still remember the hungry years during and after World War II when they relied on other nations, America in particular, to feed them. The time has come—indeed, it's long overdue—for the United States to similarly adopt an overriding national goal of remaining self-sufficient in food production. Policy decisions on a wide range of issues ranging from taxation to the management of natural resources should then be evaluated to be sure they are consistent with that goal. It's hard to imagine a simpler or more important step to safeguard the American public.

Policy 2.—State and local governments must consider the impacts of continued growth that rely on water transfers from agriculture and rural areas and to identify feasible alternatives to those transfers, including reuse

Severing water from agricultural land makes the land less productive. Period. Policy makers should be wary of putting too much emphasis on agricultural water transfers, particularly in the context of growing domestic and global food security and scarcity concerns.

There is growing recognition that states and local governments must consider the impacts of continued growth that relies on water transfers from agriculture and rural areas and to identify feasible alternatives to those transfers. For example, a 2006 report released by the Western States Governors Association (WGA) states "there is understandable support for the notion of allowing markets to operate to facilitate transfers from agricultural to municipal and urban use as a means to accommodate the needs of a growing population. While such transfers have much to commend them, third party impacts should be taken into account, including adverse effects on rural communities and environmental values. Alternatives that could reasonably avoid such adverse impacts should be identified."

The Family Farm Alliance is working with WGA and Western States Water Council to develop a report on successful and unsuccessful agricultural-to-urban water transfers to determine how transfers can be accomplished in a manner that avoids or at least mitigates damage to agricultural economies and environmental values, while at the same time avoiding infringement on private property rights. The Alliance position will be built upon a policy founded in fundamental truths:

- Although water is lost to evaporation in surface reservoirs that serve agricultural, environmental and urban uses, there is very little "wasted water" associated with moving and applying irrigation water. Water not directly consumed through evapo-transpiration often serves other purposes, such as replenishing groundwater, buffering soil salinity and supporting riparian vegetation.
- Further tightening of urban water conservation measures, in essence, "hardens" those urban demands. Some degree of flexibility must be embedded in urban water conservation programs to allow these areas to employ more restrictive water conservation measures during drought periods. Without having the ability to save water during drought periods via drought conservation measures, the resulting hardened demand will force urban water managers to more quickly look to secure water from other areas; namely, agriculture and the environment.
- A multitude of unique solutions exist for Western communities wrestling with growing urban water use. The Northern Colorado Water Conservation District is currently seeking to 9 develop new offstream storage to protect agriculture as urbanization sweeps into Northern's traditional service area. Farmers in the Klamath Irrigation Project (CALIFORNIA / OREGON) are paid through an environmental water bank to temporarily fallow land or pump groundwater in place of using Klamath River water. On the other hand, unsuccessful implementation of Central Valley Project Improvement Act water transfer provisions in California suggests that water markets cannot be legislated.

There will be nothing done with water in the West without there being winners and losers. Cities may expect to buy water from farms, but that is not a long term solution as global food shortages make farming a crucial national need.

Policy 3.—When water demands and environmental laws conflict, balanced solutions that respect the socioeconomic realities of the West must be found

Environmental enhancement and mitigation programs are competing for existing sources of water. Across the West, environmental activists have attempted to redirect water to environmental uses through litigation and negative media campaigns, without adequate public process or regard for prior commitments. These actions have caused major conflicts, costly lawsuits and delayed benefits for endangered species and the environment.

In recent years, many in the environmental community have focused on irrigation projects and dams as the source of all woes facing Western fisheries. This distracts policy makers from employing a balanced, comprehensive approach to all factors that limit the abundance of at risk, native fish species. In California's Bay-Delta, for example, environmental activists have focused almost exclusively on state and federal water pumps in the Delta that supply water for millions of acres of the most productive farmland in the world, not to mention drinking water for millions of Southern Californians. They ignore or downplay many other factors that stress fish, including the loss of plants located in the Delta; the introduction of non-native species, including predator species like the striped bass, the decline of food availability; and the discharge of toxics into Delta waterways and streams tributary to the Delta. Over the course of the last two decades, the effort to recover native species in the Delta has been heavily focused on limiting operations of the state and federal projects. Tens of millions of acre-feet have been managed in order to protect and enhance populations of Delta smelt, salmon and steelhead. Yet, these efforts have failed, and abundance indices for these species are at record lows[2].

There is a better way. Solutions to these complex issues can be found by reasoned, well intentioned people. Water users care about the environment. Creative, successful solutions can be found by motivated, unthreatened parties. Incentives that create reasons to succeed will do more good for the environment in a shorter period of time than actions that rely on threats of government intervention. Successful incentives will ultimately reduce occasions for judges to be forced to substitute their own judgment for that of professionals and stewards of the land.

Policy 4.—State laws and institutions must be given deference in issues relating to water resource allocation, use, control and transfer. The best decisions on water issues happen at the state and local level

The federal government has repeatedly recognized this fact. In 1952, Congress passed the McCarran Amendment. This law specifically waives the sovereign immunity of the United States in matters that pertain to state water right adjudications. This system may be frustrating for federal agencies but it works.

---

[2] July 17, 2008 Letter from U.S. Reps. Costa, Cardoza, Radanovich, Nunes and McCarthy to Dr. Balsinger and Director Hall re: Bay-Delta Conservation Plan Process.

Solutions to conflicts over the allocation and use of water resources must begin with a recognition of the traditional deference to state water allocation systems. Federal agencies must acknowledge that they are required to adjudicate water rights for federal purposes according to state law and abide by state decrees defining both federal and non-federal rights.

Recently, in many areas of the West, federal agencies have attempted to redirect water to solve environmental issues, without regard for state law or prior commitments, via implementation of federal laws that have the effect of overrunning state statutes. These actions cause far more problems than they resolve. Environmental issues must be resolved through a cooperative process that respects state water law.

A simple commitment by federal agencies to work within the framework of existing appropriative systems instead of attempting to fashion solutions which circumvent current water rights allocation and administration schemes would form the foundation for eliminating the gridlock that now paralyzes federal water management decisions.

Such a commitment would encourage states and water right holders to proactively address water allocation issues by eliminating the now omnipresent fear that a subsequent federal mandate will either undermine local efforts to address an allocation issue or suddenly require unexpected additional reallocations of water which render local cooperation impossible.

Policy 5.—Aging water infrastructure must be addressed promptly and with priority commitments, as failure do to so will create a failed legacy for the next generation

Specific action can be taken in Washington, D.C. to tackle the looming water infrastructure problems plaguing the West:

1. Direct more funding to the Department of Interior WaterSMART grant program to—implement (i.e. "build") projects that have been submitted but not approved for funding.

2. Reaffirm the loan guarantee authority provided in the Rural Water Supply Act.—Congress should specifically direct funding and implementation of the loan guarantee program authorized by The Rural Water Supply Act of 2006. Unfortunately, Reclamation loan guarantees, a long-awaited critical financing tool for water users across the West, are 11 now being held up because of incorrect interpretations of clear Congressional direction by the Office of Management and Budget (OMB).

3. Establish a direct loan program for local agricultural water districts.—This would require full appropriation by Congress, over and above what Reclamation already funds. The program would provide low interest loans to irrigators and repaid by them.

It is imperative that we find creative ways to provide for the operation, maintenance, and modernization of existing water supply infrastructure. Implementation of these recommendations would provide important first steps towards solving our aging water infrastructure problems.

Policy 6.—New water supplies must be developed to provide for recreational and environmental needs, allow for population growth and protect the economic vitality of the West

We believe that it is possible to meet the needs of cities and the environment in a changing climate without sacrificing Western irrigated agriculture. To achieve that goal, we must expand the water supply in the West. There must be more water stored and available to farms and cities. Maintaining the status quo simply isn't sustainable in the face of unstoppable population growth, diminishing snow pack, increased water consumption to support domestic energy, and increased environmental demands.

It strains credibility to believe that conservation alone will supply enough water for the tens of millions of new residents expected to arrive in Western cities during the coming decades. Farmers and ranchers understand that conserved water cannot realistically be applied to instream uses, as it will more likely be put to beneficial use by the next downstream appropriator or held in carryover storage for the following irrigation season.

Many water projects are ready and waiting to be developed in the West[3]. While conservation and recycling programs have done a tremendous job of meeting new

[3] Western Water Supply Enhancement Study. Family Farm Alliance, 2005.

growth, still, only a small amount of new water has been developed in the past 30 years. We cannot continue to "conserve just a little more" forever.

The federal government must adopt a policy of supporting new projects to enhance water supplies while encouraging state and local interests to take the lead in the implementation of those projects. It's time to start developing and implementing the water infrastructure needed to cope with a changing climate, meet the needs of a burgeoning population, and support a healthy agricultural base in the West. While on- stream storage should not be seen as unacceptable, off stream storage, groundwater banking, and countless other forms of water development should be encouraged as a matter of federal policy and law.

Local and state interests have shown enormous creativity in designing creative water development projects. For example, the State of Wyoming has initiated its Dam and Reservoir Program, where proposed new dams with storage capacity of 2,000 acre feet or more and proposed expansions of existing dams of 1,000 acre feet or more qualify for state funding. Wyoming water managers and policy makers recognize that dams and reservoirs typically provide opportunities for many potential uses. While water supply is emphasized in the Wyoming program, recreation, environmental enhancement, flood control, erosion control and hydropower uses are also explored as secondary purposes.

Modern, integrated water storage and distribution systems can provide tremendous physical and economic flexibility to address climate transformation and population growth. However, this flexibility is limited by legal, regulatory, or other institutional constraints, which can take longer to address than actually constructing the physical infrastructure[4].

The often slow and cumbersome federal regulatory process is a major obstacle to realization of projects and actions that could enhance Western water supplies.

The Family Farm Alliance wants to work with the new Administration, Congress, and other interested parties to build a consensus for improving the regulatory process. The real reason the Alliance continues to push for improved water storage and conveyance infrastructure is not to support continued expansion of agricultural water demand (which is NOT happening in most places). Instead, we seek to mitigate for the water that has been reallocated away from agriculture towards growing urban, power, environmental and recreational demands in recent decades. If we don't find a way to restore water supply reliability for irrigated agriculture through a combination of new infrastructure, other supply enhancement efforts, and demand management—our country's ability to feed and clothe itself and the world will be jeopardized. We need to pin down how much new water is needed for new uses, and then find ways to support those uses in a sustainable way that doesn't hurt irrigated agriculture. New infrastructure is one such way; improved conveyance and storage projects provide the best flexibility to manage and move water in the West.

Policy 7.—We Must Coordinate and Prioritize Western Water Research Needs

Our country has tremendous, but limited, resources available to fix our problems, so we must prioritize. One priority research item should be a comprehensive validation of West-wide changes in climate change-driven streamflow. This should be followed by quantification of the amount of additional reservoir storage, conservation targets, etc required to re-regulate this change in hydrology. This would quickly illustrate to policy makers the need to start modernizing our water infrastructure. This assessment should be accompanied by a comprehensive study of the collective impacts of agricultural land and water changes in Western states over the last 10 years, as well as predicted trends. A study of this sort may provide the type of hard findings that may alert policy makers to the "big picture" ramifications of this issue.

The potential water impacts associated with use of alternative fuels must also be studied. Throughout the West, we are seeing proposals to build plants to make ethanol, another "answer" that may (or may not) lower greenhouse gas emissions. An April 2007 Sacramento Bee editorial provides a reality check on how much water it would take to grow all the corn required to meet California's goal of producing a billion gallons of ethanol a year. According to the Bee's calculations, that's about 2.5 trillion gallons of water for 1 billion gallons of ethanol, which is more than all the water from the Sacramento-San Joaquin Delta that now goes to Southern California and valley farms. Because there is only so much water for agriculture in California and other Western states, this means that some other existing crops will not be grown, thus furthering our dependence on imported food sources.

---

[4] CLIMATE WARMING AND WATER MANAGEMENT ADAPTATION FOR CALIFORNIA, Stacy K. Tanaka et al, Department of Civil and Environmental Engineering, Department of Agricultural and Resource Economics, University of California, Davis 95616

Another growing demand that will be placed on Western water resources is driven by power requirements. The total water consumed by electric utilities accounts for 20% of all the nonfarm water consumed in the United States. By 2030, utilities could account for up to 60% of the nonfarm water, to meet the water needs required for cooling and pollutant scrubbing. This new demand will likely have the most serious impacts in fast-growing regions of the U.S., such as the Southwest.

There are also risks and opportunities to manage water associated with petroleum development. Across the western United States alone, more than 5 billion gallons per day of "produced water" is brought to the surface during petroleum production[5]. This wastewater has historically been re-injected back into the ground and "lost" to further uses. Recovering usable water from sources contaminated by oil and gas drilling operations could significantly help our farmers, ranchers and recreational users, not to mention the habitats of many plants and animals. Meanwhile, with the growing emphasis on opening up oil shale production in the Rocky Mountain West, new oil and gas techniques are expected to use large amounts of water under pressure to extract the oil and gas from underground. Recovered "produced water" could help satisfy this new demand.

Even without warming climate conditions, continued growth in the West will put the squeeze on both water and power use. When you throw in climate change and energy considerations, the projections are alarming.

Priority 8.—Real management is needed in the real "reservoir" of the West—our federallyowned forest lands in upper watershed areas

Federal agencies must improve management of the West's biggest "reservoir"—our watersheds.

In most Western states, much of the water used derives from snowmelt in mountainous areas. We are hearing more frequent reports from state and local governments and water users who question how the federal government is managing the watersheds.

The Yellowstone fires that occurred 20 years ago provided a wakeup call to many that nearly a century of federal forest firefighting may have actually made the forests more flammable and more dangerous. The U.S. Forest Service policy of putting out all fires may have actually filled the forests with fuel, making them harder to protect[6].

During the early 1990's, forest management practices underwent a drastic change[7]. In 1994, at the behest of environmental organizations claiming to protect the forest habitat of the northern spotted owl, a "threatened" species under the Endangered Species Act, 25 million acres of federal forests were put off limits to commercial timber harvesting. The federal government also greatly expanded "wilderness areas," closed hundreds of miles of national forest roads long used by firefighters to reach isolated wildfires, and terminated salvage timber sales. As a result of minimizing the mechanical-thinning approach to forest management—coupled with 100 years of a flawed federal fire suppression policy—the national forests became overgrown with underbrush and overfueled with dead or dying trees. They also became less accessible to firefighting crews.

A July 2008 report released by the National Research Council[8]—one of the first major studies on forest and water since a U.S. Forest Service project in 1976—underscores the importance of forests to the nation's water supplies. The report finds that modern forest practices have helped to protect streams and riparian zones, but more needs to be learned about the implications of such practices as thinning or partial cuts. This understanding can lead to the development of "best management" practices could help balance timber harvest with sustainable water flow and quality[9].

Summary

Western water policy over the past 100 years stands out as one of the modern era's great successes. Over 180 federal water projects serve 17 Western states. These provide water to more than 31 million people, and deliver irrigation water

---

[5] Revolutionary New Water-Saving Technique Gives Oil And Gas A New 'Green Look' In Rockies Nickle's Energy Group, 2008.

[6] Yellowstone Fires of '88: Twenty years of recollection". Rocky Barker, 2008. PERC Reports Summer 2008.

[7] Why the nation's forests are burning so hot. M. David Stirling, Pacific Legal Foundation. August 3, 2008 Eureka (CALIFORNIA) Reporter.

[8] Hydrologic Effects of a Changing Forest Landscape. National Research Council of the National Academy of Sciences. July 2008.

[9] Oregon State University News and Communication Service, July 14, 2008 Media Release "New Report: Greatest Value of Forests is Sustainable Water Supply".

to 140,000 farmers and 10 million acres of farmland. These lands produce 60% of the nation's vegetables and 25% of its fruits and nuts.

Millions of acres of arid Western desert have been transformed into the world's most efficient and productive agricultural system.

Irrigated agriculture is an incredible investment[10]. It continues to be a leading Western economic driver. Now is not the time to retreat. Sound policies are needed that encourage continued investment in irrigated farming rather than risking diminished domestic food production because cities are taking farm water. Relying on agriculture to be a "shock absorber" to soften or eliminate the impending water shortage is not planning. Rather, it is a choice to effectively put our heads in the sand and hope for the best. It will worsen the overall impact of climate change on our nation's economy and security.

Western irrigated agriculture is a strategic and irreplaceable national resource. It must be protected by the federal government in the 21st Century.

Now is the time for leadership at all levels—local, state, and federal—to face the challenges and create opportunities that will define the future of the West. Recognizing the value of irrigated agriculture is vital. Understanding the current and future role of irrigated agriculture in the West through aggressive action to repair aging infrastructure and create new water supply enhancement projects is imperative. Properly managing federal watersheds and encouraging federal agencies to work with the agricultural community to solve local water challenges are equally crucial. Through thoughtful planning, the Congress and the Administration can play a truly important role in helping find the solutions that have proved so elusive to date.

[10] A 1998 study by Dr. Darryl Olsen and Dr. Houshmand Ziari, estimates the impact of irrigated agriculture in the Western states to be $60 billion annually (direct and indirect income). The annual return to the economy from the $11 billion investment in the federal system has been estimated at $12 billion annually. In other words, the economy of the United States receives a greater than 100% return each year on this investment.

APPENDIX

RESPONSES TO ADDITIONAL QUESTIONS

RESPONSES OF L. JERRY HANSEN TO QUESTIONS FROM SENATOR SHAHEEN

Climate Change

Question 1. How should we be planning for the impacts of climate change on our water supply-both domestically and globally? What is being done now to address the uncertainty that climate change invariably brings with it?

Answer. We are following the Council on Environmental Quality's (CEQ) climate change adaptation implementing instructions (issued in March 2011) to assess the likely impacts of climate change on our mission and operations. Once that assessment is complete, we will incorporate those climate change considerations into all applicable Army planning processes (for example, our installation land use master plans, our Integrated Natural Resource Management Plans, our training range management plans, and our future stationing decisions).

National Policy

Question 2. Do you believe we are in need of a national policy to address water supply issues in this country? If so, what would be the key components to such a policy to ensure its effectiveness?

Answer. Water, across all its characteristics, is a national security issue. It is critical to our country's long term prosperity and our overall resilience as a nation. The Army recently completed a research project to develop a water security strategy. It is the first attempt at a framework with strategic goals and objectives. The key components bring together the multiple aspects of water, including supply, quality, distribution, cost, and supply chain for a single global organization. There is no single agency within the federal government that has the responsibility for water issues.

Sustainability

Question 3. I am impressed with the Army's net zero installations and commend you for the great work on that front. What are your plans for continuing this work and expanding it to other Army facilities? Will you be sharing lessons learned or best management practices with other Federal agencies who are working toward the same goals?

Answer. The Army has identified six Net Zero Pilot Installations in each of the Energy, Water, and Waste categories and two integrated installations, for a total of 17 different installations counting multiple category sites. The Pilot Installations are striving for Net Zero by 2020, but all Army installations are encouraged to pursue Net Zero. A total of 25 installations will be chosen by end of FY 2014 to reach Net Zero Energy by FY 2030. The overall goal is to achieve net zero at all Army installations by 2050.

Yes. Our Net Zero pilot installations are the seedbeds for the Army, and will serve as model sustainable communities, both for the Army and the nation. The Net Zero Installation Initiative has been disseminated throughout the Army. Our ASA(IE&E), the Honorable Katherine Hammack uses her Garrison visits to emphasize the importance of Net Zero to the Army. We have set up several mechanisms for the Net Zero pilot installations to collaborate with the other installations, to share their successes and lessons learned. We meet regularly with our counterparts working Energy and Environmental programs within the Department of Defense and other federal entities, such as the Department of Energy, Council on Environmental Quality and the EPA. We have also set up a public web site where we will share our successes and lessons learned.

RESPONSES OF L. JERRY HANSEN TO QUESTIONS FROM CONGRESSWOMAN LEE

Question 4. Please describe the process you would have to undertake to determine the value of water at your facilities. Is water valued differently under different circumstances and locations? For instance in facilities located in New England as compared to Utah or the Dakotas.

Answer. The Army has no specific definition of "value of water" nor have we determined the parameters of water values. The Army values the importance of water to conduct our mission and our Soldiers are active members of the local communities using the availability of fresh water. Water is essential to the success of our mission across the U.S and its territories, where reliance is mostly placed on municipalities or privatization for both supply and wastewater treatment, as well as worldwide—wherever we may expect to operate.

Without accurate knowledge of water's availability, it is impossible to predict accurately the effect of water withdrawals from ground water resources. A key concern for the U.S. Army is the vulnerability of military installations to critical resource issues. Water issues of concern-including adequate supply, increased cost of production per unit volume, quality, habitat degradation and salinity issues-already impact military installations and military operations in many locations. There is a need to assess vulnerability of regions and installations to water supply and to develop strategies to improve any adverse effects. This work by the Army and others should employ methodologies to conduct national screenings of watershed vulnerability and prepare regional water budgets-to include documenting supply and demand in regions containing Army installations, which have developed installation water demand projections.

To achieve water sustainability and Federal water conservation targets contained in Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management, the Army initiated the Net Zero vision as a holistic enterprise approach to appropriately manage our natural resources with the goal of achieving Net Zero installations. The Net Zero vision is to reduce energy, water, and waste on our installations. This approach is a force multiplier enabling the Army to appropriately conserve available resources, manage costs and provide our Soldiers, Families and Civilians with a sustainable future.

The Net Zero Water Installation limits the consumption of freshwater resources and returns water back to the same watershed so not to deplete the groundwater and surface water resources of that region in quantity and quality over the course of a year. The net zero water strategy balances water availability and use to ensure sustainable water supply for years to come. This concept is of increasing importance since scarcity of clean potable water is quickly becoming a serious issue in many areas of the world. The continued draw-down of major aquifers results in significant problems in the future. Strategies such as harvesting rainwater and recycling discharge water for reuse can reduce the need for municipal water. Desalination can be utilized to convert briny, brackish or salt water to fresh water so it is suitable for human consumption or irrigation.

The US Environmental Protection Agency (EPA) Science Advisory Board (SAB) conducted a public teleconference on 5 December 2011 for consultation and assisting EPA to scope, plan and develop a report on water's contribution to the U.S. economy. The report will consider economic sectors, research on the value of water in the U.S. from market consumption, and present cost and pricing information that is critical to support water resource decision-making. The Army anticipates the results of this study.

Question 5. In your view, which agency is the most capable to put a value on water?

Answer. For drinking water and wastewater, the federal Environmental Protection Agency is most capable. It has the most in-house staff experience to determine the market value of water because of its regulatory responsibilities and long history of working with others with an interest in the market value of water.

Question 6. Are you aware that the Environmental Protection Agency is embarking on the preparation of a report to address the Value of Water to the U.S. Economy? If so, have you contributed to this report/study? If not, what are your plans concerning the report/study?

Answer. The ASA(IE&E) was not familiar with the Environmental Protection Agency's (EPA) study, The Value of Water in the U.S. Economy. We have contacted the study's primary manager, Dr. John Powers, and talked to him about the goals of the study. The study's internal kick-off meeting within EPA occurred the first week of December 2011. The EPA then subsequently met with the U.S. Army Corps of Engineers (USACE) to discuss factors and approaches for addressing the value

of water. EPA and USACE plan to meet quarterly to discuss multiple topics, one of which will be ways the Army may contribute to the Value of Water project.

RESPONSES OF L. JERRY HANSEN TO QUESTIONS FROM SENATOR MURKOWSKI

Endangered Species Act

Question 7. What are examples of common mitigation efforts that the Army is forced to take to accommodate ESA?

Question 7a. Generally, how have ESA mitigation efforts affected military readiness? Can you provide specific examples of how ESA compliance has negatively impacted the Army's training or readiness?

Question 7b. How often does the ESA delay Army procedures or business? Examples?

Answer. Examples are: (1) manage training areas for species conservation rather than training requirements; (2) restrict availability (time, or duration of a training event); (3) restrict or place off-limits the use of training lands and ranges (decrease size, number, or type of training events to minimize impacts on listed species; (4) restrict or eliminate the use of certain weapons, ammunition, pyrotechnics, or smoke; (5) fund species specific studies or monitoring of species to determine mission impacts to listed species (6) purchase conservation easements on private lands to support conservation efforts for species; and (7) make significant changes to existing infrastructure to accommodate species requirements.

a. ESA mitigation impacts on training remains a major challenge to Army readiness, particularly where the mitigation activities restrict training and decrease the full capability of the land or ranges to meet training requirements. The use of the ESA and the National Environmental Policy Act (NEPA) however, by third parties to bring lawsuits against the Army as a tool to stop or restrict training has compounded this challenge.

b. A few examples of how ESA compliance has negatively impacted the Army's training (restrictions)—are: (1) Fort Irwin, CA—delayed the opening of the southern expansion and western expansion areas due to extensive mitigation and related NEPA actions; (2) Fort Benning, GA—requires movement of specific heavy maneuver training events associated with the Maneuver Center of Excellence off the FY 09 footprint of Fort Benning, GA (land acquisition) to mitigate impacts to the Red Cockaded Woodpecker; (3) Fort Hood, TX—currently Fort Hood has restrictions that impact heavy and light maneuver on a total of 54,195 acres due to mitigation for the Golden Cheeked Warbler; (4) Fort Lewis, WA is managing four candidate species: two butterflies, the Streaked Horned Lark and a pocket gopher; and (5) Yakima Training Center, WA is managing the Greater Sage Grouse which is a candidate species. Both WA installations have instituted restrictions on maneuver training in the hope of precluding their listing under the ESA. Fort Lewis has also initiated the purchase of conservation easements on private lands to off-set impacts from listed and candidate species on Ft Lewis.

b. Because of the complexity and magnitude of numerous current and new Army missions, the consultation process is normally longer than the specified consultation timeframes. The above examples also serve as examples of ESA delaying mission activities.

Question 8. The Department of Defense has a greater density of endangered and threatened species than any other Federal Agency with more than 420 species inhabiting DoD land.

Question 8a. How many of those species currently inhabit Army land?

Question 8b. The red-cockaded woodpecker is the highest priority species on Army Lands. What is the resource output specifically relating to the red-cockaded woodpecker by the Army? i. How many Army bases are affected by this particular species?

Answer. As of FY2010 Army installations reported 213 threatened and endangered species onsite at 101 installations.

a. The Army's expenditures on the management of the Red-cockaded Woodpecker for the previous 5 years are approximately: FY11—$8.7 M; FY10—$11.0 M; FY09—$10.4 M; FY08—$ 10.3 M; FY07—$ 7.0 M.

b. The Red-cockaded Woodpecker affects 8 Army installations: Fort Jackson (including Leesburg Training Site), SC; Fort Bragg, NC; Fort Gordon, GA; Fort Benning, GA; Fort Stewart, GA; Camp Blanding, FL; Fort Polk (including Peason Ridge), LA; and Military Ocean Terminal Sunny Point, NC.

Question 9. What are the resource expenditures on a yearly basis that the Army expends addressing ESA issues and mitigation efforts on Army land?

Question 9a. How many lawsuits have been filed against the Army by environmental groups regarding ESA? Are there any pending lawsuits against the Army regarding ESA listings or mitigation efforts?

Question 9b. Has the Army ever been involved with a settlement agreement with a special interest group relating to an ESA lawsuit?

Answer. The Army expenditures on the management of threatened and endangered species over the past 10 years are approximately: FY11—$ 38M; FY10—$ 44M; FY09—$36M; FY08—$41M; FY07—$ 44M; FY06 -$ 40M; FY05—$ 42M; FY04—$26M; FY03-$30M; FY02—$ 24M

a. There have been at least 10 cases brought by environmental groups pursuant to the Endangered Species Act, challenging proposed Army actions or biological opinions issued by the U.S. Fish & Wildlife Service (USFWS) that involved proposed Army actions. These cases have involved challenges to Army actions at: Pohakuloa Training Area and Makua Military Reservation, HI; Fort Benning, GA; Sierra Army Depot, CA; Fort Sam Houston, TX; Fort Huachuca and Barry Goldwater Range, AZ; and, Fort Irwin and the National Training Center, CA. There are currently no pending lawsuits against the Army brought pursuant to the ESA.

b. Yes. Although somewhat rare, the Army has entered into settlement agreements with special interest groups relating to litigation brought pursuant to the Endangered Species Act. For example, in response to one of the lawsuits brought by the Center for Biological Diversity (CBD) concerning Fort Huachuca, the Army and USFWS entered into a settlement agreement with CBD, which required the Army and USFWS to reinitiate §7 consultation regarding Fort Huachuca's impact on the Huachuca Water Umbel and Southwestern Willow Flycatcher. The Army has also entered into settlement agreements with regard to ESA litigation or potential litigation concerning actions at Fort Benning, GA (Red-cockaded Woodpecker), and in Hawaii (various endangered plants).

Question 10. In the near future, how do you believe that the Army will operate in conjunction with the ESA? Do you believe that the negative impacts and resource expenditures will increase?

Question 10a. Does the Army have any recommendations on how the ESA could be reformed so that it does not burden the military financially or operationally?

Answer. Army will continue to meet the compliance requirements of the ESA and be a leader in the conservation of certain species but at a cost of lost flexibility in both resource allocation and availability of training lands. Yes, new court ordered species listing decisions due to the US Fish and Wildlife Service settlement agreement with non-governmental organizations will continue to increase management requirements for threatened and endangered species on Army training lands. In addition, the drawdown will cause an increased training load on Army installations and subsequent training impacts from listed species. However, a reduction in end strength may reduce the initial impacts of species management on training at some installations in the future.

a. There are several recommendations for reducing the burden on the Army: (1) encourage Federal Agency coordination and legislation that will permit the Army to fund offsets for on-installation mission impacts to other Federal lands that have a suitable mission compatibility with species conservation; (2) provide adequate funding to other federal land management agencies to conserve species on their lands so the burden to recover certain species is shifted from DoD lands to other Federal Lands that have a more "organic" conservation mandate or mission compatibility; (3) incorporate Army mission requirements into the development and revision of ESA mandated threatened and endangered species recovery plans and (4) provide additional incentives to landowners (federal, state, local, private) to support and promote the conservation of species on their lands that directly support Army requirements. These recommendations only pertain to the Army and are not intended to represent recommendations of the other military services.

Mineral Resources

Question 11. The Army obviously has many facilities throughout the U.S., often in areas where there are significant shale gas resources. Does the Army own the mineral rights to the resources beneath military bases and do you plan to develop these? Does the Army have a plan to structure partnerships with private industry to explore and produce those resources?

Answer. In most but not all cases, the United States does own the mineral rights beneath Army installations and ranges.

Under current mineral leasing laws, the Bureau of Land Management, not the Army, has the authority to lease Army property for development of shale gas resources. In almost all cases, the development of shale gas resources would trigger the expenditure of additional Army resources to accommodate the military mission

with the private energy development. Current law is a significant disincentive because it does not compensate an installation for devoting its own time and funds into facilitating shale gas resource development; rather, any funds raised by the development flow directly into the U.S. treasury. Consequently, the Army does not currently have a plan to develop these resources, although we would like develop these resources in the future. The Army would need authority to eliminate current financial disincentives and create financial incentives to allow military bases to improve energy security and recover costs associated with shale gas production. Without these changes to financial incentives, any authority to develop such resources on Army lands would likely go unused.

Water

Question 12. Does water have very specific value in connection with DoD and Army Operations

Answer. The Army recognizes the value of water as an enabler to operations and as a constraint on the endurance and resilience of Soldiers. We also recognize the tactical and operational risks assured access to water poses during major operations. The Army "Sustain the Mission Project" report, September 2009, quantifies the casualty potential from distributing water on the non-linear battlefields in Iraq and Afghanistan. The Army is using these data to inform the development of near and long-term solutions that will provide greater resiliency through improved methods of production, purification and distribution, and by giving Soldiers a broader range of sources.

The Defense Department and the Army have produced policy, directives and doctrine to ensure water considerations are appropriately addressed. DoD Directive 4705.1, dated 9 July 1992 and recertified 8 December 2003, provides specific direction to all DoD components as related to Water in Contingency Operations and further designates the Army as the executive agent for land-based water resources. Further guidance in Joint Publication 4-03, Joint Bulk Petroleum and Water Doctrine, explains the value and conceptual operational information. Army Regulation 700-136, Tactical Land-Based Water Resources Management, further establishes the responsibilities of Army organizations. TB MED 577/NAVMED P-5010-10/AFMAN 48-138-IP, Sanitary Control and Surveillance of Field Water Supplies, is the Army and tri-Services approved Technical Bulletin establishing Water Quality Standards to include all policy, standards, guidelines and procedures to ensure a safe water supply.

Question 13. Has the Army inventoried its water resources and needs from the point of view of operational readiness?

Answer. Determining requirements is a continual process. The Army has formed a team incorporating the Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology; Office of the Deputy Chief of Staff, Logistics; Office of the Deputy Chief of Staff, Resource Management; the Product Manager for Petroleum and Water Systems; Tank Automotive Research, Development and Engineering Center; the Combined Arms Support Command; and the Joint Water Resources Management Action Group (JWRMAG) to define the requirements for water equipment, current and future, and identify methods of fulfilling capability gaps. This effort surveys all areas of the commercial market to identify and assess the latest technology in all areas related to water.

The Army has made long-term efforts to address operational water requirements at both the small unit level and for larger units conducting sustained operations. We have partnered with the USMC on their Expeditionary Energy, Water and Waste Initial Capabilities Document (ICD) to define the requirements for development of water equipment to support small tactical units. We have also completed our "Capabilities Based Assessment for Base Camps" to define the requirements for larger, sustained operations. Both of these documents will be used for future capability development.

For current and recently completed operations, the Army deployed and is deploying a number of technologies to reduce the risk to Soldiers from distributing water, and to provide Commanders with an expanded selection of sources to support their operations. For instance, the Army has leased water-well drilling equipment and drilled many wells in Iraq and Afghanistan to provide a local source of water and eliminate movement of water on unsecure routes. We have also fielded or are fielding new purification equipment suitable for small units and individual Soldiers for use at the point of need. In addition, as of December 2011, we have deployed 62 new Shower Water Reuse Systems that can recover 75% of shower water for reuse, thereby reducing overall demand. The Army has produced 116 of these systems with an objective of 236 total.

Question 14. Does the Army value water appropriately in its operations?

Answer. Yes. We are incorporating the United States Army Combined Arms Support Command (CASCOM) approved Water Planning guide as a planning factor for contingency operations in all Combatant Commands and Army Supporting Commands. In addition, the Army is developing a Fully-Burdened Cost of Water capability for inclusion in the "Sustain the Mission Project" decision support tool. This will give Commanders and planners a means to determine the true cost of supporting a deployed force with water. This information can be used to make informed decisions on the costs associated with different sources and methods to acquire, purify, and distribute water in a particular warfighting scenario. Once informed, Commanders can make decisions that limit their operational and tactical risks in ways that increase their freedom of action and increase force endurance and resiliency.

Question 15. Please describe the expertise of your Department in assessing the Army's water resources and needs?

Answer. The Army has a wide array of expertise in water spread across its installations, operations, and Army Corps of Engineers Civil Works programs. Installation and headquarters personnel must keep an installation functioning under all situations, including ensuring sufficient water supply is available to meet its needs now and into the future. This requires programming and budgeting for infrastructure maintenance, renovation, and eventual replacement. Frequently, installation water related infrastructure continues to be used after its design life has been exceeded which raises the risk of failure, both small and catastrophic. This includes both the drinking water distribution system and the waste water disposal system. Operations related water includes personnel concerned with water quality for Soldiers; drilling for, processing, and storing sufficient quantities of water for multiple uses during contingency operations; and transporting water when local supplies are unavailable or insufficient. The challenge for water in operations is to decrease the need to transport water so that there are fewer convoys needed, thus directly reducing the injury risk to Soldiers that transport and provide security for these numerous convoys. The Army Corps of Engineers Civil Works' expertise in water resource development includes flood control, navigation, recreation, and, infrastructure and environmental stewardship.

Question 16. Are you aware that the Environmental Protection Agency is embarking on the preparation of a report to address the Value of Water to the U.S. Economy?

Answer. The ASA(IE&E) was not familiar with the Environmental Protection Agency's study, The Value of Water in the U.S. Economy. We have contacted the study's primary manager, Dr. John Powers and talked to him about the goals of the study. The study's internal kick-off meeting within EPA occurred the first week of December 2011. The EPA then subsequently met with the U.S. Army Corps of Engineers (USACE) to discuss factors and approaches for addressing the value of water.

Question 17. Is the Department of the Army or the DoD to your knowledge contributing to or planning to contribute to or monitoring the development of or planning to monitor the development of that study?

Answer. In early December 2011, the EPA met with the U.S. Army Corps of Engineers (USACE) to discuss factors and approaches for addressing the value of water. This is the first of regularly planned quarterly meetings between the EPA and USACE to discuss multiple topics of interest. Future meetings will include discussion of the study as an agenda item.

RESPONSES OF ANTHONY WILLARDSON TO QUESTIONS FROM SENATOR LEE

Question 1. Is water both a private and public resource? Within Western water law, how do you address water as a public resource, specifically within Western water law?

Answer. Water is a complex mixed economic good with both public and private attributes, the use of which is governed by State law, generally under the so-called Prior Appropriation Doctrine, though there are exceptions especially related to groundwater. In the West, State constitutions declare it to be a common public resource, but also provide for its private beneficial use, or "appropriation," which may or may not be exclusive and uses may or may not be consumptive. While interests in water are often thought of as a private property right, it is usually a usufructuary right, or private right to the use of a public resource that can be bought, sold, leased, bequeathed and otherwise transferred.

There are conditions, limitations and restrictions placed by the State on these private rights of use, including its beneficial, non-wasteful use for specified purposes. Uses may or may not be tied to or appurtenant to the land on which the water is used. Also, State law prohibits "injury" to other private water users, and while often

derided as a disincentive to water conservation, requires that water be used as prescribed or the right to its use may be lost, by abandonment or forfeiture, and returned to the public domain and again "appropriated" to another's use. This is the so-called "use it or lose it doctrine," which was designed to limit "speculation," avoid granting rights to "unused" waters, and encourage the maximum beneficial use of the resource, generally viewed in economic terms.

The State grants water use permits, recognizes "perfected" rights, reviews and approves applications to transfer water rights (both temporarily and permanently), and with few exceptions has the authority to consider the broad public interest as part of the State's decision. Once "perfected," or put to use as required by State law, that specific quantity of water is thereafter generally considered to be private property, the exclusive use of which is controlled by a simple queuing concept or the principle of "first in time, first in right." This is a basic principle of the West's Prior Appropriation Doctrine.

There are exceptions to these general rules. For example, in Texas, groundwater is considered private property, which limits the amount of control the State has over the development and management of the resource. Even so, groundwater management areas have been established to provide some local limitations on the means of extracting groundwater to provide some accountability and avoid conflicts between pumpers.

Taken as a whole, the Prior Appropriation Doctrine that has evolved in the West is intended to avoid the impacts of unfettered use of the water "commons" leading to the over exploitation or degradation of the resource to the detriment of the public. It is also important to recognize that water once used for its intended purpose is often returned to a river, stream or aquifer, and State law essentially requires that it be returned in good condition. Reasonable and beneficial use requirements and the prohibition against waste apply to both quantity and quality. Waters are "reused" by the next "appropriator." Thus water is used and reused multiple times, and may often be "fully" appropriated.

In considering a water use permit application, States do consider whether or not water is available for appropriation. However, these determinations are general and relative given changing circumstances, such as drought, which raise considerable uncertainty as to the availability of water to meet the demands of various uses. Senior users have a right to use their full appropriation, before junior users, and at times given water supply hydrologic variability, the resource may be "fully" or "over" appropriated. State law allocates rights to the use of water, and when water is physically scarce, administers water rights according to the "first in time, first in right" and "use it or lose it" principles.

While the concepts are simple, their physical and legal application can be very complicated. Water use has been further complicated by the subsequent enactment and application or imposition of federal restrictions related to Tribal trust and other responsibilities, including environmental protections. The extent to which such restrictions on the use of private property are constitutional have been the focus of a number of lawsuits, and some "takings" claims have been upheld.

Question 2. Please describe the role of water rights in valuing water and alternative uses and the available infrastructure.

Answer. To a large extent the value of water for any use depends on the degree of certainty related to its availability. In the Eastern U.S., this is largely a matter of meteorology, but in the West, given general water scarcity it is equally a matter of law. The most valuable water rights are those with the most senior priority dates. Often in the West, the most senior use rights were granted in the 1800s, long before the growth of urban metropolises and environmental protections.

These senior property rights cannot be taken without just compensation, by government action, though their exercise can and has been restricted by statute, some might say reasonably and others unreasonably. They can and do move through economic transactions between willing buyers and sellers, but price and value are complicated by both the public and private aspects of water as an economic good. Many western farmers and ranchers (water right holders), tied to the land and water through generations, may not view any price as sufficient compensation for changing their way of life. For many their water rights are a valuable commodity that also provides for their economic security later in life, especially where there are no heirs willing or able to assume responsibility for the family operation.

As with real estate, it is also true that the value of water depends to a large extent on location, location, location! It should also be noted that in much of the West, land without water is of little value. Water supplies located closest to centers of demand will be more valuable. As with any commodity, transportation and distribution costs are a significant and sometimes overriding consideration.

Given its relative value as a matter of weight, compared to other commodities, water can be very expensive to move. In the West, there are literally thousands of transfers of water between different watersheds and river basins, some across long distances that depend on extensive infrastructure investments. The ability to capture, store and release water as needed from thousands of reservoirs and other facilities, large and small, also greatly contributes to the reliability, resiliency and value of a particular supply of water. The economic value of water as a commodity is significantly reduced if it cannot be stored and moved. Therefore, the availability of water-related infrastructure is essential in calculating the costs and value of any water supply.

However, it should also be noted that water left instream for various purposes, including aesthetic, environmental, fish and wildlife, and recreational uses are also valuable and should not be underappreciated. More and more, states recognize these values and protect (within their water rights systems) instream uses. Water need not be diverted from a river or stream to have value.

Question 3. When the Western States Water Council addresses the value of water, what is the first thing you should understand or address? What other issues need to be addressed as you look at the value of water?

Answer. Aside from the role of water rights, as previously described, when seeking water for any use, physical and economic supply and demand are paramount as with any other commodity. Benjamin Franklin has been credited with saying, "We know the value of water when the well runs dry." To a large extent, the value of water is related to the cost of an alternative supply or costs related to doing with less or doing without. More and more industries are beginning to consider the impact of water scarcity on their operations and the cost of doing business. Water is an essential, but sometimes under-appreciated input to production, and may at times be a critical limiting factor.

Water can also be a growth limiting factor, and some western urban areas are facing this very real possibility. Moreover, as the value of potable water supplies has increased, so too has the value of wastewater produced by urban areas, which can be treated and used for a variety of non-potable purposes. Water in the West is moving from agricultural to "higher" uses, mostly urban. The Western Governors' Association and WSWC are exploring opportunities to mitigate adverse impacts of such transfers on rural communities and the environment.

It should be noted that recognizing, defining and addressing water supply and demand problems in general depend on geographic, hydrologic, meteorological and climate data and sound science and modeling for effective decision making. Western states depend on many federal agencies for such information and related research, and some of the most critical programs in need of consistent and increased federal support are mentioned in my written testimony. The value of water cannot be determined effectively without sufficient, accurate information on present and future supplies and demands.

Question 4. Do you have any concerns with Federal regulatory initiatives as they may pertain to water? What are some of the estimates of costs that may be associated with these initiatives? Do the benefits get near the costs?

Answer. The Western States Water Council has in the past called for a rational, reasonable federal regulatory framework, as it relates to water, but has not sought to comprehensively define what that means. The Council has adopted various positions and resolutions, as well as commented on occasion, with respect to specific regulatory proposals (which are attached). As indicated, not all of these Council actions have had unanimous support, though at a minimum, two-thirds of our voting member states approved them.

The Council has raised specific issues and related to expansion of federal jurisdiction under the Clean Water Act (CWA) through redefining "waters of the United States," duplicative regulation of pesticide applications under both the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and CWA, and the possibility that waters transferred from one water body to another (including from one watershed or basin to another) without the addition of any pollutant might become subject to federal permit requirements under the CWA's National Pollutant Discharge Elimination System (NPDES).

There are various estimates of costs related to each initiative, as indicated in the attachments, but it is safe to say that they are substantial, in the hundreds of millions of dollars, and that whether or not the increased environmental benefit would outweigh the costs is debatable.

Question 5. In your experience have State Water Quality Officials been concerned about the cost benefit balance of the initiatives you have mentioned?

Answer. State and federal budgets are similarly stressed during these difficult economic times. Water quality officials are struggling to maintain existing services

and protections in the face of dwindling financial and human resources. As described in the attached statements, WSWC members are concerned with the increasing cost and potential burden of new regulatory initiatives, and question the water quality benefits that would result. Again, not all of our states are of the same opinion regarding the specifics, but it is fair to say that in general the overwhelming majority agree that there needs to be sufficient flexibility to address priority concerns and focus resources on those problems that the States themselves have identified as most likely to produce the greatest return in improved water quality at the least cost. States have both their own sovereign authorities and delegated federal responsibilities for environmental protection, including water quality protection, and are generally best positioned to determine how to allocate their resources and address water quality issues within their borders. Moreover, new unfunded federal initiatives and mandates are not likely to be effective, and may divert resources from more productive actions.

Question 6. What are the opportunities and challenges of water conservation?

Answer. Water conservation is a fundamental concept behind State water law, policy and planning and will continue to be a critical strategy for meeting present and future needs. It is a tool for addressing both short and long-term demands by stretching existing supplies. However, water conservation is best viewed as a means to specific ends. It is not a panacea for all of our water problems. It is an effective tool for addressing temporary emergencies such as drought or other supply interruptions, but is generally not a permanent solution to shortages due to long-term population growth.

While using water more efficiently is generally a good option, it is not without its limitations and opportunities for wise use are best considered on a case-by-case basis taking into consideration all of the costs and benefits. Increasing water use efficiency can require costly capital investments on one hand, while on the other delaying or mitigating the need for other infrastructure improvements.

Conservation can reduce demands to divert more water from lakes, rivers and streams, improving instream conditions. But it can also reduce returnflows, groundwater recharge and eliminate less efficient uses (given our present artificial hydrologic system comprised of numerous man-made reservoirs and other impoundments, canals, laterals, and ditches) that have created wetlands, seeps, bogs and perennial streams where there were once dry plains, gulches and ephemeral streams.

Question 7. Would you mind providing a list of key federal statutory and regulatory authorities that impact a holder of a State issued water right or permit?

Answer. The most significant federal statutes that impact the exercise of State granted property rights to the use of water in the West include the Clean Water Act's NPDES program and Section 404 dredge and fill permitting requirements; and the Endangered Species Act Section 7 mandates and consulting requirements for federal agencies, as well as Section 9 individual species "take" prohibitions.

The fulfillment of tribal trust responsibilities and settlement of Indian water right claims are another substantial cloud over the exercise of State granted water rights, though significant progress has been made within existing resources to address this concern.

Outstanding and unknown federal requirements increase the uncertainty surrounding the value of property rights related to water.

Question 8. Assuming that a national study to determine the value of water could be done; what challenges would you see with its preparation or use?

Answer. The Council and Western Governors agree that as a Nation we need to place a higher value on water and invest more towards meeting our present and future needs.

Any study of the value of water must recognize that to a large extent it is a personal and subjective determination. Moreover, it is often as much a political as an economic decision, and any underlying objectives, biases and assumptions should be transparent in any study.

The value of water is a function of our willingness to pay as well as a price at which we are willing to sell. Former EPA Assistant Administrator for Water Ben Grumbles has opined that water is always worth more than we are willing to pay. Indeed, we should rightly recognize the many economic externalities inherent in valuing both public and private goods and services provided by water.

Often public regulators of water purveyors relate its price to the cost of service and/or acquiring alternative or additional supplies. Others would suggest including opportunity costs in the value, and still would price water at whatever the market will bear.

Given the uncertainty and difficulty inherent in determining water supplies and demands, valuing water will be equally challenging. There is a general lack of suffi-

cient data for sound decision making, as referenced in my written testimony, which makes any valuation difficult.

In September 2007, the National Science and Technology Council's Committee on Environment and Natural Resources, Subcommittee on Water Availability and Quality (SWAQ), released a report entitled: "A Strategy for Federal Science and Technology to Support Water Availability and Quality in the United States." In part the report reads: "Many effective programs are underway to measure aspects of our water resources. However, simply stated, quantitative knowledge of U.S. water supply is currently inadequate (U.S. Government Accountability Office, 2005; National Research Council, 2004). The United States should measure water resources more strategically and efficiently."

Any valuation on a national basis may likely to be so general as to not be useful, but a summary of principles to guide valuation on a site-specific and individual user and uses basis could be helpful—including water related services, including environmental services that should be considered in valuation.

Question 9. In your view, which agency is the most capable to put a value on water?

Answer. While the value of water is largely determined by markets, and myriad collective individual decisions, there is a role for government to ensure market externalities are taken into account. Governments through various incentives, subsidies, regulation and other actions play a large role in determining the value and price of water. The value of water to the West and the Nation is and will continue to be dynamic, but undoubtedly it should be given a high public priority.

It is unlikely that any one federal or state agency or agencies could effectively accomplish the task of putting a value on water, but each can contribute to a collaborative effort to better define the value of water and its role in maintaining a healthy economy and environment.

The WSWC and others are currently collaborating with the U.S. Geological Survey in an assessment of the Nation's water resources, both availability and existing and future uses. This and similar efforts will be worthwhile, but not likely to produce a definitive answer to what's the value of water.

Water is literally the lifeblood of the West, and as suggested by Benjamin Franklin, many of our citizens know its value when the "well runs dry." Much of the West is again facing the prospect of drought following an extremely dry December that in some places has been record breaking. Given our climate and growing population, water will only become even more scarce and precious.

Question 10. Are you aware that the Environmental Protection Agency is embarking on the preparation of a report to address the Value of Water to the U.S. Economy? If so, have you contributed to this study? If not, what are your plans concerning the study?

Answer. We are aware of the study, but have not been asked to participate or contribute. However, EPA's Office of Water has offered to discuss this study with us and we are working on scheduling a time to meet. We would hope to collaborate with EPA on this effort.

RESPONSES OF AARON SALZBERG TO QUESTIONS FROM SENATOR SHAHEEN

Global Security

Question 1. I'd like to talk about water as a global security issue. The areas likely to face some of the most severe water challenges - the Middle East, South Asia, Africa-are also characterized by high international tensions, disputed borders, and competing claims to shared water resources. Can you discuss the security ramifications of increased water demand and decreased water supply and the regions that Congress needs to focus on?

Answer. By 2025, many of the countries in the regions listed above will be significantly water stressed-either because demand will exceed supply or because the country will not have the infrastructure in place to ensure sustainable access to the water necessary to maintain social and economic development. Within a country, increasing demands, competition between communities over water rights and use, and the lack of access to safe drinking water may be increasing factors in local conflict and state fragility and failure. Between countries, increasing demands, unilateral development (e.g., withdrawing water upstream without notifying downstream countries), weak or non-existent bilateral or regional institutions (for promoting joint management of shared water resources), and/or existing animosities could exacerbate tensions. In some regions, floods and droughts will threaten increasing numbers of people and cause greater economic dislocations. In all cases, as water supplies become increasingly limited it will become more difficult for countries to meet

their health (e.g., safe drinking water and food security), economic growth (e.g., energy production and agricultural output), and environmental needs.

Question 2. Are there key areas internationally where water issues exacerbate tensions and could create new conflict?

Answer. Between countries or regionally, conflict over water resources is extremely rare. That said, there are a number of regions where demand is increasingly stressing supply, unilateral development is taking place, rapid political and environmental changes are occurring, there already exists a high-level of tension, and there are weak or no institutions for managing differences over water resources management (e.g., North-east and Sub-Saharan Africa; South, Central and East Asia; and the Middle East). In these regions water will likely become an increasing source of tension and a greater factor in regional disputes.

International Institutions

Question 3. What legal regimes are in place internationally with respect to the management of water? What efforts are being made to build institutions to address water management in developing nations?

Answer. There is no binding, comprehensive, multilateral, international agreement on the management of shared waters, though there are several bilateral and regional arrangements that deal with specific water resources. In 1997, the UN General Assembly adopted the "UN Convention on the Law of the Non-navigational Uses of International Watercourses" which has not been ratified by enough countries to enter into force. The Convention codifies many of the commonly endorsed principles of shared water resources management (e.g., equitable and reasonable utilization, obligation to cooperate and not cause significant harm, prior notification) but must be interpreted on a case-by-case basis subject to the unique conditions of each basin. As such, it is a useful tool but not a clearly defined set of international obligations. (The United States has signed but has not ratified the Convention.) A similar convention has recently been drafted by the UN for the management of groundwater. Between countries, many types of legal arrangements exist with differing degrees of specificity, institutional arrangements, and political support.

The United States is working at both the national and regional level to strengthen institutions for water resources management. This includes, for example, support at the local level to establish water user groups and water cooperatives, at the national level to develop sound water resource plans/strategies and laws that govern land tenure and water rights, and regionally to establish or strengthen institutions between or among countries to advance the cooperative management of shared waters. To advance these efforts, the United States has established the Shared Waters Program within the United Nations Development Program to serve as a multi-donor platform for supporting regional dialogues on shared waters.

RESPONSES OF AARON SALZBERG TO QUESTIONS FROM SENATOR COONS

Question 1. As Chairman of the Foreign Relations Africa Subcommittee, I remain deeply concerned about the crisis in the Horn of Africa. Failure of consecutive rainy seasons has led to the worst regional drought in 60 years, and famine has ensued in Somalia due the lethal combination of a lack of water, lack of governance, and restricted humanitarian access. When compared with the rest of the region, what factors have made climatic conditions worse in Somalia? To what degree has deforestation associated with the charcoal industry-which serves as the main source of income for al-Shabaab-contributed to the lack of water in Southern Somalia?

Answer. Increased frequency of natural disasters attributed to climate change and increased vulnerability due to non-climatic factors has made the Horn of Africa very susceptible to food crises. Vulnerable populations do not have the opportunity to fully recover before they are faced with another disaster, keeping them in a cycle of poverty. The current drought in the Horn of Africa is exacerbating ongoing humanitarian, governance, and security concerns in the region. Each country in the Horn (e.g., Djibouti, Ethiopia, Kenya, and Somalia) is experiencing the crisis amid unique domestic considerations, but all are shouldering significant burdens that are further challenged by the past year's significant increase of Somali refugee arrivals.

However, the worst drought in 60 years has not led to the worst humanitarian crisis in 60 years. Indeed, the development of national agriculture and food security plans by Kenya and Ethiopia in addition to increased capacity in the region to predict climate events and prepare for potential impacts help to stymie the spread of famine outside of the regions of Somalia inaccessible to humanitarian aid. The U.S. Government's global hunger and food security initiative, Feed the Future, aims to strengthen the positive agricultural development trend in the Horn with its programs in Kenya and Ethiopia, as explained below.

Africa has the fastest rate of deforestation anywhere in the world, which has significant implications for water and other major issues, including agriculture, human health, and conflict over natural resources. The region's vulnerability is compounded by developmental challenges such as endemic poverty, weak governance, limited investment and access to capital, environmental degradation, and conflict.

Question 2. Recently released analysis from USAID's Famine Early Warning System, FEWS NET, has indicated that though the famine will persist in Somalia through the end of 2011, certain areas of Somalia have experienced modest improvements and were recently downgraded from Phase 5 famine to Phase 4 "emergency crisis." What steps are being taken to ensure this progress is sustained, and what is the prediction for future rainy seasons in the Somalia and the region?

Answer. On November 18, 2011, data released by the USAID-funded Famine Early Warning Systems Network (FEWSNET) and the U.N. Food Security and Nutrition Analysis Unit (FSNAU) indicated improvements in food security in all areas of Somalia, largely driven by large-scale international humanitarian assistance efforts. Though famine conditions abated in three of the six areas previously declared as experiencing ongoing famine in southern Somalia, FEWSNET and FSNAU acknowledged the fragility of the situation, noting that famine could reappear if there were a decline in the level of international assistance and/or new disruptions to humanitarian access or trade.

On November 28, al-Shabaab issued a public statement banning 16 U.N. agencies and international non-governmental organizations from operating in al-Shabaab-controlled areas of southern and central Somalia. This action further diminished options for providing assistance and greatly increased the possibility that famine conditions could return.

On December 22, the President announced an additional $113 million in assistance to the Horn of Africa to support food, health, shelter, water, and other needs across Kenya, Ethiopia, and Somalia. U.S. Government funding for relief efforts in the Horn of Africa now stands at $870 million, maintaining the United States' position as the largest single donor, including $205 million in humanitarian assistance in FY11 and FY12 to Somalia. Our assistance includes food aid, treatment for the severely malnourished, health care, clean water, proper sanitation, and hygiene education and supplies. To help improve food security in areas where humanitarian access remains constrained, we are also providing market-based interventions such as the distribution of improved seed varieties to support fodder production, cash vouchers that enable households to purchase basic food and other requirements in local markets, and increasing access to cereals among vulnerable populations.

The National Oceanic and Atmospheric Administration's Climate Prediction Center Seasonal Precipitation Outlook for the May-June-July period indicates below normal rainfall over southwestern Ethiopia and equal chances of below, normal, or above rainfall for Somalia [accuracy of prediction models degrades significantly as we predict conditions further into the future]. The Intergovernmental Authority for Development Climate Application and Prediction Center for eastern Africa will be holding its seasonal climate outlook forum (COF) at the end of February. The Greater Horn of Africa (GHA) National Meteorological Services will issue the consensus climate outlook for the season at the end of the COF process. Seasonal outlooks are used by GHA governments as well as donors to plan and prepare for potential climate extremes in the coming season. These efforts were part of USAID/OFDA's capacity building programs to strengthen capacity on meteorological services in the region.

USAID/OFDA, in partnership with NOAA, USGS, the UN World Meteorological Organization, and National Meteorological and Hydrological Services in the region, provided support to the IGAD Climate Prediction and Applications Centre (ICPAC) to increase capacity for climate prediction and applications in the regions. ICPAC Climate Outlooks have been critical in preparedness and planning for droughts and other climatic shocks in the region. In coordination with the U.S. Government, ICPAC provides access to U.S. climate models and experts to develop outlooks in the region.

Question 3. Describe drought mitigation efforts in East Africa funded by the U.S. government and the process of groundwater development in the Horn of Africa. To what extent have U.S.-funded projects to build wells along pastoral routes proven effective? Is this a long-term solution to mitigating the impact of droughts, which will almost surely continue to afflict the region?

Answer. USAID's efforts in recent years to reduce vulnerability among the Ethiopian population have yielded substantial results. Despite the regular cycle of droughts in parts of the country, the number of emergency beneficiaries has dropped from 15 million in 2003 to a maximum of 4.6 million currently, since many vulner-

able people have been assisted by the government's long-term Productive Safety Net Program (PSNP), supported by USAID and other donors.

In Kenya, U.S. assistance to farmers and microenterprises, that together generate 30 percent of gross domestic product (GDP), has helped improve incomes and create jobs for hundreds of thousands of Kenyans. The United States is working to improve food security for the two million Kenyans chronically dependent on food aid through the Feed the Future initiative. Regionally, USAID support for increased trade in staple foods, including livestock, and improved farmer access to integrated regional markets, improves food security by linking surplus to deficit areas, which can mitigate climatic shocks. USAID is also investing in technologies including soil liming that can significantly boost maize yields, potentially transforming the production of western Kenya's largest staple crop.

USAID and USDA together worked with UC Davis, UC Riverside and the International Rice Research Institute in the Philippines to develop submergence tolerant rice-rice that not only withstands floods, but thrives in them. Over 1 million farmers are already seeing improved harvests. And by partnering with national rice research centers across South Asia, we hope to reach 70 million more people.

By investing in drought-resistant seeds and better management of water resources, we can protect millions of people from the perennial threat of famine and build resilience against an increasingly unpredictable climate.

USAID/ OFDA's due diligence has been focused on balancing groundwater extractions against pressing humanitarian needs. In that vein, USAID stresses the sustainable use of existing water sources first -- and the development of new ones (e.g., new wells) only where yields of existing sources are insufficient. For example, in Somalia, OFDA has funded the extension of water systems from existing wells by redeveloping the wells and installing piped water networks. Implementing partners conducted drawdown tests to size the pumps.

Globally, reliable hydrogeological studies, data, and information are limited, and ground water sources have been developed without understanding characteristics of the aquifers. Lack of knowledge of water resources in east Africa has significant impacts on the ability to plan, organize, and implement an effective potable water strategy for the region in response to the current humanitarian crisis and future development activities. In 2005-2006, USAID/OFDA funded a Darfur groundwater exploration activity to address this issue. OFDA, USGS, Radar Technologies France, and UNESCO collaborated to develop a product to understand aquifer potential in Darfur for sustainable development of groundwater resources to address needs of IDPs and host communities. The process-based on new radar remote sensing technologies combined with optical remote sensing, geology, geomorphologic features, and climatic data-revealed significant groundwater aquifers not visible from the surface to sustain use of water for humanitarian assistance. Ground Penetrating Radars over various aquifers in Sudan have verified the results of the study in identifying drilling locations. Water drilling site maps and drilling manuals have been produced, and NGOs, UNESCO, and UNICEF were trained on the use of these products. UNICEF has been using these maps to provide water to IDPs in Darfur, Sudan while ensuring sustainable use of groundwater resources to avoid overtaxing the aquifers.

Since 2010, one of OFDA's partners in Somalia has constructed several piped water systems that incorporate sustainable operation and maintenance function. The water points that were developed are all in operation today and provide water to Somalis along the traditional pastoral routes.

Question 4. Wise Power is a Delaware-based company that is producing decentralized solar power units that don't need to connect to the grid. They are finding that there is a strong need for their product in Africa. How important do you think decentralized power-generating technologies, like independent solar power units, or small hydro projects, will be in countries like Africa that currently have poorly developed grid networks? Can these technologies address power needs for small water projects including groundwater pumping, irrigation, in addition to home and business power generation? What steps are being taken to assist with power diversification in Africa and elsewhere to create alternative sources of electricity given the depletion of hydro-power in areas susceptible to water shortages? Have we considered encouraging solar and geothermal sources of electricity in areas that cannot sustain hydro-resources?

Answer. Decentralized power generating technologie -along with grid technologies-will play an important role in diversifying energy supplies and increasing access to modern energy services for the 1.3 billion people in the world who currently have no access to energy, including in sub-Saharan Africa and South Asia. To provide electricity to this population, the International Energy Agency estimates that approximately 120 GW of off-grid and mini-grid power will need to be added globally

by 2030, and that 90% of that power will come from renewable sources, including solar, wind and biomass. In the right conditions, these technologies perform exceedingly well in small water projects, including groundwater pumping, irrigation, heating, cooking, and also in meeting basic human needs and providing for productive uses for homes and small businesses.

The United States Government is actively involved in a number of bilateral, regional, and multilateral efforts to promote energy diversification through the use of renewable resources in the developing world, including in sub-Saharan Africa. USAID's Africa Infrastructure Program is providing ongoing support to over 15 African governments improving the investment environment for, and advancing the actual negotiation of renewable energy projects. For example, it is supporting: 1) the development of over 400 MW of wind generation capacity in Kenya, Namibia, Lesotho, and Mozambique; 2) capacity building related to the East Africa and Geothermal Risk Mitigation Facility and Kenya develop geothermal resources capacity in East Africa; 3) the development of feed-in tariffs for micro-hydro resources in Rwanda and Uganda; and 4) solar and wind mapping efforts in Mozambique, and the West African ECOWAS region. The United States Government is also working through the International Renewable Energy Agency (IRENA) to develop country-relevant solar and wind mapping systems and technologies that will give policy makers access to necessary information on renewable resources available to promote distributed generation through solar and wind.

Question 5. DuPont and other biotechnology companies have developed, and continue to develop crop varieties that have improved nutritional value, are able to more readily utilize soil nutrients, and are drought resistant. How much of a role will these crops play in achieving greater agricultural production with minimal use of water and other resources? What is the State Department doing to encourage public-private partnerships to develop and make these technologies available?

Answer. World population is projected to grow to approximately 9 billion people by 2050. At the same time, climate change is putting greater strains on agricultural production. The UN Food and Agriculture Organization estimates that to meet the expected global demand, farmers will need to increase food production by 70 percent using less land, less water, less fertilizer and less pesticide. In order to achieve these goals, scientists and farmers will need to use all available tools, including improved agricultural practices and improved seeds.

Improved crops, developed through the use of genetic engineering and other new breeding technologies, will play a critical role in helping the world meet its food security goals in a more sustainable manner. The potential role for drought-tolerant crops in this effort is enormous, especially in drought-prone areas of the world that may be increasing as a result of climate change. U.S. farmers typically lose 10-15% of their annual yield because of drought and water stress, and losses in Africa are even larger. Biotechnology companies are currently marketing conventionally bred varieties that can flourish with less water and are developing genetically engineered varieties that will further improve the drought tolerance of crops. Such varieties will sustain crop yields under conditions of water shortage by enhancing the resilience of crops to climate variation. Another important goal for research in biotech crops is to enhance the nutritional content of crops to improve human health, and also to allow crops to be grown on lower quality soils with fewer fertilizer inputs to both increase crop productivity and protect the environment.

Private-Public Partnerships

The challenges posed by increasing population and climate change to global food security cannot be met without private/public partnerships, which make up a significant share of the global agricultural research effort. The U.S. Government partners with companies, NGOs, private foundations, and international research organizations, such as the Consultative Group on International Agricultural Research (CGIAR) and International Maize and Wheat Improvement Center (CIMMYT), in a variety of ways to ensure the availability of crops relevant to developing countries, and that countries interested in adopting biotech crops have the capacity to do so. For example, the production and evaluation of drought tolerant maize varieties for subsistence farmers in sub-Saharan Africa is being carried out by private-public partnerships, with funding provided by the Bill and Melinda Gates Foundation and USAID. USAID is also partnering with DuPont/Pioneer, CIMMYT and the Bill and Melinda Gates Foundation on the development of maize varieties that can grow with less fertilizer and with Arcadia Biosciences on drought and salt tolerant rice. Crops developed through these partnerships will be made available royalty-free to subsistence farmers.

Actions Taken by the Department of State and USAID

The Department of State and USAID are facilitating the adoption of improved crops in several ways:

- In 2011, Assistant Secretary of State Jose Fernandez organized a series of meetings with the African diplomatic corps that brought together industry, NGOs and government officials to discuss ways of promoting agricultural investments by establishing transparent, predictable and science-based regulatory systems. The roundtable discussions were attended by nearly two dozen African Ambassadors and included senior representatives from the U.S. Department of Agriculture and USAID.
- The U.S. Government maintains a dialogue with U.S. biotech companies and with U.S. and international research centers.
- Through our embassies, we publicize the advantages of biotech crops by providing information on request and through the sponsorship of informational visits by U.S. experts.
- Our embassies, in seven targeted countries in East and West Africa are developing their 2012 agricultural biotechnology outreach action plans. These action plans will focus on measures that will be taken to promote further advancement and implementation of the technology.
- We bring representatives of foreign governments to the United States for tours of agricultural facilities, including a group of African agricultural ministers in October 2011.
- The Department of State advocates for timely approvals of new biotech crops abroad, since the most significant delay in the adoption of this technology is the time that it takes to evaluate and obtain approvals in many parts of the world.
- The Department of State is also facilitating the adoption of nutritionally enhanced staple crops overseas, such as Golden Rice, and working with U.S. regulatory authorities to ensure that such products also meet food safety standards in the United States. USAID is additionally providing long-term support to the development of these crops.
- Promotion of improved crop varieties is also supported through Feed the Future (FTF), the U.S. global hunger and food security initiative. FTF recognizes that, to meet the global food security imperative, activities should be implemented with a broad base of public and private partners, leveraging diverse resources, and the latest scientific advances and innovations. FTF currently invests heavily in accelerating the dissemination of heat- and drought-tolerant, climate-adapted cereals to increase productivity on the tens of millions of hectares affected annually by drought, and in helping farmers adapt to higher temperatures that are already impacting the yields of staples such as wheat, rice, and maize. Leveraging partnerships with the private sector, and proprietary technologies, is critical to success in this area and USAID has recently issued a call for proposals to support new public-private alliances aimed at developing climate resilient cereals using advanced breeding and biotech methods. FTF also supports research on new private sector business models that can allow U.S. companies to recoup their investment in varieties produced through biotechnology, while ensuring access to these technologies by small-holder farmers.
- Integrating improved natural resource management (especially water and soil management) and climate change adaptation is a key cross cutting theme in FTF implementation, and we seek to achieve increased agricultural productivity and better nutrition through sustainable agricultural intensification. Improved crop or animal varieties and better access to inputs like fertilizer is important, and promoting the best water and soil management practices will be critical to long lasting gains. Thus, we are supporting both biotech and improved management innovations to enhance ecosystem functions.

○