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Opportunities and challenges to address domestic and global water supply issues
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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 resources 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 quantify 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

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

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 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

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

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

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.