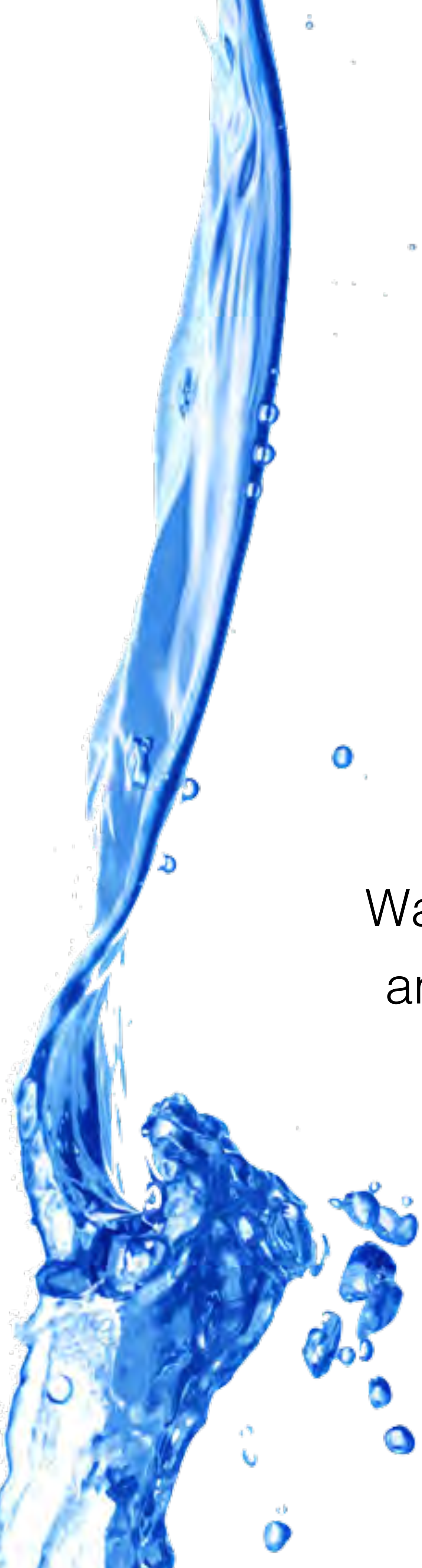

Columbia University
School of International and Public Affairs

Workshop Summer 2014
Final Report

H.R. 765: Water Infrastructure Resiliency and Sustainability Act of 2013

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Workshop in Applied Earth Systems Management I

2014 Final Report

H.R. 765: Water Infrastructure Resiliency and Sustainability Act of 2013

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1. Executive Summary

One of the most significant problems of the 21st Century will be caused by the scarcity of clean water resources due to changing hydrological conditions caused by climate change.

In the United States, most water infrastructure was built before World War II, affecting water system reliability and increasing expenditure on emergency repair. An investment of $1 trillion for the next 25 years is anticipated to maintain current standards of water services[1] and does not cover other critical areas such as floodwater retention, storm-water run-off, green infrastructure, and wetlands.

The Water Infrastructure Resiliency and Sustainability Act of 2013 (H.R. 765) proposes to implement a grants program aimed at financing water infrastructure projects. The Bill formulates a competitive grants program open to owners and operators of water systems throughout the country to help implement a broad array of water infrastructure projects that would increase the system's reliability, quality or adaptability. The goal of the Bill is to increase resiliency of water systems in the face of changing hydrological conditions. The grants program will be administered by the Environmental Protection Agency (EPA). Priority will be given to projects that are under severe stress or are the most vulnerable to changing water supply scenarios due to climate change.

The increasing frequency and intensity of extreme weather events point to the urgency of H.R. 765. Mitigation of the harmful effects of climate change requires the overhaul of existing infrastructure. H.R. 765 can serve as one step toward renovating the country's aging infrastructure.

2. Background and Context

America's water infrastructure is living on borrowed time. A recent report by the American Society of Civil Engineers grades American water infrastructure a D+.[2] This is a worrying because of the implications of an aging water infrastructure are exacerbated by increasing population densities coupled with changing hydrological conditions. A typical drinking water supply system is expected to last between fifteen and ninety five years[3]. The urgency of the issue further increases when one takes into account climate change and rising sea levels that impair the ability of current systems to function effectively.

[1]http://www.awwa.org/Portals/0/files/legreg/documents/BuriedNoLonger.pdf
[2] http://www.infrastructurereportcard.org/drinking-

[2] http://www.infrastructurereportcard.org/drinking-water/
[3] Same as above

Comparing drought and flood conditions in California and Florida

The scientific community has reached general consensus about climate change being responsible for changing weather patterns and increasing the intensity and frequency of extreme weather events[4]. Climate change will affect the hydrological cycle in terms of precipitation levels, atmospheric concentrations of water vapor, temperature increase, cloud formations, run-off and stream-flow patterns[5]. The earth has warmed 1.4°F since 1880 and temperatures are expected to rise another 2°F by the end of this century[6]. Increased temperatures result in shorter winters, producing more rain instead of snow in late autumn and early spring, which consequently decreases snowpack. Rain on snow can create flash floods and inundate reservoirs that would normally receive water at a steadier pace during the summer. Higher temperatures increase the rate of evaporation, depleting reservoirs and decreasing soil moisture. The extended growing season

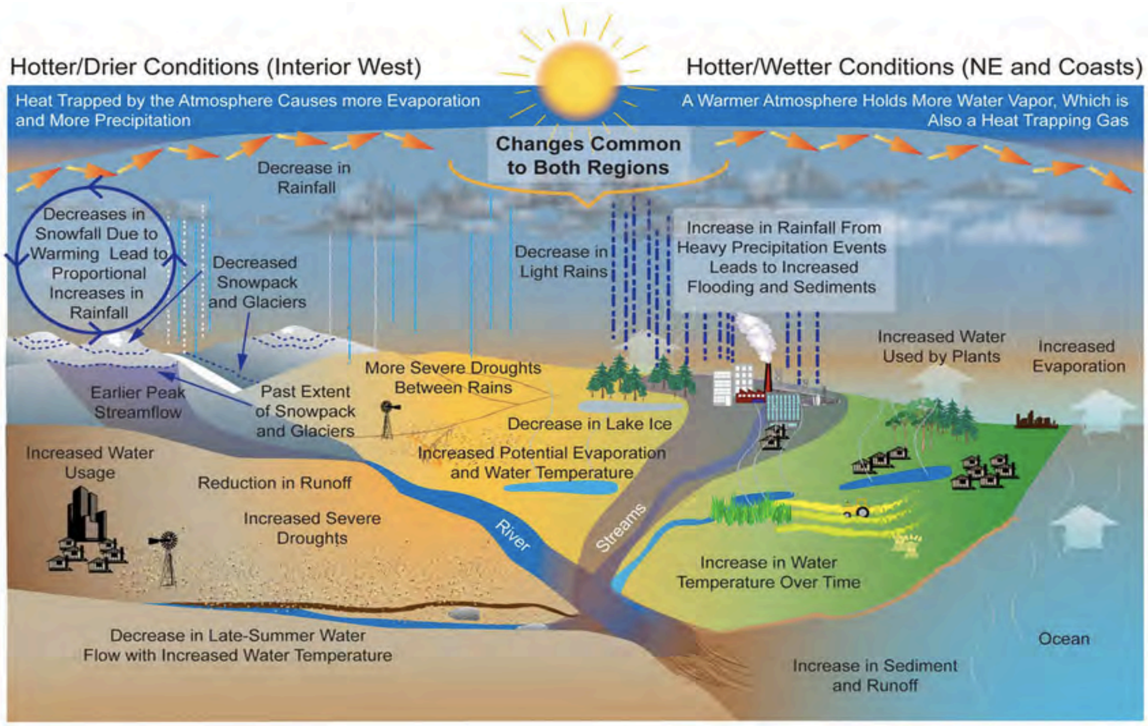

Figure 1 Projected changes in the water cycle. Source: USGCRP (2009)
The two extremes of variability in precipitation patterns are drought and flood. Most of the continental United States has been impacted by one or the other since the beginning of the 20th Century

4 Social Sciences - Environmental Sciences: William R. L. Anderegg, James W. Prall, Jacob Harold, and Stephen H. Schneider, Expert credibility in climate change PNAS 2010 ; published ahead of print June 21, 2010, doi:10.1073/pnas.1003187107

5 NASA. 2012. The Water Cycle and Climate Change. http://earthobservatory.nasa.gov/Features/Water/page3.php

6 "Earth Observatory: Global Temperatures," Accessed June 10, 2014, http://earthobservatory.nasa.gov/Features/WorldOfChange/decadaltemp.php.

intensifies agricultural needs, which currently account for 62% of fresh water withdrawals in the U.S. (excluding thermoelectric power).[7]

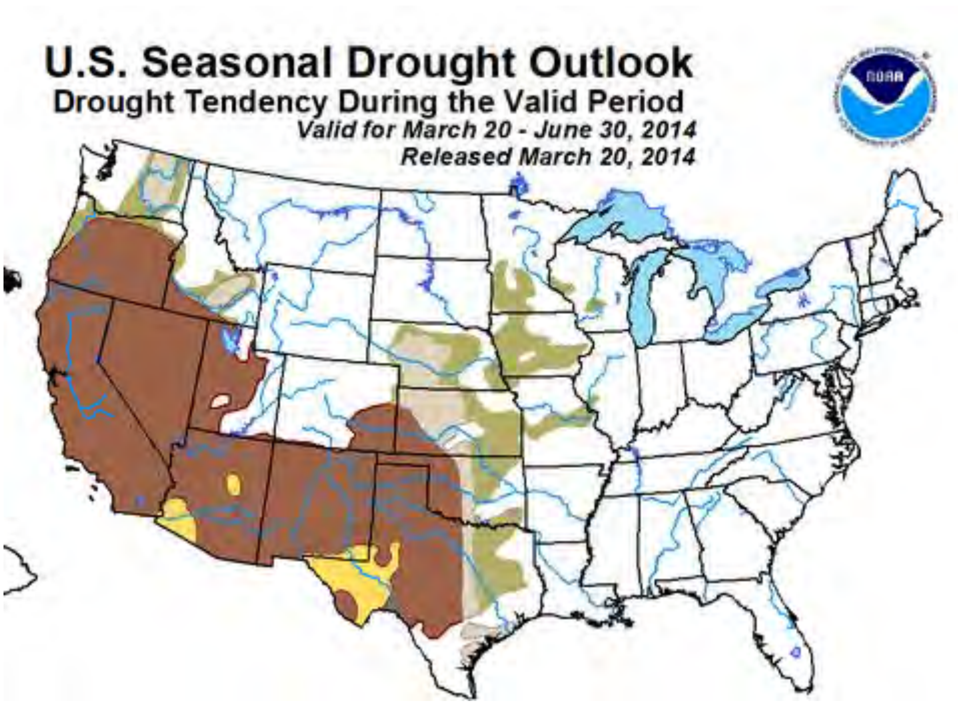

Figure 2. US Seasonal Drought Outlook for period of March 20 – June 30, 2014.

California Drought

The current drought in California exemplifies the impacts of increased temperatures. The state is home to one of the largest water systems in the world, managing 40,000,000 acre feet of water per year. Its various sub-systems serve 38 million people and irrigate 29 million acres of farmland, which in turn produce 11% of the US agricultural output[8]. Given the system's scale and impact, California is extremely sensitive to changing hydrological conditions. 2013 was the driest year since 1849, with current precipitation 76.36% below average precipitation levels. Snowpack on the Sierra Nevada mountain range has been minimal and many reservoirs are at 50% capacity.[9] Infrastructure changes, such as replacing pipes, could save 700,000 acre-feet of water per year from non-visible leaks[10]. This does not even take into account the potential damage from natural disasters. The State Water Project built its last reservoir in 1973, even though the population has increased from approximately 21 million

[7] "Irrigation Water Use," Accessed June 17, 2014, http://water.usgs.gov/edu/wuir.html.

[8] State and Country Quick Facts: California," last revised June 11, 2014, http://quickfacts.census.gov/qfd/states/06000.html.

[9] Bob Henson, California Drying': the outlook for rainfall, water supply, and energy, January 13, 2014, http://www2.ucar.edu/atmosnews/opinion/10879/california-dryin.

[10] Leak Detection, Mar 13, 2010, http://www.water.ca.gov/wateruseefficiency/leak/

to 38 million in the last 40 years and continues to grow[11].

Flash floods in Florida

Precipitation levels are expected to increase because warmer air has higher capacity to hold moisture, approximately 7% more for each additional degree centigrade increase. Since 1901, precipitation rates have increased 0.2% per decade. Scientists cannot predict future patterns of precipitation, however, there is consensus that regions currently experiencing precipitation peaks will become wetter and dry regions will become drier. The increased precipitation will have a tendency to occur in "extreme, one day events" which can put excess pressure on storm water systems and cause flooding[12].

In April 2014, a storm from the Gulf of Mexico hit Florida and Alabama, breaking records for rainfall in the Pensacola area, with 20.47 inches of precipitation over two days. In the two weeks leading up to the storm, the region received 2-6 times the average precipitation for that time of year[13]. The onslaught of rain created sinkholes and damaged roads and homes.

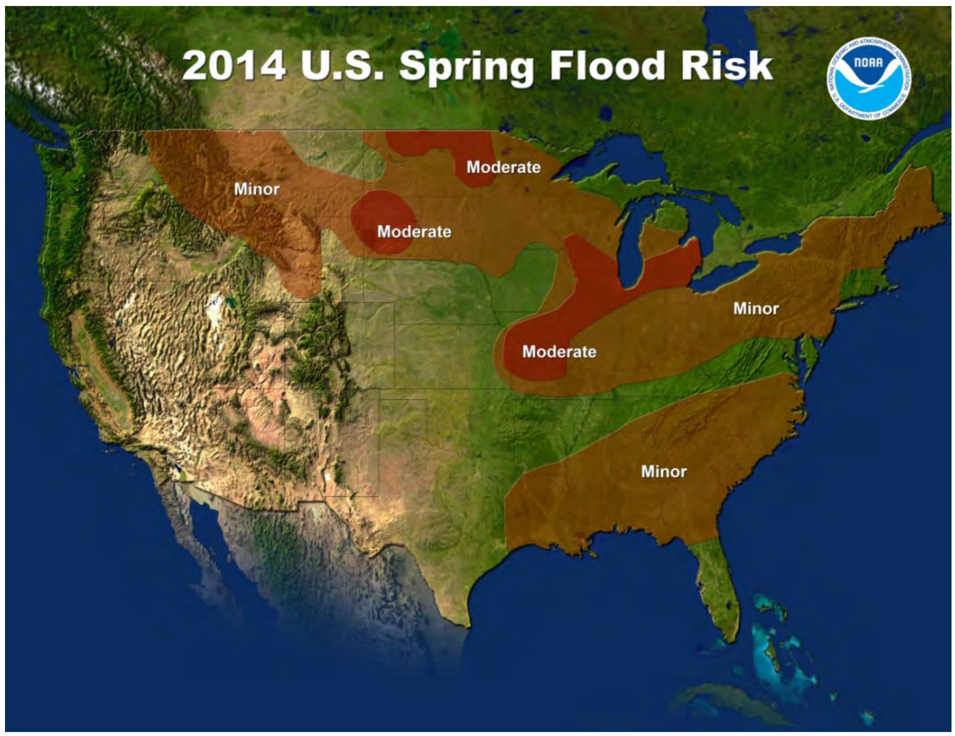

Figure 3: U.S. Spring Flood Risk, National Oceanic and Atmospheric Administration

Pensacola's gutter and storm water system overflowed and caused local water contamination from sewage. Storms such as these are capable of destroying habitats and infrastructure, increasing turbidity, and contaminating

[11] Wayne Lusvardi, Drought could cascade through State Infrastructure, January 23, 2014, http://calwatchdog.com/2014/01/23/drought-could-cascade-through-state-infrastructure/

[12] Climate Change Indicators in the United States, May 29, 2014, http://www.epa.gov/climate/climatechange/science/indicators/weather-climate/index.html

[13] North Central Gulf Coast Historic Flash Flood Event – 29-30 April 2014, May 7, 2014, http://www.srh.noaa.gov/mob/?n=flashflood_04292014.

rivers and coastal regions. Additionally, when heavy rain falls in a city, the impervious nature of paved surfaces prevents replenishment of groundwater resources. Improvements to storm water systems and road surfaces could help cities take advantage of increased precipitation.

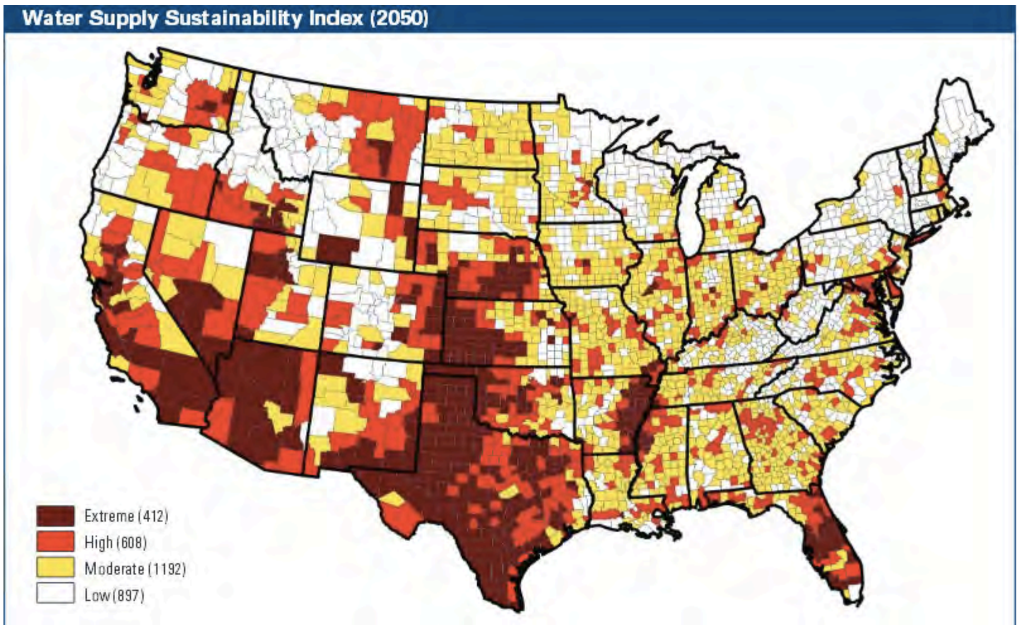

Figure 4: Water Supply Sustainability Index (2050), National Resources Defense Council (2010)

State-wise water risk index

The vulnerability of water systems is impacted in different ways across the country. A study conducted by the National Resources Defense Council rated states in the US according to a sustainability metric based on water demand, susceptibility to drought, groundwater use and projected increase in summer water deficit. The figure below represents the condition of water resources in the U.S. in 2050.

Southern and Southwestern parts of the U.S. face grave risk to water supply systems. States like California, Nevada, Florida, and Arizona have been facing severe drought conditions, and, consequently, severe water shortages. Moreover, almost all regions of the U.S. face moderate to extreme susceptibility to water related risks.

Policy Background

2013 was the driest year in California on record and the drought trend is continuing. [14] As reservoir levels continue to shrink in California, water supply systems are put under increasing pressure to serve the population. This is evident in the graph depicting the current and historical

[14] California Department of Water Resources: http://www.water.ca.gov/waterconditions/, http://cdec.water.ca.gov/cdecapp/resapp/getResGraphsMain.action

reservoir levels for the twelve major reservoirs across California. Positioned all over the state, each one has lost a significant amount of storage volume compared to the historical levels. Two have lost more than 25% while the rest have lost more than 40% to 50% of the historical levels.

In this context of threatened water supply in California, H.R. 765: Water Infrastructure Resiliency and Sustainability Act of 2013 was introduced by California Democratic Representative, Lois Capps on February 15, 2013. It has been co-sponsored by twenty-four of Representative Capps's colleagues, all of whom are Democrats, including seven from California. The Bill has currently been referred to the Committee on Transportation and Infrastructure, as well as the Committees on Energy and Commerce, and the Committee on Natural Resources. Representative Capps previously submitted this Bill in the House of Representatives on August 1,

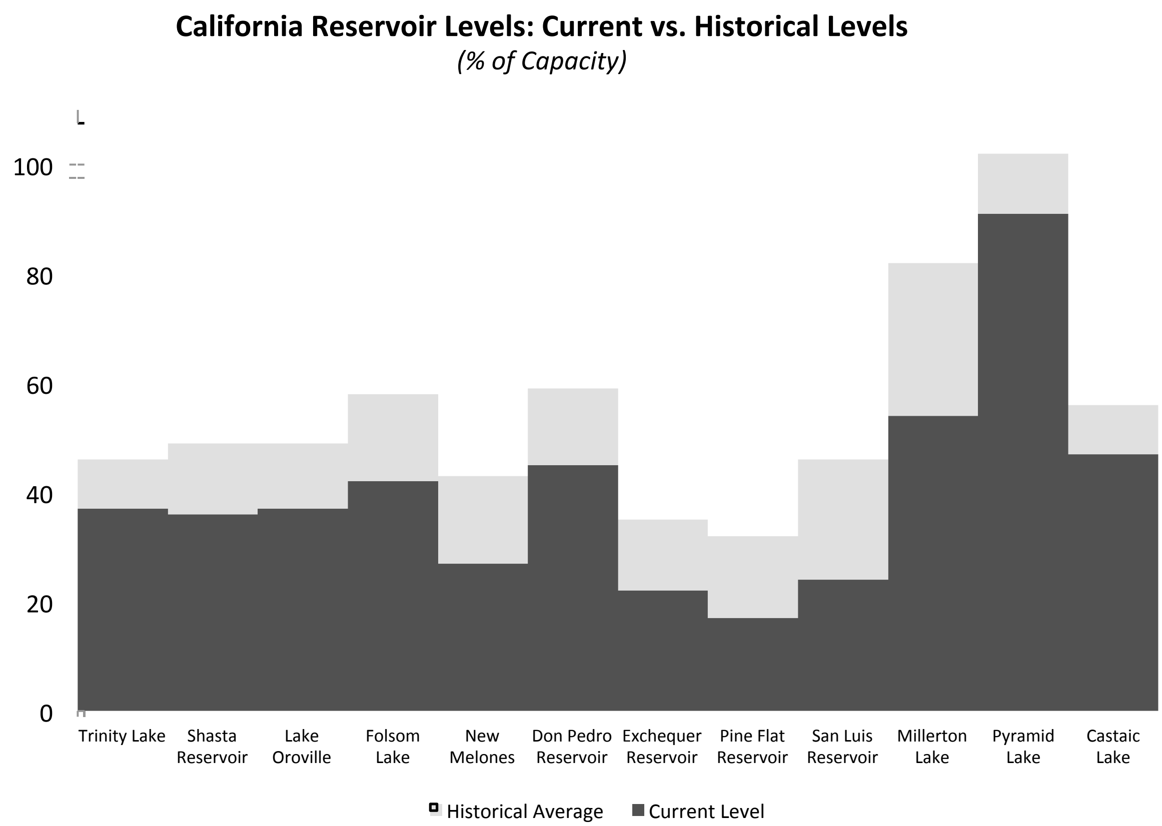

Figure 5: Comparison of historic and current California reservoir levels. Source: California Department of Water Resources

2011, but it stalled due to lack of political support.

The Bill is supported by fourteen national and local organizations, including interest groups ranging from the World Wildlife Foundation to the American Water Work Association as well.[15]

3. H.R. 765: Components of the Bill

The Bill authorizes the EPA Administrator to establish a competitive grants program to fund water infrastructure improvement projects. It grants funds to owners and operators of water systems to increase the resiliency or adaptability of the systems to any ongoing or forecasted changes to their hydrologic conditions. $50,000,000 would be available each fiscal year from 2014 through 2018, whereby the recipients utilize the funds at any stage of the planning, design, construction, implementation, operation, or maintenance of their project[16]. To ensure successful implementation of the program, the EPA Administrator would submit a report to Congress no later than three years after the Bill is enacted and every three years thereafter. This should include information regarding the types of projects that apply, as well as information on the projects that ultimately receive funding. In order to calculate the cost of the improvement plan, the EPA Administrator will report on services that are integral to the completion of the plan and they will not include other amounts that the water system receives from the Federal Government.

[15] Williams Matt. "House Bill Would Help Prepare Water Systems for Climate Change." Association of California
Water Agencies. Feb. 21 2013. Accessed. June 11 2014.
(http://www.acwa.com/news/climate-change/house-Bill-would-help-prepare-water-systems-climate-change).

[16] H.R. 765 Water Infrastructure Resiliency and Sustainability Act of 2013

In light of climate change factors, when granting funding, the EPA Administrator is to prioritize projects by ones facing the greatest and most immediate risk. This should be determined based on the most applicable, up-to-date scientific research available.

In addition, the projects are to meet at least one of the following six goals: 1) Promote more efficient water use, water conservation, water reuse, or recycling; 2) Use decentralized, low-impact development technologies and nonstructural approaches, including practices that use, enhance, or mimic the natural hydrological cycle or protect natural flows; 3) Reduce storm-water runoff or flooding by protecting or enhancing natural ecosystem functions; 4) Modify, upgrade, enhance, or replace existing water system infrastructure in response to changing hydrologic conditions; 5) Improve water quality or quantity for agricultural and municipal uses, including through salinity reduction; 6) Provide multiple benefits, including to water supply enhancement or demand reduction, water quality protection or improvement, increased flood protecting, and ecosystem protection or improvement[17].

One of the main objectives of this grant program is to be a resource for owners (an entity including a regional, State, Tribal, local, municipal, or private entity) of smaller water systems. This can be interpreted by looking at the structure to which the Bill aims to distribute funds. It is stipulated that the share of "the cost of the program, strategy, or infrastructure improvement… shall not exceed 50 percent of the cost of the plans for improvement." (10.16-23). This condition is meant to narrow the scope of the projects. The limited funding available may also deter owners of larger projects from applying to the grant. However they can still apply for a lesser amount to go toward a smaller piece of the project.

One limitation of the amount awarded that is stipulated in the Bill is that no more than 20% of funds may be made available for activities related to reducing flood damage, risk and vulnerability. In other words, the grant is not meant to be a rescue fund. Instead, the money should go toward the strengthening of water systems, not rebuilding after a natural disaster.

Although the variety of projects that are eligible to receive a grant is wide, the Bill also aims to fund a number of proposals that "utilize innovative approaches" while trying to meet the

[17] H.R. 765 Water Infrastructure Sustainability and Reliability Act of 2013

goals of improved hydrologic conditions. These may include more efficient water use, low-impact developmental technologies, reducing storm water runoff and flooding, upgrading or enhancing water system infrastructure, improving water quality or quantity for agricultural use, and providing multiple benefits. [18]

Alternative financial instruments

While many water systems recover costs directly from local ratepayers, significant funds are also provided on the federal level through several subsidized loan and grant programs. The largest federal funds are the Drinking Water State Revolving Fund (DWSRF), which focuses on drinking water quality, and the Clean Water State Revolving Fund (CWSRF), which targets wastewater treatment and natural water resource protection. In recent years, the CWSRF has provided approximately $5 Billion per year, while the DWSRF has provided approximately $1.3 billion per year[19,20]. Specific grant programs exist to address particular water issues, such as green infrastructure installation, watershed management, and pollution reduction. These specialized programs provide funds on the order of $1 billion per year[21]. However, owing to the global recession, these traditional funding programs have suffered major setbacks. The House Appropriations Committee passed a 2013 Bill that curbed EPA's funding by 17% compared to the 2012[22]. Consequently, funding for the Clean Water State Revolving Fund and the Drinking Water State Revolving Fund also went down significantly.

Traditionally, bonds issued by public water utilities have played a big role in financing water infrastructure projects. Previously considered to be one of the safest investment options on the assumption that freshwater will always be abundant, investors are slowly shifting away from water utility bonds because of the increasing uncertainty of water availability[23].

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[18] H.R. 765 Water Infrastructure Sustainability and Realiability Act of 2013

[19] EPA. (2014) Clean Water State Revolving Fund. Retrieved from: http://water.epa.gov/grants_funding/cwsrf/cwsrf_index.cfm, on July 11, 2014

[20] EPA. (2014) Clean Water State Revolving Fund. Retrieved from: http://water.epa.gov/grants_funding/cwsrf/cwsrf_index.cfm, on July 11, 2014

[21] EPA (2014). Catalog of Federal Funding Sources for Watershed Protection. Retrieved from: https://ofmpub.epa.gov/apex/watershedfunding/f?p=fedfund:1, on July 11, 2014

[22] http://www.waterworld.com/articles/print/volume-28/issue-10/editorial-features/show-me-the-money-options-infrastructure-funding.html

[23] http://www.ceres.org/resources/reports/water-ripples-expanding-risks-for-u.s.-water-providers

Stakeholders Affected

Increases in the vulnerability of water supply affect agricultural, industrial, and domestic use. As the third most populous country, with 318,000,000 people, the United States' water supply and usage affects millions of people a day in very different ways. Two of the most populated states, with a population of 38,330,000 in California and 26,450,000 in Texas, have drier, more arid climates and are more prone to experiencing periods of drought. Whereas the top ten highest density states are all along the East Coast, from Florida to Massachusetts, which has an increased risk of flooding and severe storms due to climate change.

Agriculture accounts for a significant portion of the country's water consumption. In 2008, a total of 79,863,524 acres in only 17 states were irrigated croplands. Just five states account for 52% of the total irrigated acreage. Agricultural water comes from a variety of sources, including rivers, streams, canals, lakes, groundwater, and rainwater. Changes in the quantity, quality, and reliability of these sources can dramatically affect food prices and national security.

Industries are major water consumers, with approximately 90% of industrial withdrawals occurring in 23 states. Although industry withdrawals have decreased by 30% since 1985 as

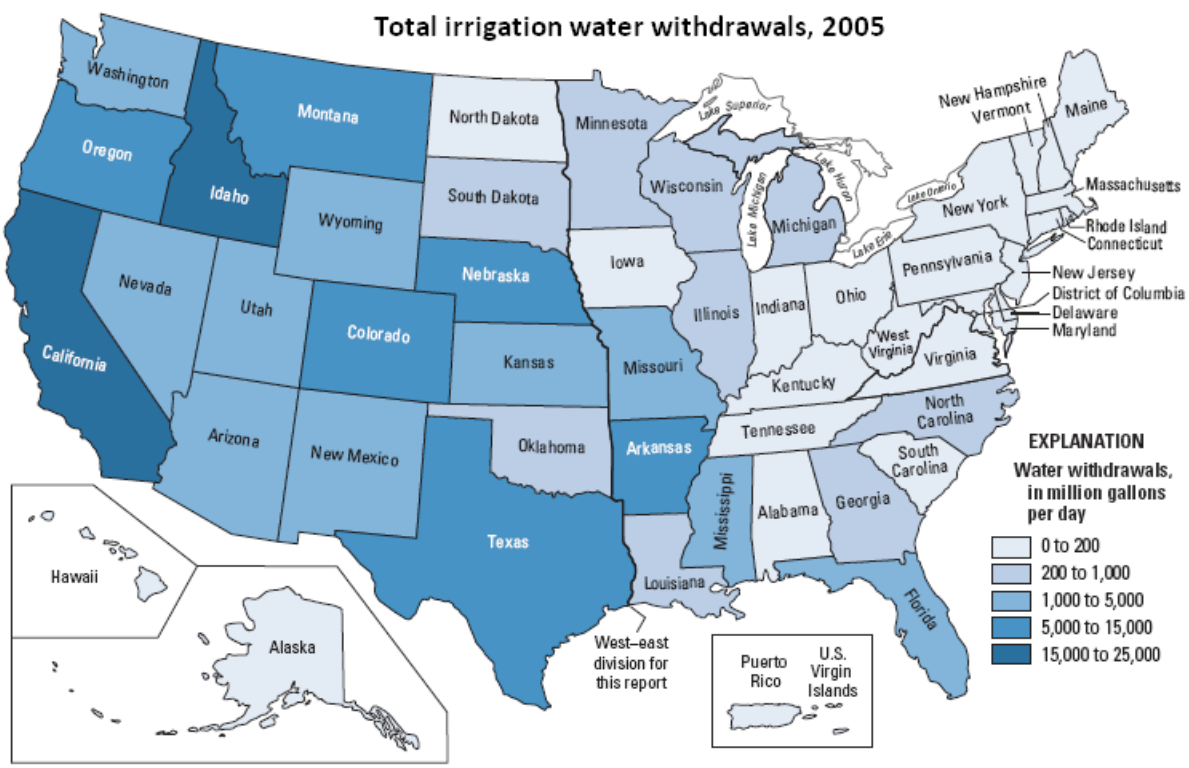

Figure 7: Total Irrigation water withdrawals, 2005: Source: USGS 2014

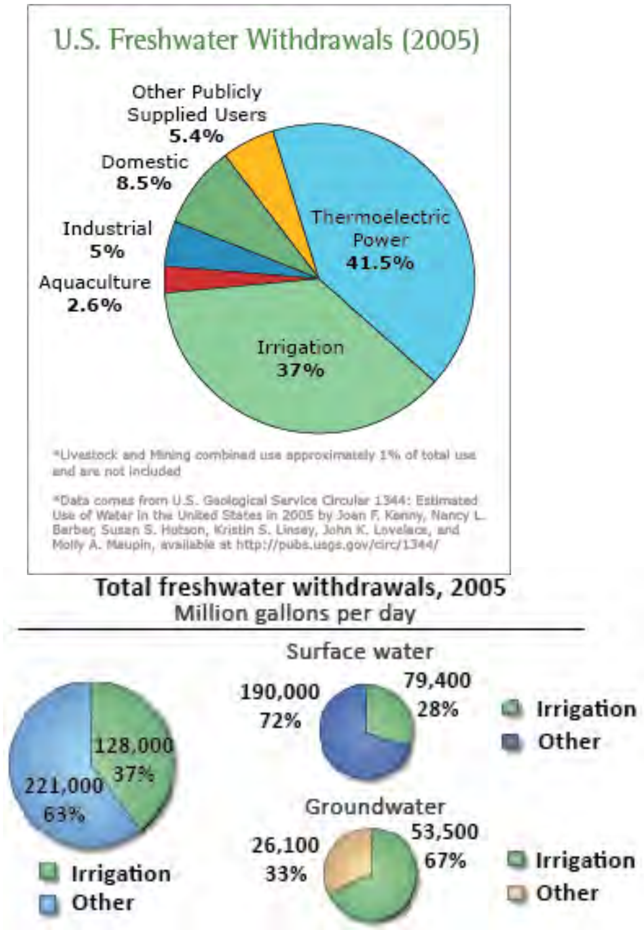

Figure 6: Sector-wise breakdown of freshwater withdrawals in the US. Source: USGS (2005)

manufacturing employment declined by 19%, new industries are beginning to increase usage. Since water is used in many procedures, including fabricating, washing, processing, transporting, cooling it is an essential part of industrial needs. New industries continue to come online every year, like biofuel refining. In order to accommodate all their water needs, alternative water should be considered for use, like waste, saline, or grey water.

Significant problems in water infrastructure also stem from domestic consumers. American homes waste approximately 11,000 gallons of water every year as a result of running toilets, dripping faucets, and household pipes, amounting to more than one trillion gallons of water each year. Increasing population will continue to stress these systems past the point of repair and will ultimately necessitate complete renovations.

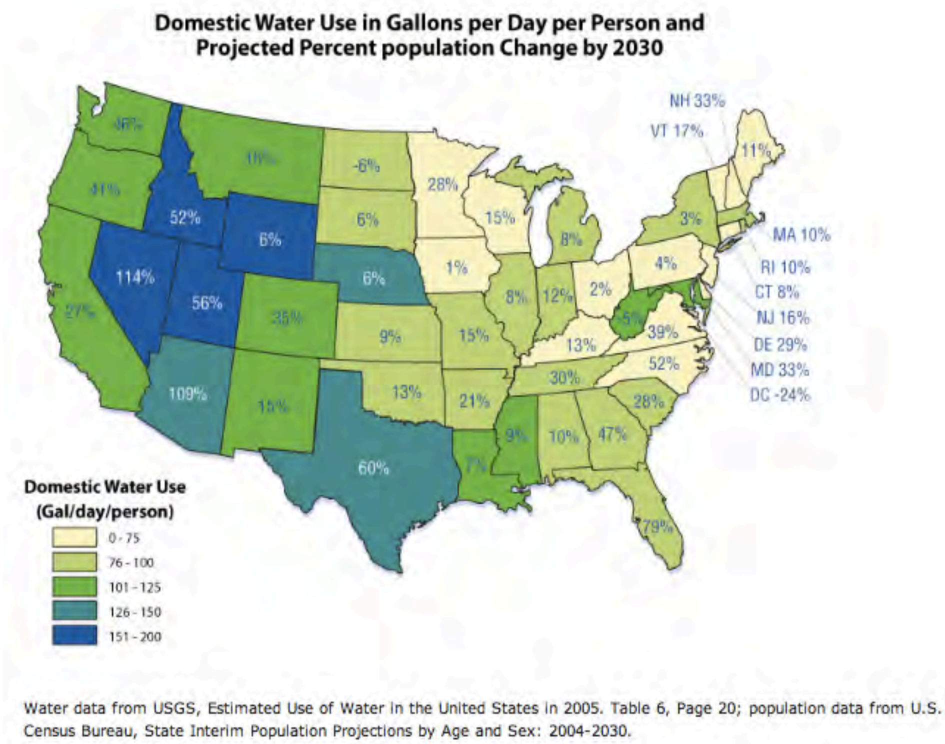

Figure 8: Domestic water use in gallons per day and projected change by population growth by 2030. Source: USGS

4. Supported Projects & Potential Impacts

Supported Projects

H.R. 765 supports a broad range of efforts to improve water systems, many of which do not fit the more traditional idea of a water infrastructure project. Section 1. c) of the Bill provides a list of appropriate uses for funds, including:

- water metering;
- managing, reducing, treating, or reusing municipal storm and waste water;
- constructing desalination plants;
- watershed preservation and protection;
- renewable energy integration in water systems;
- adaptive water pricing policies;
- agricultural water banking;
- floodplain reclamation; and
- water system sustainability modeling.

For ease of classification, supported water infrastructure projects can be grouped into four project categories: natural, technological, structural, and regulatory.

Natural

Natural water infrastructure solutions seek to promote the flow of water by restoring natural ecosystems. This can be accomplished through the removal of manmade structures such as dams or concrete channels, or through the engineering of ‘green’ infrastructure that mimics a natural system.

Technological
Technological water infrastructure solutions seek to complement existing water treatment, distribution, or collection systems by providing automated data collection and system control services, or network optimization solutions.

Structural
Structural water solutions look to improve systems through the upgrading of traditional water systems. Structural water solutions like water treatment facilities, desalination plants, and flood levees can improve hydrologic conditions on large scales, while solutions like porous concrete or upgraded water mains achieve more localized impacts.

Regulatory
Regulatory water infrastructure solutions seek to advance water systems with ‘soft’ measures, taking advantage of the influence that the public sector can have on consumer and private sector behavior. Regulatory projects supported by H.R. 765 are mostly demand side management solutions, such as adaptive water pricing, but can also include supply side management solutions like groundwater banking policies.

Beneficial Impacts
In providing this support, the Bill hopes to create water systems that emphasize decentralization, reduce environmental impact, enhance natural ecosystem functions, and focus on water conservation. These types of projects can have many beneficial impacts on the environment, water infrastructure, and the communities they serve.

Impacts on the Environment
Projects that restore the natural flow of water will both increase green space and take advantage of ecosystem services that enhance water quantity and quality. For example, river restoration projects that replace straight concrete channels with naturally meandering flow paths and riparian wetland buffers will not only offer natural water treatment and flood protection, but also encourage the development of native species that are well adapted to pre-industrialization water levels and flows.

Impacts on Infrastructure
Installation of decentralized infrastructure allows water to be contained and managed within smaller areas. The installation of porous

concrete, for example, reduces urban runoff by retaining precipitation in the subsurface. This redistribution of water reduces the stress of intense rainfall on storm-water collection networks, particularly benefitting municipalities with combined sewer outfalls that discharge raw sewage into water bodies during storm events. Several green infrastructure solutions, such as green roofs and riparian buffers, also serve to mitigate the damaging effects of storms by reducing the magnitude of peak flows during rain events. The concept of retaining water, and slowing its path to a receiving water body, serves to benefit municipal infrastructure by diminishing the effects of flooding which seems to be an increasingly common occurrence in urban areas.

Impacts on communities

Communities will benefit from H.R. 765 in the form of more resilient, reliable and sustainable water systems. Decentralized water infrastructure will improve the ability of municipalities to adapt to changing hydrologic conditions by decreasing the risk of water system failure and allowing for incremental improvements to be made without expensive overhauls of more traditional infrastructure. Projects like gradual installations of porous concrete roadways can help reduce the sediment load to water resources. Natural infrastructure solutions have a multitude of benefits, from the beautification of the community, improvement of local water quality, natural water filtration and nutrient uptake, to the recharge of local aquifers. Water conservation strategies, which can be aided by technological and regulatory solutions, will make community water management systems more sustainable, with incentives for more judicious water use to curb the growth of water consumption.

Deschutes Estuary Restoration

This project proposes the removal of a dammed lake at the mouth of the Deschutes Estuary in Olympia, WA. The restoration of natural estuarine wetland conditions would help reduce sedimentation and eutrophication problems

Fall River Tree Filter Concept Design

The town of Fall River, MA, is currently exploring the development and installation of specialized tree planters that facilitate the collection of rainwater runoff from urban streets.

Memphis smart meter installation

The City of Memphis, TE, has pursued the widespread adoption of smart meters that will monitor water consumption, among other energy uses. Initial studies found that users were more conscious of water consumption, and were able to save on their monthly utility bills.

Sacramento North Area Groundwater Banking

The City of Sacramento is developing a groundwater banking strategy with nearby municipalities to actively manage groundwater recharge through the diversion of water from surface water reservoirs and treatment plants towards aquifers. This allows for water to be transferred without evaporative losses or expensive pipes.

Smaller communities could benefit from local innovation that H.R. 765 grants can incentivize. Municipalities with lower tax bases will be given the opportunity to pursue the same innovative water management strategies that more affluent communities have been able to explore by receiving a source of funds that emphasizes non-traditional infrastructure.

5. Controversies

There are few scientific controversies for this Bill, but individual projects could generate controversy during the planning, design, construction, and maintenance phases. A number of processes have cost-benefit controversies, such as desalination plants. While a desalination plant can provide a very valuable resource in drinking water, it can also damage ecosystems. A particular scientific controversy case study is highlighted below.

Desalination is the process of removing salts from non-potable water sources such as seawater, creating fresh and safe, drinking water. It is a drought-proofed technique and can be implemented at any time of the year. A popular desalination technology is reverse osmosis, which involves the pumping of saltwater through impermeable membranes under extremely high pressure. Although the technology currently accounts for approximately 60% of installed capacity in the nation, it has always been a controversial issue.[24,25]

The recent debate between the Santa Barbara City Council and local environmental groups exemplified the controversies surrounding desalination plants. The plants were originally built in the 1990s in order to solve a water supply crisis in the late 1980's. Since 1991, the city received sufficient freshwater supply and decided to put the facility on constant hold. On February 11, 2014, the city announced a drought caused by three years of below average rainfall and decided to reactivate the plants.[26] The City Council and local energy companies believe that the desalination plants will help the city obtain a new source of high-quality drinking water and reduce reliance on outside water sources. Furthermore, the construction of the plants will deliver an economic boost and create more job opportunities in the city.

However, several local environmental groups and scientists argue that there will be controversies over reactivation of the plants. Highly saline effluent, or brine, would go back to the ocean and damage marine life. Second, the desalination plants consume large amounts of electricity. Third, the project would cost approximately $29 million to

[24] International Desalination Association-An overview http://idadesal.org/desalination-101/desalination-overview/

[25] Feletcher, Jaimee "Controversial H.B. desalination plant seeks final approval" Nov.6, 2013 http://www.ocregister.com/articles/water-534924-project-poseidon.html

[26] Project Status, City of Santa Barbara, Accessed Jul.23, 2014 http://www.santabarbaraca.gov/gov/depts/pw/resources/system/sources/desalination.asp

start and $5 million for annual operation.[27]

6. Program Measurements

Indicators to measure the program could be grouped into four categories: water quality, water quantity, resilience improvement and ecosystem protection. Due to the broad nature of the different solution strategies, the indicators used for measuring success may vary depending on which solutions are chosen.

Indicators of Water Quality

To ensure water quality, the U.S. currently regulates over 90 different contaminants in drinking water. The measurement for water quality enhancement could focus on the concentration these contaminants, which are closely related to both human and environmental health.

- Nitrate is a nitrogen-oxygen chemical unit that combines with various organic and inorganic compounds. Nitrate causes health problems for both adults and infants when present in public or private water supplies in amounts greater than the drinking water standard of 10 milligrams per liter, set by EPA, Therefore, a lower concentration of nitrate presented in water indicates higher quality of water.
- Arsenic, a semi-metal element in the periodic table is linked to cancer of the bladder, lungs, skin, kidney, nasal passages, liver, and prostate when its concentration in water is greater than 0.010 parts per Billion.
- E. coli presence is a good indicator of bacterial level in the water. Its level can be attributed to sewage and animal waste release, which poses many health threats. In addition, since E. Coli produces a powerful toxin that causes severe illness, high presence of E. Coli indicates lower water quality.
- Turbidity measures the amount of suspended particles in water. Low turbidity is associated with healthy water quality, filtration effectiveness, and low presence of harmful microorganisms.

Even though the Bill supports a wide range of projects and the listed indicators above are not case specific, the level of Nitrate, Arsenic, E Coli, and suspended materials are key indicators of water quality of diverse water systems and are closely related to human and environmental health.

[27] "Santa Barbara turning to desal to curb drought" May 20, 2014 http://calcoastnews.com/2014/05/santa-barbara-turning-desal-curb-drought/

Indicators of Water Quantity

To evaluate the improvement of water quantity supplied, the indicators should measure how much more quantity water is supplied by a water facility to satisfy the water demand in a particular region. Therefore, the Satisfaction of Water Demand and Water Availability Data are used as parameters to measure the improvement of water quantity.

- Satisfaction of Water Demand, is calculated based on the data of Total Water Consumed per year. It provides an annual overview of the water demand for any given region. The Satisfaction of Water Demand in the particular region is calculated by applying the Water System Capacity in the region divided by the Total Water Consumed per year. If the value is lower than 100%, it indicates the amount of water supplement from the water system does not match the total water demand in that region. This indicates water shortage for the region.
- Water Availability measures the number of annual water cut down due to natural disasters, such as flood and storm. A lower Water Availability indicates that the water system supplies enough water continuously.

Indicators of Resilience Improvement

In addition to the measurement of water quality and quantity, indicators of measuring resiliency improvement are important in ensuring improved resiliency and sustainability of water infrastructure. Rather than measuring the resilience directly, the data of Annual Non-Routine Water Infrastructure Repair Cost and Rate of Recovery from Environmental Stresses tests can reflect whether the resilience of water systems is improved.

- Annual Non-Routine Water Infrastructure Repair Cost is the total irregular infrastructure repair cost each year, which in turn gauges overall infrastructure resilience. More specifically, a higher Annual Non-Routine Water Infrastructure Repair Cost indicates lower resilience of the water system.
- Rate of Recovery from Environmental Stresses tests if the water system has the capacity to cope with and recover from extreme environmental stresses and shocks including extreme weather events such as storm and blizzard. It also measures how long the recovery takes. A longer recovery time is associated with lower resilience.

Indicators of Ecosystem Protection

Besides engineered infrastructures, this Bill also aims to enhance water management by increasing watershed preservation and protection, through the use of natural infrastructure like restoration and conservation of wetlands. Percentage Covered of Native Plant Species and Average Wetland Buffer Width are two indicators used to measure the success of ecosystem protection.

- Percentage of Area Covered of Native Plant Species is a core indicator of ecological integrity. It focuses on biotic quality, which supplements output quantity measures of wetlands acreage. Higher percentages indicate a more successful wetland conservation or restoration.
- Average Wetland Buffer Width describes the width of the tract of land surrounding a wetlands area, which relates ecosystem health to anthropogenic land use. A greater buffer width from an intact ecosystem, such as a wetland, provides better flood abatement and water filtration of nutrients and sediments.

7. Conclusion

A combination of changing hydrological conditions and aging infrastructure threatens existing water networks. The funding gap to address the challenge of renovating, repairing and innovating water systems is significant. Funding programs like H.R. 765 can go a long way in providing financial support to many different kinds of smaller scale water infrastructure projects. The broad scope of the Bill ensures that a wide variety of projects, with regional and risk-specific parameters will be considered.

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