WESTCAS Issue Paper
Research and Technology

CLIMATE CHANGE

Background

- The West has a variable climate, diverse topography and ecosystems, an increasing human population, and a rapidly growing and changing economy. Western landscapes range from the coastal areas of California to the deserts of the Southwest to the alpine meadows of the Rocky and Sierra Nevada Mountains.
- The climate of the West varies strongly across the region and over time. Historically, the region has experienced exceptionally wet and dry periods. During the 20th century, temperatures in the West have risen 2-5 degrees F (1-3 degrees C). The region has generally had increases in precipitation, with increases in some areas greater than 50%. However, a few areas, such as Arizona, have become drier and experienced more droughts. The length of the snow season decreased by 16 days from 1951 to 1996 in California and Nevada. Extreme precipitation events have increased.
- Since 1950, the region's population has quadrupled, with most people now living in urban areas. Thus, once predominantly rural states are now among the most urban in the country. The economy of the West has been transformed from one dominated by agriculture and resource extraction to one dominated by government, manufacturing, and services. National parks attract tourists from around the world. The region has a slightly greater share of its economy in sectors that are sensitive to climate than the nation as a whole; these include agriculture, mining, construction, and tourism, which currently represent one-eighth of the region's economy.
- As a result of population growth and development, the region faces multiple stresses. Among these are air quality problems, urbanization, and wildfires. Perhaps the greatest challenge, however, is water, which is typically consumed far from where it originates. Competition for water among agricultural, urban, power consumption, recreational, environmental, and other uses is intense, with water supplies already oversubscribed in many areas.

Regulatory Status

There is no regulatory status directly applicable to climate change, although there are many regulatory issues associated with it: water quality standards, endangered species act, reuse, aquifer storage and recovery, storm water capture and reuse, etc.

Current Status of Technology

Models of climate change are large scale and are not reliable for projections in specific areas. Planning to accommodate climate change requires a reasonable idea of the type and magnitude of change that is anticipated.

Research Needs

The West's water resources are sensitive to climate change. The semiarid West is dependent upon a vast system of engineered water storage and transport, such as along the Colorado River, and is governed by complex water rights laws. Much of the water supply comes from snowmelt, and higher temperatures will very likely reduce the snowpack and alter the amount and timing of peak flows. In some places, it is likely that current reservoir systems will be inadequate to control earlier spring runoff and maintain supplies for the summer, but more research is necessary to identify which systems are most vulnerable. It is also possible that demand will increase.

In a wetter climate, the potential for flooding will increase when precipitation comes in more intense events or where total precipitation increases substantially. It is possible that more precipitation would also create additional water supplies, reduce demand, and ease competition among competing uses. Greater runoff would likely increase hydropower production and ease some water quality problems, although it is also possible that there would be more non-point source pollution.

In contrast, a drier climate is likely to decrease supplies and increase demand for such uses as agriculture, urban needs, and power production, thus making water supplies much tighter. Native Americans, among others, are exercising their rights to water, and may do so to a greater extent, further tightening supplies.

- As sea levels rise, entire groundwater flow systems will "back up" -- and data collection and modeling are necessary to develop predictions of:
    - Increased infiltration of fresh and/or saline water into wastewater collection pipes that are located in coastal areas. This would cause problems for wastewater utilities.
    - Changed conditions regarding the stability and safety of structures, including the potential to "float" pipes that do not flow full, and generally to disrupt the geotechnical stability of structures.
    - Stormwater infiltration to the water table may not happen as readily, and thus flooding could occur more frequently, counter to the predicted frequency which was based on higher rates of infiltration.
    - Septic systems would not work as well, with all sorts of ramifications -- including water quality impacts, direct public health problems, and increased need for more energy-intensive WW collection and treatment systems.
- Regarding the effects of rising sea levels on coastal groundwater supplies, there are some important impacts that require "adaptation" as well as increased energy costs:

    - Higher treatment costs, to deliver fresh water through treatment of pumped groundwater of higher salinity.
    - Potential need for relocating water supply wells, with all the associated energy costs (exploration, test-drilling, full-scale installation and testing, etc.).
    - Option for creating a saltwater intrusion barrier (a la SoCal) -- which requires injection wells that would need to be powered for injecting the water (gravity feed is almost always insufficient). This may also trigger requirements for pre-treating the injection water. In addition, roughly half of the injected water would be "lost", with half flowing out to sea and the other half back landward.
- Storage and recovery
- Treatment and reuse
- Climate predictions and modeling and data to support regional predictions
- In considering adaptation mechanisms, it is important to point out that humans have a great ability to adapt to change, while natural ecosystems are likely to be more vulnerable. Some potential adaptation options for human water management in response to climate change and other stresses follow.
    - Increase ability to shift water within and between sectors (including agriculture to urban).
    - Use pricing and market mechanisms proactively to increase efficiency of water use.
    - Incorporate potential changes in demand and supply in long-term planning and infrastructure design.
    - Create incentives or requirements to move people and structures out of floodplains.
    - Identify ways to manage all available supplies, including groundwater, surface water, and effluent, in a sustainable manner.
    - Restore and maintain watersheds (for example, by restoring appropriate vegetation) as an integrated strategy for managing water quality and quantity. Restoring watersheds that have been damaged by urbanization, forestry, or grazing can reduce sediment loads and nutrients in runoff, limit flooding, and reduce water temperature.
    - Reuse municipal wastewater, improve management of urban storm water runoff, and promote collection of rainwater for local use to enhance urban water supplies.
    - Increase the use of forecasting tools for water management. Some weather patterns, such as those resulting from El Niños, can now be predicted with some accuracy, and this can help reduce damages associated with extreme events.
    - Enhance monitoring efforts to improve data for weather, climate, and hydrologic modeling to aid understanding of water-related impacts and management strategies.

WESTCAS Focus

A fundamental goal of WESTCAS is to encourage and support research to meet the needs of member utilities. Climate change and the approaches for understanding it and dealing with its impacts are critical to the arid states of the Southwest. WESTCAS can play an important part in

helping water and wastewater agencies prepare for the impacts of climate change by focusing on the following activities.

- Support funding for data collection and modeling for more accurate regional and local effects of climate change on water resource management.
- Provide education at conferences on the impacts of climate change in the Southwest.
- Support research on water reuse and conservation.
- Provide examples of approaches being used by other utilities to plan for the uncertainties resulting from climate change and resulting diminishing water supplies compounded by the current global financial crisis.