American Water Resources Association
2009 SPRING SPECIALTY CONFERENCE
Managing Water Resources Development in a Changing Climate
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Wednesday, May 6
1:30 PM – 3:00 PM
Session 32: Changing Water Demand and Uncertainty I

1. Potential Impacts of Climate Change and Population Growth on U.S. Water Supply and Demand in the Next 50 Years - Ge Sun, USDA Forest Service, Raleigh, NC (co-authors: Steven G. McNulty, Jennifer A. Moore Myers, Erika C. Cohen, Robert Herring)

Climate change and population growth have been widely regarded as the major threats to water resources in the 21st century in many regions of the U.S. We believe that water shortages must be addressed from both the supply and demand aspects, both of which are highly variable in space and time at the national scale. The overall goal of this study was to improve current water stress forecasting to better inform water resource policy makers, and the public about when and where potential water shortages might occur. We developed a series of models that calculate water supply and demand to create a Water Supply Stress Index (WaSSI). Water availability at the USGS 8-digit hydrologic unit code (HUC) scale was estimated by a monthly water balance model that accounts for climate, landuse/landcover, groundwater withdrawal, and return flow from all water sectors. Seasonal human water consumption was estimated using historic water use data, as reported by the USGS or state water bureaus. Climate change scenarios were applied to examine the sensitivity of evapotranspiration and water yield on future climate change at the regional scale. We present modeling results on the combined effects of climate change and population growth on water stresses across the lower 48 states in the next 50 years. We will also discuss how forests and forest management can play a role in responding to water shortages under a changing climate and urbanizing environment.

2. Estimating Water Use in El Paso County Texas Based on GIS and Remote Sensing Imagery for the Past 30 Years - Jiao Wang, Texas State University, San Marcos, TX (co-author: Nate Currit)

Water is one of the most important resources for all aspects of human life. Water use is affected by many factors including population growth, economic development and climatic change. A more accurate and reliable water use data set is essential to the municipal government in its policy making related to water use planning, especially in those area where water is a scarce resource. El Paso county, Texas lies in an arid region with an average annual rainfall of only about 8 inches. Its fast growing population and dry climate have placed more pressure on its water use situation in the past few decades. Water use in El Paso county could be categorized into domestic supply, industrial and agriculture irrigation demand. Water use data used to be reported by withdraw source or public suppliers, which only shows the amount of water being used but is not effective in estimating where water is being used . GIS and remote sensing technology have been utilized in a broad range of applications including population distribution and land use classification. In this study, dasymetric mapping method was applied on 3 sets of Landsat imagery for the past 30 years to distribute population based on block group level census data, which improved the accuracy of population density. Land use and land cover data was derived from Landsat imagery to provide the size and location of agriculture area for estimating demand of irrigation. Water use for the past 30 years in El Paso county was then estimated based on the method mentioned above. The results showed that water use has been rising with the population increase, especially in those areas which were rural area and changed into urban land due to the city sprawl. Future water demands could be predicted with knowledge of the trend of land use and land cover transition and population growth. This paper provides an alternative way combining GIS and remote sensing to estimate water use which is more efficient and detailed compared to traditional methods.

3. Management of Water Resources under Uncertainty in a Changing Climate - E. Annette Hernandez, Texas Tech University, Lubbock, TX (co-author: Venkatesh Uddameri)

Lake Meredith, located in the southern High Plains of Texas, has historically provided 70% of the total water needs to the 11 member cities dependent on it for water supply. The lake is fed by the Canadian River and was created as a means of storing water for immediate water supply as well as during periods of drought. Consequently, the quantity and quality of the water in the lake is of great importance to those cities

dependent upon it. Besides the natural processes that tax the water resources of the Lake, the area is also inundated by salt-cedar which utilizes enormous amounts of water. The member cities have begun to supplant this main source of water with groundwater. If the current level of use is maintained, the groundwater supplies should last another 100 years. However, if lake levels continue to drop, groundwater sources will be further tapped and projections will be minimized. In this case, other sources of water shall have to be found. Therefore, for planning purposes, it is important to completely understand the processes occurring in the Lake Meredith region. Previously, correlations were made between lake levels and other factors such precipitation and evapotranspiration, the effect of climate change upon this important water source has not been fully studied. Therefore, a holistic assessment of climate change on Lake Meredith was attempted using copula theory to link rainfall, temperature, stage height, and water levels. This resulted in a probabilistic assessment of the uncertainty of the impact of climate change on the water quantity associated with Lake Meredith. While predicting exact future Lake volume is unrealistic, planning scenarios and conservation efforts are more acceptable when uncertainty is explicitly defined. Ultimately, the subjectivity inherent to inclusion of decision maker ideas and opinions has the largest influence on the course of resource management; however, this work provides additional information so that a more sustainable solution can be reached.

4. Climate Change and Adaptive Drought Operations Planning in Water Supply - Steve Thurin, HDR Engineering, Bellevue, WA (co-author: Emily Larson Flanagan)

The Central Utah Water Conservancy District (CUWCD) is responsible for providing and maintaining a reliable supply of water to its many wholesale and retail customers, as well as meeting strict minimum flow criteria to protect endangered species. This responsibility includes the need to understand the risk to its supply due to climate change or variability. The reliability of the District's diverse and hydrologically-variable water supply is strongly affected by seasonal, annual, and decadal changes in the volume and/or timing of precipitation, snowmelt, and runoff on the watersheds above the District's five primary storage reservoirs. Temperature and precipitation changes on the same scales may also affect water users' demands for District water, increasing or decreasing needs by a factor of 50 percent or more. Based on recent trends in weather data and projections from large-scale computer models of meteorological systems, many experts predict that certain significant climate changes are likely to occur over the next 50 to 100 years. In the project area these predictions suggest that temperatures may be 3 to 6 degrees warmer and that seasonal precipitation may decrease by 10 percent. Whether or not these predicted changes occur, and whether they affect District watersheds, a better understanding of the influence of hydro/meteorological variations on its water supply reliability will be valuable to CUWCD personnel. A two-part study is being performed. The initial study is a focused, needs-based analysis of the risk to CUWCD water supply reliability from climate change. The subsequent operations planning study examines the interactions between hydrology, demands, and supplies. The goal is to predict how CUWCD should best operate, in the face of hydrologic variation and climate uncertainty. The study results will be used by CUWCD to develop predictive supply indicators and drought operations plans to meet future needs despite variable hydrology and the possibility of changing climate.