Philadelphia Case Study on Climate Adaptation

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Background/Objectives. The Philadelphia Water Department (PWD) is located at the confluence of two large rivers, the Delaware and the Schuylkill. It is subject to several climate change risks, such as flooding due to extreme precipitation, sea level rise and storm surge, as well as potential temperature-related impacts to the quality of their source of drinking water. To better understand the risks, PWD created a Climate Change Adaptation Program in 2014. The now seven-year effort started with a survey of vulnerabilities to PWD assets, followed by an intensive four-year period of analysis of climate change impacts. The intent was to understand and make actionable the projected changes to temperature, precipitation, and sea level rise/storm surges.

Approach/Activities. Global Climate Model (GCM) data need a significant amount of analysis to become actionable on a municipal or utility scale. In this case, PWD developed several unique tools and approaches to assess extreme rainfall and the combined effects of sea level rise and storm surges. One innovative approach was to take downscaled daily precipitation from GCMs and transform it into a realistic set of future hourly time series, providing key inputs for both stormwater design and hydraulic/hydrologic models. The approach uses GCM projections, scaled by season and storm size, to transform current rain gage hourly or sub-hourly time series to future hourly or sub-hourly precipitation time series. To explore future precipitation variability, a weather generator was developed that can explore precipitation variability on any time scale and develop statistical profiles of potential future precipitation conditions. Finally, to address the impacts of sea level rise on storm surge related flooding along the Delaware River, PWD developed a Changing Flood Frequency Tool designed to provide a rapid and inexpensive assessment of current and future flooding potential for assets located on the tidal Delaware River. The tool uses the elevation of a particular asset or location to calculate the risk of flooding between the current period and 2100 based on asset elevation, storm surge probabilities, and sea level rise, providing a year-by-year return interval for storm surge for different sea level rise scenarios, as well as a cumulative risk of flooding over the projected useful life of the asset.

Results/Lessons Learned. The ultimate application of the tools, analyses and insights gained from the intensive evaluation of climate change projections was the development of a Climate-Resilient Planning & Design Guidance document. The document provides guidance for planners and engineers on what climate change projections to consider when planning new projects, performing environmental analyses, retrofitting existing assets or building new assets. The Guidance document includes assessment of risk and probability of coastal flooding, projections of extreme temperature, and expected changes to extreme precipitation. For extreme rainfall, the guidance provides future design storm intensities for a complete range of storm durations and return periods. For coastal flooding, the Guidance includes information on adaptive planning practices, flexible planning, as well as a design flood elevation that accounts for sea level rise and storm surges through the end of the century. The Guidance now provides PWD with the tools and information necessary to incorporate climate change risk in the planning, design, and operations of their drinking water, wastewater, and stormwater systems.