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WATERSHED SCIENCE BULLETIN

AWSPs
Association of Watershed & Stormwater Professionals

Journal of the Association of Watershed & Stormwater Professionals

A program of the Center for Watershed Protection, Inc.

Integrating Climate Change Science into Watershed and Stormwater Management

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MISSION: The mission of the *Watershed Science Bulletin* (the *Bulletin*) is to synthesize research and experience from the numerous disciplines that inform watershed management and transmit this valuable information to researchers, regulators, practitioners, managers, and others working to protect and restore watersheds everywhere.

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Cover photo courtesy of Lori Lilly, Watershed Ecologist / Planner, Center for Watershed Protection
This photo was taken along Young's Bay estuary in Astoria, OR. The Young's Bay estuary is a component of the Columbia River estuary, a nationally significant estuary in the northwest corner of Oregon that supports some of the largest anadromous fish runs in the world and provides unique habitat for sensitive and endangered species.

harsher weather and rising waters, creek by creek, acre by acre, neighborhood by neighborhood? Allow me to channel Mr. Luntz and provide some practical advice: If you want to build public support for stream restoration, erosion prevention, or polluted runoff reduction, it is more important for you to stress the traditional benefits of this work—clean water, improved flood safety, and a home for wildlife—than the need to prepare for climate extremes or the historical rationale for your efforts, such as floodplain development and channelization.

List of Sources

Google. No date. Google trends. http://www.google.com/trends

For More Information

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This vignette was prepared by Eric Eckl, founder of Water Words That Work, LLC, a marketing agency that helps nature protection and pollution control organizations professionalize and modernize their communications.

Oyster River Culvert Analysis Informs Coastal Climate Change Adaptation

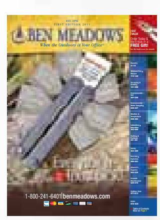
Many coastal communities in the eastern United States are experiencing an unusual and persistent increase in heavy and extreme storms that is generally consistent with climate change projections. Existing drainage systems were not designed to safely pass the volume of water resulting from these events, and new systems still are being designed using 50-year-old standards. As a result, there is an increased likelihood that drainage components will fail, damaging infrastructure and property, causing loss of life, and degrading both fluvial and estuarine aquatic ecosystems. However, published adaptation research and planning guides remain typically characterized by general resilience building or regional vulnerability studies.

On October 5th, 2010, the White House Council on Environmental Quality issued its *Progress Report of the Interagency Climate Change Adaptation Task Force*, one of the key findings of which is that the federal government must "…promote and implement best practices for adaptation…."[1] A recent study by a team in New Hampshire is helping to actualize these goals. The Oyster River Culvert Analysis Project assessed the capacity required for a coastal watershed's stormwater drainage system to accommodate mid-twenty-first century climate change and population growth. This study delivered results in a form understandable to, and usable by, planners, resource managers, and decision makers. The project was performed by Syntectic International, led by Latham Stack and Michael Simpson, under contract to the Piscataqua Region Estuaries Partnership. It was one of six pilot projects selected nationwide for funding under the US Environmental Protection Agency's Climate Ready Estuaries Program. The study estimated adaptation costs, developed methods for managing uncertainty, and examined the capacity of nonstructural methods such as low-impact development (LID) to mitigate climate change impacts. The project

[1] US Council on Environmental Quality, Progress Report of the Interagency Climate Change Adaptation Task Force: Recommended Action in Support of a National Climate Change Adaptation Strategy (Washington, DC: Council on Environmental Quality, 2010), page 8.

challenged the validity of the commonly held assumption that climate model output is too uncertain to support reliable, quantified, and actionable information for local-scale adaptation needs.

For this project, a multidisciplinary team used conservative, well-established analytical methods. The team computed runoff using the *curve number* method and modeled current and projected culvert capacities using standard civil engineering formulas. To project population growth, they performed a build-out to current zoning standards. They estimated future precipitation using state-of-the-art statistical methods and output from the highly-regarded Geophysical Fluid Dynamics Laboratory 2.1 coupled-climate model. The team used a statistical downscaling method, validated against historical rainfall records. They projected mid-twenty-first century precipitation amounts for two greenhouse gas emissions trajectories: the optimistic (A1b), and the pessimistic (A1fi) scenarios. They developed an achievable LID scenario that would maintain, on each building site, 25 mm (1 in) of the precipitation falling on impervious surfaces. The team estimated replacement and upgrade construction costs, and the resulting impact on town budgets and property tax burdens.



Key findings include the following:

- Of the watershed's culverts, 5% are already undersized for the 1971–2000 rainfall pattern, and 32% have impaired conditions that reduce flow capacity.
- The mid-twenty-first century design storm is estimated to be 35% and 64% greater, for optimistic and pessimistic climate change scenarios, respectively, than that historically used for specifying drainage systems. What historically had been a 1-in-25-year (i.e., a 4% probability) storm is projected to become a 1-in-7.5-year event. And what had historically been a 1-in-150-year storm is projected to become a 1-in-25-year event.
- Of the culverts in the watershed, 17% and 28% probably will be undersized by mid-twenty-first century, for optimistic and pessimistic climate change scenarios, respectively.
- Watershed-wide, the cost of upsizing at-risk culverts is estimated to be 9% greater than the cost of replacing all culverts with ones of identical size at the end of service life. Spread over a 30-year period, this adds 0.02% to annual town budgets. Preparing a community's drainage system for climate change is estimated to cost 65%–80% less than repairing damage to road–stream crossings that results from undersized culverts.
- Uncertainty in climate model output is not an obstacle to adaptation. For culverts in the watershed, 65% are projected to be adequately sized even for the upper 95% confidence limit of the pessimistic climate change scenario. Adapting the watershed's drainage system for pessimistic climate change costs only 5% more than adapting for an optimistic expectation, so incorporating a safety margin to accommodate uncertainty carries little penalty. Because of the discrete sizes of premanufactured drainage components, an upgrade for a culvert undersized for optimistic climate change generally will provide adequate capacity for the most-likely pessimistic climate change conditions.
- Most culverts projected to be undersized are on rural, low-traffic roads; as a result, the risk from failure of these components is lower than if failure occurred in highly-populated neighborhoods or high-traffic roads.
- A practical and politically palatable LID standard can significantly mitigate the impacts of optimistic, but not pessimistic, climate change. For the study site, under optimistic climate change impacts LID can reduce the number of culverts requiring upgrading by 25%–100%. However, as rainfall becomes more extreme, the goal of maintaining on-site 25 mm (1 in) of rainfall on impervious surfaces becomes less significant. Under pessimistic impacts, LID reduces the number of culverts requiring upgrading by only 5%–8%.

This study makes a significant contribution to climate change adaptation of estuaries and coastal watersheds by proposing a simple yet reliable model capable of generating specific estimates of civil infrastructure vulnerabilities. These results may be of interest to planners, resource managers, stakeholders, and decision makers, as they consider preparing for predicted increases in rainfall intensity and watershed runoff. The authors hope that this work will increase awareness of the need for, and practicality of, climate change adaptation.

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For More Information

A copy of the project report can be found at http://www.prep.unh.edu/resources/pdf/oyster_river_culvert-prep-10.pdf. Or contact Latham Stack at lstack@syntectic.com.

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