Cornell University

New York State
Water Resources Institute

Masters of Engineering

Biological and Environmental Engineering
Cornell University

Stormwater Infrastructure: Flood Risks and Ecological Connectivity

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Ecohydrology Group, Soil and Water Lab

Background

Flood risks in the northeastern US are an acute and growing concern. Widespread flooding from recent hurricanes Irene and Lee as well as Super-Storm Sandy have garnered national and international attention. However, many more localized flash flood events have peppered the region with perceived increasing frequency. Projections of more frequent large or high intensity rainfall events, combined with expanded development of currently rural landscapes, suggest the flood risks will continue to escalate.

Stormwater systems are integrated into our landscapes to protect property and infrastructure from storm runoff and flooding. However, many aspects of current stormwater systems are either not well designed or were designed under a suite of assumptions or conditions that no longer exist, e.g., past climate, historical land use, etc. For example, road culverts are commonly too small to convey the peak runoff from storms that occur, on average, as frequently as every five years.

In addition to being commonly undersized, some stormwater infrastructure, especially culverts, constitute barriers to aquatic organisms.

It is important to analyze the state of our current stormwater infrastructure with respect to flood risks and aquatic ecology in order to prioritize the distribution of limited funds for upgrading stormwater systems.

Project Summary

Students will work in teams to collect stormwater infrastructure data and analyze the existing capacity of the system. Stormwater infrastructure refers to road culverts but may also include road ditches, stormwater catch basins and pipes, stormwater retention structures, and green infrastructure (e.g., bioswales). The capacities through the stormwater system will be compared to estimates of storm runoff under recent and projected climate conditions as well as current and projected land uses. All data and analyses will be incorporated into a regional database for use by communities and municipalities in prioritizing stormwater upgrades. In addition, a final report will be prepared for each watershed-based team and uploaded to the Internet.

Students will also receive formal training in the North Atlantic Aquatic Connectivity Consortium (NAACC) protocols for assessing potential aquatic barriers. These protocols will be used in field data collection and the data will be added to the regional NAACC database. Some students may choose to develop a project that utilizes these data.

Students are welcome to propose additional analyses including:

- The potential influences of green infrastructure on flood risk reduction
- Novel alterations to existing stormwater infrastructure to reduce flood risks
- Development of apps or online tools for uploading, accessing and/or manipulating project data
- Development and carrying out of simple analyses, e.g., size of a culvert for a particular landscape position and risk

Program Outcomes

- Hands-on experience in hydraulic analysis of stormwater systems
- Introduction to surveying and field-data collection
- Introduction to the use of GIS in hydrologic and hydraulic analyses
- Formal training in aquatic connectivity assessment
- Opportunities to work directly with agencies, communities, municipalities and other organizations interested in stormwater risk assessment and/or aquatic habitat protection
- Expertise in hydrology, water resources engineering and management, and associated computational tools via course work and applications to the Masters of Engineering Project
- Ability to prepare a professional engineering report
- Expansion of the regional databases on stormwater infrastructure

Suggested Courses (e.g., choose at least two from each group)

Hydrology and Aquatic Ecology

CEE 4320/632	Hydrology
BIOEE 4560	Stream Ecology
BEE 4710	Groundwater
CEE 6330	Flow in Porous Media and Groundwater

Water Resources Engineering and Management

BEE 4730	Watershed Engineering
BEE 4740	Water and Landscape Engineering Applications
NTRES 3240/6940	Ecological Management of Water Resources
CEE 5980	Introduction to Decision Analysis
CEE 6200	Water Resources Systems Engineering

Applied Computational Tools

CSS 4200	Geographic Information Systems
CEE 4110	Applied Remote Sensing and GIS for Resource Inventory and Analysis
CEE 6100	Remote Sensing Fundamentals
NTRES 6700	Spatial Statistics

For More Information

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