ALTERNATIVE FUTURES FOR HEADWATER STREAM AND WETLAND LANDSCAPES IN THE UPPER DELAWARE BASIN, NEW YORK, USA

Background: From September 2004 to June 2006, flood events of national significance (i.e., federally and state declared disaster areas requiring millions of dollars in federal and state flood aid) occurred within the Upper Delaware Basin of New York (Delaware River Basin Commission, 2007a). The lower portion of the watershed is approximately 120 miles northwest of New York City. In particular, Sullivan and Delaware counties of New York experienced property damage, loss of life, streamside erosion, and degraded water quality, which affected downstream river and estuary areas. It is predicted that flooding will continue to occur frequently within the watershed (Delaware County, 2006). Flood events may have adverse impacts on the New York City's municipal water supply watersheds, which are in the same geographic area as the Upper Delaware Basin. Degradation of stream resources may also limit recreational uses such as fishing. In addition to flood events, future urban growth is expected for the Upper Delaware Basin, particularly in Sullivan County. Existing and future urban growth management needs to consider ecosystem services of the watershed, specifically to identify and evaluate existing flood storage and water quality maintenance, and preserve and enhance these functions. Ecosystem services also need to be identified for probable future landscape conditions and whether or not there will be sufficient levels of the services for human based needs. Headwater streams and wetlands are important in providing the aforementioned ecosystem services.

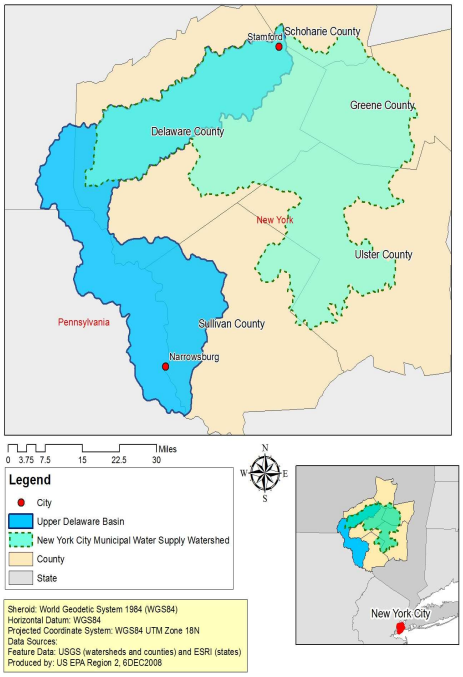
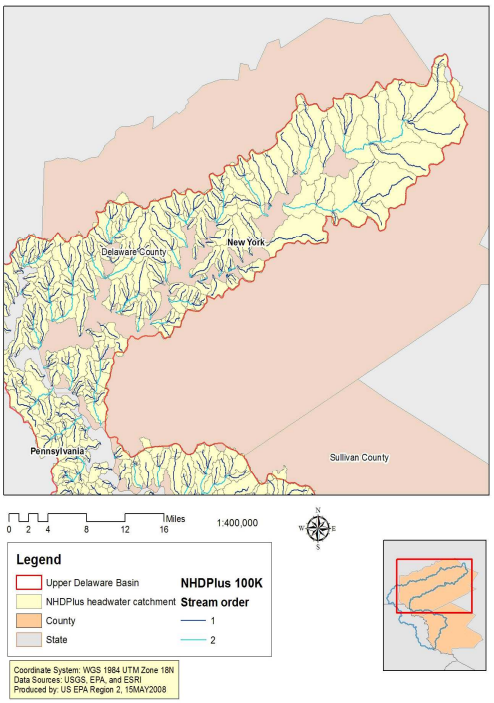


Figure 1: Upper Delaware Basin: Watersheds and Counties

Project Description: To understand the existing levels of ecosystem services provided by wetlands and headwater streams within the watershed, a landscape analysis of flood storage capacity and water quality maintenance contributions of wetlands and streams for the Upper Delaware Basin was completed. Analyses included: 1) identification of aggregated headwater stream networks, 2) watershed-based preliminary assessment of wetland functions (W-PAWF), 3) stream corridor condition assessment, using a GIS-based Streamside Health Model (Meixler, 2003), and 4) wetland storage capacity derived from stormwater monitoring of New York City Department of Environmental Protection reference wetlands and stormwater modeling using the Natural Resources Conservation Service's (NRCS) TR-55 and TR-20 models.



The EPA Region 2 GIS server provided a portion of the datasets used (NHDPlus and NHDinGeo 1:24 K for the Region 2 map extent), while other online sources supplemented desired data needs (NHDPlus, NHD, US Fish and Wildlife Service National Wetlands Inventory, etc.). The primary GIS software resource was ArcGIS 9.2, including ArcMap and ArcCatalog. Other ArcMap extension tools employed included XTools Pro Version 5.0.0 and DigitalGlobe Image Server.

Figure 2: Upper Delaware Basin: 1:100K Headwater Stream Network Base-Map

Baseline stream analysis included headwater streams (1st and 2nd order) and catchments from the NHDPlus (1:100 K) dataset; and intersecting line-work from NHDinGeo. Combined USGS National Hydrography Dataset (NHD) and NYCDEP 1:24 K flowlines characterized 81% (1,745.4 stream miles) of the total stream network as headwater reaches. The results of the wetland assessment prioritized US Fish and Wildlife Service National Wetland Inventory wetlands for conservation, preservation, and protection based on predicted high or moderate performance values for surface water detention, nutrient transformation, and nutrient and particulate retention. Most NWI wetlands were predicted to have moderate or high values. Streamside condition results prioritized degradation potential of NHD 1:24 K headwater streams using adjacent land-cover types ranging in the degree of human induced disturbance. Seventy six percent of headwater stream reaches are predicted to be in excellent or good condition. The remaining 24% of stream corridors are predicted to be in fair to poor conditions. Estimates of stormwater storage capacity of NWI wetlands within a typical rural and urban headwater catchment (NHDPlus) were derived for a one year (prior dry conditions) and a one hundred year (prior wet conditions) storm event. Results show that there is an estimated deficit of flood storage capacity from existing wetland resources.

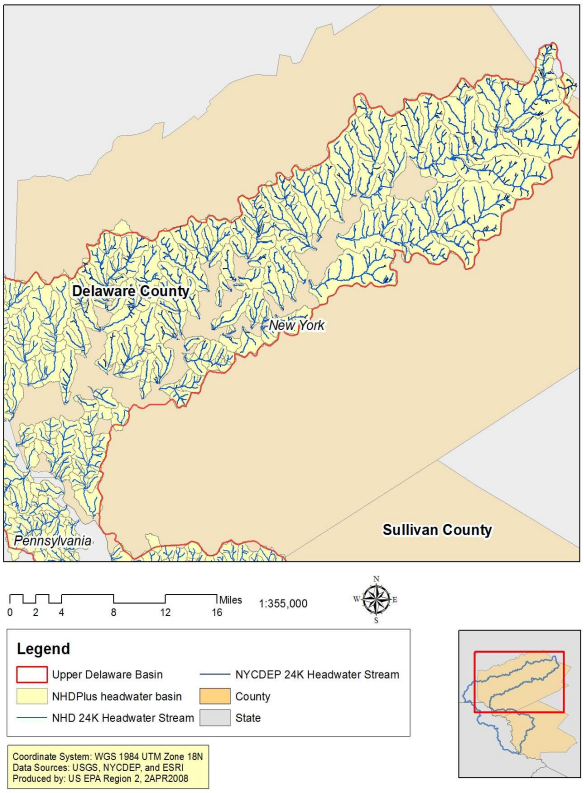


Figure 3: *Upper Delaware Basin: Watersheds and Counties*

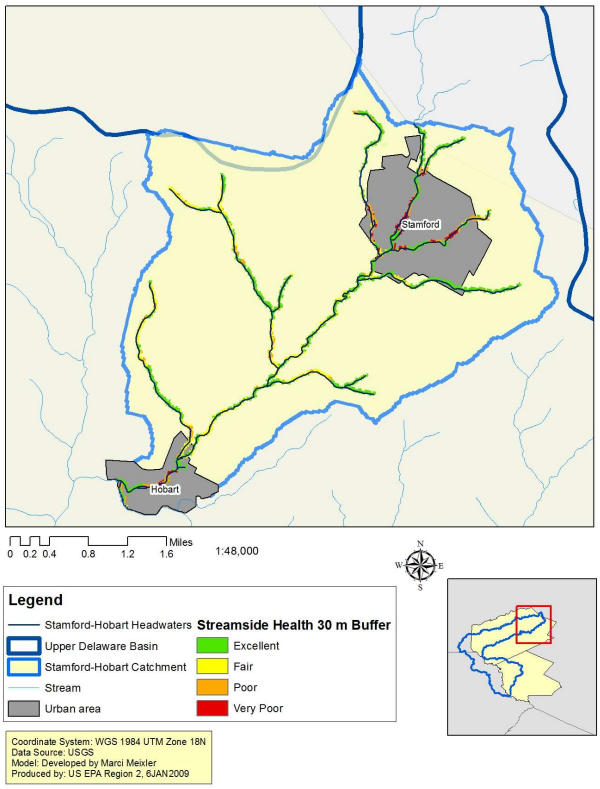


Figure 4: *Streamside Health Assessment Model: Upper Delaware Basin, Stamford-Hobart Headwater Catchment, Delaware County, NY*

Ecological, hydrologic, and urban growth analyses provided necessary information for selecting appropriate conservation designs for stormwater best management practices (BMPs); including buffered and restored wetlands and riparian corridors, natural stream channel design, bioswales, resized culverts, pervious surface technologies, and compact development. The economic costs of surface water detention provided by existing wetlands within typical urban and rural headwater catchments were derived from the predicted monetary costs of constructing new stormwater storage capacity with stormwater BMP retrofits. The costs of existing surface water detention ranged from approximately $12.7 – $151.4 million dollars. Federal monetary aid provided for flood damages and losses was compared to the predicted costs of existing surface water detention services provided by wetlands within headwater catchments.

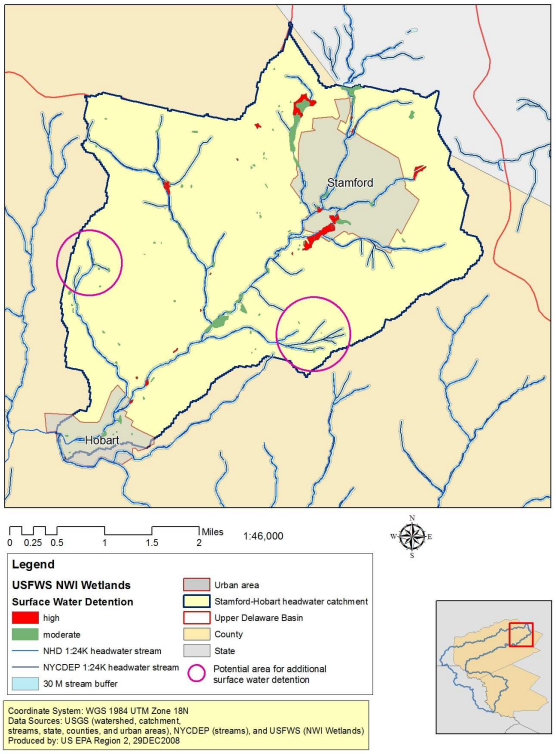


Figure 5: *Stamford-Hobart Headwater Catchment: Predicted Surface Water Detention Functionality of NWI Wetlands, Delaware County, NY*

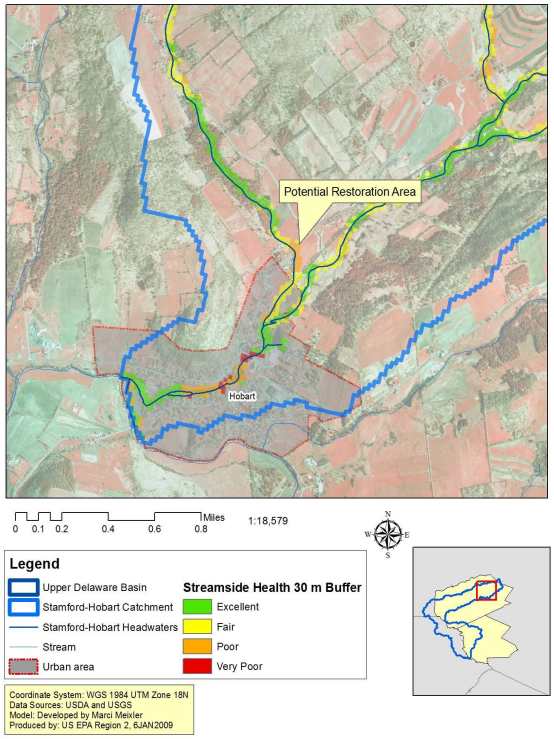


Figure 6: *Potential Stream Restoration or Stormwater BMP Area: Stamford-Hobart Headwater Catchment:*

In conclusion, the analyses of baseline conditions of ecological and hydrological functions from this study informed appropriate selection of conservation design-based stormwater BMPs for possible flood and water quality management strategies for an urbanizing Upper Delaware Basin. Actual results for the Upper Delaware Basin may be most applicable to the Catskill Mountains region. The approach used in this study may be applicable to watersheds across the United States of America and the world in need of finding solutions for managing more frequent intense floods and increases in urban development.

Project Sponsor:
USEPA National Network for Environmental Management Studies 2007 Program (EPA's Environmental Education Division (EED), Office of Children's Health Protection and Environmental Education (OCHPEE) and USEPA Region 2 Wetlands Protection Team)

Partners:
Dr. Claire A. Jantz (Shippensburg University); Joel Dubois (Greene County Soil and Water Conservation District); Scotty Gladstone (Delaware County Soil and Water Conservation District); Ralph Tiner and Herb Berquist (US Fish and Wildlife Service); Christina Falk, Mike Usai, and Terry Spies (New York City Department of Environmental Protection); Ryo Kiyan and Heather Brown (Sullivan County Department of Planning and Community Development, Sullivan County, NY); Cindy McKay (NHDPlus Team); Marci Meixler (Cornell University); Jerry Fraine and Jack Isaacs (New York State Department of Environmental Conservation); and FEMA Region 2.

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