LITTLE CONESTOGA CREEK WATERSHED ASSESSMENT, LANCASTER, PA.

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INTRODUCTION

River systems have been dramatically impacted by dams, reservoirs, channelization and land-use changes. Impacts include loss of water quality and biodiversity and changes in the functional characteristics of streams (Petts & Calow, 1996). At the same time there are increasing demands being placed on river systems. Over the last few decades numerous attempts have been made to restore damaged stream ecosystems. Given the complexity of river systems there is an increasing efforts to apply scientific principles to the development of environmentally sensitive approaches for managing rivers.

In Pennsylvania numerous individuals and organizations, including the state government, have recognized the urgency of the situation and are encouraging restoration efforts through legislative initiatives and funding opportunities.

Most streams in Lancaster County, southeastern Pennsylvania, have been heavily impacted by human activities. Land-use change has dramatically accelerated over the last few decades and concern over stream health has resulted in numerous stream restoration projects. Local watershed groups have been formed and stream restoration projects are being initiated or proposed in numerous locations in the county.

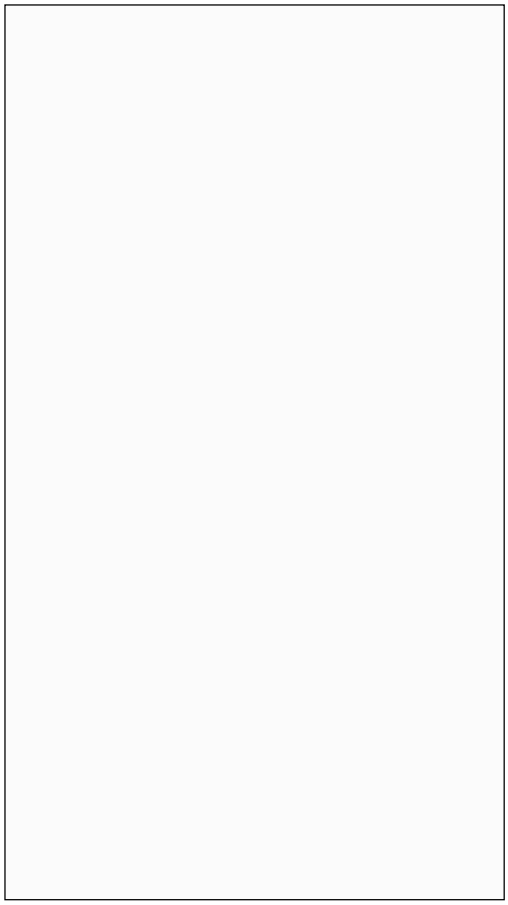

Figure 1. The Little Conestoga Creek Watershed in Lancaster County, PA including project locations (1 = Bachman Run, 2 = Swarr Run, 3 = Long's Park Creek).

Unfortunately many of these initiatives are occurring without significant scientific input. There is a need to provide this information to

these efforts in order to maximize the potential for success.

BACKGROUND

Prior to 1700, the area of Lancaster County was inhabited by Native Americans, particularly the Susquehannock group (Kent, 1984; Wallace, 1989). In the early 1700's the area was settled and rapidly cleared by Europeans. Lancaster County was founded in 1729 and Lancaster City in 1730. By 1999 the County's population was 460,000 (US Census Bureau, 2000). Since the 1950's the population has increased by between 9 and 15% per decade and it is projected that around 110,000 people will be added to the county population over the next 20 years. Lancaster County also ranks as one of the most agriculturally productive areas in the US. It supports large Amish and Mennonite communities and is a top tourist destination in Pennsylvania.

The steady increase in population has resulted in gradual conversion of woodlands to fertile agricultural land and increasingly the conversion of agricultural land to urban and suburban development. Between 1970 and 1990 the proportion of county land defined as urban more than doubled, from 44 square miles to 105 square miles, out of a total of 946 square miles (Lancaster County Water Resources Task Force, 1996). At present, only about 11% of a once fully forested county consists of woodland. Most of these wooded areas occur as narrow strips along the Conestoga and Susquehanna rivers where the banks are steep and unsuitable for farming, as small woodlots, or on elevated ridges beyond the border of Lancaster City.

The Conestoga Creek, the main drainage in Lancaster County, flows into the Susquehanna River and then into the Chesapeake Bay. Most of the rivers in the county are highly impacted by agricultural and urban land use. For example, the Conestoga Creek has the highest nutrient yields entering the Susquehanna River (Ott et al., 1991). Concern about local and regional environmental issues has led to a dramatic rise in interest in stream restoration in the county. Interest has come from numerous groups including trout fishermen, conservation organizations and local governments. At least 6 stream restoration projects have been completed or are in progress in the County.

The Little Conestoga Creek

The Little Conestoga Creek is one of the main tributaries of the Conestoga Creek and is located completely within Lancaster County (Figure 1). The watershed covers an area of 65.6 mi^2 and is 68% agricultural, 22% urban and 10% forested (Loper & Davis, 1998). Much of the watershed is within the Urban Growth Boundary of Lancaster City and is undergoing rapid change from agriculture to suburban and urban land use. About 90% of the watershed is underlain by fractured carbonate bedrock particularly of the Conestoga Formation. The thick residual soils produced from the carbonate produce rich agricultural topsoil and as a result agriculture is still the leading land-use in most of the sub-basins of the watershed. However, at least one sub-basin is 82% urban.

Stream water in the basin is used for irrigation, livestock, and commercial operations but is not used for public supply. Residents in the basin obtain their water from municipal water systems (83%) which obtain their water from the Conestoga River and the Susquehanna River, or from private wells. Discharges into the basin include industries with National Pollution Discharge Elimination System (NPDES) permits, storm-water, and sewage treatment plants (Loper & Davis, 1998).

Nutrient levels in the basin are high with the lower part of the West Branch of the Little Conestoga frequently having nitrate concentrations above 10mg/L. As expected nutrients are highest in sub-basins with the highest agricultural land use. Urban/suburban development produces other impacts such as increased sediment loads and bioassessment studies have shown that almost the whole watershed is impaired (Loper & Davis, 1998).

Recently a grassroots watershed alliance has been formed for the Little Conestoga Creek (The Little Conestoga Watershed Alliance -

LCWA). Several stream restoration projects have been proposed but little is known about where the main problems exist in the watershed. To some extent projects are determined by opportunity - developers that are prepared to modify plans to accommodate environmental friendly stream development or land owners prepared to allow a stream restoration project on their land. However, there is a need to study the dynamics of the stream system in order to understand how the system is responding to the changes that are occurring in the watershed.

Figure 2. The Little Conestoga Watershed Assessment participants on a field trip to the Chesapeake Bay.

PROJECTS

From the beginning it became clear that we could not study the whole watershed in detail. We decided to divide into 3 groups and each group would study a sub-basin of the LCW that represented a different land-use history.

Project 1: Bachman Run

Students: Ashley Hawes, Jennifer Fallon, and Abby Bowers.

This sub-basin is experiencing rapid sub-urbanization. Conversion of agricultural lands to suburban developments and improved erosion controls during construction appear to be reducing the sediment flow into this stream. Reduced sediment loads and increased discharge is resulting in the remobilization of the floodplain and channel sediments. The result is bank erosion, channel incision, and channel widening. Many landowners are responding with hard engineering 'solutions'.

Project 2: Swarr Run

Students: Garrett Bayrd, Aaron Davis, and Nancy Harris.

This sub-basin includes agricultural land-use as well as suburban developments. Many of the suburban areas were developed before the implementation of storm water management regulations in Pennsylvania. The resulting dramatic increase in discharge, combined with a reduced sediment load, has resulted in channel incision. Where bedrock, or armored channel beds occur, lateral erosion and channel widening is evident. Straightening of many of the stream channels during the 1940's and 1950's has exacerbated the problems by increasing the stream gradients. Uncontrolled access to the streams by livestock has resulted in wide, shallow channels in many areas.

Project 3: Long's Park Creek

Students: Kyle Cavanaugh, Lauren Manion, James Orsher, and Jaime Tomlinson.

The urban development in this small sub-basin distinguishes it from the other tributaries of the LCW. The channel is highly modified by channelization, hard engineering of the banks, and floodplain destruction. The nutrient and sediment content of the creek is generally lower that the other tributaries of the LCW, while the metal content of the sediment is much higher.

CONCLUSIONS

During this study it became abundantly clear that streams are complex systems. Streams, particularly in areas undergoing rapid land-use changes, are often out of equilibrium. In the LCW, deforestation since the 1700's probably resulted in a dramatic increase in the sediment flux to the floodplain system. Improvements in agricultural practices and sub-urbanization have reduced this sediment influx, while rapid run-off

has increased. Floodplain and channel sediments are now being remobilized. Locally this results in complex, and frequently unwelcome changes in the channel morphology. Perhaps more importantly increased sediment in the streams is negatively impacting ecosystems downstream such as the Chesapeake Bay.

ACKNOWLEDGEMENTS

We thank the KECK Geology Consortium and NSF for supporting this project. Jesse Yoburn helped with logistics and technical problems and was funded through the Franklin & Marshall College Hackman fellowship program. Janie Wissing helped in countless ways.

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