Modeling channel maintenance in a coastal plain watershed

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Abstract

The Crabtree Canal, located in Horry County, SC is the main conveyor of stormwater in a watershed that has undergone considerable urbanization in the last few decades. A study was initiated to provide a working management tool to determine hydrodynamic conditions on the watershed driven by hypothetical storm events and alternative ditch management techniques. The tool will comprise a one dimensional hydrodynamic model of the Crabtree Canal that will aid the Horry County Stormwater Department in evaluating alternate stream management techniques.

Introduction

Flooding issues in the 1960's prompted the U.S. Army Corp of Engineers to channelize Crabtree stream. The canal was constructed to a trapezoidal shape. The watershed has undergone considerable urbanization in the last few decades. A consequence of urbanization is increases in peak and volume of stormwater runoff. The consequences of these increases on the receiving stream are channel instability, down cutting and widening; typically accompanied by bank instability and bank erosion. To address the issues of bank erosion and mass wasting, alternative channel maintenance practices have been proposed by the Horry Country Stormwater Management Program. The provision of additional floodplain and a low flow channel consistent with natural channel design practices is one such alternative. The objective of this alternative is to create a more stable channel cross section, and to promote the attenuation of increased peak flows on the floodplain. An additional aspect of peak flow attenuation is a reduced ability for the stream to transport sediments, potentially reducing sediment exported from the watershed. A tool is being developed using the one-dimensional HEC RAS flow modeling software to simulate alternative stream management strategies, and their effects on within channel flow dynamics.

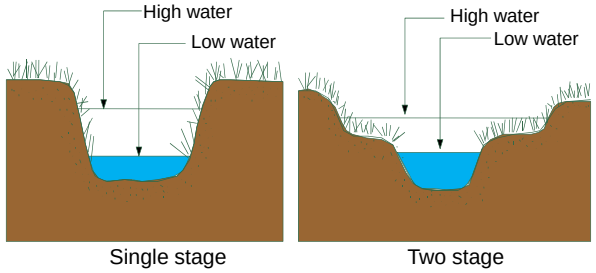

Figure 1. Single stage design vs. two stage design

Methodology

The majority of the geometry data required for input into HEC RAS was derived from LiDAR data. Topographic surveys were conducted to determine channel geometry at sections that had standing water and therefore impenetrable by LiDAR. Win-TR55 will be used to generate inflow hydrographs.

Tidal variations that influence the downstream section of Crabtree Canal and the impacts on stormwater conveyance will be examined. Calibration of the model will be based on information provided by a USGS flow gage situated in the study reach. The model is initially being developed to reflect current flow conditions. Subsequently, varying floodplain widths will be imposed to determine the effects on flow depths, average channel and overbank flow velocities, and average shear stresses in the system.

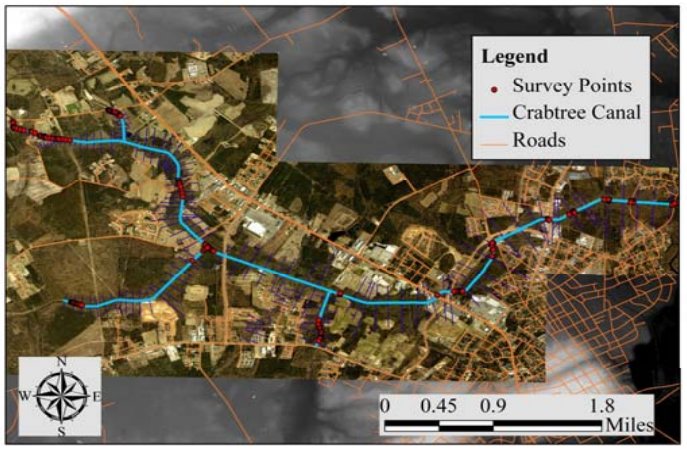

Figure 2. Aerial view of Crabtree Canal

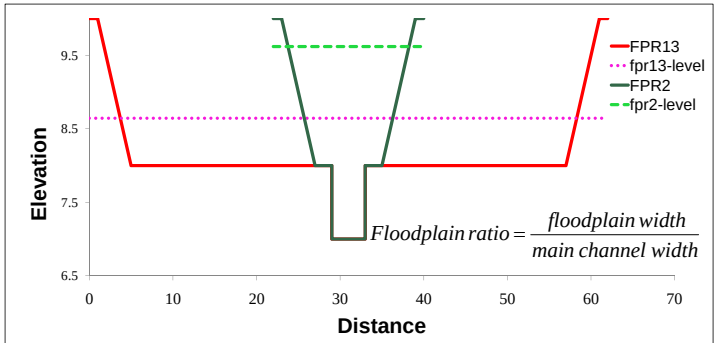

Figure 3. Comparison of Floodplain Ratios

Figure 4. Maintenance on Crabtree Canal in 1967

Figure 5. Crabtree Canal in 2008

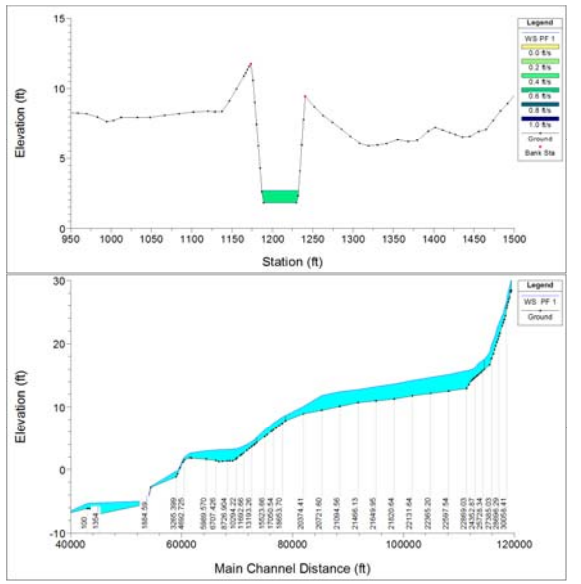

Figure 6. Steady flow simulation (cross section and profile view)

Anticipated outcomes

- A tool to evaluate alternate stream management techniques and determine potential zones of instability in Crabtree Canal.
- An evaluation of the effect of reconnecting the floodplain to a "low flow" channel as a means to improve bank stability and improve stormwater conveyance within Crabtree Canal.

Conclusions

- A "two-stage" channel configuration is expected to function more as a natural stream system as well as providing a functional floodplain. As a consequence of this study, efforts to increase bank stability and mitigate sediment export will result in an improvement of overall water quality.

References

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Acknowledgments

Dr. Jeffery Allen (Strom Thurmond Institute), Dr. Susan Libes (Coastal Carolina University), Joe Dignam and Stephen Williams (City of Conway), Tom Garigen and Jackie Taylor (Horry County Stormwater Management Program)