Sustainable UD water

WATERSHED ACTION TEAM FOR ECOLOGICAL RESTORATION

Hydrologic Response from a Developed Piedmont Watershed

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1. Introduction

Stormwater runoff has the ability to erode Earth's surface, causing channels to form along its path from impervious areas to streams, rivers, etc. Large channels, known as gullies, can be examined to determine the extent of the effects of stormwater. The resulting analysis can also provide insight into the implementation of appropriate stormwater management practices.

2. Objectives

- **For gullies located in a Piedmont watershed:**
  - **(1) Quantify total suspended solids loads received over time.**
  - **(2) Determine temporal probable peak flows.**

(Above) Photographs of the three gullies being analyzed within this study; 2013.

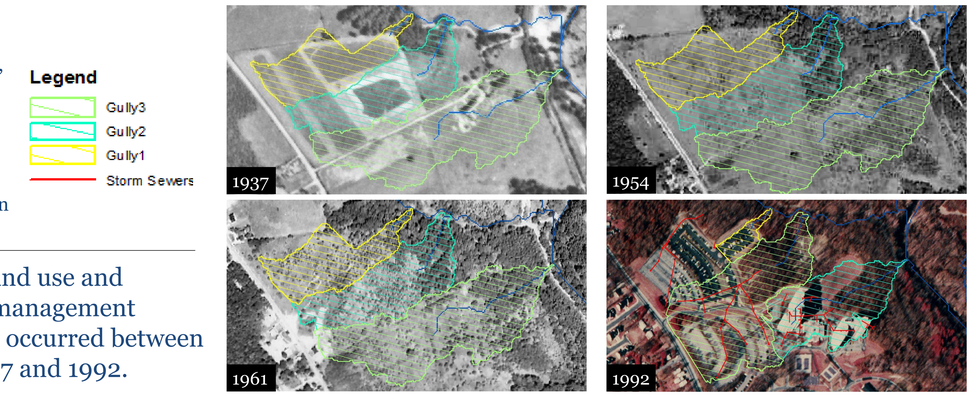
3. Methods

- **Data representing Pre-1492 (completely forested), 1937, 1954, 1961, 1968, and 1992 land development and stormwater management conditions were analyzed in this study. The three sites examined in this study are located near Newark, DE within the Christiana River Watershed and shown above.**
  - **(1) Land use data generated by ArcGIS was combined with annual precipitation estimates and mean pollutant concentrations in the Simplified Method in order to determine the total suspended solids pollutant load each sub-watershed has experienced over time.**
  - **(2) Within the TR-55 Hydrology Model, land use data was processed with time of concentration data to produce the expected 2-, 10-, and 100-year storm flows associated with each year and watershed being examined.**

4. Key Results

Sub-Watershed Delineation Results

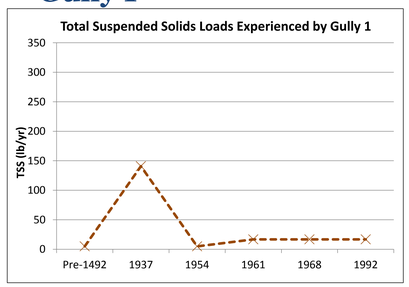
Figure 1. Aerial photographs from 1937, 1954, 1961, and 1992 containing the sub-watershed delineation for each gully. 1968 aerial photograph omitted due to lack of variation from 1961 land use.

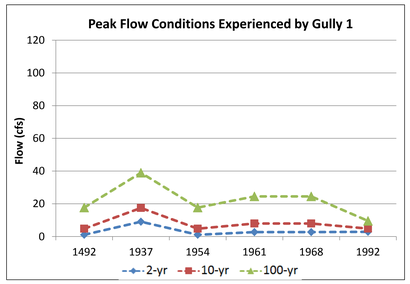


- Significant land use and stormwater management development occurred between the years 1937 and 1992.

Pollutant Load and Peak Flow Analysis Results

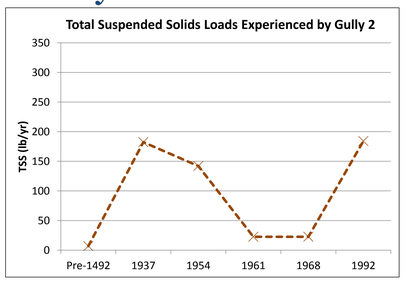
Gully 1

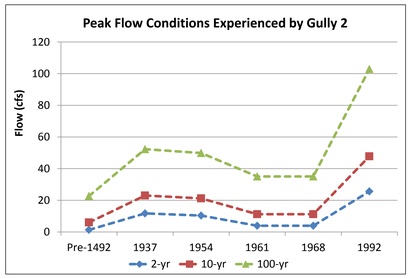




- Increase in both modeled TSS load and flow during the year 1937 correlate to peak in farming society and agricultural land.
- Comparatively low TSS values are due to the small size of the watershed characterizing Gully 1.

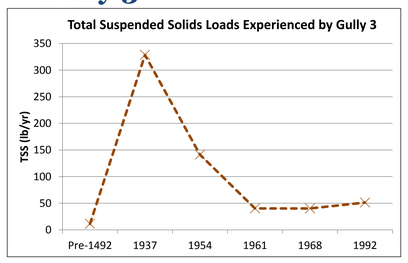
Gully 2

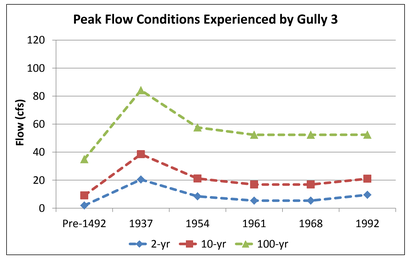




- Rise in both TSS load and peak flow in 1992 corresponds to increase in watershed boundary associated with Gully 2 due to the installation of a sewer system and large parking lot depicted on 1992 aerial photograph.

Gully 3





- Relatively large predicted values for TSS load and peak flow experienced by Gully 3 in comparison to 1 and 2 correspond to the size of its watershed boundary in relation to those of Gullies 1 and 2.

5. Conclusions

The results of this study demonstrate that:

- **(1) Because TSS loads and peak flows are functions of land use, graphical results for each parameter over time exhibit the same shape.**
- **(2) Severe increases in predicted loading and flow can be resultant of:**
  - **(a) Increases in appearance of specific high nutrient- and/or high metal-containing land use (i.e., agriculture, parking lots).**
  - **(b) Increases in sub-watershed size due to changes in flow patterns (i.e., introduction of sewer system).**

6. Future Work

- **Conduct field studies in order to:**
  - **(1) Increase the accuracy of the models.**
  - **(2) Compare model results to actual data.**
- **Perform spatial survey on each gully in hopes of:**
  - **(1) Classifying them further.**
  - **(2) Obtaining data to serve as input into more advanced hydrologic modeling/prediction system (i.e., HEC-RAS).**

7. Acknowledgements

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