

Changes in the Morphology of Esopus Creek, Catskill Mountains, New York, 2004 – 2016, Due to Natural Factors

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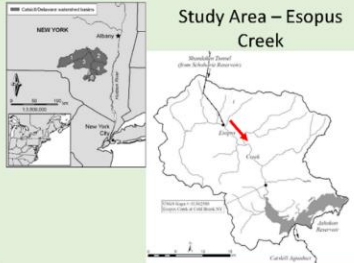
Department of Geological Sciences and Environmental Studies



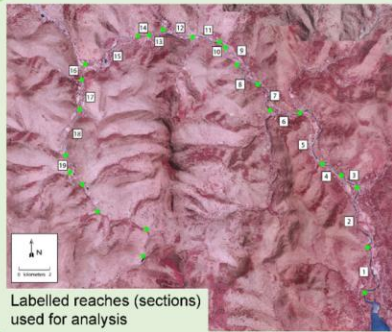
Center for
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Previous Study¹:

- Prior to 1959: Channel widening occurred due to 3 large floods over 7 years as well as increased moderate flow events.
- 1959 – 1980: After a 22 year flood hiatus & decreased moderate flow events, the channel narrowed. Seven months prior to photos taken in 1980, the largest recorded flood (at the time) impacted the area.
- 1980 – 2001: Increase in moderate flow events & three large floods 5 years apart led to channel widening.

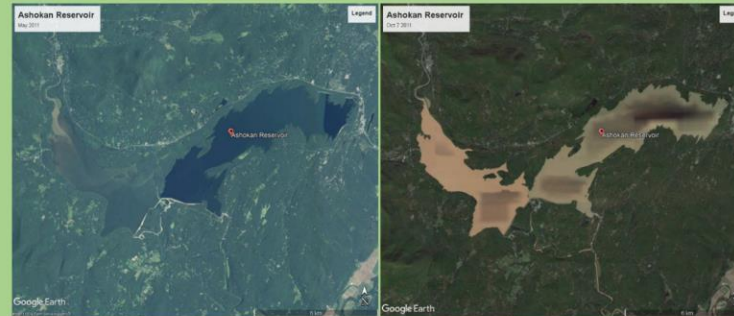


Study Area – Esopus Creek



Labelled reaches (sections) used for analysis

Esopus Creek reacts to large flow events with major short-term changes in river morphology, but quickly stabilizes afterwards.



Ashokan Reservoir before and after the 2011 Hurricane Irene flood. Images taken from Google Earth. Note the plume of suspended sediment entering the reservoir from Esopus Creek in the top left of the pre-Irene image.

Methods:

- Using the New York State Geographic Information Systems Clearinghouse website, located the aerial orthoimagery that contained the study area (Ulster County, Towns of Shandaken and Olive, years 2004, 2009, 2013, and 2016).
- Condensed the downloaded datasets so that only the images that contained the river were saved and utilized.
- Mapped the channel midline of the river by creating individual shapefiles for each section to determine smaller scale morphology and sinuosity changes.
- Compiled all datasets and shapefiles into a single map for yearly comparison analysis.



Esopus Creek at the Shandaken Tunnel outlet before (left) and after (center) the 2011 Hurricane Irene flood (photos from NYDEP). The right photo (courtesy of P. Knuepfer) shows the same site in October 2019. Note the stabilization of channel is now left of pre-flood position. Also note the revegetation of the rightmost bank in the 2019 photograph. View from each photo is towards the upstream end (flow is towards the left).

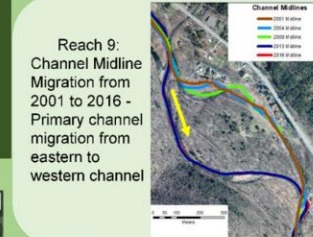
References:

1. Miller, N., 2009, Historic Channel Change on Esopus Creek, Upstream of the Ashokan Reservoir, Catskills, New York, 81 p.
2. Erwin, S., and Davis, D., 2005, Phase 1 geomorphic assessment of Esopus Creek above Ashokan Reservoir: NYCDEP Stream Management Program, 93 p.

Results and Analysis:



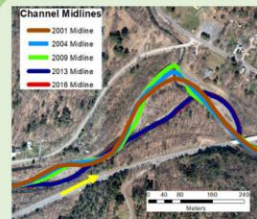
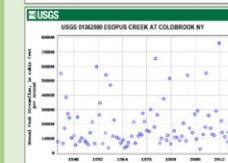
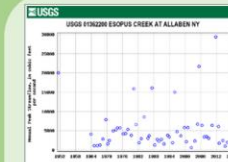
- 2011 flood shifted channel, created and moved bars
- Post-2011 channel and bar stabilization, re-vegetation



Reach 9: Channel Midline Migration from 2001 to 2016 - Primary channel migration from eastern to western channel



- 2009 Reach 12:
- Major erosion into eastern side of stream post-2005 flood; channel-belt widening.
 - Point bar growth.



- Reach 12-13:
- Meander cutoff
 - Channel shift
 - Main channel cut through of vegetated point bar

The maximum annual discharge at gage stations at middle (Allaben) and downstream (Coldbrook) locations. Major flows in 2005 (Allaben) and 1980 (Coldbrook) and flow of record in 2011 (both).

Findings:

- Minor channel changes due to 2005 flood (channel migration, erosion of point bars & vegetation), especially upstream of Allaben
- Hurricane Irene (2011) caused major channel shifts, migrations of mid channel bars, changes in tributary interconnections
- Post-Irene channel stabilization and vegetation recovery on bars
- 2005 flood: more significant changes upstream half of Esopus Creek
- 2011 flood: impacted both upstream and downstream.

Conclusions:

- Large events produce major short-term channel changes
- Stream stabilizes quickly (within a few years), new bars revegetated.
- New channel patterns may persist even through subsequent floods.
- Frequency of moderate events also impact channel-belt width, meander migration, bar erosion and deposition

