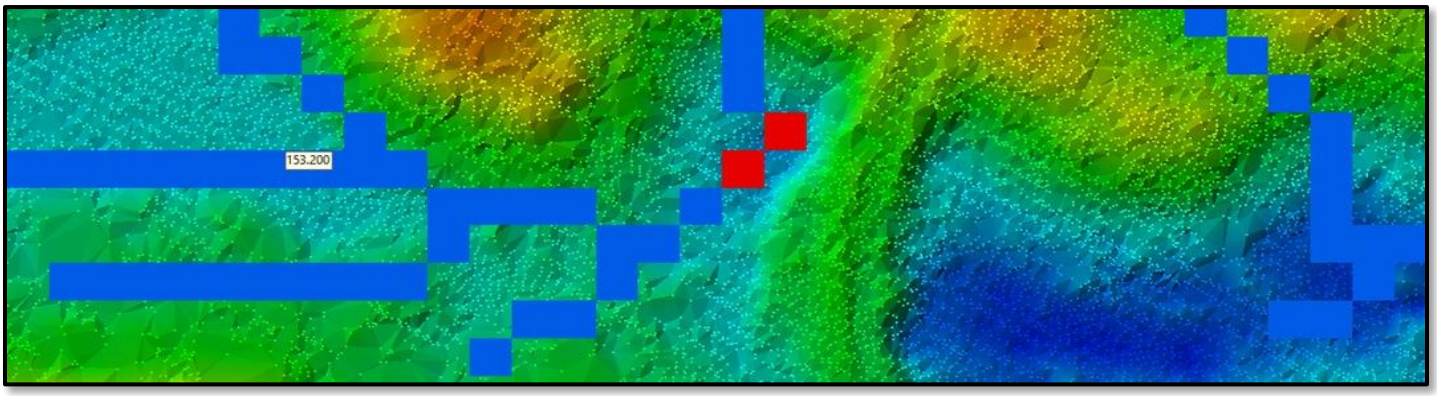
# Modeling Peak Flows at Culverts: Ulster County Improves Resiliency

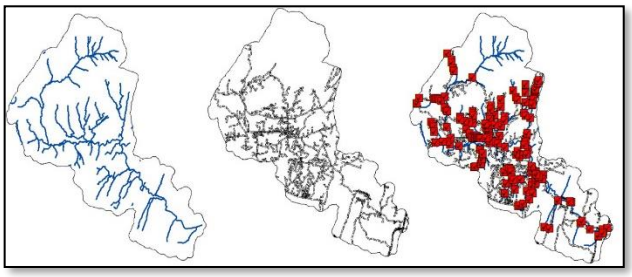



**The Problem**

Ulster County is a mix of urban and rural development covering over 800mi$^2$ in the Hudson River Valley which also includes a significant portion of the eastern Catskill Mountains. Drainage in most of the County is governed by roadside ditches and culverts which ultimately lead into critical Hudson River tributaries. Landcover changes due to development over the past generation have increased runoff in roadside drainages and streams, which in many cases is routed through infrastructure not designed to handle current peak flow conditions.

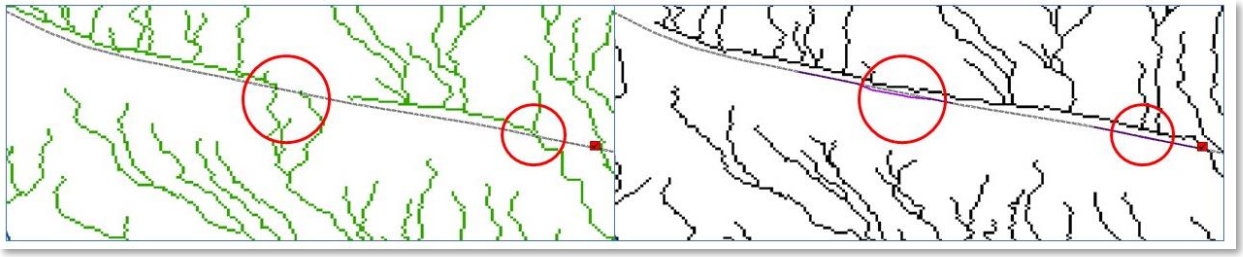
**Challenges**

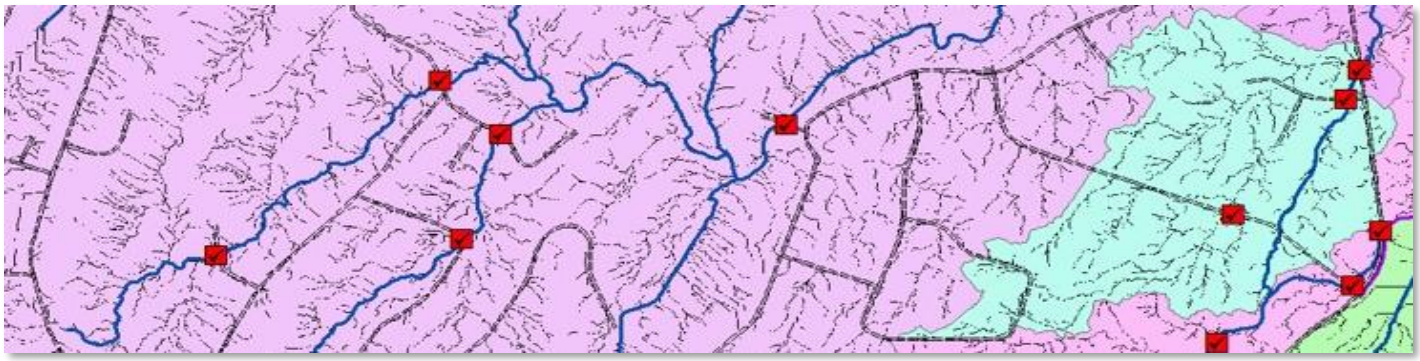
Peak flows during wet weather events have caused localized flooding and road over-wash, damaging culverts and pavement while destabilizing embankments and causing significant erosion. In recent years, local highway departments have been reacting to flood damage with emergency repairs. The County Department of the Environment (the County) is working with the Town of Woodstock in the Sawkill Watershed to instead become proactive in identifying culverts that are potentially undersized, and hence pose the greatest risk of failure during a given storm event. Members of the GroundPoint Engineering team worked with the County to use publicly available high-resolution airborne LiDAR data to analyze current drainage conditions and model peak flows at various culvert locations in the Sawkill Watershed.



**Solutions**

The public domain LiDAR data for Ulster County not only meets the USGS QL2 Standards (aka 1 ft contours), but the derived 1m elevation model is 900 times higher resolution than the previously available 30m version. Members of the GroundPoint Engineering Team were able to use the raw LiDAR data to create a hydrologically corrected surface model to evaluate detailed drainage patterns and model drainage catchments for individual culverts. The County provided over 100 culvert inventory locations in order to compare existing culvert capacity (based on culvert size) to anticipated peak flows (based on modeled rainfall and runoff).





GroundPoint developed an enhanced surface model from the original LiDAR data and edited it iteratively to reflect actual field conditions. The process identified improvements in the culvert inventory point data such as missing culverts, culvert location adjustments, and flagging potentially erroneous entries. The culvert inventory data was based on a standard data model provided by the North Atlantic Aquatic Connectivity Collaborative (http://streamcontinuity.org). The improved culvert inventory data became the basis for mapping detailed drainage catchments to each point. Additional catchment characteristics such as total area, average slope, time of concentration, and average runoff curve number were derived in order to calculate peak flow estimates based on NOAA Atlas 14 precipitation predictions. The approach was adapted from work developed at the Cornell Water Resources Institute (WRI) based on the Soil Conservation Service TR55 Runoff Model.

*The results identified improvements in the culvert inventory data and provided a mechanism for prioritizing culverts, and comparing existing flow capacity against predicted wet weather events.*

**Results**

The peak flow calculations helped in ranking culverts based on the likelihood that their existing capacity is insufficient to handle predicted wet weather events. The hydrologically corrected surface model and detailed drainage maps became an important quality tool for validating the culvert inventory data. The culvert data is being used not only to evaluate flow capacity, but also the potential for supporting biological connectivity, which is an important factor in enhancing ecosystem services and watershed resiliency.

*Characterizing flow in roadside ditches and through culverts represents a new, cost effective way to evaluate peak flow conditions associated with highway infrastructure. LiDAR data proves critical in providing detail that is not otherwise possible.*

**About GroundPoint Engineering**

GroundPoint Engineering is a professionally licensed engineering firm that specializes in high resolution topographic mapping and drainage analysis. Working with data from airborne LiDAR and UAVs, GroundPoint creates data that supports detailed analysis and provides the input to more complex runoff and water quality modeling packages.

For more information about how GroundPoint Engineering can help with your drainage challenges, visit drainagemapping.com or contact us at 845.224-7780

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