

Nana Agyei Owusu
Afriyie- Accra, Ghana



LIDAR-DEM Based Modelling of Culvert Placements

Digitizing road-stream crossings was previously done manually but with the current availability of high-resolution Digital Elevation Models (DEM's), crossings can be accurately delineated and minimum culvert requirements for various discharge events predicted.

Project Description

- An ArcGIS toolbox model is built for an existing 60km forest supply road in central New Brunswick(NB). DEM data is acquired from UNB Forest Watershed Research Center. Culvert data and road inventory is provided by JD Irving LTD.
- A 120m buffered layer of the road is masked with its corresponding DEM to generate Flow accumulation (FA) and Slope

- The FA and slope are used to generate a cost raster as follows

Cost raster = $40 \log_{10}(FA+1) + \text{slope}$

- A least cost path(LCP) is generated, and point intersected with a 4-Hectares DEM derived stream network layer to locate the road-stream crossings. DEM FA's are derived at each crossing.
- Discharge is calculated at each crossing point, for storm discharge events equivalent to 100mm/day discharge events.
- Minimum required culvert diameters are calculated per given discharge using the Manning equation assuming

- (i) Even flow of discharge
- (ii) Peak hydrograph flow (~ 3 x even flow)

Preliminary Findings

- 164 road stream crossings were predicted from the model using the study area. Most predicted culvert locations were different from actual placed culvert locations. This could be due to:
 - (i) insufficient roach breaching
 - (ii) ditches are used as flow collectors before culvert installation
- Of the 164 predicted, 96 had culvert data recorded by the NB data and for a 100mm/day discharge event with even flow. Only 4 of the NB culverts were found to be undersized however, with peak hydrograph flow, 23 culverts were undersized.

Completion

The Model is still under development. Pre-processing of the DEM to breach flow network is ongoing and the research is expected to be verified and completed in April 2022.

Applications

- Reference point for identifying culvert locations and sizing for new and existing roads and repair of existing culverts.

Supervisors : Paul Arp, PhD, ForEM & Jae Ogilvie, MSc, ForEM

Funding agencies : Forest Watershed Research Centre - UNB, JDI Limited in collaboration with NSERC