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The contents are provisional and will be superseded by a paper in the DMT’11 Proceedings.

See also earlier Proceedings (1997-2010) http://ngmdb.usgs.gov/info/dmt/
Inventory Mapping and Characterization of Landslides Using LiDAR: Kenton and Campbell Counties, Kentucky

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Introduction

Landslide identification and hazard mapping using LiDAR has proven successful in other landslide prone areas of the U.S. The purpose of this project was to develop a methodology using LiDAR data optimal for the geologic setting of Kenton and Campbell Counties and document landslides as part of an existing inventory. To do this, potential landslides were mapped and digitized that were previously not visible on existing maps or coarse digital elevation models. Field verification of these locations, where possible, also followed. Developing a methodology for viewing high resolution LiDAR to identify potential landslides provides a framework analyzing landslide data that is crucial to understanding the nature of the landslide prone areas and reducing long-term losses from landslide hazards.

Geology & Common Landslide Types

Ordovician bedrock geology in Kenton and Campbell Counties consists of, in ascending order, the Kope Formation, Fairview Formation, Grant Lake Limestone, and Bull Fork Formation. Although landslides can occur in any of these units, the Kope Formation is especially problematic and is associated with many of the landslides in the area. The Kope shale weathers easily, slumping and producing colluvial soils of variable thickness. Composition of the colluvium ranges from clayey (predominantly illite) to silty with abundant limestone slabs. When colluvial colluvium is mixed with large amounts of water, water pressure increases, which adds to the overall load on the slope.

Thickness of colluvial soils ranges, but is typically thicker at the toe of the slope. Landslides typically occur on steep slopes in the colluvium or along the colluvial-bedrock contact. Other surficial deposits in the area are prone to landslides as well. Pleistocene glaciation in the region produced clayey lake deposits, outwash, glacial drift, and other fluvial deposits that fail. Artificial fill, particularly above and below roadways, is also susceptible to landslides.

Data Sets

- Standard LiDAR LAS files (provided by the Northern Ky Area Planning Commission)
- Digital Elevation Models (DEM’s)
- Slope maps
- Hillshade DEM’s (bare earth)
- Topographic contours (2 and 4 ft)

- 1:12,000 scale geology
- 2-ft color aerial photography (leaf off)

Results

- 234 potential landslide extents digitized
- 10% initially attributed as confident
- Other slides attributed as moderately confident or questionable
- 15% of slide extents digitized were field checked. Of these, 43% were confirmed, 40% were likely, and 17% were not accessible.
- Types of landslides were not determined.

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Project Methodology

- Used Quick Terrain Modeler to create hillshade DEM’s from the LAS files
- Imported DEM’s to ESRI’s ArcMap for visualization and spatial analysis
- Reexamined digitized landslides in Quick Terrain Modeler
- Performed field checking (example photos above)

Visualization

- Extents were digitized based on geomorphic signature: Scarp presence? Thick toeslope? Slope curvature? Hummocky?
- Systematic panning across the hillshade DEM’s at various scales was used to identify and digitize the areal extent of potential landslides.
- A tiling scheme provided by the planning commission was used to help organize the visualization process
- Panning and zooming across the DEM’s occurred: 1:10,000, 1:5,000, and 1:2,000
- Selected digitized features (25%) were reexamined in Quick Terrain Modeler with different azimuths, sun angles, and 3D
- For half of those, confidence was changed from questionable to moderately confident