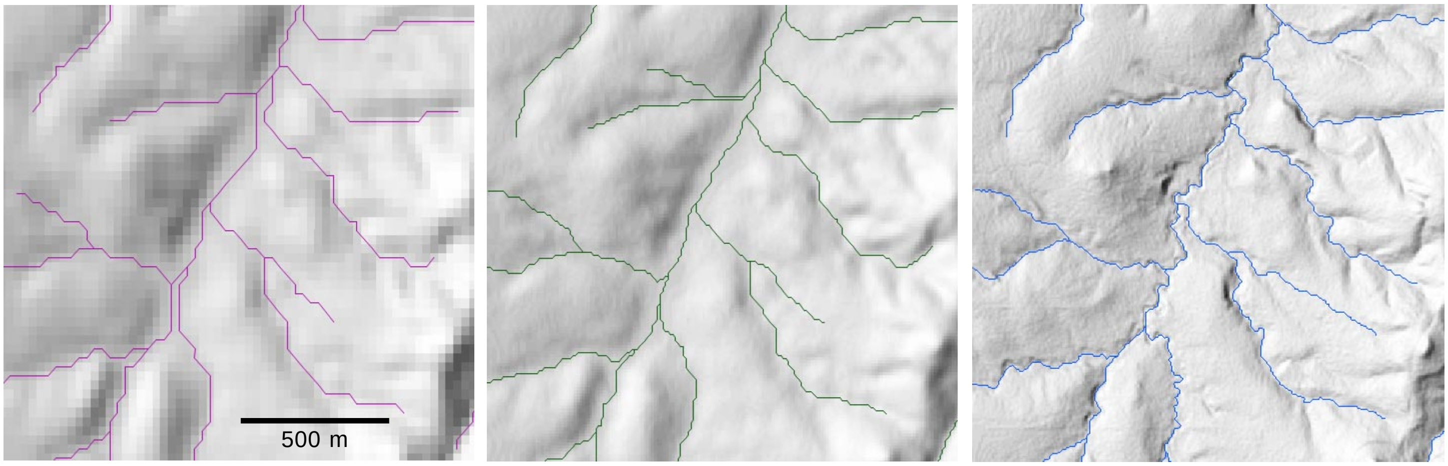
Terrain Operations

DRAFT
12 Sep 2007

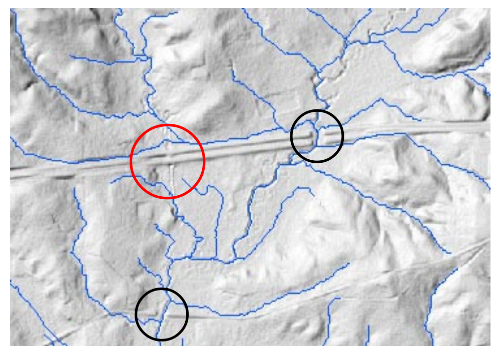
DEM Quality Determines Watershed Accuracy



30-meter NED **10-meter NED** **5-m LIDAR DEM**

Comparison of flowpaths computed by TNTmips Watershed process from DEMs of differing cell size and quality for a low-relief area in northern Louisiana. Flowpaths (colored lines) are overlaid on shaded-relief images computed from the respective DEM. Cell values in each DEM are integer feet; maximum topographic relief in area shown is 170 feet (52 m). Left, 1 arc-second National Elevation Dataset (NED, approximately 30-m cell size). Center, 1/3 arc-second NED (approximately 10-m cell size). Right, LIDAR DEM with 5-m cell size provides the best definition of stream channel locations.

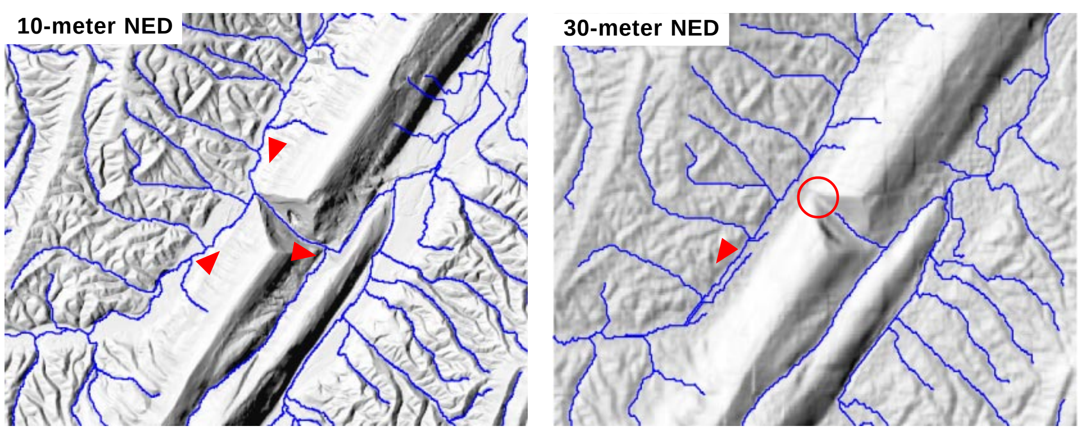
The accuracy of the watershed boundaries, stream flow patterns, and their many associated attributes produced by the TNTmips Watershed process depend greatly on the quality of the Digital Elevation Model (DEM) used as input for the process. The spatial resolution (cell size) of the DEM is one important component of DEM quality. A DEM with smaller cell size can more accurately depict the ground elevations of real landscapes, and the Watershed process can thus more accurately locate and provide more detail in watershed boundaries and stream courses (see illustrations above). In high-relief areas, where streams flow through narrow, steep-sided canyons, DEMs with larger cell size may not be able to adequately resolve the bottoms of these narrow features. Canyons may be locally “blocked” by cells that span the canyon walls and bottom, which thus have anomalously high elevations and create spurious depressions upstream from them. In some cases these artificial barriers may be higher than other locations on the depression boundary; when these depressions are filled, the watershed process then routes the flow through the lowest (in this case incorrect) pour point into an adjacent drainage, producing major errors in the derived flow network (see illustrations below).



This bare-earth LIDAR DEM was edited prior to distribution to breach manmade structures (highway embankments and bridges) crossing major streams (black circles). Some smaller drainages are still blocked (red circle), causing Watershed flowpaths to be diverted by these features.

DEMs produced by different methods (photogrammetry, interpolation of topographic contours, SRTM, LIDAR) all include artifacts of various kinds that result in local inaccuracies in elevation. For example, “bare earth” DEMs produced from LIDAR data or by photogrammetric methods may include bridges and highway embankments that appear to block stream courses that in reality flow under them. Older 30-meter DEMs produced in

(over)



Watershed flowpaths computed from 10-m NED (left) and 30-m NED (right). In the left illustration a stream correctly breaches a major ridge (flow directions shown by red arrowheads). The 30-m DEM (right) has insufficient resolution to accurately represent the true elevations at the upstream end of the narrow, steep-sided gorge (red circle), diverting watershed flowpaths to an incorrect lower-elevation outlet. Local editing of the spurious cells in the 30-m DEM can remove the blockage.

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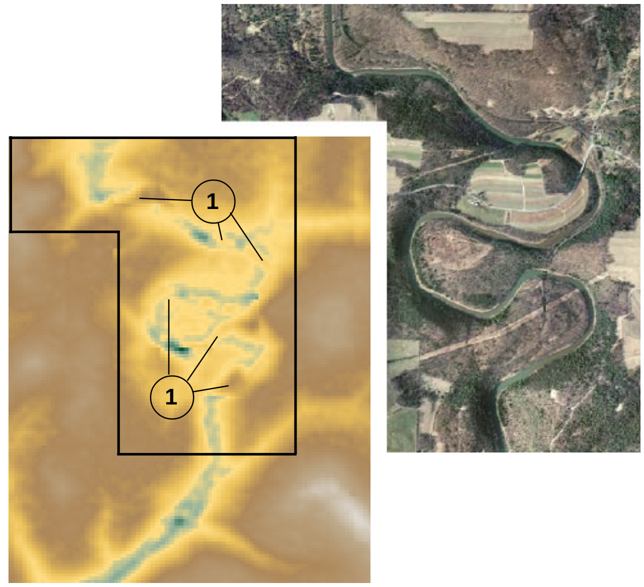
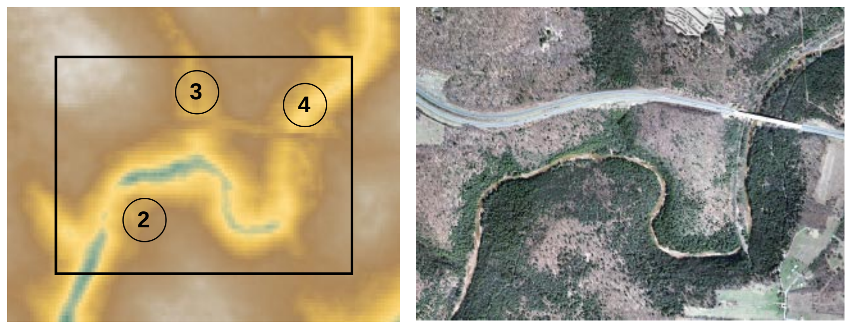
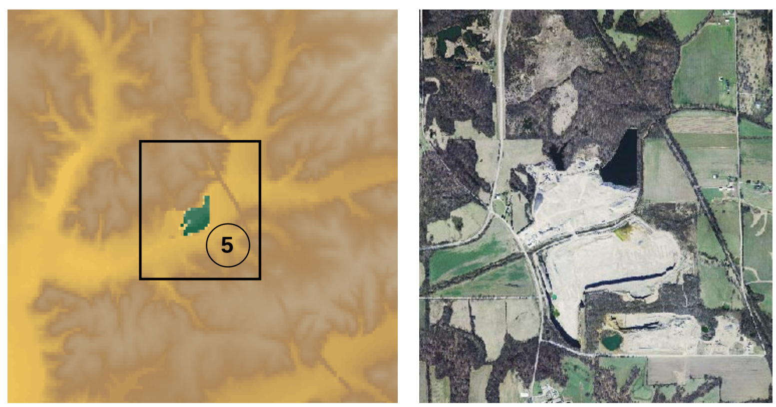
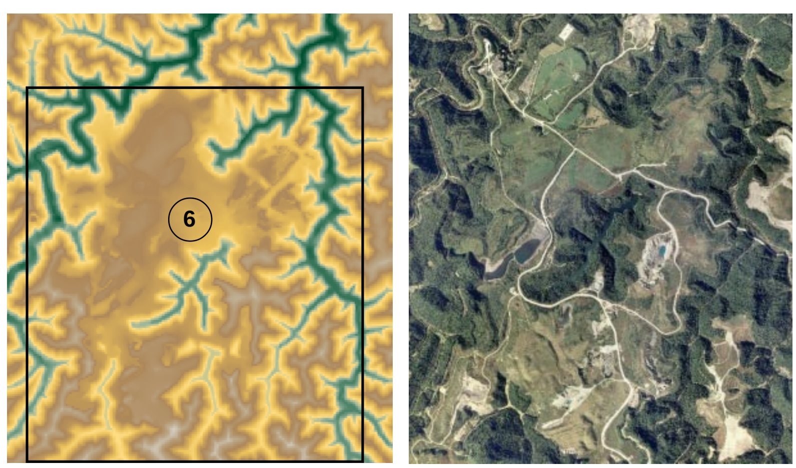
the United States by photogrammetric methods (manual profiling and electronic image correlation) include striping artifacts, anomalously high elevations in areas of forest cover, and patchy areas of poor elevation quality. Some of this older, poor-quality data persists locally in the current National Elevation Dataset (NED) of the United States distributed by the U.S. Geological Survey. As examples of the elevation errors that may occur, some of the production artifacts that MicroImages has encountered in the 1 arc-second (approximately 30-meter cell size) NED are tabulated and illustrated below along with color orthoimages of the problem areas.



Some elevation anomalies may be evident when you view the DEM, especially when it is displayed with a color palette or with relief shading. In other cases the anomalies may only be revealed because of their effects on the initial Watershed process results, such as unfilled depressions and nested watershed polygons. Some elevation artifacts can be handled adequately by setting proper depression-filling parameters in the Watershed process, or allowing the process to automatically insert a null cell (drain) in the bottom of unfilled depressions (see the Technical Guide entitled *Terrain Operations: Fill or Drain Depressions in DEMs*). Other artifacts may require editing the elevation values in the DEM using the TNTmips Editor to enforce the proper drainage patterns. Plan to rerun the Watershed process several times and carefully compare the interim results to other data sources such as digital topographic maps, orthoimages, and satellite images to determine the nature of the anomalies. The imagery available online in Google Earth also provides a convenient reference for evaluating DEM problems. If these comparisons are made in TNTedit, the DEM raster can be edited to correct these conditions prior to each subsequent Watershed process run to improve watershed boundaries and drainage patterns and the many parameters computed to describe them.







Local Elevation Anomalies Encountered in 1 arc-second (30-meter) NED
(numbers keyed to illustrations)

1. General poor data quality producing stream valley blockages; probably older data produced by photogrammetric methods.
2. Anomalously high elevations in stream valley in area with patches of coniferous forest (dark green in leaf-off color orthophoto); data probably produced by photogrammetric methods.
3. Highway embankment depicted in DEM blocking stream valley.
4. Highway bridge depicted in DEM blocking stream valley.
5. Quarry creates local artificial depression in wide stream valley.
6. Strip-mined area with ridges removed and spoils dumped in adjacent valleys; wholesale blockage of drainages.

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