Catchment Slope Calculation
in Vertical Mapper

Technical Note.
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In order to calculate subcatchment slope, two or three lines (or more) are drawn through the sub-catchment along alignments that represent the average slope (see Figure 1). The area-weighted slope (See Figure 2) of each line can then be computed directly using Vertical Mapper. Note that it is essential to follow a consistent direction when drawing the catchment slope lines, for example, they should always be drawn from upstream to downstream, or visa-versa.
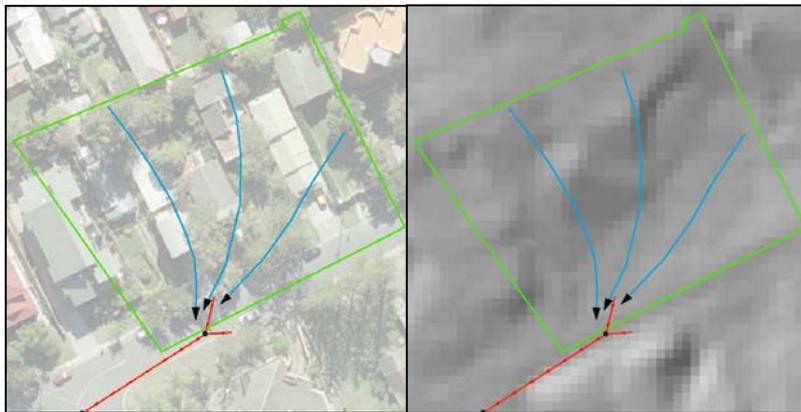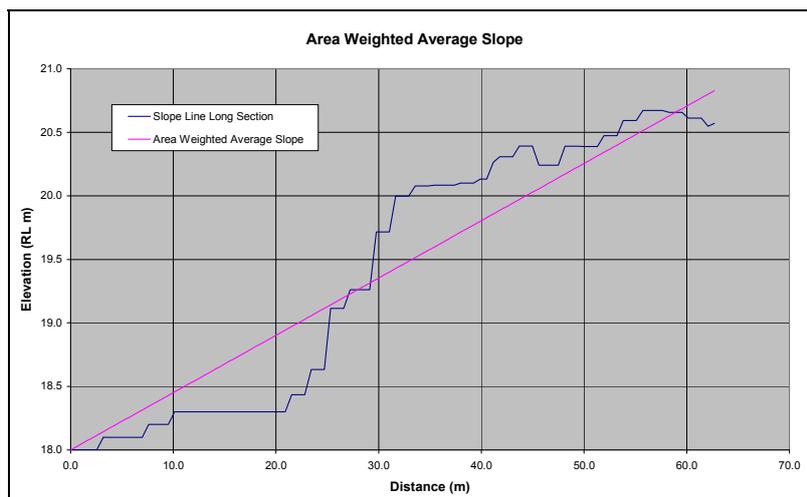

Figure 1. Example slope lines.

Figure 2. Area Weighted Average Slope.

In Figure 2, the area under both slope lines (the real profile and the averaged profile) must be equal in order to achieve an area weighted average slope. In this case the area is about 88 m². Also, the horizontal length of each line is equal, about 63 m. Given that both lines have equal area and horizontal length, it then follows that the average height of each line must also be equal, that is, 88/63 = 1.4m.

Therefore the 'mean elevation' of both lines in Figure 2 is 18.0 + 1.4 = RL 19.4m. This parameter of 'mean elevation' is the key to the automation of slope calculation. The slope of the Area Weighted line is calculated by:
- rise = mean height * 2 [ie, 1.4m *2 = 2.8m]
- run = 63m
- slope = 2.8/63 = 0.044 (4.4%).

Vertical Mapper can be used to calculate these above parameters for the slope calculation. In the Vertical Mapper Grid Manager under Analysis (see Figure 3 below), select the Line Inspection tool, select the Table which contains the catchment slope lines under Table to Update, then tick the "Average Value" and "Start Value" boxes to determine the Average grid value along the slope line, and the start RL of the slope line. Vertical Mapper will then append these calculated values to the slope line Table as new attributes.
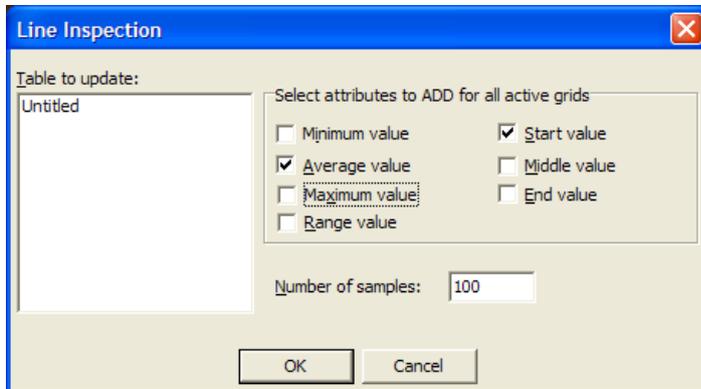

Figure 3. Vertical Mapper Line Inspection tool

Also note that the horizontal line length can be calculated through Table | Update Column | Assist (see Figure 4 below).
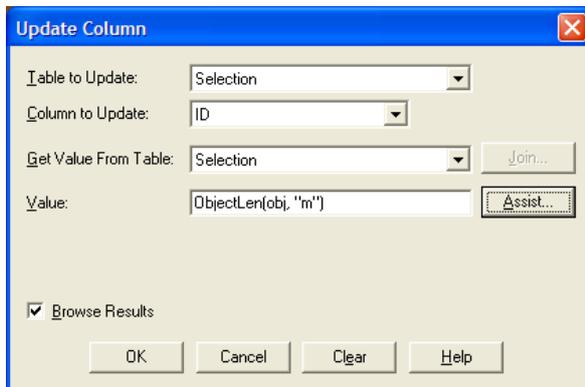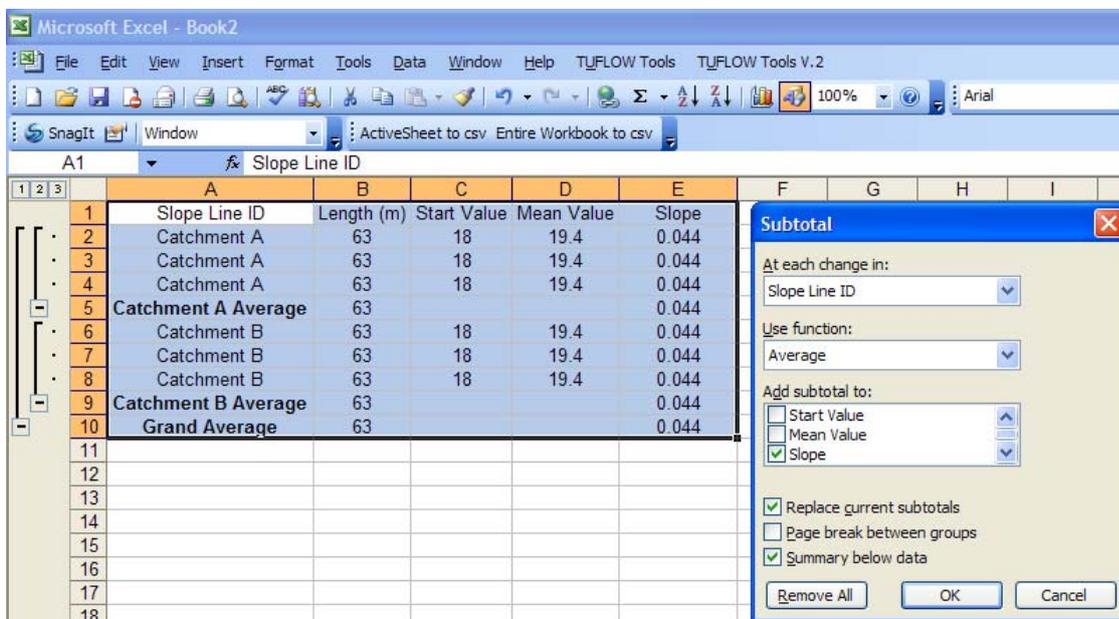
Figure 4. Mapinfo Calculation of Line Length

The catchment line Table's new attributes can then be exported to Excel (Table | Export), and the following equation used to calculate the area weighted average slope:

area weighted average slope = (Average Value – Start Value)*2 / ObjectLength

The method is particularly powerful as it can calculate the above parameters for hundreds of slope lines and catchments in just seconds. If undertaking calculations for more than one sub-catchment, it is worth updating the Slope Line ID table (in Mapinfo) with the underlying Catchment ID (using Table | Update Column) in order to allow for sorting in Excel. In Excel, use the Data | Subtotals function in order to calculate mean slope and mean length of sets of slope lines within each sub-catchment.