How to estimate the overland flow time in predevelopment based on watershed delineation

Earthwork · https://mes100.com/docs/how-to-estimate-the-overland-flow-time-in-predevelopment-based-on-watershed-delineation/

Overland flow time

For overland flow time, the formula to calculate the time is given as below:

$$t_o\:=\:\frac{\left(107\:\times \:n\:\times \:L^{\frac{1}{3}}\right)}{S^{\frac{1}{5}}}$$

This formula is used to estimate the **time of concentration (to)**, which is the time it takes for runoff from the furthest point in a watershed or drainage area to travel to the outlet or a stream.

Flow Path Length (L): The longer the distance water has to travel across the surface, the longer it will take to reach the outlet

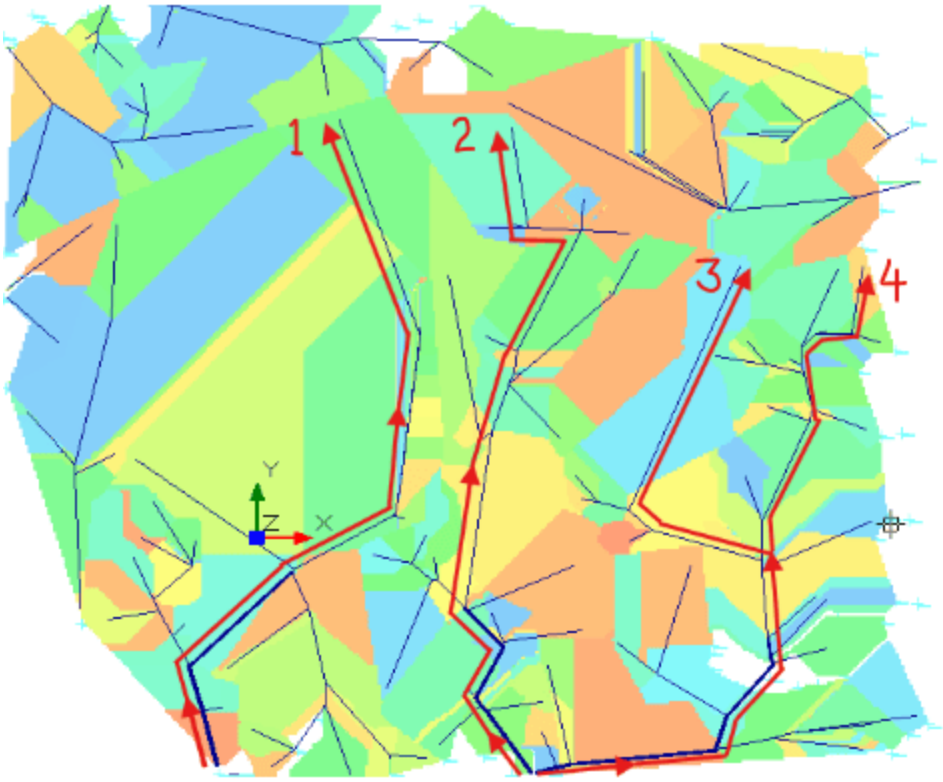
Surface Roughness (n): The rougher the surface, the slower the water flow will be, leading to a longer time of concentration

Slope (S): The steeper the surface, the faster the water will flow, which means a shorter time of concentration

How to calculate to using Watershed Analysis in MiTS?

Depending on the project;s terrain, watershed analysis will generate many streamlines that consist of many polylines. And each line will have its own to. From the sample project file, we can see that 4 paths are longer than the rest and could potentially have the greatest overland flow time.

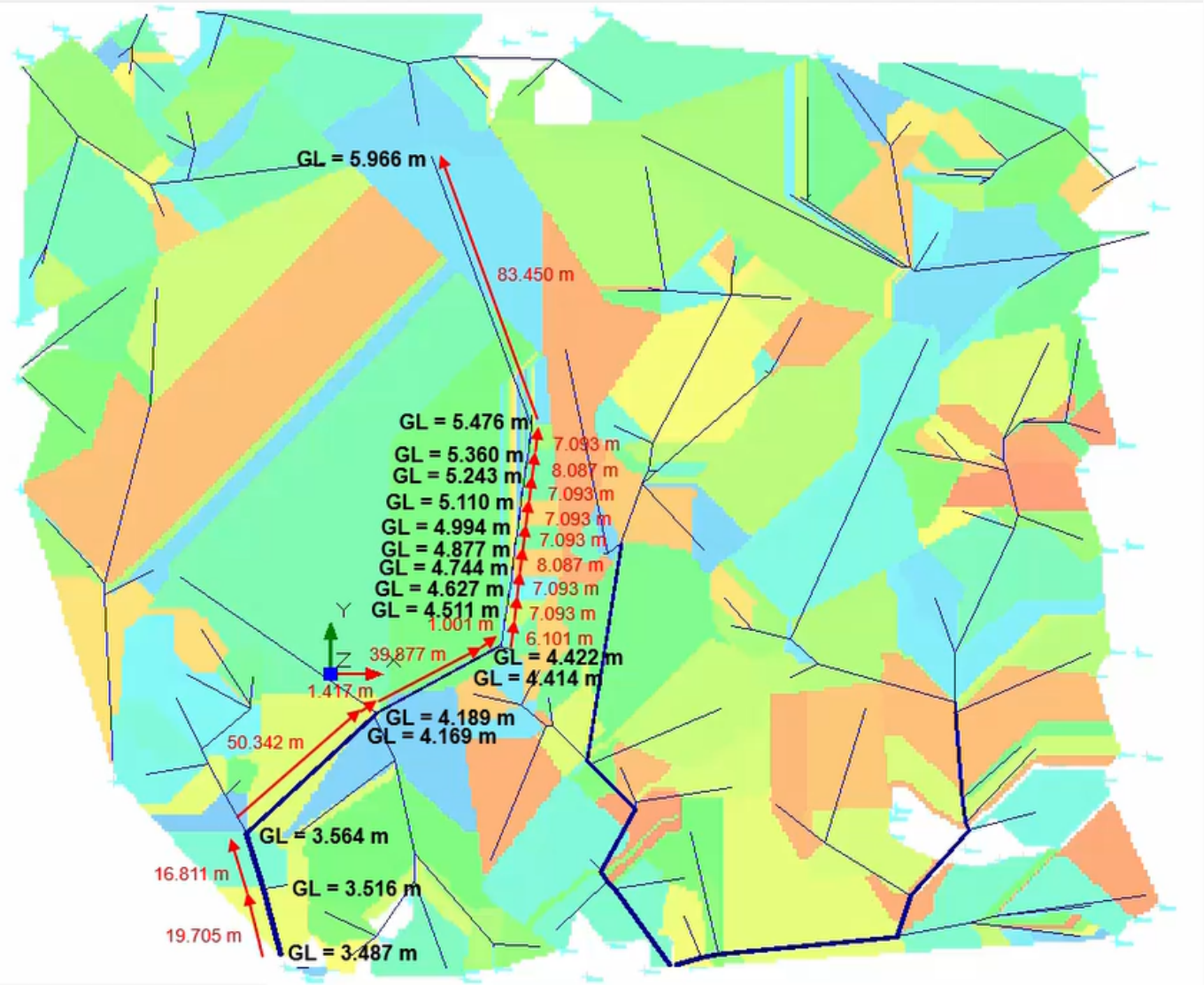
Sample Project File **HERE**



4 longest path

Using the Measure tool from the CAD tab, we can measure the length of each path and determine the ground level at each path vertex. The example below shows the process of determining the length and ground level of each vertex along path 1.

Measuring Length and GL using CAD tools



Length of polyline and GL of vertex along path 1

Let’s say the whole area is averagely grassed, so it’s n would be 0.45. The overland flow time, to for path 1 would be the sum of to of each polyline.

$$t_o\:=\:\frac{\left(107\:\times \:n\:\times \:L^{\frac{1}{3}}\right)}{S^{\frac{1}{5}}}$$

$$\sum t_o\:=\:t_{o1}\:+\:t_{o2}\:+\:t_{o3}\:+...+\:t_{on}$$

$$\sum t_o\:=\:\frac{\left(107\:\times \:0.45\:\times \:19.705^{\frac{1}{3}}\right)}{0.1472^{\frac{1}{5}}}\:+\:\frac{\left(107\:\times \:\:0.45\:\times \:\:16.811^{\frac{1}{3}}\right)}{0.2855^{\frac{1}{5}}}\:+...+\:\frac{\left(107\:\times \:\:0.45\:\times \:\:83.450^{\frac{1}{3}}\right)}{0.0.5872^{\frac{1}{5}}}$$

$$\sum t_o\:=\:19.0791\:+\:15.8489\:+...+\:23.4055$$

$$\sum t_o\:=\:179.9225\:min$$

The to for all 4 paths after calculated is as per below:

Path 1 = 179.9225 min

Path 2 = 179.9134 min

Path 3 = 160.4612 min

Path 4 = 206.9849 min

As the largest to is path 4, this value can be used for the analysis of predevelopment stage.

Related



Ngu Soon Hui

I'm the Benevolent Dictator for Life for MiTS Software cum Editor of this website. Read more here.

You can also contact me at soonhui@mes100.com