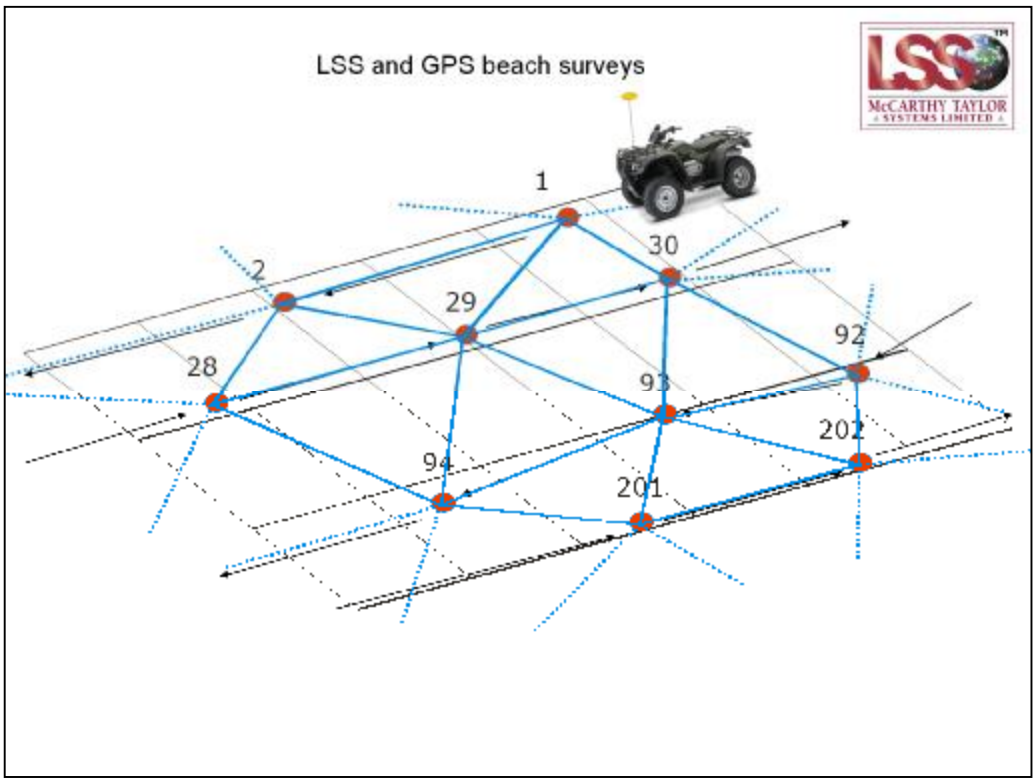
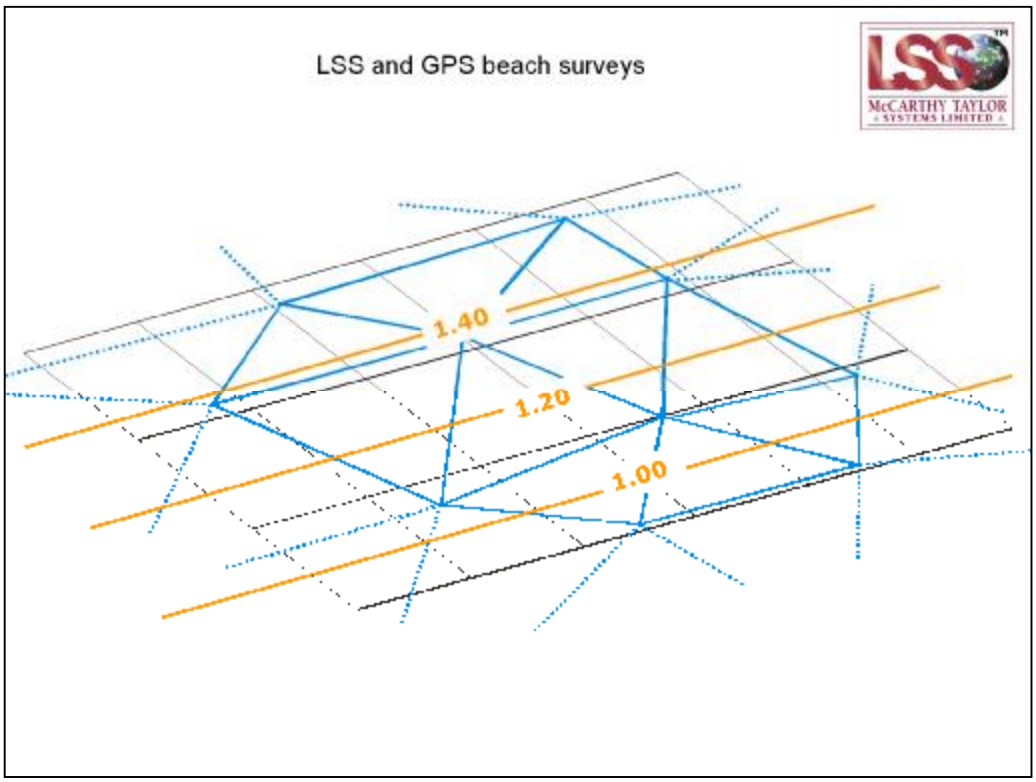


This presentation explains how LSS corrects for the non-verticality of the GPS antenna when mounted on an all terrain vehicle.

We see here a section of beach. The red dots indicate where the GPS device recorded a surveyed point. In this case the antenna is mounted 1.44m above where the front right wheel makes contact with the ground.

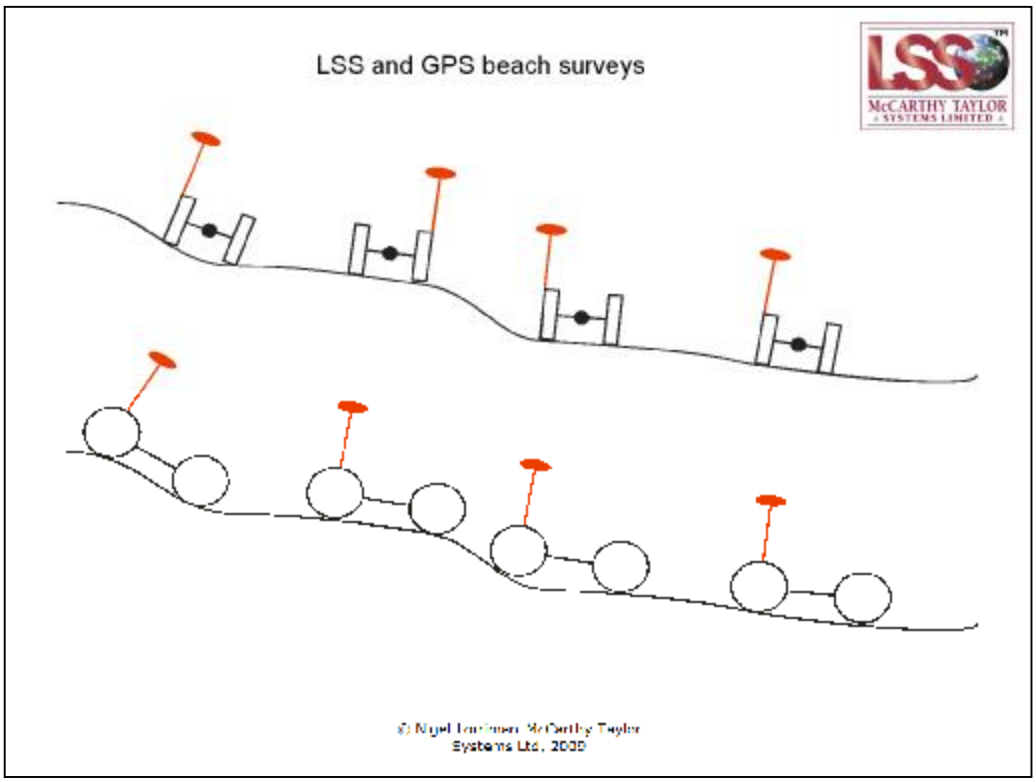
The numbers you see simply represent the order in which the points were surveyed because this becomes important later on.

When the data is loaded into LSS as a series of XYZ points it immediately generates a triangular mesh known as a terrain model. It creates the most equilateral triangles it is able given the data presented to it.

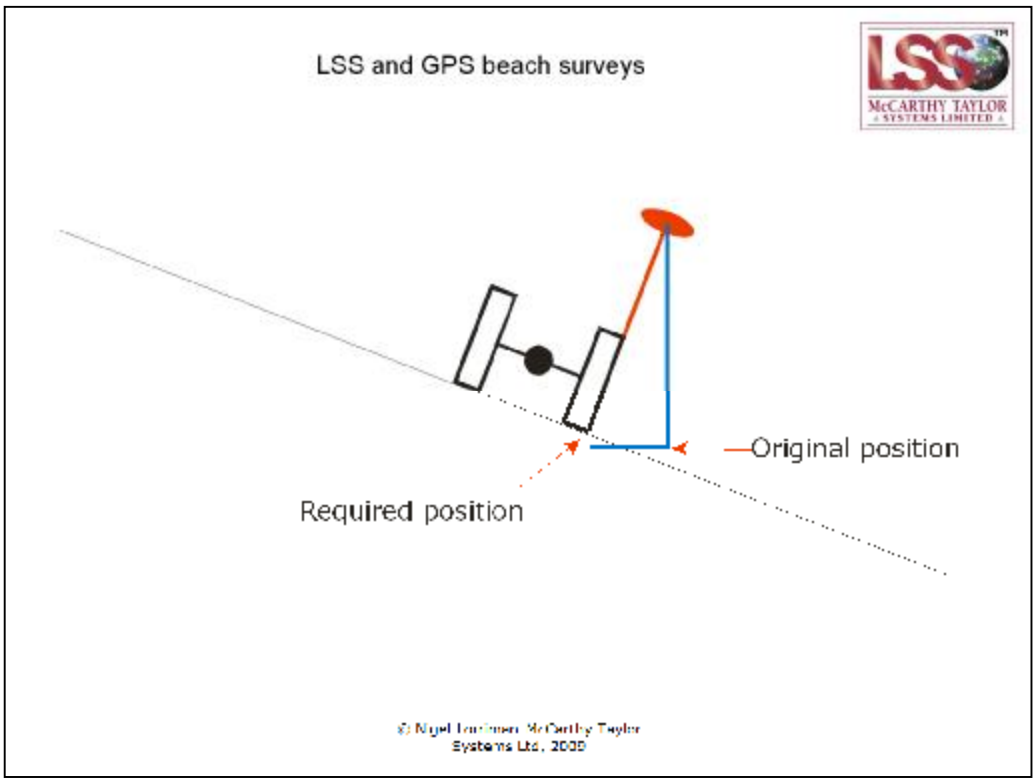


Through this triangular mesh can then be drawn contours.

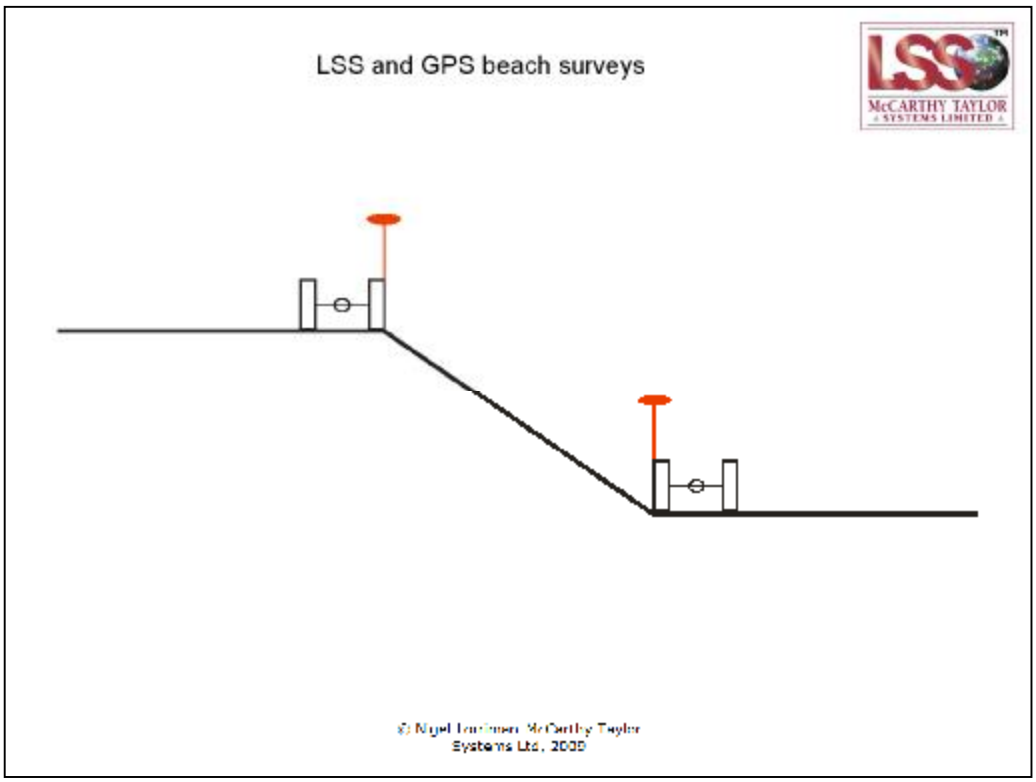
The problem we have, though is that the beach is sloping and the all terrain vehicle (ATV) is rarely level. It will have some element of pitch and roll, thus giving us a false picture of where the GPS antenna is in relation to, in this case, the front right wheel.



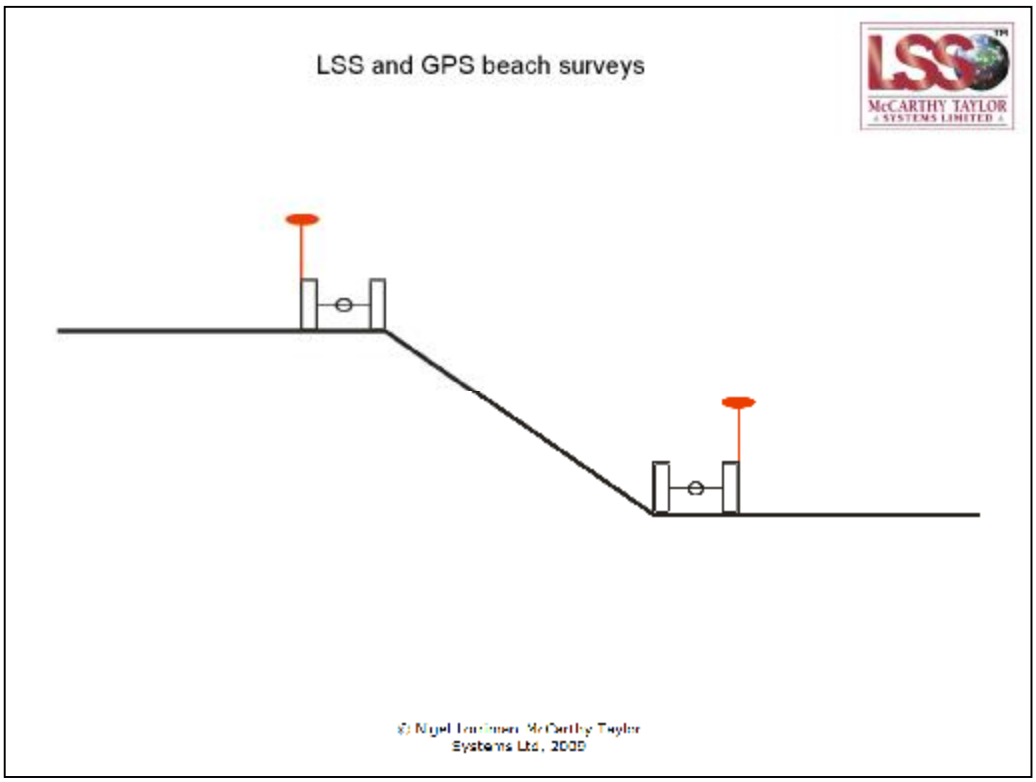
If the ATV is driven along the beach ridges there will be more yaw. If it is driven up and down the ridges there will be more pitch. Whichever method is chosen, there are inherent inaccuracies should we choose not to correct for this situation.



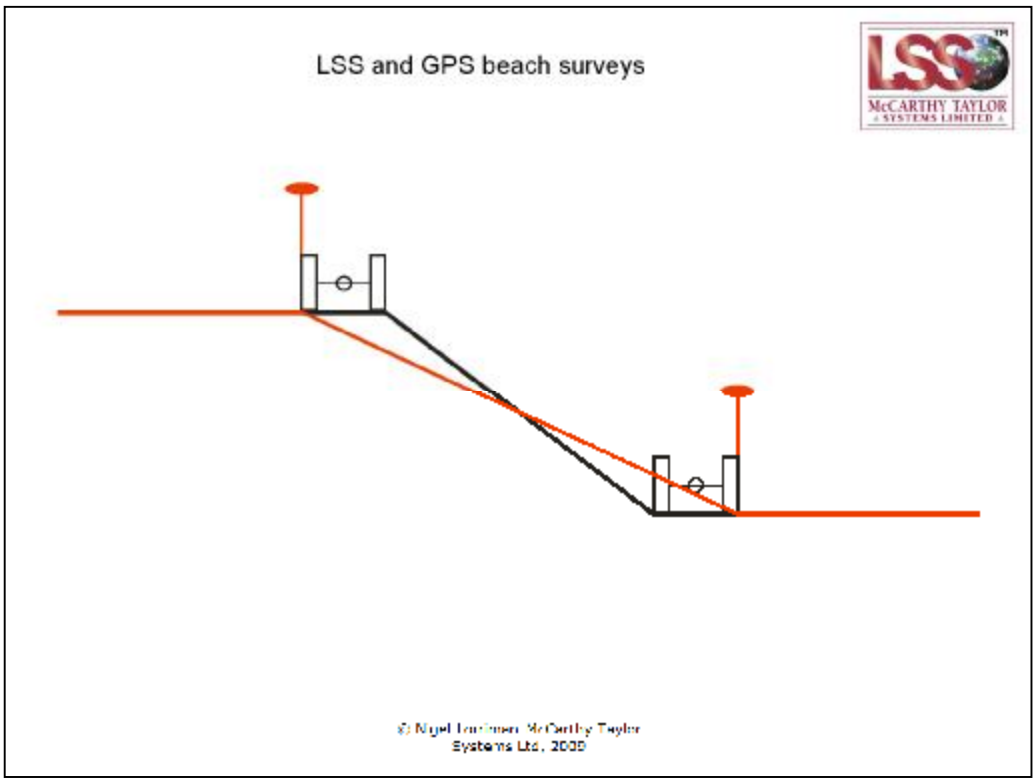
For any given GPS reading the calculated position of the antenna will always be lower than the actual position and it will be offset in a direction which is a product of the pitch and yaw values.



But before we consider how LSS corrects for these inaccuracies, it is important to emphasise the value of collecting the right data in the first place. Here we have a beach ridge. We need to make sure that the antenna is as close to the breaks of slope as possible, otherwise the following will happen...

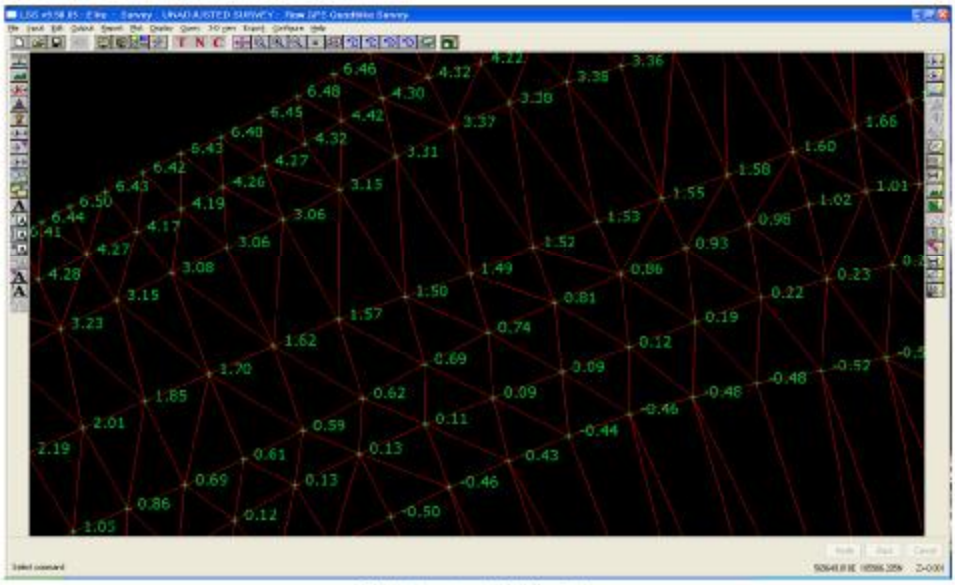


The breaks of slope won't be correctly positioned because the antenna is on the 'wrong' side of the ATV.



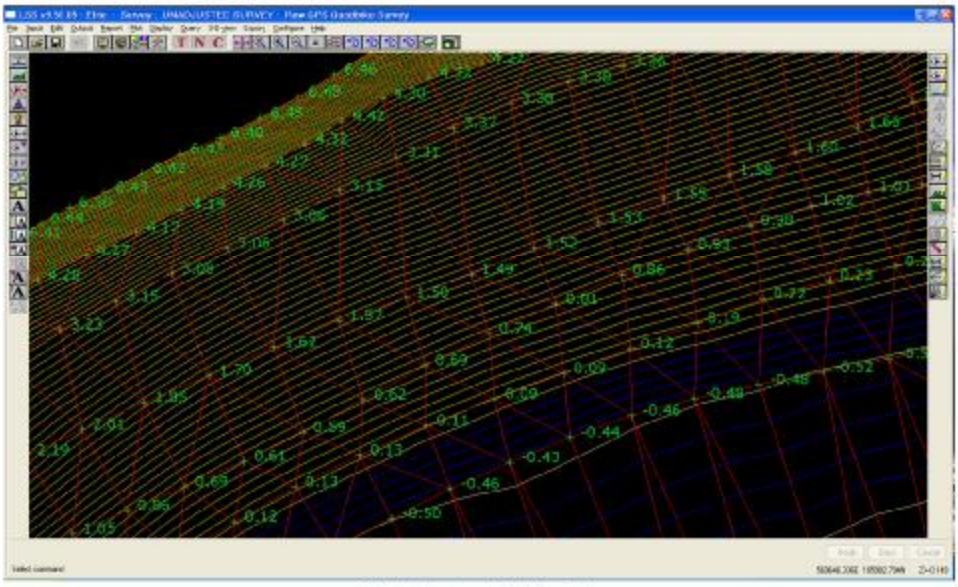
The resulting slope will therefore be wrongly defined.

LSS and GPS beach surveys



Having surveyed the beach we now have the terrain model – in its uncorrected form. The numbers are the levels for each point.

LSS and GPS beach surveys



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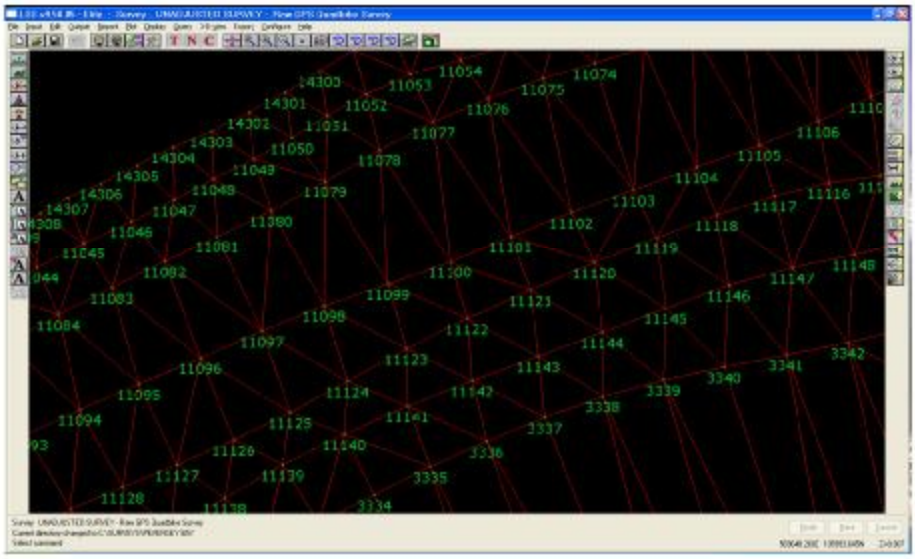
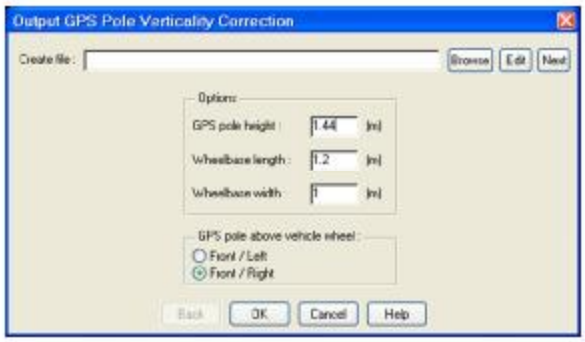
Now with contours switched on.

LSS and GPS beach surveys



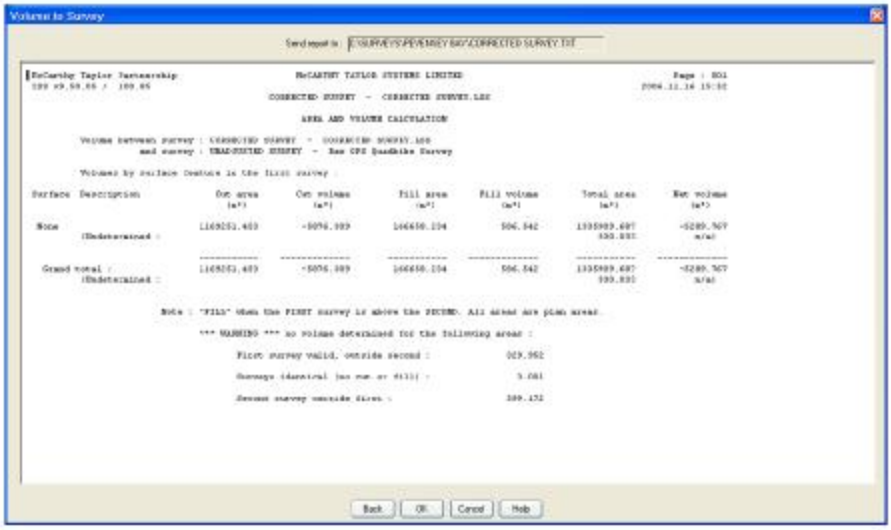
Now we display the point numbers which show us the order in which the points were collected.

LSS and GPS beach surveys

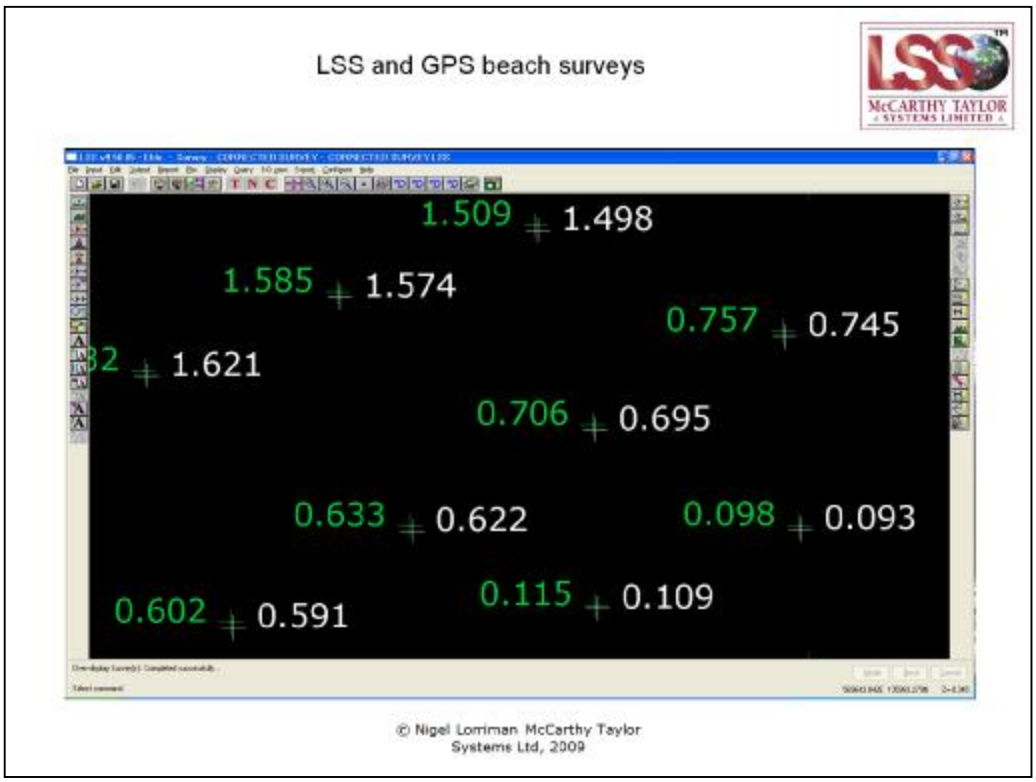


Choose the command 'GPS pole verticality' and enter the ATV parameters. We will end up with a new survey containing the corrected GPS positions.

LSS and GPS beach surveys

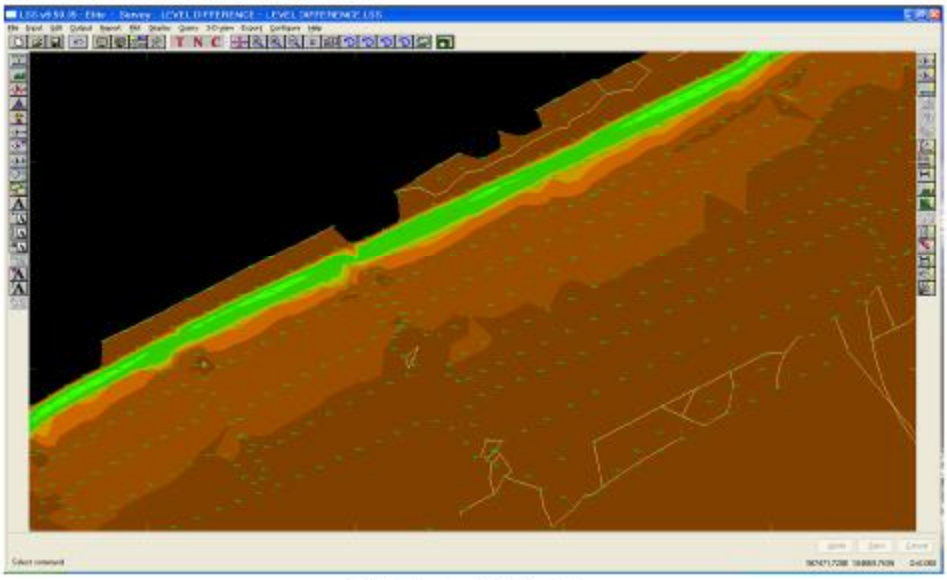


The model this exercise produces will look very similar to the original, but the volume calculation shows you that it is not. Here we have a 5,000m3 difference between the corrected and uncorrected models.



What we see here are the original (uncorrected points in white) and corrected points in green. Not only have they moved vertically, but horizontally.

LSS and GPS beach surveys



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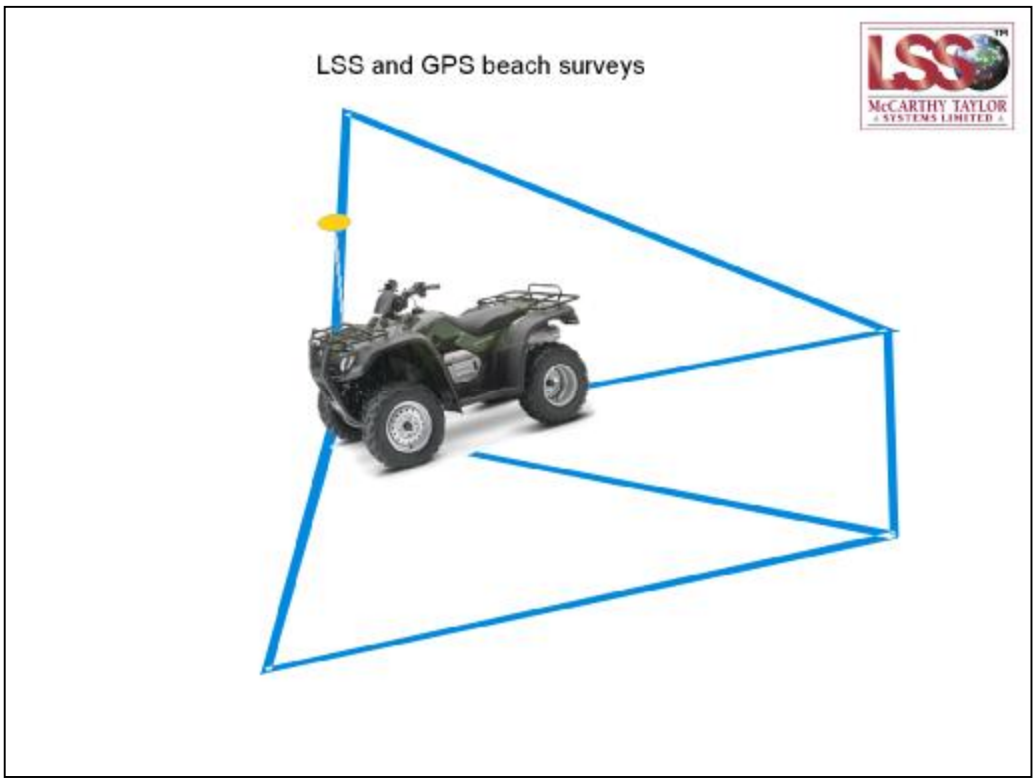
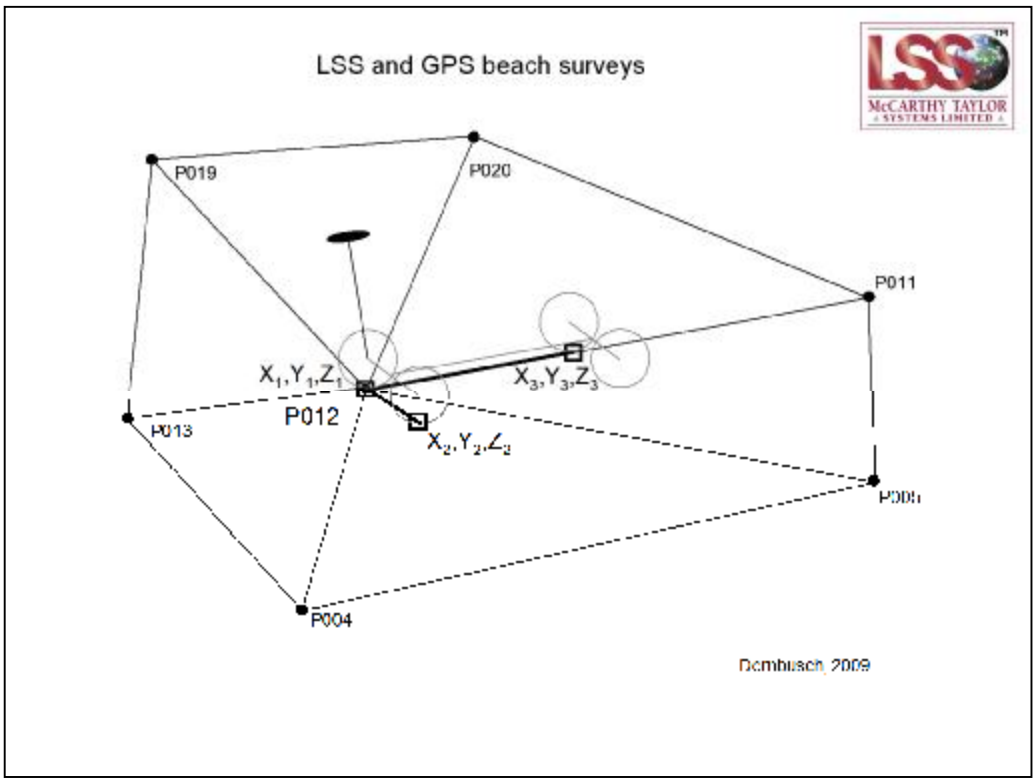
This is an isopachyte (level difference) model which shows the differences in level between the uncorrected and corrected models. The brighter colours indicate the greater level difference. These will fall where the slopes are steepest and hence where the greater verticality correction has been applied.



So, back to the terrain model created from the GPS data. The order the points were loaded into the model tells us what direction the ATV was travelling. Therefore we know where the antenna was in relation to every surveyed point.



We take the footprint of the ATV and calculate from the original terrain model triangulation the levels of the three primary corners. From these we can determine the adjusted XYZ of the surveyed point.

LSS and GPS beach surveys

Slope	Vertical correction	Horizontal correction
1 in 10	7mm	143mm
1 in 8	11mm	179mm
1 in 6	20mm	237mm
1 in 5	28mm	282mm
1 in 4	43mm	349mm

(pole height 1.44m Wheelbase length 1.2m width 1.0m)

The kind of corrections are as follows, but remember it's not just the vertical difference that should be considered. The horizontal difference is also important.

The techniques described here are available in LSS Elite.

Thanks go to Ian Thomas of Pevensey Bay Coastal Defence Ltd for helping us identify the issues around surveying by GPS from an ATV.

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