



MAPPING PALAEOCHANNELS OF THE SWINDALE BECK USING AN UNMANNED AERIAL VEHICLE DERIVED DIGITAL ELEVATION MODEL FOR APPLICATION IN RIVER RESTORATION



AIM:

The Swindale Beck is situated in the eastern side of the Lake District in the upper Eden Valley in Cumbria. It underwent artificial straightening 200 years ago which contributed to downstream flooding and a loss of biodiversity.

In 2015 a river restoration scheme was established as part of a flood alleviation initiative. The aim was to reintroduce a more natural flooding regime, and in doing so enhance groundwater recharge and support the hay meadows and rush pasture which are Sites of Special Scientific Importance (SSSI) and Special Areas of Conservation (SAC).

This study analyses the historical dynamics of the Swindale Beck by using Structure from Motion (SfM), a low cost method to survey the river before restoration began and to suggest a proposed restoration route.

METHOD:

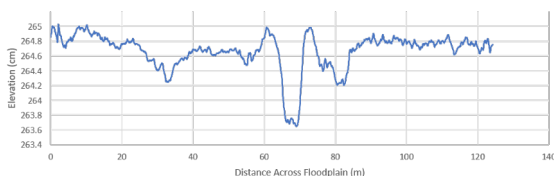
45 georeferencing control points were distributed across the reach and their GPS was recorded. A DJI Phantom 3 Pro UAV was flown across the study area at a height of 100 m and photos were taken every 4 seconds to ensure quality image overlapping. In total 600 photographs were used and loaded into AgiSoft Photoscan Pro 1.1. SfM was used to create a sparse point cloud which was then georeferenced using 14 GCPs and finally a dense point cloud was created. This was then exported as an orthophoto and a DEM which were both analysed in ArcMap using different spatial analyst tools.

RESULTS:

The accuracy of the DEM was comparable to that of LiDAR. Combining the DEM and hillshade was found to represent the palaeochannels most clearly. Their position was substantiated by topographic profiles which revealed that the Swindale Beck had a dynamic past.

Using this information, the river was restored using a route similar to the one proposed here. The new channel is 140 m longer and 2 m wider than the old route and is better connected to the floodplain through the removal of levees, thereby enhancing groundwater recharge. The new sinuous channel has provided habitat for plant and invertebrate species and salmon have returned to spawn.

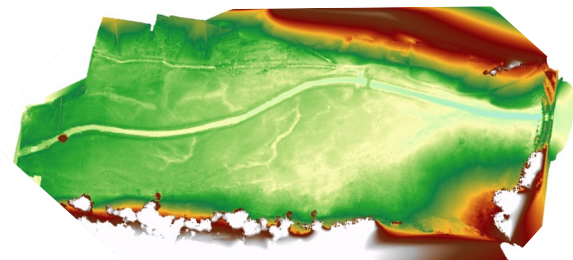
DEM STATISTICS	X	Y	Z
STANDARD DEVIATION (m)	0.121	0.132	0.248
RMSE (m)	0.183	0.161	0.116
MEAN ERRORS (m)	0.116	-0.018	-0.053



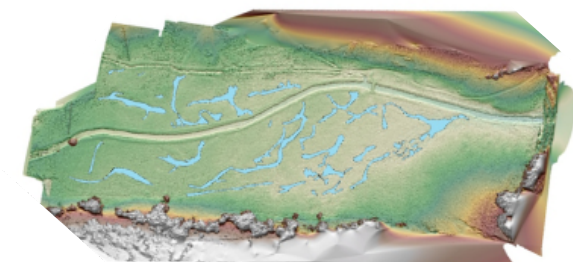
F) TOPOGRAPHIC PROFILE ACROSS THE FLOODPLAIN



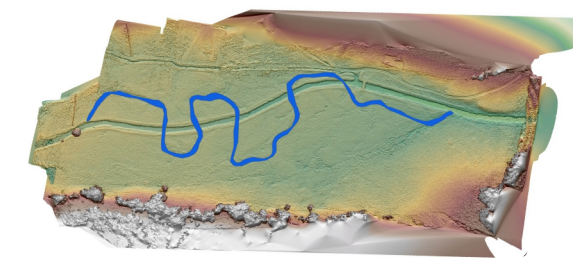
A) AERIAL PHOTOGRAPH



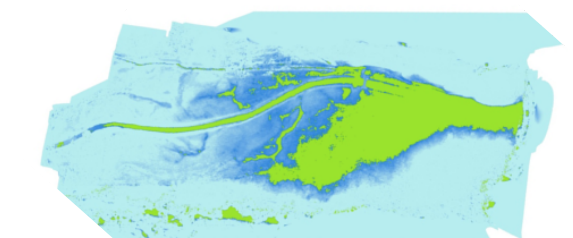
B) DIGITAL ELEVATION MODEL



C) DEM + HILLSHADE SHOWING PALAEOCHANNELS



D) PROPOSED RESTORATION ROUTE



E) NEGATIVE RELIEF (70CM)

ACKNOWLEDGEMENTS

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