Typical Landforms of River Valleys, with examples from the North Cotswolds

Introduction

This article will focus on the principal landforms of the North Cotswold landscape, namely the river valleys and the hill slopes that separate them. The river valleys show a recognizable evolution as they pass downhill from the high wolds, before passing out into the lowlands of the Upper Thames Valley. The hill slopes of the North Cotswolds all lie within one or another river drainage basin and form the catchment area for the river in question. The slopes provide a major source of water to the rivers, either through run-off or via recharging of the water table through soakaway. They also provide the major source of sediment to the rivers, either by run-off carrying soil and rock particles (especially after ploughing), or by slumping when the river over-steepens its banks causing failure, or (in the past) by periglacial freeze and thaw activity (Jeans (2021)).

In the text that follows, the illustrated localities are shown on the location map (Fig. 1). Other localities mentioned can be found on the OS 1:25,000 map of The Cotswolds.

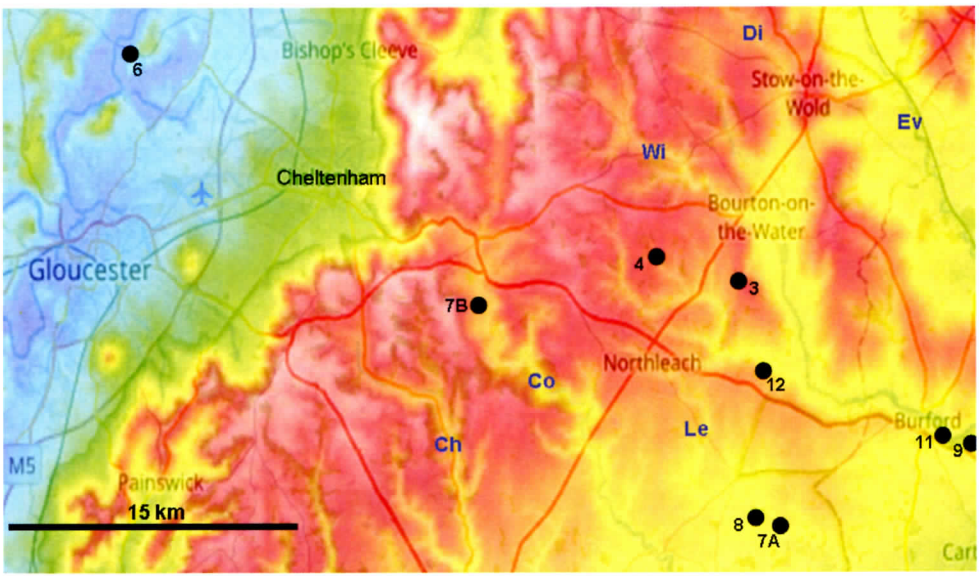

Fig. 1: Map showing (in black) the location of the Figures which illustrate the features of river valleys. In blue are the main Cotswold dip-slope rivers. Ch = Churn; Co = Coln; Le = Leach; Wi = Windrush; Di = Dikler; Ev = Evenlode.

The Cotswolds comprise a steep north-west and west-facing escarpment formed of Inferior Oolite Limestone of Middle Jurassic age, and a gently south-east dipping dip slope. The escarpment is indented by deep, steep-sided valleys ('combes'), with streams that flow north or west to the Avon or Severn Rivers. The dip slope is incised by south-east-directed valleys with streams (e.g. the Coln, Leach, and Windrush) which form north-bank tributaries to the upper River Thames (Fig. 1).

The valleys of the high wolds are quite open and rolling (e.g. the Windrush above Taddington), and generally dry, because rain water soaks away into the limestone. As one moves downstream, the valleys become quite steep-sided and deeply incised (e.g. the Windrush around Temple Guiting). Depending on where the water table is intersected, the valleys may be either dry or have perennial streams. In their middle reaches, the valleys are broader and more open, and usually contain perennial streams, especially where erosion has cut down to the impermeable Liassic shales which underlie the Oolitic Limestone (e.g. the Windrush from just above Bourton-on-the-Water, and Sherborne Brook from just above Haycroft).

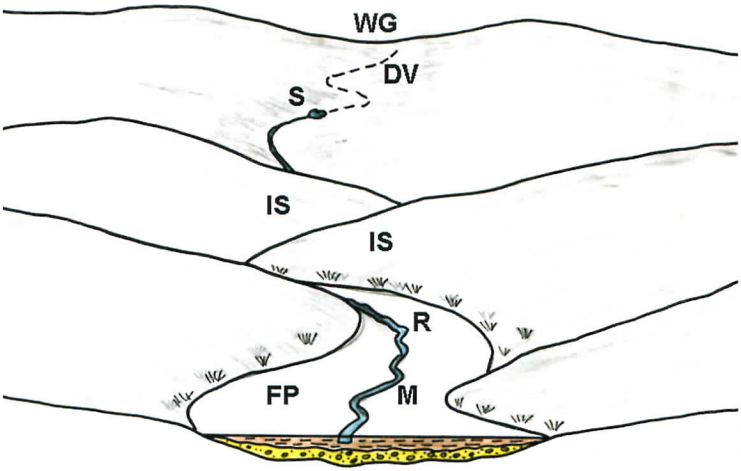

Fig. 2: Sketch showing typical features of the upper reaches of a Cotswolds river valley. WG = Wind Gap in escarpment; DV = Dry Valley; S = Spring; IS = Interlocking Spurs; R = River; M = Meander; FP = Flood Plain.

River Valley Landforms: Upper Reaches

Rivers rise at springs, and flow downstream, creating a progressively wider river valley, which can be divided into two general areas (Fig. 2) - the river channel itself, which is dominantly an area of erosion, whilst the floodplain or valley floor across which the river flows is generally an area of sediment deposition.

Springs (Fig. 2) can occur where the water table intersects the land surface (e.g north end of Haycroft Wood (Fig. 3); or Goms Hole); where an impermeable shale bed is exposed in the river bed (e.g. R. Dikler at Waterhead Barn); or where a fault runs across the valley (e.g. Pump House, south-east of Notgrove). Above the spring line there is often a dry valley (Fig. 2) which may pass up into a wind gap at the crest of the escarpment (see Jeans (2020)).

Fig. 3: Spring emerging in Haycroft Bottom (The Fork Wood: Grid Reference (GR) SP163167)

Surface streams can disappear down swallow holes into the subsurface. There are no true

Fig. 4: View upstream of Broadwater Brook just north-west of the Fosse Way, showing 3 interlocking spurs (GR SP132176). The stream makes its course around the base of each spur.

swallow holes in the Cotswolds, unlike the Yorkshire Dales (e.g. Gaping Ghyll). Instead, the river water just soaks away when the river reaches a particularly permeable horizon. Self and Boycott (2004) mention what they call 'Whirley Holes' (local Cotswold name for swallow holes) from Oakwell Swallett, and the Needlehole near Upper Coberley, but I have been unable to find either locality.

Where a stream flows over a resistant rock ledge a waterfall is formed (e.g. the basalt of High Force on the River Tees in Yorkshire). There are no equivalent hard rock units in the Cotswolds, hence no waterfalls: the rivers quickly smooth out any minor irregularities in their beds.

The upper reaches of a river valley often show interlocking spurs (Figs. 2, 4). They are alternating fingers of land that jut out into the valley such that the stream is forced to flow around them. Opposing spurs are separated by a narrow valley floor which is mainly taken up by the river channel. Lateral erosion progressively widens the valley

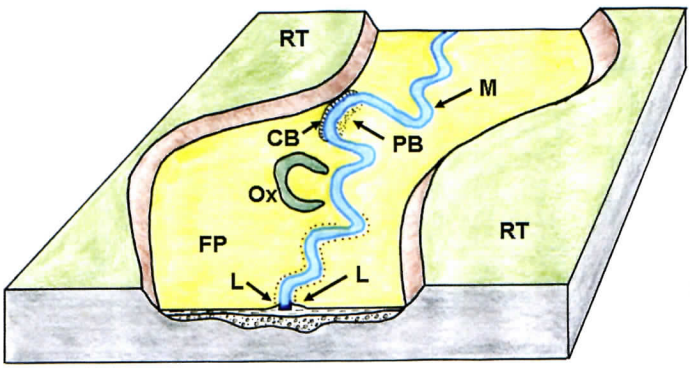

Fig. 5: Sketch showing the typical landforms of the middle reaches of a river valley. RT = River Terrace; CB = Cut Bank; PB = Point Bar; Ox = Oxbow; FP = Flood Plain; L = levees.

Fig. 6: A floodplain doing what it is supposed to do, i.e. storing flood water and preventing it from causing damaging floods further downstream, and depositing fine silt and clay to refresh the fertility of the floodplain fields. From the B4313 just E of the R. Severn, between Tirley and Apperley (GR SO853277).

and eventually removes the interlocking spurs, creating an open floodplain which (in general) progressively widens downstream. An exception to this downstream widening occurs where a more resistant, harder band of limestone intersects the valley, causing a narrowing of the valley, as seen on the Windrush above and below Aston Farm, NW of Bourton on the Water, and also between Great and Little Barrington. Note that the Jurassic limestone is not sufficiently hard to support a waterfall, although these river sections do show an increase in stream gradient.

Fig. 7: Meanders, both large and small, as seen on the River Leach above Sheep Bridge (A: GR SP185070) and on the River Coln near Fulford (B: GR SP026178).

Fig. 8: River Leach near Dean Farm, showing a meander with its cut bank (CB) where erosion occurs, and its point bar (PB) where deposition occurs. (GR SP169079).

River valley landforms: middle reaches

The middle course of a river (Fig. 5) has more energy and volume than the upper course. The gradient is gentler and more lateral erosion widens the valley. The river channel also becomes deeper.

When rivers flood they deposit sheets of fine sediment over their floodplain. This not only builds the fertility of the floodplain soils, but also serves as a natural water storage scheme (Fig. 6), enabling the slow discharge of floodwater thus preventing more extreme flooding downstream.

Meanders are typical landforms found in this, low-gradient, stage of the river valley. A meander (Fig. 7) is one of a series of sinuous curves in the course of a river, produced as the river erodes the outer, concave bank (the cut bank) where water flow is fastest, leading to slumped river banks, and deposits sediment on the inner convex bank (creating a point bar) where water flow is slowest (Fig. 8).

This pattern of erosion and deposition causes the meanders to slowly migrate both downstream and across the floodplain.

Oxbows are created in times of flood, when there is a tendency for highly curved meander loops to be cut off as the river takes the shorter, steeper course across the 'neck' of the meander. This creates an oxbow, which initially is usually a lake, but which progressively

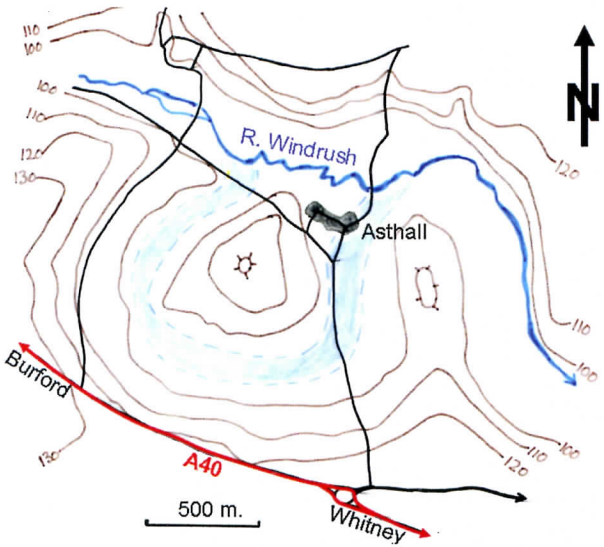

Fig. 9: Sketch map of the Windrush cut-off meander, or oxbow (shown by the contour pattern and shaded blue) around Asthall village. (GR SP286113)

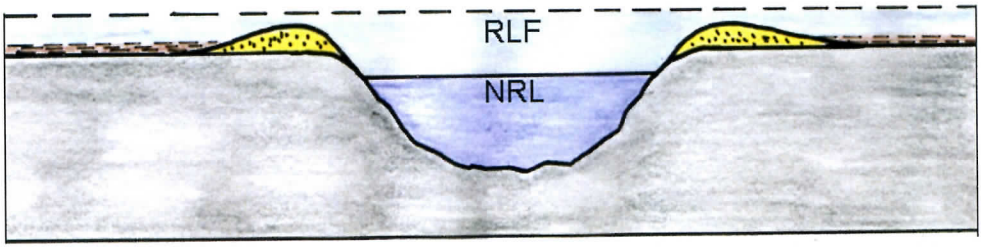

Fig. 10: Cross section of river valley and floodplain showing how levees develop during periods of flooding. NRL = normal river level; RLF = river level during flooding.

becomes infilled with sediment, creating an arcuate, dry, abandoned meander loop above the present river level, as can be found around Asthall, just east of Burford (Fig. 9).

Levees are natural embankments produced during flood events. When a river floods, it deposits its sediment load over the flood plain due to a dramatic drop in the water's velocity as it leaves the main channel (Fig. 10).

The largest and heaviest load is deposited first and closest to the river bank, often on the very edge, forming raised mounds. The finer material is deposited further away from the banks causing the mounds to taper off laterally. Repeated floods cause the mounds to build up and form levees, as can be seen along the banks of the Windrush below Burford (Fig. 11).

However, note that some farmers regularly dredge their river beds, and dump the mud and stones on the river bank, creating an (artificial) levee. This can be seen along the Coln below Stowell Park: I saw them being created, which is the only reason I know they are artificial.

Long-lived river systems produce a series of flat terrace surfaces along their course.

Fig. 11: Levee forming the bank of the River Windrush just downstream from Burford. Note that the line of the footpath is noticeably lower than the top of the levee. (GR SP264114).

Fig. 12: River terrace upon which much of Sherborne village is built, ~12m above the level of Sherborne Brook. (GR SP169149).

When the river starts to erode and cut down into its floodplain, either because the volume of water increases (e.g. snow-melt during glacial periods) or because of post-glacial uplift of the Earth's crust, the old floodplain becomes abandoned and a new younger floodplain starts to form at a lower level (Fig. 5). The abandoned, now higher, flat floodplain surface becomes a river terrace, and is an indication that the river once flowed at a higher level. River terraces are often 'paired', i.e. terraces exist at roughly the same elevation on opposite sides of the river valley. If the terraces can be dated, for example by peat deposits (radio-carbon dating) or by contained Stone Age artefacts, the rate of down-cutting or uplift can be calculated.

River terraces are larger features than strip lynchets (Jeans (2022)) with higher 'risers', and wider 'treads', and they can extend for kilometres along the sides of river valleys.

River terraces are prime sites for human settlement (Fig. 12), from the Stone Age to the present. They are close to the river (supply of water / fish / power) but above flood levels, and are also composed of fine river alluvium, which makes excellent soil for agriculture.

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