River Synderford Geomorphology Walkover Appraisal

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July 2023

1 Summary

The River Synderford supported salmon spawning till the mid to late 1900s (with a single fish recorded at Maudlin Cross in 1997). For centuries the river has been a strategically important breeding ground for the River Axe’s trout population. For much of its history it has been a wooded valley, with well-connected wetlands extending from the valley floor up the valley sides.

It is currently becoming increasingly degraded, with the coarse stone riverbed having become mobilised, and with incision undermining trees and cutting into underlying clay layers and triggering excessive channel migration and enlargement. Furthermore, there are only fragments of the valley side wetland habitats remaining, with most having been drained and bypassed.

Intervention should seek to restore stable cobble bed river habitats, with a shallow channel that is well connected to wetland valley floor habitats. There is potential to create a catchment wide river floodplain and wetland ecology that merges riverine, freshwater valley floor and spring line wetland, through wet grass, wood and fen habitats extending up into the valley sides. Not only will this provide a rich mosaic of biodiverse habitats, but will ensure a resilient trout recruitment.

The preferred option is to restore shallow paleochannels that remain evident in the landscape, and are considered likely to retain a viable cobble and gravel riverbed. These would need to be restored as low capacity, woody material obstructed channel. Where paleochannels cannot be restored, the channel should be raised to historic bed levels along its current route. Further habitat restoration should include reconnection and creation of wetland valley bottom habitats, diversion of side streams into springs and flushes, and extension of these wetland habitats where possible up the valley sides.

2 Introduction

The River Synderford springs from Pilsdon Pen, flowing west, before turning north at Birdsmoorgate to Join the River Axe just north of Bere Farm. It cuts through the Upper Greensand chert bearing layers, and reveals strong evidence of a periglacial cobble and gravel strata reaching across the valley floor, which till recent times has formed the riverbed.

This review considers historic evidence of the nature of the river and its ecology, includes a summary of the geomorphology walkover, and a set of recommendations for feasibility assessment. Appendix A includes details notes on the walk over visit.

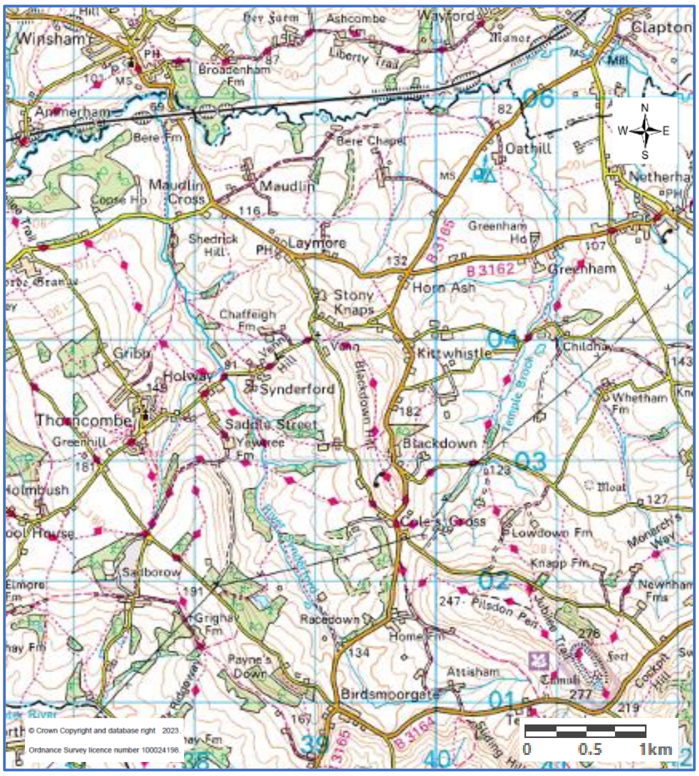


Figure 1. River Synderford catchment

3 History of the Synderford river valley

A range of sources of information are available to tease out the history of the Synderford valley and its ecology. These range from historical documents, map records, topographic reminders to the eye and through aerial surveys, as well academic research into the paleoecological and geomorphological histories in the area.

Together these paint a changing landscape, built on past geology and then set in motion during the last glaciation period. At the end of the glaciation period, thawing lead to collapse of hillslopes and the spread of chert cobble and gravel layers across much of the lower and mid valley floors. Valley wide wetlands, rich in wildlife, persisted through till at least the Iron Age, with a clean flowing cobble and gravel river running through it, possibly in multiple channels.

However, woodland clearance for farming on the valley tops is likely lead to the release of sediments into the valley and the gradual development of floodplains through the Roman and medieval periods. However, in many sections, especially the steeper upper and mid sections this would have been quite marginal. A mill leat and mill were constructed at Shedrick in this time.

Till the mid-1800s the valley remained largely wooded, and the stable cobble and gravel riverbed within this provided a valuable breeding ground for trout and probably Salmon, providing valuable support to the overall fish population within the River Axe.

By the late 1800s, however, much of the woodlands within the valley and along the hillslopes were cleared. Agricultural land drains would also have been installed, changing the hydrology of the river system. These changes triggered a change to the geomorphology of the river and the ecology that it could support.

3.1 Historical records

Pulman’s 1854 The Book of the Axe includes brief references to the river, its importance to the River Axe’s trout population, and its woody nature. The relationship between the woody nature of tributaries and the healthiness of their breeding ground he similarly relates for the Kit Brook and Blackwater Brook.

> “*It is called the Synderford Brook, and is particularly valuable as a breeding-stream, on account of the proximity of its mouth to the Ford Abbey preserves, in which it helps most materially to keep up the supply of fish. The stream is small and woody;- not worth fishing with the fly, although a few parts of it are sufficiently open.*
>
> *Being peculiarly a breeding-stream, it cannot be fished late in the season without material injury to the next year’s stock of fish in the main river. Not a fish should be taken out of it after July*.”

The National Library of Scotland holds digital copies of maps across England, including through the River Synderford Valley. The OS Six Inch 1888-1913 map represents the earliest accurate mapping on their records.

There is notably little woodland suggested within the Synderford valley bottom in the 1888 map. Wooded riparian corridors are suggested between Lower Shedrick and Oxenleaze Coppice, with perhaps half a mile of some upstream of Synderford. Wetwood Coppice is shown extending down to the river on the west side, with partial woodlands then appearing up to Castlewood Farm. Short sections of the river are shown as wooded close to Attisham.

The 1949-1972 OS 1:10,000 map indicates rough grazing and woodland for a short distance upstream and downstream of Oxenleaze Coppice. The woodlands between Wetwood Coppice and Castlewood Farm appear to be comparable in extent as in 1888.

The OS Six Inch 1888-1913 Maps also suggest channel movement away from an earlier route used as the parish boundary in reaches between Yew Tree Farm at Synderford through to upstream of Wetwood Coppice.

At Castlewood Farm the river took a route on the west of the valley, demonstrating that the current lake was constructed on the line of the former channel. The lake is absent from maps up until at least 1972. Whereas the Birdsmoorgate pond was already in place in the valley bottom by 1888. The channel between there and Attisham is variously shown or absent in the various maps since 1888.

There is a long history of milling on the River Synderford. Harris (2020) charted the history of Shedrick (Shiteroc) back to the 12th century. He found records of an annual rent from the grist mill from the early or mid-13th century.

More widely, Beaminster Museum (Harris 2018) dates weavers and mills in the area from 1593. It lists Chaffeigh's Mill, Crofts (Crafts) Mill (on Stonelake Brook), Shedrick Mill, Synderford Mill (on Stonelake Brook).

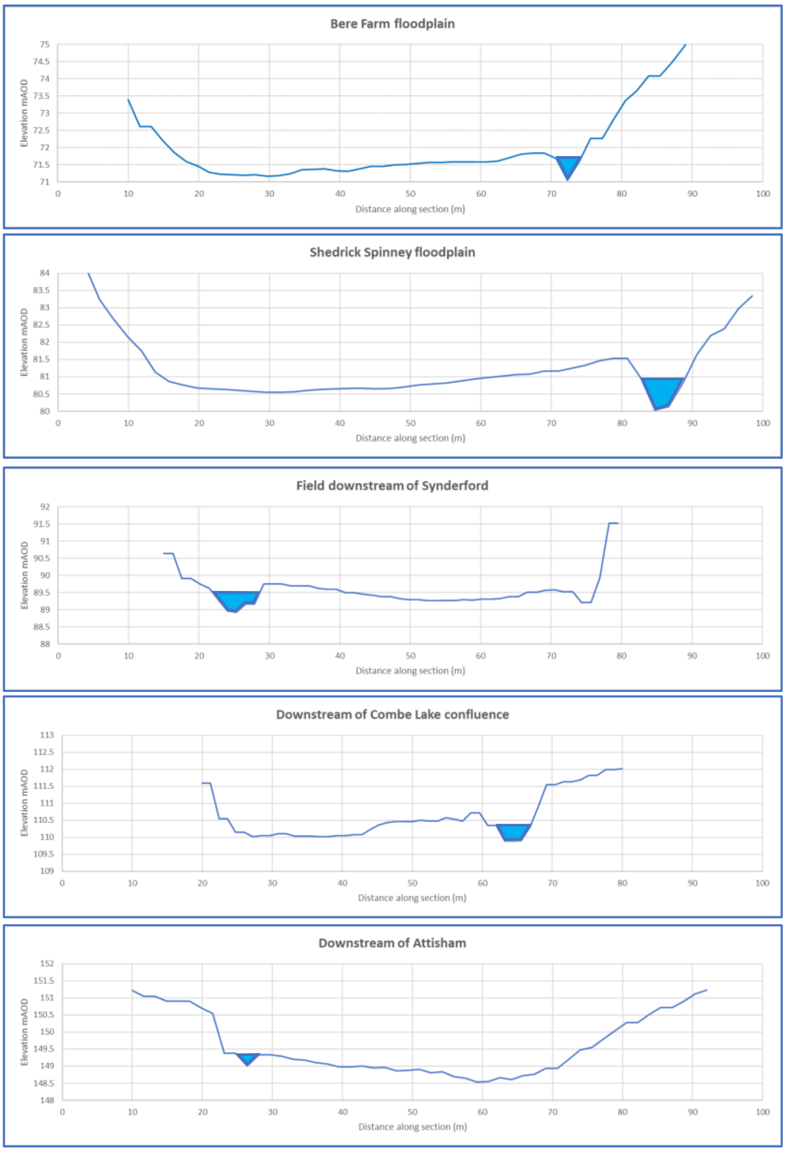
Shedrick and Chaffeigh Mills were operating as woollen mills in 1838 (Harris 2020). Shedrick Mill was possibly converted to flax in the 19th century, with flax grown on the Chaffegh and Blackdown side of the valley. Harris (2021) notes unsubstantiated claims of Chaffeigh Mill dating back to 1750, although it was not mapped on the 1806 or 1809 OS maps as Shedrick Mill was. The mill was documented in 1839 on the Tithe Map, and again in 1859 for child labour offences and insurance. However, it was not mentioned on the census in 1861.

OS Six Inch 1888-1913 shows milling in place at Lower Shedrick and the remains of the cloth mill at Chaffeigh.

3.2 Aerial Survey LiDAR

Aerial Survey is available throughout the Synderford catchment at 2m grid resolution. Cross sections have been taken at 5 locations up the River Synderford valley: across the floodplain upstream of Bere Farm; at Shedrick Spinney; in the long field downstream of the road bridge crossing at Synderford; downstream of the Combe Lake confluence, and between Birdsmoorgate and Attisham.

In all these locations, it is clear that the watercourse has been diverted to the side of the floodplain, away from and elevated above the natural route in the valley bottom.



At Shedrick Spinney the diversion is a result of the mill. Whereas agricultural practices may have resulted in the diversion at Bere Farm.

Downstream of Synderford, the slight elevation mismatch along with the presence of a parallel drain on the eastern side of the valley, suggests the watercourse was relocated for agricultural benefits. This is may well also be the case downstream of the Combe Lake, where the river has been diverted away from the wetland area to the west.

Downstream of Attisham, the channel is clearly perched, characteristic of a mill leat, with a near ninety degrees turn at the downstream returning it to the valley bottom.

Figure 2. Diverted and perched channel routes revealed by aerial survey data

3.3 Geomorphological literature review

A series of papers by Antony Brown (et al) on quaternary rivers, that includes the River Axe and the River Culm, gives a good understanding of the formation of the river and floodplain geomorphology.

Brown et al (2015) reveals the main Axe valley cut through Upper Greensand (Cretaceous period layers), and into the lower lying early Jurassic and Triassic layers, during glacial periods. Over the last 300,000-400,000 years, this deep valley was then buried with a stacked sedimentary sequence 20-30m thick of fluvial and periglacial sedimentation of near horizontally chert and sand-rich rocks. The lower sections of the Synderford valley follow a similar process, whereas, at higher elevations the valley cuts directly into the Upper Greensand layers.

Valley slope mapping by Brown et al (2015) indicates thaw-slump scars, related to large hill-slope failures caused by rapid permafrost melting with water pressures and hydraulic fracturing of the Upper Greensand chert layers that provides the source for this infilling material. They propose that over-sized and interlocking chert stones may have prevented incision of the river in interglacial periods until some 14,000-12,000 years before present. Similar thaw-slump scars are apparent in the Synderford valley, although at a smaller scale.

As the area emerged from the Lateglacial Interstadial, a periglacial braided river system extended across the width of the Axe valley and most likely across much of the lower and mid Synderford valley. Brown & Walling et al (2020) chart the evolution of such channel forms for the nearby River Culm from this braided state through to an anastomosed form around 5300 years ago.

This pattern is repeated across Europe with rivers dominated by vegetation, having no significantly raised floodplain, but wetland mires and flushes extending across the valley floor (Brown et al, 2018).

Around 4,000 to 2,000 years ago, deforestation and arable farming lead to an increase in silt-clay deposits that "*transformed European floodplains, covering former wetlands and silting-up secondary channels*" Brown et al (2018). Pulman (1854) looks back to the beginning of the 1600s when Axe valley hillsides were wooded throughout (with oak, elm, sycamore and beech), with only 'openings to view the crystal stream', and of hedgerow elms that were later removed. This correlates with intensification of farming in the Blackdown Hills from 1500 to 1600s associated with ecclesiastical estates, as reflected in radiocarbon dates of floodplain deposits in the Culm catchment (Brown et al, 2013).

However, Pulman's notes the wooded nature of the Syderford in 1854. This is not represented on the 1888 OS maps, which shows a broadly similar tree coverage to today. These two sources suggest a distinct period of intensification of farming within the Synderford valley during the middle to late 1800s.

4 Walk over description

The Synderford was walked from the confluence of with the River Axe to the B3165 Halscombe Bridge, on the 18th and 19th April 2023. Reach by reach notes and photographic descriptions are given in Appendix A. As summary of findings are presented below.

4.1 Summary

Along the entire length of the Synderford are signs of channel incision, channel planform instability, excessive mobility of coarse bed load material, and an acceleration in the rate of degradation. Whilst there are locations where livestock access to the river, in terms of grazing and poaching pressure, are significant, incision and instability is persistent beyond these pressures.

In many locations the river has been canalised and perched on the valley sides, either for milling or agriculture. The river is now adjusting away from these unnatural elevated routes.

Similarly, there are numerous signs of former channel routes, which predate these alterations. In many cases these support wetland plants and appear to be fed by ground water egress.

Not only has the main channel been altered, but side tributaries have been cut through former wetland flushes and mires. As well as speeding and concentrating flows that enter the river, they remove the buffering influence of the wetlands on sediments and nutrients.

Just upstream of the Combe Lake tributary confluence, there remains a short reach that retains the original channel form – that of a shallow channel, with clean stable riverbed, well connected to the floodplain. A further short section alongside Wetwood Coppice, retains comparable bed levels, although signs of incision have begun to emerge here. In both cases, the channel upstream and downstream of these sections is unstable, and their future is therefore threatened.

Along much of the river, the bed is typically 300-600mm below the level of the periglacial cobble gravel riverbed, with localised erosion well in excess of this. Mature trees, complete with their entire root balls, are being undercut and are slumping into what should be a small stable channel.

The erosion of the riverbed, along with chert cobbles and gravels in the geology layers the tributaries are cutting through, provides a substantial bed load. This includes cobbles up to 300mm in diameter. All of this material is, however, mobile, and so is being flushed downstream. Whilst temporary deposition areas are currently providing spawning grounds for trout, these are becoming increasingly mobile and increasingly starved of new material. The expectation should be for erosion and incision to outstrip supply, leading to starvation of these habitat features and acceleration degradation.

5 Recommendations for Restoration Feasibility Assessment

It is essential that the cobble and gravel bed load is stabilised if the Synderford is to remain a recruitment ground for trout, and for a chance of it being capable of recruiting salmon. However, the river channel must not be considered in isolation, but rather needs to be considered as a coherent whole with the valley floor landscape, as well as in association with the various feeder stream, ditches, springs and flushes that form the wider catchment landscape.

Given the significant barrier that Halscombe Bridge (B3165) presents, the small highly impacted channel upstream, and indeed the incised valley form down to the ornamental lake at Castlewood Farm, restoration is considered in terms of the reach downstream of Castlewood Farm Lake and the reach upstream to the source.

From the Lake upstream, restoration of the valley form should focus on wetland creation, flow attenuation and water quality treatment. Where land use permits, the channel might be entirely filled with brushwood, planted up as dense wet woodland, or converted to valley bottom wetland habitats.

Recommended options for downstream of Castlewood Farm lake: -

1) For all of the following options (2-4): all ditches, minor tributaries, and side streams should where possible be infilled such that their inflows enter the valley bottom as flushes, springs, or mire habitats rather than surface water channels. The intent will be to create wetland habitats (fen, mire etc) that extend from the valley floor up through the valley slopes, to attenuate flows entering the Synderford, and to provide water quality treatment and buffering. Up slope of this, tributaries might be attenuated with introduction of large woody informal leaky dams. Consideration for retention of an open channel form directly connecting to the Synderford might be considered for some side stream in order to retain the cobble gravel input. These might be the Combe Lake tributary, Lower Causeway Coppice stream, Synderford Coppice/Causeway Coppice streams, Stonelake Brook and Shedrick Hill stream.

   Furthermore, land drains within the floodplain should be blocked or removed wherever feasible.

2) **Large woody material obstruction of the main channel**. This do minimum option should be considered as a passive restoration of the channel and valley. The concentration of obstructions should be assessed to determine levels required to push frequent high flows onto the floodplain that can encourage reformation of paleochannels, as well as ensuring aggradation of the current river channel bed.

However, feasibility should balance the impacts of this option on fish passage, and the relative timeline of impacts on fish spawning habitat smothered in the current channel compared to those to formed in the re-emerging paleochannels. Consideration of release of fine sediment from reestablishment of paleochannels should also be considered.

3) **Riverbed rehabilitation with channel roughening**. The riverbed would be restored fully with an oversized cobble and gravel bed to the top of the adjacent stone strata in the riverbank and floodplain. This would rapidly create salmonid spawning and run habitats and prevent further degradation. The stone fill is expected to be 300mm to 600mm deep in general, but may be greater, such as at the Irish ford at ST3883502039 (the access track downstream of Castlewood Farm) where levels should aim to reach the invert of the pipes. Where there had been extreme bed scouring, especially in localised pools, an underlying clay or sand fill might be appropriate to reduce stone quantities.

   The options would also include introduction of large woody material, to reduce in channel velocities and introduce habitat cover and flow diversity. This might be creation of reaches with multiple large tree jams and or laying willow/alder/hazel along the riverbanks.

   Floodplain conditions would be expected to become wetter due to raised water table levels. This may well require revised grazing regimes; it may suit wet woodland creation.

4) **Paleochannel restoration, with riverbed rehabilitation and channel roughening elsewhere**. There are several locations where paleochannels are apparent, and/or the current channel is evidently perched above the natural valley floor. Coring will be carried out to confirm presence of gravel strata in these, and the depth of this. The sections include from Bere Farm towards Shedrick Bridge, from 300m upstream of Shedrick Bridge to alongside Shedrick Spinney, the field downstream of Synderford bridge, and potentially between the Lower Causeway Coppice and Coombe Lake streams.

   This option should be designed to ensure that the valley bottom geomorphology remained vegetatively control. As such, a small shallow channel would be expected, with sufficient bankside, riparian and valley bottom vegetation to minimise channel migration. To ensure initial channel stability, this should include introduction of large woody material with multiple tree jams and or laying willow/alder/hazel along and across the channel.

   Very elevated water table conditions will result from this compared to current conditions. This may well require alterations to grazing and would suit wetland priority habitat creation.

These options, especially where combined with floodplain tree planting, should result in a net increase in flood attenuation for the benefit of property and infrastructure downstream. However, they have the potential to increase flood depths locally.

Local increases in extreme flood depths will need to be managed or avoided at Synderford, mainly relating to the road bridge, Sewage Works, and the property upstream of the road bridge on the western side of the river.

Option feasibility should consider river and floodplain habitat restoration potential, wetting/drought impact avoidance of floodplain farmland, constructability, carbon impacts/benefits, sediment and nutrient capture benefits, and maintenance and management requirements.

6 References

Brown, A.G., Basell, L.S., Toms, P.S., 2015, A stacked Late Quaternary fluvio-periglacial sequence from the Axe valley, southern England with implications for landscape evolution and Palaeolithic archaeology, *Quaternary Science Reviews*,116 (2015) 106e121

Brown, A.G., Lespez, L., Sear, D.A., Macaire, JJ., Houben, P., Klimek, K., Brazier, R.E., Van Oost, K., Pears, B., 2018, Natural vs anthropogenic streams in Europe: History, ecology and implications for restoration, river-rewilding and riverine ecosystem services, *Earth-Science Reviews*, Volume 180, May 2018, Pages 185-205

Brown, A.G., Rhodes, E.J., Davis, S., Zhang, Y., Pears, B., Whitehouse, N.J., Bradley, C., Bennet, J., Schwenninger, JL., Firth, A., Firth, E., Hughes, P., Walling, D., 2020, Late Quaternary evolution of a lowland anastomosing river system: Geological-topographic inheritance, non-uniformity and implications for biodiversity and management, *Quaternary Science Reviews*, 260 (2021) 106929

Brown, A.G., Toms, P., Carey, C., Rhodes, E., 2013, Geomorphology of the Anthropocene: Time-transgressive discontinuities of human-induced alluviation, *Anthropocene*, 1, 3-13

National Library of Scotland, 1888, Somerset Sheet XCII.SW; Surveyed 1887, Published 1888, *Ordnance Survey 6 inch to Mile*, First Edition

Thorncombe Village Trust, https://www.thorncombe-village-trust.co.uk/, accessed May 2023

Harris, D. 2018, Other water mills in Thorncombe, Beaminster Museum

Harris, D. 2020, Shedrick Mill Thorncombe, Beaminster Museum

Harris, D. 2021, Chaffeigh Mill Thorncombe, Beaminster Museum

Pulman, G.P.R., 1854, The book of the Axe, Book, Longman, Brown, Green and Longman, London

Appendix A – Walkover photo records