Natural England Commissioned Report NECR140

New Forest SSSI Geomorphological Survey Overview

Annex B: Latchmore Shade Restoration Plan - SSSI Unit 48

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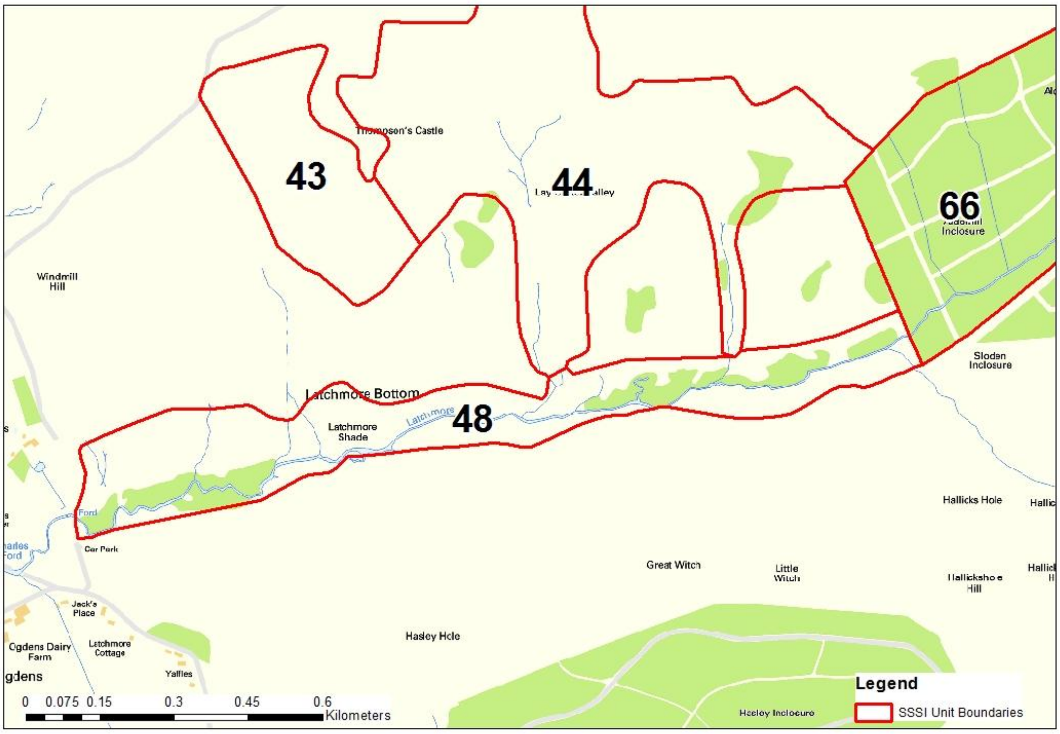
1 Latchmore Shade Restoration Plan - SSSI Unit 48

1.1 Introduction

Latchmore Shade (Unit 48) incorporates the lower reaches of Latchmore Brook (Figure 1-1). Latchmore Brook flows from east to west through the SSSI unit and is considered to be in an unfavourable recovering condition. It is approximately 23.37ha in size. The unit has process based linkages with unit 66 upstream and the Latchmore Mire and Thompsons Castle SSSI units to the north (Figure 1-1).

This unit is made up of a number of habitats including wet heath, mire, broadleaved woodland and wet grassland.

Figure 1-1: SSSI Unit 48 location (flow direction is east to west)



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1.2 Current hydromorphic conditions and issues

A summary of the hydromorphic conditions for unit 48 is given in Table 1-1.

Table 1-1: Summary of hydromorphic conditions for unit 48

Geomorphological Assessment Area		Latchmore Brook d/s reach
Site Name		Latchmore Shade
Size (ha)		23.4
SSSI Unit(s)		48
Channel Condition	River Type (s)	Weak lowland anastomosed; wandering; active meandering; plane bed
	Responsiveness	High - moderate gradient, straightening, strong gravel supply, tree clearance (historic)
	Sediment delivery, type and mobility	Strong upstream and local gravel sources, few fines. Reduction in gradient at wandering section. Very mobile gravels
	Main Source of water	Upstream source (Studley Head, Homy Ridge) and drains

	Aquatic vegetation	The channel is dominated by gravels and at the time of survey the water level was high and no aquatic vegetation was evident
	Drainage Damage	Right bank drains incised, straight and embanked Significant knick point erosion along several drains and impacting mire areas
	Morphology	Pool, riffle, point bar, plane bed, mid-channel bar, lateral bar, transverse bar, debris jams
	Incision	Yes - impacting groundwater levels and flood regime. Incision in drains, knickpoints evident
	Engineering	Channel straightening. Dredging. Embankments
	Bank activity	Moderate, some lateral activity in wandering section. Some bank collapse associated to incision
	Flow type (s)	Flows impacted by upstream drainage network. Flood peaks concentrated in channel.
Floodplain Condition	Valley Type	Wide floodplain
	Main Source of water	Drains / overland flow, out of bank flows
	NVC communities	W11, W1, M23a, M29, M16a, H2, U4
	Key Habitat Types	Broadleaved woodland, Marshy grassland, Wet heath, dry grassland, scattered bracken, Valley mire, Acid dry heath
	Drainage	Swamps / ponds where embankments on channel bank
	Scrub/Tree Encroachment Damage	Trees/scrub encroaching into marshy grassland and wet heath habitats
	Palaeo features	Yes - palaeo meanders evident, particularly on left bank above anastomosed section and on both banks close to enclosure
	Floodplain connectivity	Moderate to over-connected
	Poaching and Grazing Pressures	Significant grazing damage
Generic restoration options		Reinstate palaeo channels. Debris jams to manage incision. Remove embankments on main channel and drains. Fill in drains.
Additional Comments		

Latchmore Brook within SSSI Unit 48 varies between:

- A weakly anastomosing lower course characterised by a wooded local floodplain and multi-channel flow network (Figure 1-2).
- A single thread, mildly incised channel running through floodplain woodland with disconnected palaeo-channel features including a well defined sinuous single thread channel on the left bank (Figure 1-3).
- A stabilised wandering reach characterised by an inset floodplain and numerous vegetated gravel bars, dissected by a shallow dominant channel and several sub-channels all with abundant mobile gravels accumulating as shoals and more permanent riffle zones (Figure 1-4).
- A second incised, single thread reach again with abundant mobile gravels accumulating as mid channel bars and riffles. Floodplain palaeo-channels are prominent in places (Figure 1-5).
- A short ‘infilled’ plane bed single thread reach characterised by a generally shallow uniform depth with mobile gravels and strong floodplain connectivity (Figure 1-6).
- A third incised single thread reach with some mobile gravels and areas of exposed boulder clays, accumulating as mid channel bars and riffles. Floodplain palaeo-channels are prominent in places. This channel type extends into the plantation woodland where the channel has also been straightened historically and a prominent left bank palaeo-channel can be traced (Figure 1-7).
- Several natural and artificial watercourses entering from the north some of which are actively incising through knickpoint erosion. This is impacting on mire functioning in some tributary headwaters.

Figure 1-2: Weakly anastomosed lower course of Latchmore Brook SSSI Unit 48.

Figure 1-3: Mildly incised single thread reach of Latchmore Brook SSSI Unit 48.

Figure 1-4: Stabilised wandering reach of Latchmore Brook SSSI Unit 48.

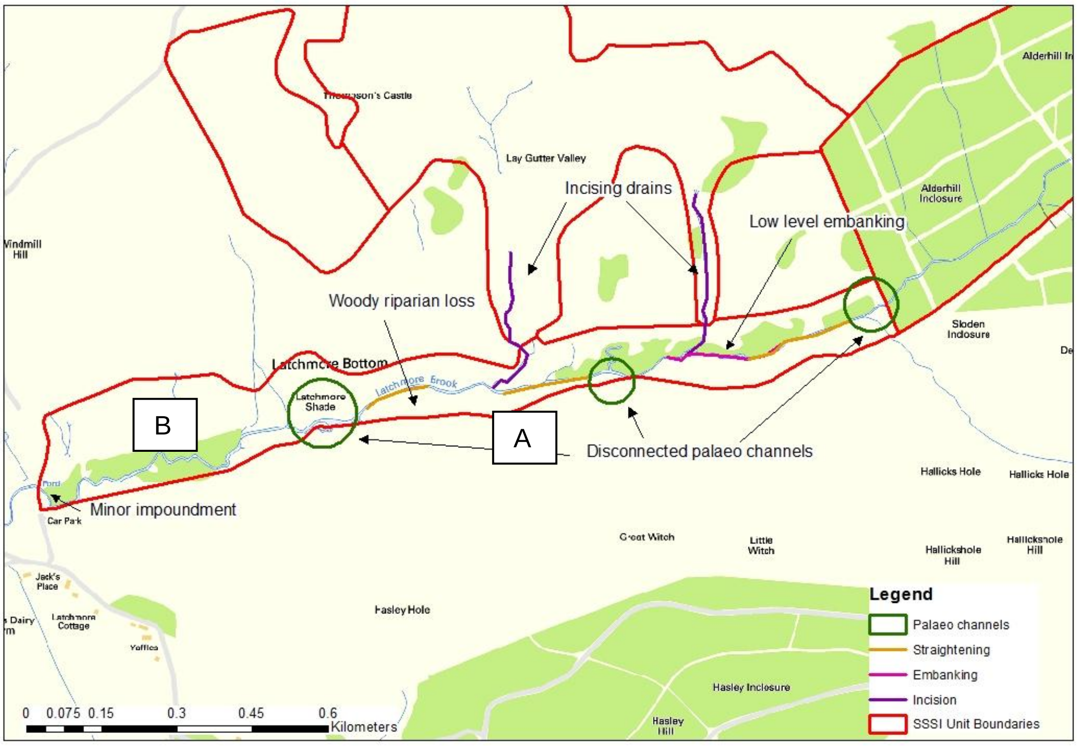
Figure 1-5: Prominent palaeo-channel associated with Latchmore Brook SSSI Unit 48.

Figure 1-6: Plane bed single thread reach of Latchmore Brook SSSI Unit 48.

Figure 1-7: Forested single thread reach of Latchmore Brook SSSI Unit 48.

The source of Latchmore Brook is at Studley Head and Horny Ridge to the east and flows through SSSI units 540 and 66. Unit 48 is supplied with gravels from upstream and from local bank erosion and remobilisation of instream gravel deposits. The combination of a steep watercourse, strong gravel supply, historic channel straightening, riparian tree clearance and local grazing pressures creates a dynamic and responsive watercourse sensitive to perturbation. Figure 1-8 summarises the existing hydromorphology and pressure impacting unit 48.

Figure 1-8: Current hydromorphic conditions and pressures



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The natural anastomosed channel network has been extensively modified through the SSSI unit with historic channel straightening along considerable lengths of the watercourse. The channel has reacted to this straightening by initially cutting down into the bed, creating an incised single channel. This will have increased flood shear stress levels promoting local erosion, particularly where flows are concentrated around in-channel bars (Figure 1-9). Subsequent resupply of gravels from upstream has resulted in a general over-filling of the channel in the middle reaches (Figure 1-8 - A) to create a shallow plane bed system, leading to frequent floodplain inundation. This channel state is not stable and will be subject to a renewed period of scour and disconnection as part of the general damped erosion/deposition cyclic response to the straightening.

Figure 1-9: Local flow concentration and bank erosion linked to gravel bars on Latchmore Brook.

The historic incision of the channel has altered flood frequency and groundwater levels and much of the natural vegetation has become lost. This community change has been exacerbated by historic (and more recent) tree clearance and regeneration is being prevented by current management practices including grazing. The overall pattern of flooding frequency is significantly disrupted with reaches where the occurrence of overbank flow has been reduced due to incision and other areas where inundation rates are increased above normal due to gravel infilling. In addition flood connectivity is locally reduced where arisings from channel dredging are deposited on the bank.

The impact of incision, infilling and spoil dumping on groundwater levels has resulted in the drying of the immediate floodplain resulting in hummocky lawns across former *Molinia* mire in incised reaches and wetter where gravels have infilled the main channel. Floodplain swamp and pond areas have developed

The gradient along Latchmore Brook through SSSI unit 48 is generally low compared to upstream, with the channel exhibiting a characteristically anastomosed network through a narrow wooded riparian margin and reduces compared to upstream Unit 66. The change in gradient and associated tree clearance has created a long term sediment storage and reworking zone which has previously been laterally active. The result is a stabilised wandering section which is inset into the wider floodplain and is characterised by a number of low vegetated and unvegetated bar features.

Floodplain connectivity improves through anastomosed reaches within the wooded lower section (Figure 1-8 - B) of the SSSI, although several channels remain disconnected from the main channel. Whilst on site, high flow levels had activated some of the anastomosed channels within the floodplain, however, restoration would look to increase the frequency of wetting of these channels (Figure 1-2). The anastomosed network is assisted by debris jams which have provided local improved floodplain connectivity (Figure 1-10).

Figure 1-10: Woody Debris on Latchmore Brook.

This initial incision episode linked to the channel straightening has also caused multiple knick point development moving through the tributary / drain systems on the right (north) bank of the river (Figure 1-11). The impact has been variable with the channels to the east displaying general stability whilst those coming off of the west of Latchmore Mire and Thompsons Castle SSSI units are far more unstable. In these channels incision into mineral deposits is severe and active and must be addressed using suitable gully control techniques. Where incision is extending into valley mire a different approach is required. Repairs are suggested to the fluvio-glacial mineral ridge that formed the original control on the mire together with associated organic infill of the upper watercourse to restore predominantly subsurface and diffuse surface flow. The drainage pattern influencing the SSSI reach is shown in Appendix A.

Figure 1-11: Knick point erosion on the tributary channels of Latchmore Brook.

Significant palaeo channels have been identified along the reach and reconnection could be possible through some of the proposed restoration measures in Table 1-2. These have been identified from the audit and supplied LIDAR. Reconnecting these whilst maintaining the existing channel will encourage anastomosed network development.

1.3 Probable channel development

It is likely that the entire watercourse was anastomosed at one time before partial tree clearance. In addition the multi-thread network of interlinked functional channels has been rationalised into a single dominant channel.

Ditching of the upper catchment will have impacted on the flood flow regime of the watercourse creating a more responsive system where flood peaks are concentrated and increased and water enters the main channel more efficiently. This effectively creates a higher energy system more capable of erosion and sediment transport.

Straightening of the watercourse has occurred along a number of reaches and this has had a profound effect on the nature and functioning of the river. The length of watercourse will have been shortened leading to a steepening of the system and the associated dredging will have over-deepened the channel. This in combination will have increased flood shear stress levels promoting erosion. Where the channel banks are stronger (due to the presence of more resistant boulder clays rather than fluvio-glacial gravels or where riparian woody vegetation is dense enough to provide a coherent resistant root mat, or perhaps where the channel banks may have been revetted) erosive energy will have been concentrated into vertical incision into the bed leading to an over-deep channel. Where the banks are less resistant (due to tree clearance, presence of gravels etc.) lateral erosion will also have occurred. This is evident in the wandering section of the Brook. Often in rivers with moderate to high energy, lateral erosion and widening is also associated with bar deposition concentrating flows around gravel shoals and promoting further lateral activity.

The initial impact of straightening would have been incision along significant lengths of the wooded watercourse and wandering behaviour across the cleared zone. This initial incision episode is likely to have caused the knick point development moving through the tributary / drain systems.

More locally the incision will be followed by in-channel deposition as gravels are dropped in lower energy zones during flood recession. Significant shoals will then influence channel hydraulics upstream, reducing the water slope and promoting more deposition. This ‘cut and fill’ activity is evident along the Brook with fill zones characterised by plane bed, shallow gravel reaches and more local gravel shoals and bars causing local lateral erosion. This pattern is often repeated over time as gravels are re-eroded and re-deposited along the system and this will in turn have generated successive knick-points along the tributaries / drains many of which remain active today.

The process of adjustment to the channel straightening, dredging, flow regime alteration and floodplain vegetation disruption is continuing despite the historic nature of many of the changes. As such the river remains highly responsive in nature and will not stabilise as a result of re-routing the watercourse back through a palaeo-course that was occupied possibly a century ago when channel and catchment processes and pressures would have been very different from today.

The river can also be said to be recovering in the sense that it has now created a diverse hydromorphology consisting of multiple distributary channels and locally sinuous channels through what were straightened, single thread reaches with an associated mix of pool, riffle, plane bed, point bar, mid-channel bar, lateral bar, transverse bar, gravel morphology and significant woody debris induced features. The nature and distribution of these features is however likely to alter significantly over the next decades as the large scale erosion, transport and deposition patterns change.

Similarly the impacted tributary / drain systems are responding to a series of knick points along their courses and themselves display multiple cut and fill sequences. Alterations to the Latchmore Brook will not impact on the current knick points which must be restored independently.

1.4 Current Ecological Condition

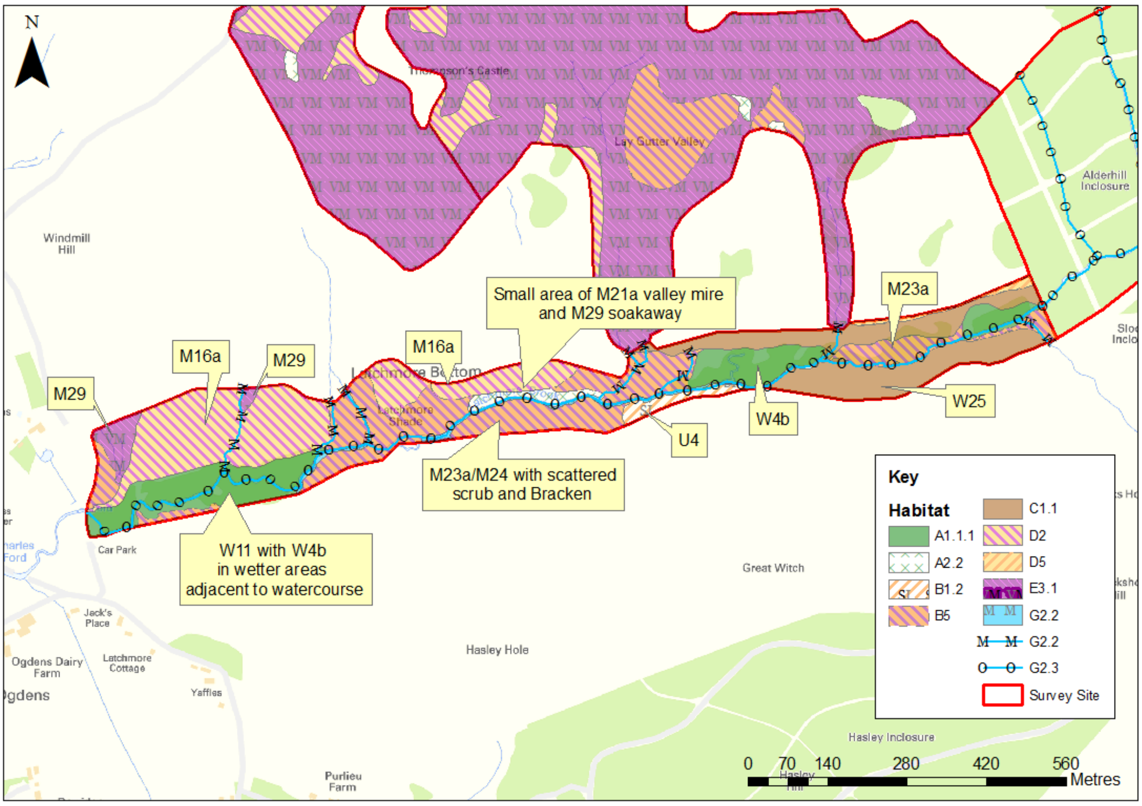
The historical modifications to Latchmore Brook and associated drainage impacts have resulted in damage to adjacent habitats. In particular, the mire and wet heath habitats, found mostly to the north of the watercourse, within the western end of the unit, are degraded with a lack of *Sphagnum* species, and it is likely that these habitats were once more extensive.

As a result of drainage, extensive areas of wet grassland/lawns are now present adjacent to the watercourse. These areas are quite heavily grazed and contain frequent Purple Moor-grass *Molinia caerulea* with rush *Juncus* species in wetter areas. Scrub, Gorse *Ulex europaeus* and Bracken *Pteridium aquilinum* are also quite frequent within the wet grassland, particularly Bracken, which becomes particularly extensive towards the eastern end of the unit.

Along the watercourse there are small areas of woodland with Oak *Quercus* sp, Downy Birch *Betula pubescens* and Grey Willow *Salix cinerea* frequent. Some tree clearance has been undertaken within these areas and elsewhere along the watercourse and therefore in some sections there is just scattered scrub and occasional trees remaining. Bracken is also quite frequent along the bank tops of the watercourse.

Two small patches of Rhododendron *Rhododendron ponticum* were recorded within the eastern end of the unit.

Figure 1-12: Phase 1 Habitat Map



1.5 Restoration plan proposals

A summary of the current pressures, unmitigated impacts and restoration proposals is given in Table 1-2 and shown in Figure 1-13.

The key hydromorphological and ecological gains associated to the proposed restoration measures are:

- Palaeo channel reconnection, alongside embankment removal and incision management creating improved morphological features;
- Tributary incision management and mire restoration;
- Improved anastomosed channel network development will improve hydromorphological diversity;
- Better floodplain connection through water level raising and artificial drain restoration;
- Improved in-channel habitat and mire and heath restoration.

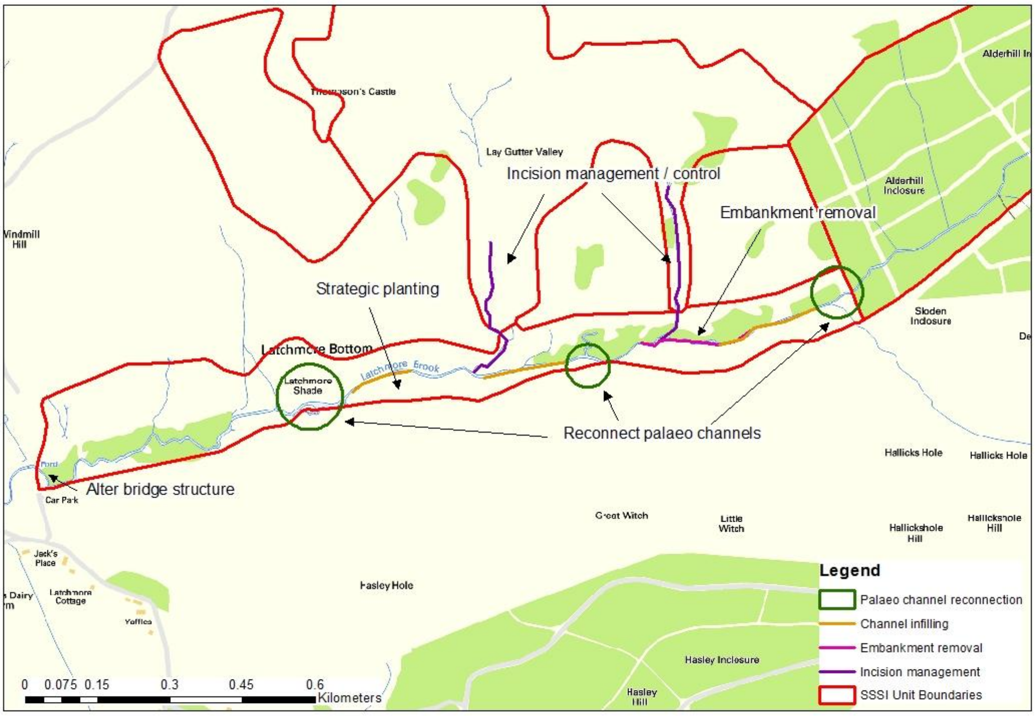
Table 1-2: SSSI Unit 48 proposed restoration measures

Pressure	Impact	Restoration proposal	Hydromorphic improvement	Ecological improvement	Constraints / issues
Straightening	Long term river response, cut and fill activity. Enhanced in-channel energy levels. Disconnected sub-channels. Loss of in-channel features. Tributary instability.	Palaeo channel reconnection. Infill. Restore in-channel morphology. Restore connectivity. Treat knick points.	Reinstate some channel length lost through straightening - helping to reduce incision. Encourages anastomosing channel development. Reduces fine sediment inputs. Slows gravel movement. Stabilises in-channel features.	Increased channel morphology increases the niches available. Anastomosing channel promotes areas where plants can gain a foothold in backwaters and areas where fish can lay-up. Gravel bars will be colonised by seral vegetation communities.	Incision rates means reinstating the palaeo channels requires strategic bed raising, along the watercourse. Independent works needed on tributary systems. Cultural objections.
Historic dredging	Long term river response, cut and fill activity. Enhanced in-channel energy levels. Disconnected sub-channels. Loss of in-channel features. Tributary instability.	Incision management - debris jams, morphological restoration, floodplain works. Infill. Restore connectivity. Treat knick points.	Reconnecting the floodplain will improve in-channel hydromorphic condition and will reduce incision. Debris jams naturally occur along the reach, use local materials. Morphological enhancement to raise bed and water levels will help improve floodplain connectivity. Local floodplain works may be necessary to give sufficient connectivity. Encourages anastomosing channel development.	Floodplain reconnection will help the growth if aquatic vegetation communities in side channels and the development of riparian woodland, especially Alder (W1, W8) woodlands. This in turn will promote further channel development.	Incision is severe in places, meaning significant works / features would be required to improve this. Debris jams may form a barrier to fish. Large amounts of material are likely to be required if bed works are undertaken to reopen sedimented palaeo-channels Cultural objections.

Pressure	Impact	Restoration proposal	Hydromorphic improvement	Ecological improvement	Constraints / issues
			Reduces fine sediment inputs. Slows gravel movement. Stabilises in-channel features.		
Embanking (low level)	Enhanced in-channel energy levels. Disconnected sub-channels.	Embankment removal - main channel and drains	Reconnect the floodplain, reducing incision rates and improving in-channel hydromorphic conditions. Slows gravel movement. Stabilises in-channel features.	Reduce the water table in the riparian zone and encourage the development of mire (M25a) habitat	Consideration of existing created habitat. Cultural objections Grazing losses
Riparian vegetation removal / grazing	Loss of bank stability. Loss of shading. Loss of organic inputs to the watercourse.	Reduced tree clearance at bank edge. Replant or allow to naturalise through reducing grazing pressure.	Will help to stabilise banks in the wandering sections and alongside bed restoration to minimise incision, could improve floodplain connectivity Creates riparian hydromorphic diversity. Acts as fine sediment trap. Allows woody debris accumulation.	Opportunities to improve and expand wet woodland habitat alongside watercourse and mire communities, especially on the right bank of the stream where these are heavily impacted by poaching in particular. Some ancient *Salix cinerea* trees in this area have affinities with W4b, rather than W1 woodland types as they previously grew in a mire habitat that has been drained.	Further tree clearance should be avoided.
Forestry	Significant impact on low flow regime. Flow quantity, quality, variability. Impacts on water temperature.	Phased removal upstream (Unit 66)	Reduced risk of drying, improved hydromorphic diversity, lowered risk of in-channel fine sediment accumulation	Improve diversity of in-channel and floodplain habitats. Opportunities to increase and/or provide new areas of wetland habitat.	Coniferous plantations may need to be maintained Significant short-term disturbance impacts associated with tree felling

Pressure	Impact	Restoration proposal	Hydromorphic improvement	Ecological improvement	Constraints / issues
	Fine sediment dynamics. Water table impacts.				

Figure 1-13: Proposed restoration measures for SSSI Unit 48



1.6 Design considerations

The channel is unlikely to completely stabilise as a result of re-routing the watercourse back through a palaeo channel that was once occupied, probably at a time when channel and catchment processes and pressures would have been very different from today. However, retaining the dynamism of the channel should be an objective of the restoration plan.

Palaeo-channel entrance and exit elevations must be carefully considered to avoid instigating uncontrolled instability.

Tributary instability issues must be addressed independently using appropriate measures linked to channel energetics.

Retaining and improving the currently disconnected anastomosed network in SSSI should be a target of the restoration plan.

Spoil deposits are creating artificially wet zones, the merits behind retaining these must be carefully considered.

Source area issues linked particularly to flow regime alteration should be addressed as part of any restoration / naturalisation programme.

Any restoration / naturalisation programme must be mindful of the sensitivity and responsive nature of the system.

Historic woodland removal and subsequent management has resulted in a mildly wandering channel reach with a unique morphology and dynamics. This must be considered as part of any restoration / naturalisation programme.

Grazing pressures are impacting, particularly in the wandering reach.

1.7 Restored channel and monitoring requirements

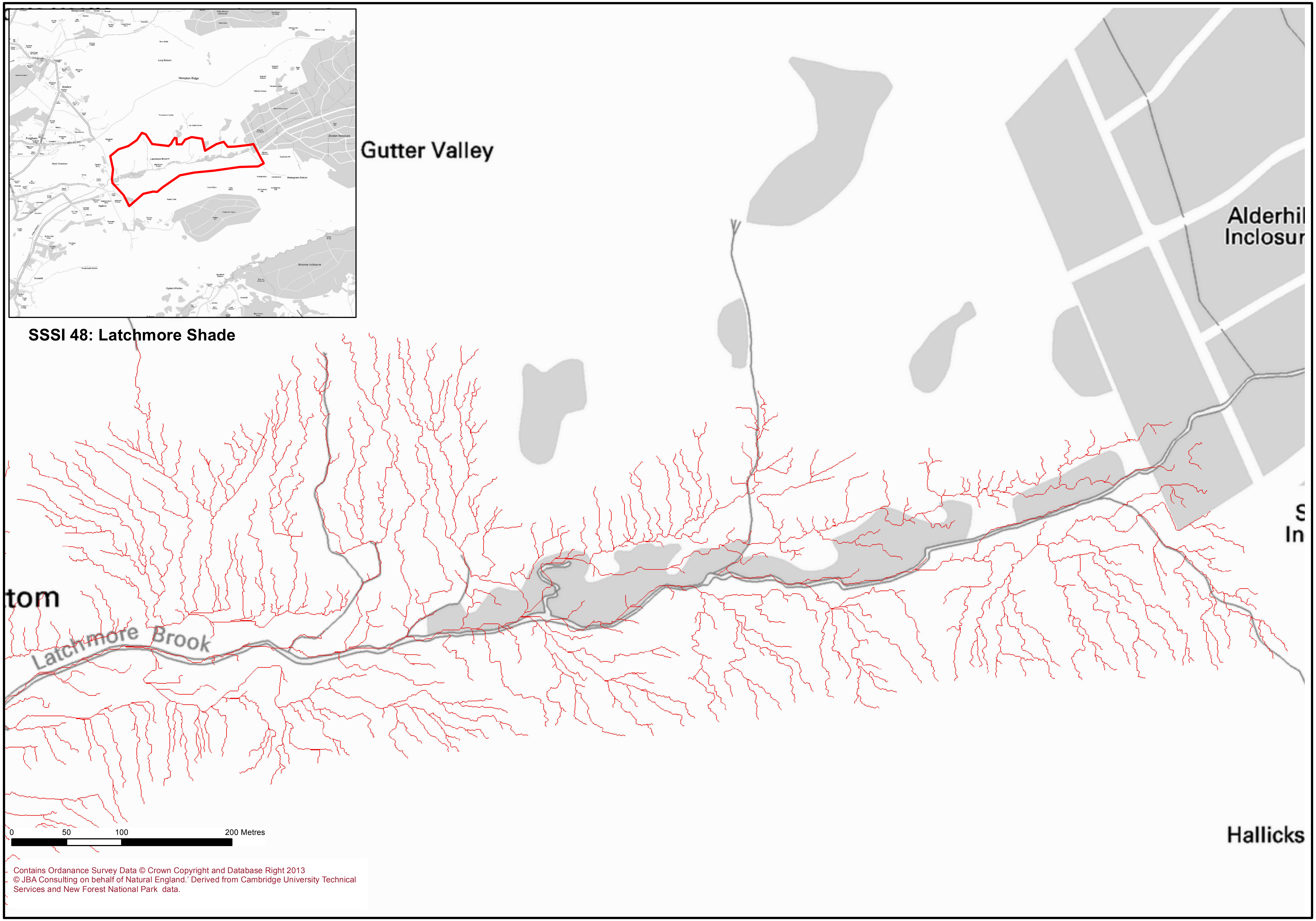
It is anticipated that the proposed restoration works will create a dynamic, sinuous channel with some anastomosed sections and improved floodplain connectivity, with frequent overbank flooding and a heightened potential for local channel switching in response to natural debris blocking. This pattern of development is difficult to document accurately due to the complex nature of the river network and the difficult surveying conditions. As such a qualitative monitoring approach is recommended with automated time lapse photography employed at key restoration points to record daily images of flow types, morphology and vegetation character. This could be undertaken alongside two-yearly reconnaissance audits to determine hydromorphological change over the entire reach, which fixed point photography will not cover. The daily photographic records should be analysed to estimate and record the parameters detailed in Table 1-3.

Table 1-3: Monitoring parameters, frequency and suggested approaches for the Unit 48.

Parameter	Approach	Frequency	Approximate cost
Morphologic unit change	Time lapse camera / audit	Daily (Annual statistical summary)	Capital 5 x £200 Half yearly downloading £200 Annual summary £300 Two - yearly reconnaissance audit £500
Flow change	Time lapse camera / audit	Daily (Annual statistical summary)	
Sedimentology	Time lapse camera / audit	Daily (Annual statistical summary)	
Vegetation change	Fixed point camera survey	Biennially	
	Fixed point quadrat survey	Biennially	Survey £350 Analysis £500
	Fixed point aquatic macrophyte survey		
NB. Costs assume downloading and site visits as part of wider field campaign.			

Appendix A - Artificial drains and flow lines - SSSI Unit 48

SSSI 48: Latchmore Shade



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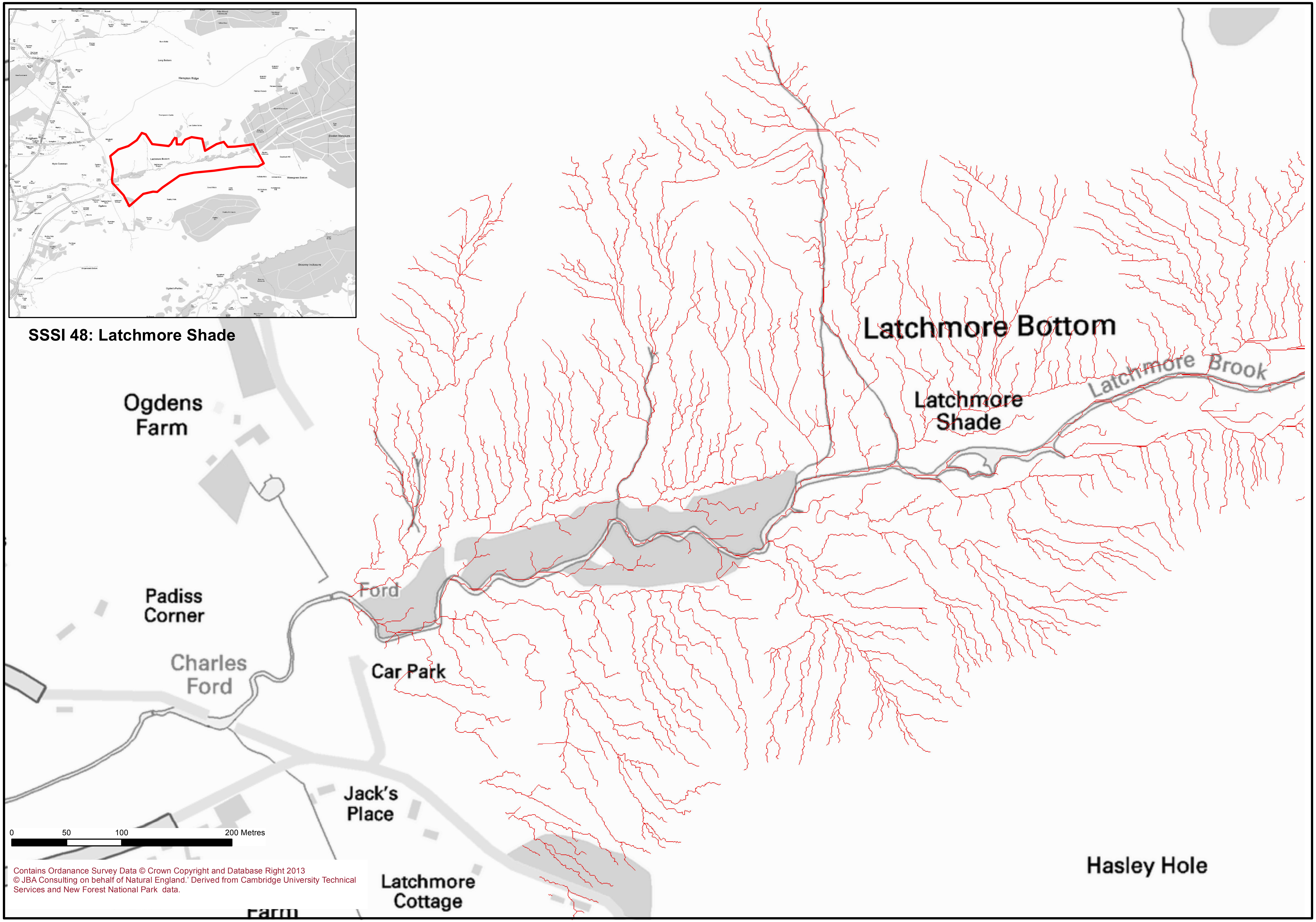
SSSI 48: Latchmore Shade
Ogdens Farm
Padiss Corner
Charles Ford
Ford
Car Park
Jack's Place
Latchmore Cottage
Farm
Latchmore Bottom
Latchmore Brook
Latchmore Shade
Hasley Hole
0 50 100 200 Metres
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