Natural England Commissioned Report NECR140

New Forest SSSI Geomorphological Survey Overview

Annex C: Amberwood / Alderhill Restoration Plan - SSSI Unit 66

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1 Amberwood / Alderhill Restoration Plan - SSSI Unit 66

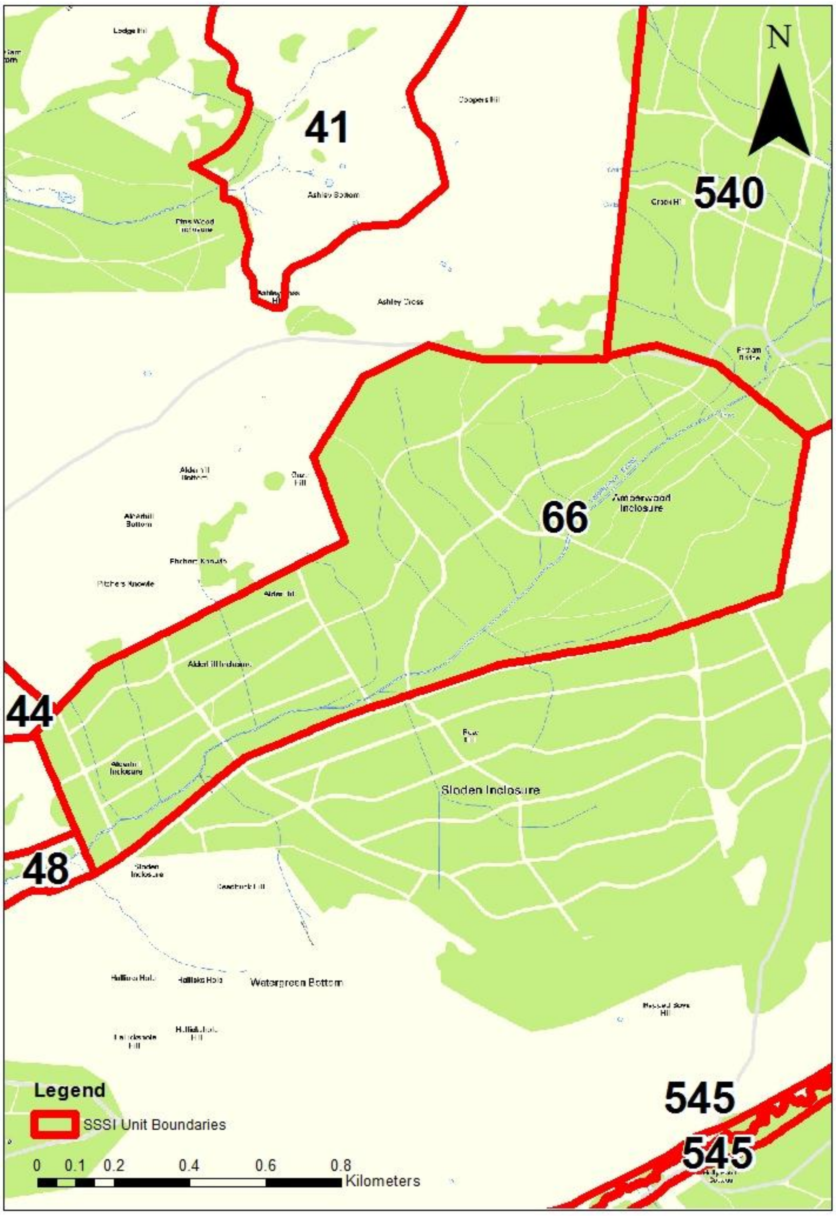
1.1 Introduction

Amberwood / Alderhill (Unit 66) incorporates the middle reaches of Latchmore Brook and flows into the downstream SSSI Unit 48 (Figure 1-1). The SSSI unit is considered to be in an unfavourable recovering condition. It is approximately 126.5ha in size.

This unit consists of two plantation woodlands. Amberwood Inclosure consists predominantly of Oak *Quercus robur* with some areas of planted conifers (predominantly Corsican Pine *Pinus nigra maritima* and Norway Spruce *Picea abies*). Alderhill Inclosure is dominated by conifer plantation with some areas of Oak remaining.

It is essential that incision in the downstream 48 SSSI unit (Latchmore Shade) is also mitigated as any works undertaken with Unit 66 risk being compromised in the future if this is not undertaken as a result of continued knick point propagation upstream. Works within Unit 540 upstream will also influence the flow regime within this unit and will help to manage issues identified in this report, as part of the overall restoration of Latchmore Brook and should be undertaken to ensure a sustainable approach is adopted.

Figure 1-1: SSSI Unit 66 location (flow direction is north east to south west)



1.2 Current hydromorphic conditions and issues

A summary of the hydromorphic conditions for unit 66 is given in Table 1-1.

Table 1-1: Summary of hydromorphic conditions for unit 66

Geomorphological Assessment Area		Latchmore Brook m/s reach
Site Name		Amberwood/Alderhill
Size (ha)		126.5
SSSI Unit(s)		66
Channel Condition	River type (s)	Weak lowland anastomosed; active meandering and widening; passive meandering
	Responsiveness	Moderate - moderate gradient, straightening, strong gravel supply, tree clearance (historic)
	Sediment delivery, type and mobility	Strong gravel supply but less deposition due to greater incision. Few fines. Very mobile gravels. Fewer gravel

		features than d/s reach, but improve closer to SSSI 540
	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
	Morphology	Pool, riffle, point bar, lateral bar, mid-channel bar, transverse bar, debris jams. All gravel features fewer and not as well developed as d/s reach unit 48
	Incision	Yes - more incised than d/s reach. Incision in drains, knick points evident.
	Engineering	Channel straightening throughout. Dredging. Embankments. Bridges, with boulder weirs to manage incision
	Bank activity	Moderate, some lateral and collapse associated to incision
	Flow type (s)	Flows impacted by upstream and local drainage network. Flood peaks concentrated in channel.
Floodplain Condition	Valley type	Wide floodplain
	Main source of water	Drains / overland flow, some out of bank flows
	NVC communities	W14, W10a
	Key habitat types	Coniferous plantation, Mixed woodland plantation, Broadleaved woodland
	Drainage	Embankments on bank edge where previously dredged / straightened. Natural drainage impacted through artificial drainage network
	Scrub / tree encroachment damage	Floodplain is wooded, however some felling has taken place
	Palaeo features	Yes - not as evident as d/s reach but some evident
	Floodplain connectivity	Moderate to low
	Poaching and grazing pressures	Little
Generic restoration options		Reinstate palaeo channels. Debris jams to manage incision. Remove embankments on main channel and drains. Fill in drains.
Additional comments		Debris jams frequent and manage incision locally, allowing gravel feature formation u/s and some multi-thread creation

Latchmore Brook within SSSI Unit 66 varies between:

- a weakly lowland anastomosed system, particularly in the mid to upper reaches where debris jams have created better upstream connectivity, activating a multi-thread system at higher flows (Figure 1-2);
- an active single thread channel, with some characteristics of an actively widening channel type where banks are erodible and gravel inputs are strong (Figure 1-3);
- a passive single thread channel where bank cohesion is higher.

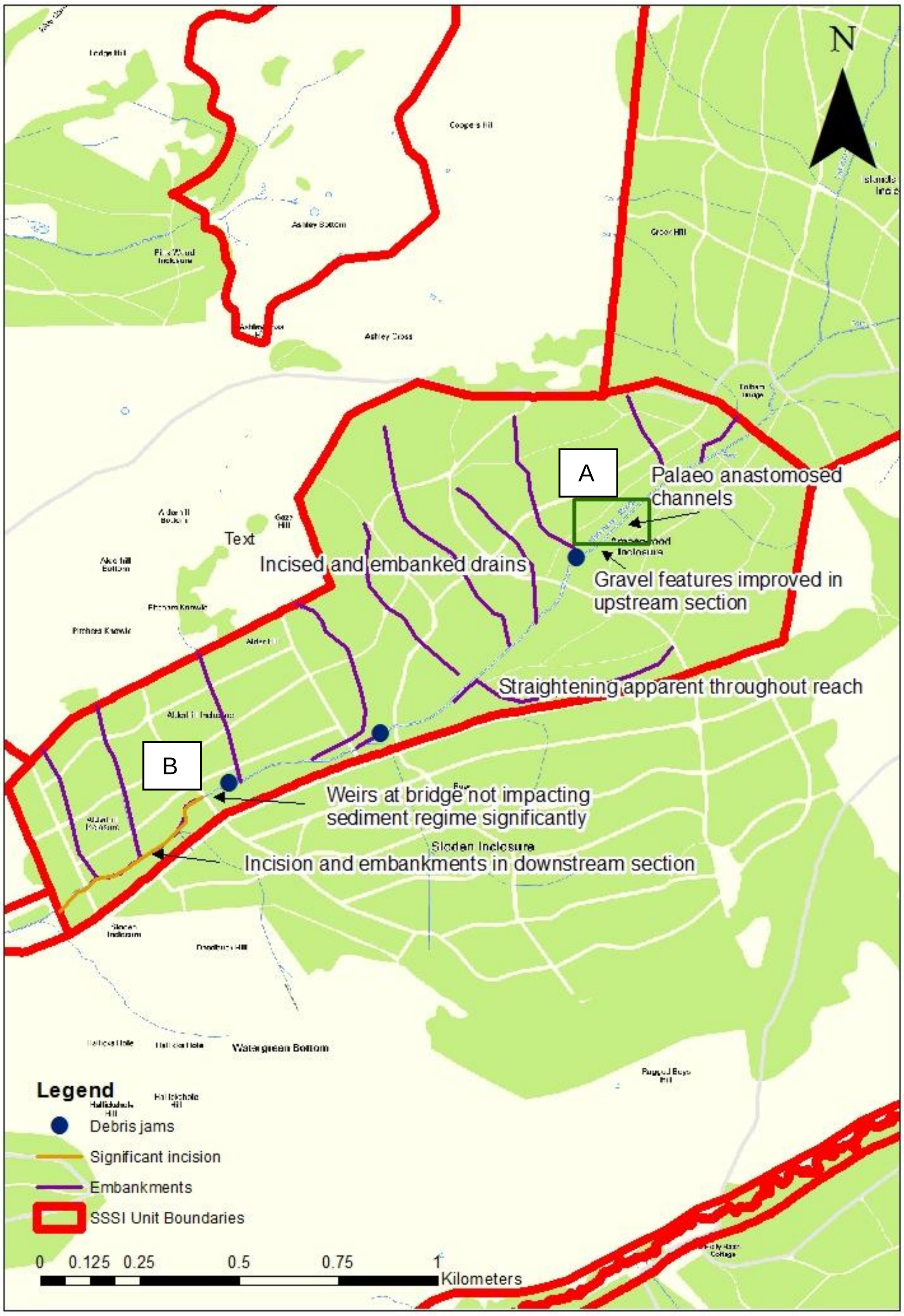
Figure 1-2: Weak anastomosed channel at debris jam

Figure 1-3: Actively widening characteristics in some locations

The source of Latchmore Brook is at Studley Head and Horny Ridge to the east. This unit is supplied with gravels from the upstream unit 540. This reach also supplies the downstream Unit

48 with gravels and less is stored within this reach compared to Unit 48 downstream. Figure 1-4 summarises the existing hydromorphology and pressure impacting Unit 66.

Figure 1-4: Current hydromorphic conditions and pressures



The gradient of this middle reach of the Latchmore Brook is reduced compared to upstream Unit 540. The gradient visibly reduces in the upper section of this unit where gravel features are improved and where anastomosed palaeo channels exist in the local floodplain (Figure 1-4 - A), albeit currently disconnected. It is also clear that significant channel straightening has been undertaken (from maps and LIDAR) in the past along the majority of the reach. Straightening of the watercourse 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 (Figure 1-5).

Figure 1-5: Bank erosion along reach

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) erosive energy will have been directed at vertical incision leading to an over-deep channel, this is particularly true in the downstream section of unit 66 (Figure 1-4 - B). Where the banks are less resistant (due to tree clearance, presence of gravels etc.) lateral erosion will also have occurred. This is evident in locally widened sections, particularly in the upper sections of Unit 66 (Figure 1-4 - A). Where floodplain connectivity is improved, within the wooded upper section, a multi-thread anastomosed channel network is evident, although this is presently disconnected significantly 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 1-2).

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 (Figure 1-3). This is particularly true for the upper sections of this reach of the Latchmore Brook.

The initial impact of straightening would have been incision along significant lengths of the wooded watercourse (Figure 1-6) and widening across areas with erodible banks. This initial incision episode is likely to have caused the multiple knick point development moving through the tributary / drain systems (Figure 1-7).

Figure 1-6: Downstream incision

The result of poor floodplain connectivity and the modified flow regime, in a responsive river type, has been vertical incision, particularly in the lower reaches where more cohesive banks, bankside embankments and a steeper gradient have focused erosive energy on the channel bed. Ditching of the majority of the reach and 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. The degree of artificial drain creation is shown in Appendix A and is impacting significantly on the flow regime. This effectively creates a higher energy system more capable of erosion and sediment transport (Figure 1-3).

More locally the incision will be followed by in-channel deposition, in the upper reaches of this unit where gradients are shallower, 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 Latchmore Brook, particularly in the middle reaches of Unit 66, 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 tributary / drains.

There has been some incision in the mid to lower reaches of this unit where erosive energy is contained within the banks rather than spread across the floodplain at higher flows resulting in bed erosion. This creates oversteep banks that are prone to collapse as a result of undercutting, as well as further reducing floodplain connectivity. This is exaggerated in some locations by the presence of embankments on the bank tops, which are particularly evident in the lower reach of this unit. As a result of incision in the brook, connecting drains are also incised in some locations. The incision within the drains is also impacted by embankments on the bank edge of the drains (Figure 1-7).

Figure 1-7: Incision in right bank drain, showing embankments

Groundwater levels have also been altered as a result of the incision, infilling and spoil dumping (embankment creation). Sections of the immediate floodplain have become drier than natural in the mid to lower reaches.

Gravel supply (there are significant gravel sources within the river banks, Figure 1-8, locally and upstream sources are particularly important for gravel features in the upper reaches) is strong and this, combined with flow regime alterations through surrounding drains, as well as historic tree clearance, give responsive channel conditions.

Figure 1-8: Local gravel bank sources

The strong supply of gravels has resulted in significant gravel feature growth within the channel in the upper reaches where gradients are shallower in the form of mid channel bars, lateral bars, transverse bars and point bars (Figure 1-3). Poor connectivity with the floodplain means that the pattern of erosion and deposition is exaggerated (as a result of incision and embankments) meaning growth has been enhanced locally, particularly in areas where widening can readily occur.

Natural woody debris features are relatively common along the channel, which have often been created as a result of local bank erosion / collapse (Figure 1-9). These create short lengths of impounded watercourse that do improve floodplain connectivity significantly. These provide useful analogue features for the restoration plan.

Figure 1-9: Natural woody debris jams

Significant palaeo channels have been identified in Figure 1-11 and show where reconnection could be possible through implementing 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

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 further incision within downstream Unit 48 could increase incision within this unit.

The river can also be said to be recovering to a degree in the sense that it has now created a diverse hydromorphology consisting of 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 stream will not impact on the current knick points. Management of the drains themselves will be required.

Incision is likely to continue in the lower to mid reaches where significant floodplain disconnection means most flows are likely to be contained within the channel with little potential for significant lateral movement due to cohesive banks.

The anastomosed channels within the upper reaches may become further disconnected if incision continues.

1.4 Current Ecological Condition

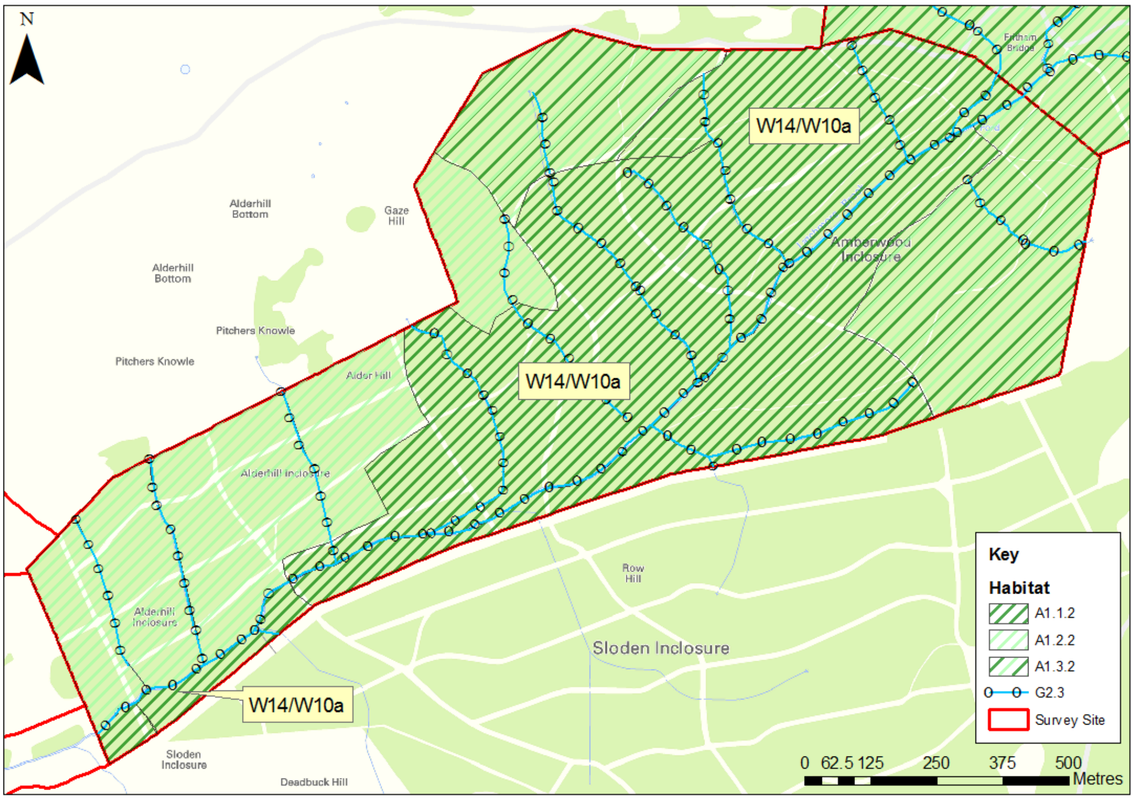
This unit is made up of two plantation woodlands. Amberwood Inclosure consists predominantly of Oak and Beech *Fagus sylvatica* with some areas of planted conifers (predominantly Corsican

Pine *Pinus nigra maritima* and Norway Spruce *Picea abies*). The ground flora is dominated by Bracken *Pteridium aquilinum*. In more open areas, along tracks and rides, there are patches of acid grassland.

Alderhill Inclosure is dominated by conifer plantation with some areas of Oak remaining. Again, the ground flora consists predominantly of Bracken apart from in wetter areas, which occur adjacent to Latchmore Brook, where Soft Rush *Juncus effusus* and Tufted Hair-grass *Deschampsia cespitosa* are more frequent.

At the time of the site walkover survey there was no aquatic vegetation present within the channel of Latchmore Brook. *Rhododendron pomnticum* was present along the banks of the watercourse.

Figure 1-10: 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 1-11.

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;
- 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 66 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.	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.	Improve diversity of in-channel and floodplain habitats and creating greater interconnectivity between the two. This will serve to create backwaters and low-flow areas where aquatic plants can gain a foothold and fish can lay-up.	Incision rates have meant reinstating the palaeo channels requires significant bed raising, particularly in the upper reaches.
Historic dredging Straightening	Long term river response, cut and fill activity. Enhanced in-channel energy levels. Disconnected sub-channels. Loss of in-channel features.	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.	Improve diversity of in-channel and floodplain habitats. Opportunities to increase and/or provide new areas of wetland habitat. As above, creates greater niche diversity within the watercourse and re-connects it with the palaeo-features on the adjoining floodplain. Increased gravel stability will allow for vegetated bars to develop and increase the diversity of the riparian habitats present.	Incision is severe in the upper reaches, meaning significant works / features would be required to improve this. Debris jams may form a barrier to fish, however, it is unlikely a fish pass would be required. Large amounts of material are likely to be required if bed works are undertaken, particularly upstream. Lack of light reaching the watercourse will reduce the species diversity in the watercourse.

Pressure	Impact	Restoration proposal	Hydromorphic improvement	Ecological improvement	Constraints / issues
			Reduces fine sediment inputs. Slows gravel movement. Stabilises in-channel features.		
Embanking	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. Drain embankment material could be used to infill drains. Slows gravel movement. Stabilises in-channel features.	Improve diversity of in-channel and floodplain habitats. Opportunities to increase and/or provide new areas of wetland habitat. Increases heterogeneity of the riparian habitat and allows features to develop and vegetate over.	Drains may also require infilling to restore natural flow regime and reduce incision. Consideration of existing created habitat. Opportunities limited by light levels reaching the streamsides
Artificial drainage	High flows impacted. Water table lowered locally.	Drain infilling	Restore a natural flow regime, reducing incision in the drain and channel network. Reduces flood peaks. Reduces fine sediment inputs. Slows gravel movement. Stabilises in-channel features.	Improve diversity of in-channel habitats and reconnection of old floodplain features.	May require import of material.
Riparian vegetation removal	Loss of bank stability. Loss of shading. Loss of organic inputs to the watercourse.	Tree clearance at bank edge in selected locations Replanting of suitable tree species	Will help to stabilise banks in the wandering sections and alongside bed restoration to minimise incision, could improve floodplain connectivity	Improve diversity of in-channel habitats. May be necessary in some areas to remove alien species and allow light onto the	Tree clearance is a necessity in some locations.

Pressure	Impact	Restoration proposal	Hydromorphic improvement	Ecological improvement	Constraints / issues
		Removal of alien species, in particular *Rhododendron.*	Creates riparian hydromorphic diversity. Acts as fine sediment trap. Allows woody debris accumulation.	watercourse promoting vegetation growth.	
Forestry	Significant impact on low flow regime. Flow quantity, quality, variability. Increases water temperature. Fine sediment dynamics Water table impacts.	Phased removal of alien forestry trees. Ring-barking of selected trees	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. Increases in light levels on the forest floor and on the streamsides. More standing dead wood and an increase in dead wood habitats both in and alongside the watercourses.	Coniferous plantations may need to be maintained Significant short-term disturbance impacts associated with tree felling Cultural objections.
Woody, non-native invasive species	Alters floodplain species assemblage. Impacts bank stability.	Exterminate (Rhododendron) and allow natural regeneration / plant alder & willow.	Creates riparian hydromorphic diversity	Increased floristic diversity of ground flora on floodplain Restoration of wetland habitats Increased light availability	Continued maintenance requirements Cultural objections

Figure 1-11: Proposed restoration measures for SSSI Unit 66

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.

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

The major straightened / modified drainage channels are identified in Figure 1-11. Other minor modifications could be considered for infilling and Appendix A should be used for reference.

Works within this unit should be prioritised or aligned with works undertaken in units 540 upstream and 48 downstream. The linkage between the units is important and issues identified within Units 540 and 48 are likely to be impacted / mitigated by works undertaken in this unit. Therefore, works in this unit and Unit 540 should be undertaken either at the same time or before works in Unit 48.

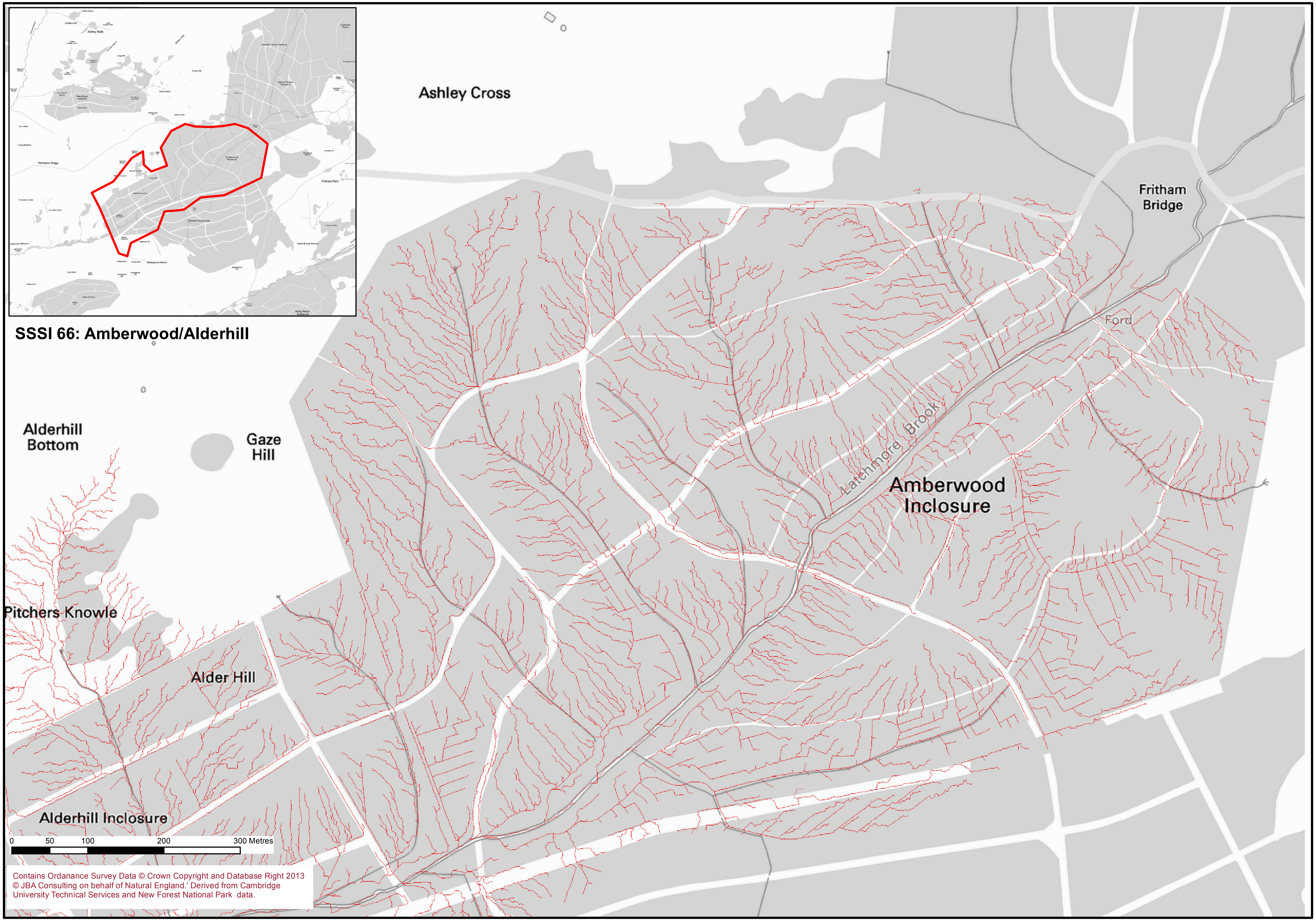
1.7 Restored channel and monitoring requirements

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 540.

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 66



SSSI 66: Amberwood/Alderhill
Ashley Cross
Fritham Bridge
Ford
Latchmore Brook
Amberwood Inclosure
Alderhill Bottom
Gaze Hill
Pitchers Knowle
Alder Hill
Alderhill Inclosure
0 50 100 200 300 Metres
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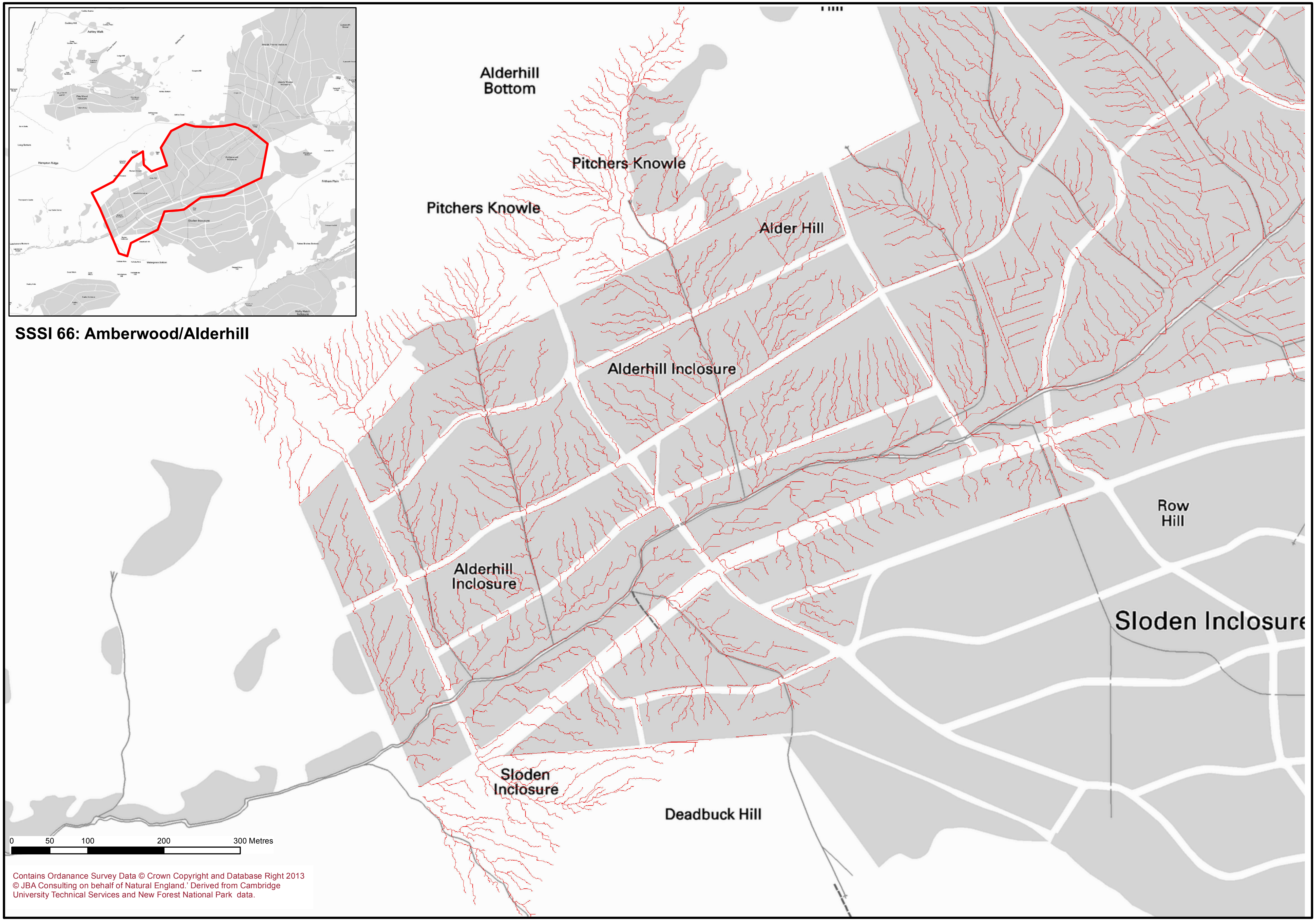

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