Natural England Commissioned Report NECR140

New Forest SSSI Geomorphological Survey Overview

Annex Q: Islands Thorns / Amberwood Restoration Plan - SSSI Unit 540

First published 06 March 2014

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1 Islands Thorns / Amberwood Restoration Plan - SSSI Unit 540

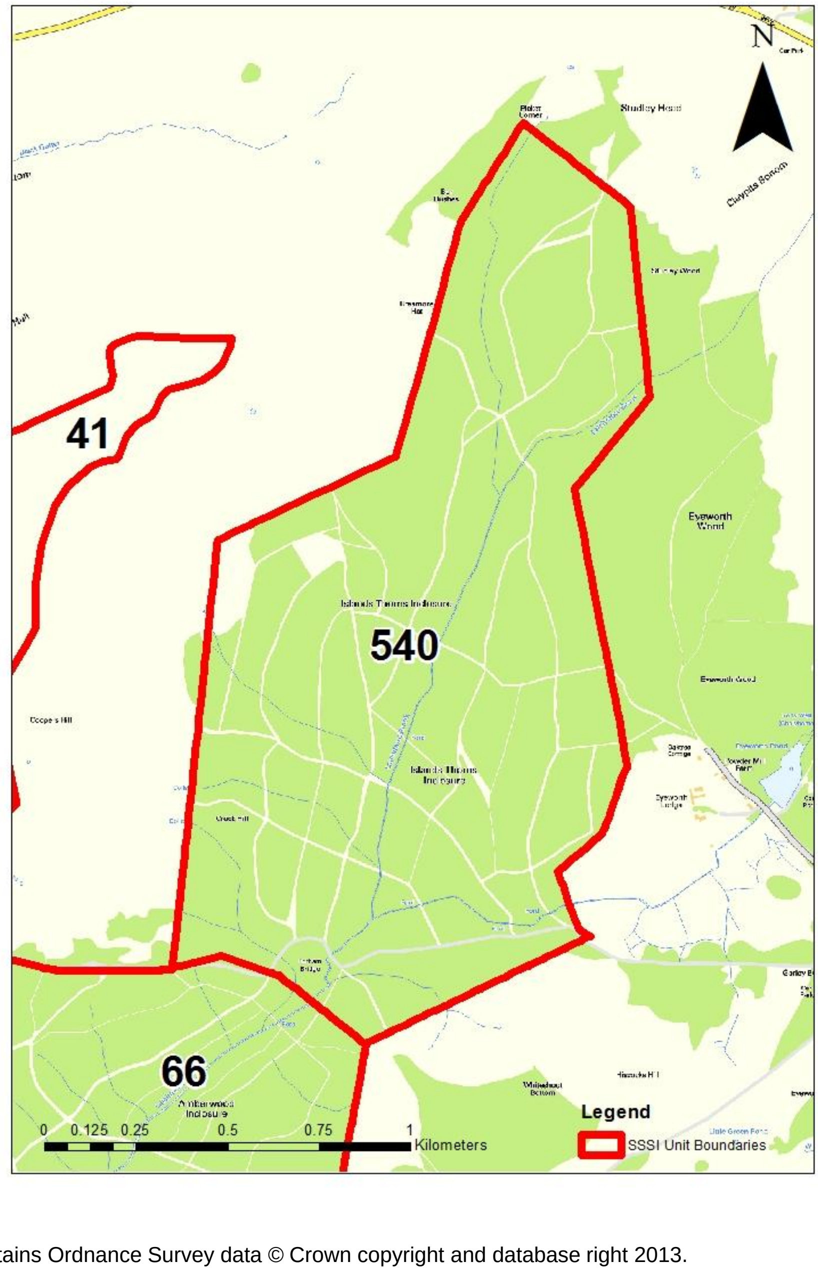
1.1 Introduction

Islands Thorns / Amberwood (Unit 540) incorporates the upper reaches of Latchmore Brook and flows into the downstream SSSI Unit 66 (Figure 1-1). The SSSI unit is considered to be in an unfavourable recovering condition. It is approximately 195.29ha in size.

This unit consists of mixed woodland made up of predominantly Beech *Fagus sylvatica*, Oak *Quercus robur*. and conifers (predominantly Corsican Pine *Pinus nigra maritima* and Norway Spruce *Picea abies*).

It is essential that incision in the downstream 66 SSSI Unit (Amberwood / Alderhill) is also mitigated as any works undertaken with Unit 540 risk being compromised in the future if this is not undertaken as a result of continued knickpoint propagation upstream.

Figure 1-1: SSSI Unit 540 location (flow direction is north to south)



1.2 Current hydromorphic conditions and issues

A summary of the hydromorphic conditions for unit 540 is given in Table 1-1.

Table 1-1: Summary of hydromorphic conditions for unit 540

Geomorphological Assessment Area		Latchmore Brook u/s reaches
Site Name		Islands Thorns / Amberwood
Size (ha)		195.3
SSSI Unit(s)		540
Channel Condition	River type (s)	Lowland anastomosed at confluence of two watercourse; active meandering / passive meandering upstream
	Responsiveness	Moderate / high - steep gradient, straightening, strong gravel supply, tree clearance (historic)
	Sediment delivery, type and mobility	Gravels in banks. Strong gravel supply but less deposition than d/s reach. Deposits composed bigger gravels / cobbles due to steeper gradient, more transportational
	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	Drains over both banks incised, straight and embanked
	Morphology	Pool, riffle, debris jams, mid-channel bars, transverse bars - not as well developed as d/s reach and composed of larger gravels / cobbles
	Incision	Less incision on LB watercourse. Upstream of confluence main channel is incised. Big incision at u/s extent and in right bank drains (2-3m)
	Engineering	Channel straightening, possible dredging, embankments at d/s end of this reach
	Bank activity	The watercourse is more sinuous than OS mapping suggests indicating lateral movement. Bank collapse associated to incision
	Flow type (s)	Flows impacted by upstream and local drainage network. Flood peaks concentrated in channel.
Floodplain Condition	Valley type	Narrower 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 close to confluence, poor further upstream due to incision levels
	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

Latchmore Brook within SSSI Unit 540 varies between:

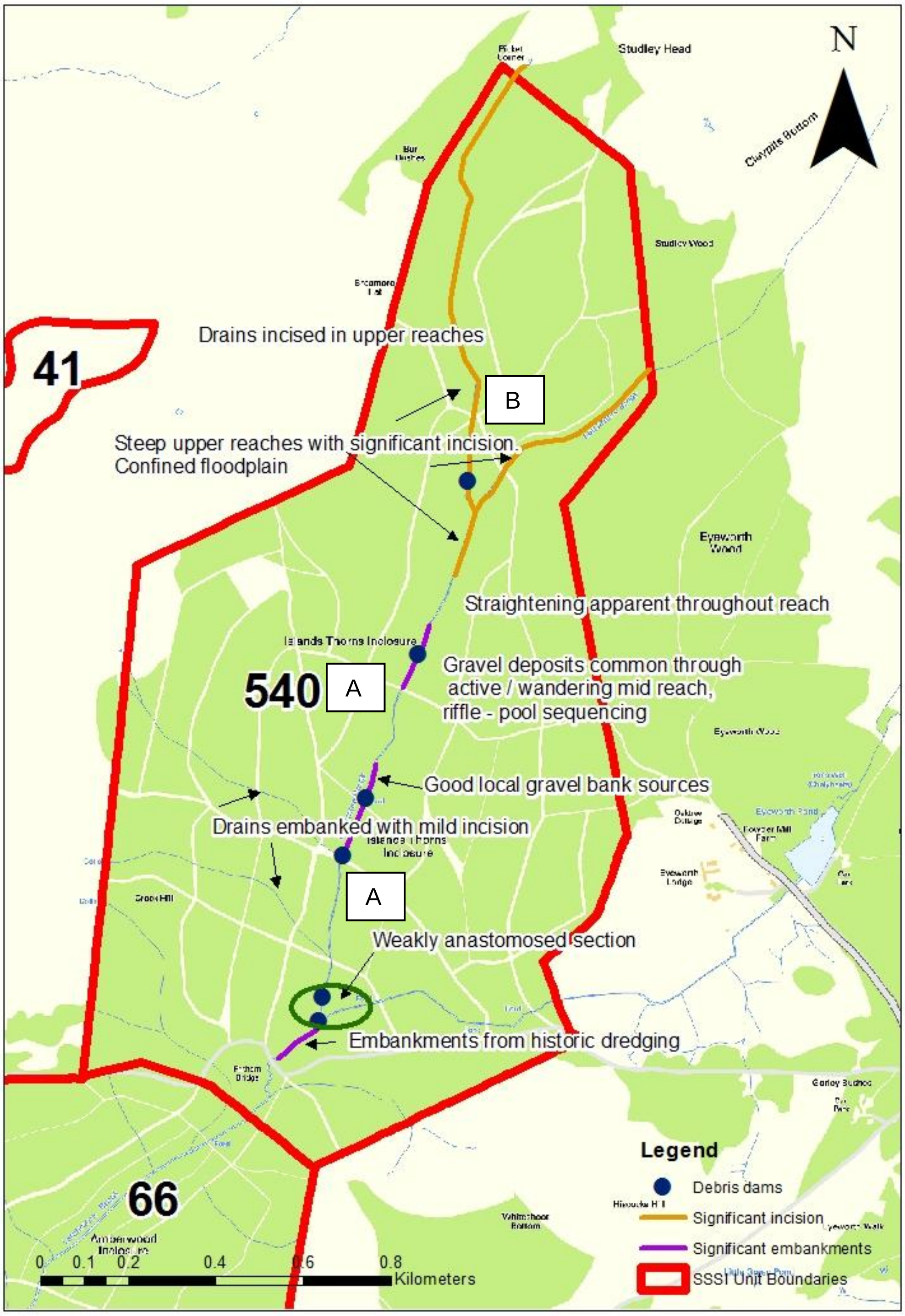
- a weakly lowland anastomosed system at the downstream end of the reach where the stream from the east meets the Latchmore Brook (Figure 1-2);
- an active single thread channel, with some mild characteristics of an actively widening channel type as gravel inputs are strong (Figure 1-3);
- a passive single thread channel.

Figure 1-2: Weak anastomosed channel

Figure 1-3: Actively widening characteristics in some locations

The source of Latchmore Brook is at Studley Head and Horny Ridge to the east. The upper reaches provide an important source of gravels for downstream Unit 66 (Amberwood / Alderhill) and the upper reaches are mostly transportational which are important for supplying the downstream gravel features. Figure 1-4 summarises the existing hydromorphology and pressure impacting unit 540.

Figure 1-4: Current hydromorphic conditions and pressures



The Latchmore Brook has a moderate gradient in the mid to lower reaches (Figure 1-4 - A) and a steeper gradient in the upper reaches where it is narrower and more incised (Figure 1-4 - B). It has also been subject to channel straightening in the past throughout. 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 common 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. 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. Where floodplain connectivity is good, within the wooded downstream section where the two watercourses meet, a multi-thread anastomosed channel network has developed between stabilised wooded areas. Lateral and vertical erosion is reduced through these sections as channels are wetted at different flow levels, spreading erosive energy across a wide area as flow levels increase. Whilst on site, high flow levels showed the mild anastomosed channel network well (Figure 1-2). The success of the anastomosed network is assisted by local debris jams which maintain improved floodplain connectivity (Figure 1-6).

Figure 1-6: Debris jam at anastomosed channel section

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 mid to lower 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 1-7) and wandering behaviour across areas with erodible banks. This initial incision episode is likely to have caused the knick point development moving through the tributary / drain systems.

Figure 1-7: Upstream significant incision

The result of poor floodplain connectivity and the modified flow regime, in a responsive river type, has been vertical incision, particularly in the upper reaches where more cohesive banks and a steeper gradient have focused erosive energy on the channel bed. Ditching of the upper and mid 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. This is particularly evident in the upper reaches of this unit where smaller gravels are readily mobilised downstream leaving smaller deposits of larger, often cobble sized, material (Figure 1-8).

Figure 1-8: Smaller larger gravel / cobble deposits in upper reaches

More locally the incision will be followed by in-channel deposition, in the mid to lower reaches 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 low to middle reaches of unit 540, 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 incision up to 3m (from bank top to stream bed level) in the upper reaches of this unit, where the channel in significantly narrower than mid to lower reaches. 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 (Figure 1-7) through 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, downstream of the anastomosed section. 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 1-9).

Figure 1-9: Incision in upper reach 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 where the floodplain is wider than upstream where it is narrower and more confined.

Gravel supply (there are significant gravel sources within the river banks, Figure 1-10, locally and upstream sources are particularly important for gravel features in the mid to lower reaches) is strong and this, combined with flow regime alterations through surrounding drains, as well as historic tree clearance, give responsive channel conditions.

Figure 1-10: Local gravel bank sources

The strong supply of gravels has resulted in significant gravel feature growth within the channel in the mid to lower 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 common along the channel, particularly in the mid to lower active sections, which have often been created as a result of local bank erosion / collapse (Figure 1-11). These create short lengths of impounded watercourse that does improve floodplain connectivity significantly, as is clearly seen in the mild anastomosed section of this reach. These provide useful analogue features for the restoration plan.

Figure 1-11: Natural woody debris jams

Significant palaeo channels have been identified in Figure 1-13 and show where 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

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 incision within downstream Unit 66 could eventually threaten the anastomosed network within this unit if this is not mitigated.

The river can also be said to be recovering 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 upper reaches where extreme floodplain disconnection means most flows are likely to be contained within the channel with little potential for significant lateral movement due to cohesive banks.

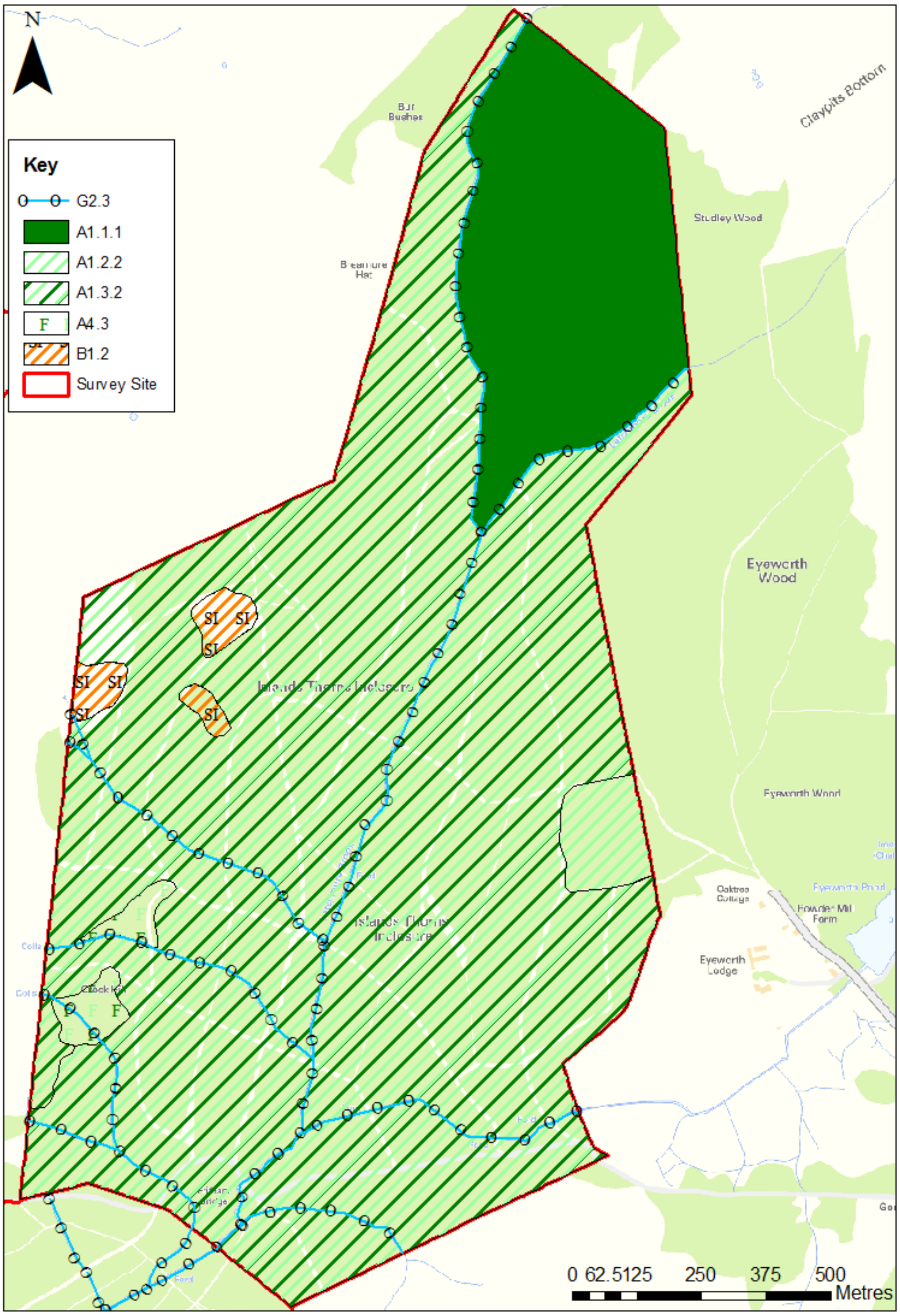
1.4 Current ecological conditions

The unit consists of mixed woodland with predominantly semi-mature Beech and Oak and conifers (Corsican Pine and Norway Spruce) with some affinities to W14 woodland, although heavily modified. There is some Holly *Ilex aquifolium* and Rhododendron *Rhododendron ponticum* within the understorey. The ground flora is dominated by Bracken *Pteridium aquilinum*.

In more open areas, along tracks, rides and areas that have been felled, there are patches of grazed grassland and Soft Rush *Juncus effusus* dominated wetland areas.

At the time of the site walkover survey there was no aquatic vegetation present within the channel.

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;
- 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.

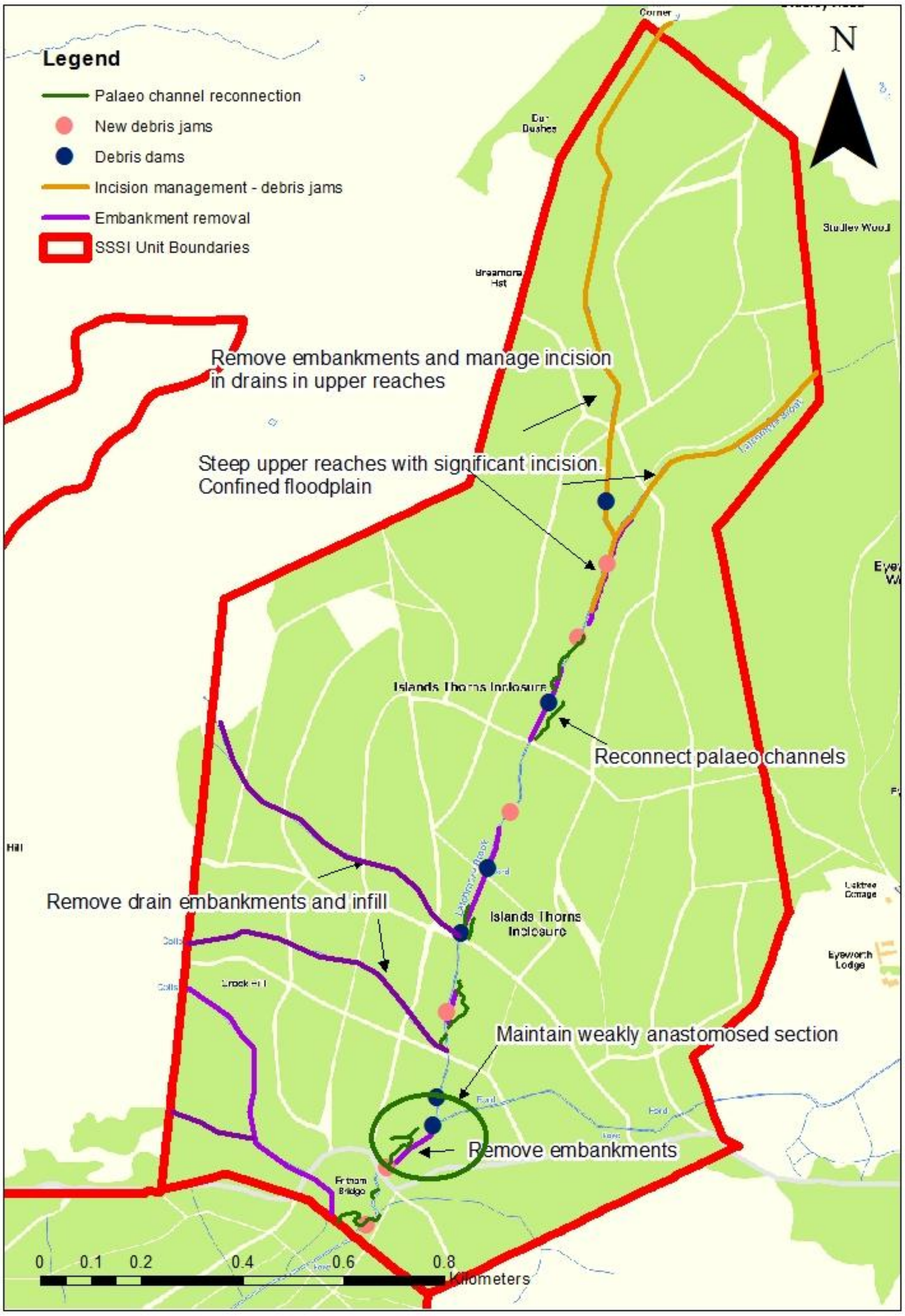
Table 1-2: SSSI Unit 540 proposed restoration measures

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.	Increase diversity in-channel and alongside by creating features that can be colonised by vegetation, creating seral communities.	Incision rates mean reinstating the palaeo channels requires significant bed raising, particularly in the upper reaches. Studley Wood GCR within this unit may constrain drainage restoration proposals.
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.	Increase over-woodland floor flow of stream which will find many sub-channels and promote additional development of wet woodland conditions and potentially promote the growth of plants, such as *Carex paniculata* in Alder woodland.	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, a fish pass may be required although this is unlikely. Large amounts of material are likely to be required if bed works are undertaken, particularly upstream. May require some felling of trees. Studley Wood GCR within this unit may constrain drainage restoration proposals.

Pressure	Impact	Restoration proposal	Hydromorphic improvement	Ecological improvement	Constraints / issues
			Reduces fine sediment inputs. Slows gravel movement. Stabilises in-channel features.		Cultural objections
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.	Will improve diversity of in-channel and floodplain habitats. Opportunities to increase and/or provide new areas of wet grassland and/or mire habitat	Drains may also require infilling to restore natural flow regime and reduce incision. May require some felling of trees. Cultural objections
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.	Remove unnatural drainage and replace with a more natural one mimicking the conditions prevailing before the forestry drainage works were undertaken, benefitting plant and invertebrate species.	May require import of material. Studley Wood GCR within this unit may constrain drainage restoration proposals. Cultural objections
Riparian vegetation removal	Loss of bank stability. Loss of shading. Loss of organic inputs to the watercourse.	Reduced tree clearance at bank edge. Ring-bark selected trees Half-felling	Will help to stabilise banks in the wandering sections and alongside bed restoration to minimise incision, could improve floodplain connectivity	Create standing and fallen dead wood habitat as well as CWD and 'living dams' in streams. Promote heterogeneity of habitats.	Tree clearance is a necessity in some locations.

Pressure	Impact	Restoration proposal	Hydromorphic improvement	Ecological improvement	Constraints / issues
		Replant	Creates riparian hydromorphic diversity. Acts as fine sediment trap. Allows woody debris accumulation.		
Forestry	Significant impact on low flow regime. Flow quantity, quality, variability. Increases water temperature. Fine sediment dynamics Water table impacts.	Phased removal of non-native species Ring barking	Reduced risk of drying, improved hydromorphic diversity, lowered risk of in-channel fine sediment accumulation	Increased floristic diversity of ground flora on floodplain due to increased light levels at ground level Restoration of mire habitats in the riparian zone and the promotion of natural wet woodland in these areas.	Large-scale removal of conifer species is unlikely to be feasible or economically viable. Cost Cultural objections.
Woody invasive species	Alters floodplain species assemblage. Impacts bank stability.	Exterminate and allow natural regeneration / plant Alder & Willow.	Creates riparian hydromorphic diversity	Increased floristic diversity of ground flora on floodplain through increased light penetration. Restoration of wet woodland habitats.	Continued maintenance requirements. Cost Cultural objections.

Figure 1-13: Proposed restoration measures for SSSI Unit 540



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.

The major straightened / modified drainage channels are identified in Figure 1-13. 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 66 and 48 downstream. The linkage between the units is important and issues identified within units 66 and 48 are likely to be impacted / mitigated by works undertaken in this unit. Therefore, works in this unit and unit 66 should be undertaken either at the same time or before works in unit 48.

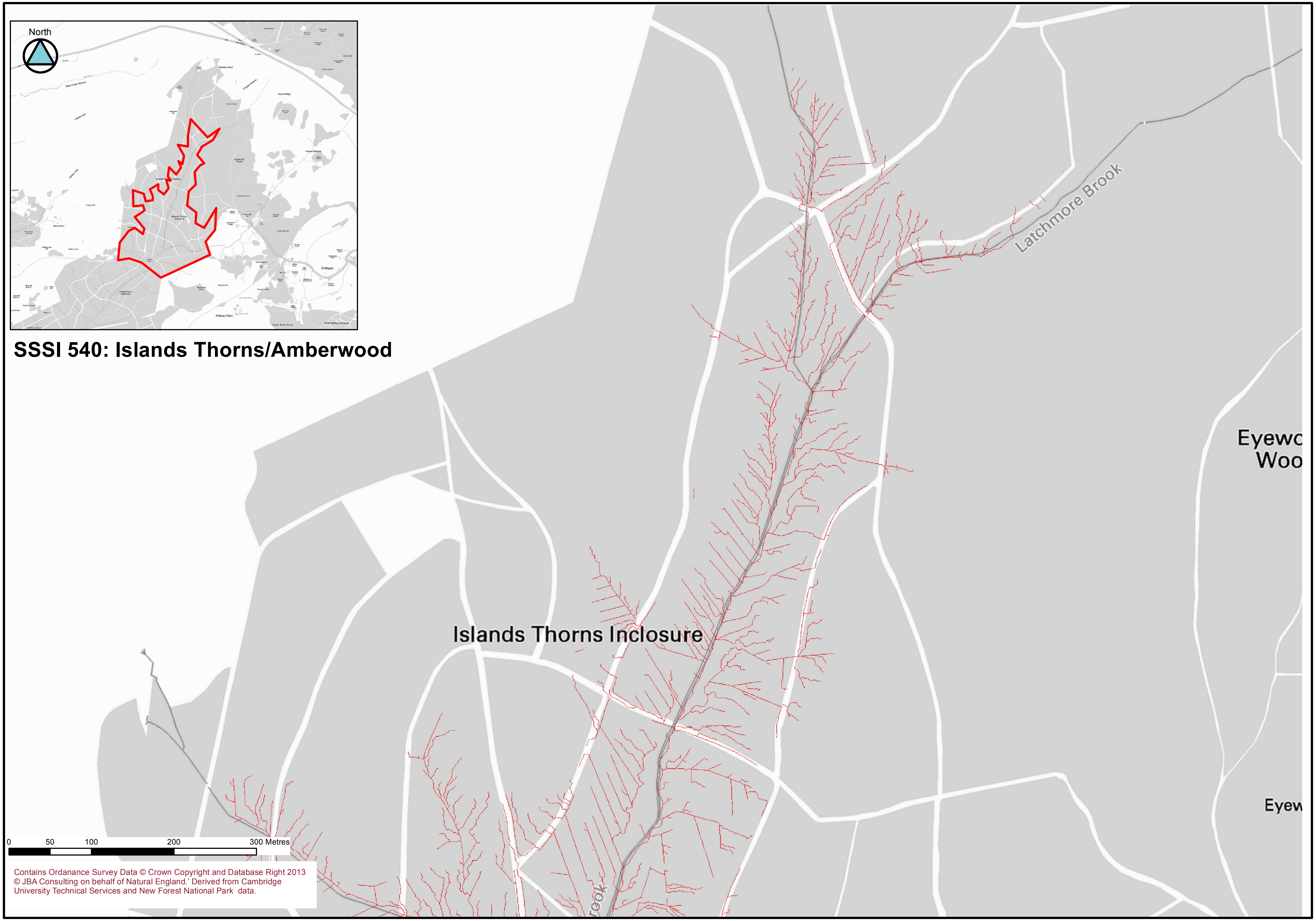
1.7 Restored channel and monitoring requirements

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.

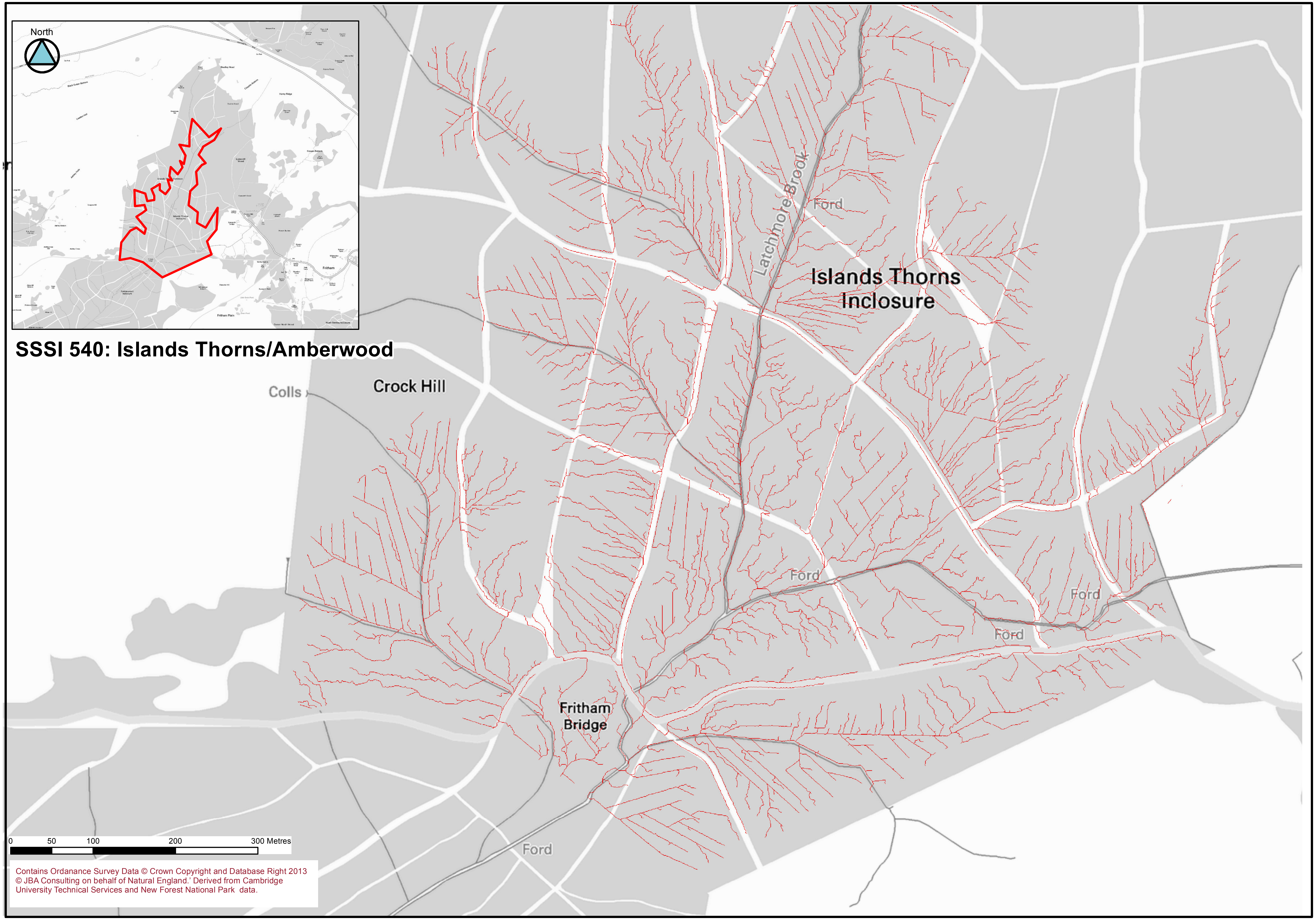
Table 1-3: Monitoring parameters, frequency and suggested approaches for the Unit 540.

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 540



SSSI 540: Islands Thorns/Amberwood


North
SSSI 540: Islands Thorns/Amberwood
Crock Hill
Colls
Latchmore Brook
Ford
Islands Thorns
Inclosure
Ford
Ford
Ford
Fritham
Bridge
Ford
0
50
100
200
300 Metres
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