

# Upper River Witham: Syston and Barkston

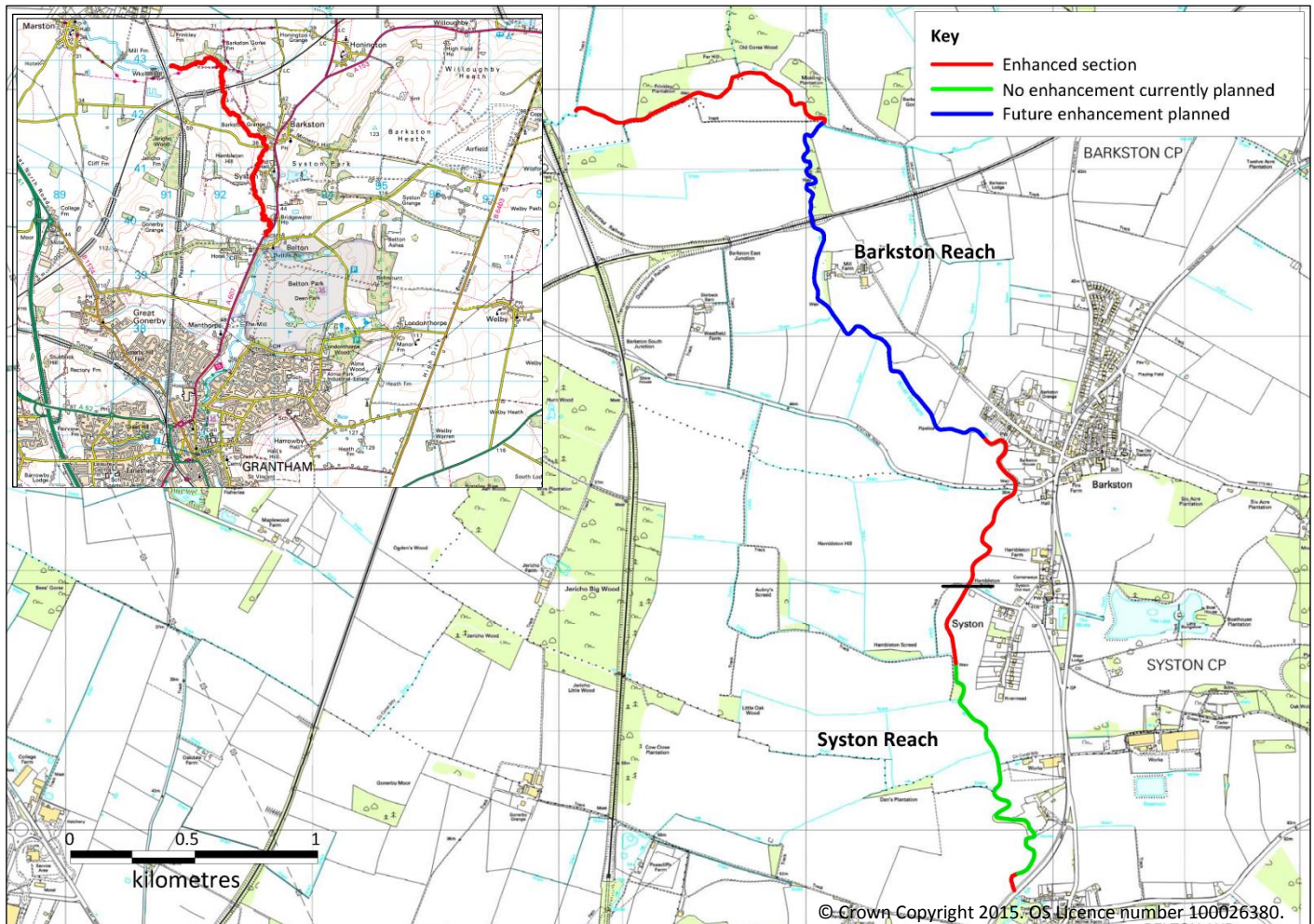
v1 (01.03.16)

- Location:** c4km north of Grantham
- Upstream Grid Refs:** Syston: SK92843975; Barkston: SK92844138
- Length:** Syston Reach: 2.2km; enhanced length: 900m (the remaining 1.3km would benefit from significant enhancement when funding is available). Barkston Reach: 3.5km; enhanced length: 1.5km (a further 1.9km has been identified for enhancement in the future).
- Completion Date:** Syston: September 2014; Barkston: December 2014
- Cost:** Syston: c£9K; Barkston: c£9K
- Partners:** These schemes were implemented by the Environment Agency in partnership with the Grantham Angling Association Fly Fishing Section (GAAFFS) and with the co-operation and agreement of the adjacent landowners.



**Summary of Techniques:** Channel narrowing and flow deflection to create flow variation and beneficial bed scour using a variety of techniques: log flow deflectors (vanes), log/faggot and brushwood mattresses (silt-traps); pollarding and coppicing riverside trees to open the channel; and increasing in-stream woody habitat by securing deadwood and hinging and pinning (layering) live riverside trees.

## Location Map



## Background

The Upper River Witham rises west of South Witham and flows for more than 65 km northwards through Colsterworth, Great Ponton, Grantham, Long Bennington, Bassingham and North Hykeham towards Lincoln. More than 165 km of river and tributary streams drain the c573 km<sup>2</sup> catchment.

The landscape of the catchment is varied in character, ranging from the livestock-dominated limestone valleys upstream from Grantham, through the mixed farming terrain of the middle reaches, to the flat-lying arable farmlands downstream from Long Bennington. Over recent centuries, and particularly the last 100 years, the once naturally meandering river channels have been straightened, deepened, widened, impounded and embanked to reduce flood risk and improve land drainage. These modifications, together with catchment land management practices, have contributed to a decline in river corridor habitat quality.

The Upper Witham and its tributaries are divided into 19 separate waterbodies for Water Framework Directive assessment and only 3 are assessed as having Good Ecological Status. The section of the Upper Witham which includes the System and Barkston reaches is currently assessed as “Moderate” due to high phosphate levels, excessive algae (diatoms) and poor fish populations. The enhancement works seek to address these issues as part of the wider *Upper Witham River Corridor Habitat Plan*.

## Pre-project Survey Work

Walkover surveys were undertaken to scope the enhancement proposals and fish surveys, undertaken annually at Hambleton "Sleeper" Bridge (SK9265640987), provide a baseline for future monitoring.

The walkover surveys identified that the in-stream habitat at the bottom of the Syston Reach was in generally good condition, but that there were opportunities to improve river function by reducing erosion and sedimentation and modifying flow patterns to improve habitat for fish and invertebrates. The upper section of the Syston reach has been historically straightened and dredged. However, it does retain a variety of habitats along with good adult fish cover. Gravel introduction have been carried out in the past, but the investment required to produce a significant improvement was beyond the scope of the available funding on this project. Consequently an enhancement scheme was only developed for the lower reaches.

The habitat in the Barkston Reach was also poor due to the effects of straightening, dredging and impoundment. Siltation of the over-wide riffles and the lack of cover for juvenile and adult fish were identified as key issues and addressing these was the main focus of the enhancement work.

## Project Objectives

- To modify the bed structure and improve in-stream habitats for fish and invertebrates, including native white-clawed crayfish.
- To stabilise eroding riverbanks and reduce fine sediment inputs caused by fluvial processes.
- Trap mobile fine sediments from agricultural and other sources.

The enhancement works were planned in two phases and designed by Environment Agency staff in consultation with Grantham Angling Association Fly Fishing Section (GAAFFS) and the riparian landowners.

Note. In addition to the enhancements described below, GAAFFS have received funding from the Environment Agency to control invasive non-native species (INNS), in particular giant hogweed, in this section of the river.

## Consultation and Consents

Consent for the Barkston Reach was obtained via an internal Environment Agency application which was granted on 5<sup>th</sup> August 2013 (Consent No. L-002766-13). GAAFFS was granted Flood Defence Consent to undertake the Syston enhancement on 10<sup>th</sup> September 2014 (Consent No. ANG\_N-L\_2014\_3037).

## The Enhancement Schemes

The drawings in Annex 1 show all the elements of the completed enhancement work at Syston and Barkston and the techniques used are described below. Several of the techniques have multi-functional benefits, but their principal function is to create sections of 2-stage channel where the river has been widened and deepened. Here a variety of channel narrowing structures have been installed just above the normal water level to create a low flow channel, but are readily over-topped as the water level rises to ensure that the capacity of the channel is not compromised.

### *Tree Management*

Heavy shading by riverside trees prevents the colonisation and stabilisation of accumulated fine sediment by wetland vegetation. Selected riverside trees were either coppiced or pollarded to open up the channel to assist the development of vegetated wetland margins to trap silt and naturally narrow the channel and the logs, branches and brushwood generated was used to create channel narrowing brushwood mattresses and enclosures (see below). Other trees and bushes were hinged and pinned into the channel to create live flow deflectors.



Fig 1. A coppiced willow, managed to open up the channel and generate woody material. (Syston)



Fig 2. Hinged and pinned riverside tree with added brushwood to narrow the channel and trap fine sediment. (Syston)

### **Brushwood mattresses and enclosures**

A variety of techniques were used to create brushwood mattress and enclosures to protect vulnerable banks from erosion, narrow the channel and trap suspended silt during high flows. These included:

**Open (unenclosed) brushwood mattresses:** small branches firmly secured with posts and wire bindings to create a mattress;

**Log/faggot-faced mattresses:** as above, but fully enclosed with either secured logs (generated from the riverside tree management) or faggots;

**Log-fronted mattresses:** brushwood mattresses partially enclosed by secured logs leaving the downstream end open to create a “backwater” which provides a valuable fish/fry refuge;

**Faggot mattresses:** Only one of these was constructed by securely binding surplus faggots to create a dense mattress.

In addition several brushwood structures, created by GAAFFS in the Syston reach during an earlier enhancement scheme, were modified by the addition of new log facings.



Fig 3. Erosion protection with an extensive log-faced brushwood mattress. (Syston)



Fig 4. Open Brushwood mattress demonstrating the ability of these structures to trap large quantities of fine sediment. (Barkston)



Fig 5. A brushwood mattress narrowing an over-wide riffle to promote natural cleansing of the gravels (Barkston)

Fig 6. Completing a faggot mattress. (Syston)

### Log Flow Deflectors and Vanes

Logs derived from riverside tree management were also used to construct flow deflectors and vanes. Flow deflectors are partially exposed above the water level, but slope down at a very shallow angle towards the centre of the channel, and are designed to deflect the flow during typical flow conditions, effectively narrowing the channel. Vanes, however, are permanently submerged. Deflectors and vanes create localised flow variation, helping trap and retain gravels; improve flows through gravel beds, keeping them free of fine sediment and provide an ideal fish spawning substrate; and improve the bed structure through scouring. Both types of structure, either in pairs or singles, are normally angled upstream to direct the flow towards the centre of the channel and minimise the potential for bank erosion. In addition to vanes and deflectors keyed into the bank, paired “micro-vanes” were also installed mid-channel to create more complex flow variation and bed scour.



Fig 7. A series of paired micro-vanes (Barkston)

Fig 8. Paired micro-vanes, showing their ability to scour and clean gravel. (Syston)

### Monitoring

A variety of monitoring techniques have been employed to assess the impacts of the works. These include fixed point photography, along with regular visual inspections to monitor the integrity and performance of the in-stream structures. An annual programme of fine sediment and gravel sampling to monitor changes in the bed substrate has been established and native crayfish surveys will be repeated on a 2 years cycle. Annual fish surveys are already undertaken and show that the brown trout stocks are currently healthy.

## Suppliers of Services and Materials

### Tree work and in-stream structures (Syston and Barkston)

Lions Grass Care. Contact Nick Brooks. T. 01476 594092; E. [lionsgrasscare@gmail.com](mailto:lionsgrasscare@gmail.com); W. [www.lionsgrasscare.com](http://www.lionsgrasscare.com)

### Tree work and in-stream structures (Syston)

P&R Plant Hire, Fleet, Spalding, Lincs. PE12 8NG. Tel 01406 422669. [www.pandrplanthire.co.uk](http://www.pandrplanthire.co.uk)

### Faggot and stakes (supply only)

Woodland and Water Management Ltd: [dom@woodland-water.co.uk](mailto:dom@woodland-water.co.uk) or Tel. 01327 349073

## Further Information

### For further information about the Syston scheme contact:

Katie Murphy, Technical Officer, Fisheries, Biodiversity and Geomorphology Team. Environment Agency, Lincoln  
T: 0203 025 4996. E: [katherine.murphy@environment-agency.gov.uk](mailto:katherine.murphy@environment-agency.gov.uk)

### For further information the Barkston scheme contact:

Matt Parr, Technical Officer, Fisheries, Biodiversity and Geomorphology Team. Environment Agency, Lincoln  
T. 0203 025 5014. E. [matthew.parr@environment-agency.gov.uk](mailto:matthew.parr@environment-agency.gov.uk)



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[www.environment-agency.gov.uk](http://www.environment-agency.gov.uk)

## The Water Framework Directive

The Water Framework Directive (WFD) is a major area of work for the Environment Agency. The WFD aims to get all water bodies - lakes and groundwater aquifers as well as rivers - into 'good ecological status' - or better - by 2027, with a series of 'landmarks' (2015 and 2021) to check progress.

The Water Framework Directive became UK law in December 2003. It provides an opportunity for the Environment Agency to plan and deliver a better water environment with the focus on ecology.

The Water Framework Directive will help to protect and enhance the quality of: surface freshwater (including lakes, streams and rivers); groundwater; groundwater-dependent ecosystems; estuaries and coastal waters out to one mile from low water.

The Environment Agency is the lead authority in England and Wales to carry out:

- Improvements on inland and coastal waters through better land management and protect them from diffuse pollution in urban and rural areas
- Drive wiser, sustainable use of water as a natural resource
- Create better habitats for wildlife in and around water
- Create a better quality of life for everyone

The Environment Agency is the leading organisation for protecting and improving the environment in England and Wales. We are responsible for making sure that air, land and water are looked after by today's society, so that tomorrow's generations inherit a cleaner, healthier world.



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## Glossary

**Berm:** a low, often wet, ledge or terrace at the edge of the stream that constricts the flow and allows a vegetated wetland margin to develop.

**Brash:** fine woody material including thin branches and twigs.

**Coppicing:** cutting of a tree just above ground level resulting in the regrowth of a number of shoots. The shoots are allowed to grow to provide long straight poles which are re-coppiced on rotation.

**Faggot:** a bundle of brushwood (or brash) tied together into a cylindrical shape. Used as bank revetment; to form flow deflectors; and to promote the deposition of sediment in marginal areas.

**Fish pass:** Structure to enable fish to gain access past a weir, sluice or other structure that would otherwise be impassable.

**Flood Defence Consent:** consent issued by the Environment Agency to carry out works in, over, under or near a watercourse or flood defences. An application for Flood Defence Consent is needed to ensure that any works do not endanger life or property by increasing the risk of flooding or cause harm to the water environment.

**Floodplain:** Area of land bordering a river that is prone to flooding.

**Flow deflector (groynes):** a structure projecting in to the river which is designed to constrict water flow and promote scouring and deposition of sediment.

**Glide:** a section of stream characterised by moderately shallow water with an even flow that lacks pronounced turbulence. Although most frequently located immediately downstream of pools, glides are occasionally found in long, low gradient streams with stable banks and no major flow obstructions. The typical substrate is gravel and cobbles.

**Layering (also laying or pleaching):** A technique where a small tree is partially cut at the base leaving a narrow bark and sapwood hinge which enables the tree to be laid down. The tree remains alive and able to continue growing.

**Large woody material:** pieces of naturally derived timber generally held to have dimensions greater than 10cm in diameter and 1m in length.

**Left/right bank:** the left/right hand bank of a watercourse as observed whilst facing downstream.

**Meander:** a meander is a bend in a watercourse formed as water erodes the outer bank and deposits the eroded sediments on the inside of the bank.

**Poaching:** river bank damage caused by the hooves of livestock resulting in the loss of vegetation and soil erosion.

**Pollarding:** similar to coppicing, except that the tree is cut at approximately head height to prevent damage by grazing animals. Trees managed in this way are known as **pollards**.

**Pool:** a deep section of stream bed with very little surface flow, typically located at the outside of a bend.

**Revetment:** works to protect the bed or banks of a channel against erosion.

**Riffle:** a length of stream with a steep gravel, pebble and/or cobble dominated bed, a fast flow and a broken water surface, where the water flows swiftly over the completely or partially submerged substrate.

**Riparian:** along the banks of a watercourse.

**Run:** differs from a riffle in that, although the water surface is broken, the water depth is typically greater and the slope of the bed is less.

**Scour:** Erosion of the bed or banks of a watercourse by the action of moving water.

**Sediment:** material ranging from clay to gravel (or even larger) that is transported in flowing water and that settles as the flow slows down.

**Shoal:** sedimentation within or extending into a stream or other waterbody, typically composed of sand, silt and/or gravels.

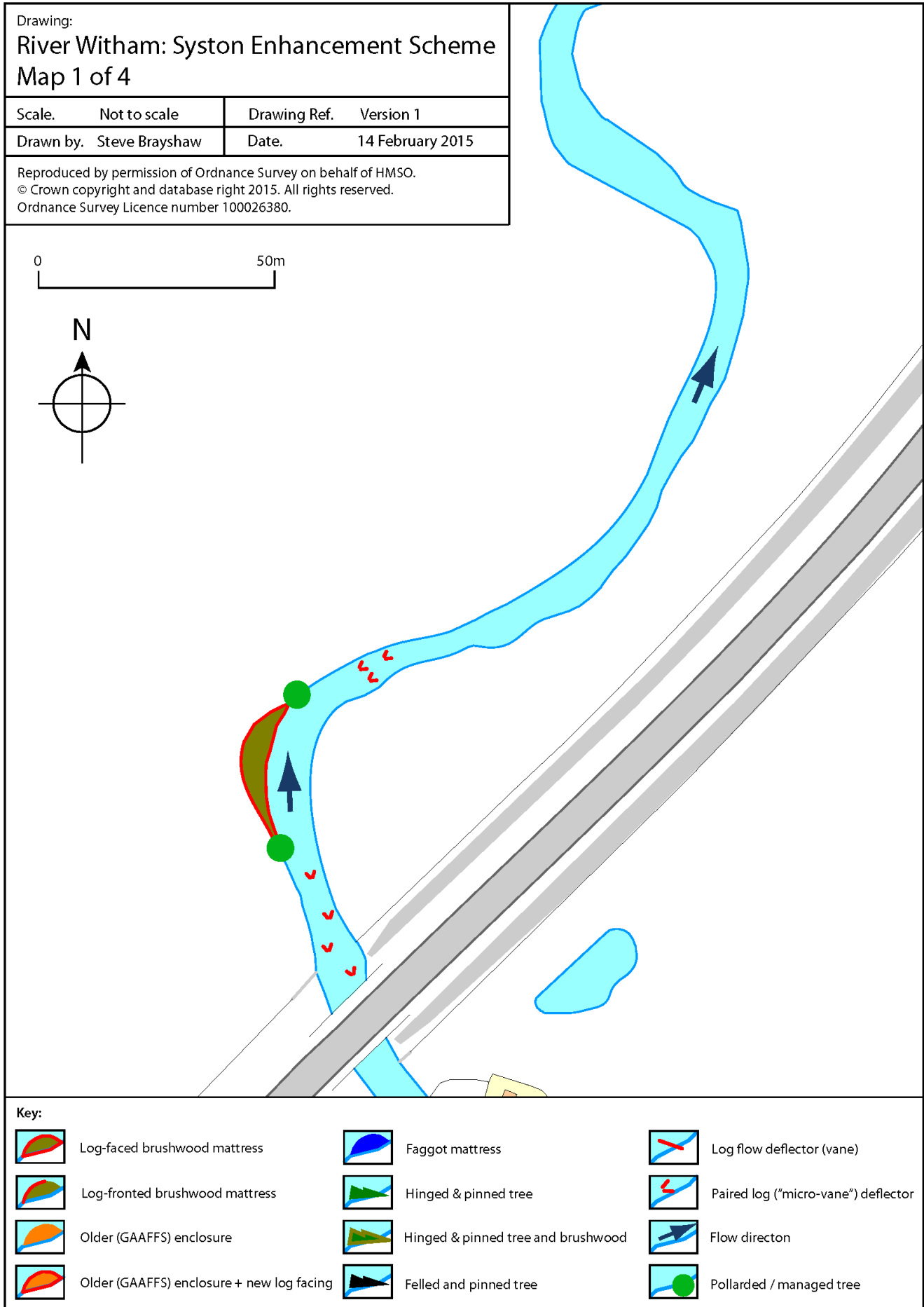
**Spate (freshet):** a period of fast river flow and raised water levels caused by heavy rain (or melting snow).

**Spiling:** the use of thin branches to create a woven 'fence' that protects the bank from erosion.

**Toe (of the riverbank):** where the river bed meets the bank.



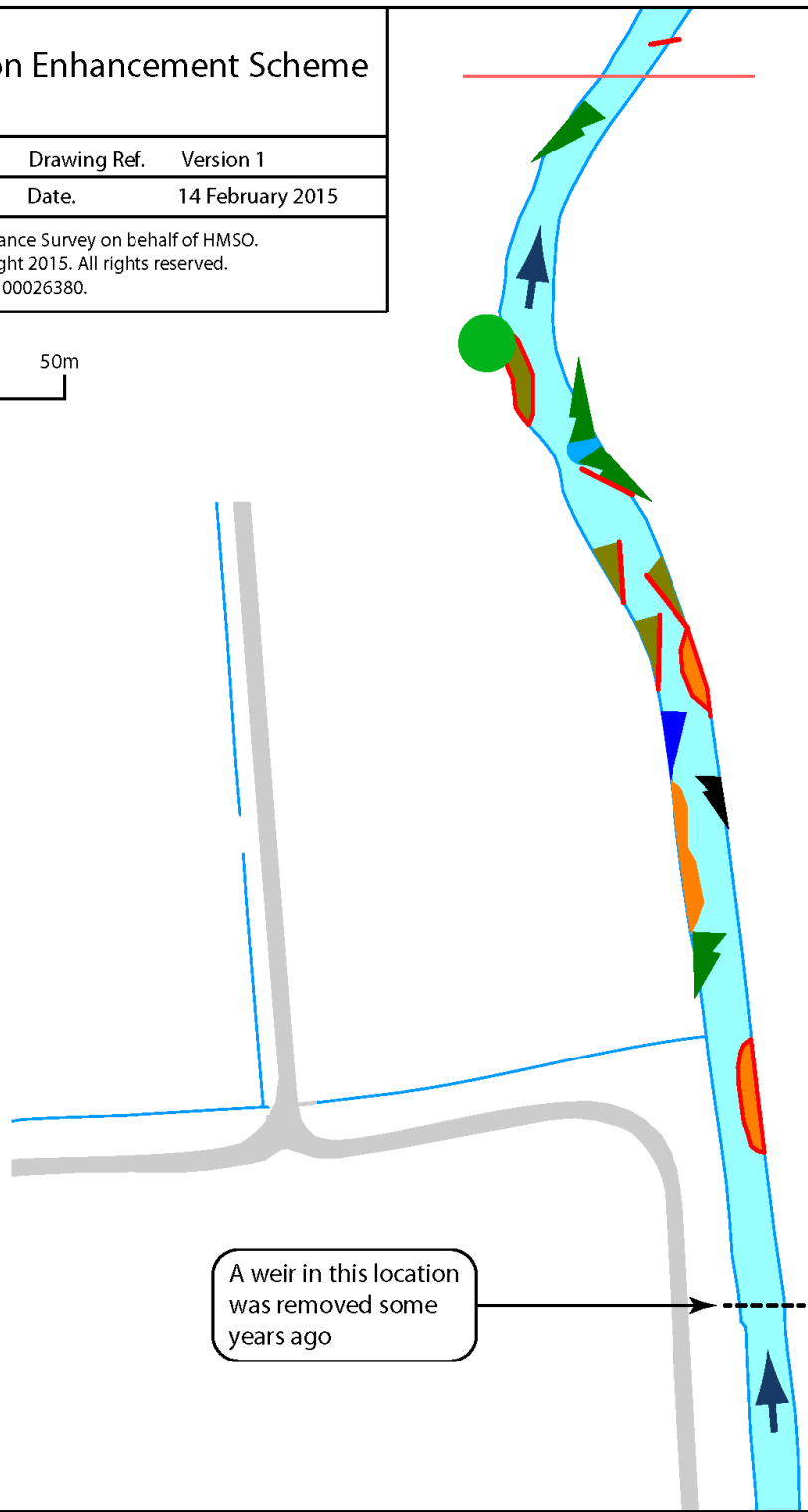
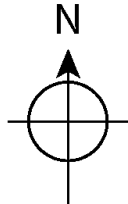
# ANNEX 1: The Completed Enhancement Scheme (mapping commences at the upstream extent)



Drawing:  
**River Witham: Syston Enhancement Scheme**  
 Map 2 of 4

Scale.	Not to scale	Drawing Ref.	Version 1
Drawn by.	Steve Brayshaw	Date.	14 February 2015

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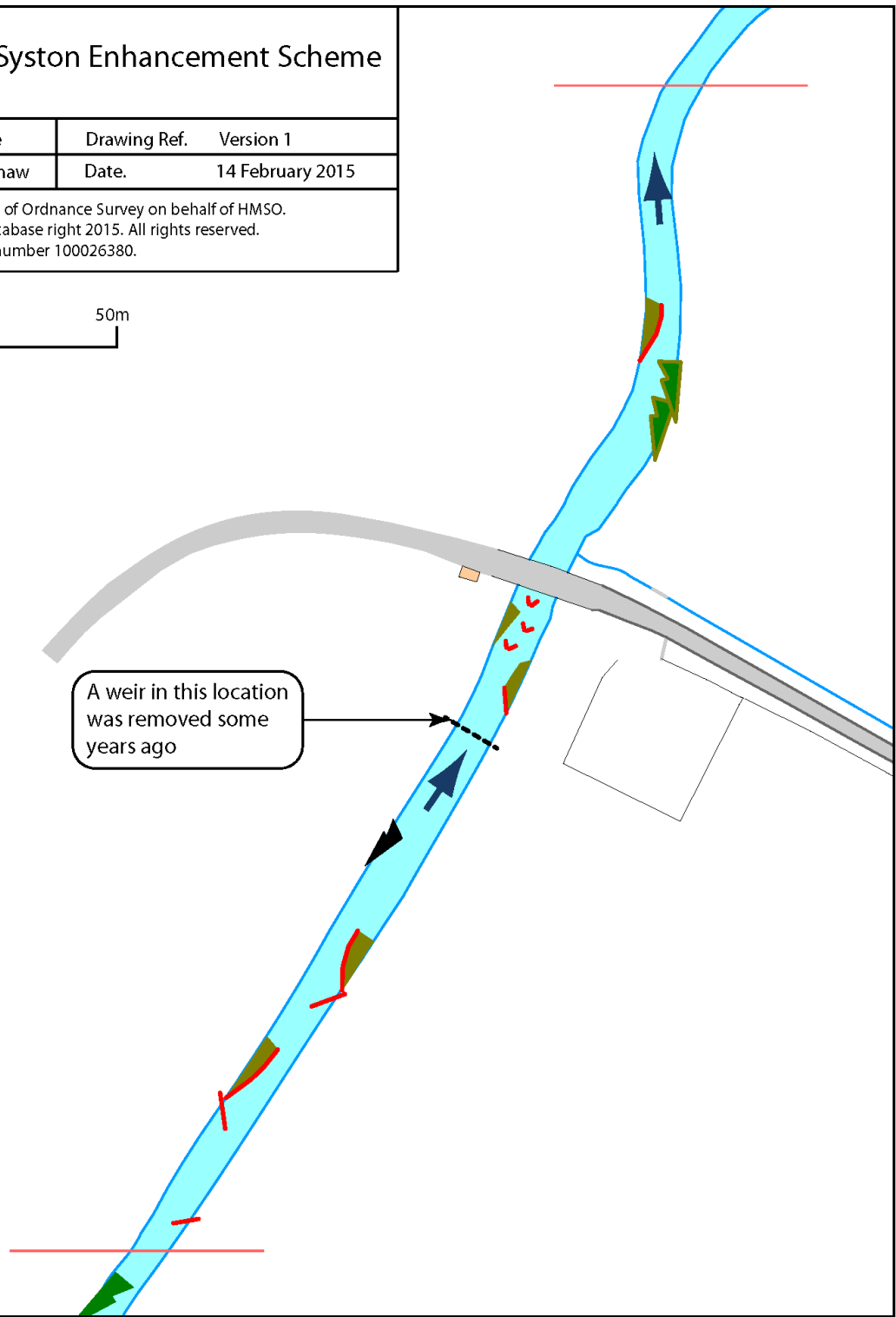
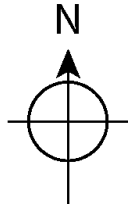
Key:

	Log-faced brushwood mattress		Faggot mattress		Log flow deflector (vane)
	Log-fronted brushwood mattress		Hinged & pinned tree		Paired log ("micro-vane") deflector
	Older (GAAFFS) enclosure		Hinged & pinned tree and brushwood		Flow direction
	Older (GAAFFS) enclosure + new log facing		Felled and pinned tree		Pollarded / managed tree

Drawing:  
**River Witham: Syston Enhancement Scheme**  
 Map 3 of 4

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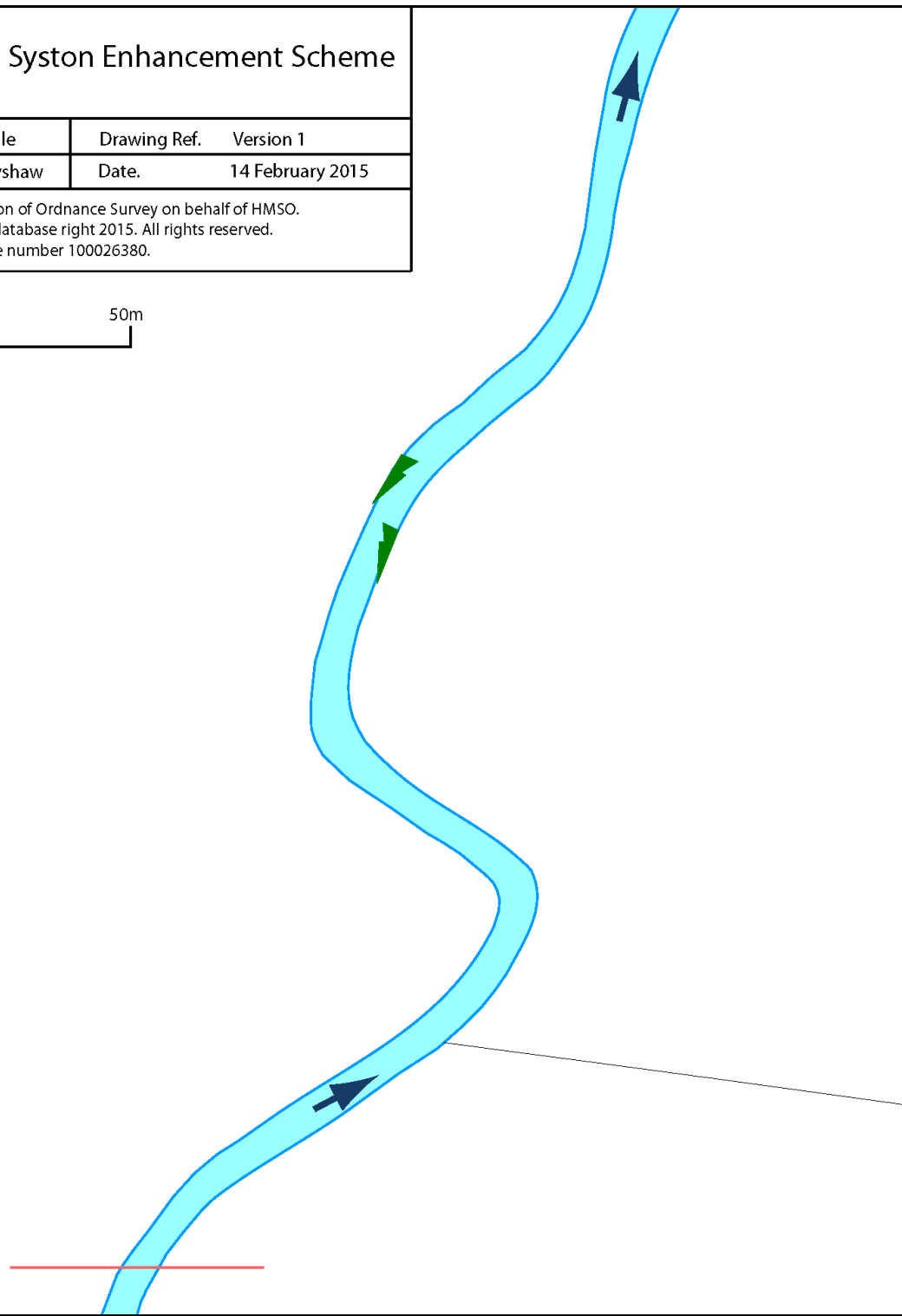
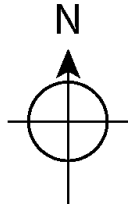
**Key:**

- |  |   |  |                                    |  |                                     |
|--|---|--|------------------------------------|--|-------------------------------------|
|  | Log-faced brushwood mattress              |  | Faggot mattress                    |  | Log flow deflector (vane)           |
|  | Log-fronted brushwood mattress            |  | Hinged & pinned tree               |  | Paired log ("micro-vane") deflector |
|  | Older (GAAFFS) enclosure                  |  | Hinged & pinned tree and brushwood |  | Flow direction                      |
|  | Older (GAAFFS) enclosure + new log facing |  | Felled and pinned tree             |  | Pollarded / managed tree            |



Drawing:  
**River Witham: Syston Enhancement Scheme**  
 Map 4 of 4

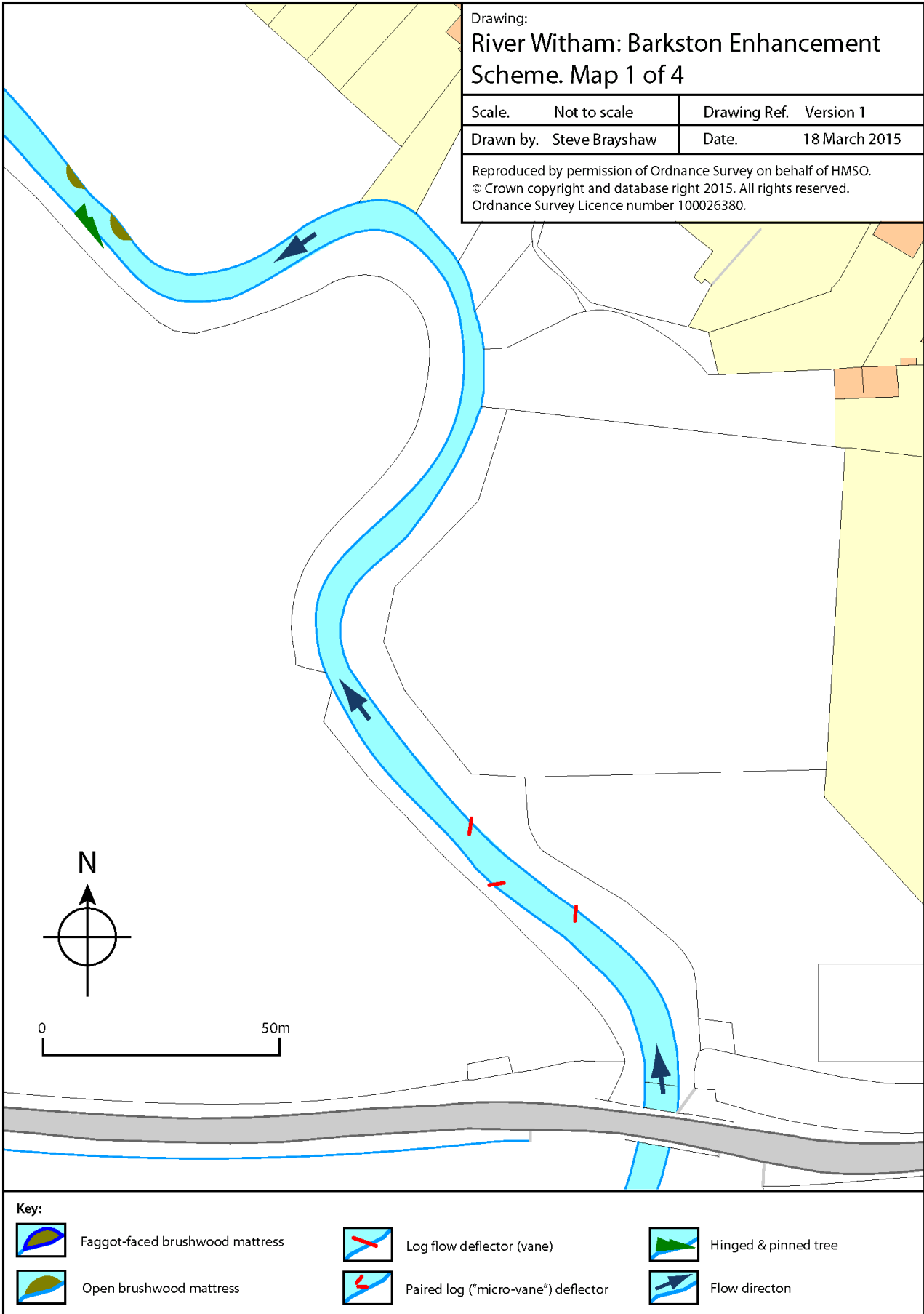
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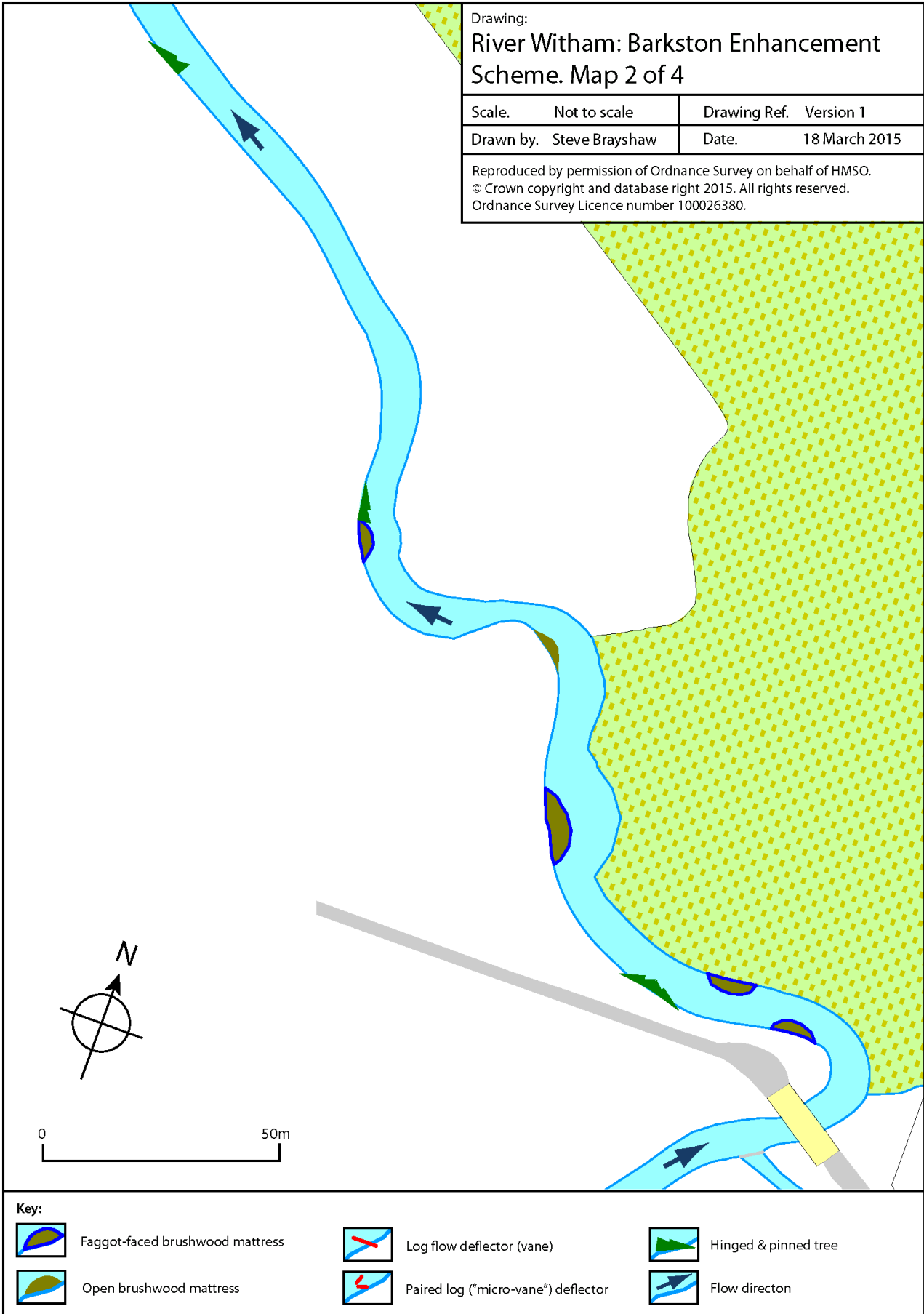
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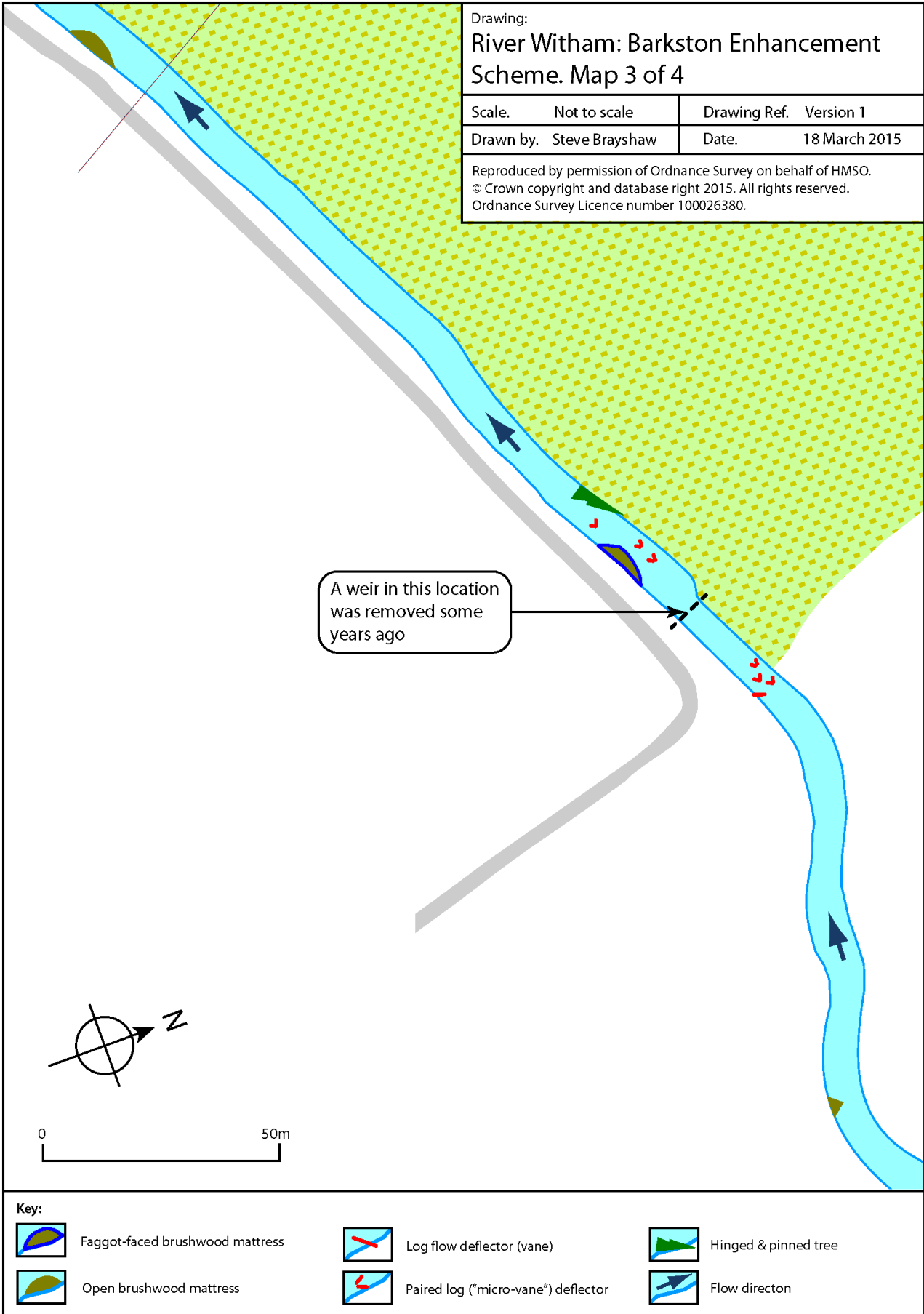


Key:

- |   |   |   |                                    |   |                                     |
|---|---|---|------------------------------------|---|-------------------------------------|
|  | Log-faced brushwood mattress              |  | Faggot mattress                    |  | Log flow deflector (vane)           |
|  | Log-fronted brushwood mattress            |  | Hinged & pinned tree               |  | Paired log ("micro-vane") deflector |
|  | Older (GAAFFS) enclosure                  |  | Hinged & pinned tree and brushwood |  | Flow direction                      |
|  | Older (GAAFFS) enclosure + new log facing |  | Felled and pinned tree             |  | Pollarded / managed tree            |



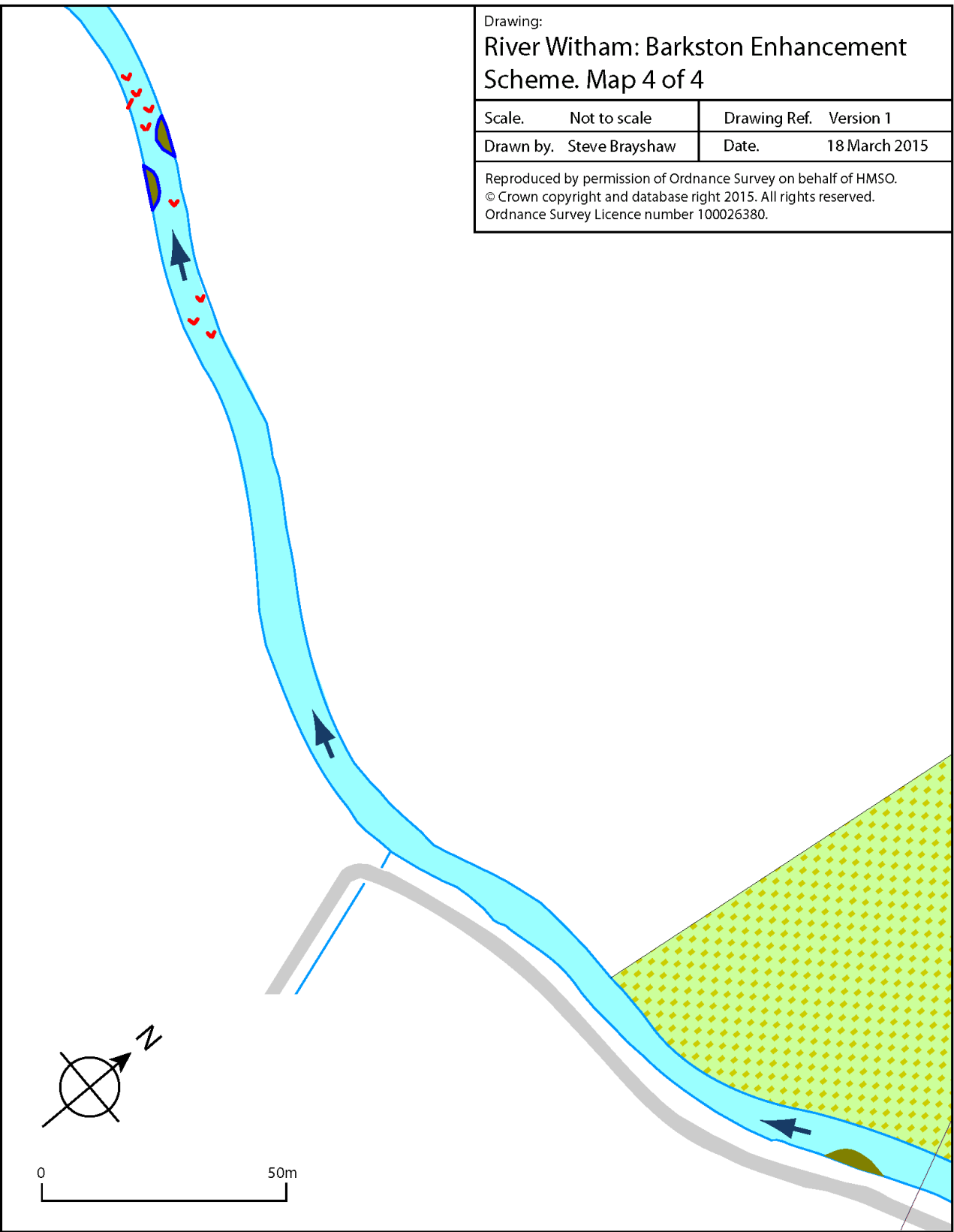










Drawing:  
**River Witham: Barkston Enhancement Scheme. Map 4 of 4**

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Key:

- |   |   |  |
|---|---|--|
|  Faggot-faced brushwood mattress |  Log flow deflector (vane)           |  Hinged & pinned tree |
|  Open brushwood mattress         |  Paired log ("micro-vane") deflector |  Flow direction       |