Westcountry Rivers Trust

Yarty: River and Floodplain Restoration Design Study

March 2025

Katy Hockaday & Julian Payne

Westcountry Rivers Trust is an environmental charity established in 1995 to restore, protect and improve the rivers, streams, and water environments in the region for the benefit of wildlife and people.

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Executive Summary

This report presents the Yarty River and Floodplain Restoration Design Study, outlining targeted interventions to enhance hydromorphology, restore natural processes, and improve ecological function. The study focuses on two key reaches Yarty Farm and Waterhouse Farm, where restoration measures aim to address sediment transport, increase habitat diversity, and improve floodplain connectivity.

A full walkover survey has been conducted to assess opportunities across multiple reaches, ensuring a holistic approach to river morphology improvements and erosion reduction. A geomorphological assessment underpins the intervention designs, balancing natural river processes with landowner priorities. Sites of opportunity have been identified, with detailed design drawings and construction instructions included to support delivery. Proposed measures include in-channel enhancements and floodplain reconnection to create long-term resilience, particularly by restoring bedload habitat for spawning salmonids, stabilising eroded banks, and implementing interventions to slow flow during peak events. These measures will also improve offline water storage and strengthen floodplain connectivity.

Regulatory and planning considerations, including Flood Risk Activity Permits (FRAP), Construction Design and Management (CDM) regulations, and ecological constraints, have been reviewed to ensure compliance and feasibility. Additionally, the study provides estimated costings and materials for each proposed intervention. By integrating geomorphic principles with strategic restoration measures, this design framework supports the recovery of river function while delivering wider environmental benefits.

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1. Introduction

The River Yarty flows into the River Axe upstream of the River Axe Special Area of Conservation (SAC) that is failing its conservation objectives primarily due to excessive phosphate and geomorphological reasons. The River Yarty and its ecology is similarly under pressure, which also results in erosion impacts for landowners.

The Blackdown Hills National Landscape have commissioned a River Restoration and Floodplain reconnection study to take a holistic view at restoration of the Yarty, inclusive of all river users and riparian owners, to protect property and infrastructure and justify expenditure to funders (existing and potential).

This builds on the previous studies:

- River Yarty delivery project September 2024 – with initial works at Cuckford Farm through to Yarty Bridge
- 'River Yarty Design Plan' August 2024 – by Julian Payne (Environment Agency) for Yarty Farm.
- 'River Yarty Feasibility Study' (March 2023, Westcountry Rivers Trust- WRT), covering Yarty Farm and Waterhouse Farm.
- 'Yarty Farm and Waterhouse Farm Geomorphology Advice Note' November 2022 by Julian Payne (Environment Agency)

The Blackdown Hills National Landscape aims to reverse impact on the Yarty by piloting targeted nature-based solutions (NbS). These include:

- In-channel river restoration by raising/ restoring the bed of the channel and better reconnecting the watercourse to its floodplain
- Associated floodplain enhancement work including lowering any flood banks, creating scrapes, inlets, bunds and swales to temporality hold water (and sediment) at peak flood events

These interventions are to: -

- Restore geomorphological function and 're-setting' the watercourse channel, such that it becomes less incised.
- Store water on floodplains for longer, storing phosphate rich sediment on the land.
- Reduce the erosive power of the watercourse and slowing the flow, especially if adjacent floodplains are 'rougher'.
- Provide enhanced habitats in-channel for fish, protected species & other taxa.
- Downstream flood risk benefits and other co-benefits.
- Provide floodplain restoration opportunities.

The works are to be carried out in three phases. A detailed design study of the Yarty Farm and Waterhouse Farm reach; a feasibility of the wider river from the A30 to Yarty Farm, with an additional section upstream of the A303; and a stakeholder engagement event.

This report represents the first element, the Design Study for Waterhouse and Yarty Farm reaches. For this the Blackdown Hills looked for: -

a. Landowner engagement
b. Geomorphological/ in-channel assessment and floodplain reconnection detailed designs
c. Floodplain temporary water storage enhancement detailed design stage mapping (including scrapes, inlets, bunds, swales, bank lowering etc.), including consideration of the existing and potential biodiversity, BNG (Biodiversity Net Gain) potential, historic environment, landscape and consents/ permissions required, use of spoil
d. Scope for and secure (if needed) in-principal planning permission, impoundment, abstraction and undertake constraints checks
e. Constraints checks including protected species
f. Scope and outline CDM and any other regs that will apply
g. Liaison with the Environment Agency regarding the existing Flood Risk Activity Permit (FRAP) and any extension required

2. River Yarty Description

The River Yarty is a tributary of the River Axe in Devon, flowing through a predominantly rural landscape characterised by mixed farmland, woodlands, and hedgerows. Rising near the Blackdown Hills, a designated Area of Outstanding Natural Beauty, the Yarty follows a meandering course south-eastward before joining the Axe near Axminster. The river supports a range of aquatic and riparian habitats, including gravel beds, riffles, and pools that provide important spawning grounds for fish species such as Salmon *Salmo salar* and brown trout *Salmo trutta*. However, sections of the Yarty have been impacted by historic land drainage, agricultural runoff, and channel modifications, leading to concerns over water quality and habitat degradation. Ongoing restoration efforts aim to enhance its ecological condition by improving natural hydromorphology, increasing floodplain connectivity, and implementing nature-based solutions to reduce sediment input and nutrient loading.

2.1 Scope of Work

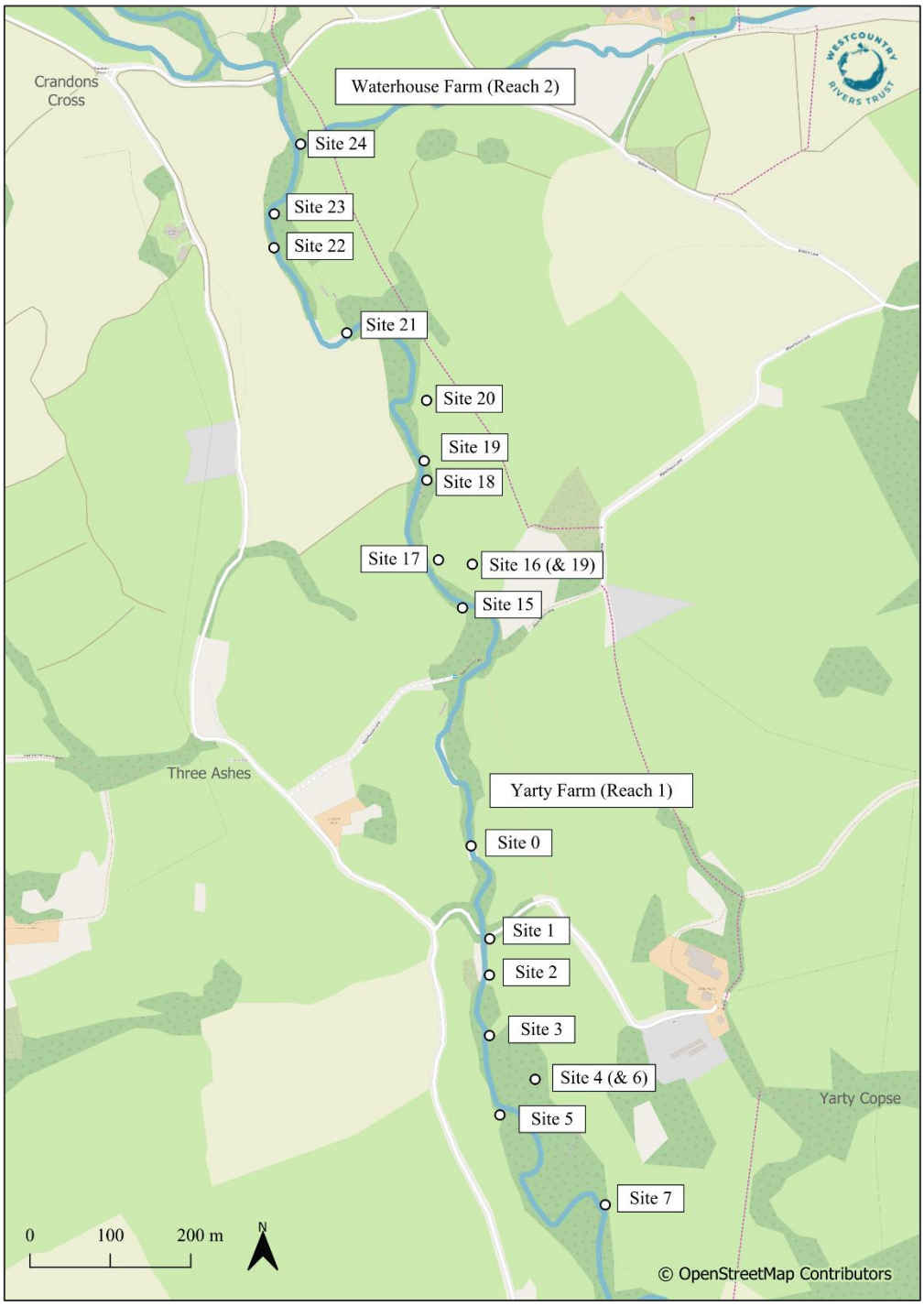


Figure 1. Map outlining the site overview for Yarty Farm (Reach 1) and Waterhouse Farm (Reach 2).

The following study has been compiled following a walkover of two stretches of the River Yarty. The surveyed area has been divided into two sections in line with the Eastern bank landowners. Reach 1 – Yarty Farm and Reach 2 – Waterhouse Farm. Sites of opportunity have been identified and listed numerically according to geographic location and suggest no prioritisation for order of works.

Visual inspection referenced to LIDAR data shows often more aggressive incision of the western bank, and a steeper drop than the eastern bank along a lot of both reaches. This is potentially due to the lack of diversity in flora where grazing and/or arable fields run right up to the river's edge. Whilst varying interventions have been recommended for multiple parts of the surveyed reach, it would be encouraged that tree planting in varying capacities is considered along the whole river corridor. This would create a riparian buffer strip of woody material to support future morphological stability, mitigate impacts of climate change and create resilience along this section and the wider catchment.

2.2 Geomorphology

The River Yarty has been a cobble bed river that supports salmon, trout and lamprey *Lampetra fluviatilis* as well as water crowfoot (Ranunculus) and other floating vegetation species.

Human modifications over the millennia have included water meadows, mill least and weirs, bridges and ford crossings. In the last couple of centuries, river management pressures have increased focused on land drainage, and hence flow capacity of the river. This involved removal of in channel vegetation and woody debris, gravel and cobble removal and dredging, with some straightening and rerouting. Furthermore, since the 15th and 16th century, the removal of wooded hillsides and hilltops for agriculture has resulted in ever higher floodplains.

The effect of clearing out the river channel as well as the deeper channels caused by higher floodplains, has been to increase the water velocity during flood conditions. As the velocities have increased the once stable cobbles have become mobile, such that the entire bed is now susceptible to erosion. This erosion takes away the very riverbed upon which the fish and the floating vegetation rely. The erosion also is now undercutting historic gravel layers, leading to faster bank erosion and land loss.

Some understanding of the geological setting helps appreciate these pressures, and hence options for managing them.

The underlying geology of much of the River Yarty valley is mudstone, with a band of sandstone mainly along the eastern hillsides. Along the very eastern ridge, from Membury up to the north, there is a small topping layer of chalk.

Crucial to the health of the river, and the ecology, is the overlying superficial geology. Much of the hilltops and valley sides are overlain with clay and flints along the east, and glacial head deposits through much of the central part of the catchment. These layers are the primary source of cobbles and gravel for the River Yarty. Peri-glacial processes, including hillslope failure, laid layers of stone across the former valley floor which are buried under flood deposits. Later, river flooding and stream erosion have provided additional stone.

As such, the River Yarty's health and stability has relied heavily on the presence of a layer of cobbles and gravels laid down at the end of the last ice age. In places these layers can be seen in the riverbanks where the river has now eroded down through them.

Whilst fluvial processes associated with side streams cutting through flint and head deposits on the hillsides provide some renourishment of stone to the river, this is not sufficient to replace the

amounts currently being lost from the main river by erosion. It is also not of a size sufficient to resist being mobilized within the main river.

Therefore, now that the river has eroded below the cobble and gravel layer, there is nothing to prevent further erosion down into the underlying mudstones and fine deposits. As such, without intervention, the river is incapable of healing itself.

We are therefore seeing, and should expect further increases in land loss, reduction in the ecological value of the river (especially its fish population and floating vegetation), and increased pressure on the downstream River Axe SAC (through increased siltation and loss of the supporting spawning grounds of the interest feature fish).

2.3 Floating Vegetation Relocation Trial

Aquatic plant species, particularly macrophytes, require specific conditions to thrive. Throughout the River Axe system, including its main channel, Ranunculus beds are in decline. These macrophytes play a crucial role in freshwater ecosystems by influencing physical characteristics such as flow dynamics, sediment transport, and channel depth. They also provide essential refuge and food for species at various trophic levels.

However, without a robust macrophyte source upstream to disperse seeds or plant fragments, and without a sufficiently complex habitat to support natural recolonisation, the restoration of these species may take a significant amount of time. In such cases, transplanting macrophytes can be an effective method to accelerate recovery, particularly following physical and chemical restoration efforts in degraded areas.

Therefore, macrophyte translocation is proposed as part of the River Yarty Restoration project. A suitable site for translocation has been identified at Yarty Farm. Although the River Yarty is relatively fast-flowing, the selected stretch features a shallow, stable substrate in an unshaded location, providing ideal conditions for macrophyte growth. The presence of existing Ranunculus beds at the site further indicates its suitability for translocation. Additionally, the donor site is located immediately upstream, ensuring a favourable proximity for successful relocation.

2.4 Landowner Engagement

Landowner engagement has been carried out through site meetings and walkovers to discuss the proposed restoration works. The scope of the project has been explained in detail, ensuring the landowner is informed of the planned interventions and their potential benefits. On the 26th March 2025 there was a stakeholder engagement event for landowners and the local community to discuss the restoration project. For Reach 1, the landowner has previously implemented some restoration measures under a separate work package, demonstrating prior commitment to river improvements. Their existing knowledge and experience have been considered in the design process to ensure continuity with previous works while enhancing the overall restoration outcomes.

3. Geomorphology Assessment and Intervention Designs

3.1 Yarty Farm (Reach 1)

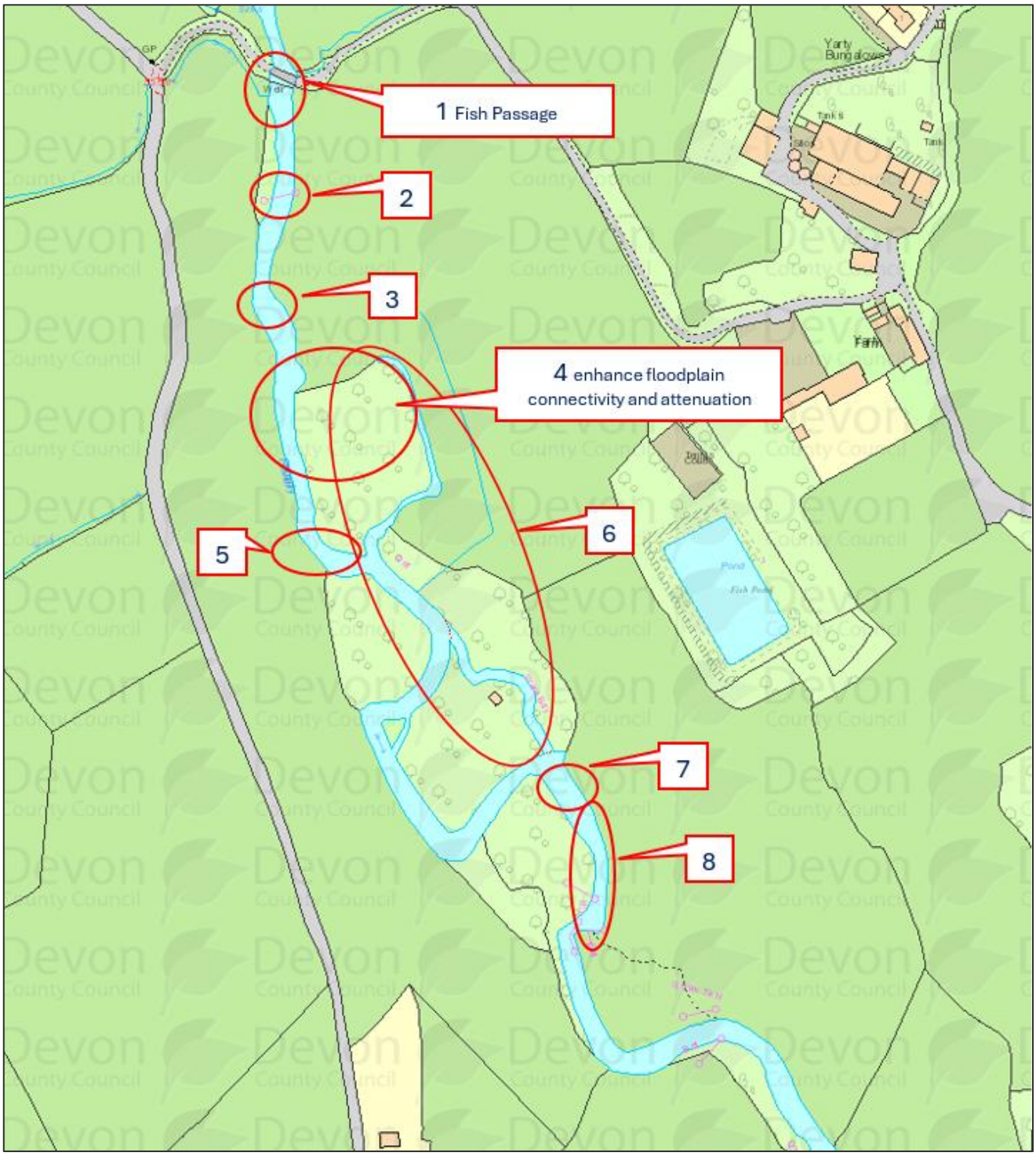


Figure 2. Map outlining the site overview for Yarty Farm (Reach 1).

Site 1:

NGR: ST 26144 02643

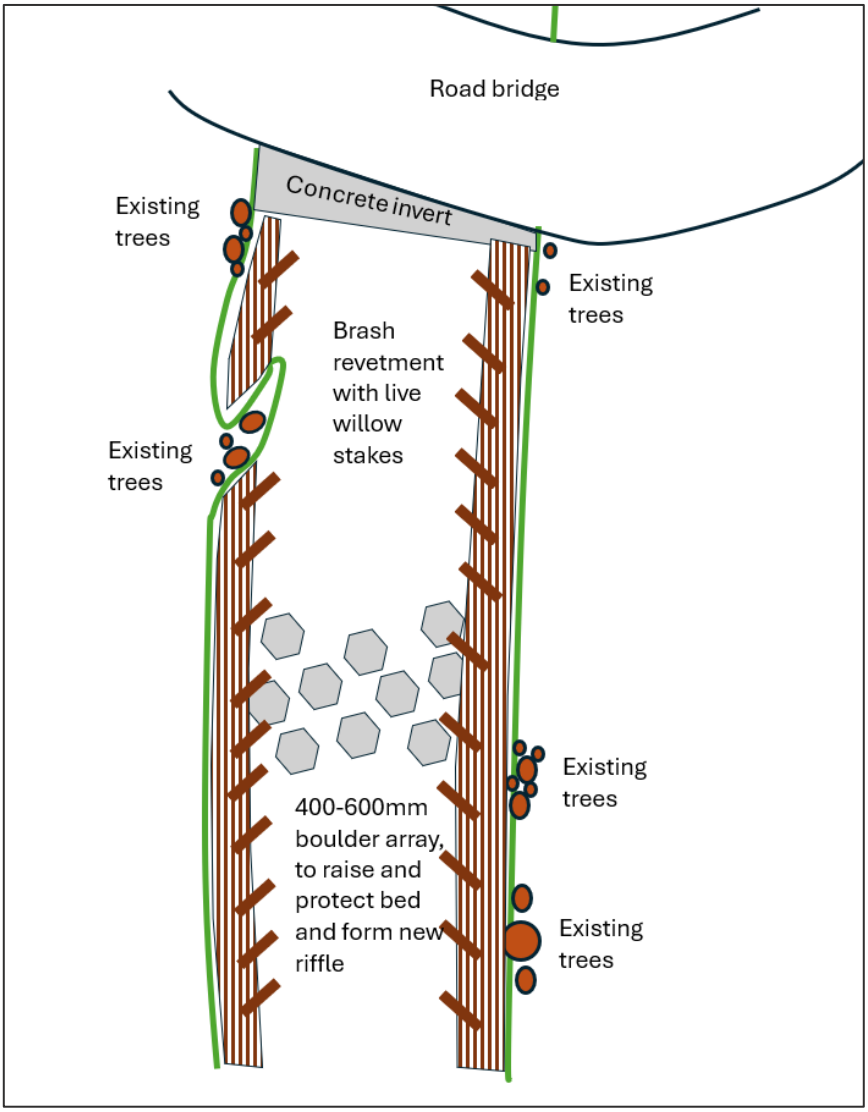
To enhance fish passage and improve channel morphology, the channel should be narrowed and roughened on both sides, encouraging the formation of a riffle downstream of the weir pool. This will create a more diverse flow regime, beneficial for aquatic habitats.

A combination of brash/brushwood revetment and/or willow trunks should be laid from the existing trees along the bank, extending up to 2 meters into the channel at the base. These materials should be anchored using live willow stakes to ensure stability and support natural channel processes.

To help form a raised riffle at the downstream end of the weir pool, a loose arrangement of large boulders (500-600mm) should be installed across the channel. These boulders should be set into the bed, with the tops positioned no more than 200mm above current bed levels to ensure they do not impede fish passage but instead create varied flow patterns and habitat complexity.

Figure 3,4,5. Photographs outlining site 1.

Detailed Design Drawing



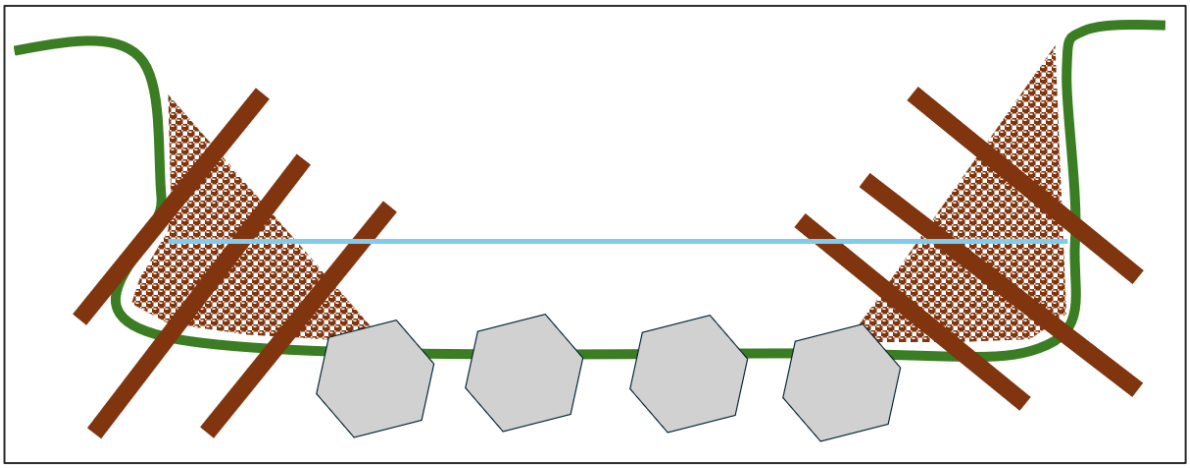


Figure 6. Showing detailed design drawing of the suggested restoration. Outlining the cross section, a loose arrangement of large boulders (400-600mm) in combination with brash/brushwood revetment.

Instructions for Design

Narrowing and Roughening the Channel

- Use natural materials, such as rock, gravel, and woody debris, to roughen the channel surface and reshape the banks to a more angled or varied profile to narrow the channel and create hydrological diversity.
- Ensure the work does not excessively block the flow or create any hazards for aquatic life.

Brushwood Revetment Installation

- Lay the brushwood or willow trunks from existing trees along the bank.
- Extend the revetment up to 2 meters into the channel at the base.
- Secure the materials in place by staking with live willow stakes, ensuring they are deeply embedded and stable.
- Ensure the revetment does not impede natural water flow or fish passage. The materials should help provide refuge and stability for aquatic organisms.

Riffle Formation Downstream of the Weir Pool

- Use boulders ranging from 500-600mm in size.
- Install the boulders in a loose array across the channel, ensuring they are placed in a way that promotes varied flow patterns.
- Set the boulders into the riverbed, ensuring that the tops are positioned no more than 200mm above the current bed level.
- The boulders should not create any barriers to fish passage but rather create a riffle that improves habitat complexity and flow conditions.

Monitoring and Adjustment

- After installation, monitor the channel and riffle to ensure that water flow remains consistent, and that fish passage is not obstructed.
- Be prepared to make minor adjustments to the boulders or revetment if necessary to maintain optimal flow conditions and ecological benefits.

Safety and Environmental Considerations

- Ensure that all works comply with relevant environmental regulations, including flood risk management and fish protection.
- Take care to minimise disturbance to surrounding habitats and wildlife during construction.
- Keep machinery and equipment well away from sensitive habitats and ensure that construction does not result in sedimentation or pollution.

Materials

Material	Quantity
Brushwood	20m^3
Boulders (400-600ø)	203t
Live Willow Stakes	120
Machinery/ Tools	
Digger	
Dumper	
Post knocker	

Cost Estimate

£67,500

The following cost estimates are based on current material prices and available information, including machinery, site operatives, and materials. Please note that these are approximate values, and costs may fluctuate due to changes in material availability, market conditions, or unforeseen site-specific factors. As such, these figures should be used as a general estimate and may be subject to revision as the project progresses.

Site 2:

NGR: ST2614302598

The right bank is eroding from the toe, and this can be addressed with the installation of a brushwood mattress revetment or faggots, anchored with live willow stakes. This intervention will protect the toe of the bank and help slow flows, allowing the willows to establish and further stabilise the area over time. The willow stakes will also provide additional resilience by reinforcing the soil and promoting natural vegetation growth along the bank.

In addition, live willow stakes should be placed around the root plate of leaning trees to reduce overland flow and enhance bank stability. The roots of the willows will bind the root plate to the floodplain, preventing further movement and providing long-term support. To minimise the risk of obstruction, any fallen or leaning trees should have their canopies trimmed to prevent snagging on the elevated top of the right bank. This will reduce the risk of blockages that could impact flow and create additional erosion.

Figure 7,8,9 Photographs showing site 2.

Detailed Design

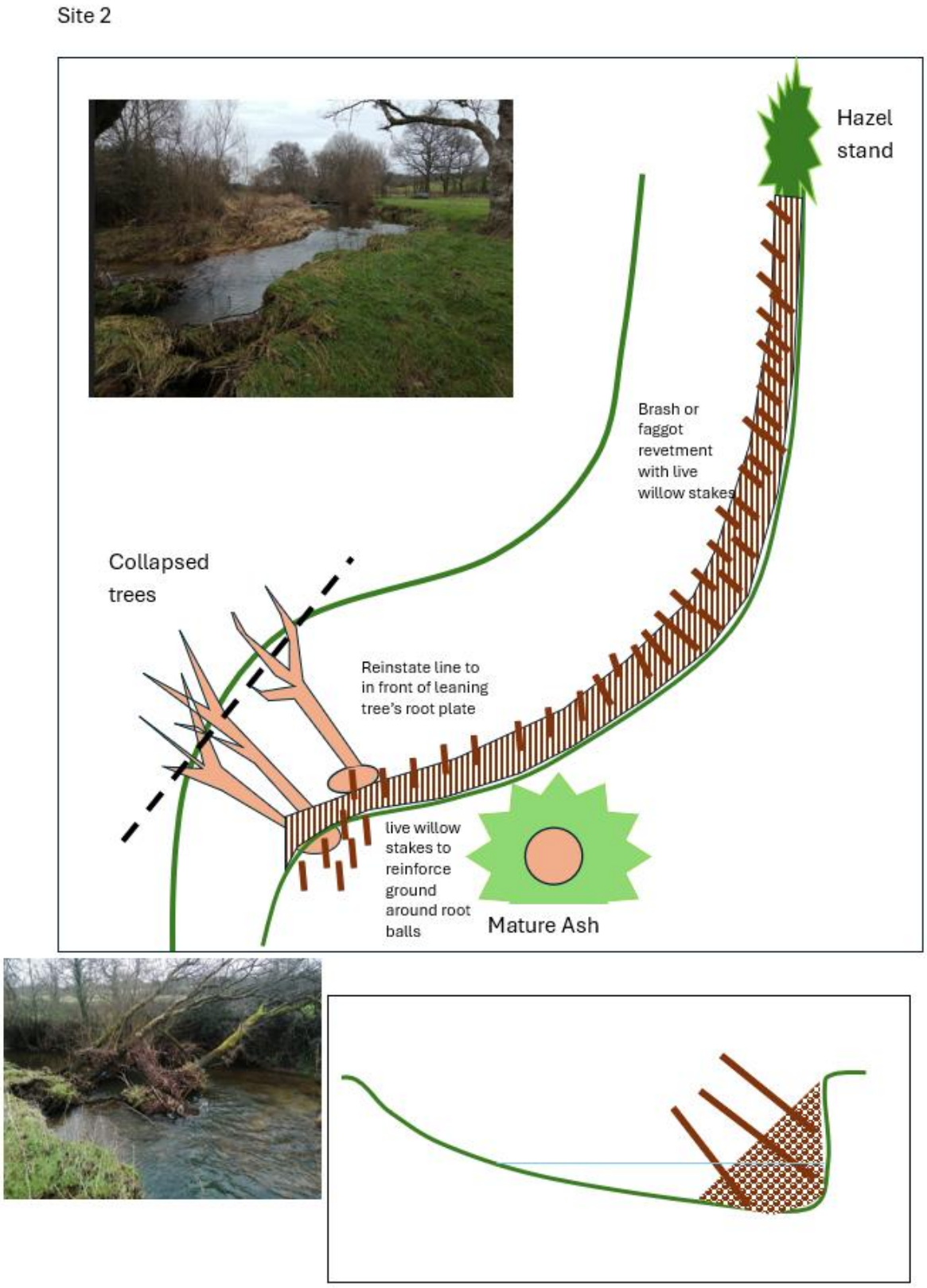


Figure 10. Detailed Design Drawing showing brash wood or faggots design. Cross Section showing willow stakes, staked into the bank holding revetment in place.

Instructions for Design

Erosion Control on Right Bank

- Lay the brushwood revetment or faggots along the toe of the eroding bank. Ensure the material extends at least 1-2 meters into the channel for stability.
- Secure the brushwood and faggots in place using live willow stakes, ensuring the materials are deeply anchored to resist water flow and bank erosion.
- Once the willow stakes establish, the revetment will help slow flow, providing natural bank stabilisation over time.
- Ensure the revetment is not too high to block fish passage and allows natural hydrological processes.

Stabilisation of Leaning Trees

- Place live willow stakes around the root plate, especially in areas where the bank is eroding.
- The willow stakes will help reduce overland flow by creating a more robust root system that binds the soil.
- As the willows establish, their roots will reinforce the bank, preventing further slippage or erosion of the root plate and ensuring long-term stability.

Cutting of Fallen and Leaning Trees

- Safely trim any branches or canopy overhanging the elevated bank to a manageable size.
- Ensure that the canopy is not obstructing the flow of the river and will not become a snag hazard during high-flow conditions.
- Care should be taken to avoid damaging the tree, as the trunk and remaining branches may still provide valuable habitat for wildlife.

Monitoring and Maintenance

- After installation, monitor the site to ensure that the brushwood revetment and willow stakes are secure and that the leaning trees remain stable.
- Regularly check the areas around the root plates for any signs of further erosion or instability and make adjustments as necessary.

Safety and Environmental Considerations

- Ensure compliance with environmental regulations to protect surrounding habitats and wildlife during construction.
- Take precautions to prevent machinery from causing further damage to the bank or habitat, and avoid disturbing sensitive areas.
- Ensure all materials are sourced sustainably, and keep construction equipment away from the river channel to avoid pollution or sediment disturbance.

Materials

Material	Quantity
Brushwood	215m^3
Live Willow Stakes	172
Machinery/ Tools	
Digger	
Dumper	
Chainsaws	
Post knocker	

Cost Estimate

£47,500

The following cost estimates are based on current material prices and available information, including machinery, site operatives, and materials. Please note that these are approximate values, and costs may fluctuate due to changes in material availability, market conditions, or unforeseen site-specific factors. As such, these figures should be used as a general estimate and may be subject to revision as the project progresses.

Site 3:

NGR: ST2614202523

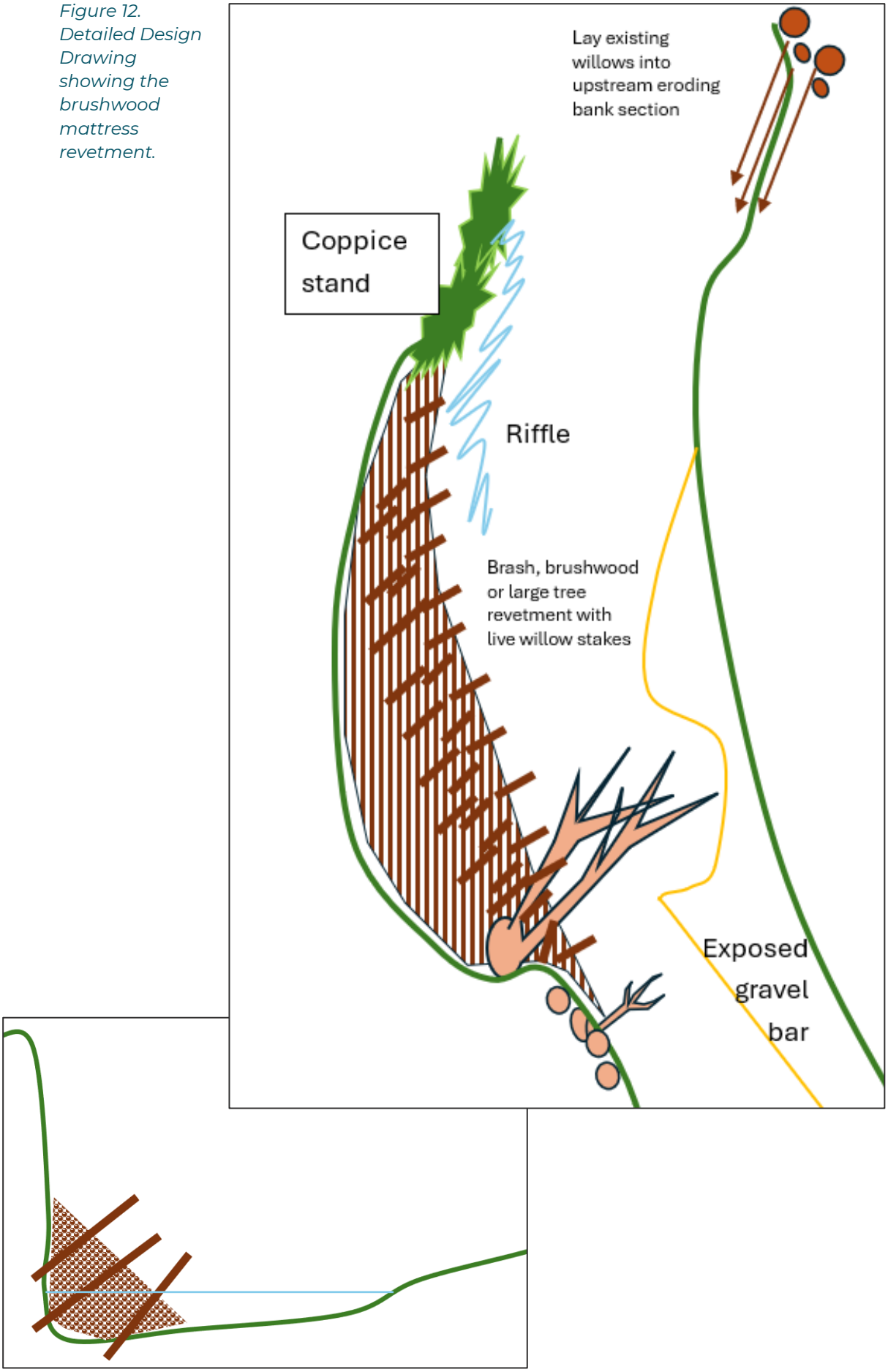
The right bank is at risk of erosion due to collapsing trees, particularly around the toe area. To address this, a brushwood mattress revetment should be installed, using large trees anchored with live willow stakes to provide both structural support and enhance ecological resilience. This method will help stabilise the bank and reduce the risk of further collapse, particularly up to the first set of coppice stands.

Additionally, a small erosion pocket is developing on the left bank, upstream of the riffle. To combat this, willow trees located immediately upstream should be laid along the line of the bank and into the channel. This technique will help to resist the erosion by reinforcing the bank with natural vegetation, which will also support habitat development and improve bank stability over time.

Figure 11. Photo illustrating Site 3.

Detailed Design

Figure 12. Detailed Design Drawing showing the brushwood mattress revetment.



Instructions for Design

Stabilise the Right Bank

- Lay brushwood or large tree trunks from existing trees along the toe of the high right bank.
- Ensure the materials extend at least 2 meters into the channel at the base to provide adequate protection from water flow.
- Secure the materials using live willow stakes, ensuring the revetment is deeply anchored to provide long-term stability.
- This intervention will stabilise the bank and slow the flow, allowing the willow to establish and further protect the bank from erosion.

Erosion Control on the Left Bank

- Lay willow trees from the existing tree line immediately upstream, along the bank and into the channel.
- Ensure the willows are securely anchored to resist further erosion by embedding the trees into the bank and channel at the base.
- The willows will help reduce erosion by stabilising the bank and providing natural reinforcement as their roots establish and bind the soil.
- As the willows establish, they will reduce overland flow, preventing further undermining of the bank and helping to form a stable channel boundary.

Monitoring and Maintenance

- After installation, regularly monitor the right and left bank interventions to ensure the materials and willows remain securely in place.
- Check the areas for any signs of further erosion or instability, especially around the erosion pocket and root areas of the laid willows.
- Adjust the materials as necessary to maintain the bank's stability and ensure continued fish passage and habitat enhancement.

Safety and Environmental Considerations

- Ensure compliance with environmental regulations for riverbank stabilisation, especially to avoid disturbing aquatic habitats and protected species.
- Minimise the use of heavy machinery near sensitive areas and avoid polluting the river with sediment or construction debris.
- Use sustainably sourced materials and take steps to protect the surrounding environment during construction.

Materials

Material	Quantity
Brushwood	30m^3
Live Willow Stakes	62
Machinery/ Tools	
Digger	
Dumper	
Chainsaws	
Post knocker	

Cost Estimate

£10,000

The following cost estimates are based on current material prices and available information, including machinery, site operatives, and materials. Please note that these are approximate values, and costs may fluctuate due to changes in material availability, market conditions, or unforeseen site-specific factors. As such, these figures should be used as a general estimate and may be subject to revision as the project progresses.

Site 4 (& 6):

4 NGR: ST 26144 02467 6 NGR: ST2619802468

This section of woodland lies within the floodplain, adjacent to the river. Several paleo-channels and depressions are present throughout the woodland; however, despite significant recent rainfall and the time of year, the area currently holds relatively little water. While some depressions do retain water, overall floodplain storage and connectivity to the river remain limited.

To enhance floodplain storage and improve connectivity between the woodland and the river, a series of interventions are proposed. The majority of trees, primarily willow, will be felled and secured in situ to slow flows and increase hydraulic roughness within the floodplain. Additionally, leaky dams will be installed at key points along the paleo-channels to retain water for extended periods, helping to maintain moisture levels and improve habitat conditions.

Further work will involve reconnecting sections of the incised riverbank, allowing more frequent and consistent overland flow into the woodland during high-flow events. This will enable water to spill naturally into the floodplain, increasing its capacity to store floodwaters. To support this, donor material from the raised floodplain zone, marked in red hatching on the accompanying map below (Figure 13), will be used for targeted infill (Site 6). However, to effectively reduce flow velocities across the lower wooded corridor, more extensive floodplain excavation will be required beyond the proposed channel infill. Any excess excavated material will need to be removed from the site to ensure proper floodplain function and avoid unintended impacts on surrounding areas.

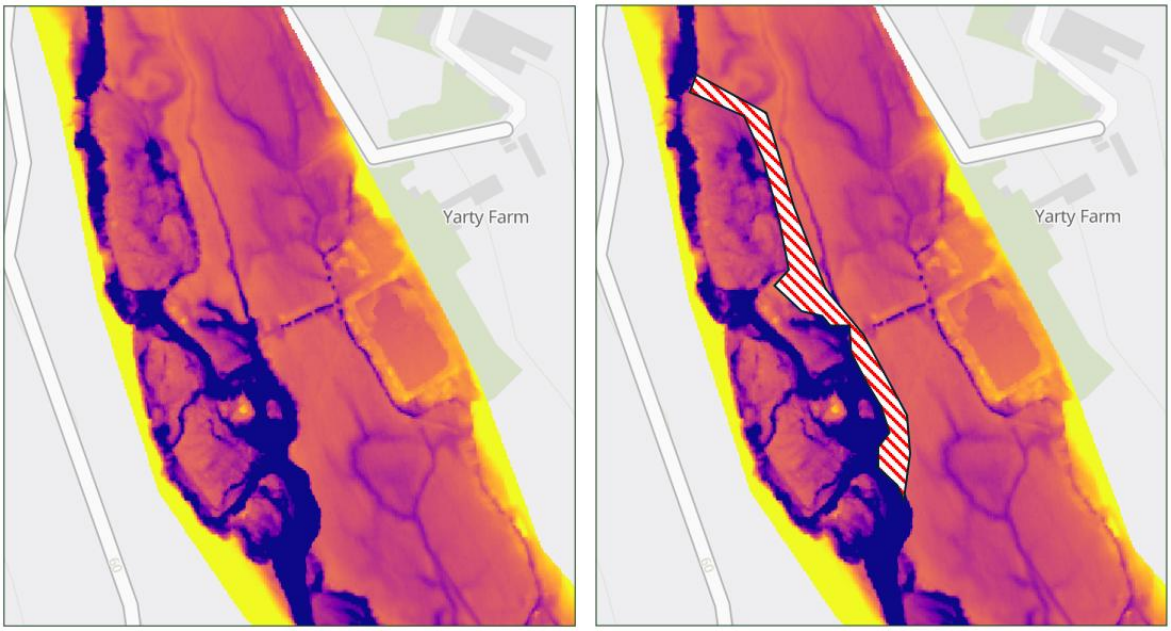


Figure 13. Digital elevation map depicting donor material from the raised floodplain zone, marked in red hatching (right).

Figure 14. Photograph showing the floodplain woodland (Site 4).

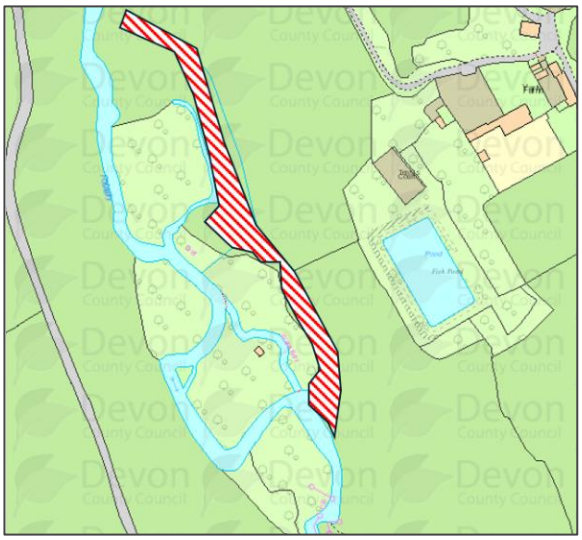


Figure 15. Map showing the area that could be excavated (Site 6).

Detailed Design

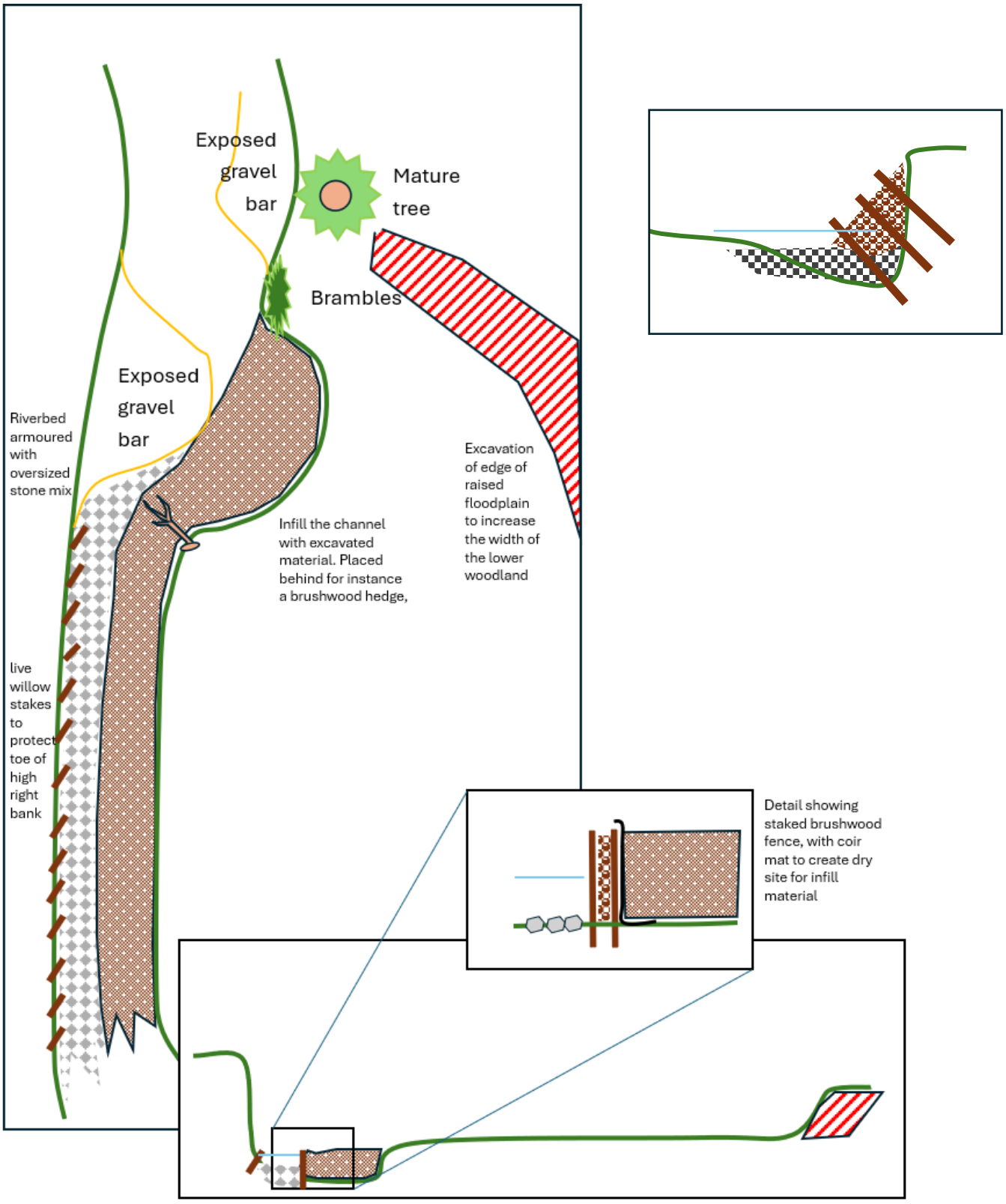


Figure 16. Detailed design drawing of Site 4(river) and Site 6 (woodland).

Site 4 Alternative. Detailed Design

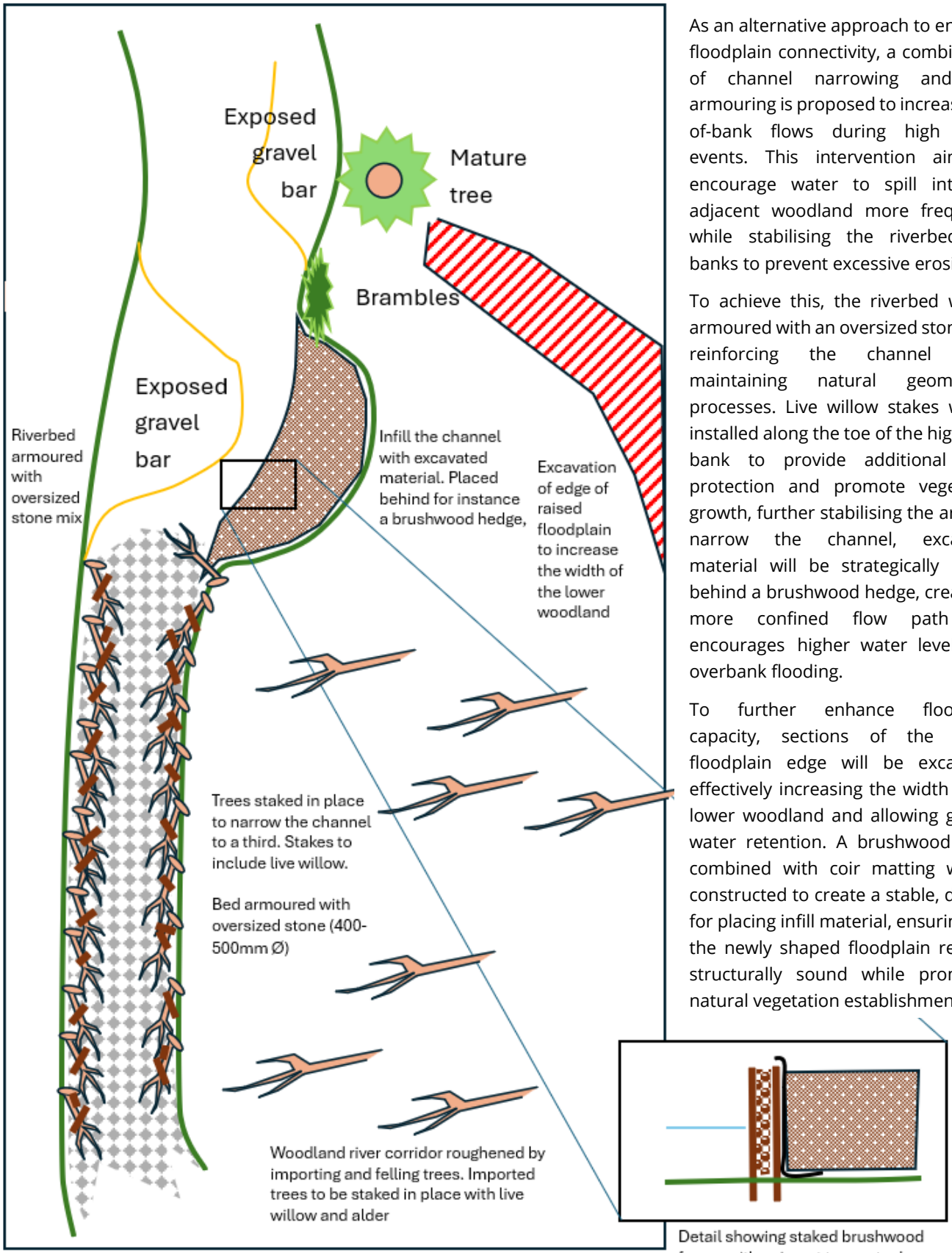


Figure 17. Alternate design for Site 4.

As an alternative approach to enhance floodplain connectivity, a combination of channel narrowing and bed armouring is proposed to increase out-of-bank flows during high water events. This intervention aims to encourage water to spill into the adjacent woodland more frequently while stabilising the riverbed and banks to prevent excessive erosion.

To achieve this, the riverbed will be armoured with an oversized stone mix, reinforcing the channel while maintaining natural geomorphic processes. Live willow stakes will be installed along the toe of the high right bank to provide additional bank protection and promote vegetation growth, further stabilising the area. To narrow the channel, excavated material will be strategically placed behind a brushwood hedge, creating a more confined flow path that encourages higher water levels and overbank flooding.

To further enhance floodplain capacity, sections of the raised floodplain edge will be excavated, effectively increasing the width of the lower woodland and allowing greater water retention. A brushwood fence combined with coir matting will be constructed to create a stable, dry site for placing infill material, ensuring that the newly shaped floodplain remains structurally sound while promoting natural vegetation establishment.

Instructions for Design

Tree Felling and In-Stream Placement

- Select and fell or hinge the majority of trees within the designated woodland area, prioritising willow species. Ensuring no bird nests or other important wildlife species are utilising the selected trees.
- Secure felled trees in situ to increase hydraulic roughness and slow down flow velocities.
- Ensure felled trees are positioned perpendicular or angled to flow to maximise their effectiveness in dispersing floodwaters.
- Avoid unnecessary disturbance to existing standing trees that provide structural stability to the banks.

Installation of Leaky Dams

- Identify points along paleo-channels to install leaky dams, focusing on areas where water movement is already occurring.
- Construct leaky dams using felled timber, brash, and other natural materials to create semi-permeable barriers that retain water but allow gradual drainage.
- Secure materials with stakes to prevent movement during high flows.

Riverbank Reconnection and Floodplain Infill

- Excavate sections of the incised riverbank at pre-determined locations to create flow paths that allow water to spill into the woodland at higher flows.
- Ensure excavation creates gentle, graded transitions to minimise erosion risks while facilitating overland flow.
- Use donor material from the raised floodplain zone (red-hatched area) for controlled infill, focusing on priority areas that will help reconnect the river and floodplain.
- If additional material removal is required, transport excess spoil off-site or place in designated storage locations, ensuring compliance with environmental and landowner agreements.

Monitoring and Maintenance

- Regularly inspect tree placements and leaky dams to ensure they remain securely in place.
- Monitor water storage levels in paleo-channels and depressions to assess effectiveness.
- Adjust or reinforce leaky dams as needed to maintain optimal water retention.

Safety and Environmental Considerations

- Follow CDM regulations to ensure safe tree-felling and excavation practices.
- Avoid unnecessary soil disturbance to prevent excessive sedimentation in the river.

- Ensure that any removed material does not impact sensitive ecological areas.
- Minimise disturbance to protected species within the woodland during construction.

Materials

Option 1	
Material	Quantity
Brushwood	150m^3
Live Willow Stakes	150
Boulders (400-500ø)	575t
Coir Matting	750m^2
Machinery/ Tools	
Digger	
Dumper	
Chainsaws	
Post knocker	

Option 2	
Material	Quantity
Brushwood	215m^3
Live Willow Stakes	125
Boulders (400-500ø)	175t
Coir Matting	240m^2
Machinery/ Tools	
Digger	
Dumper	
Chainsaws	
Post knocker	

Cost Estimate

Option One (Site 4 & Site 6): £98,500

Option Two: £38,000

The following cost estimates are based on current material prices and available information, including machinery, site operatives, and materials. Please note that these are approximate values, and costs may fluctuate due to changes in material availability, market conditions, or unforeseen site-specific factors. As such, these figures should be used as a general estimate and may be subject to revision as the project progresses.

Site 5:

NGR: ST 26177 02349

At Site 5, the base of the pool will be partially infilled to reduce its depth while retaining a portion of the pool as a fish resting feature. This approach balances habitat enhancement with hydromorphological improvements, ensuring that aquatic species still have access to deeper, slower-moving water.

To stabilise the exposed banks, live willow stakes will be installed, encouraging root growth and vegetation establishment. Over time, this will enhance bank stability, reduce erosion, and provide additional habitat benefits. The combination of pool infill and bank reinforcement will help maintain a more resilient and ecologically functional river channel.

Figure 18. Showing the degraded bank needing to be restored.

Detailed Design

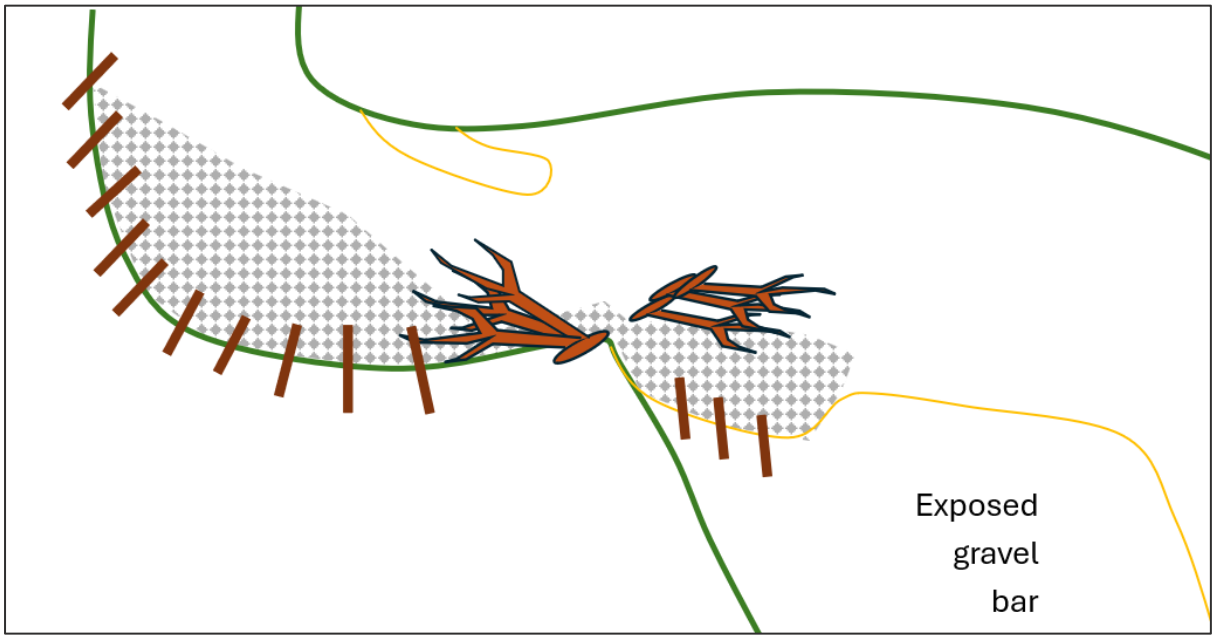


Figure 19. Showing a planform detailed design drawing of site 5.

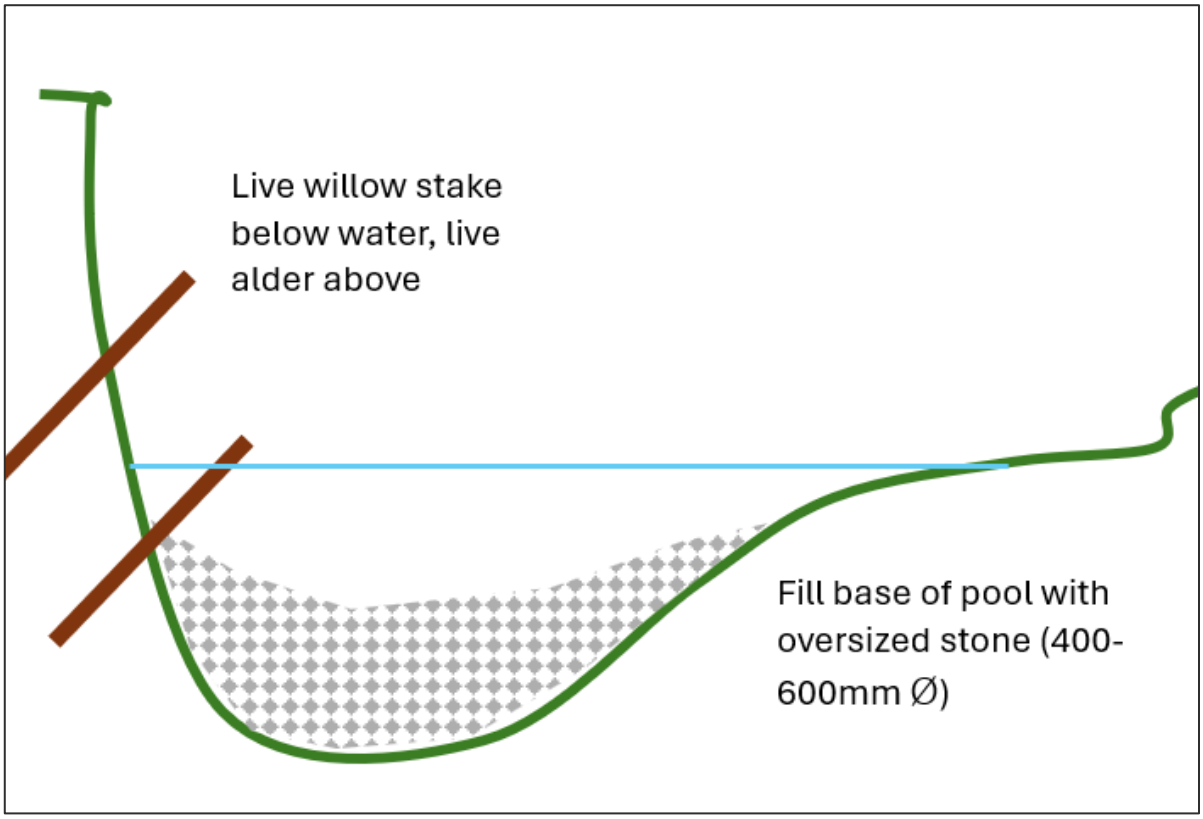


Figure 20. Detailed design drawing cross section of site 5 bank restoration.

Instructions for Design

Pool Infill and Habitat Balancing

- Mark out the designated area for partial pool infill, ensuring a portion of the pool remains as a fish resting feature.
- Transport and place oversized stones (400-600mm Ø) into the base of the pool to raise the bed level while maintaining varied depth conditions.
- Ensure stone placement is uneven to create microhabitats and reduce uniform flow velocities.

Bank Stabilisation with Live Willow Stakes

- Prepare the bank by removing loose, unstable soil while maintaining natural contours.
- Drive live willow stakes into the bank at intervals of approximately 30-50cm, ensuring at least one-third of each stake is embedded in moist soil.
- Angle stakes slightly downstream to encourage root growth along the flow direction.
- Water and secure stakes if conditions are dry to promote early establishment.

Monitoring and Final Adjustments

- Assess water movement post-construction to ensure the remaining pool depth is sufficient for fish refugia.
- Check willow stakes periodically for survival and regrowth, replacing any that fail to establish.
- Monitor bank stability and add further reinforcement if erosion persists.

Materials

Material	Quantity
Live Willow Stakes	60
Boulders (400-600ø)	108t
Coir Matting	150m
Machinery/ Tools	
Digger	
Dumper	
Chainsaws	
Post knocker	

Cost Estimate

£15,500

The following cost estimates are based on current material prices and available information, including machinery, site operatives, and materials. Please note that these are approximate values, and costs may fluctuate due to changes in material availability, market conditions, or unforeseen site-specific factors. As such, these figures should be used as a general estimate and may be subject to revision as the project progresses.

Site 7:

NGR: ST2628302311

Restore the previously eroding bend, which has now become depositional and formed a vegetated berm, by enhancing it with additional planting to further stabilise the area and encourage ecological development.

Figure 21 & 22.. Photographs showing site 7, the depositional area to be planted.

Instructions for Design

Planting Vegetation on the Berm

- Use alder, willow, and hazel whips as the primary planting species to strengthen the berm's vegetative cover.

- Plant the whips at a dense spacing of 0.6 meters to ensure rapid establishment and effective coverage of the berm.
- Prepare planting holes by removing any debris or invasive species in the area, ensuring that the soil is suitable for the establishment of the whips.
- Ensure the planting depth is appropriate, with the root collar of the whips just below the surface of the soil.
- Use decomposable tree guards with natural stakes to secure them in place and inhibit animals grazing on the newly planted whips.
- Ensure that the berm receives sufficient moisture for the initial planting period. If required, irrigate during dry spells to aid establishment.
- Check for any areas with poor drainage that may need to be addressed, to prevent waterlogging or poor growth of the whips.

Monitoring and Maintenance

- After planting, monitor the vegetation for the first growing season to ensure that the whips are establishing successfully.
- Perform regular checks to ensure the plants are not being outcompeted by invasive species or failing due to insufficient water or nutrient levels.
- Perform any necessary maintenance, such as replacing failed whips or controlling invasive plants, to support long-term establishment.
- One planted whips have matured, remove tree guards.

Safety and Environmental Considerations

- Ensure all planting activities comply with relevant environmental regulations, avoiding any damage to the surrounding habitats.
- Minimise the use of machinery in sensitive areas and ensure that no pollution or sedimentation occurs during planting activities.
- Use native species in the planting process to maintain ecological integrity and enhance biodiversity.

Materials

Material	Quantity
Native tree whips	334
Decomposable tree guards	334
Tools	
Spade	
Bucket (to water whips)	

Cost Estimate

£900

The following cost estimates are based on current material prices and available information, including machinery, site operatives, and materials. Please note that these are approximate values, and costs may fluctuate due to changes in material availability, market conditions, or unforeseen site-specific factors. As such, these figures should be used as a general estimate and may be subject to revision as the project progresses.

Site 0

NGR: ST2612302759

At Site 0, existing trees will be hinged to increase in-channel roughness, and additional live stakes will be planted to encourage vegetation establishment and long-term stability. A scour hole, measuring approximately 0.55m deep and located next to the vegetated bar, will be infilled to reduce further erosion. Over a 25m section, a live-staked brushwood mattress will be installed to reinforce the bank and slow water velocities.

To further enhance channel stability and improve habitat diversity, two multi-tree jams will be constructed, each consisting of 5–10+ large trees. The bed of the pool will be lined with large boulders (600mm+), helping to maintain structural integrity and create diverse flow conditions. Additional trees downstream of the meandering bend will be hinged, increasing channel complexity and promoting sediment retention. New bank protection measures will be implemented along the meander, using a combination of willow stakes and stone boulders to reinforce the bank against erosion. The proposed tree planting along the outer bend will act as a natural barrier, helping to obstruct overland flow routes and further stabilise the meander.

Figure 23,24,25. Showing the location of Site 0 and photographs of the restoration area.

Detailed Design

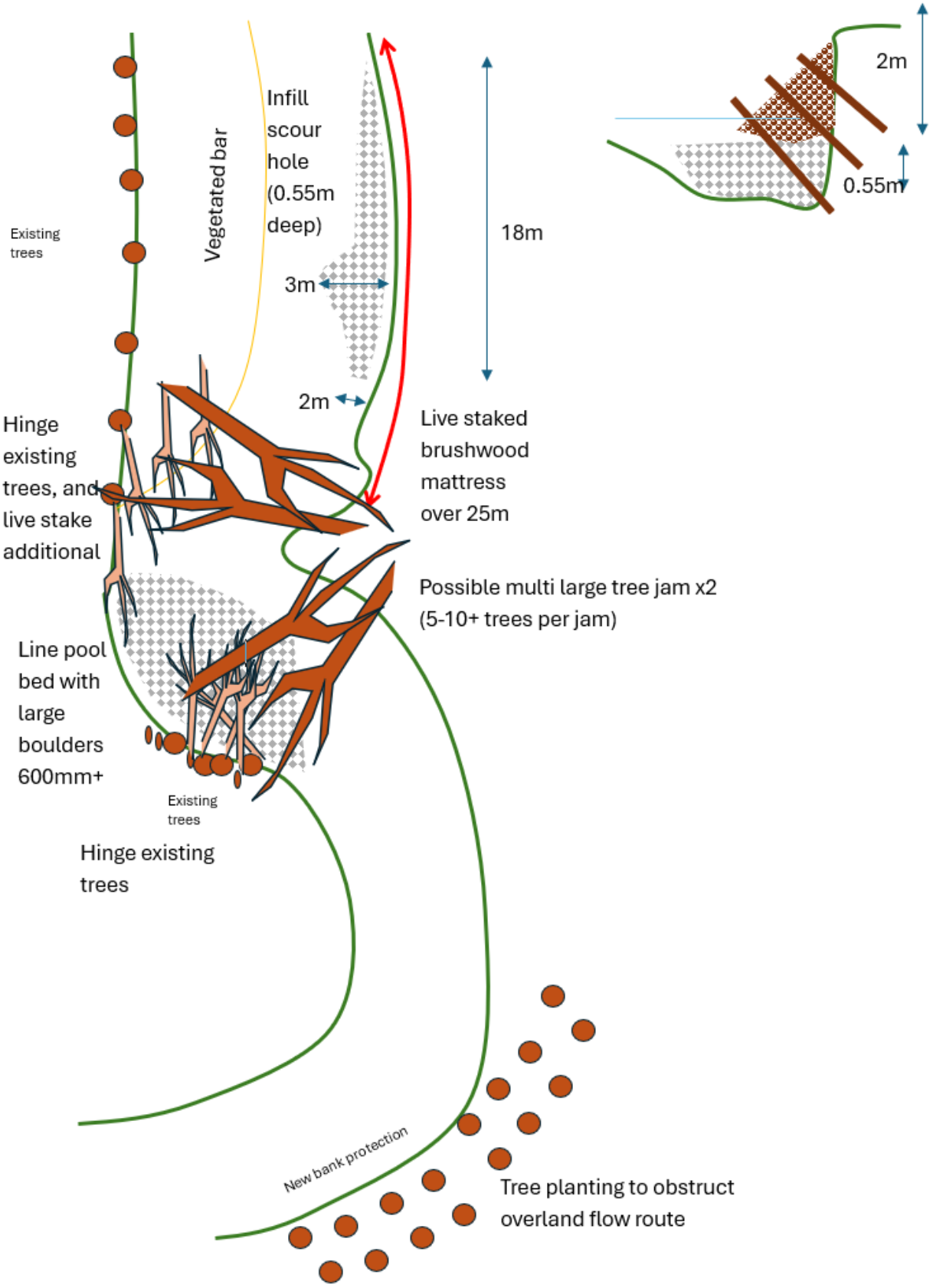


Figure 26. Detailed design drawing of Site 0.

Instructions for Design

Pool Bed Armouring

- Source boulders for this restoration.
- Place large boulders (600mm+) within the pool area, ensuring an even distribution.
- Set boulders into the bed to prevent movement while maintaining some flow variability.

Infill Scour Hole

- Place the boulders into the scour hole (0.55m deep) next to the vegetated bar, ensuring even distribution.
- Compact lightly to prevent washout but allow for natural settlement.

Live-Staked Brushwood Mattress (25m Length)

- Lay a layer of brushwood along the designated 25m stretch of bank line on top of the secure boulders.
- Secure the brush wood with live willow stakes driven into the bank at regular intervals.
- Ensure brushwood is tightly packed to create a stable, erosion-resistant structure.

Live Staking for Vegetation Establishment

- Prepare live willow stakes (at least 1m in length) and insert them into the bank at 0.5m intervals.
- Ensure stakes are deep enough to access moisture and encourage successful rooting.
- Monitor and maintain stakes to ensure establishment.

Multi-Tree Jams (2 Locations)

- Select and transport 5–10+ large trees per check dam.
- Position trees within the channel, ensuring they interlock to form a stable structure.
- Anchor trees using stakes, biodegradable rope (e.g. hemp or sisal), or natural wedging against existing features.

Hinge Existing Trees

- Identify and select suitable trees along the channel for hinging.
- Cut partially through the base of each tree, ensuring they remain attached and can be laid into the channel to increase roughness.
- Secure hinged trees as needed to prevent displacement during high flows.

Hinge Additional Trees Downstream of the Meander

- Follow the same tree hinging process downstream of the meandering bend.

- Ensure trees are positioned to maximise flow deflection and sediment retention.

Bank Protection on the Meander

- Install willow stakes along the bank, spacing them appropriately to encourage rooting.
- Place stone boulders at the base of the bank to reinforce against erosion.
- Ensure materials are properly embedded and stabilised.

Tree Planting to Obstruct Overland Flow on the Outside Meander Bend

- Plant a mixture of native tree species along the outer meander bend.
- Space trees at suitable intervals to create an effective natural barrier.
- Secure biodegradable tree guards onto tree whips.
- Monitor and maintain trees to ensure establishment and growth.

Post-Construction Monitoring and Maintenance

- Regularly check the stability of hinged trees, brushwood mattress, and tree jams.
- Inspect live stakes and planted trees for survival and replace as needed.
- Monitor sediment accumulation and adjust structures if required to maintain function.
- One planted whips have matured, remove tree guards.

Materials

Material	Quantity
Brushwood	113m^3
Boulders (600$_{ø}$+)	336t
Live Willow Stakes	100
Trees for dams	10 trees
Native tree species	30
Decomposable Tree guards	30
Machinery/ Tools	
Digger	
Dumper	
Chainsaws	
Post knocker	
Spade	
Bucket (to water whips)	

Cost Estimate

£65,500

The following cost estimates are based on current material prices and available information, including machinery, site operatives, and materials. Please note that these are approximate values, and costs may fluctuate due to changes in material availability, market conditions, or unforeseen site-specific factors. As such, these figures should be used as a general estimate and may be subject to revision as the project progresses.

(Site 8 – Site 14: not part of current scope)

3.2 Waterhouse Farm (Reach 2)

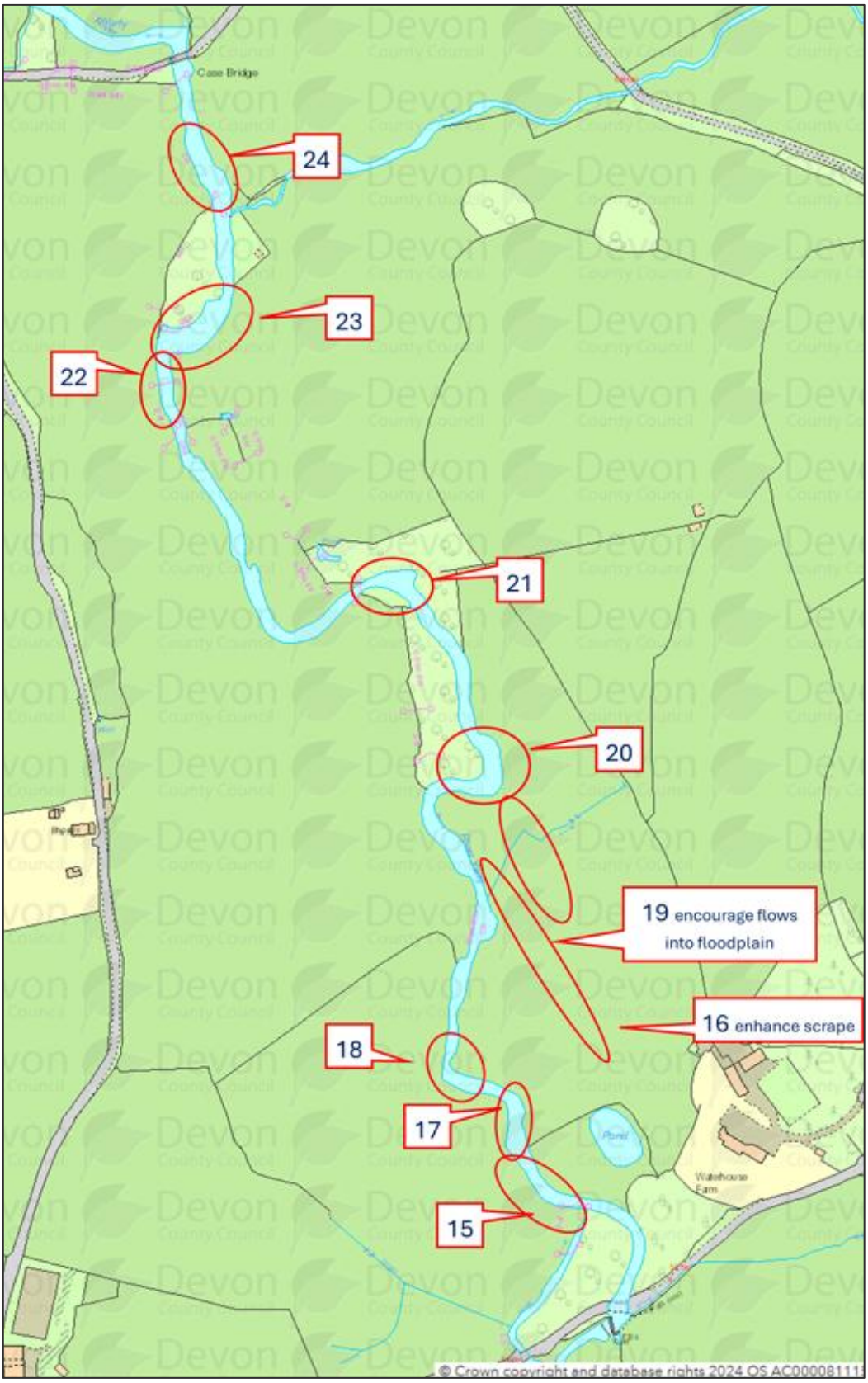


Figure 27. Map showing Reach 2- Waterhouse Farm site locations.

Site 15:

NGR: ST2611603054

Site 15, located at the southernmost point of Reach 2 (Figure 26), requires targeted interventions to stabilise the riverbank, reduce erosion, and enhance habitat resilience. High flow events have contributed to bank scouring and bed erosion, necessitating reinforcement measures. To address this, a combination of brash bundles, stone revetments, and tree planting will be implemented. These measures will dissipate flow energy, secure the bank against further retreat, and encourage vegetation establishment. In addition, a boulder array will be installed in the riverbed to stabilise sediment and enhance in-channel diversity, further supporting the overall ecological function.

Figure 28 & 29 . Photographs showing Site 15

Detailed Design

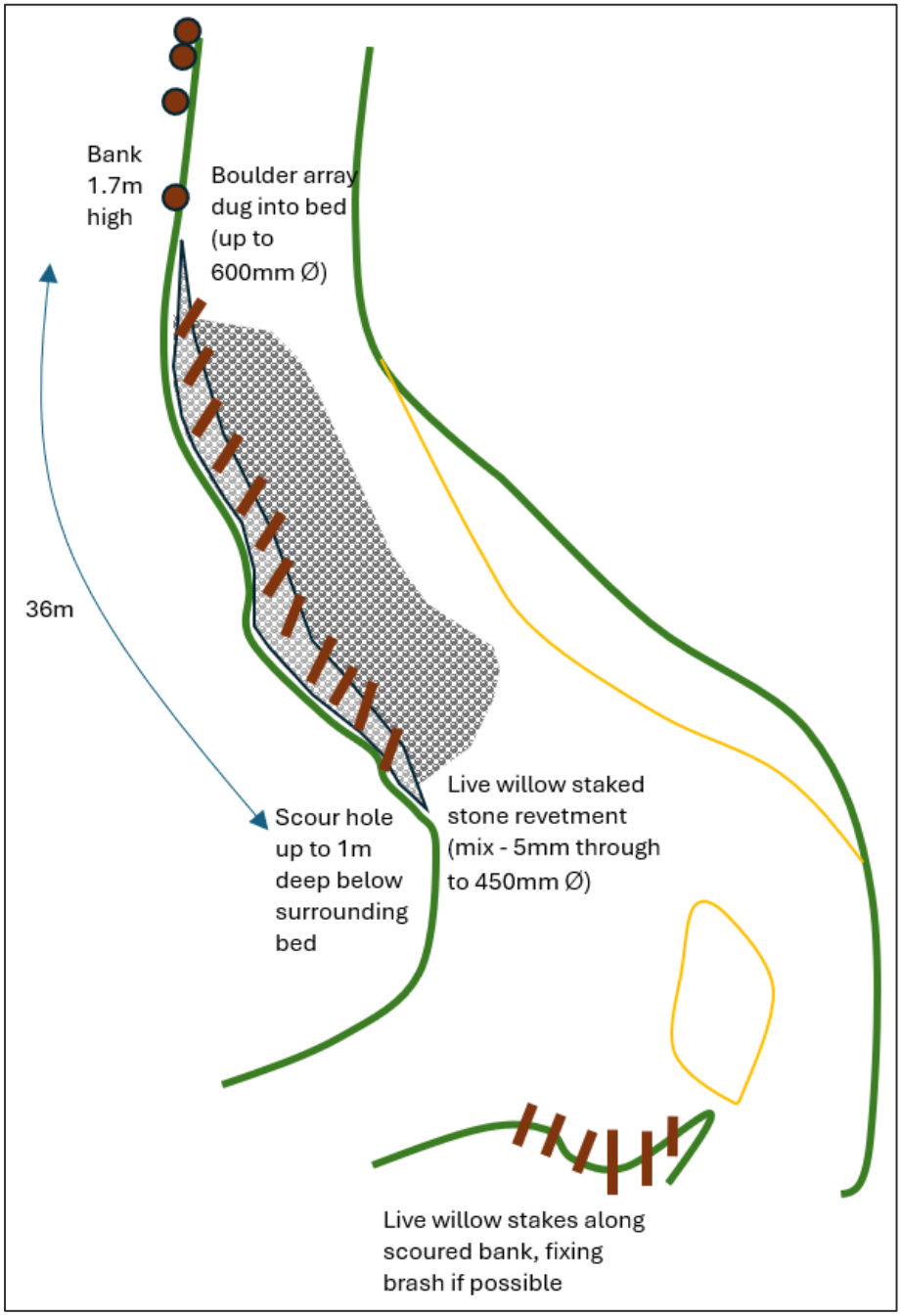
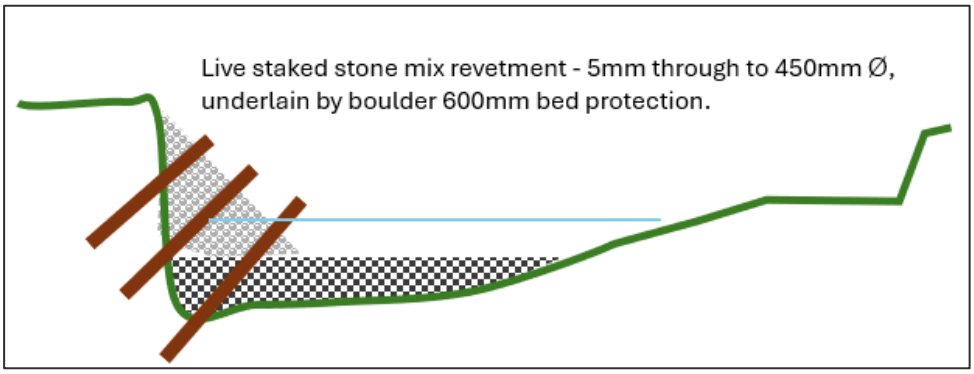


Figure 30. Detailed design drawing outlining the restoration works for Site 15.



Instructions for Design

Boulder Array for Bed Protection

- Install boulders (up to 600mm Ø) in the riverbed to stabilise the substrate and mitigate bed erosion.
- Ensure boulders are strategically positioned to create natural flow diversity and sediment retention areas.

Bank Reinforcement with Brash Bundles

- Secure brash bundles along the riverbank to reduce flow velocity and protect against further erosion.
- Stake the bundles in place using live willow stakes, ensuring strong anchoring and natural root development.

Live Willow-Staked Stone Revetment

- Construct a graded stone mix revetment (5mm to 450mm Ø) along the scoured bank, underlain by 600mm boulder protection for added stability.
- Integrate live willow stakes within the stone revetment to enhance structural integrity and encourage vegetation growth over time**.**

Tree Planting for Long-Term Stabilisation

- Plant native tree species along the riverbank to improve soil cohesion and reduce future erosion risks.
- Ensure a mix of species suitable for riparian environments, with preference given to fast-rooting species like willow and alder.
- Secure biodegradable tree guards onto tree whips.
- Monitor and maintain trees to ensure establishment and growth.

Monitoring and Maintenance

- Inspect structures after high flows and reinforce if necessary.
- Monitor vegetation growth, replacing failed plantings where needed.
- One planted whips have matured, remove tree guards.
- Manage invasive species to ensure successful establishment of native plants.

Safety and Environmental Considerations

- Follow environmental regulations to avoid habitat damage.
- Minimise machinery use and prevent sediment pollution.

Materials

Material	Quantity
Live Willow Stakes	148
Oversized Gravels (5-400ø)	130t
Boulders (400-600ø)	566t
Machinery/ Tools	
Digger	
Dumper	
Chainsaws	
Post knocker	

Cost Estimate

£77,000

The following cost estimates are based on current material prices and available information, including machinery, site operatives, and materials. Please note that these are approximate values, and costs may fluctuate due to changes in material availability, market conditions, or unforeseen site-specific factors. As such, these figures should be used as a general estimate and may be subject to revision as the project progresses.

Site 16 & 19:

16 NGR: ST2612903108 19 NGR: ST2607103237

At Site 19/16, there is an opportunity to enhance floodplain connectivity by facilitating overland flow and increasing water retention within the adjacent wetland. A high-flow channel should be excavated, to direct excess water from Site 20 toward the wetland area located south of the drainage ditch. This intervention will enable greater overbank flow during high water events, improving flood storage capacity and promoting natural hydrological processes.

To further enhance water retention, the existing drainage ditch will be blocked to prevent direct bypassing of flows into the main river channel. This will encourage prolonged water retention in the floodplain, allowing for increased groundwater recharge, sediment deposition, and the development of wetland habitats. By slowing runoff and dispersing flows across the floodplain, these measures will help mitigate erosion, enhance biodiversity, and contribute to overall river resilience.

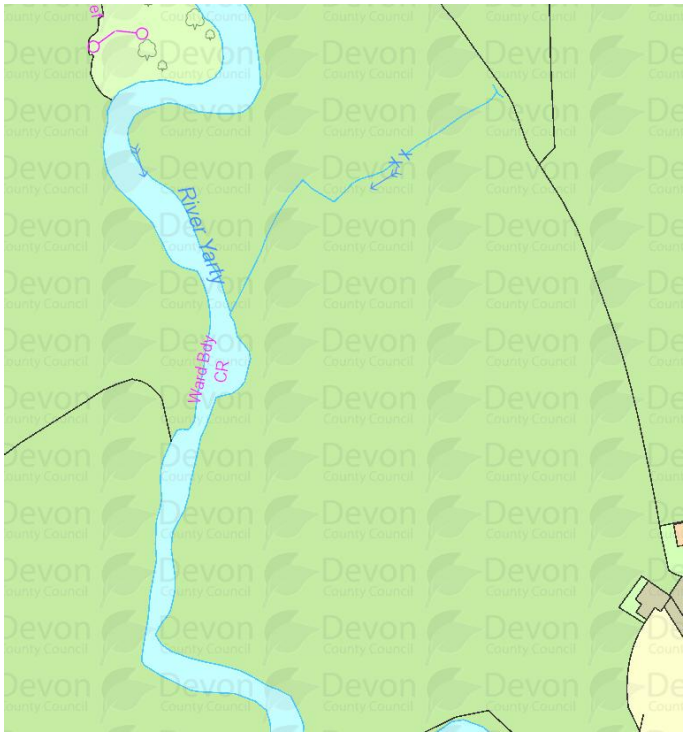


Figure 31,32. Map and planform view of Site 16 to 19.

Figure 33 Photograph showing the wetland that could be improved.

Detailed Design

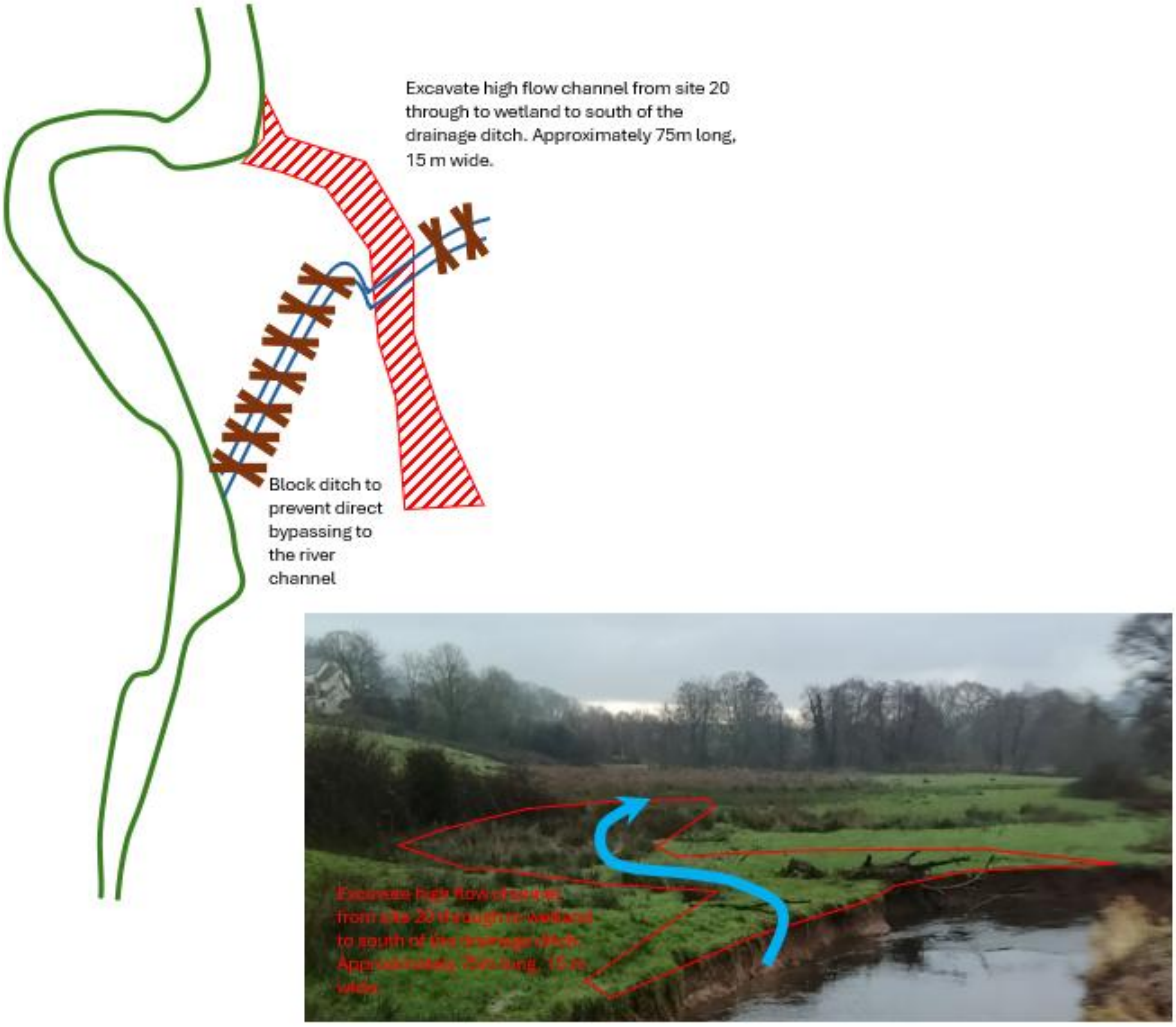


Figure 34. Detailed design drawing showing ditch blocking and excavation.

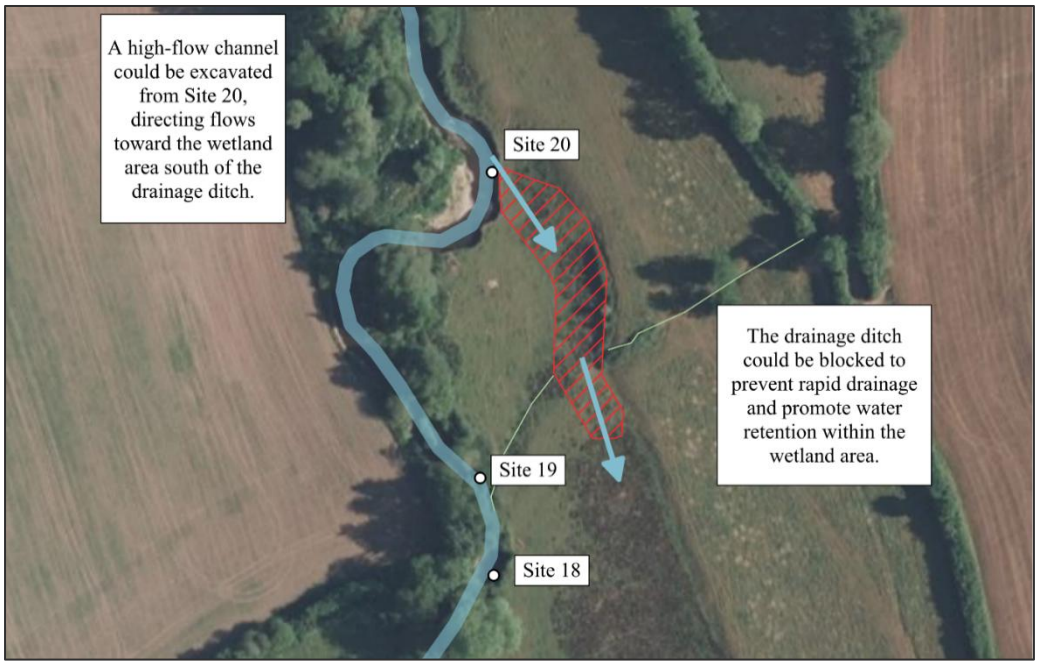


Figure 35. Pano showing excavation area, and flow pathways

Figure 36. Photograph of the wetland.

Instructions for Design

Excavation of High-Flow Channel

- The high-flow channel should be excavated to direct excess water from Site 20 towards the wetland area south of the drainage ditch.
- The channel should be approximately 75 meters long and 15 meters wide, with a varying depth depending on local topography.
- Use a mechanical excavator or equivalent machinery to carefully excavate the channel.
- Ensure that the channel bottom is graded to allow for smooth flow of water into the wetland area.

Sediment Management

- During excavation, any excavated material should be stockpiled in an appropriate location that will not impact the surrounding area.
- After excavation, surplus material may be used to assist with the construction of filling in the drainage ditch that should be blocked.
- The surplus material can be placed over the brushwood within the ditch, allowing for air gaps to be compacted while minimising the risk of sediment mobilisation.

Blocking of Existing Drainage Ditch

- Use brushwood to densely pack the gully, effectively blocking the drainage ditch and preventing water bypass into the main river channel.
- Secure the brushwood with wooden stakes to prevent displacement, ensuring the structure remains stable over time.
- Introduce coarse woody debris (e.g., logs or root wads) within the blockage to further slow water movement and improve long-term effectiveness.
- If necessary, place a layer of coarser material (gravel/cobble) or a geotextile base beneath the brushwood to minimise fine sediment washout and improve hydraulic efficiency.

- Ensure the final layer of brushwood is tightly compacted and secured in place with additional material (e.g., sediment, coir netting) to prevent soil runoff into the river.

Vegetation

- Install live willow stakes along the embankment to promote stabilisation and long-term growth.
- Where possible, use coir mats or other erosion control measures to aid in establishing vegetation and reducing erosion during establishment.

Enhancement of Wetland Area

- Once the drainage ditch is blocked, ensure water is directed into the wetland area as designed. This will facilitate increased water retention during high-flow events and encourage groundwater recharge.
- Monitor water levels and adjust if needed to ensure that the wetland remains flooded as intended during peak flow periods.
- Promote biodiversity by allowing the wetland area to develop naturally, with minimal intervention. Introduce additional wetland species if required to enhance habitat diversity.

Post-Construction Monitoring and Maintenance

- Conduct inspections during the first year of operation to assess the performance of the high-flow channel, blocked ditch, and wetland area.
- If the wetland area is not retaining water as intended, or if the high-flow channel is not functioning effectively, make necessary adjustments such as modifying the channel dimensions or enhancing flow control structures.
- Ensure that willow stakes and any other planted vegetation establish and thrive. If required, supplement planting to encourage long-term ecological development.
- Monitor the wetland edges for signs of erosion. Reinforce with additional materials (e.g., coir mats, brushwood) as necessary.
- Regular monitoring of the blocked ditch should be carried out post-installation to assess structural integrity and ensure no sediment runoff is happening, adapt measures if needed.

Materials

Material	Quantity
Brushwood for dams	60m^3
Live Willow Stakes	50
Machinery/ Tools	
Digger	
Dumper	
Chainsaws	
Post knocker	

Cost Estimate

£11,500

Costing included here is only for the ditch blocking, due to the fact of the interlinked relationship between Site 16 and 20 one cannot be without the other. Therefore, costing of the excavation will be included within Site 20 Option 2.

The following cost estimates are based on current material prices and available information, including machinery, site operatives, and materials. Please note that these are approximate values, and costs may fluctuate due to changes in material availability, market conditions, or unforeseen site-specific factors. As such, these figures should be used as a general estimate and may be subject to revision as the project progresses.

Site 17:

NGR: ST2608703114

To reduce further incision and erosion at Site 17, a planted buffer zone could be established between the river and adjacent fields, helping to stabilise the banks and enhance riparian habitat. Additionally, raising the riverbed could improve connectivity with the floodplain, allowing for more natural water dispersal during high flows. Bank reinforcement measures, including brash bundles, live willow staking, and stone revetment, could provide structural stability, while in-channel features such as a high-flow tree jam and boulder array could enhance habitat complexity and flow diversity. These interventions collectively aim to restore geomorphic stability and promote long-term resilience in the reach.

Figure 37 & 38. Detailed design drawing outlining the restoration works for Site 15.

Detailed Design

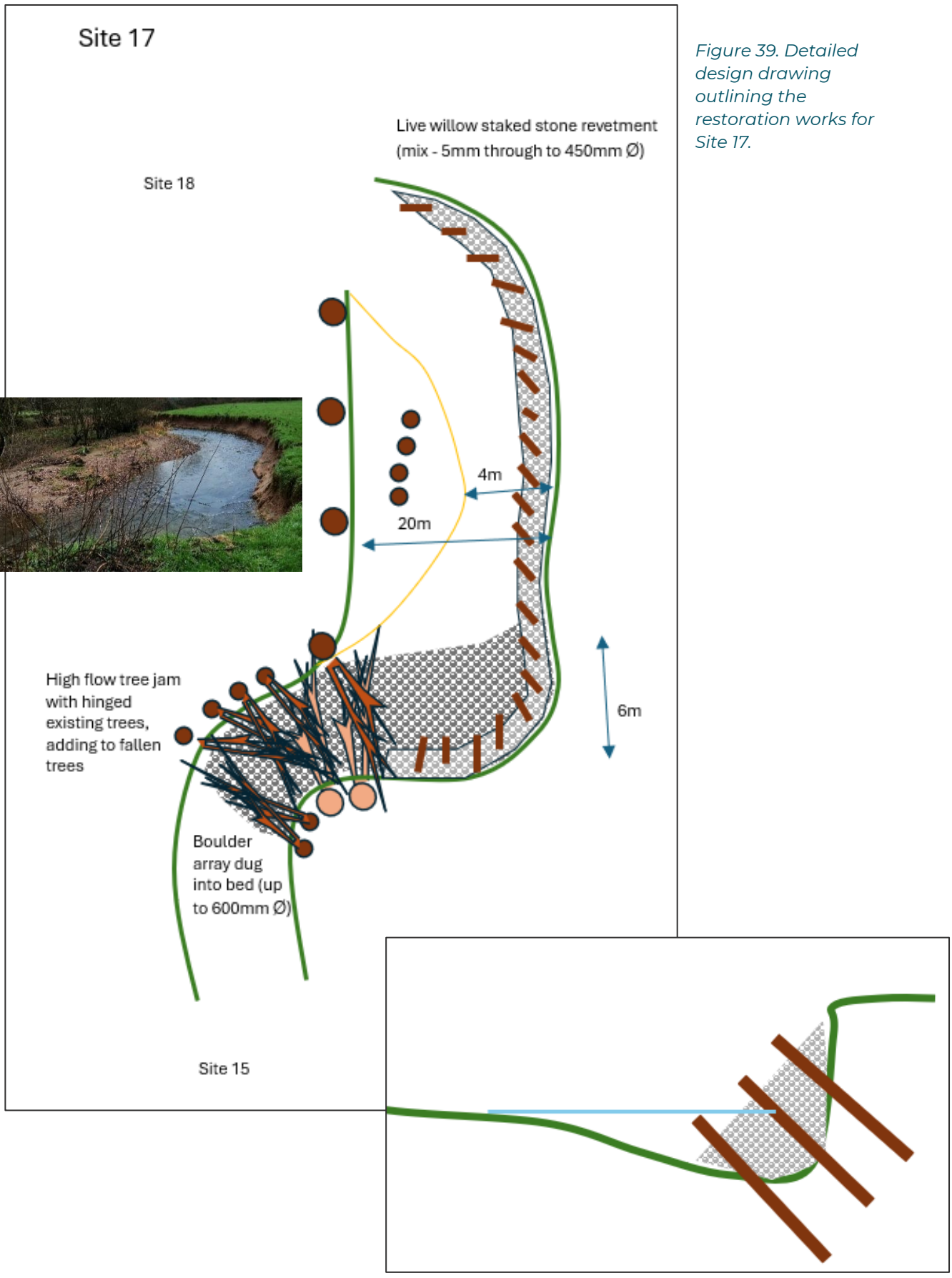


Figure 39. Detailed design drawing outlining the restoration works for Site 17.

Instructions for Design

Riverbed Raising

- Identify sections of the river where bed levels need to be raised on detailed design plan to enhance floodplain connectivity.
- Embed boulders (up to 600mm Ø) into the riverbed to provide additional flow resistance and habitat diversity.
- Introduce a mix of gravel and cobbles (5mm to 450mm Ø) to raise the bed profile, ensuring material is well distributed.

Bank Reinforcement

- Stabilise the eroded eastern bank using brash bundles secured with stakes to reduce further undercutting.
- Construct a live willow-staked stone revetment using stones of varying sizes (5mm to 450mm Ø) to protect against erosion while promoting vegetative growth.
- Stake in willow stakes and ensure the willow stakes are positioned to take root and establish stability along the reinforced bank.

High-Flow Tree Jam

- Hinge existing trees to create a high-flow tree jam on the meander bend south of the site.
- Add additional fallen trees and secure them in place to enhance roughness and slow high-energy flows.
- Ensure tree placement encourages sediment deposition while maintaining passage for aquatic species.

Buffer Zone Planting

- Plant native tree species along the eastern bank.
- Secure tree guards on to planted whips.

Post-Construction Monitoring

- Assess sediment deposition and riverbed stability after high-flow events.
- Monitor the establishment of planted and natural vegetation along the buffer zone.
- Ensure structural elements (revetments, brash bundles, and tree jams) remain intact and functioning effectively.

Materials

Material	Quantity
Live Willow Stakes	160
Oversized Gravels (5-450ø)	432t
Boulders (600ø)	238t
Tree whips	300
Tree Guards	300
Machinery/ Tools	
Digger	
Dumper	
Chainsaws	
Post knocker	
Spade	
Bucket (to water whips)	

Cost Estimate

£48,500

The following cost estimates are based on current material prices and available information, including machinery, site operatives, and materials. Please note that these are approximate values, and costs may fluctuate due to changes in material availability, market conditions, or unforeseen site-specific factors. As such, these figures should be used as a general estimate and may be subject to revision as the project progresses.

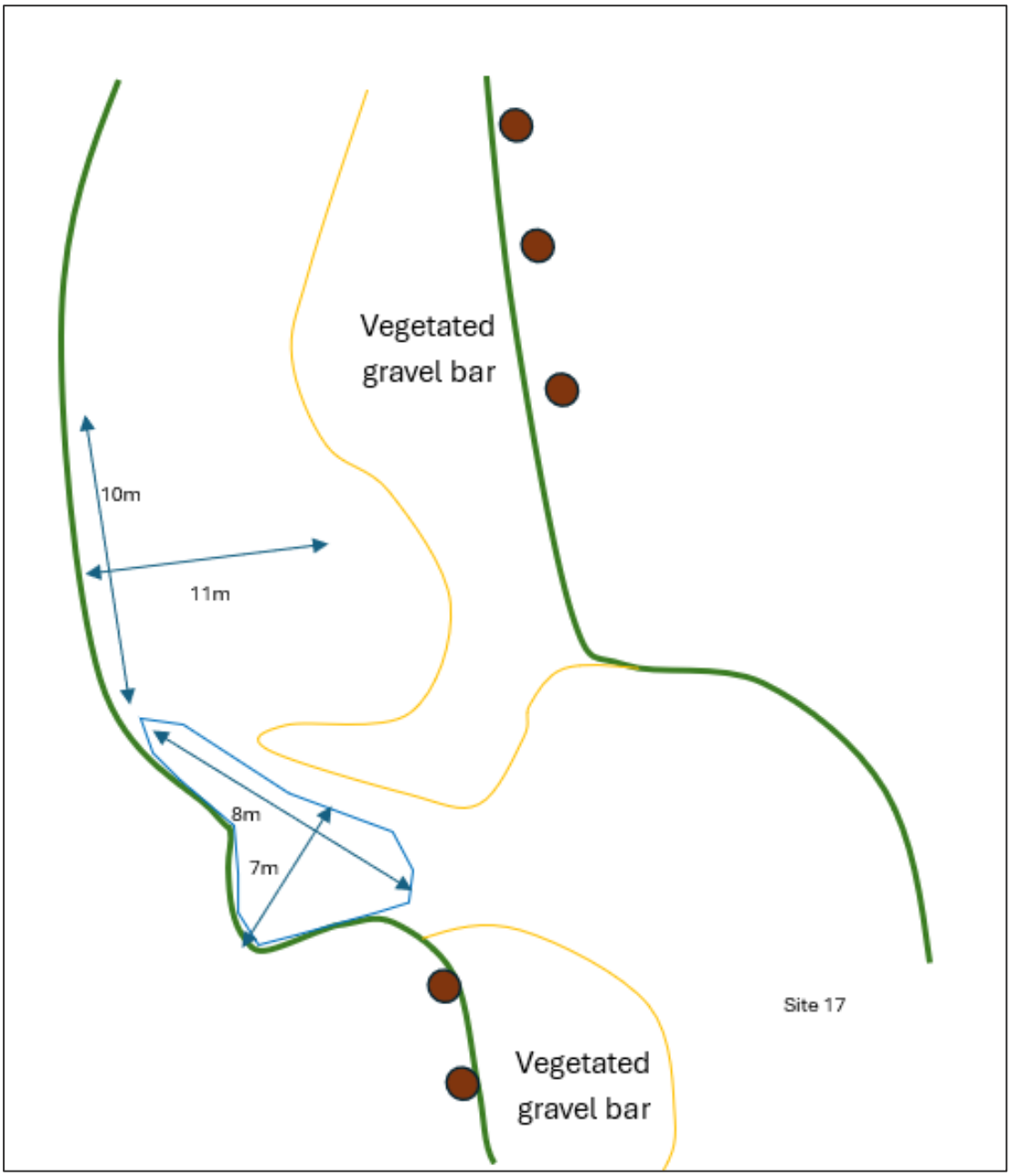
Site 18:

NGR: ST2607403213

To enhance bank stability and reduce further erosion, interventions could include bank reinforcements and infilling the base of both pools. A live-staked stone revetment could be installed, 5mm through to 450mm Ø, underlain by boulder 600mm bed layer for additional bed protection.

Figures 40, 41 & 42. Photographs showing Site 18.

Detailed Design



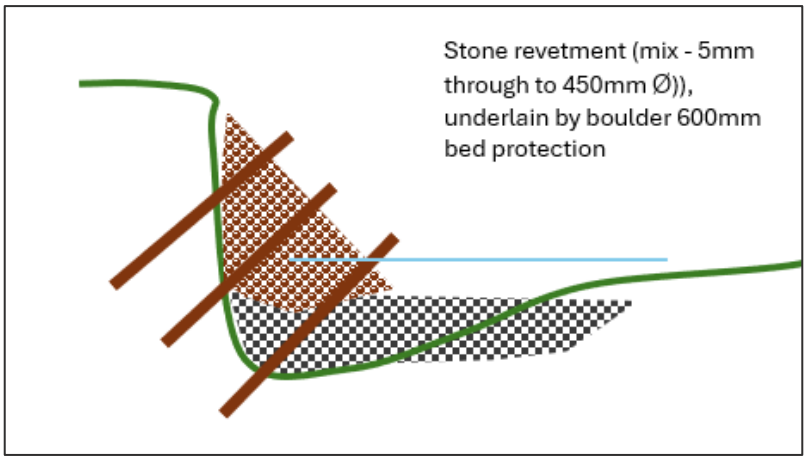


Figure 43. Detailed design drawing outlining the restoration works for Site 18.

Instructions for Design

Boulder Bed Protection and Pool Base Infill

- Install a layer of boulders (up to 600mm Ø) beneath the stone revetment to provide additional bed reinforcement.
- Ensure the base of both pools are infilled to enhance stability and reduce excessive scour.
- Ensure boulders are embedded securely to prevent displacement during high flows and graded to maintain natural flow patterns.

Live Willow-Staked Stone Revetment

- Construct a graded stone mix revetment (5mm to 450mm Ø) along the scoured bank, underlain by 600mm boulder protection for added stability.
- Integrate live willow stakes within the stone revetment to enhance structural integrity and encourage vegetation growth over time.

Post-Construction Monitoring

- Assess bank stability and scour reduction following high-flow events.
- Monitor the establishment of live willow stakes and adjust as necessary to promote growth.
- Ensure revetment and boulder bed protection remain intact and functioning as intended.

Safety and Environmental Considerations

- Follow environmental regulations to prevent damage to surrounding habitats.
- Minimise machinery use and prevent sediment runoff into the river.
- Schedule works to avoid disturbing breeding wildlife or protected species.

Materials

Material	Quantity
Live Willow Stakes	72
Oversized Gravels (5-400ø)	332t
Boulders (600ø)	440t
Machinery/ Tools	
Digger	
Dumper	
Chainsaws	
Post knocker	

Cost Estimate

£61,000

The following cost estimates are based on current material prices and available information, including machinery, site operatives, and materials. Please note that these are approximate values, and costs may fluctuate due to changes in material availability, market conditions, or unforeseen site-specific factors. As such, these figures should be used as a general estimate and may be subject to revision as the project progresses.

Site 20 (& start of 19)

NGR: ST2607503312

Bank reinforcement is necessary to prevent further erosion while also allowing for natural processes to shape the river channel. A combination of live staking, either with brash bundles or a stone mix, is proposed to provide immediate structural support while promoting long-term vegetative stabilisation.

Additionally, the use of an underlying boulder bed is intended to reinforce the riverbed, preventing excessive scour and maintaining the stability of in-channel features. To further dissipate energy and control flow velocities at the bend, tree jams would be installed, consisting of 5-10 trees per jam, staked in place to ensure durability. These structures would help slow water movement, encourage sediment deposition, and create habitat complexity.

Two options could be considered to enhance bank stability, reduce exit velocities, and improve floodplain connectivity. Option 1, a brash revetment with willow stakes would be implemented, providing a more naturalistic approach to bank reinforcement, particularly in areas where sediment accumulation and vegetative regrowth are desirable.

Option 2 offers a more structural intervention with a live-staked stone revetment and an additional high-flow excavation (Site 16) to Site 19. This would involve reducing bank height by approximately one-third to increase floodplain connectivity, allowing water to spill out more frequently during high flows and improving wetland hydrology.

Figure 44. Photograph showing site 20.

Figure 45, 46, & 47. Photographs depicting Site 20.

Detailed Design

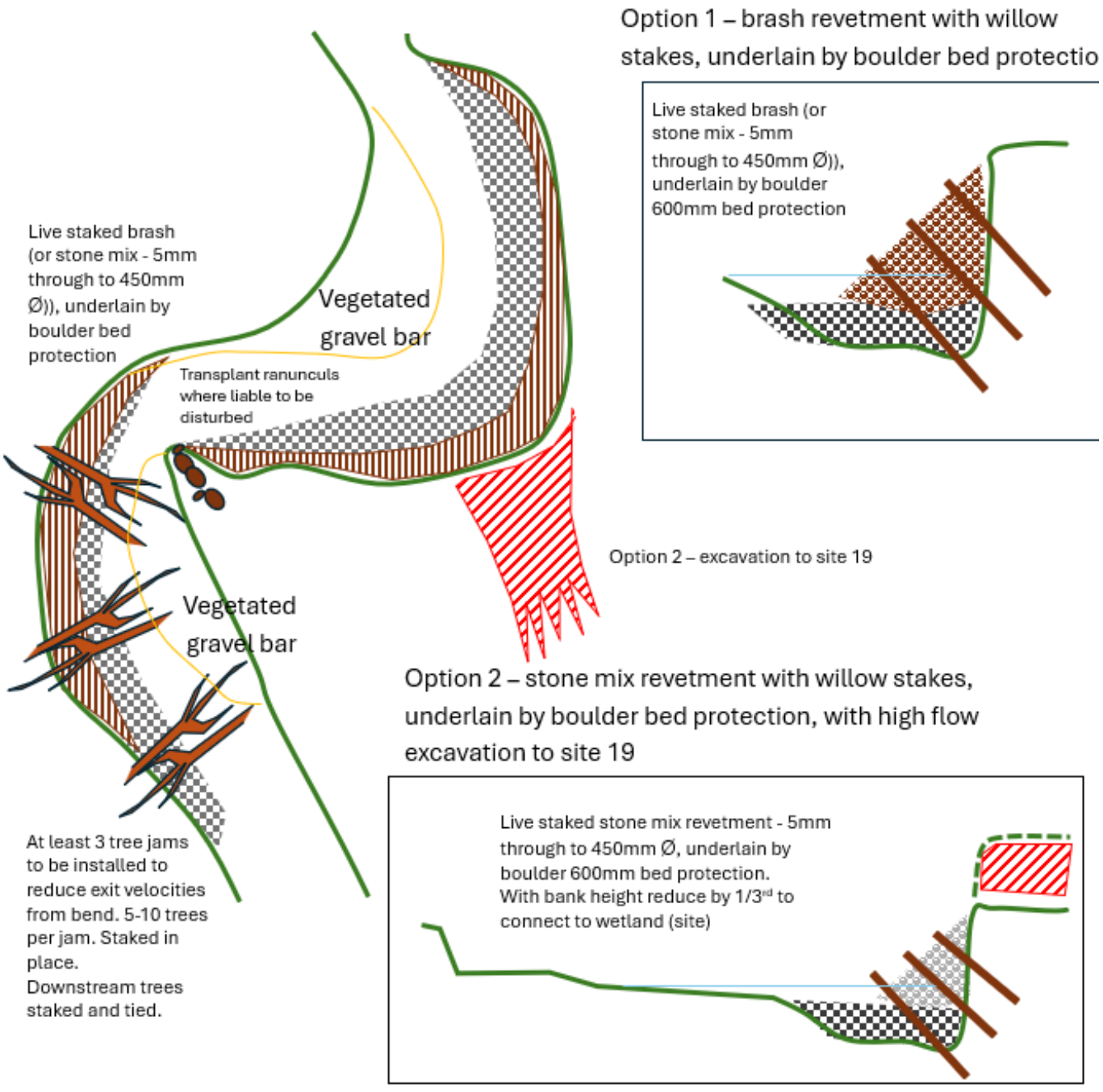


Figure 48. Detailed design drawing outlining the restoration works for Site 20.

Instructions for Design

Option 1 – Brash or Stone Revetment with Willow Stakes and Boulder Bed Protection

- Construct a live-staked brash revetment, using bundled brash secured with willow stakes to reinforce the bank. Alternatively, a stone revetment could be used (5mm to 450mm Ø).
- Underlay the revetment with a boulder bed (up to 600mm Ø) to provide additional erosion protection.
- Install at least three tree jams on the bend to reduce exit velocities. Each jam should contain 5-10 trees, staked in place for stability.
- Downstream trees should be staked and tied to ensure they remain secure.
- Transplant Ranunculus in areas liable to be disturbed during construction.

Option 2 – Brash or Stone Revetment with Willow Stakes, Boulder Bed Protection, and High-Flow Excavation (Site 16)

- Construct a live-staked brash revetment, using bundled brash secured with willow stakes to reinforce the bank. Alternatively, a stone revetment could be used (5mm to 450mm Ø).
- Underlay the revetment with a boulder bed (up to 600mm Ø) to provide additional erosion protection.
- Excavate a high-flow channel (Site 16) to Site 19 to enhance floodplain connectivity.
- Reduce bank height by one-third to allow improved overland flow into the adjacent wetland area.
- Install at least three tree jams on the bend to reduce exit velocities. Each jam should contain 5-10 trees, staked in place for stability.
- Downstream trees should be staked and tied to ensure they remain secure.
- Transplant Ranunculus in areas liable to be disturbed during construction.

Post-Construction Monitoring

- Monitor bank stabilisation and revetment performance after high-flow events.
- Assess tree jams for stability and effectiveness in reducing velocities.
- Track Ranunculus survival and adjust transplantation efforts if needed.
- Evaluate floodplain connectivity improvements following bank height reduction and excavation.

Safety and Environmental Considerations

- Follow environmental regulations to prevent habitat disturbance, particularly in Ranunculus transplantation zones.
- Minimise machinery use in sensitive areas to reduce sediment mobilisation and pollution risks.
- Time construction works to avoid disturbing breeding wildlife and protected species

Materials

Option 1	
Material	Quantity
Brushwood	228m^3
Live Willow Stakes	319
Boulders (600ø)	700t
Oversized Gravels (5-450ø)	410t
Machinery/ Tools	
Digger	
Dumper	
Chainsaws	
Post knocker	

Option 2	
Material	Quantity
Brushwood	152m^3
Live Willow Stakes	319
Boulders (600ø)	700t
Oversized Gravels (5-450ø)	274t
Machinery/ Tools	
Digger	
Dumper	
Chainsaws	
Post knocker	

Cost Estimate

Option One: £94,000

Option Two (Incudes cost of Site 16): £90,500

Due to the fact of the interlinked relationship between Site 16 and 20 one cannot be without the other. Therefore, costing of the excavation is included Site 20 Option 2.

The following cost estimates are based on current material prices and available information, including machinery, site operatives, and materials. Please note that these are approximate values, and costs may fluctuate due to changes in material availability, market conditions, or unforeseen site-specific factors. As such, these figures should be used as a general estimate and may be subject to revision as the project progresses.

Site 21:

NGR: ST26020 03414

At Site 21, interventions should focus on utilising on-site trees (50 +) to create tree jam complexes, stabilising the scarp slopes, and reinforcing the main scour hole. The scour hole should also be laid with boulders (600mm+) at the base to reduce further erosion and dissipate high-energy flows. These measures aim to reduce erosion, slow flow velocities, and promote habitat complexity while ensuring long-term bank stability. Plant alder and hazel within the area to enhance riparian vegetation and provide further bank stabilisation over time and to replace the felled trees.

Figure 49. Photograph showing Site 21 restoration works.

Detailed Design

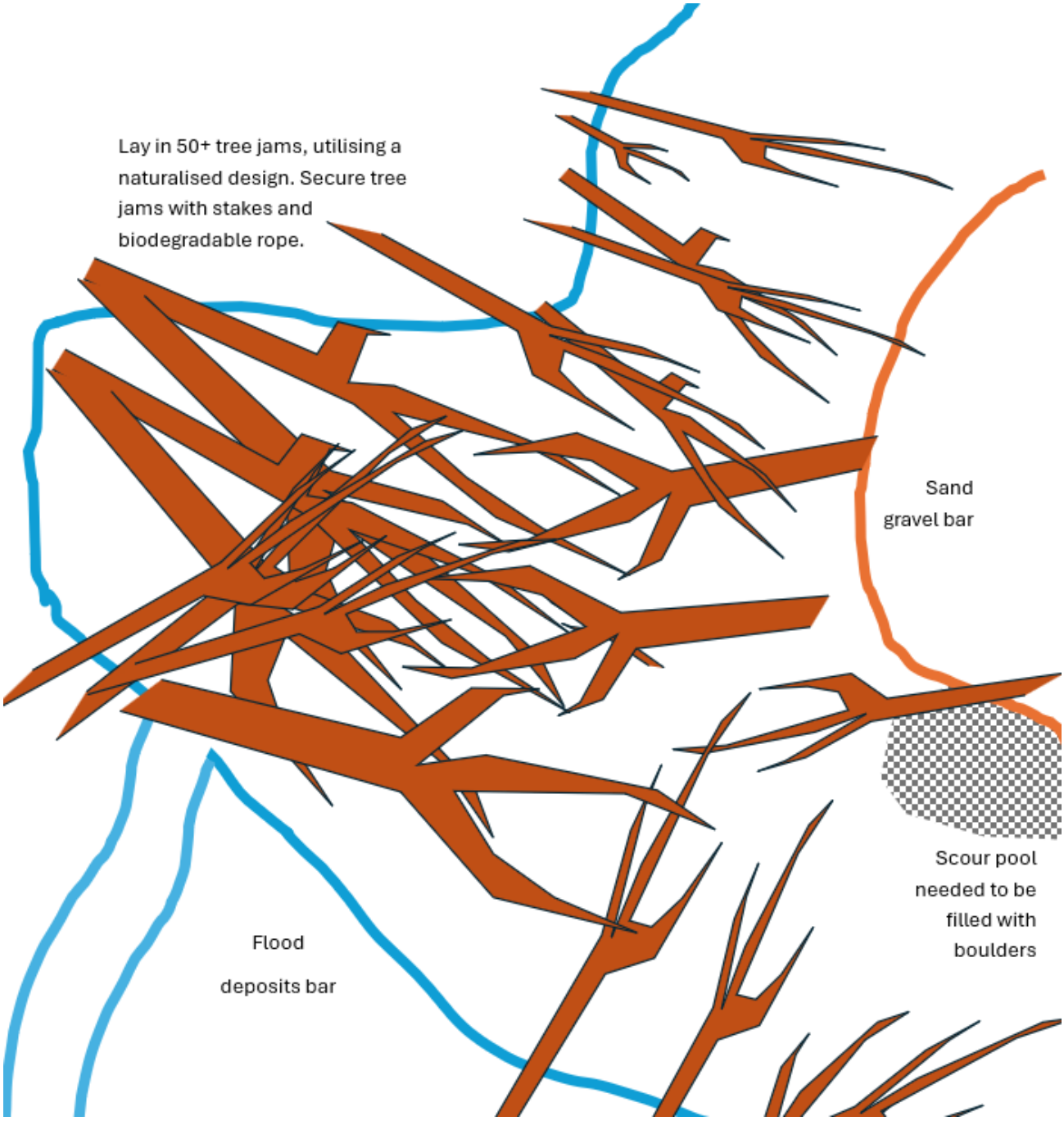


Figure 50. Detailed design drawing outlining tree jam complexes for Site 21.

Instructions for Design

Scour Hole Reinforcement

- Place boulders (600mm+) at the base of the 7m x 7m scour hole to reduce further erosion and dissipate high-energy flows.
- Ensure boulders are embedded securely to prevent displacement during high-flow events.

Tree Jam Complexes

- Identify and hinge 50+ on-site trees to create tree jams, enhancing in-stream roughness and reducing flow energy.
- If may be necessary to source off site trees for these leaky dams. These could then be transported to site.
- Fell approximately 30 trees from the tops of scarp slopes to reduce bank loading and mitigate the risk of slope failure.
- Use felled trees as additional material for tree jams, positioning them strategically to maximise their effectiveness.
- Winch trees into place where necessary to ensure proper alignment and stability.
- Secure tree jams with live willow stakes to encourage natural regeneration and long-term stabilisation.

Tree Planting for Long-Term Stabilisation

- Plant native tree species alder and hazel along the riverbank to improve soil cohesion and reduce future erosion risks.
- Ensure planted species are appropriately spaced to allow for natural succession and long-term resilience.
- Ensure a mix of species suitable for riparian environments, with preference given to fast-rooting species like willow and alder.
- Secure biodegradable tree guards onto tree whips.
- Monitor and maintain trees to ensure establishment and growth.

Monitoring and Maintenance

- Inspect structures after high flows and reinforce if necessary.
- Monitor vegetation growth, replacing failed plantings where needed.
- One planted whips have matured, remove tree guards.
- Manage invasive species to ensure successful establishment of native plants.

Post-Construction Monitoring

- Assess the stability and effectiveness of tree jam complexes, adjusting positions if necessary after high flows.
- Monitor willow staking and planted vegetation to track establishment and growth.

- Observe scour hole reinforcement to ensure boulder placement remains intact and continues to function as intended.
- Monitor vegetation growth, replacing failed plantings where needed.
- One planted whips have matured, remove tree guards.
- Manage invasive species to ensure successful establishment of native plants.

Materials

Material	Quantity
Live Willow Stakes	200
Tree whips	150
Boulders (400-600ø)	245t
Tree guards	150
Machinery/ Tools	
Digger	
Dumper	
Chainsaws (x3-4)	
Post knocker	
Spades	
Bucket (to water whips)	

Cost Estimate

£38,000

The following cost estimates are based on current material prices and available information, including machinery, site operatives, and materials. Please note that these are approximate values, and costs may fluctuate due to changes in material availability, market conditions, or unforeseen site-specific factors. As such, these figures should be used as a general estimate and may be subject to revision as the project progresses.

Site 22:

NGR: ST2588803504

To stabilise the eroded bank and reduce flow energy in this section, a graded stone mix revetment with live willow stakes could be installed along 45m of bank, with additional stone extending across the riverbed into the scour holes. These measures aim to dissipate energy, reduce further erosion, and enhance habitat complexity.

Figure 51 & 52. Photographs showing Site 22 degraded banks and pools requiring restoration.

Detailed Design

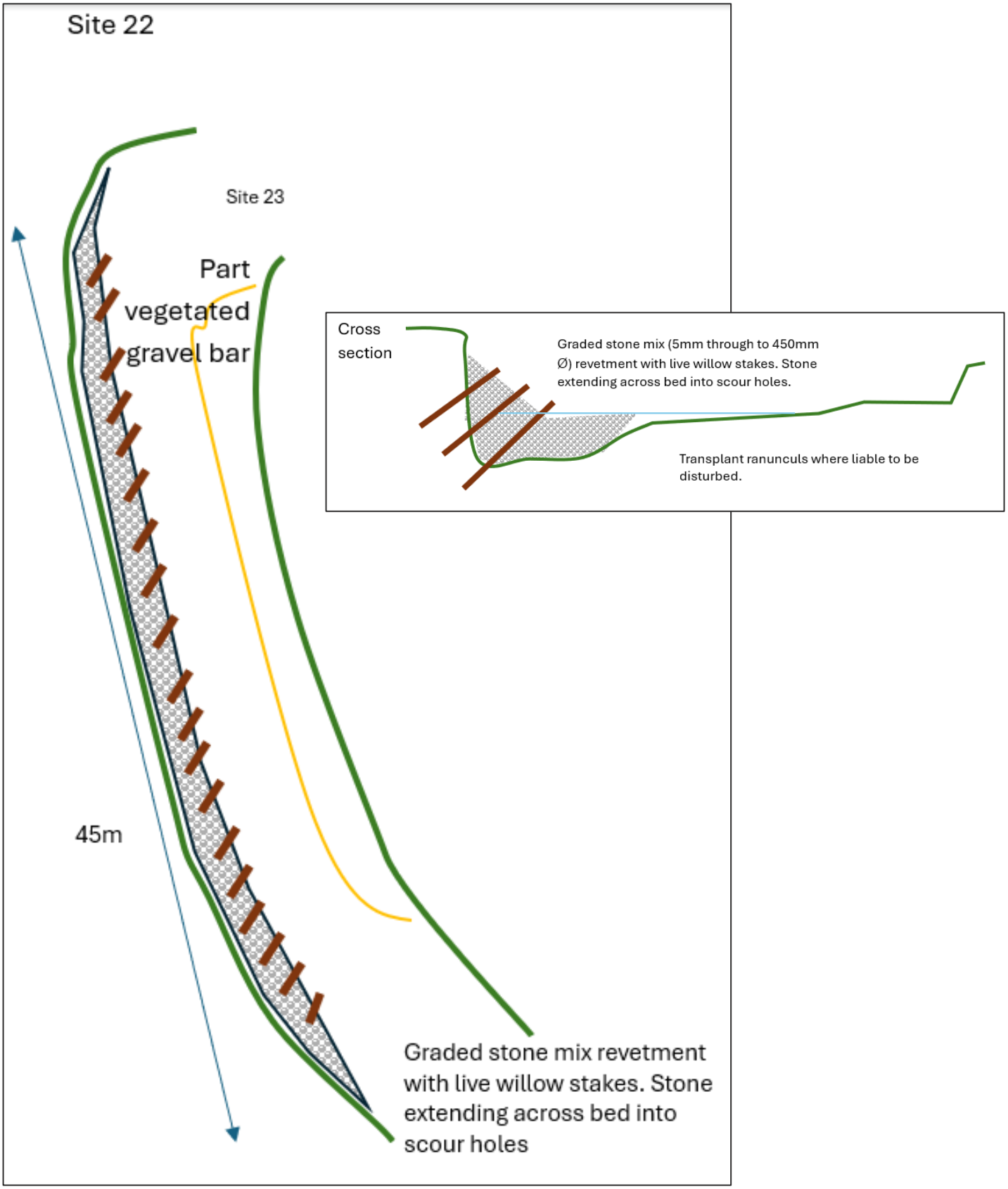


Figure 53. Detailed design drawing outlining the restoration works for Site 22.

Instructions for Design

Graded Stone Mix Revetment Installation

- Clear the site of any debris, vegetation, or loose material along the 45m section of eroded bank.
- Ensure the base of the bank has a stable foundation for the graded stone revetment, remove any temperamental or loose stone.
- Place a graded stone mix along the bank, with larger stones at the base and progressively smaller stones towards the top to create a stable, energy-dissipating structure.
- Ensure the stone mix extends across the riverbed, into the scour holes, to promote energy dissipation and reduce flow concentration in these areas.

Live Willow Stakes

- Install live willow stakes along the top and middle sections of the revetment, spaced at 1-1.5m intervals.
- Drive the stakes at least 2 feet into the soil to a depth that ensures their stability, leaving the tops of the stakes just above water level.
- Ensure that the willow stakes are oriented to encourage rooting and growth to further stabilise the bank over time.

Habitat Enhancement

- Backfill the graded stone revetment with a mix of gravel, cobbles, and coarse woody material to enhance habitat complexity and provide shelter for aquatic species.
- Leave small gaps between stones to encourage vegetation growth and create refuges for invertebrates.

Final Checks and Maintenance

- After installation, monitor the structure during the first few flood events to ensure stability and make any necessary adjustments.
- Regularly check the willow stakes and revetment for signs of erosion or undermining and replace any damaged or missing stakes as needed.

Safety and Environmental Considerations

- Minimise disturbance to existing riparian vegetation and aquatic habitats during installation.
- Ensure machinery use is restricted to designated access points to prevent unnecessary bank damage and sedimentation.
- Conduct works outside of fish spawning season to avoid ecological disruption.

Materials

Material	Quantity
Live Willow Stakes	180
Oversized Gravels (5-450ø)	607t
Machinery/ Tools	
Digger	
Dumper	
Chainsaws	
Post knocker	

Cost Estimate

£24,500

The following cost estimates are based on current material prices and available information, including machinery, site operatives, and materials. Please note that these are approximate values, and costs may fluctuate due to changes in material availability, market conditions, or unforeseen site-specific factors. As such, these figures should be used as a general estimate and may be subject to revision as the project progresses.

Site 23:

NGR: ST2588903546

Two potential approaches could be considered at Site 23 to stabilise the bank, reduce flow energy, and improve the river's connectivity with downstream wetland areas.

Option 1 The use of boulder arrays in the riverbed aims to absorb and dissipate the energy from flowing water, particularly in areas of high flow, which is essential for preventing further bank erosion and maintaining the riverbed's integrity. Tree revetments, made from brash and brushwood, would be staked in place with live willow stakes, creating a natural barrier. The addition of tree jams positioned before and after the meander bend would further slow the flow of water, creating turbulence that helps reduce erosion while fostering habitat complexity in the channel.

Option 2 proposes a more significant alteration of the channel's flow dynamics to restore floodplain connectivity. During construction, a high-flow channel could be excavated to reconnect the river to its downstream paleochannel wetland depression. The addition of a brushwood hedge, reinforced with live stakes, would stabilise this infilled channel, encouraging sediment deposition and vegetation growth. The creation of a staked brushwood fence with coir matting would provide a dry site to support the newly infilled material and minimise erosion. To ensure effective floodplain restoration, bank height reduction by approximately two-thirds would be implemented, allowing for increased frequency of overbank flow and facilitating better water retention within the floodplain. Tree jams, as in Option 1, would be implemented for slowing the flow and promoting habitat development along the river's meander.

Figure 54. Photograph showing Site 23, where restoration and bank lowering should take place.

Figure 55. Option 2: Area for excavation to create flow pathways and scrapes downstream, connecting to wetland/paleochannel downstream to hold additional water and reconnect the floodplain.

Figure 56. Option 2 infill line with excavation materials:

Detailed Design

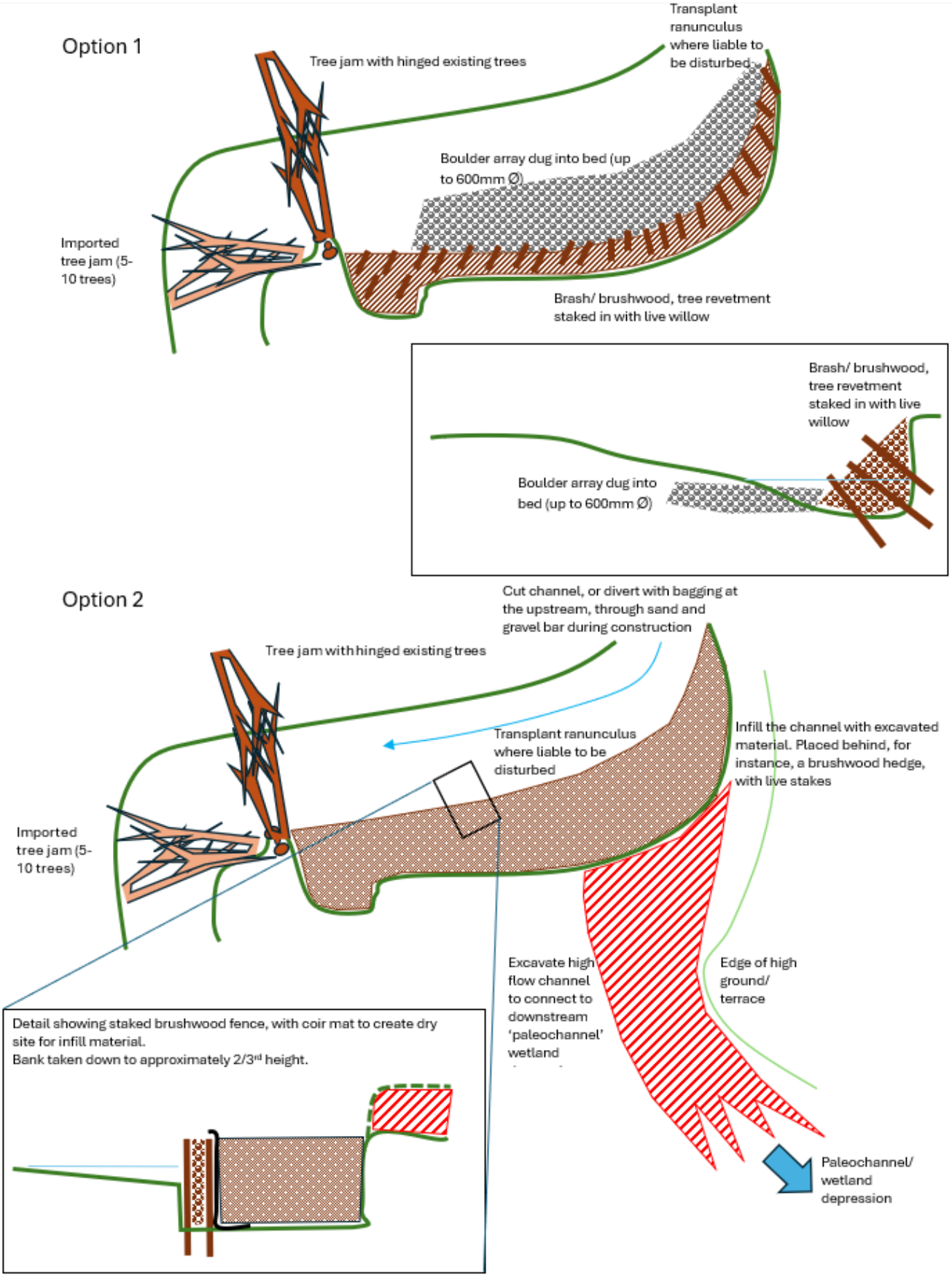


Figure 57. Detailed design drawing outlining the restoration works for Site 23.

Instructions for Design

Option 1 – Bank Restoration with Boulder Arrays and Tree Jams

- Install a boulder array (up to 600mm Ø) within the riverbed to reduce flow velocities and provide structural bed stabilisation.
- Construct a brash/tree revetment, staked in place with live willow stakes, to reinforce the bank and encourage vegetative stabilisation.
- Install a tree jam before the meander bend using hinged existing trees to slow flows and reduce erosion pressure.
- Place an additional tree jam directly after the meander bend, incorporating 5-10 imported trees, secured in place to enhance flow resistance and create habitat diversity.

Option 2 – Channel Diversion, High-Flow Connection, and Bank Lowering

- Temporarily divert the channel during construction by cutting a temporary bypass or using bagging at the upstream section to redirect flow through a sand and gravel bar.
- Excavate a high-flow channel to connect with the downstream paleochannel wetland depression, improving floodplain connectivity and overland flow distribution.
- Infill the existing channel using excavated material, placing it behind a brushwood hedge reinforced with live stakes to provide stability.
- Construct a staked brushwood fence with coir matting to create a dry site for infill material, ensuring gradual stabilisation and integration into the floodplain.
- Lower the bank height by approximately two-thirds, allowing for more frequent overbank flow and improved floodplain engagement.
- As in Option 1, install a tree jam before the meander bend using hinged existing trees and place an additional imported tree jam (5-10 trees) directly after the meander bend for further energy dissipation.

Safety and Environmental Considerations

- Limit in-channel work to low-flow periods to minimise sediment disturbance and avoid impacting fish spawning or aquatic life.
- Avoid unnecessary clearance of riparian vegetation, and ensure all removed material is repurposed where possible (e.g., for brash revetments).
- Ensure heavy machinery operates from designated access routes to prevent excessive bank damage and soil compaction.

Post-Construction Monitoring and Maintenance

- Assess tree jam stability and effectiveness in reducing flow energy, ensuring no excessive movement or displacement.
- Monitor bank stability and vegetation establishment, ensuring willow stakes take root successfully. Replant where necessary.

- Evaluate the success of high-flow channel excavation in enhancing floodplain reconnection, observing water movement and sediment deposition.
- Inspect infill stability behind brushwood hedges and adjust placement if needed to ensure gradual integration into the floodplain.

Materials

Option 1	
Material	Quantity
Brushwood	240m^3
Live Willow Stakes	240
Boulders (600ø)	195t
Trees	9 imported trees
Machinery/ Tools	
Digger	
Dumper	
Chainsaws	
Post knocker	

Option 2	
Material	Quantity
Brushwood	180m^3
Live Willow Stakes	240
Coir Matting	3,010m^2
Trees	9 imported trees
Machinery/ Tools	
Digger	
Dumper	
Chainsaws	
Post knocker	

Cost Estimate

Option One: £69,000

Option Two: £53,500

The following cost estimates are based on current material prices and available information, including machinery, site operatives, and materials. Please note that these are approximate values, and costs may fluctuate due to changes in material availability, market conditions, or unforeseen site-specific factors. As such, these figures should be used as a general estimate and may be subject to revision as the project progresses.

Site 24:

NGR: ST2592303632

Site 24, the most upstream location within the reach, presents an opportunity to implement measures that will stabilise the banks, enhance habitat diversity, and provide a long-term source of sediment supply to support natural river processes. To achieve this, live staking and tree hinging will be used to reinforce the banks, gravel augmentation will introduce a range of stone sizes to restore sediment transport dynamics, and riparian vegetation enhancements will improve habitat structure and resilience.

Figure 54 & 55. Photographs showing Site 24.

Instructions for Design

Gravel Augmentation for Channel Morphology Improvement

- A 500t gravel augmentation should be implemented to introduce a range of stone sizes (10mm – 400mm Ø), ensuring a diverse sediment mix that can mobilise naturally and settle throughout the reach.
- Gravel deposition at this upstream site will provide a sustained source of bed material, helping to restore sediment transport dynamics downstream.
- Material placement should follow an assessment of flow patterns to maximise effectiveness and mimic natural depositional processes.

Bank Stabilisation through Live Staking and Tree Hinging

- Live staking will be carried out at multiple levels along the 120m reach, targeting the toe, mid-bank, and top of the bank to encourage vegetative reinforcement and stabilise eroding sections.
- Where appropriate, existing trees may be hinged to introduce woody material into the channel, slowing flow velocity, promoting bank protection, and enhancing habitat complexity.

Vegetation and Habitat Enhancements

- Ranunculus and other aquatic vegetation at risk of disturbance will be transplanted to suitable locations within the reach to maintain habitat integrity.
- Tree planting on both sides of the channel is optional but recommended to enhance riparian cover, improve bank stability, and contribute to long-term channel resilience.

Post-Construction Monitoring & Considerations

- Monitor gravel movement to ensure appropriate distribution and assess whether additional augmentation is needed over time.
- Assess live stake survival rates and supplement with further planting if necessary.
- Evaluate bank stability and erosion trends post-intervention, particularly following high-flow events, to determine whether additional reinforcement is required.

Safety and Environmental Considerations

- Minimise in-channel machinery use to prevent unnecessary sediment mobilisation and disturbance to existing vegetation.

Materials

Material	Quantity
Live Willow Stakes	360
Oversized Gravels (10-400ø)	500t
Tree whips	600
Tree guards	600
Machinery/ Tools	
Digger	
Dumper	
Chainsaws	
Post knocker	
Spades	
Buckets (to water whips)	

Cost Estimate

£23,000

The following cost estimates are based on current material prices and available information, including machinery, site operatives, and materials. Please note that these are approximate values, and costs may fluctuate due to changes in material availability, market conditions, or unforeseen site-specific factors. As such, these figures should be used as a general estimate and may be subject to revision as the project progresses.

4. Regulatory and Planning Context

4.2 Flood Risk Activity Permit

The proposed works have been assessed against relevant environmental and planning regulations to ensure compliance. A Flood Risk Activity Permit (FRAP) has already been obtained for the site, and the planned restoration works have been reviewed to confirm they fall within the scope of the existing permit. Any activities involving in-channel modifications, floodplain reconnection, or temporary water storage features have been checked to ensure they align with the conditions of the FRAP.

If any adjustments to the design require additional permissions, these will be addressed through consultation with the Environment Agency. In addition, the project should adhere to Construction (Design and Management) Regulations (CDM) to ensure all health and safety risks are managed appropriately, with risk assessments, method statements, and site-specific safety measures in place.

4.3 Construction Design and Management Considerations

CDM Considerations

The proposed works should comply with the Construction (Design and Management) Regulations (CDM) to ensure the safety of all involved parties. Working in or near water presents specific risks, and it is essential to integrate safety measures throughout the planning and design stages.

Safe Access and Egress: Safe access and egress points should be established to ensure that workers can enter and exit the work site safely, particularly when working in or near water. The bank stability should be assessed to prevent collapse, and all access routes should be designed to mitigate risks associated with soft or unstable ground.

Flow Management

Flow management will be a critical aspect of the works. Temporary diversions or silt barriers should be considered to regulate water levels and minimise sediment release. Where work occurs near deep or fast-flowing water, appropriate drowning prevention measures should be in place. This includes life jackets, throw lines, and designated safe working zones.

Machinery and Vehicle Movements

Machinery and vehicle movements must be carefully managed to reduce ground disturbance and environmental risks. Tracked vehicles are preferable on soft or unstable ground, and designated haul routes should be used to minimise damage to riverbanks. Refuelling should be carried out away from the watercourse, and spill kits should be readily available. Pollution prevention measures, such as silt control, appropriate fuel and chemical storage, and waste disposal plans, must be in place to minimise environmental impacts. All plant operating in or near the river should use bio-hydraulic oil and should be free of oil drips. Spill kits should be located adjacent to all plant and equipment that could potentially pollute the surrounding environment. Best practices for environmental protection should be followed, and construction noise should be monitored. If necessary, acoustic barriers should be used to minimise noise impact throughout the works, in compliance with the PPG (Pollution Prevention Guidelines) documentation.

Utilities and Overhead Lines

Prior to any excavation, all overhead and underground services should be checked using a Cable Avoidance Tool (CAT) and Genny. An over-line assessment should also be carried out to determine safe working distances from power lines. These assessments are crucial to avoid potential hazards during construction activities.

Weather and Flood Risks

Weather and flood risks should be assessed, and work should be scheduled to avoid high-flow periods. Emergency plans must be in place to respond to rising water levels and other environmental conditions that may pose a risk to workers or the surrounding area.

Risk Assessments

A thorough risk assessment should be carried out as part of the CDM process to identify potential hazards associated with the works. This includes assessing risks related to working near water,

machinery operation, access routes, flood risks, and environmental impacts. The assessment will help in the development of safe working practices, emergency response plans, and environmental protection measures. It is essential that all contract workers are made aware of and fully understand the risk assessments, CDM considerations, and safe working practices. This can be achieved through pre-construction briefings, and a process should be in place to ensure that workers acknowledge and follow the outlined safety measures.

Public and Landowner Safety

Public and landowner safety should be a priority. Clear signage, fencing, and communication strategies should be in place to prevent unauthorized access and to inform stakeholders of any potential hazards. Regular communication should be maintained with landowners and local communities to ensure their awareness and cooperation throughout the project.

4.4 Regulatory Requirements

Planning Permission

Individual sites undertaken independently should not require planning permission. However, if multiple sites are developed together as part of a larger-scale project, planning consent may be required. It is advisable to confirm requirements with the local planning authority before proceeding.

Impoundment and Abstraction

Within the current scope of restoration efforts, no impoundment or abstraction is being undertaken; therefore, this should not be necessary. However, if the works change and require any form of water impoundment or abstraction, all necessary permits and licenses should be obtained in accordance with the Water Resources Act.

Environmental Considerations

As part of the River Yarty and Floodplain Restoration Design Study, a comprehensive constraints assessment has been conducted to ensure all ecological, legal, and regulatory factors are considered before implementation. This includes evaluating the presence of protected species, habitat sensitivities, and other environmental constraints that may influence the design and delivery of the proposed works.

Before on-site works commence, checks should be undertaken for bats, nesting birds, badgers and burrows in riverbanks, which may indicate the presence of protected species such as water voles or otters. If site workers do not have the necessary ecological expertise or experience in identifying and mitigating risks to protected species, it is recommended that a qualified ecologist conducts these checks to ensure compliance with wildlife protection legislation. River and riverbank works should be scheduled to avoid the fishing spawning and gravel incubation period typically from late October to early June.

The proposed restoration works fall within the Grey Long-Eared Bat *Plecotus austriacus* Landscape Connectivity Zone, which is important for maintaining the movement and habitat connectivity of this protected species. Additionally, the Devon Environmental Viewer identifies the potential presence of Great Crested Newts *Triturus cristatus* within the area, which may require further investigation. For more information on ecological considerations, please refer to the Appendix.

The works must comply with environmental protection laws, including measures to prevent pollution of the watercourse, protect wildlife, and mitigate any potential environmental impacts. This includes adherence to the Wildlife and Countryside Act 1981 and the Conservation of Habitats and Species Regulations 2017. If protected species are identified, mitigation strategies such as timing restrictions, habitat enhancements, and exclusion zones should be incorporated into the design.

The constraints assessment also considers statutory designations, such as Sites of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC), and Local Wildlife Sites, as well as potential archaeological and heritage constraints. While there are no statutory ecological designations within the immediate restoration sites, the area is located within a Strategic Nature Area (SNA) designated for Neutral Grassland, within the National Landscape (AONB) and highlight on Priority H Inventory for deciduous woodland. There are no recorded heritage assets or scheduled monuments on the Historic Environment Record (HER) within the site. The project has also considered biodiversity impacts and aims to enhance ecological value through habitat creation and restoration. A Biodiversity Net Gain (BNG) assessment could be conducted to ensure measurable ecological improvements.

5. Funding & Costings

The estimated costs for the proposed restoration works have been developed through a combination of pre-established rates for standard measures and indicative estimates for bespoke interventions. The funding strategy incorporates a mix of mainstream funding sources, including government grants and environmental stewardship schemes, as well as additional grant opportunities specific to the restoration activities. To support accurate cost estimations, quotes for materials and equipment were obtained, with particular attention to gravel and boulder pricing. The Holcim Aggregates Plymouth Office was contacted for quotes on gravel deliveries, with pricing based on 8-wheeler steel-bodied vehicles (20t loads), including VAT. Please note that all quotes are subject to material and haulage availability, and costings for site workers and machinery have been averaged using historical data and industry benchmarks.

The potential for Biodiversity Net Gain (BNG) uplift has been identified in assessing ecological enhancements and funding opportunities for the River Yarty restoration project. However, a full BNG baseline assessment requires a separate detailed study using an approved metric (e.g., Defra's Biodiversity Metric). This would involve habitat classification, condition scoring, and unit calculations to establish pre- and post-intervention biodiversity values. While this report does not provide a full BNG assessment, it acknowledges the potential for securing additional funding through BNG credit schemes and recommends further analysis to quantify these opportunities.

6. Tree Planting

Tree planting has not been specifically recommended as an intervention for all individual sites, though, both Reach 1 and 2 will benefit from widescale planting.

Considerations should be made regarding the suitability and design of any planting schemes that are proposed, and appropriate checks and searches should take place. The England Woodland Creation Offer (EWCO) could be a viable grant funded option provided their minimum planting area is met. This scheme will cover capital costs and comes with potential incentivised 'uplift payments' as well as ongoing maintenance payments annually. A minimum requirement for the riparian planting is a 10m buffer strip from the river, and the total area of planting must be at least one hectare. Sites within this section of the River Yarty may also qualify for additional EWCO funding under three targeting themes - 'Nature Recovery', 'Water Quality', and 'Keeping Rivers Cool' which may increase the level of 'uplift payment'. At appropriate sites EWCO can also fund other interventions mentioned in this report and capital items such as; Leaky Dams, drinkers, fencing, gates and more.

An indicative map of potential planting opportunities is presented below. The total area of the scheme is 3.3ha and would see a riparian buffer along the entire river corridor of this reach. This would provide future woody material and climate resilience, allow future lateral movement of the channel, reconnect woodland corridors, support mitigating nutrient challenges and providing natural flood management benefits in the catchment. Each section could be considered on a site-by-site basis and planting specifications and open space be retained as required.

Map Showing Potential Woodland Creation

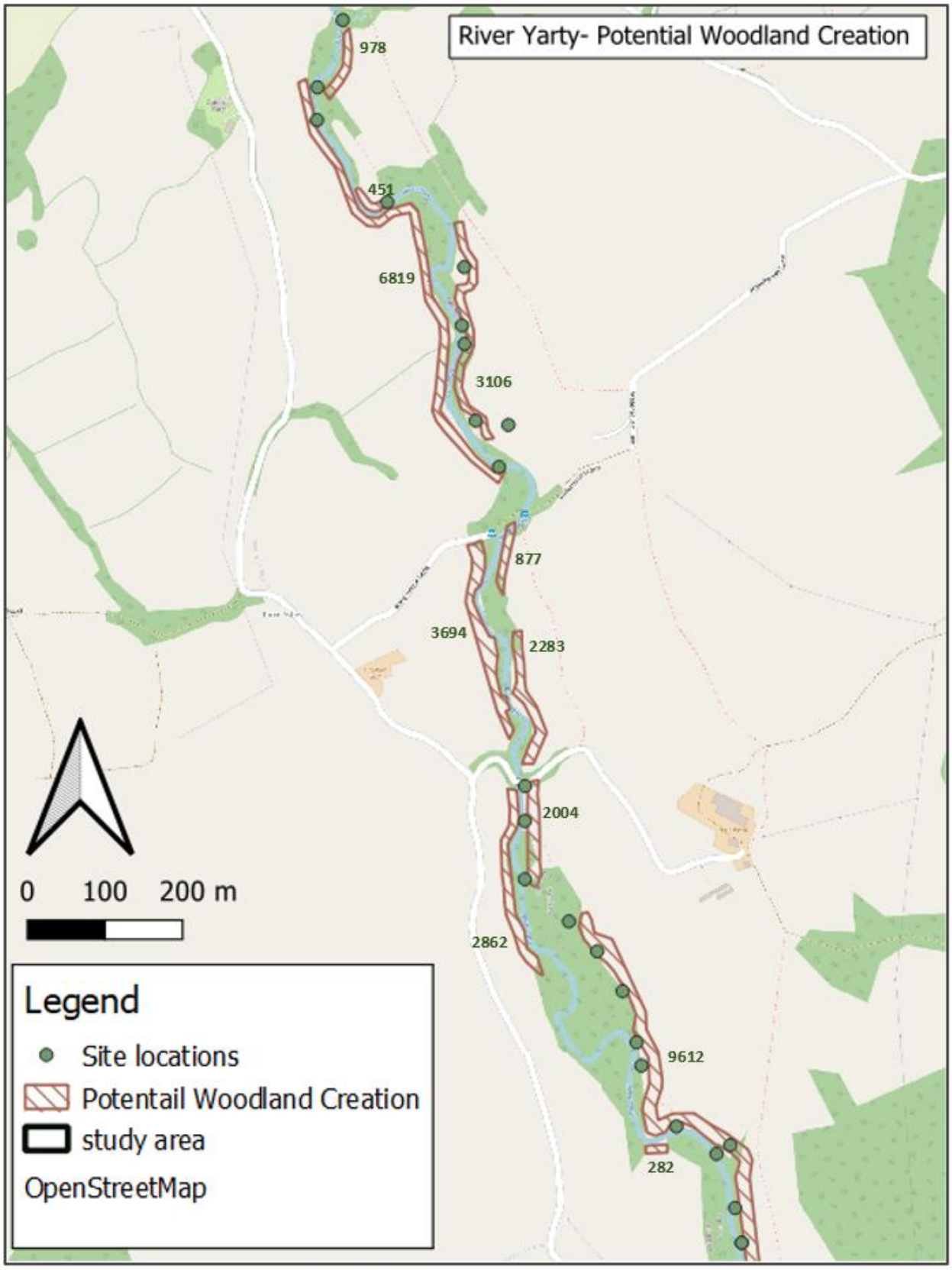


Figure 56. Map showing tree planting recommended zones..

7. References

"Yarty Farm and Waterhouse Farm Geomorphology Advice Note" November 2022 by Julian Payne

England J & Gurnell, M, 2016 Incorporating catchment to reach scale processes into hydromorphological assessment in the UK. Environment Agency. Water and Environment Journal. Print ISSN 1747-65

8. Appendix

8.1 Consents and Constraints Checks

Consents/ Considerations	Applied/ Checked	Notes
Land Drainage Consent (DCC)	Checked	N/A
Flood Risk Activity Permit	Applied	Current scope permissions received.
Planning Permission	Checked	See section 4.4
Environmental Impact Survey	Checked	See section 4.4
Water Impoundment Licence (EA)	Checked	See Section 4.4
Water Abstraction Licence (EA)	Checked	See Section 4.4
Historic Environment		
Historic Environment Record Check: Scheduled Monuments (Historic England)	Checked	No HER are highlighted within site restoration work areas.
Fjordr Historic Data Check	Checked	Fords and footbridges will not be affected
Habitat and Ecology		
Priority Habitat	Checked	Yes – Deciduous Woodland
Protected Species	Checked	Yes – GCN Consultation Zone Grey Long-Eared Bats Connectivity Zone
SSSIs (Natural England)	Checked	No
Local Designations	Checked	No
Fisheries (EA)		In-river work to be undertaken from late October to early June, unless permission from EA is granted.
Protected Landscapes		
Within AONB	Checked	Yes
Forestry Commission		
EWCO Target Areas	Checked	No

8.2 Criteria for Ecological Assessment

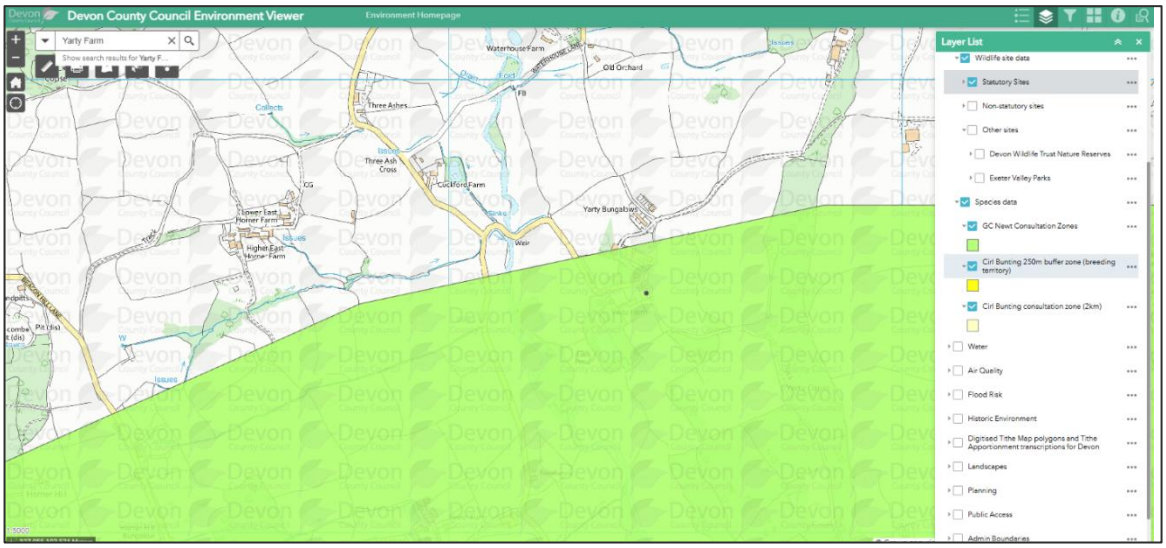


Figure 57. Map showing Great Crested Newt Consultation Zone highlighted.

Great crested newts *Triturus cristatusare* identified as a potential constraint on the Devon Environmental Viewer (Figure 57). However, as the current scope of work does not involve direct interventions within the floodplain, a full assessment is unlikely to be necessary unless further works extend into this area. If additional works are undertaken in the floodplain, this may change, and further assessments could be required. An Environmental DNA (eDNA) test may be necessary to determine the presence of great crested newts in waterbodies or surrounding habitats before proceeding. In the long term, the planned bank regrading and lowering will improve connectivity between the river and its floodplain, increasing the extent of wetland habitats. This will enhance conditions for species such as the great crested newt by expanding suitable breeding and foraging areas.

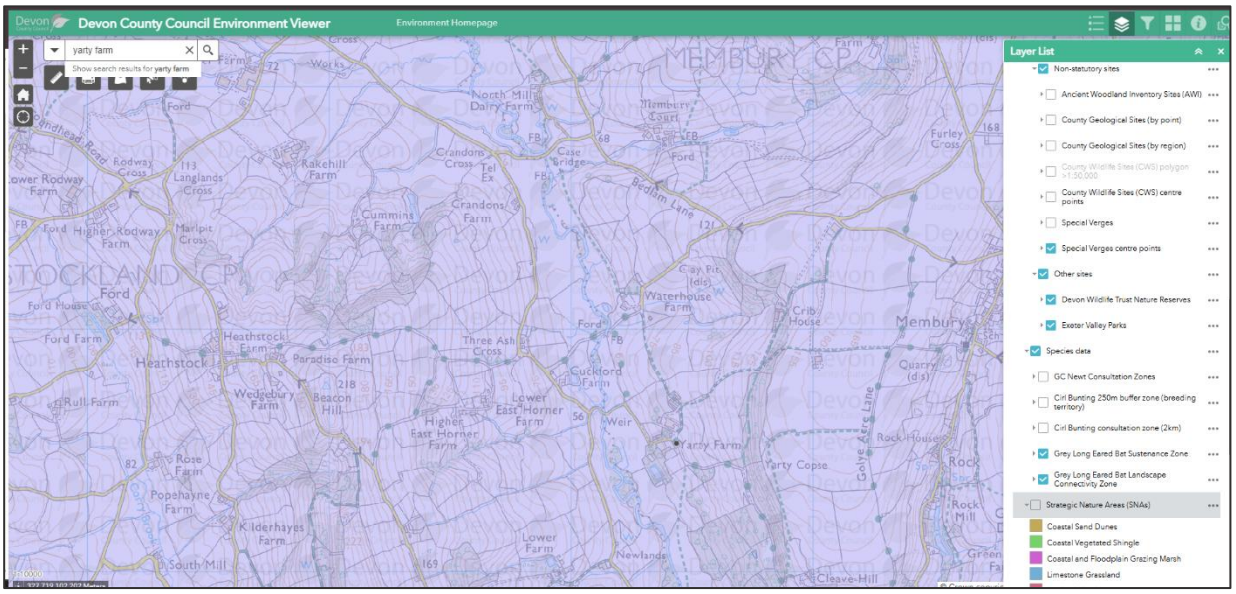


Figure 58. Map showing the Grey Long Eared Bat Landscape Connectivity Zone highlighted.

Grey Long-Eared Bats are highlighted on the Devon Environmental viewer (Figure 58). The proposed restoration works fall within the Grey Long-Eared Bat *Plecotus austriacus* Landscape Connectivity Zone, an area identified as critical for maintaining habitat connectivity for this rare and highly sensitive species. Grey Long-Eared Bats rely on well-connected landscapes with features such as hedgerows, woodland edges, wet meadows, and unimproved grasslands for foraging and commuting. As some tree clearance is planned, a pre-clearance bat assessment should be carried out to check for potential roosting features. It's important to assess whether any trees have features suitable for bat roosting, such as: cavities, cracks, or splits in trunks and branches, loose or peeling bark and woodpecker holes. If suitable features are identified, mitigation measures such as retaining these trees, installing bat boxes, or adjusting felling methods should be considered to minimise impacts. To support habitat connectivity, efforts should be made to retain and enhance vegetative corridors and maintain low-light conditions in key areas.

If site workers do not have the necessary ecological expertise or experience in identifying and mitigating risks to protected species, it is recommended that a qualified ecologist conducts these checks to ensure compliance with wildlife protection legislation before any work commences.

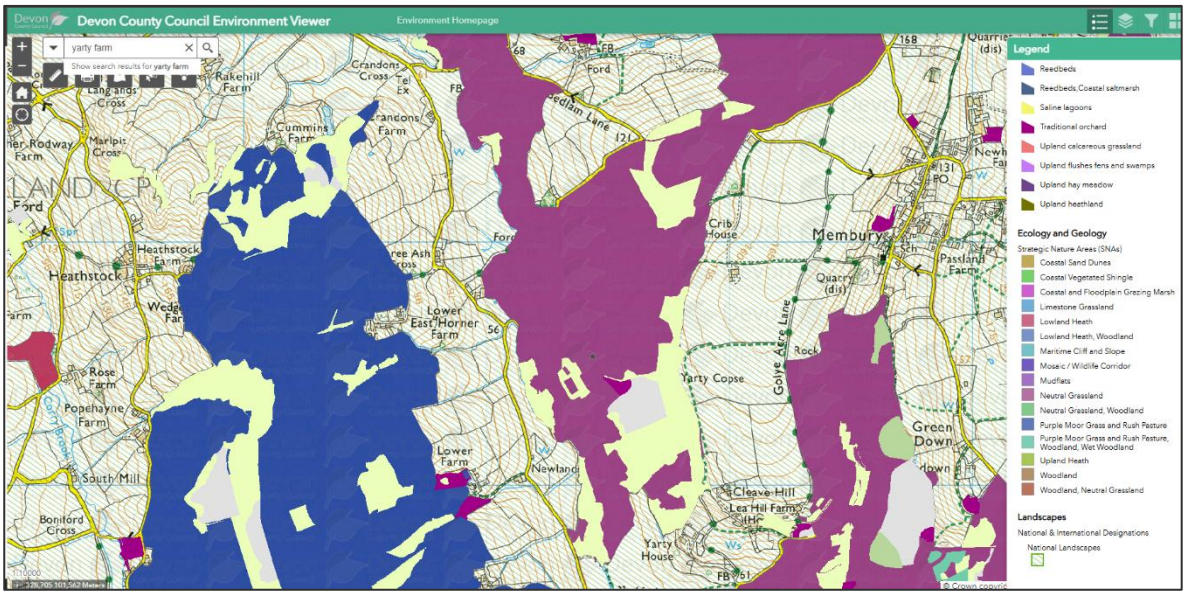


Figure 59. Map showing the project site falls within a Strategic Nature Area (SNA), Area of Outstanding Natural Beauty (AONB) and Priority Habitat Inventory for deciduous woodland.

The constraints assessment also considers statutory designations, such as Sites of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC), and Local Wildlife Sites, as well as potential archaeological and heritage constraints. While there are no statutory ecological designations within the immediate restoration sites, the area is located within a Strategic Nature Area (SNA) designated for Neutral Grassland. However, SNAs are not statutory designations but instead highlight areas with potential for habitat enhancement. Additionally, the site falls within a National Landscape (AONB), meaning the works should be sensitive to the landscape character

and visual quality. For example, ensuring that natural features are preserved, and locally appropriate materials are used. Given its location within an AONB, consultation with the AONB Partnership may be beneficial to ensure alignment with landscape and conservation objectives.

While Priority Habitat is not a statutory designation, it represents habitats identified under the UK Biodiversity Action Plan (UK BAP) and Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006. These habitats are of high conservation importance and should be carefully considered during planning and land management. Although Priority Habitats, such as deciduous woodland, do not carry legal protection on their own, they are a material consideration in planning decisions. In areas where restoration works overlap with Priority Habitats, particularly deciduous woodland, additional ecological assessments or mitigation measures may be necessary to ensure their protection and enhancement. The restoration project will take these considerations into account to avoid damage to and, where possible, enhance these habitats.