Norfolk Rivers Drainage Board

Standard Maintenance Operations Policy Document

Norfolk Rivers Internal Drainage Board

Version 6.0

Training and Revision Register

Date	Revision Details	Version Number
16/07/13	Training given by CL on Version 1.0. Operatives supplied with V 1.0 Field notes	1.0
02/08/13	Version 1.0 signed off by Hannah Wallace, NE	1.0
07/01/16	Hydro morphological Harm and Importance of Standard Maintenance Operations-Training	1.0
09/01/17	SMO Biosecurity and Invasive Species Training	1.0
12/10/17	Bio-security and white clawed Crayfish ID Training	1.0
24/11/17	NRIDB SMO discussed with Nik Bertholdt (NE) with a view to producing reviewed version 2.0.	1.0
25/01/18	Draft NRIDB SMO presented to the Board for Approval	2.0
16/08/18	NRIDB SMO Final Presented to Board	2.0
02/10/18	Reviewed with Nik Bertholdt (NE). Creating version 3.0.	3.0
24/04/19	Updated drain images within SMO.	3.0
28/03/22	Changed front cover to Calibri font and added Logo	4.0
28/03/22	Saved as Norfolk Rivers SMO FINAL Checked CHv4_280322	4.0
24/11/23	Reviewed document in line with Environment Act 2021. Changed to V5. Created as Draft 1.	5.0
25/01/2023	SMO v5 Draft 1 approved by NRIDB Boards at Board Meeting	5.0
06/02/2023	SMO v5 draft 1 agreed and new 5 year assent discussed at meeting between Caroline Laburn, Ezra Lucas and Paul George.	5.0
13/11/2023	SMO v5 Final Draft – sent to NE for 5year Wensum assent	5.0
26/08/2025	SMO v6 Draft 1 to be discussed at meeting between IDB officers NE and EA	6.0

Contents

Standard Maintenance Operations Policy Document

1.0 Introduction

The Norfolk Rivers Internal Drainage Board (NRIDB) manages the water levels in agricultural and residential areas, on the tributaries and main stretches of seven rivers in North and South Norfolk; namely the Rivers Wensum, Bure, Upper Yare, Tas, Stiffkey, Nar and Ant.

The rivers and tributaries within the NRIDB catchments are similar in many respects; they are all drained gravitationally, they are all affected by diffuse pollution and many have a hard bottomed, gravel substrate. Many of them are priority chalk stream habitats which have been heavily modified over time. Many of these rivers and streams exhibit a variety of hydro morphological features ranging from artificial or heavily modified watercourses around mill structures, through to natural and physically diverse headwaters of the Nar or the Stiffkey. Many of these streams will be spring fed. In general, the more diverse the physical structure of a river with riffles, pools, wet berms and marginal vegetation, then the more diverse and rich the plant and animal community will be within the aquatic environment as a result, where water quality is not a limiting factor. It is important that these features and habitats should be retained to preserve the plants and animals they support. The quantity and location of the physical features to be retained will vary from site to site depending on the nature of the river.

Since the creation of the predecessor Boards, maintenance of the boards watercourses has always been achieved by the regular weed cutting and occasional desilting of stretches of these watercourses. The NRIDB has had a Standard Maintenance Operations Document since the year 2000. The aim of this document is to allow a standardised and targeted maintenance procedure to be carried out to a consistently uniform standard in designated wildlife sites and in Board-maintained and ordinary watercourses alike. However, changes in legislation and key political drivers have resulted in regular reviews of maintenance practices with the emphasis being placed on the sustainable management of our natural resources within these catchments.

The document recognises the importance of the sustainable management of drainage catchments as natural environmental systems and as an ecosystem service and acknowledges the importance of managing the Boards drains

appropriately. This document should also be read in conjunction with the Association of Drainage Authorities (ADA) Environmental Good Governance Guide, written to aid IDBs navigate the requirements of the Environment Act 2021 and other environmental legislation.

The NRIDB Standard Maintenance Operations Document also aligns itself naturally alongside the NRIDB Biodiversity Action Plan (BAP), whereby the Board seeks to enhance Habitats and Species of principle importance whilst carrying out its Statutory function. The NRIDB watercourses may act as linking corridors for wildlife to disperse between nature conservation sites, enhancing ecological networks, improving site connection and enabling species or their genes to move. They may play an important role in the Local Nature Recovery Strategy contributing toward the Lawton principal of “bigger, better, more joined up” landscape scale approaches to nature recovery.

During this update of the document, there is also a necessity to recognise the growing evidence of climate change predictions and how this has the potential to adversely impact on future operations. The Board is taking a risk-based approach to this. Outputs help identify pressure points requiring targeted maintenance works, whilst at the same time identifying opportunities for watercourse restoration. This evidence-based approach enables officers to form robust works schedules; striking a balance of business need, flood risk management and wider environmental health within the catchment served.

The Board also embraces the industry move toward utilising natural environmental systems and Natural Flood Management (NFM) to manage water level changes, high flows and provide flood resilience to the catchment. This approach is adaptable and increases resistance to climate extremes of drought and flash flooding. A well-designed NFM scheme can save time and money in maintenance costs over time and may enhance biodiversity interests.

The Board continues to work on actions within the Water Management Alliances’ (WMA) Carbon Management Plan and will continue to review and make more efficient its maintenance programme, and use of fossil fuels, particularly where efficiencies and sustainable measures can be achieved alongside the flood risk management requirement. The Board aims to be Carbon Net Zero by 2050 and have cut at least 50% of Green House Gas emissions by 2030.

This document is consistent with the Environment Agency's suite of environmental options, which have been assessed for compatibility with the requirements of the Water Framework Directive.

2.0 Legislation

As a Statutory Risk Management Authority, the NRIDB has various national and international legislative duties to comply with, regarding the aquatic environment, biodiversity and wildlife sites within the NRIDB Drainage District. It should be noted that failure to comply with any of these statutory obligations, has the potential to result in both Personal and Corporate Liability being brought about to both individual Board Members and the Board, by the Enforcement Body. As a result, the Court may issue a fine dependent on the severity of the offence and insist on restorative works being carried out and paid for by the offender; some fines of which may be unlimited. Furthermore, some offences may attract a custodial sentence.

The main legislative drivers are as follows:

2.1 International Legislation

- The Water Framework Directive (2017) – a statutory duty to ensure that reasonable actions are taken to improve the physical and chemical nature of the waterbodies under their management, with the aim of achieving good ecological status or potential of surface waters by 2021. This can be achieved by putting in place environmental improvements or mitigation measures where applicable and undertaking sensitive management of watercourses.

- The Conservation of Habitats and Species Regulations (2017) - a statutory duty in the exercise of any functions, to have regard to this EC Habitats Directive which provides for the designation and protection of 'European sites', the protection of 'European protected species', and the adaptation of planning and other controls for the protection of European Sites.

2.2 National Legislation

- Wildlife and Countryside Act (WCA Act) (1981) - imposes a statutory duty to protect native species (especially those at threat), control the release of non-native species and protect SSSIs.

- The Countryside and Rights of Way Act (CROW Act) (2000) – this act amends the WCA Act and enforces a duty for Statutory Authorities to be responsible for conservation and enhancement of SSSIs. It also enhances Natural England’s

enforcement powers.

- Natural Environment and Rural Communities Act (NERC) Act (2006) - a statutory duty to ensure that every public authority must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity to maintain and enhance the natural environment (Habitats and Species set down in Section 41 of the NERC Act (2006)) when carrying out flood risk management activities and meet objectives and targets set out in the NRIDB Biodiversity Action Plan.

- Flood and Water Management Act (2010) – requires flood and coastal erosion risk management authorities to contribute towards the achievement of sustainable development when exercising their flood and coastal erosion risk management functions.

- Environment Act (2021) - Strengthens the General duty of public authorities, to conserve and enhance biodiversity. A public authority which has any functions exercisable in relation to England must from time to time consider what action the authority can properly take, consistently with the proper exercise of its functions, to further the general biodiversity objective, set out by Section 40 of the Natural Environment & Rural Communities (NERC) Act 2006, to require enhancement as well as conservation, of biodiversity through their functions. The act also requires public authorities to actively carry out Strategic Assessments of the actions they can take to enhance and conserve biodiversity, and then take that action.

2.3 Protected Species and Habitats and Other Considerations

There are networks of protected species and habitats across the UK. Some of these species such as water voles, breeding birds, otters and bats are given full protection under the law for both the individual species and their habitats. Some habitats and species are identified in Section 41 of the NERC Act (2006) and classified as Habitats and Species of Principal Importance, which require specific consideration by public bodies to ensure these habitats or species are enhanced by the IDB, whilst carrying out our duties as a public body.

Some habitats and species are covered by separate and specific legislation; such as the Badgers Act (1992), the Salmon and Freshwater Fisheries Act (1975), Hedgerow Regulations (1997) and Tree Preservation Orders. We need to ensure that this legislation is considered and complied with when undertaking IDB

activities.

2.4 Non Native Invasive Species and Biosecurity

The spread of Non-Native Invasive Species has the potential to cost the Norfolk Rivers IDB dearly, both in economic terms and in the loss of biodiversity interests. The spread of non-native species e.g. Japanese Knotweed, Signal Crayfish, is illegal under Schedule 9 of the Wildlife and Countryside Act (1981) (as amended). It is therefore unlawful to cause these species to spread as a result of any IDB operational activity.

Biosecurity is key to preventing the spread of these organisms into the Norfolk Rivers IDB watercourses. The NRIDB staff currently do all they can to help prevent the spread of non-native invasive species whilst undertaking operations. When the IDB drains are scoped by the Engineer and Environmental Officer, non-native species locations are recorded and if possible a plan to eradicate or control them is put into action.

Staff will undergo regular training on Non Native Species and sightings will be reported to the NNNSI. Training is reviewed and undertaken regularly and a Biosecurity Policy has been adopted by the Board.

Machinery will be steam cleaned following an operation and the machine moved to another catchment. Operator and surveyor boots will be cleaned following work between river catchments and Virkon Aquatic will be applied to cleaned machinery, equipment and footwear to prevent the spread of crayfish plague to isolated populations of White Clawed Crayfish. The Biosecurity Policy can be viewed online and is updated on a 5 yearly basis.

2.5 Conservation Sites – Statutory and Non- Statutory

Where operational activities are to be carried out within or adjacent to statutory designated conservation sites such as SSSIs, SACs, Ramsar's or SPAs permission is required from Natural England before any work can start.

Prior to undertaking an operation which may affect a SSSI, the IDB is required to give formal notice to Natural England under section 28H of the Wildlife and Countryside Act 1981 (as amended).

Prior to undertaking an operation in or adjacent to a site of international importance (SAC, SPA, Ramsar), then under the Conservation of Habitats and Species Regulations 2017 (as amended) the IDB must carry out a Habitat Regulations Assessment (HRA) or where necessary an Appropriate Assessment prior to undertaking an operation. This is carried out in consultation with Natural England. The burden of proof is on the proposer (i.e. the NRIDB) to determine that no significant effect will take place on any of the features of interest of the protected site and where an appropriate assessment has been undertaken, then there should be no adverse effect on any of the features of interest.

The NRIDB has an agreement with Natural England that any work carried out on any tributary of the River Wensum requires Natural England assent also.

Non-statutory sites such as County Wildlife Sites (CWS) do not require any formal written permission; however, these sites are noted for their habitats and species, some of which may be protected. These sites have a significant value within the county and to the Local Nature Recovery Strategy and it is within everybody's interest to ensure that work does not impact on these sites.

2.6 Emergency Works

Emergency works may be required to be carried out during exceptional or unmitigated circumstances, such as during periods of extreme weather conditions or a flood event or in the event of a structural failure or pump seizure. In many of these circumstances, third parties and their property may be put at risk. In these scenarios where there is overriding public interest, or similar events, it may be necessary to undertake Emergency Works to protect people and their property within the NRIDB catchment area. However, these emergency procedures may have the potential to impact on a SSSI or European Protected site. In an emergency situation, it is reasonable to carry out operations in or near the protected site. However, Natural England should be informed of the operation as soon as practicable after the event.

Reporting the emergency operation to Natural England is key to determining a satisfactory outcome to the emergency and prevents the deterioration of the site and the wellbeing of species therein. Reporting the operation is fundamental to prevent legal action being taken against the Board for carrying out an illegal operation in a designated site.

2.7 Cultural and Heritage Sites

Landscape, cultural and heritage sites may be present within work areas or adjacent land, some of these, such as Scheduled Ancient Monuments and Conservation areas require permission to undertake work on or adjacent to them. Advice will be sought from a qualified archaeologist or the County Archaeologist and where appropriate, Historic England (the UK governments advisor and a statutory consultee on all aspects of the historic environment and its heritage assets) will be consulted and searches undertaken prior to operations which require breaking ground.

3.0 The Conservation of Natural Features and Seeking Opportunities to Enhance or Restore

The appropriate balance between conveyance and good ecological potential must be met. Flowing watercourses have different ecological and physical characteristics to artificially created systems. They are extremely important for wildlife, particularly fish, and are very sensitive to inappropriate management. In addition the management undertaken on the headwater tributaries has implications for the whole river further down the system. Headwater system may be spring fed or have associated wet flushes which provide distinct habitats for certain species.

However, sensitive, targeted maintenance or restoration of a watercourse will be beneficial for wildlife and achieving an appropriate habitat mosaic for the watercourse will have ecological benefit for other species and communities within the river system.

The objective of restoration or sensitive management is to maintain or re-create a self-sustaining system using natural processes. However, planning and monitoring of this management is essential if maximum benefit is to be obtained from the operations to inform for future management opportunities.

Physical features will be conserved where they are found in situ and the Board will seek opportunities using information from the Flood Risk Model to liaise with landowners to undertake restoration or enhancement of natural features and investigate Natural Flood Management opportunities where appropriate. The important physical features of rivers which can be restored or enhanced are as follows:

3.1 Pools and Riffles

Pools and riffles are natural formations in gravel-bedded channels. They are dynamic, changing form in response to flood events and are valuable features for the conservation interest of a river. The riffle sections oxygenate the water and provide a spawning habitat for various fish species.

3.2 Bends and Meanders

Bends and meanders slow the river down and can be used to help the river spill out onto a natural flood plain and deposit its silt loading in high flow events. Where flood alleviation is required then they can be used in conjunction with the creation of flood relief channels (backwaters) to improve conveyance.

3.3 Backwaters

Backwaters are important features in rivers as they provide a wide range of different habitats. Backwaters in continuous connection with the main flow are valuable, particularly as nursery habitat for fish fry. They can act as a flood bypass channel at times of high flow and provide refuge for fish in times of flood or other adverse conditions.

3.4 Natural Marginal Berms and Islands

Marginal berms and natural islands help create the natural habitat mosaic for a variety of species and are formed by natural sediment transport processes in the channel bed. Both berms and island are dynamic and change in size and form in response to flood events. These natural structures add diversity to the river and will cause an increase in the current velocity around them, so creating silt free zones.

3.5 Installation or Maintenance of Woody Debris

Woody debris is an important mechanism for increasing diversity of flow and habitat and as such is an essential element of watercourse ecology. Possible options for leaving, repositioning or reintroducing woody debris in a water course will be considered on a site-by-site basis and adopted where practical and appropriate to do so.

3.6 Channel Narrowing

The practice of channel narrowing within a stream or river increases velocity, oxygenates the water and improves the diversity of flow along a watercourse. A narrowed channel naturally restores a cleansing dynamic to the watercourse and should thereby reduce maintenance requirements into the future.

3.7 Channel Capacity

Flowing watercourses will not be deepened. A deepened channel changes the natural fluvial processes of a watercourse, increases siltation and destroys the hydrological connectivity of a river to its floodplain. Where the necessity for increased channel capacity is required, then the installation of a two stage channel to increase in bank capacity during flood events should be considered.

3.8 Riverbank

Straight batters within a watercourse are not encouraged. The preferred approach is to encourage natural processes and diversity. A variety of features can be encouraged or created particularly in the margins such as low-level berms, holes, ledges, variations in height and slope etc., together with the natural vegetation. These variations in water depth and cover offer niches to a variety of plant and animal species, increasing biodiversity.

The Board will look to conserve the physical features of the waterbodies it manages and seek opportunities to restore or enhance them elsewhere where appropriate.

4.0 Maintaining Successional Processes within Watercourses

Sensitive maintenance of a watercourse, including retaining important features, will benefit many species and communities within the drainage channel network. The key to maintaining significant ecological interest is to maintain watercourses at differing stages of the successional process. For example, a newly desilted drain will exhibit an array of early colonisers such as charophytes or certain pondweed species. Drains left for a longer rotational periods prior to vegetation cutting or desilting may exhibit a larger abundance or diversity of macrophytes, while those that are unmanaged may be dominated by common reed to the near exclusion of other species. Many non-IDB drains may not be maintained for several years but the regular and rotational maintenance of IDB watercourses ensures a small percentage of the entire drainage network in the catchment retains areas of open water, which is so important to many animal and plant species.

Differing successional stages, water depths and maintenance cycles maximises ecological diversity. The other important factor which is key to maintaining this diversity, is good water quality.

5.0 The Targeted Maintenance Approach

The retention or restoration of the diverse physical nature of the watercourses is key to the requirement of the Water Framework Directive and the biodiversity of the aquatic environment. These Standard Maintenance Operations aim to provide guidance by way of a series of **Environmental Options** on the appropriate standards to be achieved where restoration cannot be achieved or where maintenance is critical. The watercourse itself, site specific Health and safety and environmental (protected sites and species) implications will all need to be considered when choosing the appropriate targeted maintenance activity from this document. Targeted maintenance works can then be carried out sympathetically, and with biodiversity interests and the physical nature of the watercourse kept firmly in mind.

Those **Environmental Options** highlighted in **red** have the greatest environmental impact, whereas those highlighted in **green** have the least impact. There is a selection of **red**, **amber** and **green** options to choose from. The option with the least environmental impact (e.g. red or amber) will be selected, unless overwise determined by the level of flood risk.

6.0 How the Standard Maintenance Operations will work in practice

This document will be called the Standard Maintenance Operations Policy Document and will be used to inform outside bodies of the way in which the NRIDB intend to carry out all future maintenance practices and will act as the basis from which all maintenance practice will initiate. The document will be subject to review on a regular basis. Version control will allow any changes to be recorded.

All Operatives, Contractors and Supervisors asked to carry out maintenance for NRIDB now and in the future, will undertake regular training based on the Standard Maintenance Operations Policy Document. Training needs will be reviewed regularly, in line with any amendments made to the Standard Maintenance Operations Policy Document.

Prior to initiating any Maintenance job, operatives and contractors will receive a job specific toolbox talk. All watercourse maintenance will receive close supervision by trained Operational and Engineering Staff and/or a member of the Environment Team.

7.0 Guidance for Operators: Nesting Birds

The Law on Bird Nests:

The IDB has permissive powers, under the Land Drainage Act 1991, to maintain watercourses to allow drainage, irrigation and to prevent flooding. Routine watercourse maintenance by IDBs is considered a lawful activity. However, in doing so, it is important to consider wild birds, their nests and dependent young when planning maintenance.

The Wildlife and Countryside Act 1981 (as amended) states that all wild birds are protected and usually cannot be killed or taken except under licence. As a result, during IDB activities, must not:

- intentionally kill, injure or take any wild bird.
- intentionally damage, destroy or take the nest of any wild bird while it is in use or being built.
- intentionally destroy an egg of any wild bird.
- intentionally or recklessly disturb certain wild birds (ie.Schedule 1) or their dependent young while they are at or near to an active nest site.

Routine Watercourse Maintenance:

The IDB routinely assesses environmental risks and opportunities of its maintenance activities and has developed sensitive standards and adjusted the timing of works where possible. Mowing of bankside vegetation and emergent and instream vegetation clearance will be undertaken throughout the year, though in peak bird breeding season works will only take place where necessary in low-risk environmental areas. However, prework checks will take place between March to September to ensure nesting birds are not present, prior to maintenance and at all times consider the Boards statutory responsibilities set out in the Wildlife and Countryside Act 1981 (as amended). Prework checks will be carried out by the Operators prior to work commencing and recorded on the operator's time sheet. For more sensitive sites, where Schedule 1 birds are of concern or when the Operator cannot identify, a competent Ecologist will undertake a pre walkover survey prior to the maintenance commencing.

Where protected species or breeding birds are found then effective mitigation will

be put in place to ensure compliance with the law. This may mean delaying works depending on what is found or leaving an appropriate buffer zone on either side of a nest. The length of the buffer zone will be species specific and should be agreed by a member of the Environmental Team (please see checklist below for buffer zones).

The extent of weed and grass cutting is kept to a practicable minimum, site staff have considerable experience and are given guidance and support in respect of biodiversity. During grass cutting, the flail height should be set to 100mm minimum to ensure water vole are not disturbed or displaced by the mowing activity (as per Annex B Management Activities IDB Water Vole Class Licence). During weed cutting, to accommodate access to growing crops and to satisfy conservation interests, wherever possible alternate banks will be maintained from one clearing cycle to the next. Some important pumped drains may require maintenance more than once in one year. Wherever possible the work will be carried out on one side of the drain in any one year cycle.

The weeding basket should always be set to ensure no deepening of the watercourse occurs during the process of weed cutting. In most instances in watercourses greater that 2m, a margin of emergent vegetation will be left uncut at the water's edge as wide as it is practical to do so.

Looking for bird nests:

The nests of small species, like Reed Warblers, are very difficult to spot, even for trained ecologists. Adult birds can often be seen flittering about in the reeds and nearby shrubs, but this doesn't guarantee a nest is nearby, let alone indicate its exact location. Operators should remain vigilant at all times.

Nests of waterfowl are easier to spot as they are larger. Examples range in size from Coot to Mute Swan. Both of these species nest at the water's edge on a raft built from reeds and other plants, while ducks tend to nest on land, a little further from water.

If you spot a nest, either on land or at the water's edge, you must take action to avoid damaging it.

What to do if you find a bird nest:

1. Assume all bird nests that you spot are active. An empty nest isn't necessarily from last year, it could be under construction.
2. Mark the location of the nest with a high-visibility peg/pin.
3. DO NOT cut any closer than; 5m from nests of small species (e.g. Reed Warblers), 10m from nests of waterfowl (e.g. Coot) and 15m from a Swans nest.
4. Let other operators and staff know the location of the next and record on your Operators timesheet. Operators are required to ring the Environment Team for advice and support on what type of nest they have found and the appropriate buffer zone required around the identified nest. Operators should take pictures of the identified nest (if they are able to without disturbing) and send to the Environment Team to help the identification process.

8.0 The Environmental Options

8.1 Mowing of Bankside Vegetation

The aim of mowing is twofold:

1. it allows unimpeded visibility for the driver
2. it prevents the establishment of trees and scrub along the nearside water's edge.

Mowing of the bankside vegetation will be carried out by a tractor and flail or a side mounted flail on a 360 hydraulic machine. In some areas where access cannot be achieved or is considered inappropriate for a machine, then strimmer's and hand tools will be utilised.

Mowing of bankside vegetation will be undertaken throughout the year, though in bird breeding season works will only take place where necessary in low-risk environmental areas, such as open grazing marsh. However, prework checks will take place between March to September to ensure nesting birds are not present, prior to maintenance and at all times consider the Boards statutory responsibilities set out in the Wildlife and Countryside Act (1981) (as amended). Pre-work checks will be recorded on the operator's timesheet.

A choice of two **Environmental Options** can be employed:

8.1.1 Environmental Option M5

Visibility for the driver is crucial in being able to carry out targeted maintenance. However, appropriate visibility to carry out operations may be achieved by applying a, “Health and Safety Cut” to the batter and bank top. This option should be considered first before any other.

- A 1m vegetated zone above the watercourse is left uncut but the remaining batter and one cut is taken from the nearside banktop, to determine the edge of the watercourse and help prevent the machine from falling in the water. The flail height will be set to 150 mm.

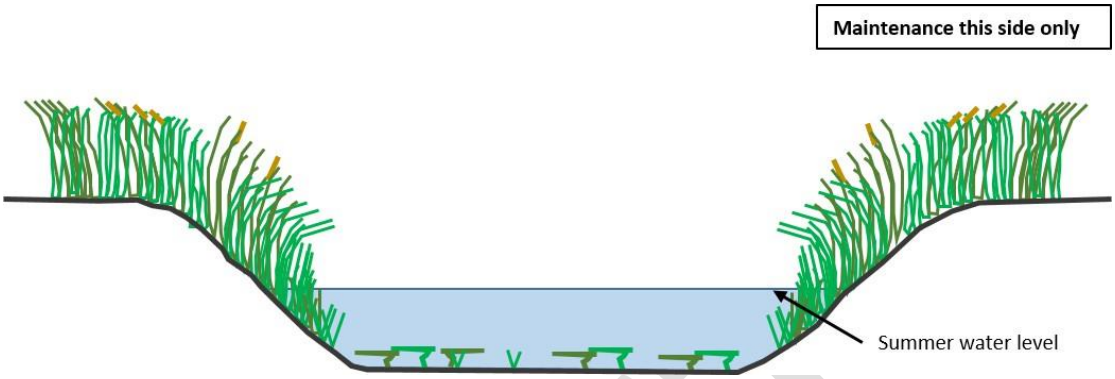
- Where there is less freeboard and the batter is less than 1m, the remaining vegetated zone will be left and one cut will be taken along the bank top. The flail height will be set to 150 mm.

- Where the opposite margin has long, over-hanging vegetation that is impacting the conveyance of the drain, a single pass can be made of the opposite bank in addition to the cut on the nearside bank.

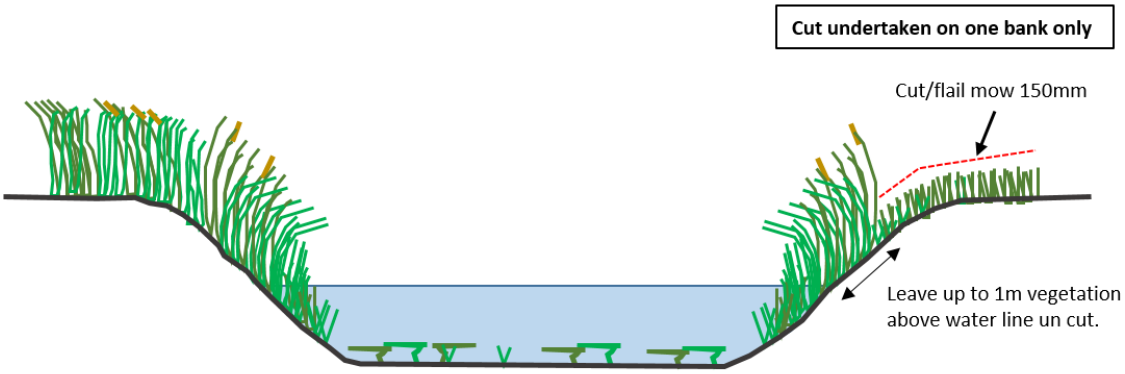
No WFD assessment required prior to instigating this method

M5 Grass Control

Before Operation

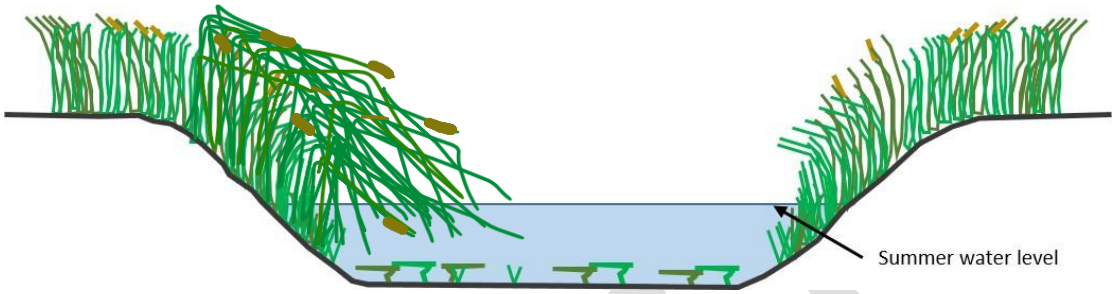


After Operation



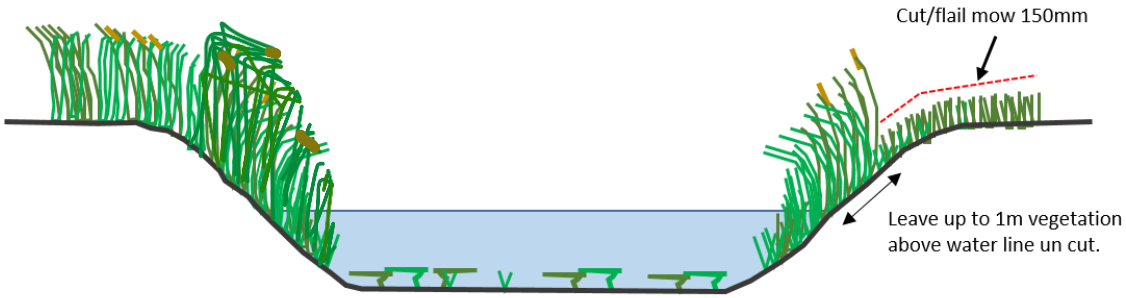
M5 Grass Control with overhanging vegetation on opposite bank

Before Operation



After Operation

Where vegetation is over hanging on opposite side, a single pass can be made on the opposite bank in addition to the cut on the nearside bank.



8.1.2 Environmental Option M4

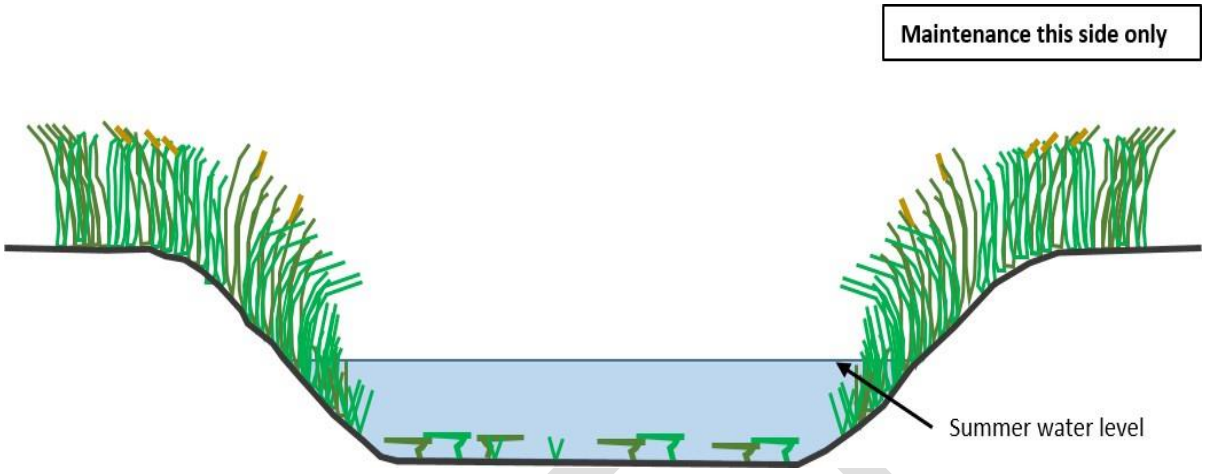
Where Environmental Option M5 is deemed inappropriate due to access issues, flood risk or more serious site-based Health and Safety factors then mowing should take place down the nearside batter only to the water's edge and one cut along the nearside bank top.
The flail height will be set to 150mm.

Where the opposite margin has long, over-hanging vegetation that is impacting the conveyance of the drain, a single pass can be made of the opposite bank in addition to the cut on the nearside bank.

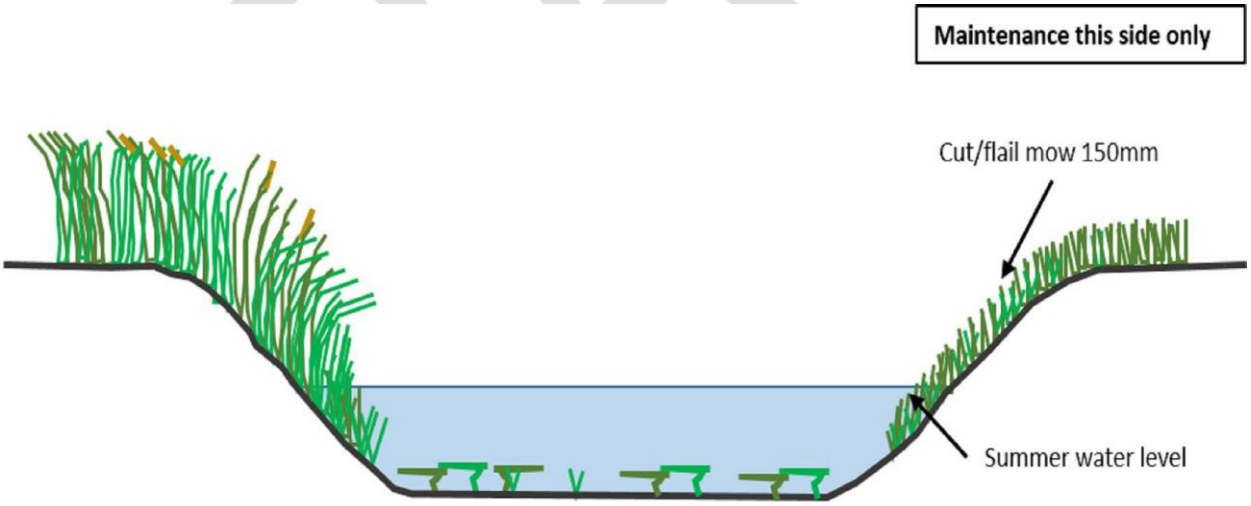
No WFD assessment required prior to instigating this method.

M4 Grass Control

Before Operation

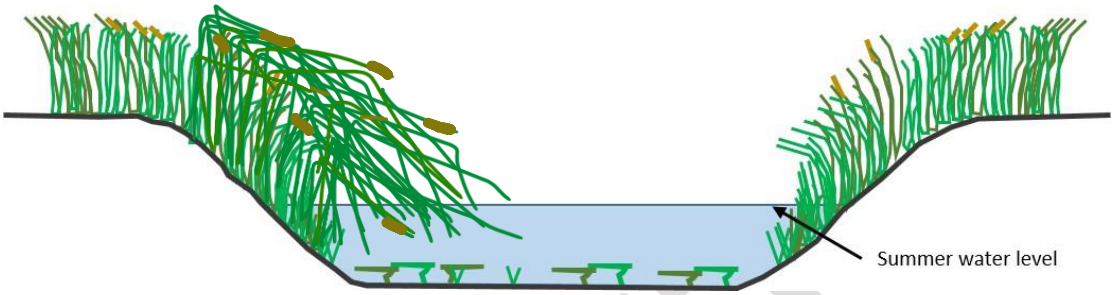


After Operation



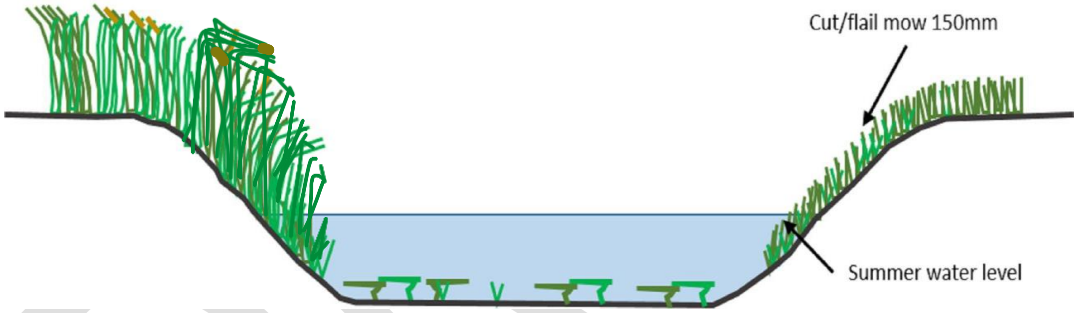
M4 Grass Control with overhanging vegetation on opposite bank

Before Operation



After Operation

Where vegetation is over hanging on opposite side, a single pass can be made on the opposite bank in addition to the cut on the nearside bank.



8.2 Tree and Bush Management

Bankside trees and shrubs provide shade and keep water cool. Instream branches improve the ecology of the watercourse by providing food and substrate for invertebrates and cover and food for fish. Over time, instream branches add natural diversity to the surrounding aquatic environment by altering the physical hydraulic function of the watercourse, which may result in scours and pool and shoal formation.
With the high ecological benefits attributed to the aquatic environment by trees, the first consideration prior to any tree, bush or branch removal should be, does it really need removing?

The aim of tree management is threefold:

1. To allow unimpeded access for machinery into a site and prevent damage to the machine e.g. Hydraulic pipework becoming caught up in branches.
2. To prevent the sides of watercourses becoming overgrown and in some instances, over shaded.
3. To prevent instream blockages occurring in areas of high flood risk.

Tree and bush work can be undertaken year round but require appropriate checks with the Environment Team prior to initiation. Prework checks are recommended between August to September and Mid-February to March to ensure nesting birds are not present, prior to maintenance. It is an offence under the Wildlife and Countryside Act (1981) to recklessly disturb a breeding bird or its nest during the bird breeding season and tree work out with these seasons in not recommended. Any tree work required during bird breeding season may be undertaken only following consultation with and having had appropriate checks undertaken by the Environmental Team.

Veteran trees may be subject to a Tree Preservation Order or may provide roosting sites for bats. Fallen trees or root systems may also act as couches or holts for Otter. The root systems may provide cover for White Clawed Crayfish. It is crucial then that trees are not cleared without prior investigation by the Environmental Team as this may constitute an offence under the Conservation of Habitats and Species Regulations (2017).

Dead trees should be left in situ as ecologically they can provide niches for a rich diversity of species, ranging from invertebrates to birds and bats. These should be left and not be touched without prior investigation by the Environmental Team as

this may constitute an offence under the Conservation of Habitats and Species Regulations (2017).
Where board's operators have found it necessary to remove or trim overhanging trees or shrubs, then trees and bushes can be cut up as wood piles or left on the bank top to enhance the terrestrial habitat.

Waste timber may also be used to enhance the watercourse or environment where it can be:

- repositioned in the watercourse margins where flood risk permits;
- cut up into reptile /invertebrate piles
- be chipped and spread where the landowner is happy for this to occur and where no detriment will be caused to the surrounding environment. Alternatively the chippings or waste timber can be removed from site under a the Board's waste carrier licence.

Burning is not recommended, however where it is necessary to do so it should be carried out under an EA Waste Exemption licence (D7), on high ground and / or away from species rich environments or flushes.

No burning should take place on peat or within a SSSI.

A choice of four **Environmental Options** can be employed:

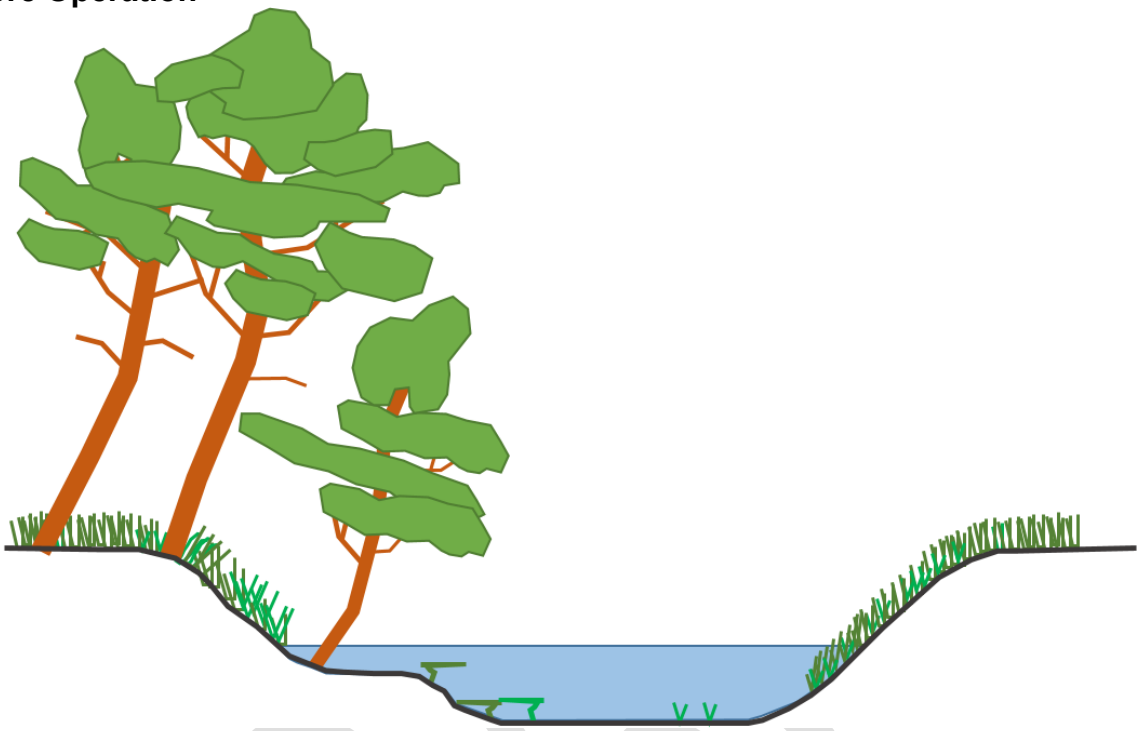
8.2.1 Environmental Option TB4

Where a tree or bush has a trunk only growing in the water and there are other trees behind, offering shade, then the tree can be removed where necessary. Cuttings should be removed from the channel. This option should be considered for small saplings and immature trees only, larger, substantial trees should be looked at individually.

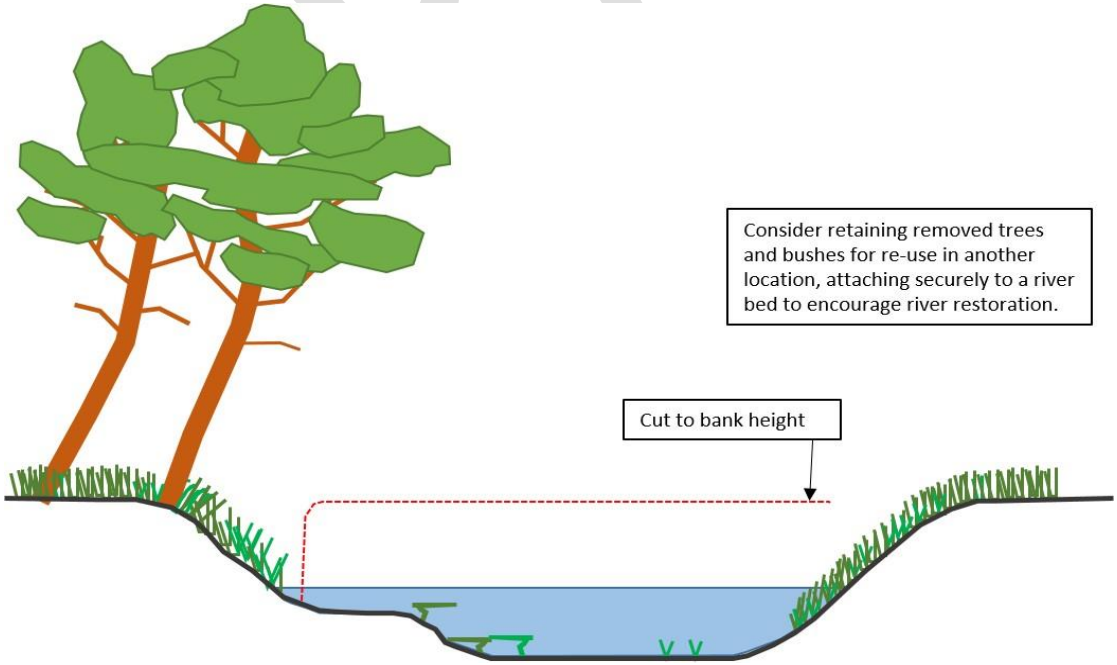
No WFD assessment required prior to instigating this method.

TB4 Tree and Bush Management

Before Operation



After Operation



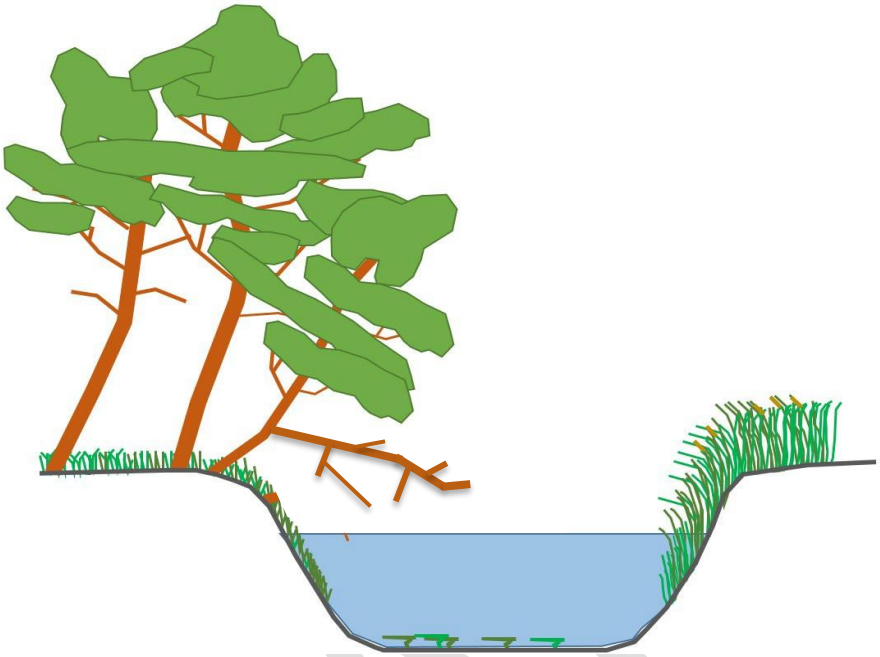
8.2.2 Environmental Option TB3

Where a tree or a bush has branches overhanging the watercourse but not actually within the water, then overhanging limbs can be removed up to the height of the bank top only. The remaining tree remains in situ. This can be achieved by using a pole saw to cut the branches, or where branches are small (less that 5cm diameter), a flail can be used to take branches back to bank, followed by a pole saw where required if the branches have been shattered.

No WFD assessment required prior to instigating this method.

TB3 Tree and bush management

Before Operation



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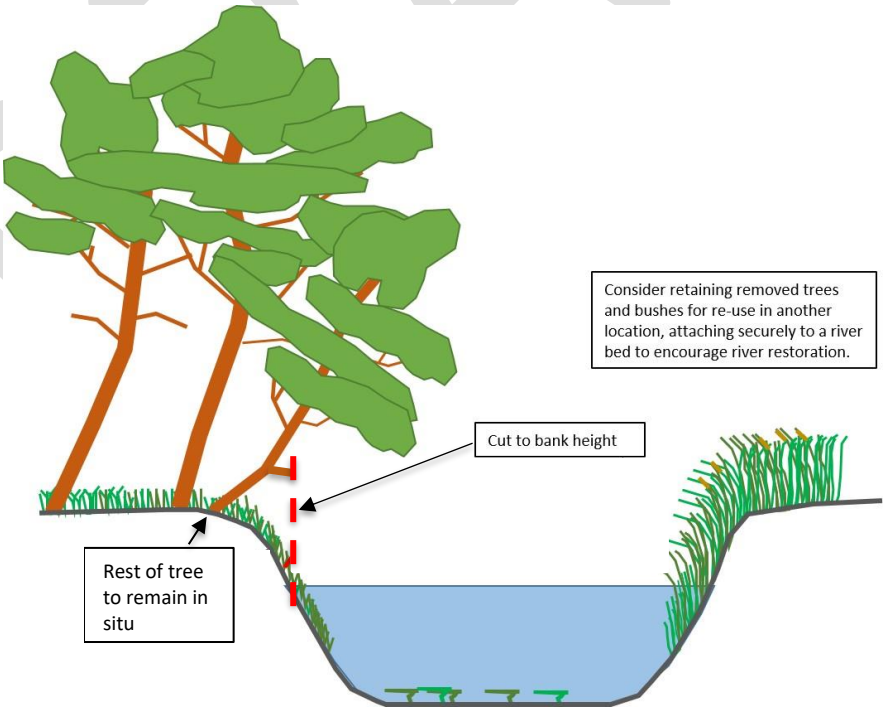


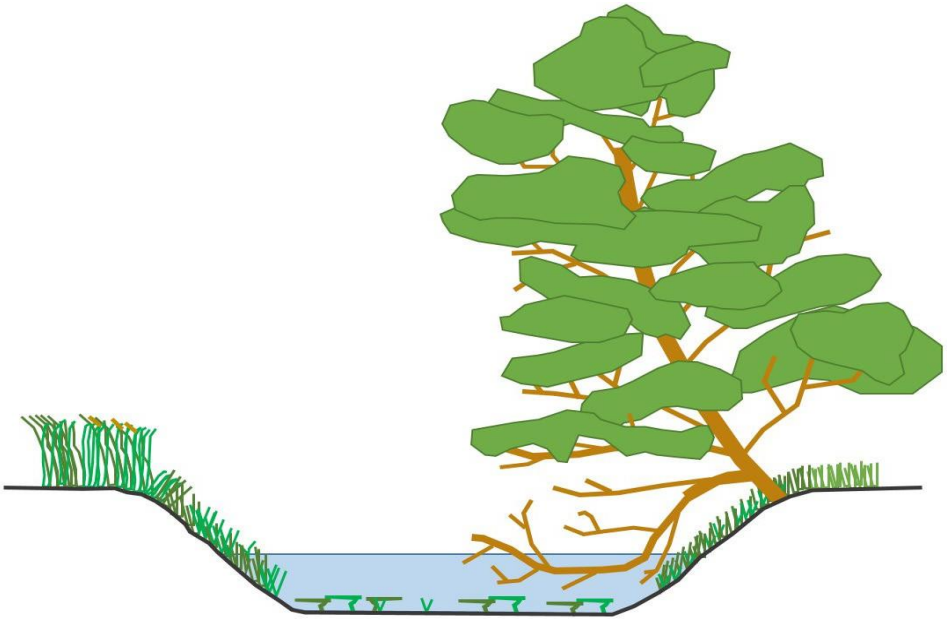
8.2.3 Environmental Option TB2

Where a tree or a bush has overhanging branches trailing in the water, then these can be removed up to bank height and the rest of the tree left in situ. It may then be possible to install the removed branches in a more appropriate position. This should be a consideration to lessen the ecological impact of removal.

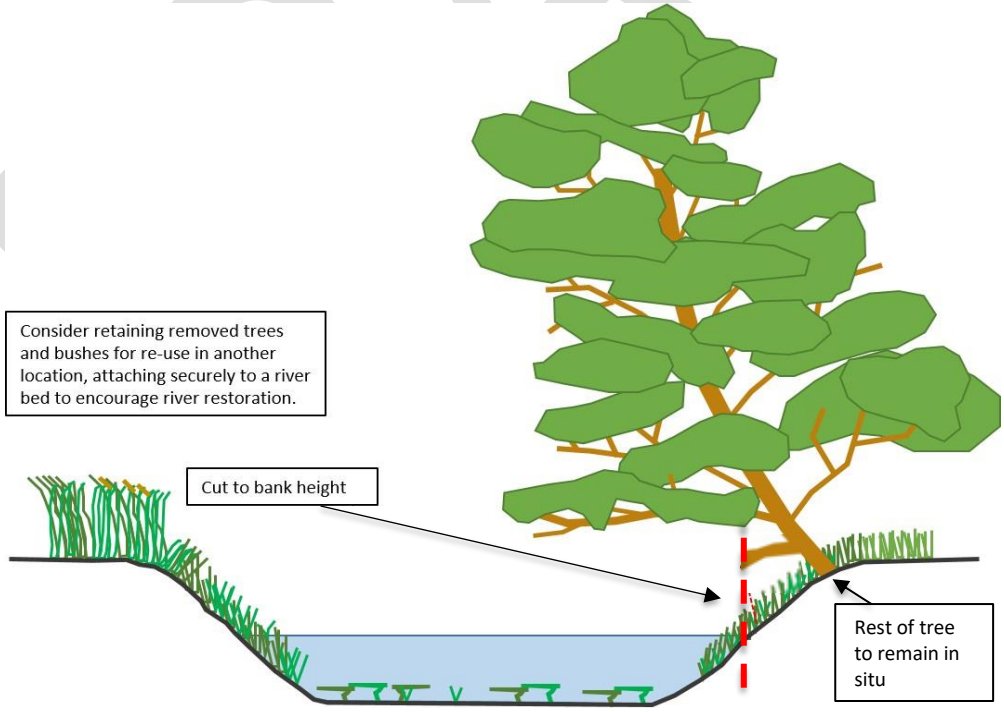
A WFD assessment will need to be undertaken prior to works.

TB2 Tree and bush management

Before Operation



After Operation



8.2.4 Environmental Option TB1

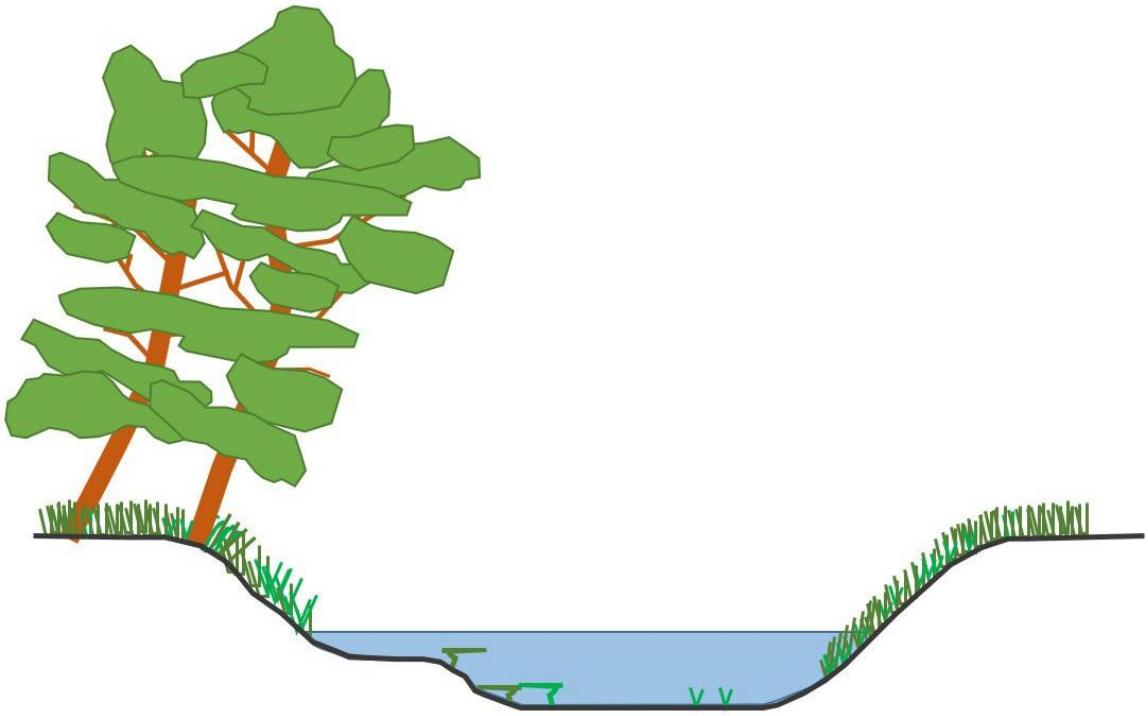
Where trees or bushes are standing away from the watercourse but access is required or flood risk is an issue, then trees can be felled near the watercourse.

A WFD assessment will need to be undertaken prior to works.

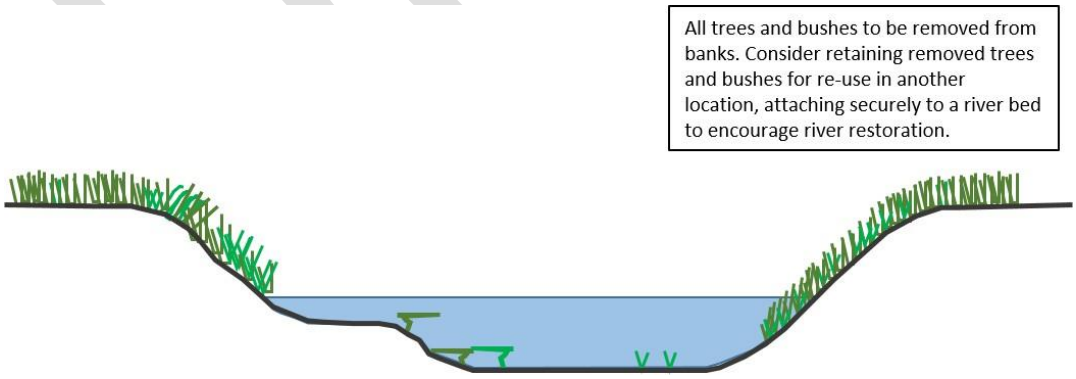
TB1 Tree and bush management

Work to be phased over a number of years.

Before Operation



After Operation



8.3 Instream Woody Material Management

Instream woody material (e.g. branches, entire trees or root balls) often fall into rivers. Historically we have removed woody debris to maintain flow conveyance and prevent downstream blockages. It is good practice however to either retain or introduce new woody material into river channels as it is a cheap and effective means of enhancing the ecological status or potential of a watercourse.

When deciding whether to retain or introduce new woody material into a watercourse, full consideration must be paid to whether it would be suitable in that particular location. There are two main risk factors to be taken into consideration:

- Flood Risk – is the site a low medium or high priority system in terms of urban, land of high agricultural or amenity value?
- Risk of obstructing a structure downstream – is the site close to a bridge or culvert that could block if woody debris was dislodged.

If the risk factors are high for both of these factors, then consideration is needed as to whether woody debris should be installed, retained, and how it can be designed to minimise risk or whether it should be removed.

Retaining Instream Woody Material

Three environmental options have been created to encourage retention of woody debris. In general, woody debris should not be removed when there is no evidence that it is causing flood risk or that it could cause a blockage.

Introducing New instream Woody Material

When removing instream woody material in one location, you are encouraged to keep the wood, as it may be installed at a different lower risk site. However, when moving woody material from one site to another, check that the source material is free of disease and non-native invasive species.

Best Practice for Enhancement

When retaining or installing woody debris, the following best practice should be followed:

- Selective (rather than wholesale) removal of instream woody material.
- Realigning the woody material so that it is pointing in a direction to alleviate the risk of obstruction.
- Repositioning the woody material away from culverts and bridges which are at risk of blockage.
- Pegging instream woody material securely into the channel bed. This can be used using ground anchors to secure it in place.
- Ensuring that the instream woody material's height is equal to or no greater than half the water depth.

Once the assessment of onsite risk has been made to retain or introduce instream woody material to a site then three environmental options should be assessed.

A choice of three **Environmental Options** can be employed:

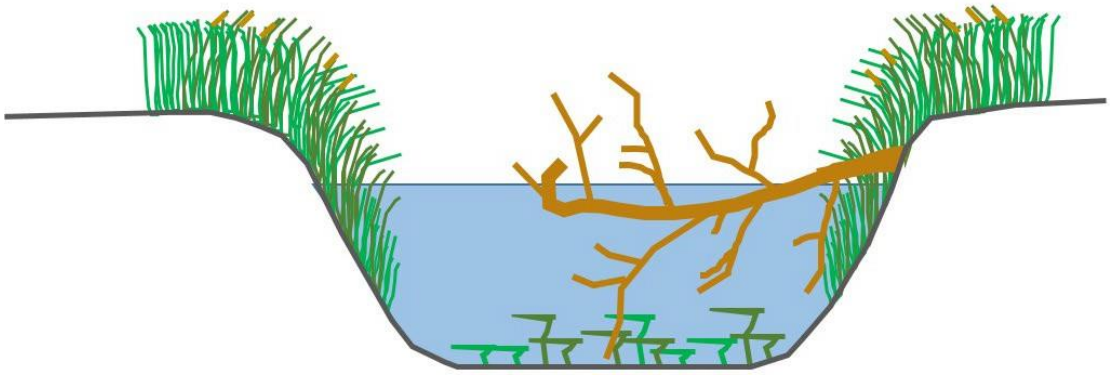
8.3.1 Environmental Option IWM 3

This option involves leaving in or introducing instream woody material to a site by securing it to the banks and or bed of the channel.

No WFD assessment required prior to instigating this method.

IWM 3 Instream Woody Debris Management

Leave in all instream woody debris and peg to the banks and the bed of the channel



8.3.2 Environmental Option IWM2

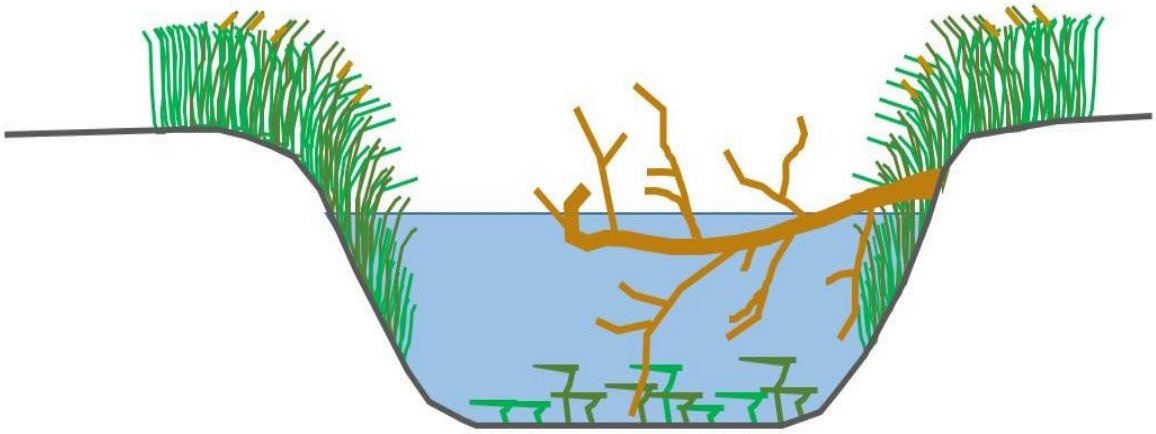
This option involves the selective removal of some instream woody material and the reorientation of the material to enable conveyance through the middle of the channel.

No WFD assessment will need to be undertaken prior to works.

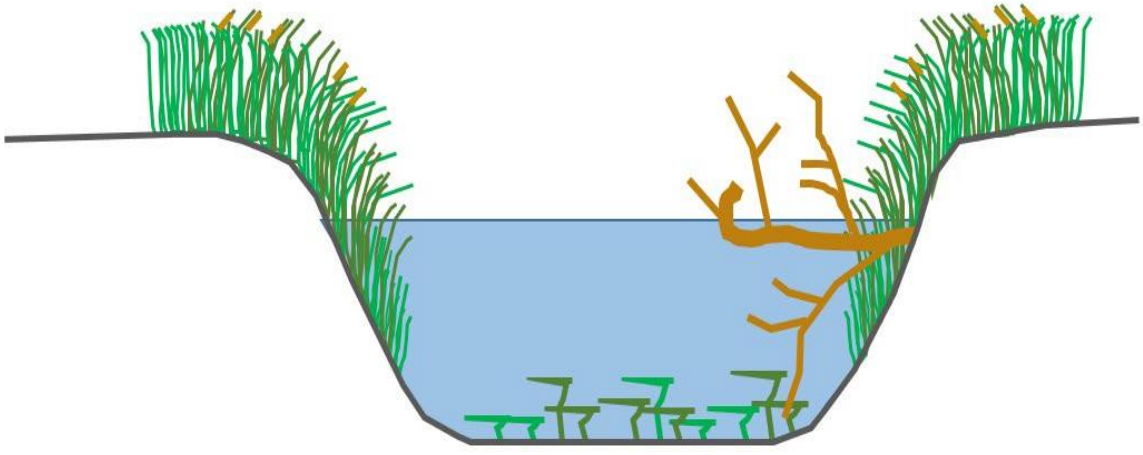
IWD2 Instream Woody Debris Management

Selective removal of some instream woody material and reorientation, to enable conveyance through the middle of the channel.

Before Operation



After Operation



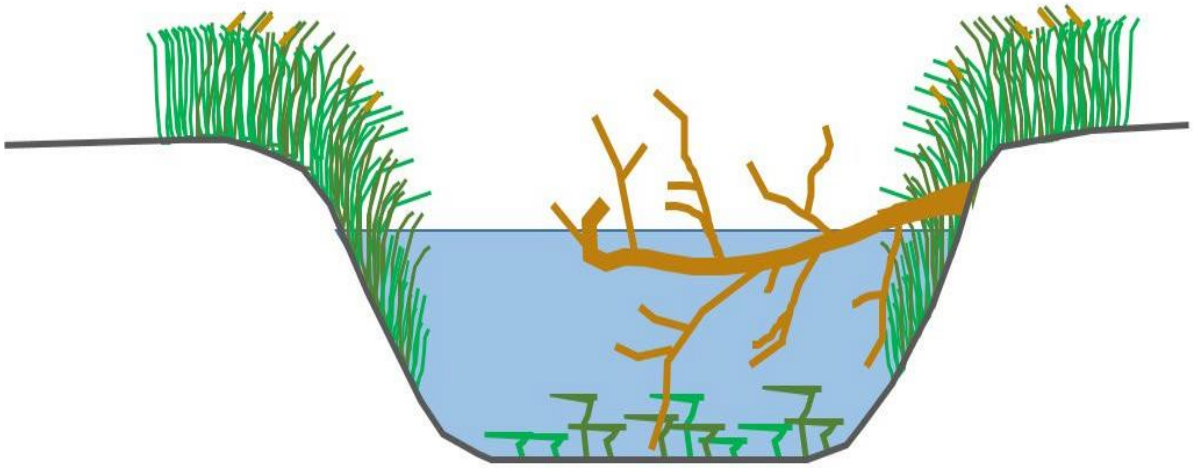
8.3.3 Environmental Option WD1

This option involves the complete removal of all woody debris from the channel.

A WFD assessment will need to be undertaken prior to works.

IWM 1 Remove all instream woody material

Before Operation



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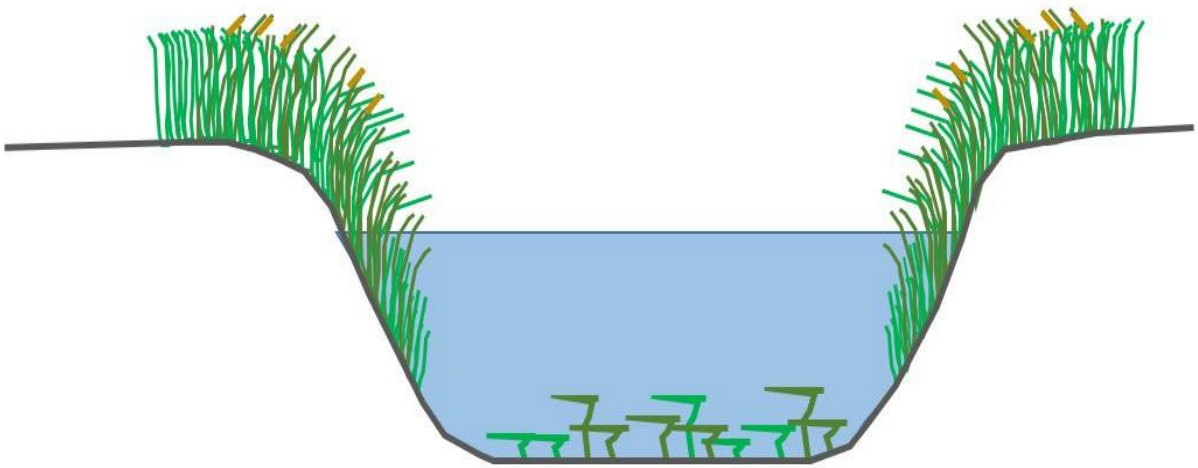


8.4 Emergent and Instream Weed Control

The Board removes vegetation from watercourses mechanically, using a weed cutting basket attached to a 360 hydraulic machine. Where this is not practical, due to the size of the watercourse or impeded access, then manual clearance is employed using hand tools, such as a chrome.

Emergent and instream vegetation clearance will be undertaken throughout the year, though in bird breeding season works will only take place where necessary in low risk environmental areas, such as open grazing marsh. However, prework checks will take place between March to September to ensure nesting birds are not present, prior to maintenance and at all times consider the Board's statutory duties set out in the Wildlife and Countryside Act (1981) (as amended).

The main aim of emergent and instream weed control is to allow unimpeded water flow within the banks of the watercourse and improve downstream conveyance. However, weed control can also be manipulated to allow water to flow between features, speeding water up in some areas and leaving other areas available for silt deposition and marginal berm creation.

The weeding basket should always be set to ensure no gravels are removed or deepening of the watercourse occurs during the process of weed cutting.

Instream weed control will work in conjunction with the mowing regime specified in Section 3.0.

A choice of four **Environmental Options** can be employed:

8.4.1 Environmental Option W7

This option allows an uneven margin to be created on the opposite bank, leaving at least 10% of the wet width vegetation left in situ in watercourses less than 10m wet width.

In watercourses greater than 10m wet width, a minimum of 20% vegetation should be left on the opposite bank. Where instream vegetation allow, the nearside margin will have patches of vegetation left in a random uneven manner also. The nearside toe should not be exposed or touched by the weed cutting basket.

Cut material should be set back behind the machine with care being taken not to place on wet flushes or block grips. Material should ideally be placed on the historic spoil bank. Wet vegetation should not be let slip down bank face.

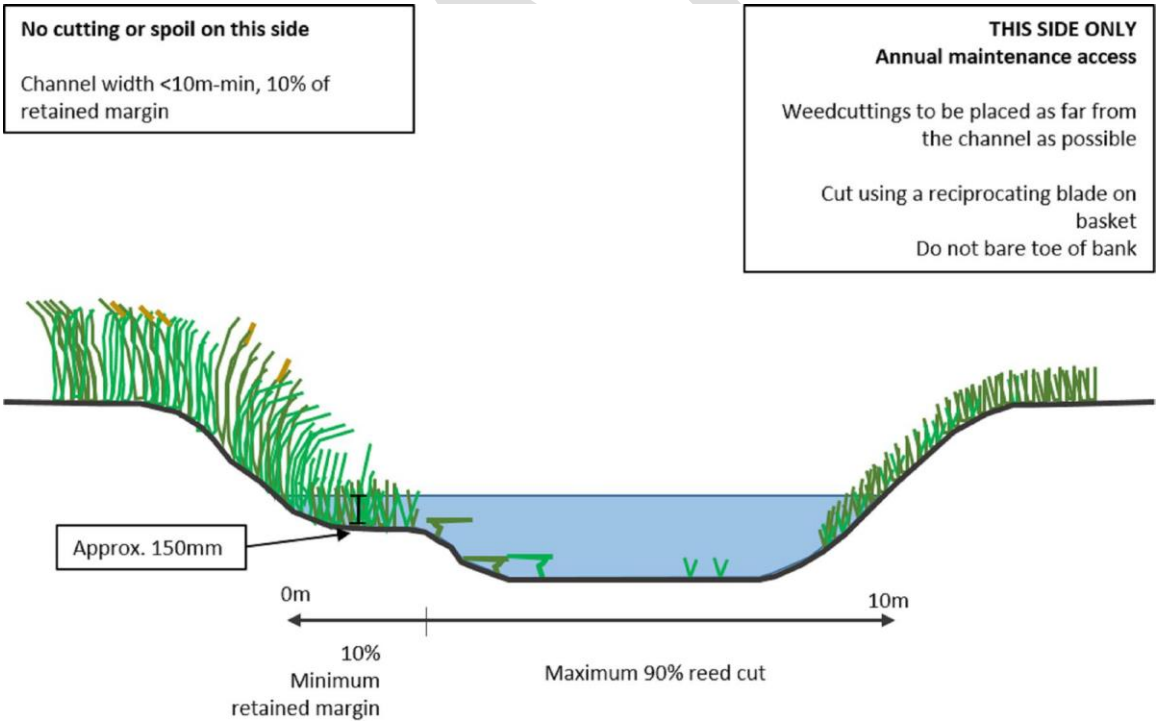
The weed cutting basket should be set to ensure that no gravels are removed from the watercourse and that no deepening of the section takes place.

No WFD assessment required prior to instigating this method.

W7 Weed Control

Aerial View of Operation

Profile View of Operation



8.4.2 Environmental Option W3

This option allows for 50% of the instream vegetation to be removed centrally, in a sinusoidal manner to allow instream diversity to be maintained and allow silt deposition to occur to encourage narrowing and berm formation. The nearside toe should not be exposed or touched by the weed cutting basket.

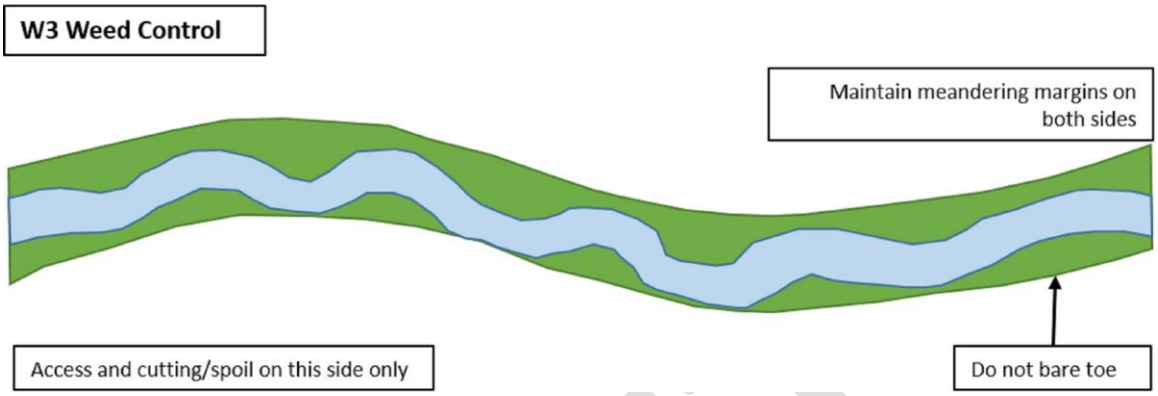
Cut material should be set back behind the machine with care being taken not to place on wet flushes or block grips. Material should ideally be placed on the historic spoil bank. Wet vegetation should not be let slip down bank face.

The weed cutting basket should be set to ensure that no gravels are removed from the watercourse and that no deepening of the section takes place.

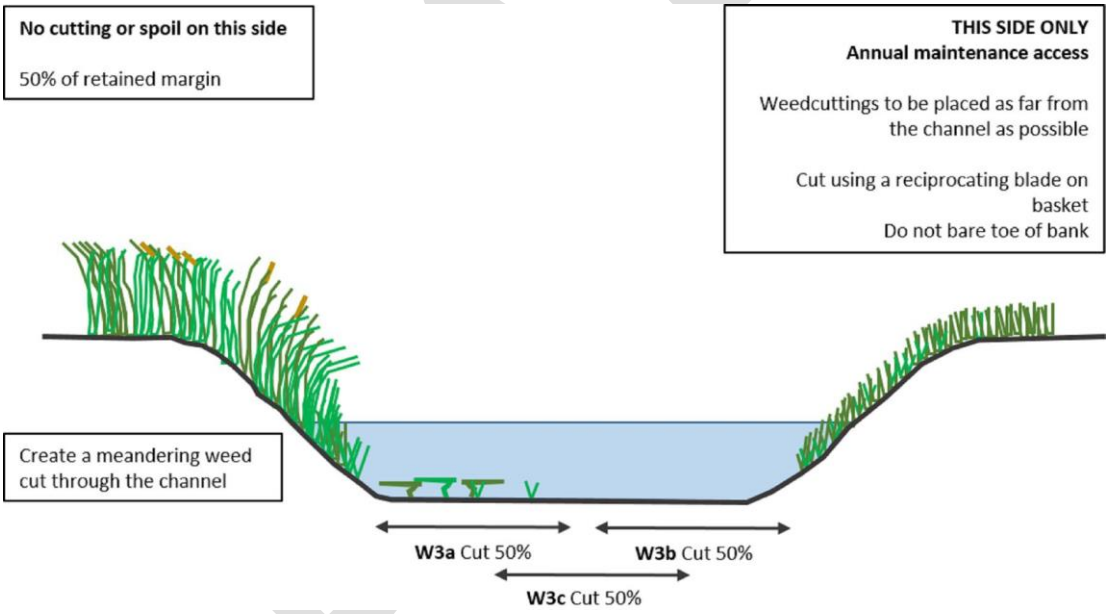
No WFD assessment required prior to instigating this method.

W3 Weed Control

Aerial View of Operation



Profile View of Operation



8.4.3 Environmental Option W2

This option allows for 80% of the instream vegetation to be removed centrally, in a sinusoidal manner to allow instream diversity to be maintained and allow silt deposition to occur to encourage narrowing and berm formation. The nearside toe should not be exposed or touched by the weed cutting basket.

Cut material should be set back behind the machine with care being taken not to place on wet flushes or block grips. Material should ideally be placed on the historic spoil bank. Wet vegetation should not be let slip down bank face.

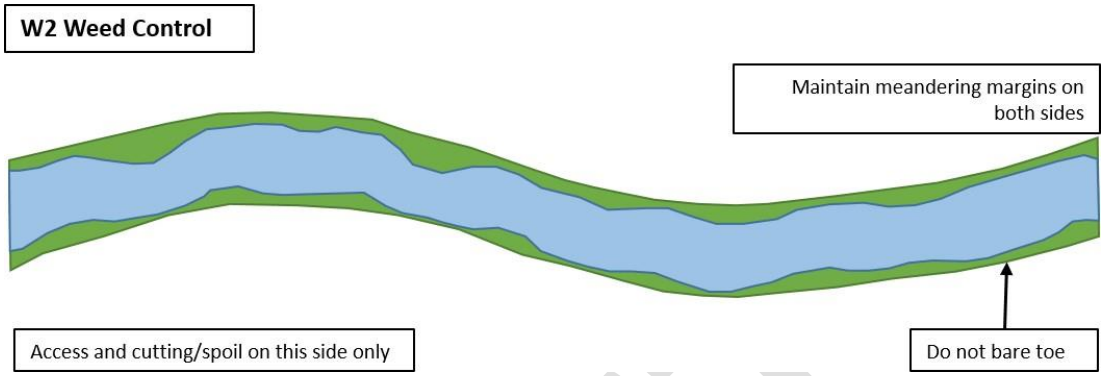
The weed cutting basket should be set to ensure that no gravels are removed from the watercourse and that no deepening of the section takes place.

The wet width of the watercourse should be considered when selecting this option, with further consideration to be made where watercourse exceed 6m wet width, as this option would become 'red'. This option is better suitable for narrower drains. Where there is a flood risk need for this option to be considered, a WFD assessment will need to be undertaken prior to works.

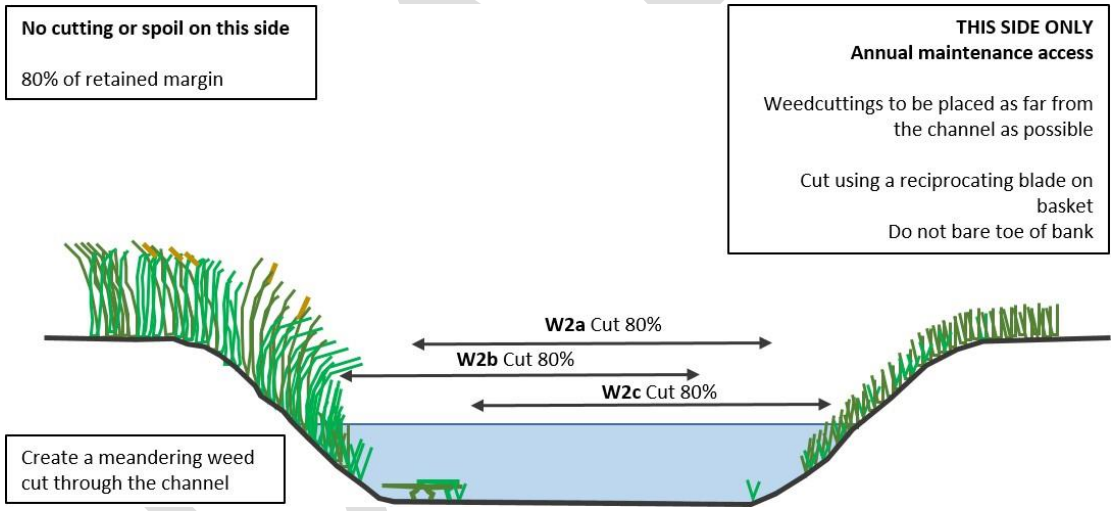
A WFD assessment will be required prior to instigating this method.

W2 Weed Control

Aerial View of Operation



Profile View of Operation



8.4.4 Environmental Option W1

This option allows for all of the instream vegetation to be removed. The nearside toe should not be exposed or touched by the weed cutting basket.

Cut material should be set back behind the machine with care being taken not to place on wet flushes or block groups. Material should ideally be placed on the historic spoil bank. Wet vegetation should not be let slip down bank face.

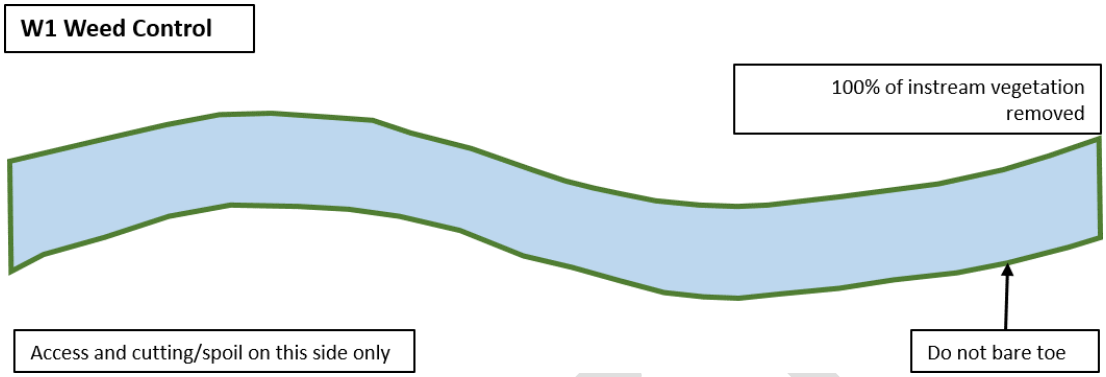
The weed cutting basket should be set to ensure that no gravels are removed from the watercourse and that no deepening of the section takes place.

Where there is a flood risk need for this option to be considered, a WFD assessment will need to be undertaken prior to works.

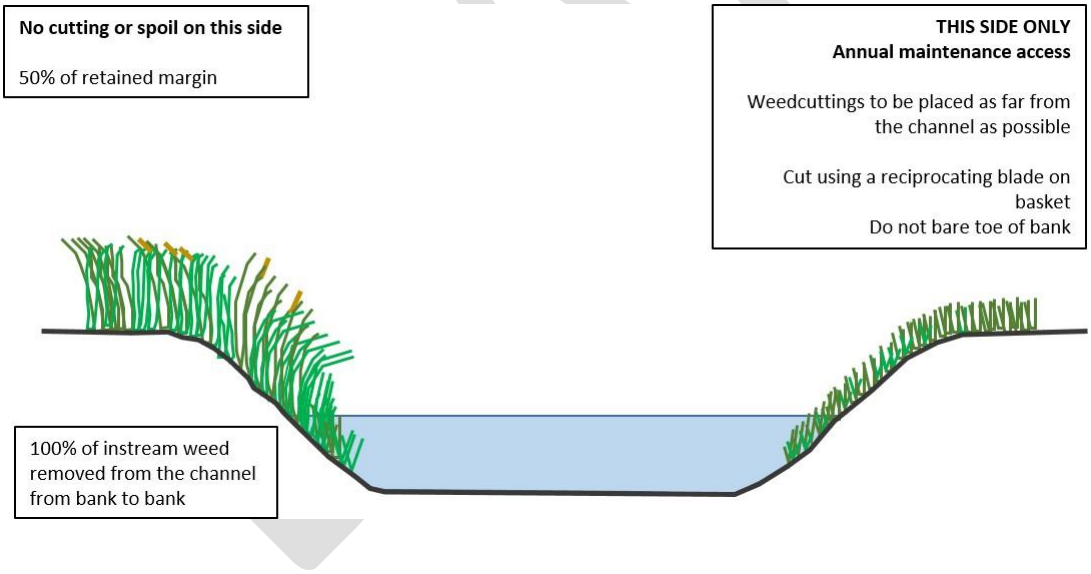
A WFD assessment will be required prior to instigating this method.

W1 Weed Control

Aerial View of Operation



Profile view of Operation



8.5 Herbicide Use for Weed Control

Chemicals are used occasionally to control growth in the Norfolk Rivers Internal Drainage District. Chemical control will be considered where weed growth cannot be effectively controlled by mechanical means, in inaccessible areas or in the case of non-native invasive species, e.g. Japanese Knotweed and Giant Hogweed.

Where species which like to grow in slow moving riverine environments, such as Branched Burr Reed, then consideration must be paid to the cause of the problem with the aim of looking toward a more sustainable solution, moving forward. Restoration of the stretch will provide a better solution to the problem of weed control than continual herbicide application. However, in some locations, where appropriate herbicide will be applied to create a sinusoidal pattern in the weed to improve central flow but encourage silt deposition and berm formation at the edges of the watercourse. This should in turn speed up central flows and discourage future infestations.

Before any herbicides can be used in or near watercourses, written consent must be obtained from the Environment Agency in the way of a Herbicide Licence (AqHerb01). Consultations with Natural England must also take place before the licence can be issued, where the chemicals may have an impact on SSSI or SAC rivers or land parcels.

If chemicals are to be used, then only herbicides and adjuvants cleared for aquatic use will be used in or beside water i.e. Glyphosate (Roundup BiActive) and Topfilm. Only suitably qualified operatives with an NPTC certificate in the Safe Use of Pesticides (PA1) and the application of pesticides in or near water, using a hand held applicator (PA6W) will be permitted to carry out any herbicide application on behalf of the NRIDB and in compliance with the Official Controls (Plant Protection Products) Regulations 2020.

Herbicides will only be used in accordance with the Control of Pesticide Regulations 1986 and the Food and Environment Protection Act 1985. The storage and use of these substances will also comply with the Control of Substances Hazardous to Health Regulations 1988. It should be noted that the use of herbicides within the Board's drainage district is also affected by agri- environment scheme requirements.

No WFD assessment required prior to instigating this method.

8.6 Instream Silt Removal

The environmental risk involved in silt removal in Norfolk Rivers IDB catchments, is deemed high and as such each operation will be looked at on a case by case basis.

The Board has powers under Section 15 of the Land Drainage Act, 1991 to deposit material arising from the maintenance of a watercourse on the banks.

De-silting is a planned activity and as far as is practicable should only be undertaken between October and February when water temperatures are cool. However, where works are deemed necessary at other times of the year, then a prior assessment of works by the Environmental Team will take place and regular dissolved oxygen monitoring will be undertaken prior to and during operations. Monitoring will ensure the organic material within the silt does not impact upon dissolved oxygen levels within the watercourse and cause a fish kill. Where dissolved oxygen levels are deemed too low, work will be stopped.

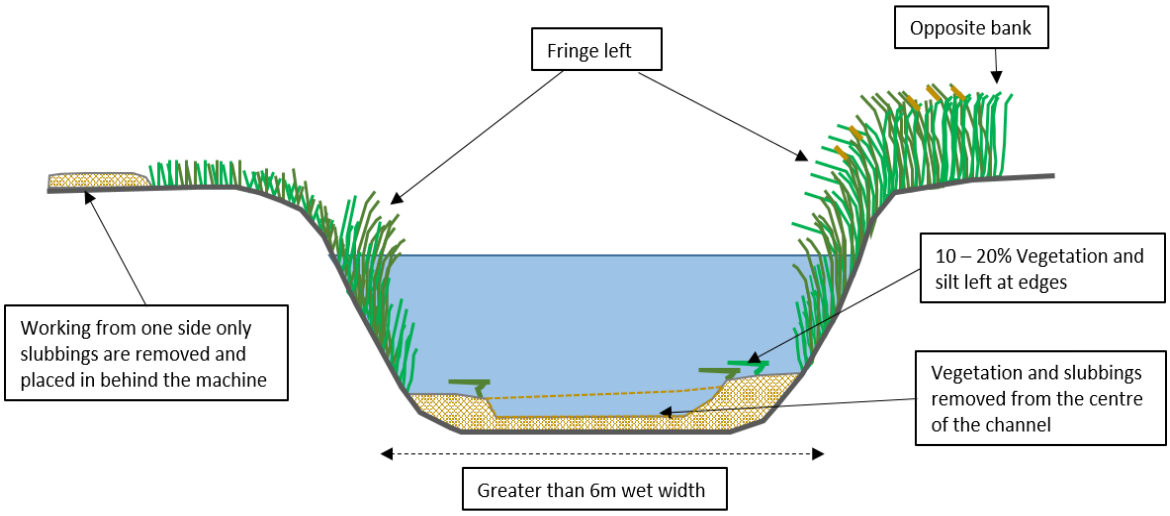
Where protected species or breeding birds are found, prior to a planned programme of works, then effective mitigation will be put in place to ensure compliance with the law. This may require delaying the works depending on what is found. Silt removed from the watercourse will be visually inspected by the driver for fish and eels to ensure that animals are returned to the watercourse.

No gravels will be removed from the watercourse and no dredging will take place, resulting in the deepening or over widening of the watercourse. Please see below for the definition and difference between silt removal (desilting) and dredging.

There are four possible options for desilting operations:

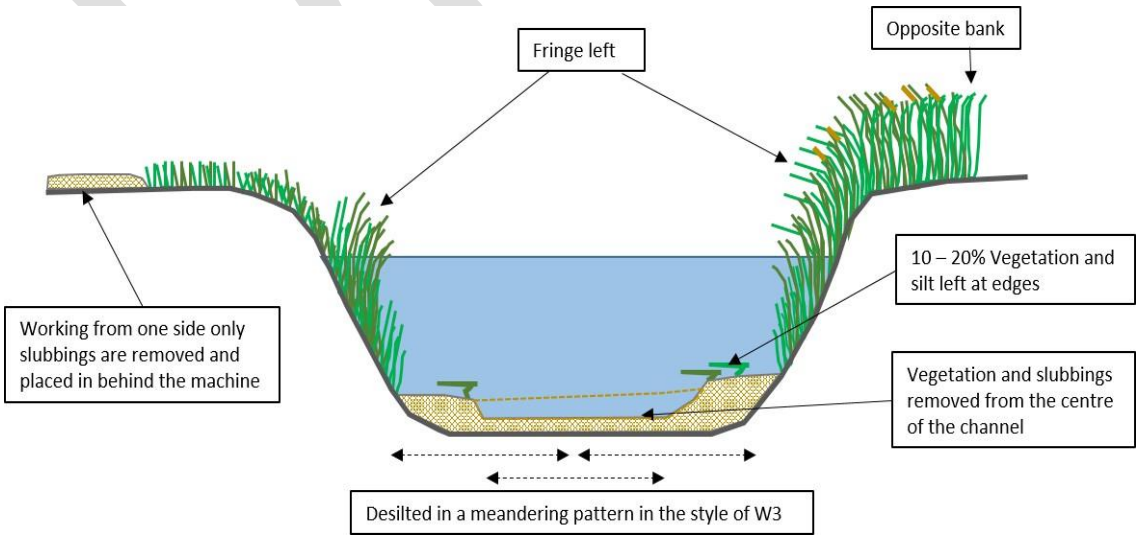
8.6.1 Option SR1

Desilting may be carried out removing silt from the central channel only, leaving marginal silts and or vegetation on both sides of the water course.



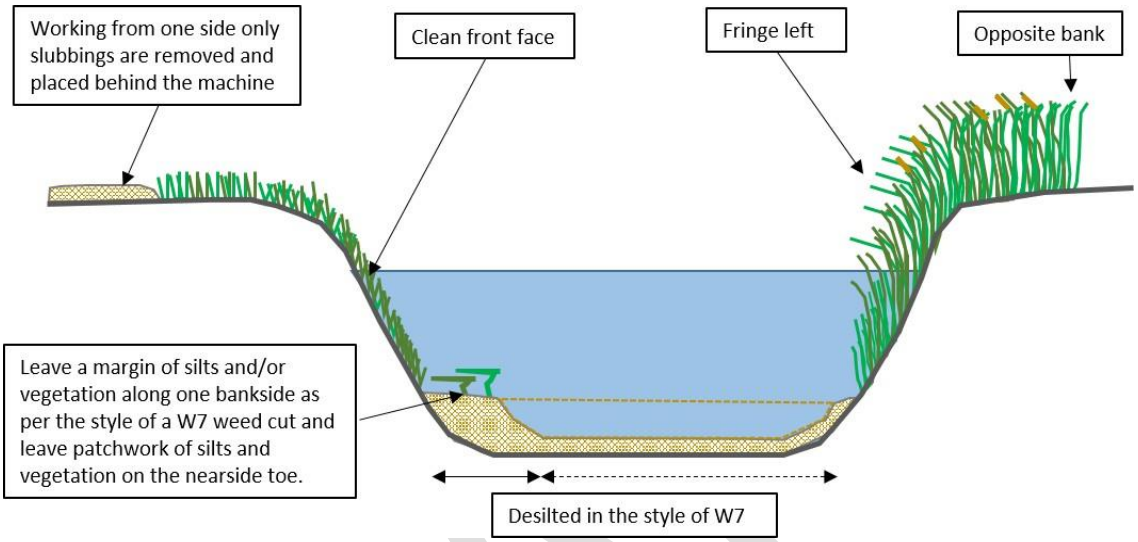
8.6.2 Option SR2

Silt removal may be carried out removing silt and vegetation from the channel in a manner so as to create a sinusoidal pattern of vegetation, leaving silts and vegetation on alternate sides of the watercourse. This method of desilting will be as per the style of the W3 weed cut.



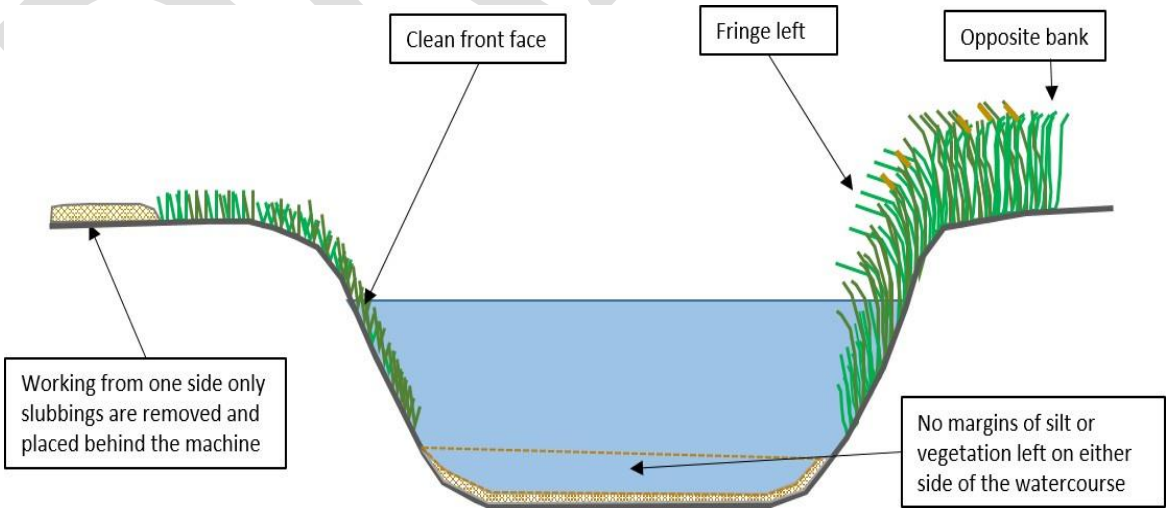
8.6.3 Option SR3

Silt removal may be carried out leaving a margin of silts and/or vegetation along one bankside as per the style of a W7 weed cut and leaving patched of silts and vegetation on the nearside toe.



8.6.4 Option SR4

Silt removal may be carried out leaving no margins of silt or vegetation on either side of the watercourse, in the style of the W1 weed cut.



General considerations of desilting a watercourse:

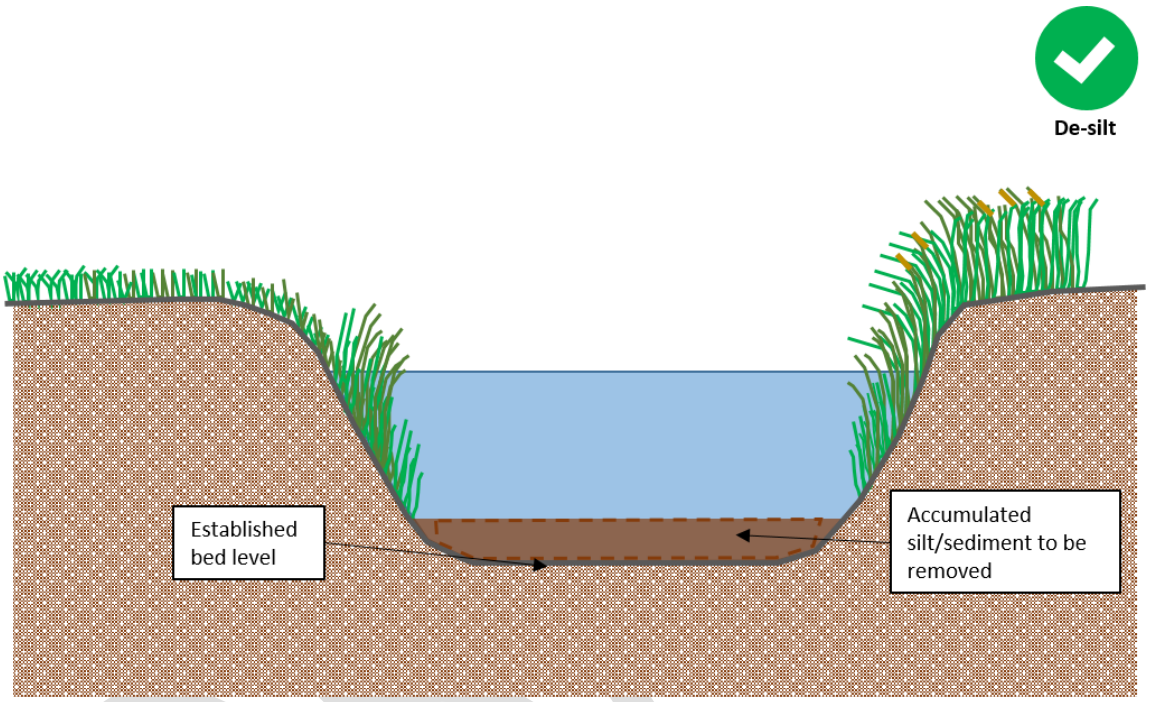
Leaving a fringe of marginal vegetation will serve to minimise risks of environmental harm, maintain the seed bank and leave cover and food for invertebrates and other aquatic animals. However, there may be situations in areas of high flood risk where the watercourse will need to be desilted from bank to bank. All the options will be considered very carefully in relation to flood risk, prior to undertaking a desilting exercise.

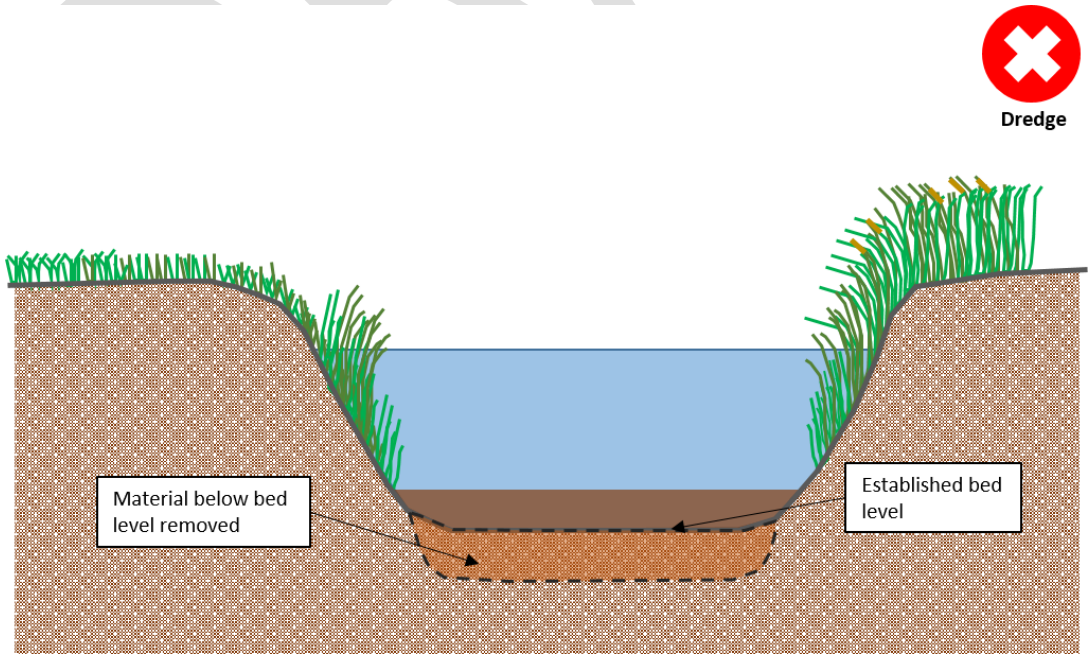
Deposits will be spread on one side, the working side of the channel only and particular care will be taken to avoid floristically rich areas or low wet areas and material will be preferentially placed on the historic spoil bank away from the bank top to prevent spoil being washed back into the water and reduce further nutrient enrichment of the watercourse.

A WFD assessment will be required prior to any desilting operation taking place and mitigation measures put in place as required.

The difference between desilting and dredging:

Desilting is when silts that have accumulated in the water channel are removed. **No deepening or overwidening of the watercourse will occur during desilting**. Dredging is where material below bed level is removed and is likely to lead to overdeepening of the channel, the slowing of flows and a continuous need for further maintenance. **The NRIDB will never undertake dredging.**





9.0 Bank Reprofiling

Banks may have been poached by cattle, horses and deer or slips may have occurred and as such, some sections of banks may require re-profiling to ensure their efficient use as land drainage channels and to accommodate and store flood flows. The environmental risk involved in this activity in the NRIDB catchments is deemed high, particularly to water vole whose habitat and the welfare of the animal itself now falls under protected species legislation of the Wildlife and Countryside Act (1981) (as amended).

No bank reprofiling should be undertaken without first receiving instruction from the Environmental Team. A desk study, scoping exercise and schedule 5 species check may be necessary. Appropriate mitigation measures and timing may be required prior to any reprofiling work. The IDB Water Vole Class licence may apply and appropriate mitigation measures may be required prior to any reprofiling work taking place. Checks must be made with Environmental Team well in advance of operation to ensure appropriate survey and mitigation is undertaken.

Consideration should be given where practicable and where landowners are in agreement, to reshaping of banks to create marginal wetland habitats (berms), however, capital grant in aid may be required in this instance.

A WFD assessment will be required prior to work of this nature being carried out.

10.0 Culvert Installation or Repair

Any culvert installation or repair will need prior assessment by the Environmental Team and a WFD assessment may be required, depending on the location and the length of the culvert to be installed or whether the culvert is to be replaced, like-for-like. The IDB Water Vole Class Licence may apply and mitigation windows should be considered. In general culverting should be avoided and other alternative measures considered.

A WFD assessment will be required prior to work of this nature being carried out.

11.0 References

Association of Drainage Authorities (2008) The Drainage Channel Biodiversity Manual- Integrating wildlife and flood risk management. Buisson, R. S. K., Wade, P. M., Cathcart, R. L., Hemmings, S. M., Manning, C. J. & Mayer, L. (2008). The Drainage Channel Biodiversity Manual: Integrating Wildlife and Flood Risk Management. Association of Drainage Authorities and Natural England, Peterborough.

Association of Drainage Authorities (2022) Environmental Good Governance Guide

Environment Agency (2012). Delivering consistent standards for sustainable asset management. Maintenance Standards Version 3, March 2012.

Environment Agency (2015). Channel Management Handbook. Report- SC110002

Holditch, D (2003), Ecology of the Whiteclawed Crayfish. Conserving Natura 2000 Rivers – Ecology Series No 1. English Nature, Peterborough

Killeen IJ (2003). Ecology of Desmoulin's Whorl Snail. Conserving Natura 2000 Rivers Ecology Series No. 6. English Nature, Peterborough.

Kings Lynn Consortium of Internal Drainage Boards (2000). Standard Maintenance Operations.

Natural England CLASS LICENCE- Intentional disturbance of water voles and damage/destruction of water vole burrows by means of 'Displacement' (Internal Drainage Boards).

Norfolk Rivers Internal Drainage Board (2008). Standard Maintenance Operations for Rivers. Water Management Alliance.

Norfolk Rivers Internal Drainage Board (2013). Standard Maintenance Operations for Rivers. Water Management Alliance.

Norfolk Rivers Internal Drainage Board (2018). Standard Maintenance Operations for Rivers. Water Management Alliance.

12.0 Appendix

12.1 Table 1: Schedule 5 Species present in Norfolk Rivers IDB

Schedule 5* species		Habitat Type					
Scientific Name	**Common Name**	**Water Body**	**In Channel Vegetation**	**Bankside Vegetation**	**Ditch Bank**	**Emergent Vegetation**	**Advised Maintenance Technique**
Arvicola amphibius	Water vole	Yes all year to feed and travel.	Yes, food and predator cover all year.	Yes, food and predator cover all year.	Yes, burrows into bank all year	Yes, Feeding on most plants	Mow bank side vegetation down to 150mm to SMO standard. Do not touch the toe of the banks during maintenance. Weedcutting in-channel vegetation to SMO standard.
Lutra lutra	European Otter	Yes, they are very mobile animals	Yes, uses it for hunting fish and other species.	Yes if there are areas for resting, couches such as in an old tree.			Leave fallen trees where possible if not causing flood risk. Consult the Environmental Team for further work on Trees.
Vespertilionidae	All bats			Yes if ancient trees are present with holes, or trees with splits, lifted bark, holes.			Leave trees that have bat potential. Consult the Environmental Team for further work on trees. A licenced bat ecologist may need to be employed.
Anguis fragilis	Slow Worm			Yes, Requires dense vegetation, especially grasses coupled with sunny areas to allow thermoregulation and, preferably, loose soil into which to burrow.			Mow bank side vegetation down to 150mm. Do not touch the bank with weed basket..
Lacerta vivipara	Common lizard			Yes, Damp or wet areas, especially where abundant grass tussocks are present to provide food, shelter, basking and hibernation sites.			Mow bank side vegetation down to 150mm. Do not touch the bank with weed basket.
Natrix helvetica	Grass snake	Yes, they are very mobile animals, can be found swimming instream		Yes, they are very mobile animals using all types of habitat.	Yes, they are very mobile animals		Mow bank side vegetation down to 150mm. Do not touch the bank with weedbasket.

Schedule 5* species		Habitat Type					
Scientific Name	**Common Name**	**Water Body**	**In Channel Vegetation**	**Bankside Vegetation**	**Ditch Bank**	**Emergent Vegetation**	**Advised Maintenance Technique**
Vipera berus	Adder			Yes, In all suitable habitats, dry, open, sunny areas with adjacent dense ground cover are essential. Hibernation sites tend to be on south-facing slopes; tree root systems, crevices in banks, and voids in piled materials are often used. Wetter areas around ponds, lakes, bogs or mires are also used (especially in the summer) providing there are dry banks or grass tussocks for basking.	Yes, especially if it is south facing		Mow bank side vegetation down to 150mm. Do not touch the bank with weed basket.
Bufo calamita	Natterjack toad	Prefers ponds		Confined to coastal sand dune systems, coastal grazing marshes and sandy heaths. North Norfolk Coast.			Do not fill in any ponds without first consulting Environment Officer for advice on survey and timing.
Triturus cristatus	Great crested newt	Prefers ponds		GCN move away from ponds and other water during the winter to find a suitable area to hibernate such as tree roots or animal burrows.			Do not fill in any ponds, without first consulting Environment Officer, even if they become dry at certain times of the year.
Papilio machaon	Swallowtail Butterfly			Yes, The caterpillar larval stage of the butterfly feed on milk parsley, this flowers during July to September. Adults use tall mixed fen and marshes.		Yes – Caterpillars feed on milk parsley	Only use previous tracking routes for the digger that has low biodiversity value. Where milk parsley is known to grow a survey will need to be completed by an ecologist to confirm its presence. If found maintenance should be avoided so not to disturb the plant and surrounding cover. Where milk parsley is identified during scoping/walkover or local knowledge informs us of its presents this should be marked out on the ground and on the plan so it can be protected.

Schedule 5* species		Habitat Type					
Scientific Name	**Common Name**	**Water Body**	**In Channel Vegetation**	**Bankside Vegetation**	**Ditch Bank**	**Emergent Vegetation**	**Advised Maintenance Technique**
Anaciaeschna isoceles	Norfolk Hawker	Yes, the larval stage, nymph inhabits unpolluted freshwater environment for up to 2 years before metamorphosing into adult form.	The optimum conditions for breeding appear to be un spoilt grazing marsh dyke systems with clean, non- saline water, rushy margins, an abundance of water soldier and the presence of other aquatic plants.				When weed mowing leave opposite margin and if water solider is present leave water soldier and other floating plants in situ and return some of them to the water if removed.

*Schedule 5 (section 9.1a, 9.4a, b, and c) of the Wildlife and Countryside Act 1981

Instruction Notes
1. Is the drain regularly maintained?
2. If the drain is regularly maintained and habitat associated with scheduled 5 species is not present the work can continue with caution following the SMO standard.
3. Is the drain maintained on a two to 10 year rotation?
4. If the drain is not regularly maintained the Environment Officer needs to assess the drain first by a desk study and scoping visit to find out whether Schedule 5 species and / or habitat is present in the area.
5. Where habitat type is present but works timing is such that Schedule 5 or other protected species won't be present and if after the planned works, sufficient habitat will remain within a natural dispersal distance of the species then works can proceed as planned.
6. Where habitat type is present but works timing is such that Schedule 5 or other protected species won't be present and if after the planned works, sufficient habitat won't remain adjust the works to ensure it will for example reduce the extent or phase the works over several seasons
7. Where habitat type is present and works timing indicate Schedule 5 species may be present appropriate action will be taken, including a thorough ecological survey to identify the presence of Schedule 5 species.
8. If after the thorough survey species are absent, work may continue within parameters set out in 5.
9. If work is required when scheduled 5 species are present suitable licenses and assents will need to be applied for through Natural England to survey and mitigate the habitat successfully.
10. If after the thorough surveys the schedule 5 species are present further measures will need to be undertaken. Such as: a. Work methods adapted to avoid "killing, or recklessly damaging" b. Work timing adapted to avoid "killing, or recklessly damaging" c. Work abandoned and alternative drainage strategy sought or working methodology sought