Appendix 7

Beaver Management Strategy

Version	V1
Date	05.07.2019
Date of next review	31.10.2019

The River Otter Beaver Management Strategy

The stepwise approach to the delivery of the proposed Beaver Management Strategy has been summarised in the flowchart overleaf (Figure 7.1).

This illustrates how appointed beaver management staff (supported by fully trained volunteers) could manage concerns formally raised by an impacted stakeholder. Each stepwise progression through the chart is sequentially followed if any given intervention is employed and proves unsuccessful.

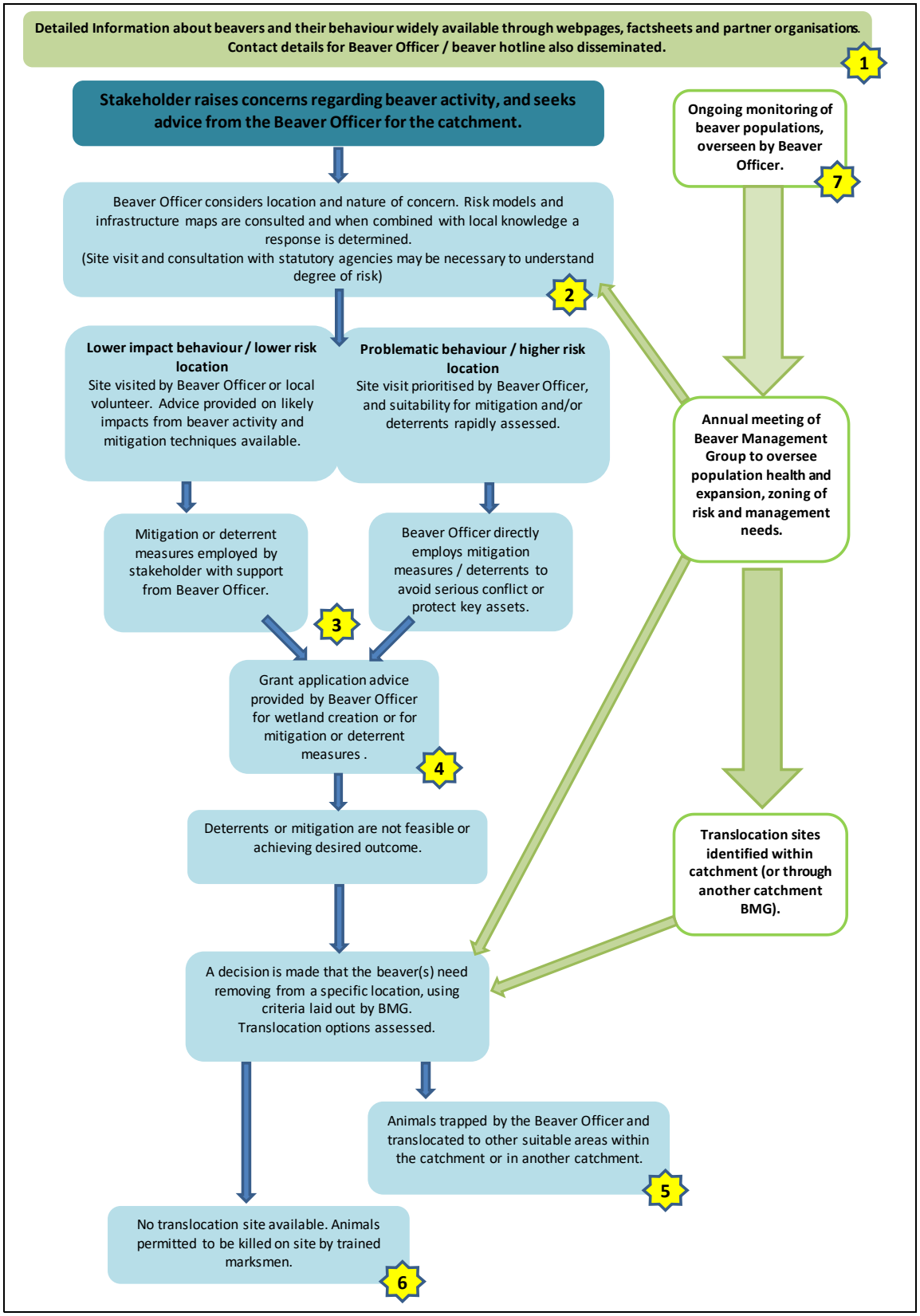
This approach has been adapted and streamlined from the flowchart successfully employed during the River Otter Beaver Trial term. It embeds the governance model described in Appendix 6 and describes how management decisions could be made for the period 2020 – 2030.

At key stages in the flow chart a numbered yellow star has been included. Supporting information associated with each star is presented in the subsequent numbered sections of the Management Strategy Framework below.

The flowchart fully embeds the core principle of adopting a management hierarchy which starts with freely available and accessible information and advice and moves to implementing avoidance and mitigation interventions. Only when these options are demonstrably unsuccessful does translocation, or finally, lethal control become a consideration.

The approach will require the need for tolerance and acceptance of lower impact beaver activity to develop, whilst ensuring more intensive support is available to those who are impacted more significantly. A key measure of success of this strategy will be that over time society's relationships with beavers will become normalised and issues previously considered problematic will be dealt with as a matter of course.

Figure 7.1 – Management Strategy Flowchart to guide beaver management approach



1 Detailed Information about beavers and their behaviour is made widely available through webpages, factsheets and partner organisations.

Eurasian beavers have been absent from the English landscape for over 300 years. As a result, much of their activity is now alien to society, often shrouded in misinformation or unhelpfully influenced by factoids. One of the most common myths is that beavers eat fish. Figure 7.2 shows how widely this view was observed amongst different sectors within national survey respondents.

There is however a huge appetite for information about beavers and their ecology, as has been demonstrated by the number of stakeholder groups that have approached the ROBT for presentations and information. It is important that stakeholder opinions are based on solid evidence as the provision of objective information tends to result in greater levels of acceptance of the species. Figure 7.3 illustrates the relationship observed in the perception survey between those that support beaver reintroduction and those with the greatest understanding of the species.

A vital aspect of raising awareness is the provision of information about potential conflicts and their likelihood. Once objective information is conveyed, stakeholders who express serious concerns regarding the presence of the species tend to become more tolerant, whilst those more ardent supporters become more understanding of the potential downsides and the need to proactively manage conflict.

If beaver activities are deemed unacceptable, subsequent management decisions must be informed and influenced by objective, evidence-based, information. Education and awareness programmes – both about beavers and land management - provide the crucial foundation from which communities are able to share landscapes with beavers.

Independently of direct contact with the Beaver Officer, all audiences must be able to freely access evidence-based information regarding beavers, their behaviour and potential impacts. In addition, information about the local context should be available to interested parties which would include:

- Beaver population data and conservation status;
- Where beavers can be seen;
- The approach to managing conflicts;
- Any legislation relevant to those managing conflicts: and
- Grants to support wetland creation in priority areas.

The majority of information would be available digitally via webpages augmented by social media. Printed factsheets and FAQs would also play an important role. In addition, the Beaver Officer with support from volunteers would deliver face-to-face advisory services, respond to general queries and also raise awareness through events programmes, landowner / stakeholder workshops and education sessions for school and community groups.

Figure 7.2 – Survey respondent answers to the question “What do beavers eat?”, presented as proportions of respondent occupations.

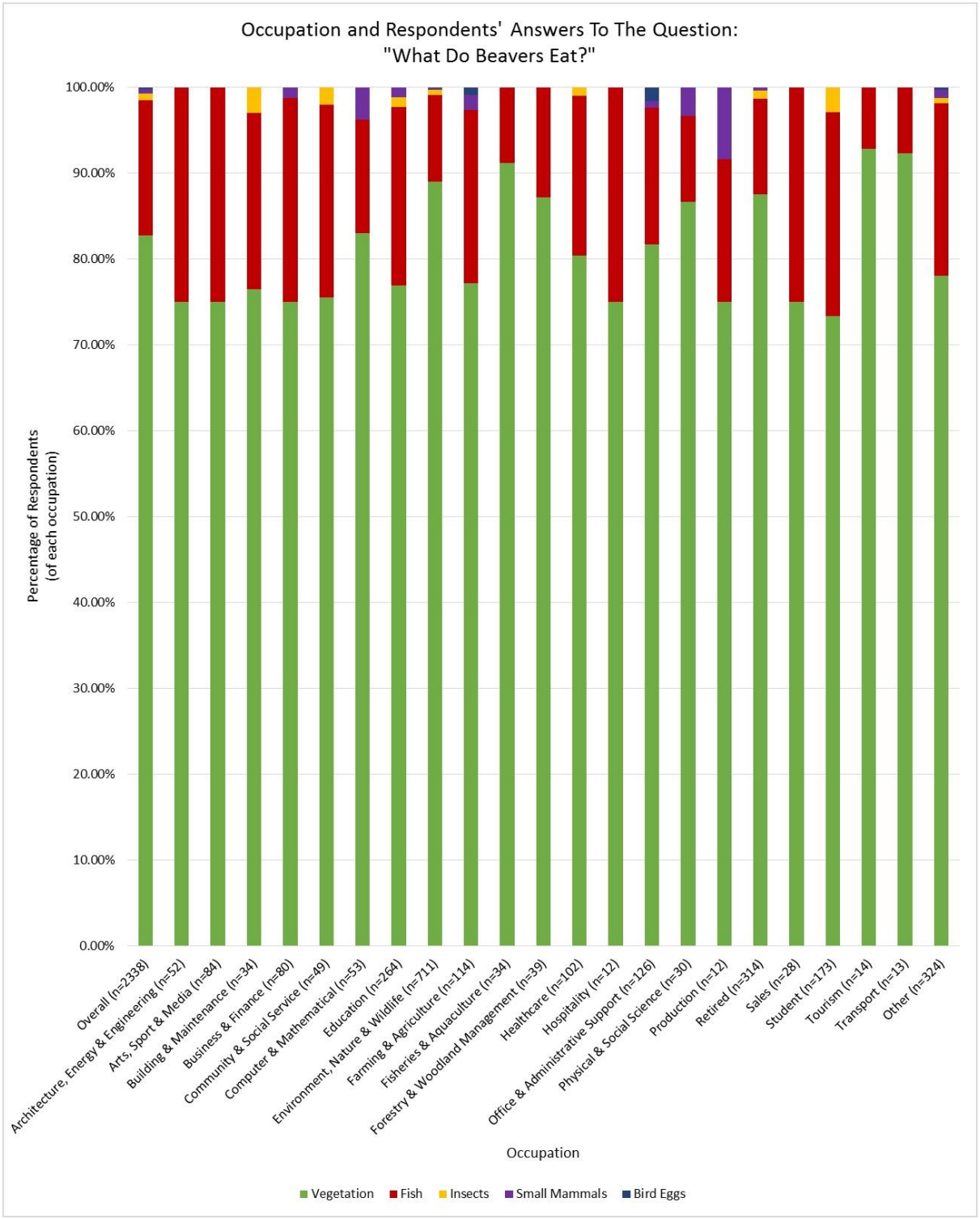
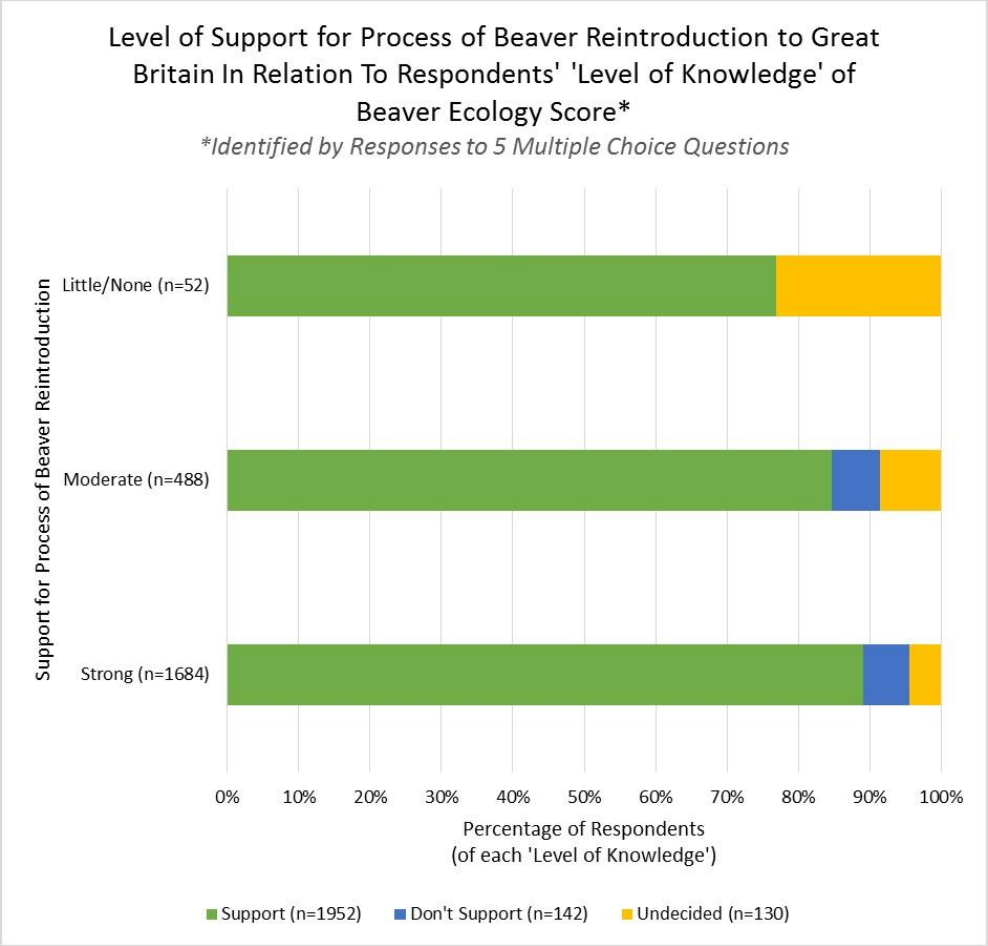


Figure 7.3 – The relationship between support for beavers and level of knowledge amongst perception survey respondents



The Beaver Management Group would also engage with key stakeholder organisations to ensure core messages were widely disseminated. More detailed training events would be provided for professional organisations advising farmers, landowners and other key groups.

This would be especially important in fostering strong connections with conservation and land management programmes operating in the catchment; for example, Catchment Sensitive Farming, South West Water Upstream Thinking, and Working Wetlands projects. This would also help ensure a coordinated approach to advice and the provision of grant support, where applicable.

2 Beaver Officer checks location and zoning of the area and determines the response.

When a stakeholder seeks support from the Beaver Officer, the detailed local knowledge of the catchment and status of important infrastructure will be critical to informing a timely and evidence-based response. Scrutiny of detailed conflict and zoning maps will allow the response to be tailored to the specific risk profile of the area, the exact location and associated severity and likelihood of occurrence. An evidence and risk-based approach will therefore be taken to prioritise advisory visits.

There will be certain beaver behaviours, such as burrowing or damming that will have different implications, and demand different responses, depending on where in the catchment they are observed. For example, a beaver dam in an urban stream or culvert, where flood risk is higher, will cause an unacceptable risk that would require immediate attention. Conversely, a series of dams in a wetland area upstream might be actively encouraged to provide flood protection to those very same properties.

Whilst it is not generally practical (or often desirable), to exclude beavers from exploring any particular watercourse within a catchment where they are widespread, it is important to differentiate between exploratory movements, and the types of behaviour that may lead to conflicts with people. These assessments will be made by the Beaver Officer on a case by case basis.

Zoning maps will be produced in partnership with key statutory organisations and stakeholders to help inform the Beaver Management Group's strategic response, and might include the following:

'Damming' low tolerance zone maps:

- Watercourses / urban streams adjacent to properties identified as at risk of flooding;
- Culverts and bridges where blockages will impede flood infrastructure;
- Civil infrastructure such Waste Water Treatment Works, or electricity infrastructure;
- EA weirs and gauging stations / hydrometric monitoring equipment; and
- Other high-risk locations identified by key stakeholders.

In some agricultural systems, landowners and land managers may regard watercourses adjacent to low lying and drained farmland as higher risk due to the likelihood of flooding or raised soil water levels and such zones should be reflected in mapping.

'Burrowing' low tolerance zone maps:

- Major man-made dams impounding water – e.g. reservoirs and large lakes;
- Flood risk management / land drainage embankments;
- Man-made canals (found in adjacent catchments);
- Riverside railway lines and other trackways immediately adjacent to steep banks;
- EA hydrometric gauging equipment; and
- Riverbanks in the immediate vicinity of bridges and roads, where burrows may cause erosion.

In some agricultural systems specific riverside agricultural fields will be considered higher risk due to the need to secure access with heavy machinery (e.g. forage harvesters) which may cause burrow collapse.

The following maps (Figures 7.4 & 7.5) illustrate how flood risk data could be used to approximately identify areas where beaver damming could present unacceptable risks to residential properties. In Appendix 5, the Beaver Dam Capacity models predict the capacity of different watercourses to be dammed, helping to target resources more effectively into those locations where the likelihood of conflict is highest. However, it is important to recognise that modelling has its limitations, that zoning maps can help to prioritise resources, and should not be used prescriptively.

Figures 7.4 - Maps of the River Tale tributary on OS base-maps. The map (left) shows properties situated within Flood Zone 2 - defined as land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%). The map (right) identifies watercourses in the vicinity of these properties where beaver dams may be unacceptable. (© Crown Copyright and database rights 2012. Ordnance Survey Licence number 100022021).

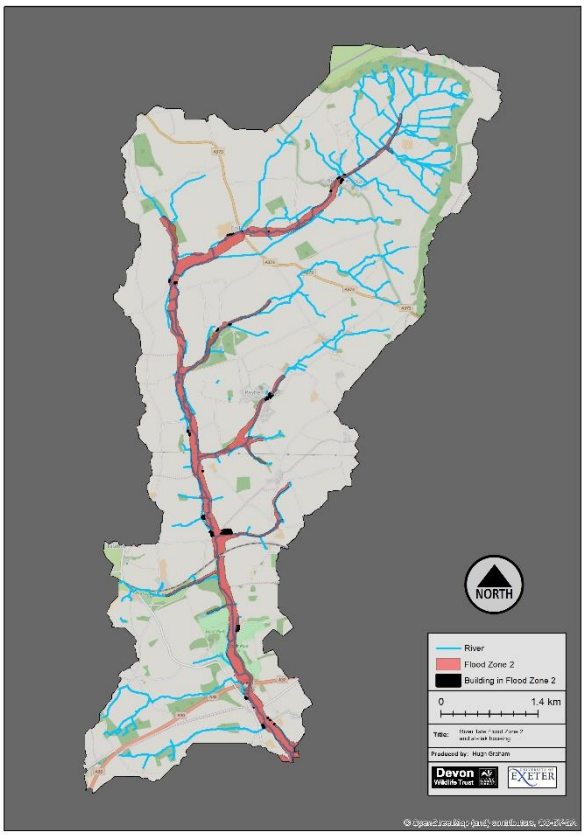
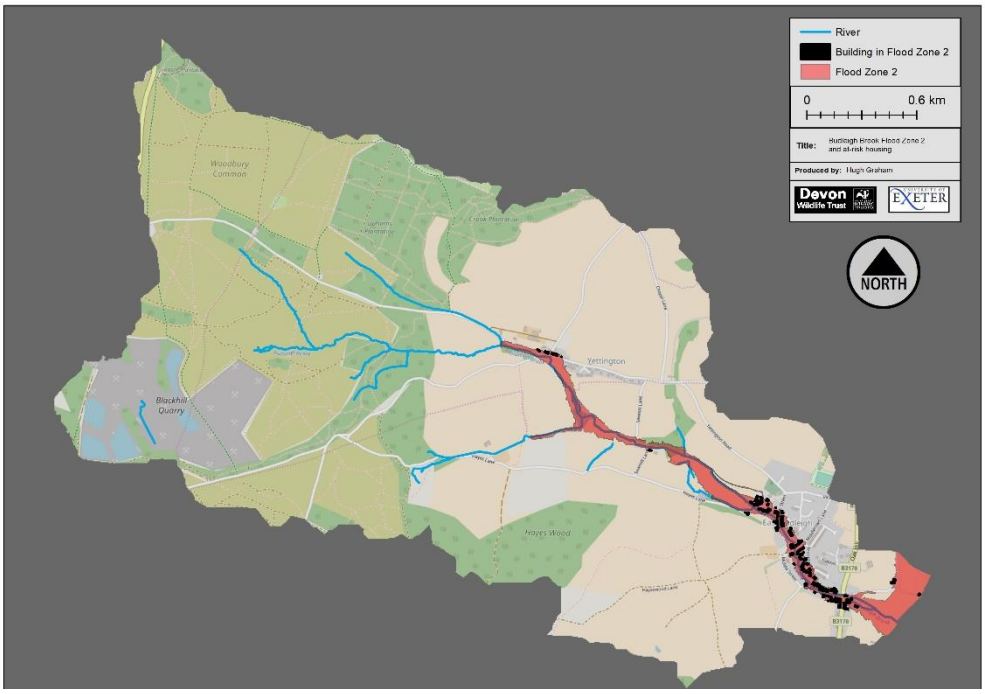
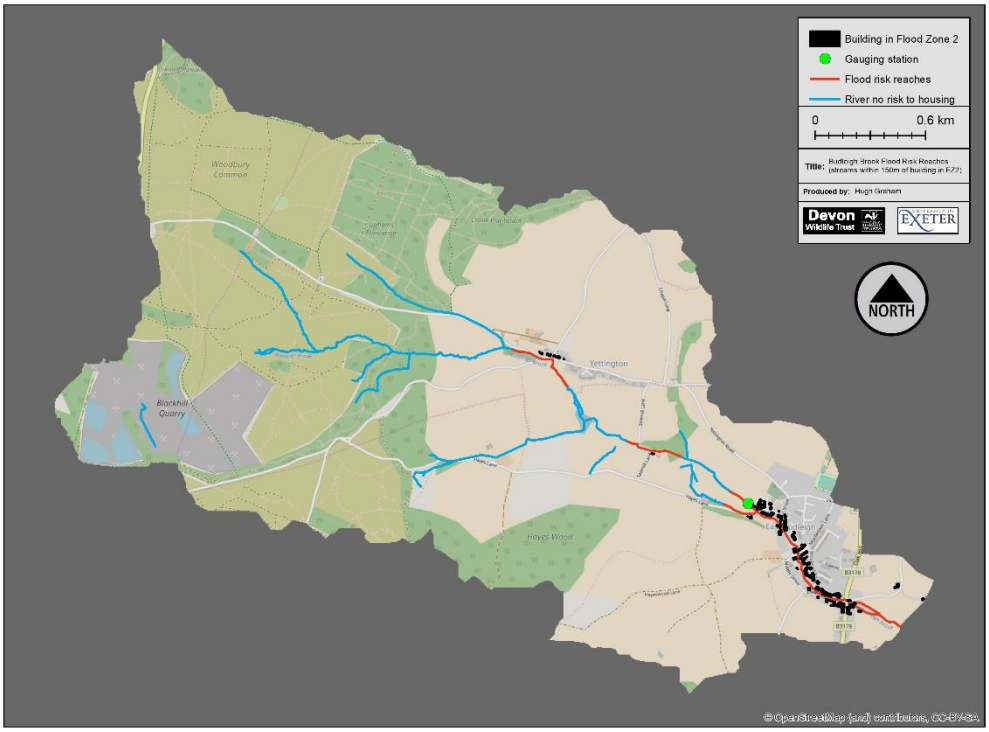


Figure 7.5 - Maps of the Budleigh Brook tributary on OS base-maps. The map (top) shows properties situated within Flood Zone 2. The map (below) identifies watercourses in the vicinity of these properties where beaver dams might be unacceptable. (© Crown Copyright and database rights 2012. Ordnance Survey Licence number 100022021).





3 Beaver deterrents and mitigation utilised to avoid conflict, or protect assets

A wide range of mitigation and deterrent measures have been developed by beaver managers in countries where beavers and people have co-existed for many years.

The Eurasian Beaver Handbook (Campbell-Palmer et al, 2016) contains detailed methodologies and is essential reading for anyone involved with this subject.

The following interventions are those most likely to be relevant to the River Otter.

Assessment of risk

On receipt of a query from a stakeholder concerned about beaver activity, an assessment of likely risk will be made (please refer to Star Section 2). In higher risk scenarios where tolerance of beaver activity is low, mitigation and deterrent intervention will be directly overseen by the Beaver Officer and made in a timely manner.

In other situations, where potential impacts are lower and tolerance is likely to be higher, advice and support will be provided by the Beaver Officer with support from field staff/volunteers (where applicable). In these circumstances, suitable mitigation or deterrent interventions would normally be delivered by the landowner, if required.

In all scenarios, advice will be given regarding grant support to provide space for wetlands within the holding, with financial mitigation support for capital works. (Please refer to Star Section 4).

High risk locations for damming and blockages

In specific locations (identified by the statutory agencies as being the highest risk), hard engineering solutions (for example, metal grills installed over culverts, or weld-mesh buried into engineered banks) may remain the most cost-effective and sustainable way to *avoid* beaver impacts over the long term.

Where engineering avoidance solutions are not cost effective or feasible, mitigation and deterrents measures will need to be employed.

High risk locations for burrowing

Where beavers have been identified regularly using areas adjacent to water management or gauging infrastructure, flood embankments or canal banks, a low tolerance approach is likely to employed.

Many embankments can be protected from burrowing, but the location of burrow entrances underwater often make activity hard to detect. The entrance to any burrow *confirmed to be unoccupied*, can be protected from further excavations by wire mesh or grills. Pliable light gauge galvanised weld mesh covering and securely pinned to the bank face is likely to be sufficient to discourage digging activity or exit/entry points. Stronger gauge weld mesh pinned or buried into the bank/bed of a water course with surrounding bank protection may be required for a burrow in frequent use. The cost of retrofitting such protection can be

significant, so pre-empting the presence of borrowing animals during any future construction or maintenance operations is important to reduce additional outlay.

Elsewhere in Europe high risk flood banks are often protected through hard infrastructure including the insertion heavy duty weld mesh or by stone facing to discourage burrowing. Sheet piling has been used where risk and impact is greatest. It should be noted, while the primary purpose of such engineered features is to provide structural integrity, it has the additional benefit of protecting against a range of burrowing species.

Where structures are set back from the main channel by a distance of greater than 30m, beaver burrowing is unlikely, however those adjacent to a watercourse may require mitigation. A future-proofed solution that may be considered in some areas is realignment of embankments. The creation of 10–20 m buffer strips of bankside vegetation, particularly wet woodland, will avoid ensure the vast majority of potential beaver–human conflicts is avoided. Such mitigation has numerous wider and more holistic environmental benefits.

It is important to note that soft engineering options are not generally feasible for deterring determined burrowing activity; however, hard revetments and sheet piling should be avoided in all but the most high-risk / high impact scenarios.

If deterrents and avoidance solutions **for both burrowing and damming in high risk areas** are not feasible, the rapid progression to the lower sections of the flowchart is likely. Measures needed to remove beavers in the future should be factored into work planning.

Mitigation or deterrent measures

Risk and tolerance	Immediate mitigation measures	Longer term techniques
Dams and culvert blocking in sensitive / high risk locations for flooding or critical infrastructure.	Repeated manual removal of dam or blockage. Ongoing monitoring and removal by local volunteers.	Engineered culvert protection measures where applicable. Removal of dam building materials from vicinity. Trapping and removal of beavers.
Landowner / farmer concerned about impacts of dams on drainage of agricultural land.	Information and grant support, in first instance. Repeated removal of dams.	Flow device / pipe through or around dam to lower water levels (consent may be required). Changing land-use or cropping to discourage damming.

		Culvert protection fencing if appropriate.
Anglers / river users concerned about beaver dams impacting on fish passage in a particular location.	Information provision. Employ PAD protocol to facilitate passage in high risk locations prior to high flow events.	Research and monitoring of fish populations and migration in beaver hotspots.
Burrowing presenting a risk to key engineered structures – dams, floodbanks, canal banks etc.	Clearance of vegetation providing cover for the beaver – detailed routine inspections facilitated. Bank protection works using weld mesh / revetment. High intensity monitoring by stakeholders and / or volunteers.	More permanent engineering of structures to make them beaver proof. Exclusion fencing from key areas if feasible. Trapping and removal of beavers.
Burrow collapses impacting on agricultural activities.	Information provision to operators of heavy machinery. Surveys of burrows prior to use of heavy machinery. Manual filling of collapsed burrows.	Buffer strips between watercourse and agricultural activity.

The removal of beaver dams

Many dams are temporary structures that are naturally washed out during periods of high river flows. They are constructed for a range of reasons, and their removal will likely have no significant detrimental impact on the beavers.

However, removing dams will often stimulate beavers to rebuild again, usually coppicing additional trees and other material available such as hedge growth. In the River Otter, for example, we have observed localised impacts where hazel in hedges adjacent to dams has been preferentially selected by the beavers as a building material.

As watercourse levels rise during the autumn period an increase in dam building activity is often observed. Complete removal may be more successful if a sustained effort is made at this time of year. If dams are allowed to become established into the spring, and burrows or

lodges are constructed in the deeper impounded water, they have the potential to become natal lodges (where females will give birth, usually in May) and raise kits over the summer months. Complete removal of dams protecting natal lodges has potential welfare implications and, in the event that beavers become protected, may be subject to future licence consideration.

As well as potentially protecting natal lodges, significant established dams are harder to remove. They are often complex interwoven structures and are often firmly embedded in the surrounding land and the use of a grab or digger bucket may be required to remove them.

The removal of dam structures must be carried out in a manner which reduces the risks of rapid release of sediment and water downstream.

Flow devices (Beaver deceivers)

This is the collective term used for various techniques to lower impounded water levels by installing piping through a beaver dam. The design of the pipe structure allows beavers to continue damming activities without effecting the height of the impounded water which is carefully regulated by the drainage piping. Several key features are important for this management technique to function correctly, so expert advice and practical support is required. Flood risk activity consent from Statutory Agencies is also likely to be required.

Although this technique has important applications it should not be seen as a panacea to solving the impacts of problem dams. This is due to the capital infrastructure required and the negative impacts of a proliferation of artificial structures in watercourses that would need to be maintained and at some point, decommissioned. There are also likely to be more impacts on fish passage than if high water levels are naturally able to flow over the dam (bypass channels).

Protocol for the Assessment of Beaver Dams to Aid Fish Passage (PAD)

As part of the ROBT, the PAD protocol has been developed and trialled. The methodology assesses the physical features of a beaver dam and quantifies the likely impact on the movement of migratory fish. A flow diagram allows managers to make informed decisions on whether to intervene at a dam where there are concerns related to fish passage, by using a series of intervention tools that would help address the potential issues that a dam could present.

For example, notching a dam to concentrate water flows, and reduce the height of the structure prior to autumn high flows may facilitate the passage of adult sea trout migrating upstream during that next flood event.

It’s important to stress that notching dams or lowering the crest height is usually a temporary measure as beavers will often repair the dam. It is particularly relevant for watercourses where anglers are concerned about fish passage and have the resources available to carry out regular, targeted interventions and monitor their effectiveness.

Exclusion fencing of watercourses

In specific smaller watercourses where there is a high risk to key infrastructure, it may be feasible to exclude beavers from an entire length of channel by installing exclusion fencing. This relies on the semi-aquatic nature of the species and the fact that they primarily move along, and will not stray far from, watercourses. Each installation will be unique to the water course and design would need to be guided by an experienced consultant who would also take into account impacts on other species, for example, otters. Consent for in-stream works is likely to be necessary.

Exclusion fencing often incorporates a secure grill / culvert across the watercourse, reinforced by two 'wings' of fencing that extend outwards and angled downstream away from the watercourse. The barrier 'wings' are designed in such a way as to turn beavers back to the watercourse.

Trialling deterrents

The use of artificial scents / chemical deterrents, flashing lights and ultrasound have been cited as being effective at deterring beavers in specific locations. Any techniques that prevent beavers using a discrete area within an occupied catchment have significant potential to resolve conflicts, but further development and trialling of different methods is required, including investigating impacts on other mobile species (such as otters). Further research in this area is recommended.

4 Grants provided through the Beaver Officer for wetland creation or for any mitigation or deterrent measures.

To support the widespread tolerance of beaver activity, and to enable space to be provided for natural riverine processes, the Beaver Officer needs to be able to offer financial support for landowners/land managers. This would be for annual revenue support and/or capital mitigation installations.

The following proposed approach to an Environmental Land Management Scheme (ELMS) has been presented in full so it can be extracted for external advocacy work.

Introduction

Beaver dams can slow water flows and intercept significant volumes of soil sediment and associated nutrient pollutants which enter watercourses. Beaver activity can also bring additional benefits by raising the water table and providing moisture to grass and crops which would normally be under drought stress. There will however be cases where landowners will be impacted negatively by beaver activity, where for example a substantial proportion of a field parcel (or parcels) are waterlogged as a result of damming. Beavers may also impede existing farming practices by restricting access by machinery and livestock and reducing the period and frequency when access can be gained to fields without causing damage (e.g. soil compaction).

The ROBT Steering Group have considered how farming and rural land use businesses can be encouraged and supported to provide space to work with natural riverine processes that are strongly influenced by beaver activity. Providing financial incentives and associated advisory support for landowners, whose land may or may not be impacted, would present significant challenges to current agri-environment programme scheme design which relies on certainty of output, both spatially and temporally.

A pragmatic, enabling and non-bureaucratic grant scheme will help to ensure beavers are considered less of a risk to farming and landowning interests especially within agriculturally productive river catchments, whilst maximising considerable natural capital outcomes.

Key Principles

The ROBT Steering Group has developed the following key principles which will contribute to the delivery of widespread and far reaching environmental and natural capital benefits arising from beaver activity and help ensure negative impacts are minimised and/or tolerable.

- Wherever possible and practicable, financial support must be available for landowners who provide space for beaver generated wetlands which provide multiple ecosystem services. These incentives should be long-term and complement cross-sectoral policy priorities and could integrate with emerging public/private Payment for Ecosystem Services (PES) mechanisms;

- On-site and one-to-one advice should be available to landowners in relation to managing existing and/or potential beaver impacts through grant programmes;

- Flexible and pragmatic mechanisms should be available whereby appropriate funding supports impacted or at-risk landowners and land-managers to mitigate beaver impacts;

- Landscapes where the presence of beavers would provide considerable public benefit should be identified and landowners incentivised to provide space for beaver colonisation and associated wetlands;

- The grants will be fair and not be unnecessarily complicated;

- Revenue grants will be open to all those that derive a direct income from the land (agriculture, horticulture and forestry) and / or those with a registered holding – minimum scheme value will apply;

- The grants will explicitly incorporate the principles of natural capital benefits derived – payments will be based on services provided, not income foregone;

- Grants will be driven by outcomes and evidence of what works and will not rely on generic prescriptions;

- Support will be based on trust and 1:1 co-operation with advisors, helping to reduce unnecessary administration and form-filling;

- Grants will encourage and facilitate new thinking, innovation and new solutions – a one size fits all approach will not be successful if applied to species with highly dynamic activities;

- Support packages will be co-designed and delivered by farmers, land managers and conservation sectors in partnership at both the scheme and agreement level.

There is also a wider principle that should be considered which relates to who the responsible party is, for funding mitigation works. The principle is that the party who is impacted typically needs to fund mitigation works; this may not be the property owner where the dam or activity is located. The principle is based on the fact that beavers are wild animals and not under the control of the property owner and therefore the property owner is not liable for the beaver's actions.

The Scheme in a Nutshell

The following proposal has a foundation in the core principles introduced above. It provides a framework from which a New Environmental Land Management Scheme would be developed. The BMWG and ROBT Steering Group have liaised with a wide range of external stakeholders and organisations involved in the design, delivery and administration of the new ELMS which has informed the development of this initial proposal.

The scheme will have two core stands:

1. Revenue Grant

Annual revenue payments are made to applicants who:

- allow space for natural riverine processes;
- encourage the colonisation of land by beavers through the provision of suitable habitat;
- provide space for raised water tables, slowing down peak water flows and activities which improve water quality.

Anyone with a registered holding and Single Business Identification (SBI) will be able to apply.

2. Mitigation support

This capital fund will be open to anyone who owns land (residential, commercial, agricultural, horticultural, forestry etc) and/or is impacted by beaver activity. The mitigation activity does not need to be located within the applicant's land-holding but the applicant will require consent for work to occur and guarantee that the intervention will be managed and maintained for as long as it is necessary, and then fully decommissioned. Additional capital work would be eligible for further funding.

<u>The Approach</u>

Revenue grant

Step 1 – Priority landscapes where beaver activity will provide significant multiple public benefits are identified and prioritised for grant funding support. Landscapes will normally be identified at the sub-catchment level.

Step 2 – Landowners in priority catchments are informed and invited to join the scheme;

Step 3 – An application is submitted by landowner. A basic Water Environment Record (WER) is produced by the landowner who identifies all watercourses and waterbodies on the holding and their characteristics, associated vegetation (e.g. scrub, tall herbs, fen, rough grassland etc), land use and landform.

The WER would identify locations of buffers alongside watercourses which would be a minimum of 2m from the top of bank alongside each watercourse on the holding. Wider buffers / complementary habitats, incorporating adjacent low-lying land would be an optional extra, and could include existing unproductive land / semi-natural habitats, or additional land taken out of production that could become seasonally or permanently flooded.

This WER is then assessed for suitability (possibly associated with the Beaver Dam Capacity (BDC) model which identifies the capacity of a watercourse to support beaver dams and overlays associated risk) and a base payment is granted to all landholdings based on length of watercourse which could foreseeably be occupied by beavers. This base payment would include support to secure the minimum 2m buffer. An additional area payment would also be made on beaver buffers greater than 2m.

The grant application would trigger a mandatory visit from the Beaver Officer who would provide advice and raise awareness of beavers, field signs, their engineering activities, mitigation techniques etc and wider catchment sensitive farming activities. Advisory visits may occur at the farm cluster scale.

The landowners who receive the base payment would be required not to carry out any identified activities which would deter beavers from their land. Buffer strips of at least 2 metres from the top of the bank of the watercourse must be in place throughout the scheme term. The strips would not need to be fenced but would not receive any annual mechanical activity or agricultural inputs but may be lightly grazed.

Step 4 – Biannual monitoring by the agreement holder of all mapped watercourses.

All watercourses will be monitored by the agreement holder. If beaver activity commences mapped evidence submitted (31st March / 30th September) which identifies:

- impounded water / open water (due to beaver activity); and
- land with high water table i.e. <5cm from surface (due to beaver activity).

Step 5 – Annual (in arrears) payment for beaver modified landscapes.

Payments would be based on the extent of impounded water and/or waterlogged (or seasonally waterlogged) land. This figure would be rounded up to the nearest 0.5 hectare.

A further supplement would be available dependent on the field size and the proportion of the field which is waterlogged. This supplement takes into account the impacts beaver would have on the normal agricultural management of the field.

Proportion of field	**Supplement**
0 -10%	Nil
10 - 25%	10%
25 - 50%	25% supplement
>50%	50% supplement

<u>Mitigation capital works</u>

Mitigation payments will be available to:

- Minimise or eliminate impacts to key infrastructure in the catchment, such as devices to protect culverts from blockages, and revetments to protect dams from burrowing activity;
- Resolve circumstances where beavers impede existing agricultural practices such as access for machinery and livestock which occur and extend beyond any field parcel which receives grant funding; and

- Pay for flow devices to regulate the height of beaver water impoundments. Payment would be made via a standardised item list, or for larger bespoke activities, through 'special project' procurement, including a competitive tendering process for projects over a threshold value. Payments would be considered in the context of any consents and permitting requirements (and associated conditions) which may be required.

Example Cost Calculations

The range of holdings and associated farming systems within the River Otter are diverse. We have however, for illustrative purposes, created a hypothetical holding with riverside land typical of the middle reaches of the catchment where a range of beaver activities are expected to take place. The example farm extends to 100 hectares and includes:

- 0.8 km of 'main river' watercourse;
- 5.6 km of 'ordinary' watercourse; and
- 2 wildlife ponds.

An annual payment (£20/hectare) of £2000 would be paid following the submission of the WER and establishment of the 2m buffer (from top of bank).

Following submission of the WER, the farmer was visited by an advisor who assessed the capacity of the watercourses to support beaver activity. Acting on this advice and information, the landowner also chose to increase the width of buffer in intensive grasslands by a further 6m (fenced) alongside both banks of the main river (1600m @ 6m width = 9,600 m^2) and on 2000m of other watercourse in the holding (2,000m @ 6m = 12,000m^2).

9,600m^2 + 12,000 m^2 = 2.16 ha of buffer strip options

This attracts a payment of £300/hectare @ 2.16 hectares = £648 / annum

In addition, fencing capital works (single strand of high tensile) were claimed.
3,600m @ £2.50/m = £9,000

In year three, beavers were active in one ordinary watercourse and their damming activity led to 2 hectares of seasonally inundated water, much of it within the existing buffer strips. Photographic evidence and maps were provided by the landowner to show extent of inundation in support of their claim. A retrospective claim for £1000 (£500/hectare) per annum was subsequently made. In addition, as 50% of the field was inundated a 25% supplement was provided (£250).

The beaver activity impeded access for livestock and farm machinery between low lying fields so capital works support for cattle crossing point was provided.

In total the ten-year scheme provided the following annual management support:

Option / activity	Number of years	Annual payment
Water environment grant	10	£2,000
Buffer strips – 6m width	10	£648
Beaver activity – seasonal inundation	7	£1,250
	Total / annum (year 1-3)	**£2,648**
	Total / annum (year 4-10)	**£3,898**
	Total (10 years)	*£35,230*

The total capital works claims were as follows:

Option / activity	Number of years	Annual payment
Fencing (high tensile)	N/A	£9,000
Cattle crossing	N/A	£750
	Total	**£2,648**

5 Animals trapped by Beaver Officer and translocated to other suitable areas within the catchment or in another catchment.

Trapping and translocation of beavers may become an increasingly important tool over the lifetime of this framework. It must only be carried out by suitably trained and licensed personnel using traps certified as humane. This would ensure legal standards are met, and that live trapping is carried out in an exemplary manner in accordance with the principles agreed by the Beaver Management Group.

For the lifetime of this plan, translocation of beavers away from conflict zones has the potential to provide animals for releases elsewhere (subject to licence by Natural England), whether enclosed or for other wild releases.

Funding for trapping and translocation may be available from the destination project, but otherwise it is anticipated that it would be an integral responsibility of the Beaver Officer role, supported through the Beaver Management Group.

Trapping techniques

An important tool in successful beaver management at a catchment scale lies in the specific identification, capture and translocation of the individuals or the entire family which are causing the identified problem. The proactive management of the genetic health of beaver populations may also require the trapping and translocation of beavers between areas.

To ensure highest welfare standards beavers must only be trapped using specifically designed traps for the species. ‘Bavarian’ design beaver traps are recommended and are certified by Defra to conform to the Agreement on International Humane Trapping Standards (AIHTS) – please refer to image below.

'Bavarian' style beaver trap

Methods for the live trapping of beavers varies between countries. In North America 'suitcase-type traps' such as Hancock and Bailey traps are in regular use. Their use has been permitted in Britain however they present a higher risk of injury to beavers and other wildlife than Bavarian style traps.

Correct placement of traps which relies on effective beaver field craft is crucial to success, whilst always ensuring exemplary animal welfare standards. Trappers must be aware of any likely fluctuations in the adjacent water levels which would endanger any captured animals and must ensure that traps are set away from possible public interference. They must be checked at least once a day when in operation, ideally being set in the early evening and then checked the following morning and then locked shut during daylight hours. The use of Short Message Service (SMS text) trap alarms which send messages to mobile phones when traps have been triggered is recommended, especially when larger numbers of traps have been deployed.

Any trapping must cease when heavily pregnant females and/or dependent juveniles are potentially present (April–September), unless there are overriding risks arising from the beaver population, or specific welfare concerns. In these circumstances more frequent checks, or the use of electronic trap notification systems is recommended.

Reports of the use of inappropriate traps (e.g. fox traps) have been documented which have resulted in beaver injury and/or escape and/or damage to traps.

Translocation to new wild location

Trapping and translocation of beavers is a viable management tool in specific circumstances. Under appropriate licensing, translocation provides a cost-effective source of beavers for licenced reintroduction projects, if the health and genetic status are considered favourable. As most areas of suitable habitat become occupied, translocation within the catchment will become less applicable. At this point, the ability to move beavers into other catchments will represent an important medium-term solution.

Translocation requires diligent planning and preparation. Key considerations are to:

- Ensure early communication with Defra / Natural England to obtain necessary licence permissions;
- Early identification of suitable release sites with landowner permission;
- Confirming the health status of beavers;
- Agree post-release monitoring plans for the beavers;
- Ensure the release site does not immediately disrupt extant core territories;
- Wherever possible and practical, pairs or family groups of beavers should be trapped and released together;
- Secure local community awareness and support, including nearby landowners.

It would be prudent to establish a best practice standard for beaver translocation to ensure activities are well planned and these factors are properly considered in all circumstances.

Transport and Holding facilities

The transport of beavers must only be undertaken in specially constructed transport crates. Transportation must be in well-ventilated vehicles or trailers, in cool conditions, to ensure that the beavers do not overheat. Beavers from different families should never be mixed in the same crate, as they are likely to fight and inflict serious wounds.

It is prudent to plan for specific circumstances where holding beavers for a limited time is required. If animals are being trapped and prepared for release elsewhere it may be desirable to keep paired animals or family groups together. On occasions beaver may also need to be held for health screening or veterinary purposes, or during recovery and rehabilitation following injury.

Suitable facilities where beavers can be held for short periods should therefore be identified (and modified if necessary) in advance. Prior planning will ensure exemplary biosecurity and welfare standards are met.

Key features for appropriate temporary holding facilities

- Access to ample fresh water that can be frequently drained and refreshed. The water should be deep enough for animals to completely submerge. Beavers will defecate and drink from this water, so hygiene is of paramount importance. Any water in and out-flows must be reinforced to prevent beaver escape – all drained water must be disposed of in a manner which does not compromise biosecurity and conform to all required consents;
- Appropriate fencing that retains animals and prevents digging, climbing and chewing. Steel sheet livestock walls are ideal. Any trees or fellable materials close to the fence line should be protected;
- Beavers should have access to a sheltered part of an enclosure to retreat to whilst management procedures such as cleaning occurs. Ideally these should allow animals to retreat and be held for their welfare and safety of staff;
- If several beavers/beaver families are being kept at the same facility, visual barriers between each pen must be installed. They should be prevented from any physical contact, and ideally have separate water sources, as chemical cues from unknown animals may also lead to stress;
- Providing the appropriate diet is crucial to maintain beaver health and welfare. Access to fresh plant material to browse on a daily basis is critical for nutrition (especially fibre) and behavioural considerations. Diets of captive animals have often been based on apples and root vegetables, which are not suitable for longer term captive care as body condition decline has been observed. Sudden changes in diets should be avoided as these impact on animal health. A wide variation in wild food stuffs should be offered as far as possible.
- All staff involved in beaver husbandry must be well trained and have expert supervision. The captive husbandry guidelines for this species have been published (Campbell-Palmer et al., 2013) and should be closely adhered to.

6 **No translocation site available. Free roaming animals permitted to be killed by trained marksmen or through the BMG.**

Lethal control

The final step of the management hierarchy for beavers is humane lethal dispatch. The BMSF clearly outlines the steps that would be required and rigorously evidenced before this option would be considered. During the establishment and building phases of population growth, where new sites can be identified for beavers to be translocated, it is not envisaged that lethal control would be required (except for cases of humane dispatch for welfare purposes). However, in the longer term, as beaver populations expand, humane lethal control may ultimately be an important last resort tool in the management of the species.

Currently outside of Scotland, beavers can be legally shot without licence, provided landowner permission is granted, and firearms and animal-welfare legislation are properly considered and complied with. However, this situation would be influenced if the legal status of beavers was to change.

The BMSF for the River Otter recommends that free shooting (i.e. freely roaming beavers - not trapped) of beavers is the most humane and appropriate method of killing. This must be carried out by suitably licensed personnel, trained in humane beaver dispatch. A closed season must be rigidly adhered to, to ensure high animal-welfare standards are upheld.

There are alternative methods of killing which have been considered which the Working Group has concluded to be less desirable in normal situations. Trapping and shooting of beavers and euthanasia of trapped animals (through injection by a qualified veterinary surgeon) are possible options (under licence). Trapping increases stress levels of the animals and also increases the risk to the health and safety of the people involved. There are exceptional situations however where these options may be employed – for example where the health status or positive identification of an individual was required. As such we recommend this technique is available, but its use limited to very specific, fully documented, and licenced cases.

7 Ongoing monitoring of beaver populations

Population monitoring

Through the course of the River Otter Beaver Trial, survey methods developed elsewhere have been adapted to allow the approximate size and distribution of the beaver population within the river catchment to be annually mapped. This methodology is based on an annual systematic survey of all the woody feeding signs within the catchment. This allows GIS 'heat maps' to be generated providing an annual snapshot of the approximate beaver territories within the catchment. This survey work is conducted between January and March when the woody vegetation field signs are fresh and also most evident due to low riverside vegetation levels. The survey results reveal an approximate number of family groups at the start of each breeding season.

All trees impacted are recorded directly into a GIS package using a handheld Trimble device (<1m accuracy) with a laser finding facility for recording exact co-ordinates for trees in inaccessible locations (e.g. on adjacent river banks). For each tree where any feeding signs are identified, the following information is collected:

- the exact coordinates;
- the species of tree;
- the distance from the river bank (+/- depending whether the tree is over the water or the land); and
- an impact category is selected – high, medium or low based on agreed criteria.

This methodology has been employed annually on the River Otter catchment since March 2015. The results provide invaluable insights into the beaver's territories, and it is recommended that this work is continued annually for the period of this framework.

However, the monitoring of beaver colonisation should be viewed as a snapshot in time with occupied areas and impacts in a dynamic state of flux within a pattern of site occupation and occasional abandonment.

Attempts to estimate the *actual number of beavers* in the catchment becomes less feasible and reliable as the population increases. Using this method, it is possible to estimate the numbers of *family groups* which is a more robust way to describe the population.

Monitoring animal health and welfare

The monitoring of general body condition by field observations and camera trapping provides a very important indication of the health of animals within the population. However, if these visual observations give cause for concern, then trapping and more detailed health screening should be carried out.

This information can be complemented by thorough health assessments of any animals trapped for other purposes, as well as the collection of bodies (e.g. recovered from road traffic collisions). A post mortem protocol has been developed by the Scottish Beaver Trial.

A similar programme for collecting and analysing dead otters has been established and funded by EA and Cardiff University:
https://www.cardiff.ac.uk/otter-project.

The genetic diversity of the River Otter beaver population is limited due to the small size of the founding population, and longer-term monitoring and management of this is essential. At the time of writing four additional beavers have been translocated, under licence, to the River Otter to diversify the genetic health. As beaver populations develop, sampling at a population level every few years (in line perhaps with cadaver health screening) is likely to provide sufficient information on general population genetic diversity. Beaver hair sample collection has been employed in other genetic studies and techniques may be sufficiently developed in future years to be employed in the River Otter. Further development of beaver genetic markers would be advantageous, working with the Royal Zoological Society of Scotland who currently carry out this work in Britain.