Beaver Management Strategy

A strategy for addressing the risks associated with a free living beaver population on the River Otter

River Otter Beaver Trial

January 2016

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Photo of Eurasian beaver feeding on coppiced willow shoots.
C. David Plummer / Davidplummerimages.co.uk

The River Otter Beaver Trial is led by Devon Wildlife Trust working in partnership with The University of Exeter, the Derek Gow Consultancy, and Clinton Devon Estates. Expert independent advice is also provided by the Royal Zoological Society of Scotland, Professor John Gurnell, and Gerhard Schwab, an international beaver expert based in Bavaria. In addition to the generous support of DWT members and others who have donated to our appeal, the trial is also funded by The Royal Society of Wildlife Trusts (RSWT). The ongoing complementary research work at the enclosed beaver trial near Okehampton is funded by Westland Countryside Stewards.

1. Introduction and purpose of this Strategy

On 2nd February 2015, Devon Wildlife Trust (DWT) on behalf of the River Otter Beaver Trial (ROBT) partnership, was granted a licence by Natural England (NE) under section 16(4) of the Wildlife and Countryside Act 1981, to release Eurasian beavers, (*Castor fiber)*, into the River Otter catchment in east Devon.

The objectives of the ROBT as outlined in the licence application were as follows:

- Identify and assess impacts of beavers on habitats, wildlife, built infrastructure and local communities.
- Identify wider public benefits associated with beaver activity in the landscape.
- Develop an effective management process for a free living beaver population.
- Understand the ecology, behaviour and population dynamics of a beaver population in a lowland, productive, agricultural landscape.
- Increase knowledge and awareness with local communities and other key stakeholders of beavers and their interactions in the landscape.
- Provide data and evidence to augment national knowledge base re beaver re-introduction.

The Management Strategy

One of these objectives; *to develop an effective management process for a free living beaver population*, will be delivered through this strategy, which will provide a framework under which beaver impacts and conflicts will be managed in the River Otter catchment over the 5 years of the trial. This will be primarily by the ROBT Project Team, and complements the ROBT work plan which forms the basis of the implementation of the trial

The Strategy builds on the Risk Assessment submitted as part of the licence application. The impacts included within this Risk Assessment have been specifically incorporated into Section 6 of this report, and are highlighted and developed further where necessary.

The Strategy is a document that will be kept live and under regular review as the trial progresses and further impacts and conflicts are identified, and as mitigation measures are piloted and refined. At the end of the trial, or before if appropriate, techniques and procedures piloted here, can be rolled out into other areas where beaver conflicts may occur.

In the event that the species becomes a European Protected Species (EPS) during the course of the trial, this document will be used to outline procedures that will be followed to ensure a pragmatic and tested approach can be swiftly adopted to resolve conflicts.

It should be read with reference to the "Ecology and Management of the Eurasian Beaver" (Campbell-Palmer *et al,* in draft) which contains the appendices outlining the detail of mitigation measures and techniques that can be used to resolve conflicts.

2. Legal context

Current Legal status of beavers in Britain

As of September 2015, the Eurasian beaver is not protected under Schedule 5 of the Wildlife and Countryside Act 1981 or under the Conservation of Habitats and Species Regulations 2010. However the Infrastructure Act 2015, added the Eurasian beaver to Schedule 9 (Part 1B) of the Wildlife and Countryside Act 1981, making it an offence to release them into the wild without a licence.

Potential changes to legal status

The implications of any decision to change the status of the species in Scotland, and the addition of the species to Schedule 9 of the Wildlife and Countryside Act are not yet clear. However it seems likely that they may soon be added to Schedule 2 of the Conservation of Habitats and Species Regulations 2010, so affording them European Protected Species status in the UK with the same legal protection as species such as bats, otters, dormice and great crested newts.

In this eventuality, activities relating to beavers carried out under the River Otter Beaver Trial will be covered by a Project Licence, issued by Natural England. A Class licence will also be issued by Natural England to enable statutory bodies associated with the ROBT (e.g. Environment Agency, Devon County Council) to carry out routine maintenance and emergency works which may impact on beavers and their activities.

In 2016, beavers will be added to Schedule 6 of the Wildlife & Countryside Act (additional prohibited methods); this means that a licence will be needed to use a cage trap to take them in preparation for the implementation of the Agreement on International Humane Trapping Standards (AIHTS) in July 2016.

Licence conditions most pertinent to this strategy

- A management strategy developed in consultation with major riparian land owners / right holders and statutory bodies that have a role in the management of riparian features must be produced and agreed with Natural England by 30 September 2015.

- Any reports of beavers in adjacent catchment areas must be reported to Natural England and followed up by the licensee. If confirmed, all reasonable attempts must be made by the licensee to trap and identify the beaver.

- All beavers released must be marked with digital identification chips and an individually identifiable ear tag. This includes any beavers caught subsequently during the project that are found not to have an identification chip.

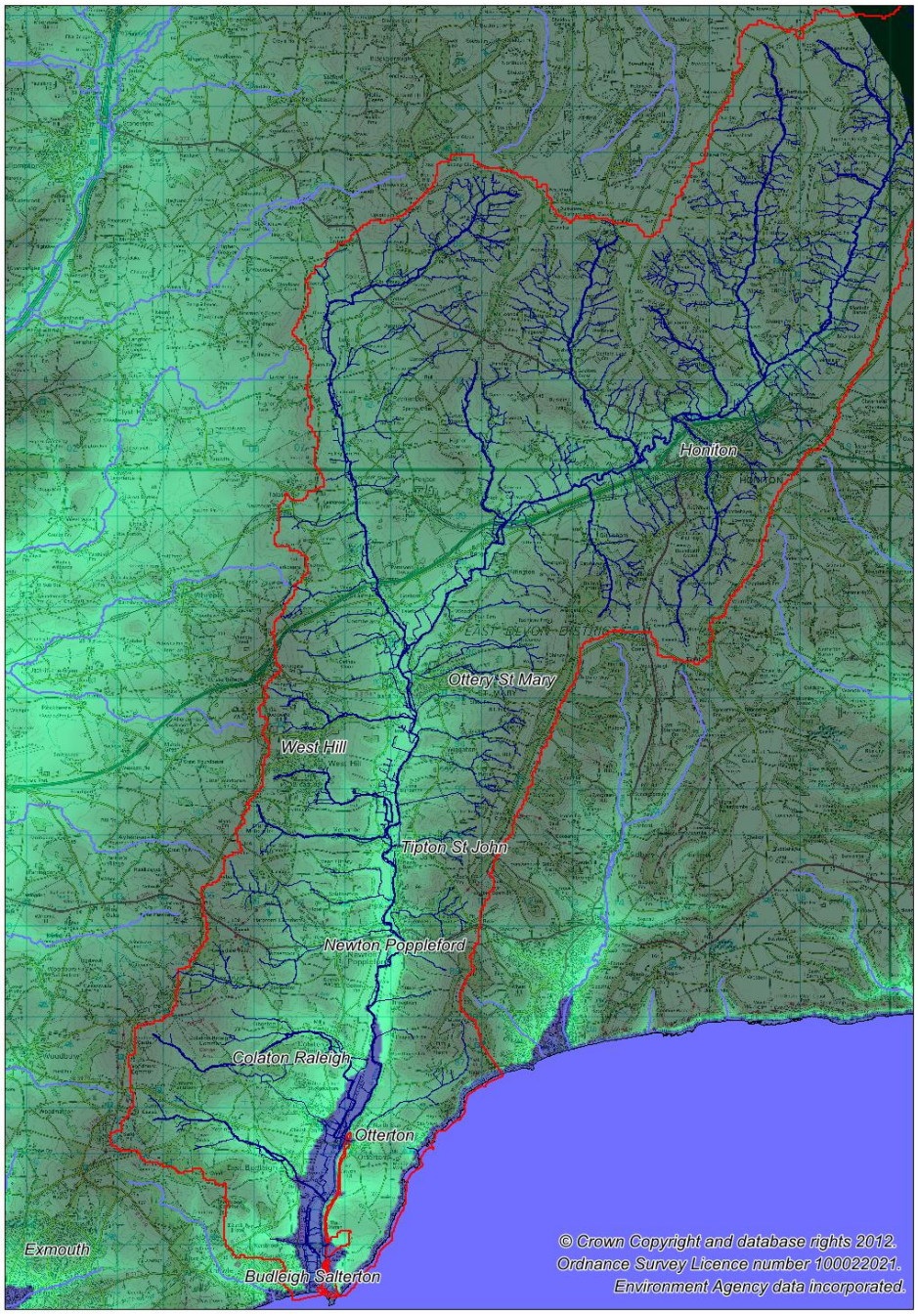
- Any impacts of beaver activity on or adjacent to protected sites must be closely monitored and Natural England kept informed.

All captured animals were fitted with ear tags. Photo Nick Upton / Naturepl.com

Environment Agency (EA) / DCC consents under Water Resources Act

The creation of in channel and floodplain structures, or other works in such areas, may be subject to the necessary consents under the Water Resources Act and/or Regional Byelaws and any proposals will be considered independently on their merits by the relevant authorities. Any proposals for such measures should be discussed with the local EA office at earliest opportunity.

A Map of the River Otter catchment with shaded relief



3. Beavers in the River Otter – past and present, and scenarios for future

The earliest of evidence of Eurasian Beavers living wild on the River Otter in East Devon in recent times dates back to 2007. At this time the activity was focused around the Fenny Bridges area, where a dead male was later recovered in April 2012.

Detailed survey work carried out by ecologists from the Animal and Plant Health Agency in February 2014 concluded that there were a total of 9 individuals living in two family units further downstream in the vicinity of Ottery St Mary and Otterton. An assessment of current behaviour and evidence of the beaver activity since the start of the trial in March 2015, confirms that the population density is low and suggests that some animals are moving extensively over large areas, unconstrained by other adjacent occupied territories.

This is typical of how a newly established beaver population behaves. The following paragraph from the "Ecology and Management of the Eurasian Beaver" (Campbell-Palmer, in draft) explains it perfectly:

> **"At low densities beavers have the ability to blend unobtrusively into an environment, with any conflicts tending to be localised. During this initial phase of colonisation they select the most favourable sites, typically larger rivers and lochs, where dam building activity is rare. As beaver populations grow and their densities increase, successive generations are forced to occupy less favoured habitats (i.e. those more likely to be modified by beavers), in minor water-courses or anthropogenic environments. In such locations their presence can become more obvious as environments are modified often through a process of dam creation to increase water levels for protection of natal lodges and access to food resources, often with more obvious feeding impacts. It is generally at this point that conflict with human land use interests become more likely. Dam creation and its attendant landscape alteration is the most common cause of conflicts with an associated requirement for management."**

This summarises the current experience on the River Otter well, where the beavers are living at low density and in the lower reaches of the river. They have yet to move into sub-optimal habitats where they are more likely to manipulate their environment, and create more wetland habitats and as a consequence increase the risk of conflicts with existing land-uses and infrastructure.

One of the objectives of the monitoring framework will be to understand the carrying capacity of the river, and to study how the population expands into and uses the resources of the currently unoccupied areas.

4. Identification of key risks

Beaver related conflicts result from different aspects of their behaviour, and part 6 of this document is structured around these different behaviours, and how different solutions can be used to mitigate these impacts. Specifically these are:

- Beaver dam creation and associated impacts;
- Beaver burrowing behaviour and the impacts of burrows;
- Gnawing, coppicing and felling trees;
- Beaver-derived deadwood in watercourses;
- Grazing of beavers on agricultural crops;
- Increased Road Traffic Accidents caused directly by beavers;
- Problems caused by changes to the movement of people and dogs as a result of beaver presence;
- Presence of beavers causing problems for human and animal health – disease and injury;
- Impacts of the beavers on sites designated for their nature conservation interest; and
- Beavers in adjacent catchments

Within the River Otter catchment there are particular risks which are also considered here.

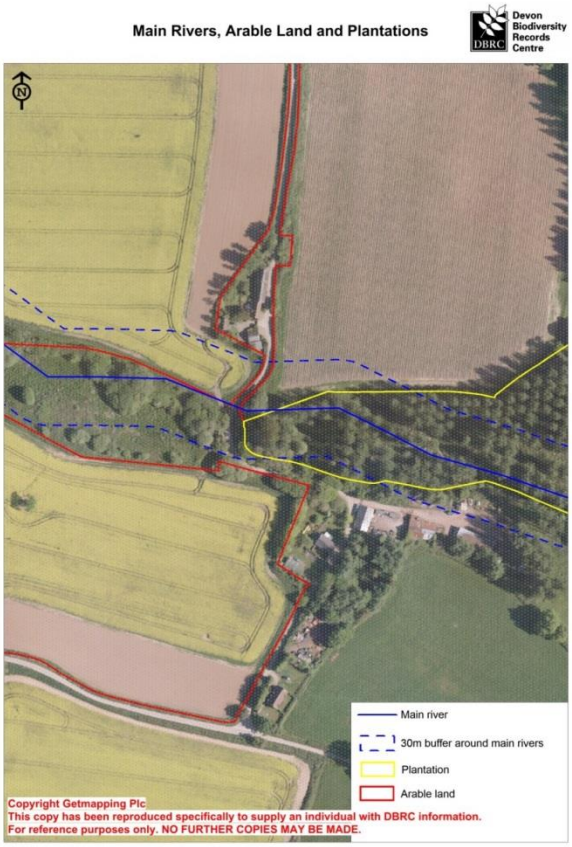
Highways and other infrastructure

The River Otter catchment is a predominantly rural catchment interspersed with significant settlements including Honiton, Ottery St Mary and Budleigh Salterton. The main A30 trunk road entering the west-country crosses and runs parallel with the river over a number of kilometres near Honiton, where the main railway line also crosses the floodplain.

Impacts of the beavers on these main routes are considered unlikely, but there are numerous rural culverts and roadside ditches that will need to be considered as part of the trial risk assessment. There are 377 highway culverts within the catchment and 137 bridges that Devon County Council has responsibility for.

Public rights of way also represent important infrastructure. Alongside the 594kms of watercourse in the catchment, there are 46kms of adjacent footpath and other rights of way. Most of these will not be impacted by beavers although there will be some, where tree gnawing, burrowing and flooding may cause impacts. Focusing on the 124kms of Main River, there are just 11.5kms of public rights of way immediately adjacent.

Aerial photo illustrating 30m buffer on either side of watercourse



Land-use and agriculture

For the purposes of this strategy Devon Wildlife Trust have carried out a GIS based analysis of areas of potential conflict within the Devon part of the River Otter valley.

A 30m buffer has been overlain on either side of the different watercourses within the catchment (Devon only), and the extent of different land-uses within this buffer calculated (see example aerial photo right).

The results shown in the table below, but the key points are as follows:

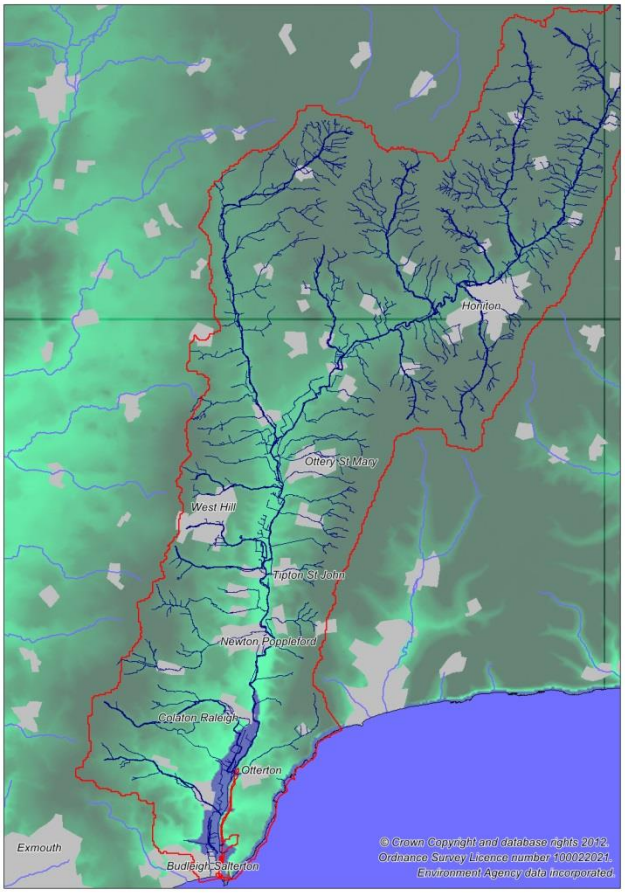
- There are 594kms of watercourse within the catchment (incl 124kms of main river). A 30m buffer on either side creates a total area of 3,378ha.
- Within the catchment, 22% of the land-use within this buffer is in arable production, and this rises to 27% in the Tale tributary.
- The Budleigh and Knowle Brooks have significant areas of forestry plantation within their 30m buffer; 10% and 8% respectively.
- Throughout the catchment, 46kms of public right of way are close to watercourses.
- Only 1% of the 30m buffer is orchard, in the Knowle Brook and Giggage areas.

Watercourse within River Otter catchment	Length of River (km)	Area of buffer (ha)	Length of PRoW (km)	Area of Orchard (ha)	% age of buffer	Area of Plantation (ha)	% age of buffer	Area of Arable (ha)	% age of buffer
Budleigh Brook	5.19	30.50	0.16	0.00	0%	3.05	10%	3.84	13%
Knowle Brook	5.02	30.07	0.59	0.19	1%	2.26	8%	0.79	3%
Love	8.77	51.81	0.96	0.08	0%	0.00	0%	6.62	13%
Otter	81.26	479.70	8.93	1.74	0%	8.01	2%	73.36	15%
Otter (Gissage)	3.45	20.46	0.00	0.14	1%	0.00	0%	4.71	23%
Tale	14.04	83.29	0.77	0.10	0%	0.13	0%	22.30	27%
Wolf	6.23	37.02	0.11	0.00	0%	0.00	0%	3.01	8%
Total Main Rivers	**123.96**	**732.85**	**11.52**	**2.25**	**0%**	**13.45**	**2%**	**114.63**	**16%**
Ordinary Watercourses	**470.46**	**2645.00**	**34.37**	**15.98**	**1%**	**68.72**	**3%**	**621.83**	**24%**
Total (all watercourses)	**594.42**	**3377.85**	**45.89**	**18.23**	**1%**	**82.17**	**2%**	**736.46**	**22%**

Flood risks and associated water management infrastructure

The main River Otter is characterised as a 'flashy' or spatey river (one in which river levels respond extremely quickly to rainfall events) and although this generates flooding risks for some properties in the valley, many of the risks arise from the river's tributaries and side channels. The Environment Agency's East Devon Catchment Flood Management Plan (CFMP) covers the River Otter catchment, and examines the flood risk in the valley in detail. The following specific risks are included within this document:

- 85 properties in Budleigh Salterton are at risk from a 1% annual probability flood event, primarily from the Budleigh Salterton Brook.
- 75 properties are at the same risk in Ottery St Mary with much of the flood risk coming from the Furze Brook which flows under the town through culverts.
- The Glen Brook and Gissage Stream flow through Honiton into the River Otter with culverts and channel improvements providing similar levels of protection to 35 properties.
- Parts of some other communities situated in the floodplain of the lower valley are at risk of fluvial flooding from the main River Otter including Otterton, Colaton Raleigh, Newton Poppleford and Tipton St John, while the Budleigh Brook also puts properties in East Budleigh at some risk.



Topographical map of Otter catchment with key settlements

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/294049/East_Devon_Catchment_Flood_Management_Plan.pdf

The impact of beavers on these flood risks is currently unclear, and will be assessed as the project proceeds. A PhD placement at the University of Exeter (co-funded by DWT) will examine any hydrological changes that occur in the catchment as a result of the beavers being present, working very closely with experts from the Environment Agency.

There are two main ways that beavers could influence flood risk. The presence of beaver dams in the headwaters of the main river or any of its tributaries could significantly reduce the flood peaks downstream. This effect is clearly demonstrated by detailed work being conducted

by the same team of specialists in Professor Richard Brazier's team at the University, much of which will be published in 2016.

The second potential effect of the beavers might be in blocking watercourses, ditches and culverts in the floodplain lower in the valley, or burrowing into floodbanks, increasing risks in the immediate locality. The project team will be closely monitoring this risk and working with the Environment Agency and Devon County Council to quantify and reduce it to acceptable (negligible) levels.

The major issue raised by the Environment Agency in respect of the beavers in the catchment is their potential to interfere with hydrometric monitoring stations recording flows in the river and side streams. Not only is there the risk that beavers might try and build dams against gauging weirs, but any burrows into the banks in the stretch immediately upstream of the monitoring station may interfere with the consistency of the data being collected. The ROBT staff will be monitoring these sites with the Environment Agency to ameliorate these risks.

A meeting with the statutory water management authority in Bavaria looking at the impact of beaver burrows on a flood embankment

5. The strategy for dealing with impacts (including the flowchart)

The cornerstone of the ROBT Beaver Management Strategy is the flowchart. This chart will be used by the project team to deal with issues as they arise. It breaks down the beaver management decision making process into a series of steps, and although each of these stages must be considered, in many cases, it can be a rapid process to navigate.

A key aspect of the strategy will be the pre-emptive avoidance work that will be carried out when beaver activity can be predicted in a particular high-risk location. For example, protecting riverside apple trees with weld-mesh fencing where they are growing close to beaver burrows. In this way many potential beaver conflicts will be avoided altogether.

The strategy involves 5 stages which are as follows:

Stage 1 – Initial contact with the project and assessment of impact

The ongoing monitoring of the beaver activity on the river by the project team, including DWT staff and volunteers, and the partners such as CDE will identify the majority of the beaver impacts. In many cases, the activity will be ongoing small scale feeding and the only action required will be the recording of the behaviour.

Occasionally new activity is reported to the project team by members of the public and key stakeholders, and this will increase as the beaver hotline is further disseminated. The Beaver hotline consists of the DWT switchboard 01392 279244 and the dedicated email address: beavers@devonwildlifetrust.com

The landowners that have had an initial visit from the DWT Project Lead have also been issued with an A5 contact card with a mobile number and personal email as an emergency contact.

A Memorandum of Understanding with the Environment Agency outlines the protocols for contact between DWT and the various EA staff that may encounter beaver activity. In many cases the EA and DCC emergency phone numbers will be published alongside the beaver hotline contact details. Discussions with these partners have concluded that any emergencies relating to highways or flooding, should go through these contact centres, who would then be able to contact the Project Lead in the event that beaver expertise was required out of hours.

In the event that the behaviour is *new or unusual* in any way, an initial site visit will be carried out by the beaver project lead or other delegated person. Depending on the type of impact and the relationship with the landowner, and the access provision, the owner might be informed at this stage. The definition of *new or unusual* is anything that has not been recorded at the location before. Ongoing feeding behaviour in an area where it has been previously recorded would not normally be new or unusual, and so would only require recording. The sudden felling or a large tree, or creation of new burrow would be *new or unusual*. Any new dam building behaviour reported would immediately be classed as *new or unusual.*

With the presence of beavers in a previously unrecorded area of the catchment, consider at this stage whether preventative measures could be taken to protect vulnerable assets, such as riverside fruit trees. This may include increasing the frequency of monitoring in the vicinity to identify new areas of activity.

Stage 2 – Impact deemed significant enough to trigger discussion with statutory agencies or the landowner

The trigger for moving onto stage 2 is whether the activity or impact is significant or likely to develop into a greater risk. This would depend on the context and the history.

The landowner's perspective and the project's relationship with them may determine the significance of the impact, and the nature of any intervention required. If the activity is new to the area, and the landowner has not yet engaged with the trial, the presence of any new activity would normally trigger this initial contact to be made. If the landowner was already engaged and comfortable with the presence of the beavers, and the activity was within the bounds of normality only new significant issues would be discussed.

Regarding statutory agencies and partners, many things would constitute significant activity or impact. These would include:

- any new damming of watercourses,
- any threat to significant trees especially where their felling might cause a hazard to rights or way or infrastructure,
- any activity within an SSSI or close to any EA structures,
- any burrows into flood-banks or where vehicle access might be compromised,
- any beaver dwellings, as well as
- other novel or unusual activity.

Depending on the nature of the behaviour, the appropriate statutory agency would be contacted immediately. In the event of a new dam or any activity near an EA structure being discovered, the EA would be contacted within 24 hours of confirmation, in accordance with the MOU. In the event of any activity within an SSSI, Natural England would be contacted within 24 hours, and likewise if any activity was likely to impact on any highways or other rights of Way, DCC would be contacted. Other responsible bodies such as South West water and Western Power would also need to be contacted in some circumstances.

Stage 3 – Impact determined to be of significance, and of concern to the landowner or one of the statutory agencies.

If either the landowner or the statutory agency expresses concern or reservation about the impact, then detailed discussions would held to resolve the situation. The NE licence group would be informed of the site at the next monthly meeting, and the Management Group might be approached for practical advice if necessary. A Site Impact Report would also be started at this stage, to establish and maintain a record of the discussions, interventions and outcomes.

For sites where the impacts were not of concern to the agencies or the landowner, ongoing monitoring might be carried out and, if impacts worsen, the same steps would be taken.

Stage 4 – Mitigation measures investigated

Stage 4 is the implementation and trialling of mitigation measures. These would be dependent on the type of impact and the location, but it will be necessary for these to be thoroughly monitored before step 5 can be discussed.

Stage 5 – Compensatory works or payments investigated, and options to remove the beavers explored

If mitigation measures are not feasible or effective, and the landowner is concerned about loss of land or income, appropriate mechanisms for compensation may be explored at this stage. At this stage, a clear mechanism for compensating landowners has not been established. If this isn't feasible or the impacts are still of concern to the statutory agencies, then removal of the beavers is the last option.

It should be noted that the final stage includes the option to consider humane lethal control, once all other options had been exhausted, including translocation. Translocation should only be discounted where there are no suitable receptor sites available, which in the context of the 5 year River Otter Beaver Trial while the catchment is still well below carrying capacity, is unlikely to occur.

The identification of receptor sites would need to be ongoing throughout the trial to ensure that suitable sites were available at short notice. The type of site that might be used would depend on the family structure and size of the group or individual being moved. Any translocation would come with risks to the individual beavers, and would require the expertise of the Management Group and advisors.

Beaver traps need to be large enough to trap beavers safely

In the event that reader has reached Stage 5, they should refer to the following appendices of "Ecology and Management of the Eurasian Beaver" (Campbell-Palmer *et al*, in draft):

- App 3j) Trapping and translocation
- App 3k) Humane dispatch

Ultimately if Natural England or the ROBT Management Group considers that if undesired and unacceptable consequences from the presence of beavers cannot be resolved, the Exit Strategy would be implemented. The triggers for this are available on request and are assessed annually by the Steering Group.

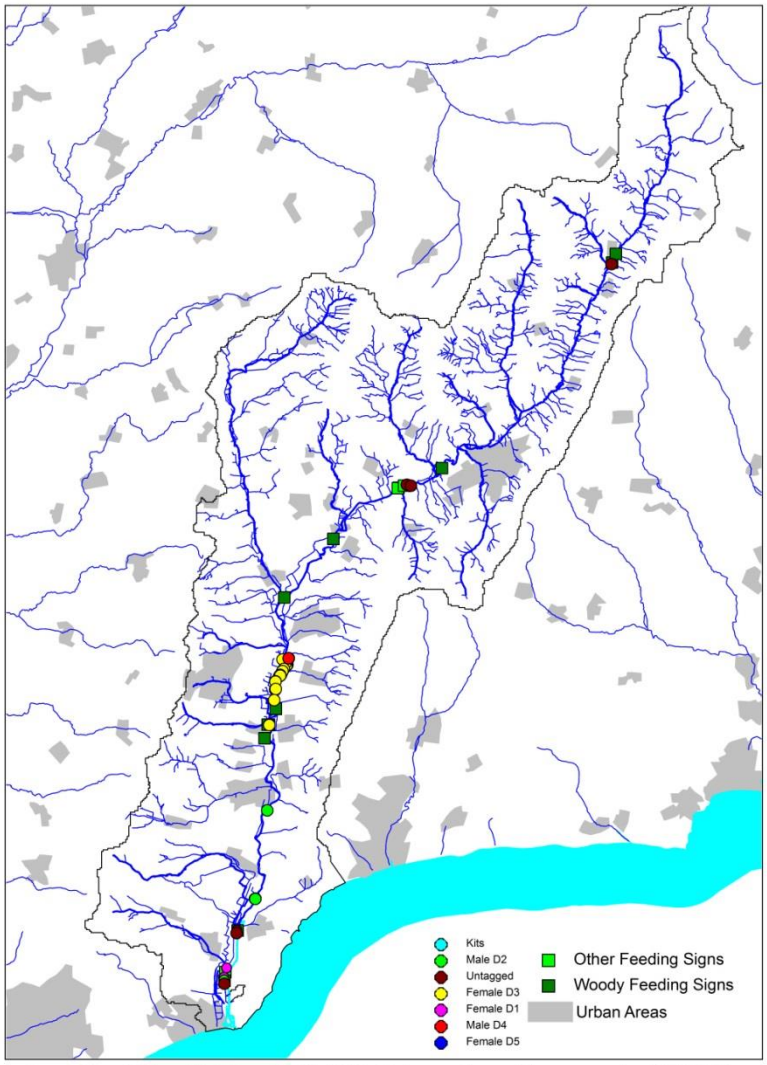
Management of Information and Monitoring

This strategy will be used by ROBT staff for the management of conflicts during the trial. Many of the behaviours and field signs of the beavers on the river will be mapped as part of the monitoring framework using the latest Trimble technology and GIS mapping software.

Maps showing the distribution of beaver behaviour will be available to the NE licence group, to the ROBT management Group and the Steering Group, as well as other key stakeholders. However in order to protect the beavers, the landowners and their neighbours from disturbance, up-to-date information on the exact location of beaver burrows will often not be disseminated.

Site Impact Reports will be prepared to cover any landholdings where stage 3 conflicts have been identified. These will be living documents, updated with new information as impacts develop and are managed. They will contain confidential information about the site owners and for this reason will not generally be published. Towards the end of the trial, the information contained within them will be collated and used to publish one of the Final Reports; *'The Comprehensive net cost assessment to farming, forestry and infrastructure management sectors.'*

An annual report will also be published for the NE Licence Group and the ROBT Steering Group which will contain summary information. In addition an annual assessment will be made on whether the triggers have been met for the implementation of the Exit Strategy which will be presented to the Steering Group for consideration.



GIS Map of beaver activity on the River Otter

Hypothetical Case Study 1: Specimen willow tree being gnawed

In November a landowner rings the Beaver hotline and reports some unusual bark stripping activity on a specimen weeping willow tree. The landowner expresses concern about this because the tree is valuable to him. Following a discussion about the location and nature of the impact, a site visit is set up within a week. (STAGE 1)

On the visit, it is confirmed that the impacts are beaver related, and the landowner reiterates his concerns about the damage. (STAGE 3) The Project Lead immediately protects this tree and 4 others with wild mesh fencing, preventing further damage. (STAGE 4). The costs of this are borne by the ROBT. Ongoing monitoring by the landowner with occasional visits by the Project Lead shows that these mitigation measures are effective.

Hypothetical Case Study 2: Beaver dam being built in shallow tributary

During a dry September, ongoing monitoring by a DWT volunteer of an area of ongoing beaver activity close to a known burrow reveals the building of a small dam in the stream. The volunteer photographs the dam and emails the Project Lead who rings the landowner, and forwards the email onto his EA contact with a suggestion that an urgent site visit is held the next day. (STAGE 2)

During the site visit, it is determined that the dam is probably only a temporary structure during the dry weather and is benefiting the stream by retaining water in a pool for invertebrates and trout, but that it will be monitored through the autumn. Researchers from the Universities of Exeter and Southampton are informed and able to install equipment to capture baseline data on fish and flows.(STAGE 2)

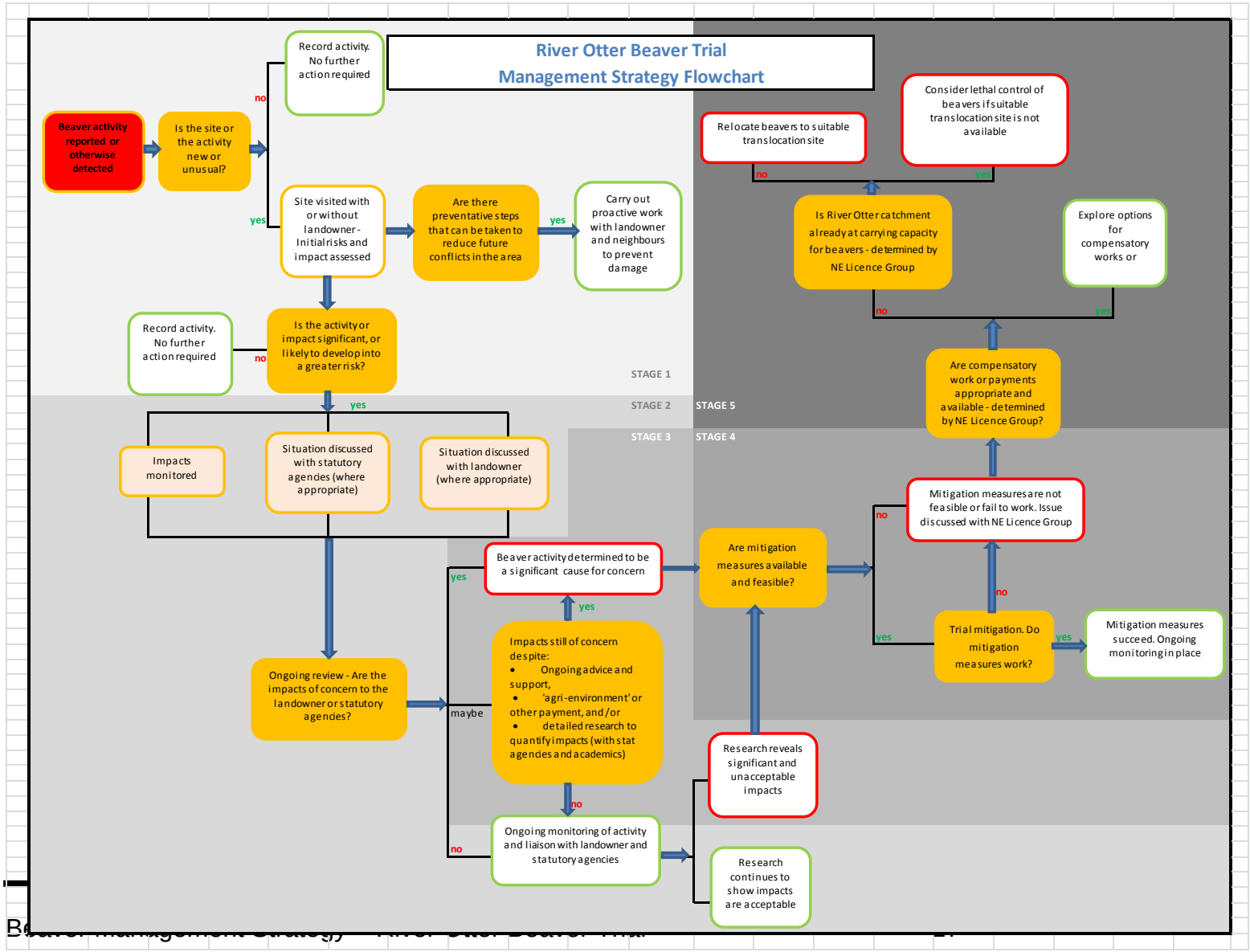
However the beavers continue to build the dam, and by the time the autumn rains arrive it is a significant structure. Another meeting with the EA and the landowner is set up. The EA are happy for the University of Southampton to closely monitor impacts on fish but the landowner doesn't want to lose any of his adjacent pasture to flooding, despite an agri-environment payment being offered. (STAGE 3).

The following day, a hole is cut through the dam and a "beaver deceiver" (flow device – see 6.1.5) installed to prevent the dam getting any higher than the top of the bank, and this is monitored throughout the winter (STAGE 4). The dam remains through the winter and regular monitoring shows it isn't impeding fish movement, and the pond created behind is reducing sediment-load in the watercourse.

River Otter Beaver Trial

Beaver Management Strategy – January 2016

Devon Wildlife Trust



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6. Specific Conflicts, Actions and Mitigation Measures

The Eurasian Beaver – Nature's water engineer

The Eurasian beaver is the second largest rodent in the world, sometimes weighing in excess of 25kgs. It is known by ecologists as a keystone species because of its ability to create wetland habitats which in turn benefit other species, but this large size, mobile nature and reputation for habitat engineering can also create real conflicts with human societies. However some knowledge about its ecology and behaviour allows these conflicts to be foreseen and managed.

It is an entirely herbivorous species, feeding primarily on aquatic and emergent vegetation along riversides and on terrestrial species including grasses and rushes, as well as a range of woody species particularly during the winter months. As well as having significant impacts on vegetation structure and canopy height alongside watercourses, and on specific trees, there are numerous benefits that arise from the coppicing of riverside trees; for example increasing bank stability and enhancement of fish spawning conditions.

Beavers live in burrows and lodges, and commonly burrow into earth riverbanks. Burrows can be important for other species such as otters, but can also have implications for the stability of river banks and flood defence embankments.

Probably their most significant impacts result from their dam building behaviour. Where beavers don't have access to deep water, in sub-optimal habitats, they can create it by damming any flowing water, and through the dredging of 'canals' and ponds.

6.1 Beaver dam creation and associated impacts

6.1.1 Why do beavers build dams?

Beavers construct dams across watercourses to impound water and provide safety from predators and fluctuating water levels. Where dams are associated with lodges or burrows, the depth of water submerges the opening, ensuring a secure and unobtrusive entrance to the structure.

Elsewhere dams create open water to enable beavers to explore their territory from the relative safety of deep water, and exploit the food resources nearby, often floating larger branches across ponds and along the network of lateral canals that may be associated with the dams. Foraging on softer vegetation such as leaves and twigs is frequently carried out from the relative safety of water, and many ponds contain the aquatic plants such as water lilies on which the beavers will also feed.

Beavers feel most secure in water, and quickly retreat to water bodies when threatened. Once in deep water, they appear more secure, and will often approach potential predators like dogs, in the knowledge that they are able to escape quickly by diving underwater with a slap of the tail, warning others in the vicinity of potential threat. If this deep water doesn't exist, they will endeavour to create it through the construction of dams.

One of the stimuli that cause beavers to dam is related to the sound and movement of water. The sound of water trickling over the top of an existing dam or structure appears to encourage them to block the leak. Where a small dam exists, the regular fixing of low-spots along its length gradually increases the size and width of the structure, and over many years, results in a more extensive structure. When a dam is neglected as the population changes its focus or moves to a different area, it will vegetate and can become a stable and semi-permanent feature in the landscape.

This same stimulus can also result in other structures being blocked by beavers. In DWT's enclosed beaver site in west Devon, three small v-notch weirs have been installed by Exeter University to monitor water flows through the site. The movement of water flowing gently over the V-notch is enough to stimulate their blocking with sticks and mud (right).

Clearly there will be examples in the Otter catchment where structures and circumstances will simulate these conditions and beavers will try and stop trickles of water, and understanding what triggers this instinctive behaviour can help us develop mitigation measures.

6.1.2 Where do beavers build dams?

This understanding of beaver ecology is the key to understanding where and why beavers build dams. Over the past 7 years, the beavers have been occupying territories in the lower reaches of the River Otter below Fenny Bridges. It is unclear whether the depth of water is sufficient to prevent them needing to impound water, or whether the high flows are simply too great to allow dams to be constructed. Either way, with the exception of a temporary structure that was reported in a small stream at Fenny Bridges, there have been no signs or reported attempts at dam building anywhere within the River Otter catchment by September 2015.

Dams are constructed with a combination of earth and silts dredged from the bottom of canals and ponds, and from twigs and sticks where available. Beavers often incorporate other features of their environment into the structure, such as fallen trees. Where woody vegetation is lacking, beavers are forced to rely more on soil and have been seen to use roots of plants such as soft rush to provide more stability. However without the reinforcing properties of sticks, these soil dams are less stable and more vulnerable to washing out during high flows.

In the lower reaches of the main river, the most likely scenario in which dams could be engineered is during a severe drought, when base flows are at their lowest, and where temporary structures may be built to retain water in some of the deeper pools and 'glides'.

As of the start of the trial in 2015, with the population of beavers at very low density, the impacts seem likely to remain subtle and restricted to the main river. However as populations rise, and beavers begin to colonise side channels, and move further up into the headwaters, it is likely that dams will be constructed, either in watercourses, or across structures where the sound of running water stimulates them to do so. It is not possible to predict if this activity will occur during the 5 year licence period of the ROBT .

Researchers from the Universities of Exeter and Southampton are keen to investigate the impacts of any beaver dams on hydrology, water quality and fish populations as part of the ROBT. As part of this work, a detailed understanding will be developed of the conditions that will encourage or allow beavers to build dams, which can then be used to predict where in the catchment beaver dams and their impacts are most likely to occur helping to inform risk based management interventions.

Beaver dams are typically made of sticks and earth dredged from under water

6.1.3 The impacts of dams

The impacts of beaver dams, both positive and negative, are highly variable but can clearly be very significant especially when in combination with other dams. Many of the potential benefits and conflicts arise from this aspect of their behaviour, and their status as a "keystone species" is clearly interrelated with it. The impacts clearly depend on the adjacent land-use, infrastructure, habitats and species present at the location when dam building takes place.

Positive impacts of beaver dams include:

- Increased heterogeneity of watercourses, including the creation of standing water and other habitats. These in turn create and enhance habitats for riparian species including fish, invertebrates, amphibians, wetland birds etc.
- Storage of water particularly in headwaters, reducing flood peaks for communities downstream, and prolonging elevated flows benefitting fish migration
- Water storage also enhances base-flows during drier conditions protecting aquatic invertebrates and fish populations from the negative impacts of low flows
- Water quality benefits, including trapping sediment and associated nutrient inputs into watercourses reducing algae blooms and smothering of gravel beds
- Dead wood habitats and exposed riverine sediments within watercourses increase the diversity of specialist aquatic invertebrates, and their role in the ecosystem.

One of a series of beaver dams at the Devon Wildlife Trust's enclosed beaver trial in North Devon, and the wetland habitats created above and below the dam

The following potential negative impacts of beaver dam creation are identified in the ROBT Risk Assessment:

- Localised flooding in undesirable locations. ie. around infrastructure or gardens, and impacting on established notable trees
- Flooding of access routes and footpaths, and other highways infrastructure
- Failure of dams increasing risk of flooding of property and land downstream
- Dams across culvert entrances or on trash screens
- More permanent flooding of agricultural land and fence-lines, causing loss of productive farmland or ability to manage livestock.
- Raising of soil water levels, and generally impeding land-drainage as a result of dams in ditches and drains, restricting certain cropping, and drowning trees
- Fish migration impacted by dams, or spawning gravels flooded by ponds
- Blocking or otherwise interfering with the function of EA Hydrometric monitoring infrastructure.

One of the other potentially detrimental impacts of beaver dams that has been identified is the obstruction of migratory salmonid fish to their spawning gravels. The overwhelming majority of scientific research (summarised in Kemp *et al*, 2012) demonstrates the benefits beavers have on fish species through the increased heterogeneity of riparian habitats, and the hydrological and water quality benefits that dams have. However with regards to the specific impacts on migratory salmonids, there is more uncertainty; as such it will be important to monitor any potentially detrimental impacts on fish migration.

On the River Otter, as of January 2016 there has been no beaver damming, as the animals have been predominantly living in the deeper water of the lower reaches. However it is a popular and locally important river for game fishing, specifically for brown trout and sea trout. Detailed baseline data on fish stocks are currently being collected by fisheries specialists from Southampton University interested in the likely impacts of beavers on fish populations in the river. Fisheries Specialists from the Environment Agency are already working closely with the ROBT to study and react quickly to any potentially negative impacts on fish migration.

6.1.4 Actions:

1. Over the course of the trial, map the populations of beavers and understand and evaluate how they re-colonise the catchment.
2. As part of PhD research projects into both fisheries and hydrological impacts of beaver dams, develop a thorough understanding of where and why these dams are created in certain types of watercourse.
3. Based on this information, predict where in the catchments dams may be constructed and cross-reference with infrastructure and land-use to identify potential risk and avoidance strategies.
4. Monitor these locations for signs of damming and any associated impacts, working closely with the Environment Agency in accordance with the MOU.
5. Follow the Management Strategy flowchart to monitor and manage potential conflicts.
6. Quantify any impacts, including on agricultural activities from dams in land drainage ditches

6.1.5 Mitigation measures to manage the impacts of beaver damming activity

The handbook "The Ecology and Management of the Eurasian Beaver" contains detailed guidance on the measures that can be taken to mitigate the impacts of this behaviour. The measures include:
App 3a) Flow devices – dam piping
App 3b) Flow devices – culvert protection
App 3c) Dam removal / notching
App 3d) Flow devices – culvert protection
App 3g) Electric fencing
App 3h) Permanent exclusion fencing
App 3i) Deterrent fencing – ditches and small streams

NB. The creation of in-channel and floodplain structures, or other works in such areas, may be subject to the necessary consents under the Water Resources Act and/or Regional Byelaws and any proposals will be considered independently on their merits by the relevant authorities.

A "Beaver Deceiver" flow device allows the height of the dam and extent of the flooding to be managed without destroying the dam or wetland.

6.2 Beaver burrowing behaviour and the impacts of burrows

6.2.1 Why do beavers burrow?

Beaver family groups can live in lodges or burrows or a combination of the two. Lodges can be very large structures often built in the middle of a pond impounded by a beaver dam. Depending on the bank height, beaver burrows can be extended upwards and become bank lodges with the addition of sticks and mud.

Dispersing beavers that find themselves in new areas without sufficient cover will very quickly dig a burrow into soft banks, and in many cases beavers use a series of burrows within their territory.

6.2.2 Where do beavers burrow?

Temporary burrows created by young dispersing beavers in summer are often above the water level and usually less than 5m long with two entrances. Adult beavers may also have a series of short burrows used as 'day rests' within their territory. Permanent burrows however have underwater entrances and have dry chambers built high in the bank to avoid flooding when river levels rise. These can then be converted into lodges if the bank profile is suitable and if the group remains in that location. These burrows have many entrances and may extend 4 – 10m inland.

A collapsed burrow in the lower River Otter, (looking from above into the chamber)

On the River Otter, the beavers appear to be mostly living in burrows, which occasionally have sticks and mud built on top. Many have been constructed in areas where dense mature willow (*Salix* spp) trees provide extensive cover, with burrow entrances deep under water below the trees.

6.2.3 Impacts from burrowing

Beaver burrows clearly play an important role in the ecology of the species, but are also thought to be important as refuges for opportunistic otters. Equally beaver burrows may also be used as refuges for non-native American mink.

In many cases burrows go completely unnoticed and have negligible impacts on human communities, but there are some instances where beaver burrows cause issues. The following are potential impacts of beaver burrows, including some identified in the ROBT Risk Assessment:

- Burrowing into flood-banks causing loss or failure of structural integrity (see picture, right)
- Burrowing increasing the rate of bankside erosion and loss of farmland
- Bank collapse causing accidents with or restricting access

by heavy machinery
- People, livestock or dogs falling into beaver burrows
- Burrows interfering with the function of hydrometric monitoring equipment

6.2.4 Actions:

1. Over the course of the trial, carry out detailed annual surveys for beaver burrows, and map all burrows identified;
2. Proactively monitor all Environment Agency assets for presence of beaver burrows in accordance with MOU;
3. As part of the PhD being conducted by the University of Exeter / DWT, monitor any changes to the geomorphological processes, and assess any impact of beaver burrows on this;
4. Follow the Management Strategy flowchart to monitor and manage potential conflicts.

6.2.5 Mitigation measures to reduce the impacts of beaver burrows

The handbook "The Ecology and Management of the Eurasian Beaver" contains detailed guidance on the measures that can be taken to mitigate the impacts of this behaviour. The measures include:
App 3d) Burrow management
App 3e) Bank and flood bank wall protection

An infrequently used beaver burrow on the River Otter

6.3 Gnawing, coppicing and felling trees

6.3.1 Why do beavers fell trees?

Beavers fell or coppice trees to obtain food and building materials.

The upper branches, twigs and leaves are a nutritious food supply available throughout the year. The bark of coppiced trees and branches is stripped to provide food during the winter months when herbaceous vegetation isn't present or is less nutritious. Food caches of cut wood are often created near the lodge during the autumn months, ensuring that the beavers have a ready supply of tender food during prolonged cold periods in winter. Many wetland tree species, such as willow and aspen, coppice or sucker in response to being felled. This regenerates the tree also providing a nutritious source of beaver food for future years. Another consequence of coppicing or felling trees is the increased growth of ground flora on which the beavers also graze.

The branches and twigs of coppiced trees are often used as building materials where nearby lodges and dams are being constructed.

Willow tree coppiced by a beaver

6.3.2 Where and what trees do beavers fell?

The choice of tree appears to depend on the individual family of beavers and the type of tree in the vicinity. Beavers have been recorded feeding on almost all native tree species although there does appear to be a particular preference for aspen and poplar (*Populus* spp.) and willow trees. In some regions birch (*Betula* spp.) and cherry *(Prunus padus*) also appear to be important.

On the River Otter, the vast majority of trees taken are willow, but with hazel (*Corylus avellana*), Leyland cyprus (*Cupressocyparis leylandii*) and sycamore (*Acer pseudoplantanus*) also featuring. Based on an initial informal assessment of the trees present in the lower Otter valley, and beaver feeding preferences, we might expect willow, poplar, sycamore and hazel to make up the majority of trees impacted by beavers.

Of particular note are the native black poplar trees (*Populus nigra* ssp.*betulifolia*) known to occur in the lower valley around Otterton, and some of the larger specimen willow and poplar trees planted on the riverbanks near settlements like Tipton St John and Ottery St Mary. Beavers are also known to take fruit trees, and also seem to favour softwoods where they are close to the water's edge; there are a number of gardens and orchards in relative close proximity to the River Otter that are at risk of damage.

Due to the beavers' desire to stay near deeper water for safety and protection, and their favoured tree species, the majority of impacts on trees will occur along the immediate riverbank. Beavers will occasionally venture further away, but rarely more than 20m from the water's edge. This makes predicting the notable trees at risk relatively straightforward, particularly while the beavers are only using the main river and population pressure is low. Once they move into the drainage ditches and tributaries, the scope for additional trees to come within their range increases.

6.3.3 Impacts of tree felling

There are a great many positive impacts of tree felling / coppicing for the environment. Britain would once have had many herbivores such as beavers maintaining dynamic open areas of habitat within floodplain wetlands. As a result, a great many wetland species evolved in open grassland and reedbed habitats with a scrub woodland component, and depend on them for their survival.

Fisheries managers frequently coppice trees over trout and salmonid spawning gravels to speed up the growth of young fry, but leave more shaded stretches to keep water cool in the pools for parr development. They also trim overhanging trees to gain casting access and in some respects this patchwork effect replicates the impacts of beavers managing riverside trees.

Coppicing of riverside trees also aids bank stabilisation, as it helps with ground level vegetation, and prevents trees becoming top-heavy and falling over, taking their root-plate and a chunk of riverbank with them. Responsible riverbank owners are already practicing rotational coppicing of trees alongside watercourses, and beavers can replicate this practice in a more natural, sustainable, and less visually intrusive manner.

Aspen and native black poplars are increasingly rare species of tree in Britain, and one potential area of research for the ROBT could be to investigate whether the presence of beavers actually encourages them to regenerate.

In addition to the loss from the landscape of important specimen or amenity trees, the following negative impacts of beavers felling trees are identified in the ROBT Risk Assessment:

- Felling trees or leaving hanging and discarded dead wood causing risk to people
- Felling trees on buildings / homes, with associated risk to life
- Felling trees on roads, access routes and other rights of way
- Felling trees on power lines / telegraph wires and other infrastructure
- Felling trees on livestock, or livestock fencing

NB – once trees or dead wood lands in watercourses, refer to the separate section 6.4 below

6.3.4 Actions:

1. Survey and map all significant concentrations of woody species impacted throughout the catchment annually.

2. Follow up all reports of impacted trees in a timely manner and address safety issues immediately, in liaison with DCC and landowners.
3. Proactively approach owners of vulnerable riverside trees (eg. apple trees in gardens etc.) and advise on tree protection.
4. Carry out research into any symbiosis between beavers, aspen and black poplar if opportunity arises.
5. Follow the Management Strategy flowchart to monitor and manage potential conflicts.

6.3.5 Mitigation measures to reduce the impacts of tree felling activities

The handbook "The Ecology and Management of the Eurasian Beaver" contains detailed guidance on the measures that can be taken to mitigate the impacts of this behaviour. The measures include:
App 3f) Individual tree protection
App 3g) Electric fencing
App 3h) Permanent exclusion fencing

Anti-beaver paint can be applied to deter beavers gnawing important trees

Recipe for beaver deterrent paint

- Exterior Oil / rubber-based (latex) paint
- Fine sand (0.75–1.0mm grain size).

Method:

1. Mix about 140g - 225g of sand in 1 litre of paint
2. Make small batches, and stir frequently
3. Apply paint to height of a minimum of 90cm (higher in areas with heavy snowfall).

See http://www.beaversolutions.com/tree_protection.asp

6.4 Beaver-derived deadwood in watercourses

The gnawing behaviour described above inevitably results in some additional trees, and other woody debris entering the watercourse. This can range from a tree that has been felled directly into the channel that may or may not still be attached to the bank, to a small stick that has been stripped of its bark and largely eaten on the bankside that is now mobile and washes downstream. It also includes a food cache placed near the entrance to a burrow in autumn, to a "temporary" beaver dam that has washed away in a flood. Beaver-cut sticks within watercourses can also be a very useful way of detecting the presence of beavers in the area in question or anywhere upstream.

The River Otter is a highly dynamic river with steep sided and rapidly eroding banks along much of its length. This results in a huge volume of trees ending up in the river simply due to these natural geomorphological processes. These trees cause banks to erode further and get washed against bridges and weirs, and require landowners and public bodies to remove them when they become a problem.

6.4.1 Impacts from dead wood in watercourses

Dead wood in watercourses is an important habitat in its own right. Depending on its size and location, specialist invertebrate species will live on or within it, and a dense area of dead wood such as a food cache can provide shelter for fish fry or macro-invertebrates. In some locations fisheries scientists are introducing dead wood into watercourses to provide these aquatic habitats.

However the following negative impacts of dead wood in watercourses include those identified in the ROBT Risk Assessment.

- Large woody debris washed downstream forming 'trash dams' and causing obstructions and flooding, including becoming lodged in culverts and on screens
- The impacts of woody debris becoming lodged on and interfering with EA hydrometric monitoring structures.

6.4.2 Actions:

1. Routinely survey EA hydrometric monitoring structures for signs of beaver debris in accordance with MOU.
2. Working with the EA and DCC to take a risk based approach to monitoring trash screens and similar locations for signs of beaver debris, and address as necessary.
3. Quantify the inputs of woody debris as part of PhD with the University of Exeter, ensuring that the results of beaver felling can be separated from other natural inputs.
4. Follow the Management Strategy flowchart to monitor and manage potential conflicts

6.4.3 Mitigation measures to reduce the impacts of beaver related woody debris in watercourses

The supply of woody debris into watercourses is a side effect of the other activities listed above (tree felling, dam building etc) rather than a separate activity. Mitigation measures would fall into 2 categories:

- Addressing the cause of the debris, such as by protecting trees in high risk areas
- Removing debris from watercourses before it causes a problem, by allocating additional resources to remove fallen trees prior to flooding events, or clearing trash screens.

6.5 Grazing of beavers on agricultural crops

6.5.1 Why do beavers feed on crops?

Beavers are entirely herbivorous animals and feed on a wide range of terrestrial plants during the spring and summer months. In the River Otter they have been seen feeding on plants such as nettles, brambles and Himalayan balsam.

They also routinely feed on grasses and reeds. Often the grazing of riverside grasses and vegetation results in distinct short sward 'lawns'. This broad diet also means that agricultural crops can be a desirable, abundant and nutritious supplementary food source at certain times of the year.

6.5.2 Where and what do they feed on?

Beavers have been recorded feeding on a range of crops including maize, cereals, oilseed rape, peas and carrots, and beets where they are in easy reach from a watercourse. They will generally only feed within 20m of a watercourse, but can increase their reach into agricultural fields through the construction of burrows and canals.

This activity is generally restricted to the spring and summer months, but they will sometimes cache maize and sugar-beet in autumn for consumption during harsh winter conditions.

Beavers also feed on fruit trees where these are close to watercourses. Orchards close to watercourses would therefore be at risk.

6.5.3 Impacts from grazing beavers on agriculture

The direct impact of grazing beavers on agricultural crops may occur in small isolated areas alongside watercourses, but seems likely to be of negligible economic impact, especially when compared with the impacts of deer and rabbits. The combined impacts of these species, however, may be significant.

6.5.4 Actions:

1. Ensure that landowners have ready access to ROBT contact details and can readily make contact to report agricultural damage as soon as it occurs.
2. Quantify any reported damage.
3. Follow the Management Strategy flowchart to monitor and manage potential conflicts.

6.5.5 Mitigation measures to reduce the impacts of grazing on agricultural crops

The handbook "The Ecology and Management of the Eurasian Beaver" contains detailed guidance on the measures that can be taken to mitigate the impacts of this behaviour. The measures include:

App 3f) Individual tree protection (eg. for orchards)
App 3g) Electric fencing
App 3h) Permanent exclusion fencing
App 3i) Deterrent fencing – ditches and small streams

6.6 Increased Road Traffic Accidents caused directly by beavers

6.6.1 Why may beavers cause road accidents?

In addition to the impacts of falling trees, burrows and raised water levels on highways which are dealt with above, beavers are often killed on roads in parts of Europe, highlighting a potential but remote risk that they might cause a road traffic incident.

Beavers are large animals, sometimes weighing up to around 23kgs; about twice the weight of a badger, *Meles meles*, and are not particularly fast moving when on land. They will travel a few kilometres within their territory in a single evening, but tend to travel in watercourses, only occasionally leaving the safety of the water to forage.

The likelihood of beavers being killed on the road or being the cause of an accident is considered to be far lower than that of badgers because of their strong relationship with the water.

6.6.1 Where and when may beavers cause road accidents?

Beavers are largely nocturnal, and so are less likely to be seen on roads during daylight, although in the long summer evenings they may be active for an hour or two before dusk.

They are most likely to be involved in an accident where a road passes close to the burrow of a family group and where there is an increased frequency of animals wanting to cross a road to reach a foraging area.

Otters are more frequently killed on the roads during flooding events when the culverts passing under roads are full of fast flowing water, causing the otter to cross the road rather than navigating the culvert. Whether beavers would react in the same way is unclear, although certainly possible.

6.6.2 Impacts of road accidents caused by beavers

Clearly there is the potential for any road traffic accidents to have high impact however the likelihood is deemed to be very low. The ROBT has secured third party liability insurance in the event of such an occurrence.

6.6.3 Actions:

1. Monitor signs of beaver activity particularly where burrows / lodges are close to busy roads, and proactively carry out mitigation measures to prevent beavers accessing highways.
2. Follow the Management Strategy flowchart to monitor and manage potential conflicts working closely with the Highways Authorities. It may be necessary to proceed to stage 5 of the Management Strategy flowchart more quickly if a beaver dwelling close to a road is deemed to pose an unacceptable risk.

6.5.5 Mitigation measures to reduce the likelihood of road accidents involving beavers
The handbook "The Ecology and Management of the Eurasian Beaver" contains detailed guidance on the measures that can be taken to mitigate the impacts of this behaviour. The measures include:
App 3g) Electric fencing
App 3h) Permanent exclusion fencing

6.7 Problems caused by changes to the movement of people and dogs as a result of beaver presence

6.7.1 Will beavers increase the problems associated with visitors to the valley?

Some sections of the River Otter are already extremely busy, with well used public foot and bridle-paths. During the summer months many of these paths are some of the busiest in Devon, and many are well used routinely by walkers. The majority of users are considerate and aware of their impacts on the farmers and wildlife of the valley. However some are not, leaving gates open and allowing their dogs to harass livestock, wildlife, and trespassing in areas remote from public footpaths. Landowners have expressed concern that the presence of the beavers might increase the incidences of trespass in some of the quieter areas, and the numbers of people using these footpaths and the associated problems.

Some dog walkers have always encouraged their dogs to play in the river, and are unaware or unconcerned about the impacts of their dogs on beavers, otters, waterfowl etc. There is clear evidence that at least one dog is disturbing beavers on a regular basis.

There is also no doubt that the presence of beavers has attracted additional people to access the river valley looking for the beavers. Some are also trespassing into areas away from public footpaths. Many are tourists and interested visitors, while others are more serious wildlife watchers and ecologists.

Many of the more serious wildlife watchers are very sensitive to their impacts and are not accompanied by dogs. There are benefits that accrue from well informed 'naturalists' legally accessing the area helping to 'police' and reduce the impacts of others, and reporting problems as they arise.

There are clearly advantages to the wildlife, including the beavers, of some areas of the valley being off limits to walkers, and concern has been expressed by landowners that some of these quieter areas are now being encroached into. Even if more sensitive visitors start using these areas, this will still encourage more acceptability among the wider population, and a gradual erosion of these 'sanctuaries.'

It is hoped that work with East Devon AONB will be carried out over the course of the trial to quantify any significant changes to the usage of rights of way as a result of the presence of beavers.

6.7.2 Where and when will increased visitors impact on farmers, beavers and other wildlife?

The impact of visitors on the river valley varies with the time of year. Farming practices and tourist numbers are very seasonal. Dog walkers are a more constant pressure, but their impacts on the wildlife and farmers are more seasonal. Nesting birds are vulnerable in the spring and summer, as are young livestock.

Beavers are particularly active at dawn and dusk, so when dog walking coincides with this activity, the impacts are likely to be greatest. Beaver kits are active during the summer months, and may be more vulnerable to disturbance. This is also the period when adult beavers will be more defensive towards dogs that are threatening their kits, with the risk that dogs may be injured in any confrontation.

There is also likely to be a slight increase in beaver tourists in the evenings towards dusk, although these people are likely to be quiet and sensitive to their impacts on the river.

There are also a few beaver enthusiasts who are on the river more often, with varying sensitivity to landowner requirements. Some are setting camera traps in secluded spots and others may follow beavers away from public footpaths.

6.7.3 Impacts of additional people and dogs on farmers, beavers and other wildlife

The following impacts of additional visitors and dogs on farming and wildlife are identified in the ROBT Risk Assessment

- Impacts on farming practices from increased trespassers and inconsiderate ramblers, including dog attacks on beavers and livestock.
- Impacts on local infrastructure due to marked increase in visitor numbers.

6.7.4 Actions:

1. Produce literature, signage and social media activity to reduce the impacts of visitors and dogs on landowners and wildlife, and take opportunities to educate users about their potential impacts on farmers and the wildlife, and potential risks of injuries to dogs from defensive beavers. Include messages within walks and talks programme.
2. Ensure that volunteers working on the project are only entering areas with appropriate landowner permissions and, where possible, ensure others interested in the beavers apply the same principles.

6.8 Presence of beavers causing problems for human and animal health - disease and injury

6.8.1 What diseases might the beavers be carrying?

As part of the health screening of the beavers carried out by the Royal Zoological Society for Scotland (RZSS) prior to release, the adult beavers were all cleared of significant and notifiable diseases of concern including *Echinococcus multilocularis* and Tularemia. If additional beavers are released into the project area, any adult animals at risk of these diseases would also be tested prior to release.

Leptospirosis (also known as Weil's disease) is commonly transmitted by rodent urine, and is commonly found in water bodies in the UK. One of the beavers was found to be carrying this disease as part of the health screening in March 2015, although this is not thought to be a significant risk to the health of the animal or that it posed an increased risk above the naturally occurring levels in the environment.

There are a number of other diseases including cryptosporidium, bovine Tuberculosis (bTB), Giardia and lungworm that were included in the health screening. None of the beavers tested positive for these diseases, although all are present in the environment, and may at some point be picked up by the beavers.

6.8.2 How might diseases be transmitted to humans or domestic animals, or injuries be caused by beavers?

In the event that beavers are carrying any of these diseases, the most likely people to be affected are the staff handling and working directly with the animals. In addition to the diseases that may be contracted by staff working with beavers, there are also physical risks associated with handling beavers in and around the water environment.

Disease risks to domestic animals are considered a low risk. Bovine TB has never been recorded in Eurasian beavers although animals released were screened for it to eliminate any concerns. Injuries to aggressive dogs by beavers defending their young is considered a possibility in certain locations on the River Otter.

6.8.3 Impacts on human health

The following human health risks are identified in the ROBT Risk Assessment

- Contraction of diseases including *Echinococcus* and other waterborne pathogens
- Injuries from aggressive beavers, or due to poor handling
- Trips and falls, or emersion in water when handling or monitoring beavers

6.8.4 Actions:

1. Ensure that all released beavers are screened for diseases, and carry out health monitoring as part of the trial as outlined in the Monitoring Framework.
2. Collect any sick or dead beavers and where possible carry out post-mortem examinations to detect the presence of any notable diseases.
3. Ensure that all operations carried out by Project staff and volunteers are covered by appropriate Health and Safety procedures, and that training on beaver handling is provided to individuals and partners likely to need it.
4. Work with dog owners to ensure that the risk of beaver / dog conflicts, particularly during sensitive summer months, is reduced.

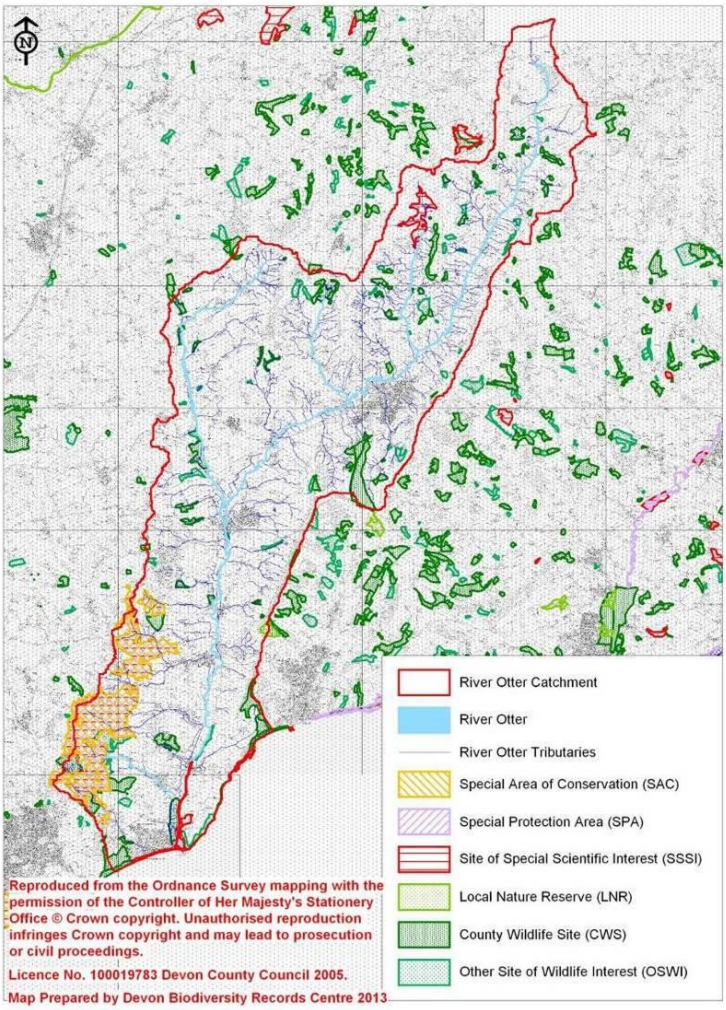
6.9 Impacts of the beavers on sites designated for their nature conservation Interest

6.9.1 Why may beavers impact on designated nature conservation sites?

The impacts of beavers on the designated interest features of protected sites are specifically stated in the ROBT licence. Nature conservation policy and legislation is prescriptive and particular habitats and species that fall within certain sites have specific interest features and associated protection. In the catchment these include a number of Sites of Special Scientific Interest (SSSI) and one Special Area of Conservation (SAC).

6.9.2 What impacts may beavers have on designated sites?

The impacts that beavers may have on designated sites are the same as elsewhere, in that they may fell and coppice trees, selectively graze on certain riparian species and modify the wetland environment. In many cases these impacts would enhance the nature conservation value of sites and add natural processes that would assist with their management. There may also be rare occasions where the clearing of trees or the creation of new ponds might conflict with the designated interest features.



Map 1: Sites designated for biodiversity interest

The following impacts on designated sites are identified in the ROBT Risk Assessment

- Detrimental impacts on interest features of SSSIs and East Devon Pebblebed Heaths SACs.

One of the key components of the ROBT is to monitor impacts of beavers on the ecology of the valley, and in the event that beavers start to use designated sites, careful monitoring of the impacts would be necessary and carried out in close collaboration with Natural England. As part of the licensing of the trial, Natural England conducted an Appropriate Assessment of the potential impacts of beavers on this European designated site, which confirmed no significant effect was likely.

6.9.3 Actions:

1. Monitor signs of beaver activity in and around designated sites, working closely with Natural England staff;
2. Follow the Management Strategy flowchart to monitor and manage potential conflicts.

6.9.4 Mitigation measures to manage impacts on designated sites

The handbook "The Ecology and Management of the Eurasian Beaver" contains detailed guidance on the measures that can be taken to mitigate the impacts of this behaviour. The measures include:

App 3a) Flow devices – dam piping
App 3c) Dam removal / dam notching
App 3e) Bank and flood bank wall protection
App 3f) Individual tree protection
App 3g) Electric fencing
App 3h) Permanent exclusion fencing
App 3i) Deterrent fencing – ditches and small streams

6.10 Beavers in adjacent catchments

6.10.1 Why would beavers move into adjacent catchments?

A condition of the ROBT licence is that they must remain within the River Otter catchment. However they are very mobile animals and may disperse to adjacent catchments in search of food or potential mates.

Dispersing 2 year old animals are the most likely to move into adjacent catchments, and this is much more likely when the population density within the catchment is higher and reaching carrying capacity. However the low number of beavers currently in the River Otter also means that there are fewer occupied territories that might constrain long-range movement of individual dispersing beavers.

6.10.2 Which adjacent catchments might beavers colonise, and where are the crossing points?

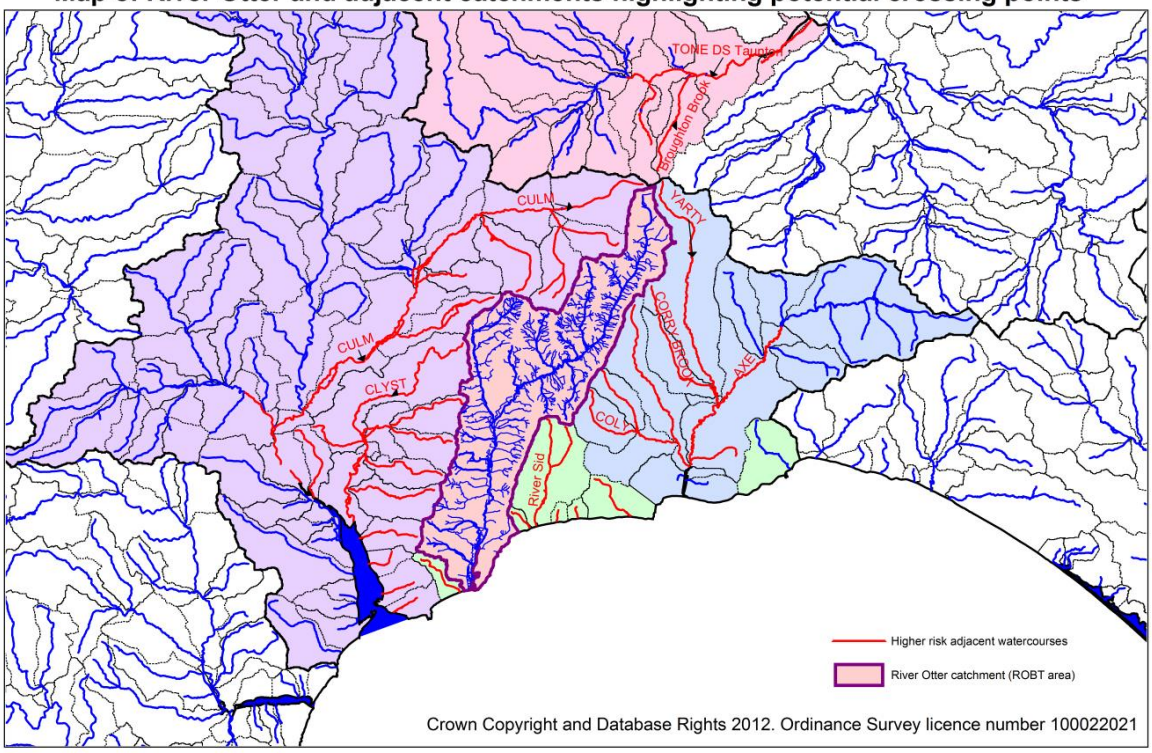
The River Otter is a discrete catchment where surface aquatic relationships with other catchments are remote. The headwater watercourses are very minor and often only visible some distance from the freely draining plateaus that separate the Otter from its neighbouring catchments.

To the west, the adjacent catchment is the River Exe including its tributary of the River Culm. Immediately to the east is the River Sid, with the Axe and its tributaries enclosing it, and also lying adjacent to the Otter headwaters. The main Axe tributaries that lie close to the Otter tributaries are the Yarty, Corry Brook, Umborne Brook, Offwell Brook and the Coly.

If the beavers choose to disperse over the Blackdown Hills in the upper headwaters of the Otter, there is a small gateway into the River Tone via the Broughton Brook which ultimately flows into the Somerset Levels.

In order to reach these catchments, the animals either need to travel across the watersheds, at the very upstream end of any of the contributing watercourses, or travel down into the sea and along the coast. The ecology of the beaver suggests the former is more likely, but there have been documented instances where beavers have travelled out to sea to forage on islands in Scotland.

Map of River Otter and adjacent catchments highlighting potential crossing points



6.10.3 What are the impacts of beavers appearing in adjacent catchments?

During the 5 year period of the ROBT licence, any beavers that leave the trial area must be retrieved.

Actions:

1. Monitor the population of the beavers throughout the River Otter catchment, and where significant dispersal is taking place close to catchment boundaries, carry out proactive surveys and landowner work to monitoring for signs of beavers crossing watersheds.
2. Ensure that, wherever practicable, the River Otter beavers that are part of the trial are clearly identifiable with PIT and ear tags.
3. React quickly to any reported sightings in adjacent catchments by trapping and retrieving them, and immediately report confirmed vagrants to Natural England.

7. References and sources of information

1. Environment Agency (2012). East Devon Catchment Flood Management Plan.
2. Campbell-Palmer et al, (in draft) “Ecology and Management of the Eurasian Beaver”
3. Kemp et al, (2012) Fish and Fisheries, Qualitative and quantitative effects of re-introduced beavers on stream fish.
4. Rhodes, (2015) The foraging preference of beavers (*Castor fiber*) on the River Otter, Devon.

Wetlands created in the Devon Beaver Project enclosure