Beaver Dam Capacity and Habitat Suitability in Cumbria

Modelling of dam capacity and habitat suitability for beaver

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Prepared for Forestry England by Exeter University as part of a beaver feasibility study by

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1. Summary

To inform future management plans, Forestry England has identified the need for greater understanding of potential beaver activity in areas of Cumbria. To help provide this information models have been run for the entire North West River Basin District. Within Cumbria, Forestry England have identified the Derwent and Ehen-Calder catchments as of particular interest. Therefore, the examples and analysis presented in this report focuses on those catchments, with further sub catchment examples (Ehen Upper containing the River Liza in Ehen-Calder and Trout Beck in Derwent) used to illustrate data outputs.

The habitat suitability and the capacity for beavers to dam channels within the study areas was assessed using beaver modelling tools developed by researchers at the University of Exeter (Graham et al., *in review*). These modelling tools consist of a Beaver Habitat Index (BHI) model and a Beaver Dam capacity (BDC) model.

There is a requirement to complete an analysis of rivers catchments to assess their suitability for supporting populations of beaver. Beaver habitat suitability is determined primarily by vegetation

suitability which has been classified nationally using a Beaver Vegetation Index (BVI) as well as access to water bodies. Together these two factors have been incorporated into a Beaver habitat Index model (BHI). BHI has been run nationally to develop a high resolution (5m) continuous raster product that can inform local decision making with regard to beaver reintroduction. BHI classifies habitat suitability from 0 (No access to vegetation - not suitable) to 5 (Highly Suitable)

Beavers are also well known as ecosystem engineers, having the capacity to change environments to suit their needs. The beaver engineering activity that has the greatest capacity to modify ecosystems is dam building. Dam building and the creation of ponded surface water has the ability to bring benefits (i.e. for biodiversity, water storage, flow attenuation) but also potentially management and conflict (i.e. localised inundation of land, blocking of critical infrastructure). BDC classifies reaches from no capacity for dam building to a pervasive capacity for damming.

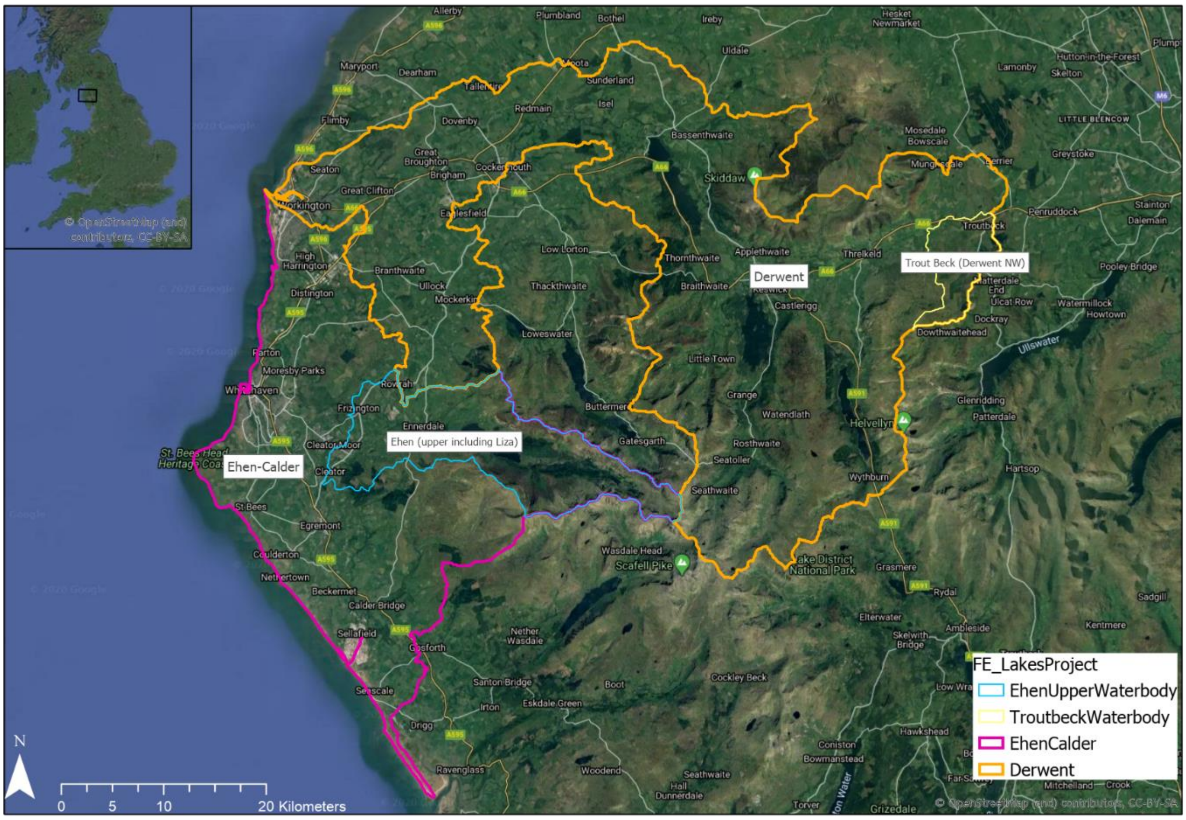

Figure 1. Study areas within Cumbria. Analysis will focus on the Ehen-Calder and Derwent catchments with a further sub-catchment example examined within each (Ehen Upper containing the River Liza and Trout Beck). Aerial imagery: Open-Source Google imagery © OpenStreetmap (and) contributors CC-BY-SA.

2. Modelling of beaver habitat suitability

2.1. Beaver Habitat Suitability Modelling

Summary Description: Production of a continuous description of habitat suitability for beaver. First a vegetation suitability index is created using multiple high-resolution spatial datasets from Ordnance Survey, CEH and Copernicus will be combined to provide detailed land cover/vegetation information which is classified based on empirical field observation of beaver habitat and preference. Vegetation suitability is combined with additional parameters describing stream networks and water bodies. Whilst beaver habitat suitability is primarily defined by vegetation suitability, beavers also require water for security and movement. Therefore, accessibility to water bodies (i.e. channels, ponds, and lakes) will also determine the viability of beaver occupancy and therefore are required to classify habitat accurately.

Outputs: This product provides a high-resolution (5m cell size) resource (raster Tiff format) for describing habitat suitability for beaver. This dataset can allow the user to explore which landscapes were most (or least) suite to beaver reintroduction and also to understand where habitat enhancement might be useful to support future reintroduction.

2.2. Beaver Vegetation Index (BVI –prerequisite for BHI modelling)

Vegetation is important for classifying beaver habitat (Hartman, 1996; John et al., 2010; Pinto et al., 2009; St-Pierre et al., 2017). It was therefore critical to establish a reliable Beaver Vegetation Index (BVI) using nationally-available spatial datasets. No single dataset contained the detail required to depict all key vegetation types. Therefore, a composite dataset was created from: OS VectorMap data (Ordnance Survey, 2018), The Centre for Ecology and Hydrology (CEH) 2015 land cover map (LCM) (Rowland et al., 2017), Copernicus 2015 20 m tree cover density (TCD) (Copernicus, 2017) and the CEH woody linear features framework (Scholefield et al., 2016).

Vegetation datasets were assigned suitability values (zero to five). Zero values were assigned to areas of no vegetation i.e. buildings and values of five were assigned to favourable habitat i.e. deciduous woodland. Values were assigned based on a review of relevant literature (Haarberg and Rosell, 2006; Jenkins, 1979; Nolet et al., 1994; O'Connell et al., 2008), field observation and comparison with satellite imagery. Vector data were converted to raster format (resolution of 5 m). TCD data were resampled to 5m and aligned with converted vector layers. An inference system was used to combine these four raster datasets to create the BVI. The workflow prioritises the reliability followed by the highest value data.

Examples of highly suitable land (graded 5) include broad-leaf woodland, mixed woodland and shrub; examples of suitable vegetation (graded 4) include shrub and marsh; examples of moderately suitable (graded 3) include coniferous woodland, marsh, shrub and unimproved grassland; examples of barely suitable (graded 2) include reeds, shrub and heathland and boulders, neutral grassland; examples of unsuitable (graded 1) include heather, acid grassland, unimproved grass and boulders, bog; examples of no accessible vegetation (graded 0) include shingle and sand, buildings, rock, urban, freshwater and saltwater.

2.3. Beaver Habitat Index model (BHI)

Whilst vegetation is a dominant factor in determining habitat suitability for beaver, so is proximity to a water body (Gurnell et al., 2008), with beavers being strong swimmers, using water bodies both to provide security, as a means of escaping predators and to access foraging areas. It is thought that most foraging occurs 10 m of a watercourse/body (Haarberg and Rosell, 2006), and rarely above 50 m (Stringer et al 2018). However, greater foraging distances have on occasion been observed and as in Macfarlane et al., 2015 it has been accepted as a maximum distance in which the vast majority of foraging occurs. Therefore, to determine suitable habitat for beaver incorporating both BVI vegetation suitability and water accessibility a 100 m buffer was applied to water bodies. To do this the OS mastermap river network and OS vector in land water bodies were combined to get the best readily available national waterbody and water course coverage.

Whilst BVI was run nationally on a 5 m scale it is best viewed as a preparatory step for BHI (and later BDC) modelling and is superseded in usefulness by the BHI dataset. It is strongly recommended that most analysis and management applications use BHI i.e. if there is an area of preferred vegetation such as willow woodland, more than 100 m from a waterbody it is thought inaccessible to beaver and therefore does not form suitable habitat.

Both BVI and BHI use a scoring system of zero to five (Table 1). Scores of five represent vegetation that is highly suitable or preferred by beavers and that also lies within 100 m of a waterbody. Zero scores are given to areas that contain no vegetation or are greater than 100 m from a waterbody. It is important to note that the habitat model considers terrestrial habitat where foraging primarily occurs and that watercourses themselves are also scored zero. It is also important to note that all scores above 1 contain suitable vegetation.

Table 1. BVI and BHI value definitions. It is critical to note that all values above 1 are suitable for beaver.

BVI and BHI Values	Definition
0	Not suitable (no accessible vegetation)
1	Not suitable (unsuitable vegetation)
2	Barely Suitable
3	Moderately Suitable
4	Suitable
5	Highly Suitable

2.4. Beaver Habitat Index maps and summary statistics for study areas within Cumbria

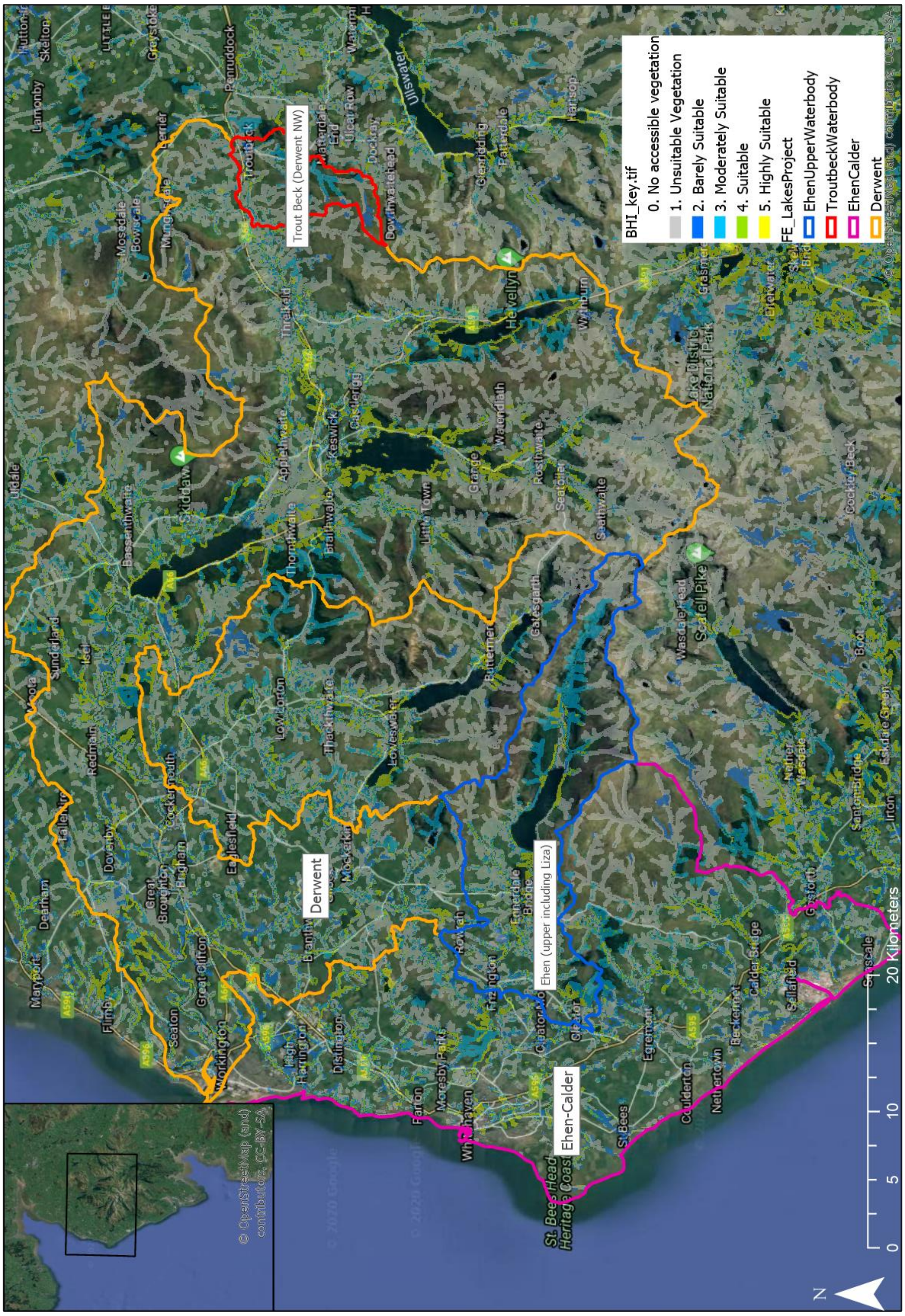

Figure 2. Beaver Habitat Index at a 5m resolution across entire study area with catchments of interest highlighted. Contains Ordnance Survey data © Crown Copyright 2007 and some features of this map are based on digital spatial data licensed from the Centre for Ecology & Hydrology, © NERC (CEH).Aerial imagery: Open-Source Google imagery © OpenStreetmap (and) contributors CC-BY-SA.

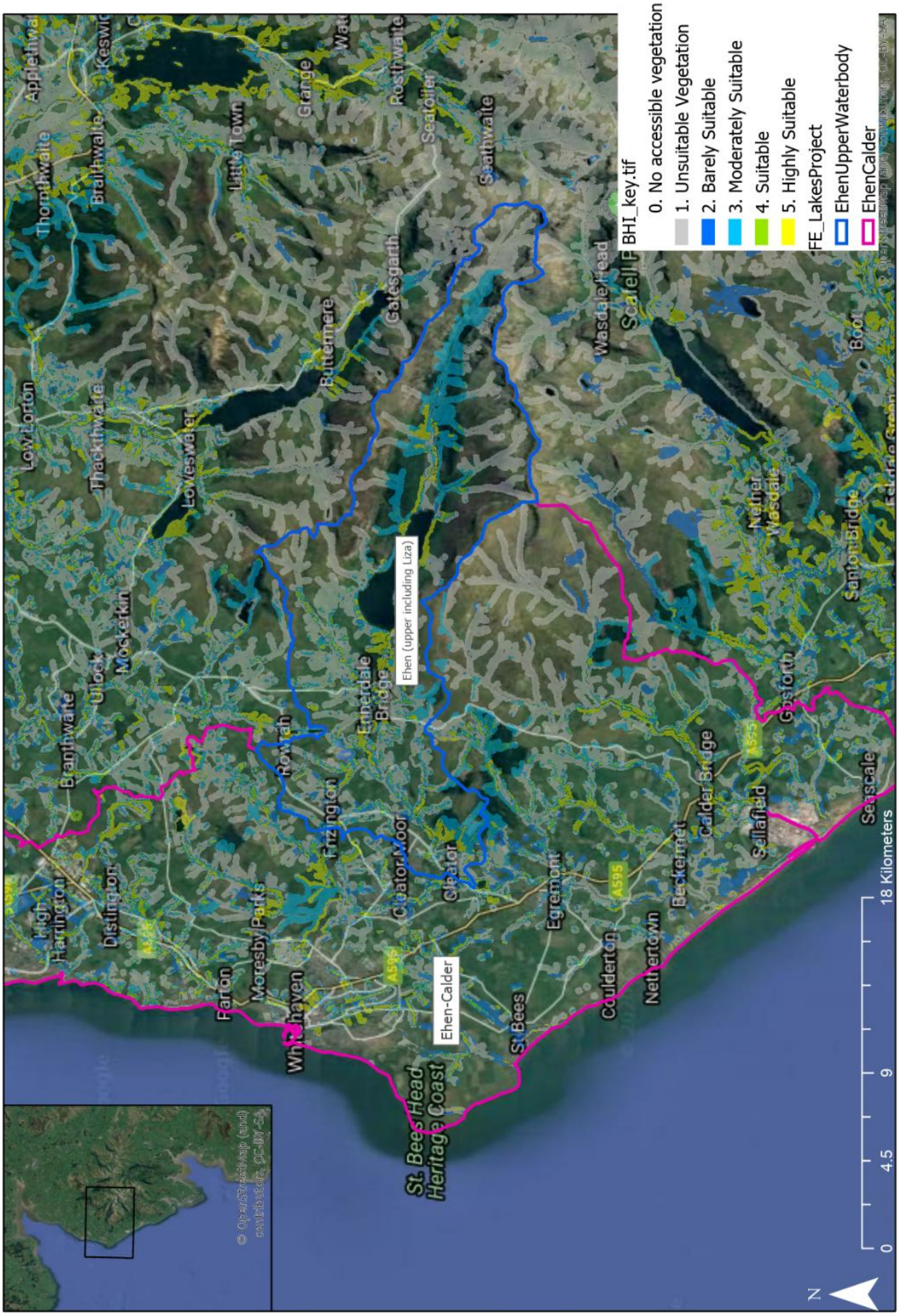

Figure 3. Beaver Habitat Index for the Ehen-Calder catchment. Contains Ordnance Survey data © Crown Copyright 2007 and some features of this map are based on digital spatial data licensed from the Centre for Ecology & Hydrology, © NERC (CEH).Aerial imagery: Open-Source Google imagery © OpenStreetmap (and) contributors CC-BY-SA.

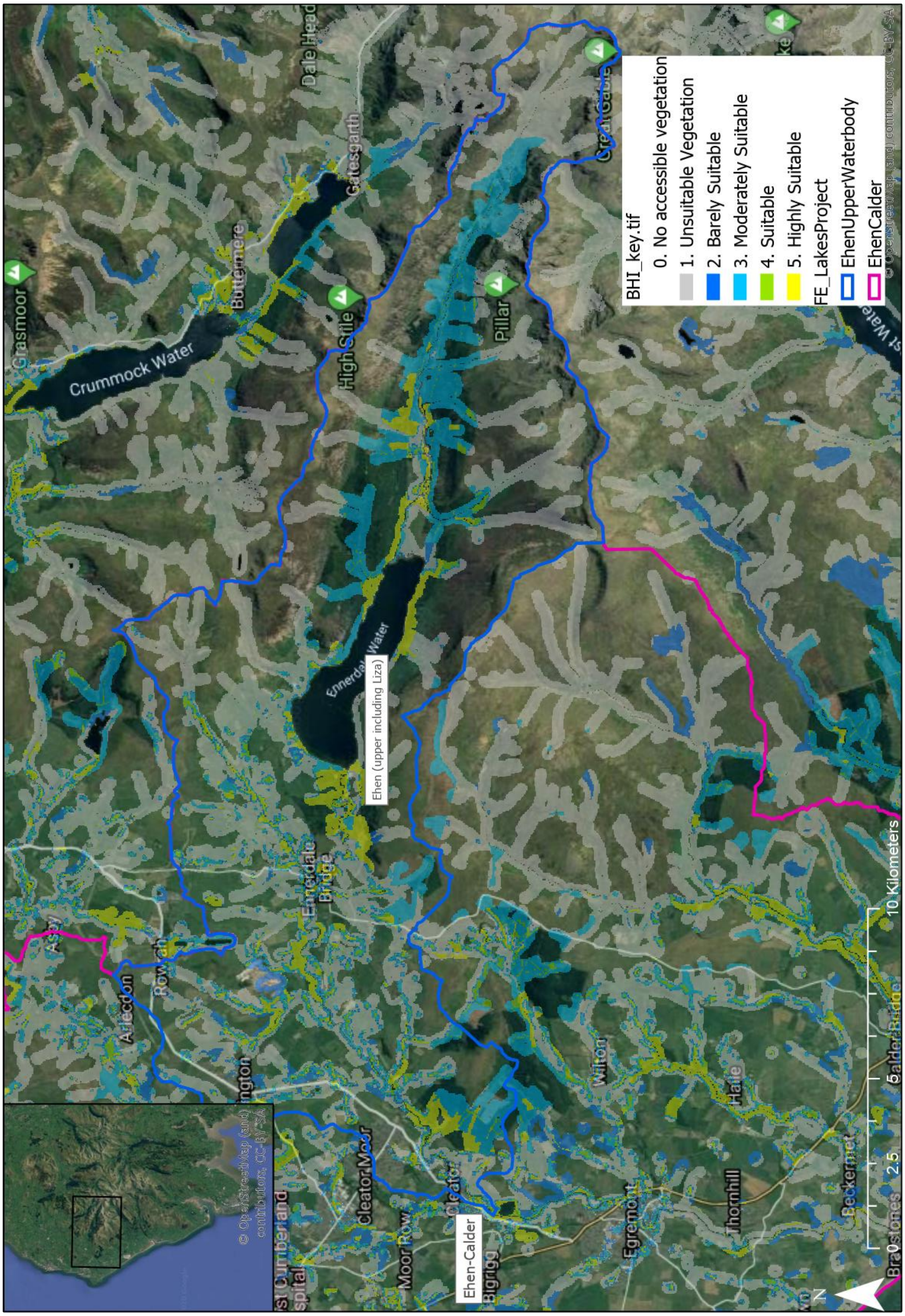

Figure 4. Beaver Habitat Index for Upper Ehen. Contains Ordnance Survey data © Crown Copyright 2007, and some features of this map are based on digital spatial data licensed from the Centre for Ecology & Hydrology, © NERC (CEH).Aerial imagery: Open-Source Google imagery © OpenStreetmap (and) contributors CC-BY-SA.

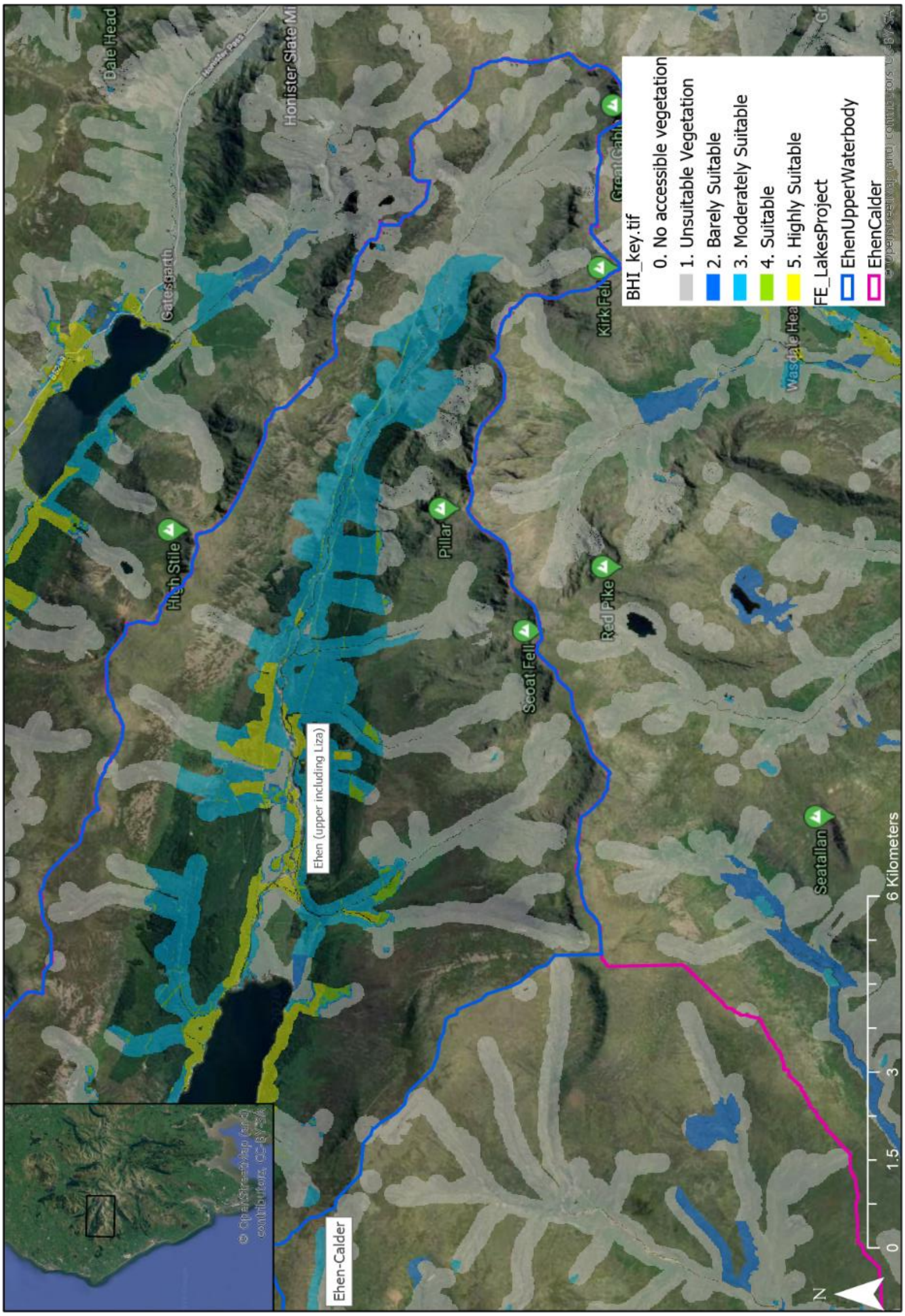

Figure 5. Beaver Habitat Index, for the River Liza. Contains Ordnance Survey data © Crown Copyright 2007 and some features of this map are based on digital spatial data licensed from the Centre for Ecology & Hydrology, © NERC (CEH).Aerial imagery: Open-Source Google imagery © OpenStreetmap (and) contributors CC-BY-SA.

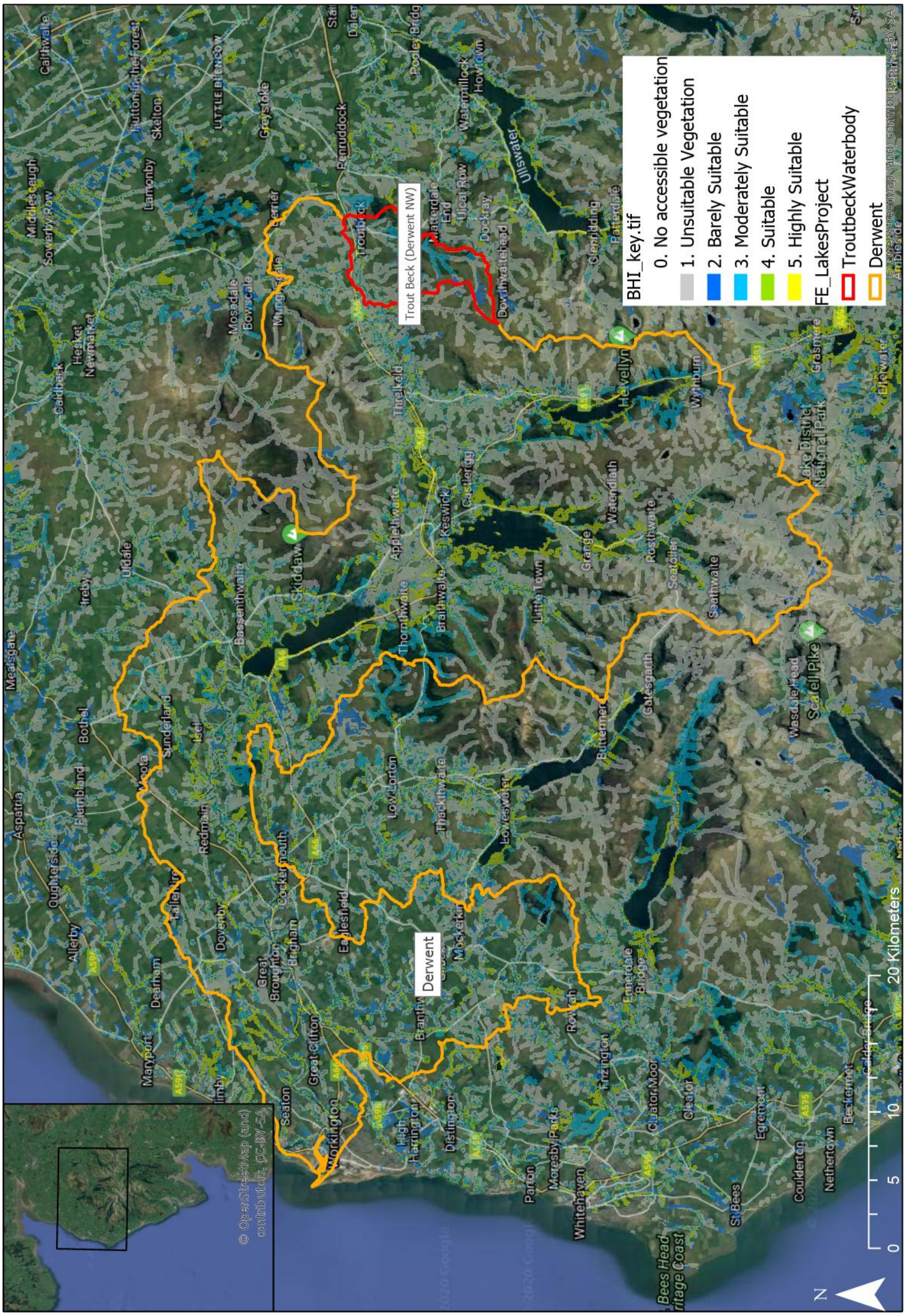

Figure 6. Beaver Habitat Index, for the Derwent catchment with the Trout Beck sub-catchment highlighted. Contains Ordnance Survey data © Crown Copyright 2007 and some features of this map are based on digital spatial data licensed from the Centre for Ecology & Hydrology, © NERC (CEH).Aerial imagery: Open-Source Google imagery © OpenStreetmap (and) contributors CC-BY-SA.

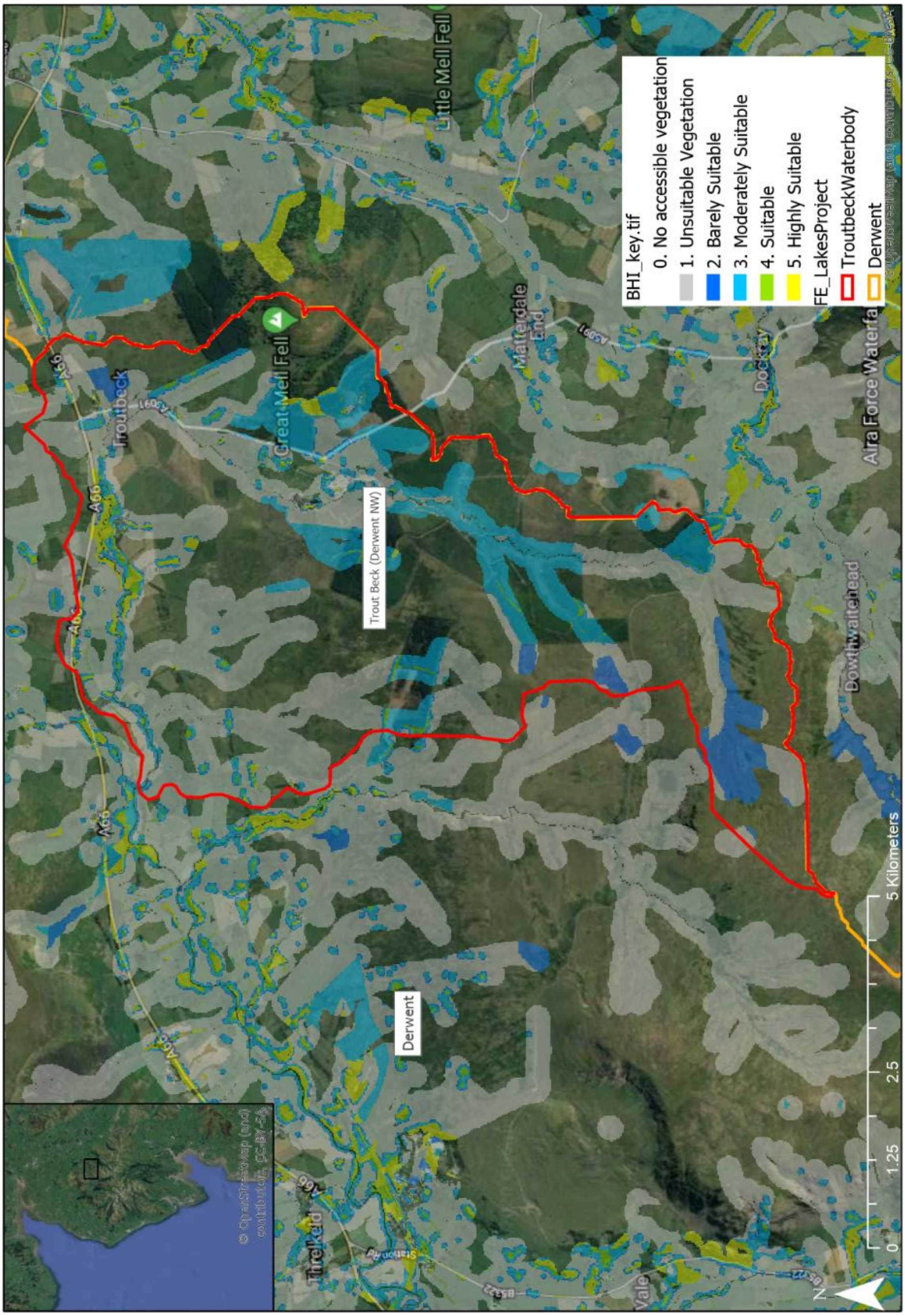

Figure 7. Beaver Habitat Index, for the Trout Beck sub-catchment. Contains Ordnance Survey data © Crown Copyright 2007 and some features of this map are based on digital spatial data licensed from the Centre for Ecology & Hydrology, © NERC (CEH).Aerial imagery: Open-Source Google imagery © OpenStreetmap (and) contributors CC-BY-SA.

Table 2. BHI summary stats for study area catchments and associated sub-catchments.

		Study Area			
	Statistic	Ehen-Calder	Ehen Upper	Derwent	Trout Beck
Summary Stats	BHI_MEAN	0.82	0.92	0.91	0.86
	BHI_MIN	0.00	0.00	0.00	0.00
	BHI_MAX	5.00	5.00	5.00	5.00
	BHI_STD	1.32	1.36	1.34	1.14
	Area (km^2)	303.81	78.60	530.79	16.44
% of BHI class	0. No accessible vegetation	59.14	54.69	50.81	50.27
	1. Unsuitable Vegetation	23.22	26.33	33.29	31.06
	2. Barely Suitable	4.25	2.03	3.04	4.23
	3. Moderately Suitable	7.47	11.12	5.91	12.44
	4. Suitable	1.43	1.24	1.07	0.78
	5. Highly Suitable	4.48	4.60	5.87	1.22
Area (km^2) of BHI	0. No accessible vegetation	179.67	42.99	269.69	8.26
	1. Unsuitable Vegetation	70.54	20.70	176.70	5.11
	2. Barely Suitable	12.91	1.60	16.14	0.70
	3. Moderately Suitable	22.69	8.74	31.37	2.04
	4. Suitable	4.34	0.97	5.68	0.13
	5. Highly Suitable	13.61	3.62	31.16	0.20

2.6. Beaver habitat suitability summary

For the study areas of interest in Cumbria Figures 2-7 present the spatial distribution of habitat classified as accessible to beaver (i.e. 100m from a water body) ranked from not suitable to highly suitable based upon vegetation type and cover. BHI summary statistics for these areas are provided in Table 2.

As with all catchments nationally, the majority of the study areas (ca 50-60 %) do not provide suitable habitat for beavers and are thus extremely unlikely to see any beaver presence or impact even if there was widespread return. This is for the simple reason that they are beyond the beavers foraging range from the waterbodies in which they would live and move.

Whilst upland areas in Cumbria can typically exhibit less riparian vegetation than lowland English catchments As illustrated in Figures 2-7 there are still extensive riparian strips of suitable and highly suitable habitat, with additional areas of good habitat around larger waterbodies. It is important to note that beavers are highly resourceful and whilst they may initially seek out the best habitat in the wholeness of time it is thought that free living beavers would be able to utilise all areas classed 2-5 and also expand the availability of suitable habitat via the engineering of canals and dams, resulting in wetland creation. In total results suggest over 40 % of the Ehen-Calder catchment (equating to 124.09 km^2) and over 49 % (261 km^2) under current land use and vegetation cover would support beaver.

If considering areas for enclosed beaver release, more care would be required in interpreting habitat suitability model results and complementary ground based feasibility work would be recommended. As illustrated in the maps above there is a large degree of spatial variability in suitable habitat cover, with extensive areas particularly in the uplands with a lack or barely suitable vegetation. Whilst these areas would likely not cause a hindrance to the establishment of mobile free living beaver populations, not all areas would support an enclosed beaver population and would require additional restoration such as natural regeneration or planting of riparian vegetation to create beaver suitable habitat.

3. Beaver Dam Capacity modelling

3.1. Beaver Dam Capacity (BDC) model summary

The Beaver restoration assessment tool (BRAT) was developed in North America (Macfarlane et al., 2014, 2015) to determine the capacity for river systems to support Beaver dams. The BRAT model has been further deployed in a range of different river systems to aid both Beaver recolonisation and beaver dam analogue led restoration. The BRAT model not only provides an invaluable tool for designing effective, empirically based, restoration strategies but it also indicates where Beaver dams might be constructed and therefore where they may cause potential management/conflict issues. The BRAT model structures the framework of the model around the river network itself and using a fuzzy logic approach which builds in the considerable uncertainty that is associated with beaver habitat/dammable reaches. Furthermore, it provides a range of output values to predict the dam capacity which has implications for beaver preference towards a given location.

We have therefore used the BRAT framework to develop an optimised beaver dam capacity (BDC) model for Great Britain; and although many of the datasets used are specific to GB, these could readily be adapted to enable its use globally.

The BDC model estimates the capacity of river systems to support dams at the reach-scale (c.a. 150m). The model also highlights reaches that are more likely to be dammed by beaver and estimates the number of beaver dams that could occur for a catchment at population carrying capacity. As such, this highly detailed tool would provide understanding of where dams are most likely to occur and in what densities, supporting future work on the conflicts and opportunities that might accrue from beaver reintroduction.

The model infers the density of dams that can be supported by stream reaches (111.1m ± 52.5) across a catchment. Using low-cost and open-source datasets, the following attributes are calculated for each reach: (i) stream gradient, (ii) low (Q80) and high flow (Q2) stream power, (iii) bankfull width, (iv) stream order, and (v) the suitability of vegetation, within 10m and 40m of the bank, for beaver dam construction. These controlling variables are combined using a sequence of inference and fuzzy inference systems which follow an expert-defined rules system that allows for the considerable uncertainty often associated with these types of complex ecological processes.

Each reach was classified for damming capacity using five categories from none, defined as no capacity for damming to pervasive where a maximum capacity of 16-30 dams could theoretically be constructed in a km of channel. It is important to note that the model assumes both reach and catchment population carrying capacity for beaver. Therefore, in reality the maximum number of dams indicated in a category class is unlikely to occur. A full list of BDC classifications is included in Table 3.

Table 3. BDC classifications and definitions.

BDC Classification	Definition
None	No capacity for damming
Rare	Max capacity for 0-1 dams/km
Occasional	Max capacity for 1-4 dams/km
Frequent	Max capacity for 5-15 dams/km
Pervasive	Max capacity for 16-30dams/km

3.2. Beaver Dam Capacity Model maps for the study areas in Cumbria

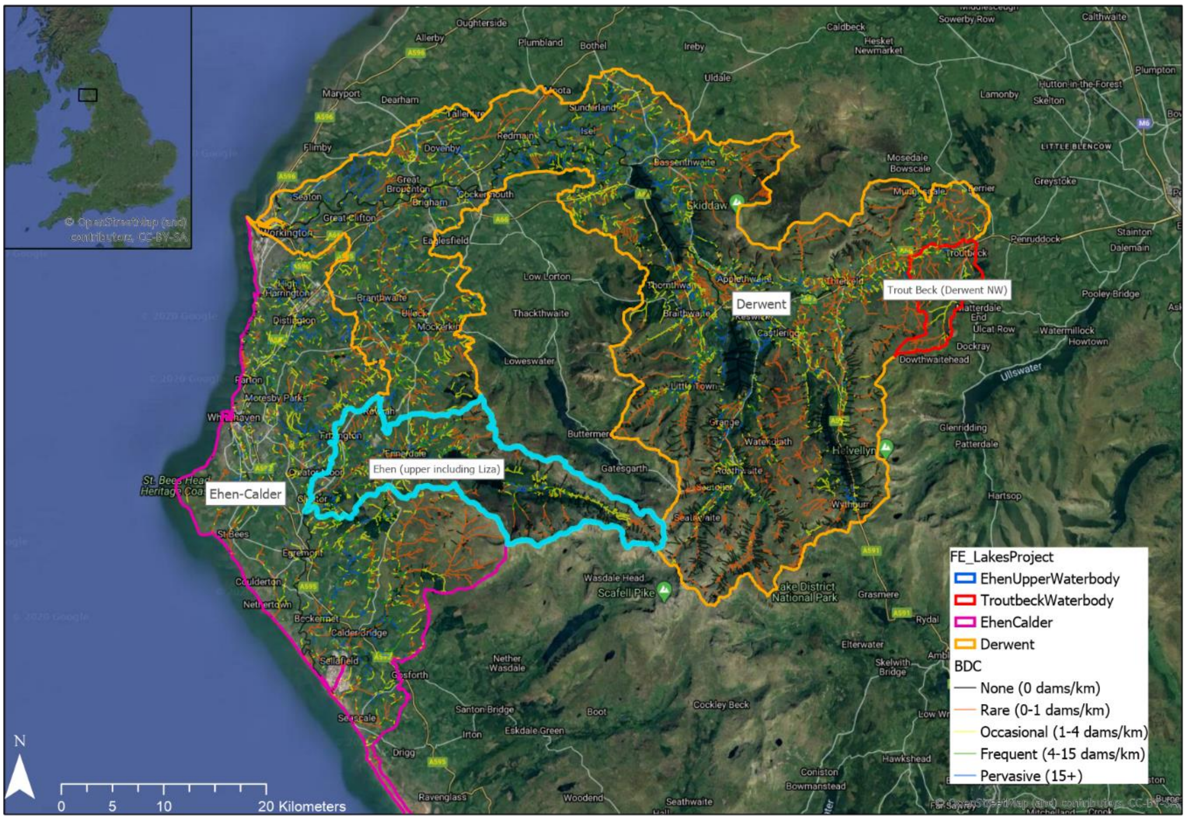

Figure 8. Beaver Dam Capacity model results for study area with catchments of interest highlighted. Contains Ordnance Survey data © Crown Copyright 2007, and some features of this map are based on digital spatial data licensed from the Centre for Ecology & Hydrology, © NERC (CEH).Aerial imagery: Open-Source Google imagery © OpenStreetmap (and) contributors CC-BY-SA.

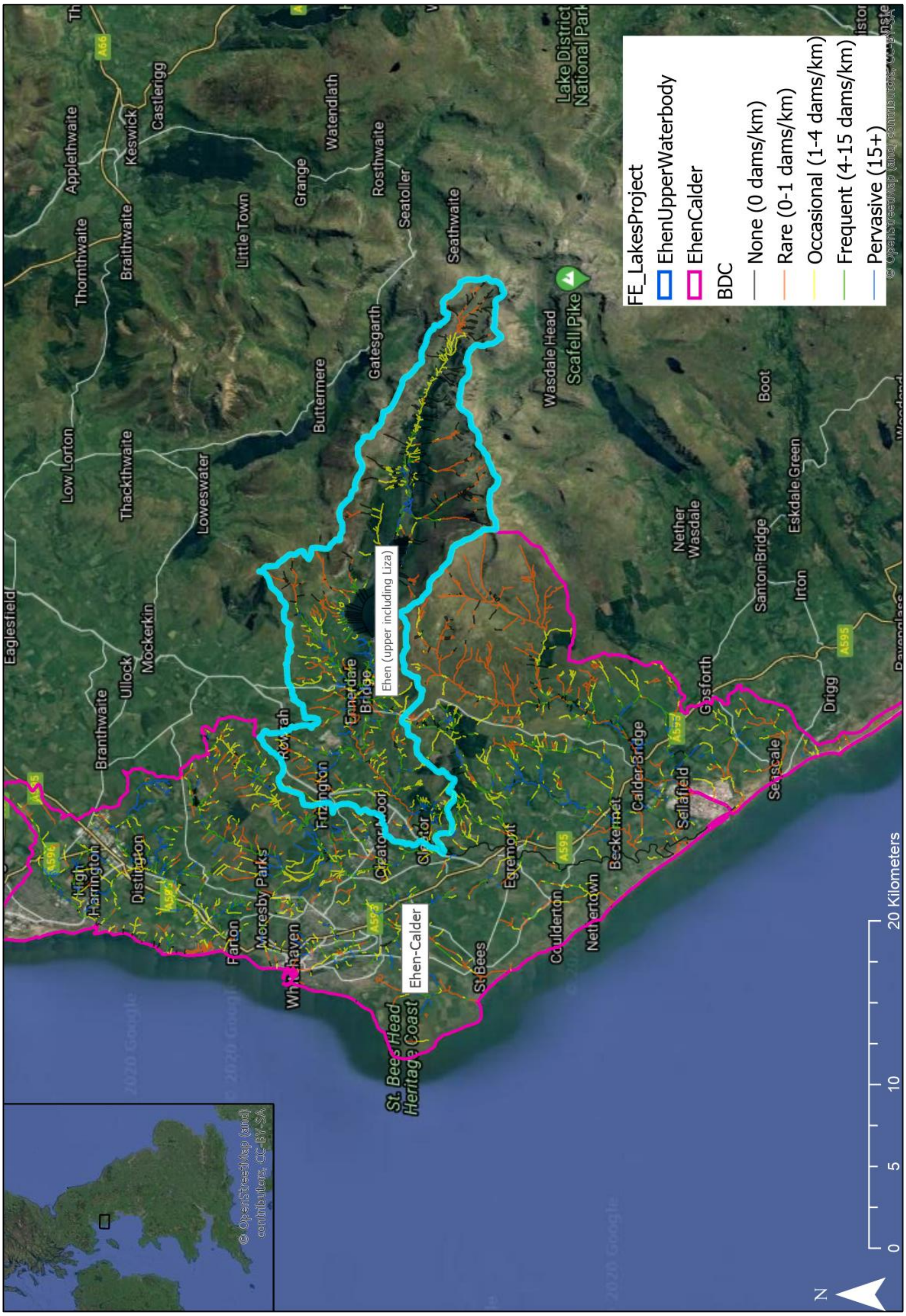

Figure 9. Beaver Dam Capacity model results for the Ehen-Calder catchment. Contains Ordnance Survey data © Crown Copyright 2007, Licence number 100017572 and some features of this map are based on digital spatial data licensed from the Centre for Ecology & Hydrology, © NERC (CEH).Aerial imagery: Open-Source Google imagery © OpenStreetmap (and) contributors CC-BY-SA.

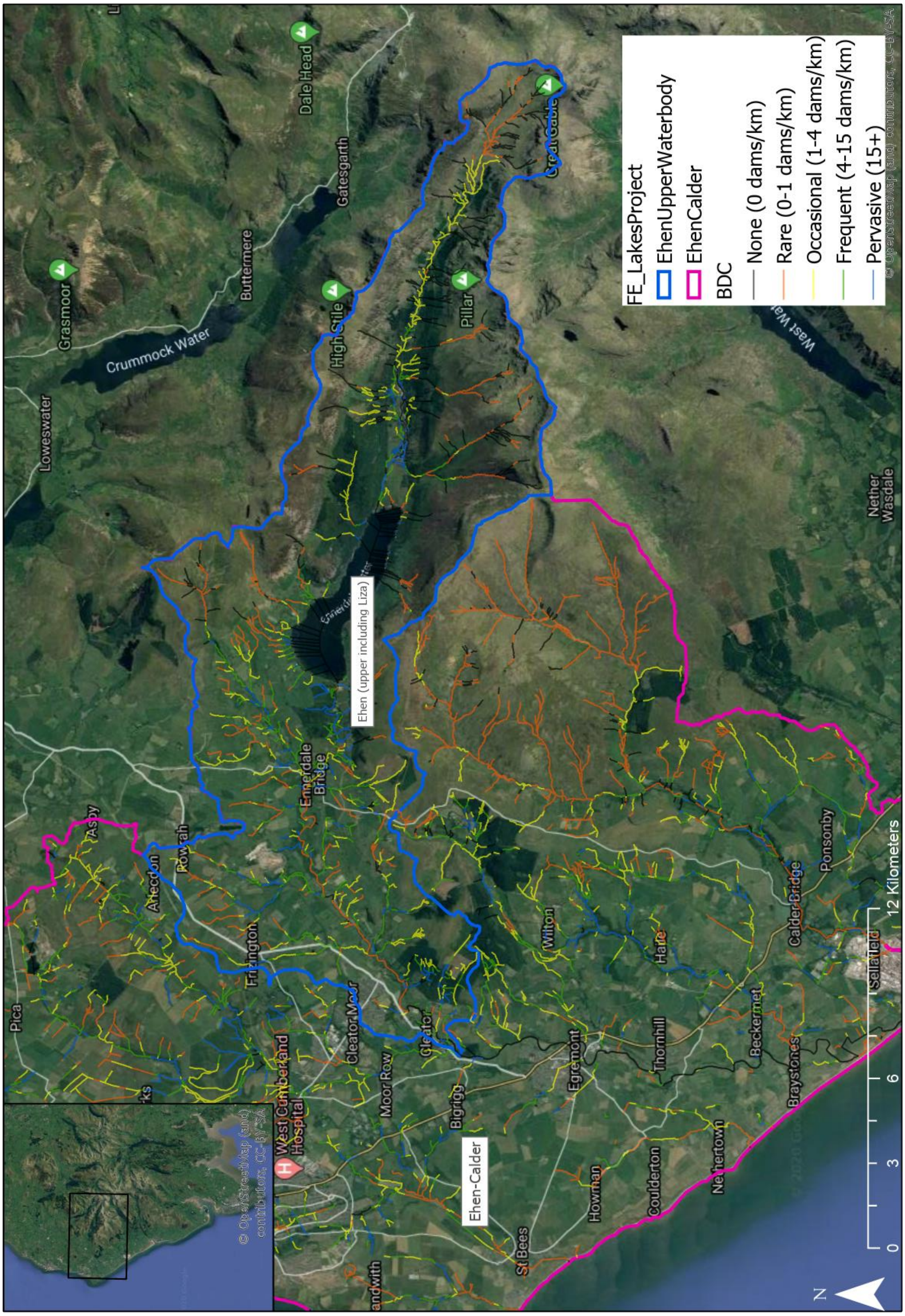

Figure 10. Beaver Dam Capacity model results for the Upper Ehen including the River Liza above Ennerdale Water. Contains Ordnance Survey data © Crown Copyright 2007 and some features of this map are based on digital spatial data licensed from the Centre for Ecology & Hydrology, © NERC (CEH).Aerial imagery: Open-Source Google imagery © OpenStreetmap (and) contributors CC-BY-SA.

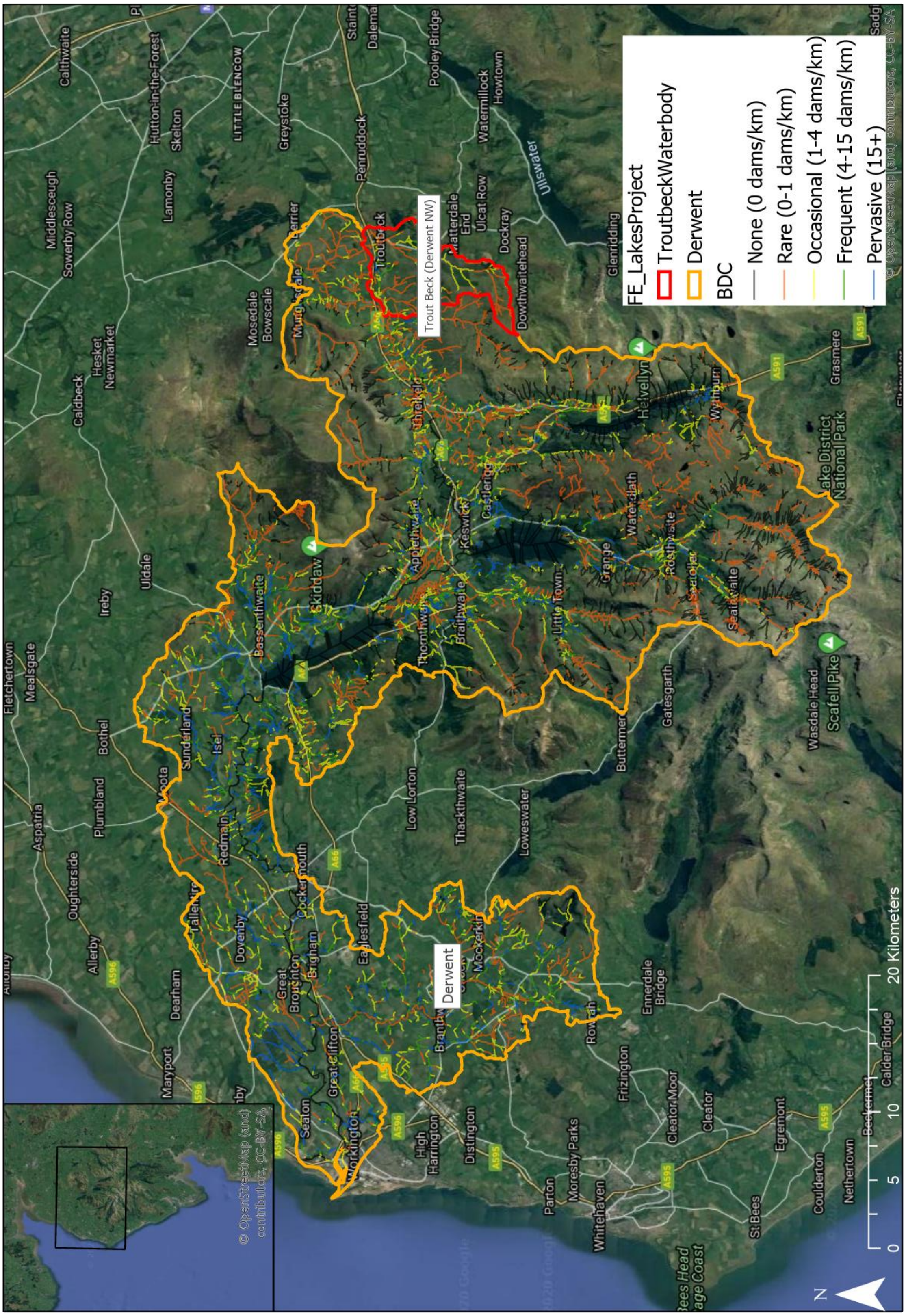

Figure 11. Beaver Dam Capacity model results for the Derwent catchment with Trout Beck sub-catchment highlighted. Contains Ordnance Survey data © Crown Copyright 2007 and some features of this map are based on digital spatial data licensed from the Centre for Ecology & Hydrology, © NERC (CEH).Aerial imagery: Open-Source Google imagery © OpenStreetmap (and) contributors CC-BY-SA.

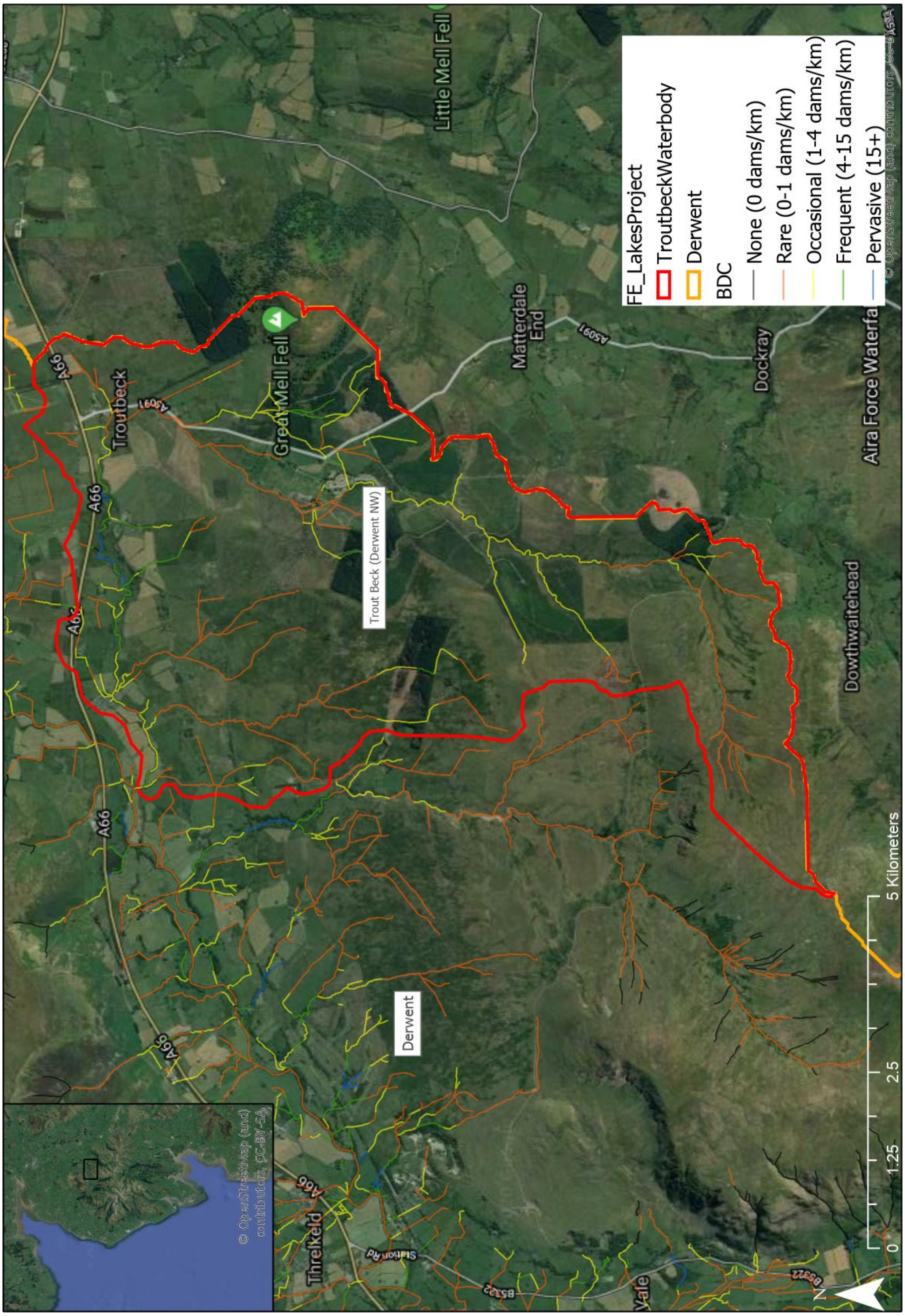

Figure 12. Beaver Dam Capacity model results for the Trout Beck sub-catchment. Contains Ordnance Survey data © Crown Copyright 2007 and some features of this map are based on digital spatial data licensed from the Centre for Ecology & Hydrology, © NERC (CEH).Aerial imagery: Open-Source Google imagery © OpenStreetmap (and) contributors CC-BY-SA.

3.3. Beaver Dam Capacity Model Summary

Figures 8-12 provide example model outputs for the Ehen-Calder and Derwent catchments. Large sections of the main channels show no capacity to dam as channels are typically above 5th and are too large and too powerful to allow damming, and there are extensive areas in both catchments which would support damming ranging from relatively low densities to areas where small channels with good riparian vegetation would support high or 'pervasive' dam densities.

Table 4 presents summary statistics and the model outputs predict that in the Ehen- Calder there is over 770 km of channel (ca 86 %) that could support some density of beaver damming. For the Derwent these figures are 1504.19 km and 76 % respectively. However, if you break down these statistics into areas classed as 'Pervasive' where you might expect beaver presence to result in the building of extensive dam sequences and the greatest environmental and management impacts (both positive and negative) to occur the figures are much lower. In the Ehen-Calder ca 100 km (12 %) are classified as pervasive whilst in the Derwent this figure is 220 km (11 %).

Due to the upland characteristics of the study area in question the model outputs doe exhibit notable difference than those say from lowland English catchments. As can be seen in Figure 10, some of the small first and second order channels in the River Liza, exhibit a zero or rare capacity for damming due to their steepness. Many areas of Trout Beck exhibit a lower dam capacity than might otherwise be expected based upon channel size due to a lack of suitable riparian habitat.

Table 4. BDC summary statistics

		Study Area			
	Statistic	Ehen-Calder	Ehen Upper	Derwent	Trout Beck
Summary	BDC Mean	5.98	5.33	5.11	2.18
	BDC STD	8.55	8.36	8.87	3.57
	Length of channel (km)	889.77	279.38	1978.55	55.06
% of each BDC class	None	13.45	28.66	23.98	0.12
	Rare	29.52	22.83	33.97	54.7
	Occasional	28.08	24.16	20.07	36.36
	Frequent	17.2	15.34	10.89	7.72
	Pervasive	11.75	9	11.1	1.11
Length (km) of each BDC class	None	119.69	80.08	474.36	0.06
	Rare	262.67	63.79	672.11	30.12
	Occasional	249.89	67.5	397.07	20.02
	Frequent	153	42.86	215.41	4.25
	Pervasive	104.52	25.16	219.6	0.61

4. Beaver habitat and dam capacity model conclusions

The model results presented herein, illustrate that throughout the Ehen-Calder and Derwent in Cumbria catchments there are extensive areas of suitable habitat to support beaver populations. Additionally, extensive lengths of channel exhibit characteristics that would make them suitable for damming if beaver were present. However, the model outputs also clearly show that there is a high degree of spatial variability in both habitat suitability and areas where damming may be expected. This spatial variability will be reflected in any beaver impacts (both positive and negative) and will need to be reflected in any restoration and management strategies.

Whilst useful, as with any model outputs, there are limitations and uncertainties (see Appendix 2 for use caveats) which need to be considered. It is highly recommended that any reintroduction, restoration and management strategies combine model outputs with expert interpretation and ground truthing.

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Appendix 1. Datasets used

The source datasets analysed during the current study were made available from the following locations:

OS Mastermap Water Network Layer: https://www.ordnancesurvey.co.uk/business-and-government/products/os-mastermap-water-network.html

APGB DTM 5m: https://docs.wixstatic.com/ugd/66c69f_482b0b6f530f4463a02626c8b194e25d.pdf

National River Flow Archive: https://nrfa.ceh.ac.uk/data

OS VectorMap Local: https://www.ordnancesurvey.co.uk/business-and-government/products/vectormap-local.html

CEH Land Cover Map: https://doi.org/10.5285/bb15e200-9349-403c-bda9-b430093807c7

Copernicus TCD: https://land.copernicus.eu/pan-european/high-resolution-layers/forests/tree-cover-density/status-maps/2015

CEH Linear Woody Framework: https://www.ceh.ac.uk/services/woody-linear-features-framework

Appendix 2. Caveats for use

Beaver vegetation and habitat index

BHI provides a resource for quantifying beaver habitat suitability with national coverage. A high (5m) spatial resolution enables it to have the capacity to inform detailed local decision making.

Examples of BHI presented overlaid on satellite imagery reflect its ability to provide a highly useful classification of beaver habitat based upon a vegetation suitability ranking and access to water (including both river network and waterbodies such as ponds and lakes). However, it is critical to note that BHI is a model rather than an absolute reflection of reality and the below caveats should be considered when using the BHI model outputs.

- Output resolution only as a high as the spatial resolution of coarsest input dataset (5 m).
- Remote sensing/mapping vegetation/landuse datasets not to species level. However, beavers are generalists foraging and utilising a wide range of vegetation so this is an applicable approach. However if more detailed information is required (i.e. protected plant species) supplementary local studies and data sets are recommended.
- Whilst broad categories have been used to classify beaver suitability it is important to highlight all classes from 2 (barely suitable) to 5 (highly suitable) are thought to contain suitable habitat that beavers being resourceful generalists could utilise.
- Each dataset essentially a snapshot in time. Areas of vegetation removal or land use change may degrade vegetation suitability whilst conversely replanting and conservation schemes may improve vegetation suitability. However, combination of datasets and methodology for ranking vegetation suitability minimise the risk of areas of suitable/unsuitable vegetation being missed currently.
- Some small channels i.e. agricultural ditches and ponds may be missing or outdated in dataset meaning beavers could access or exist in such areas but not be correctly classified by BHI model as falling within 100m of a water body.
- Most literature cites 50 m as maximum foraging range of beaver (i.e. Stringer et al., 2018) however, to incorporate uncertainty, site development (i.e. beavers damming or canal building allowing them to extend their foraging range) and due to reports of further foraging we have adopted 100 m as in Macfarlane et al., 2015. There are extreme reports of beavers moving up to 250m from channel (Macfarlane et al., 2015) but this is thought to be incredibly rare and not applicable to a general widely deployed habitat model.
- Summary statistics will reflect the above requirement for access to water, hence most if not all catchments will be dominated by areas not accessible to beaver. This does not mean they will not support healthy beaver populations.

- BHI focused on vegetation suitability and distance to channel/waterbody as a computationally effective model that can be deployed nationally. However, other local factors that will restrict access to water/vegetation particular human infrastructure culverted/constrained sections walls/fences may locally limit beaver habitat suitability.
- Due to the above considerations it is always recommended that if making important and detailed decisions at the local scale, supplementary site visits are undertaken.

Beaver dam Capacity Model

The BDC model estimates the capacity of river systems to support dams at the reach-scale (c.a. 150m). The model also highlights reaches that are more likely to be dammed by beaver and estimates the number of beaver dams that could occur for a catchment at population carrying capacity. As such, this highly detailed tool would provide understanding of where dams are most likely to occur and in what densities, supporting future work on the conflicts and opportunities that might accrue from beaver reintroduction. However, as with BHI, it is important to remember BDC is a model and for all critical decisions, particularly at the local scale, understanding from modelling results should be supplemented by site visits. The following caveats in-particular should be considered for interpretation of BDC results:

- BDC is heavily dependent on the input channel network. In some areas, flow pathways can be complex and not always accurately represented by even detailed river network GIS and mapping.
- BDC modelling is a snapshot in time and will not reflect any subsequent alterations to channel networks.
- It is important to note that the model assumes both reach and catchment population carrying capacity for beaver. Therefore, in reality the maximum number of 251 dams indicated in a category class is unlikely to occur.
- Flow conditions display a high degree of temporal variability, short term fluctuations due to rainfall events patterns and seasonal trends will alter the suitability of a channel for damming. I.e. a channel classed as having a rare capacity for damming, might see this capacity increase during drought periods, but conversely reduce to none during the wet/winter season.
- Modelling does not consider the resilience of dams. It is likely that dams in small channels with a high BDC will be more resilient than those in a larger channel with a higher stream power. However, BDC does not quantify this.
- BDC does not consider the exact spatial distribution or configuration of dams, which is also likely to be heavily dependent on beaver population dynamics.
- BDC reflects the capacity of a given reach to support beaver dams (assuming catchment beaver population carrying capacity) rather than the actual number of dams that are likely to occur. In isolation, BDC cannot predict the likely number of dams in a catchment.
- Most operational catchment boundaries used for determination of BDC extent exclude coastal and tidal reaches. Whilst these are often not suitable for beaver damming anyway it is important to highlight their omission.