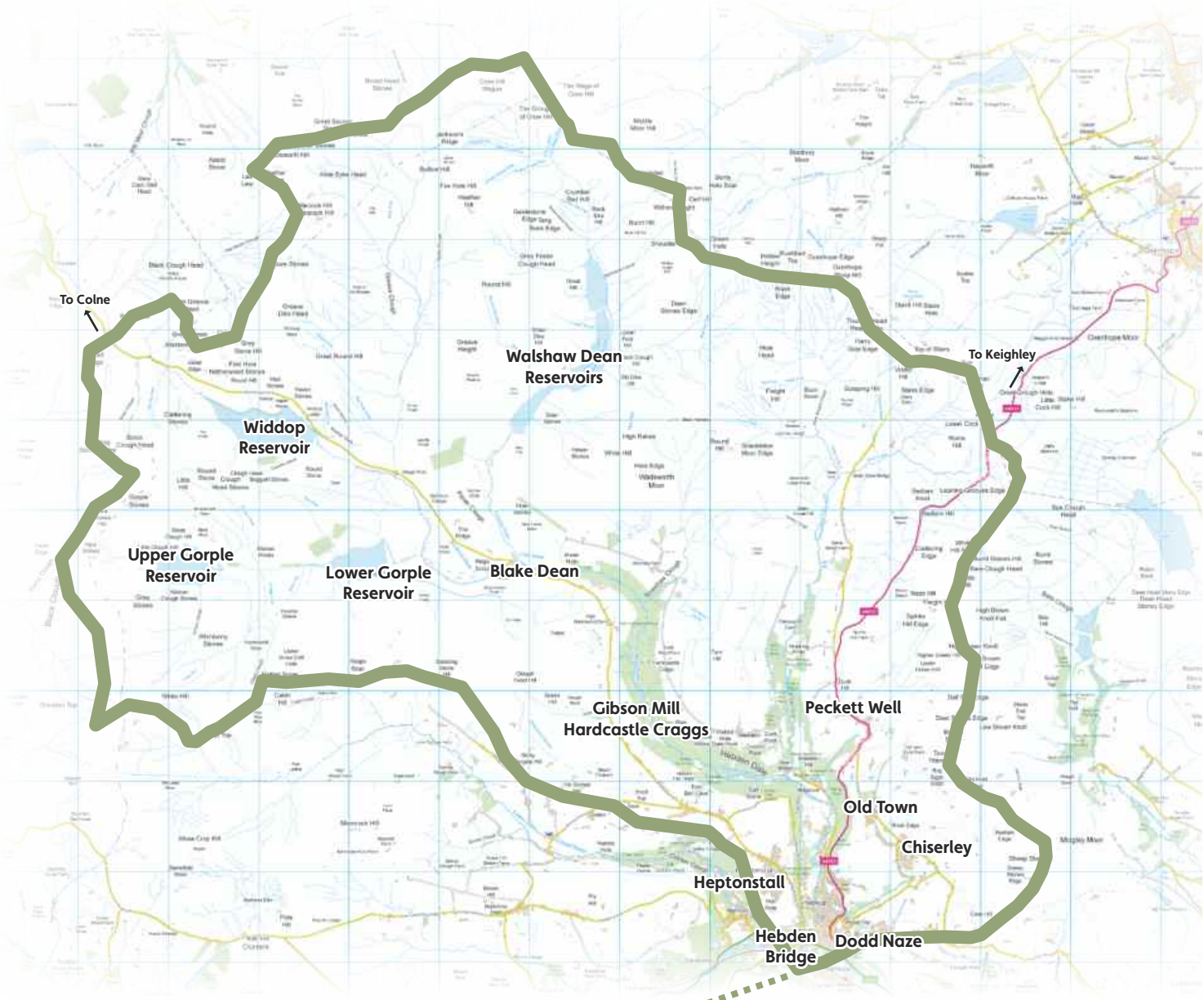
Understanding the Hebden Water Catchment

September 2013



Stretching from Widdop in the West to Wadsworth Moor above Old Town in the East, the Hebden Water catchment covers an area of

59 square kilometres.

Rainfall from this entire area drains down towards the confluence with the River Calder at Hebden Bridge

Catchment:

the entire geographical area drained by a river and its tributaries; an area characterized by all run-off being conveyed to the same outlet

Introduction

What are the key characteristics of the Hebden Water catchment?

Can we increase our resilience to the impacts of climate change through river and land stewardship?

Can we learn from experiences and research elsewhere?

These are the questions we seek to answer in this little booklet.

As residents of Hebden Bridge, we are particularly concerned about flooding issues since heavy rainfall events are predicted to become more frequent in this area, as global temperatures rise. Last year's floods were traumatic, with many businesses remaining closed for months, and our friends and neighbours struggling with ruined homes. It is estimated that clearing up and recovery after the floods cost £3.5 million from the public purse.

However we are not just concerned about flooding. Other factors in our landscape need to be considered too:-

- Over two thirds of the catchment is designated as Special Protected Area, and the area provides habitats for some of the UK's most endangered birds, like twite. Protecting our wildlife, and enhancing habitats must be central to any land-management plans.
- Water quality is affected by land management practices. The costs of water treatment are ultimately borne by the consumer, so avoiding pollution and discolouration will help to keep water bills affordable.
- In the past, inadequate attention has been paid to the value of our soils as "carbon sinks". Minimizing emissions from damaged peatland will contribute towards Calderdale's "Energy Futures" plan.
- Food security could become a more pressing national issue as weather patterns shift. Keeping food production local will increase community resilience to global food price shocks.
- Finally, we need to consider people. A healthy natural environment will attract visitors to the area, supporting the local economy, and providing less easily quantifiable "well-being"outcomes.

Writing this booklet has been a collaborative process. We've had workshops and public learning events over Summer in the Town Hall. We've attended conferences and discussion forums. We have invited Professor Malcolm Newson, one of the UK's most respected geomorphologists, to walk over the catchment with us, and explain key issues. We've been following the Natural England Uplands Scientific Review of Evidence with interest, and we've talked to a range of people with "hands on" expertise. There will always be more to learn, but we have made a start...

Professor Newson's visit

– The oldest known photograph of Hebden Water
(Alice Longstaff Collection)

A Brief History

PREHISTORIC TIMES

Unlike Airedale to the North, there were no glaciers in the Upper Calder Valley during the last ice-age, and this distant history is reflected in the landscape today – the Aire has a wide river basin, whereas our steep-sided valleys were formed through the action of meltwater alone.

By 12,000 years ago the climate had warmed, and forest cover had taken over from tundra. The first humans to arrive in the area were groups of hunters, following the movements of reindeer in Arctic conditions along the receding ice-front. After a brief resurgence of glacial activity, the area was repopulated some 10,000 years ago by family or sub-tribal groups, carrying out a system of rotational burning of areas of forest in order to attract red deer.

Large scale deforestation dates from about 7 – 8,000 years ago, when trees were burned and felled to clear land for summer grazing. The majority of peatbog initiation began at this time (removing the woodland would have caused the water table to rise, creating ideal conditions for sphagnum mosses which accumulate to form peat).

During the Bronze Age groups settled into communities, and territories developed. Deforestation continued with increased population pressure, and also demand for charcoal to smelt metal. Then, around 2,500 years ago, the climate cooled to something like we have now, and the area became depopulated once again.

ANGLO SAXON AND MEDIEVAL TIMES

Settlement began again in Anglo-Saxon times, and during the medieval period the main landscape activities were subsistence farming, hunting estates (gifted to the nobility in the Norman period) and monastic sheep and cattle ranching.

THE INDUSTRIAL REVOLUTION AND THE VICTORIAN PERIOD

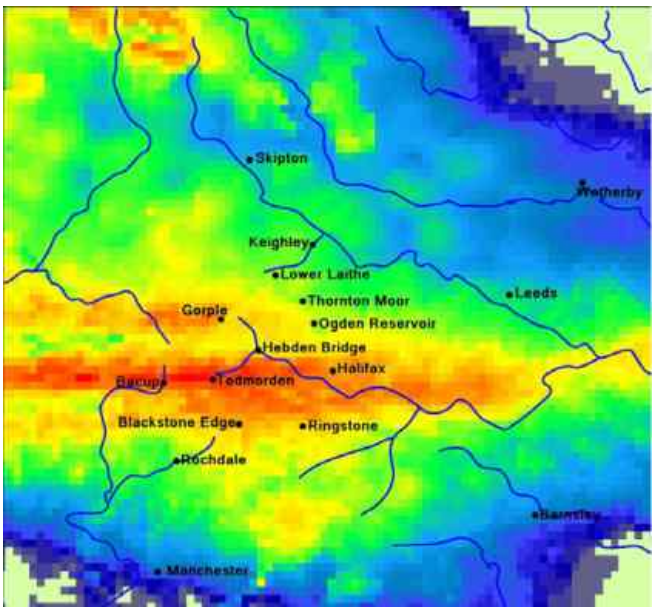
Human impact intensified from the 1770's onwards:

- Hebden Water was an ideal site for the adoption of water energy, eventually powering no less than nine textile mills. The water supply was supplemented by the construction of additional storage dams and leats, and transport links were provided by the opening of the Rochdale Canal in 1804.
- The use of coal-powered steam led to a huge increase in pollution from the Lancashire industrial towns because of the prevailing winds, and acid rain killed vegetation leaving bare peat moonscapes on the upland plateau.
- The arrival of the railway line in 1840 (and developments in gun technology) led to an expansion of leisure pursuits such as grouse-shooting, for a new moneyed class. The upland plateau areas began to be drained and this initiated heather colonisation. The heather (calluna) was then managed with rotational burning (to burn off leggy stems, and provide shoots to feed the young chicks).
- With improved transport links, the pressure for development in the valley bottoms increased. Hebden Water was "walled in" in its lower reaches to straighten its channel. The picture opposite shows Hebden Water in the 1870's.
- Construction of Walshaw Dean reservoir began at the end of the Victorian period, involving building a railway through Hardcastle Craggs and establishing a shanty town above Blake Dean to house the 600 workers and engineers – known locally as Dawson City.

Summer Floods 2012...

Friday 22nd June 2012

a "fluvial" (river) flood.



1hr accumulated radar rainfall 19.00 GMT 22nd June 2012

during a 24 hour period

nearly 4 million tonnes of water

fell on the Hebden Water catchment

June 22nd 2012 was the largest fluvial flood on record in the Upper Calder Valley, (Hebden Water rose to 1.97 metres, exceeding the previous high of 1st June 2000). However the storm which caused the flood was not a particularly rare event – 6.7 cm of rainfall in 24 hours fell at Walshaw Dean Lodge, but taking long-term averages as a guide, we could expect a similar level of rainfall once every 5 years.

As late as May, there had been warnings about low reservoir levels leading to water shortages, but two spells of very wet weather in early June were sufficient to soak the soils and replenish the reservoirs to near capacity (97%). Within the catchment, rainfall is measured at Gorple and at Walshaw Dean Lodge, and during the first three weeks of the month they received 15.2 and 13.8 centimetres of rain, respectively – over one and a half times the long-term average for the time of year. However, rivers in the upper Calder are "flashy" (they rise and fall quickly), and Hebden Water was at its normal level.

As day broke on Friday 22nd June intense storms over Calderdale raised river levels at all locations and also filled much of the available water storage. From midday and throughout the afternoon, steady rainfall continued at a lower rate. At around 6pm local time an intense storm developed in a line from west to east over the southern edge of the upper Calder and Colne and within half an hour a second storm line developed slightly further to the north over Todmorden, Hebden Bridge and Mytholmroyd. The heavy rainfall continued until around midnight.

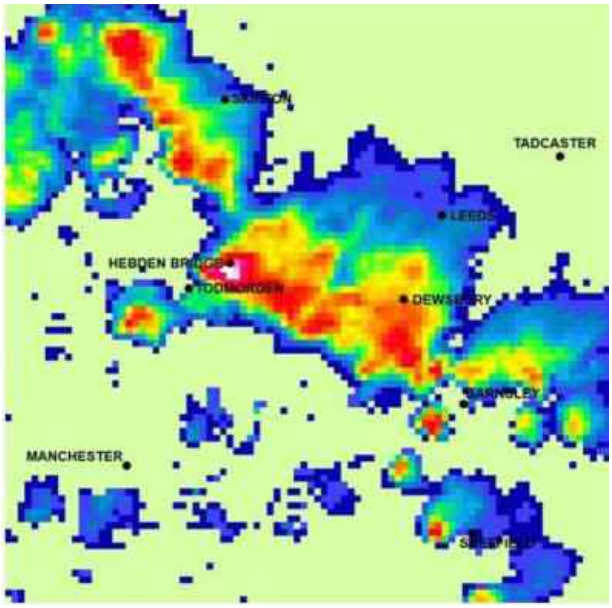
Hebden Water overtopped its banks shortly before 11 p.m. The River Calder was exceptionally high, and whorls formed at the confluence causing water to "back up" the Hebden Water Channel. It is thought that this could have added up to 80 cm to the peak level.

Rain, rain and more rain.

...every flood a different flood

Monday July 9th, 2012

a "pluvial" (run-off) flood.



1hr accumulated radar rainfall 13.00 GMT 9th July 2012

At its most intense, rainfall reached

4.3cm per hour

During the 9th July storm, intense rain fell for a short time. There was no time for water to drain away or into rivers, so strangely there was a surface water flood yet river levels were not especially high. This storm over Hebden Bridge was part of a line of storms stretching from Lincolnshire right across to the Mersey. The full intensity of rainfall over Hebden Bridge was not captured by the rain gauge network but Meteorological Office estimates based on radar rainfall data suggest that a storm of this intensity would only be predicted every 75 years on average. Freak storms, such as this, have been very rare and are very difficult to predict.

Prior to the flood, the area had experienced the wettest four month period on record – June had seen over twice the long term average rainfall, and this weather pattern had continued into July. Consequently soils were saturated. The storm could not have hit at a worse time...

..or at a worse place. On his visit, Professor Newson described the area above Nutclough as "an amphitheatre of flood risk hazard." With the topography of the landscape acting as a natural funnel, water poured off the moors down Popples Lane, and was chanelled down the lanes and tracks, picking up rocks and debris on the way. Field drains were overwhelmed and water streamed through Dodd Naze housing estate (high on the hillside above Hebden Bridge).

Meanwhile large amounts of water were funnelled into Nutclough, which acted as a temporary bottleneck until its water storage capacity was overwhelmed. The culvert at the lower reservoir adjacent to Keighley Road partially blocked, filling up the reservoir which then spilled through 2 adjacent properties and down Keighley Road into Hebden Bridge town centre.

A really big storm in a teacup.

The River and the Town

Before we turn our attention to the wider catchment, it makes sense to consider what actions could be taken in the town itself:-

The Confluence:-

In normal conditions, it may not matter that Hebden Water and the Calder oppose each other at the confluence (Hebden Water flows South West, and meets the Calder flowing East).

However, in periods of heavy rainfall when both watercourses are swollen, the angle at which they meet is a recipe for disaster. Huge whorls form, with water circling round and round rather than flowing downstream. This causes an impediment, backing up water into the town.

An "engineering solution" altering the angle at which the two rivers meet could help with flow, and potentially take 0.8 metres off the flood peak.

Drains

Making sure that drains are kept unblocked is sensible – indeed a third potential flood in Hebden Bridge last August was narrowly averted by prompt action to prevent blockages in the drains. However no drainage system can cope with the huge volumes of water and sediments which are generated in very heavy rainfall events.

Shoals

Rivers constantly wash down rocks and gravels, which form shoals, such as those pictured opposite. The impact of shoals as well as channel side vegetation varies across the catchment from location to location. A recently completed study in Mytholmroyd has found that the vegetation and not the shoals has an impact on flood risk. A similar study will need to be carried out on Hebden Water to determine what impact shoals and vegetation have.

Victorian structures in the Watercourses

The town's industrial heritage has also left a legacy of old structures in the river. Many of these old walls and culverts are in a state of considerable disrepair, and will need attention over the coming years.

Being Prepared!

Much work has been carried out over the past year to improve the area's preparedness for floods. A multi-agency project team has been set up, involving the Environment Agency, Calderdale Council and other partners; new flood wardens have been recruited; and flood forums established. In April this year Calderdale was chosen by DEFRA as a national pilot, seeking to boost community, business and household resilience, improve communications and examine how upland and river stewardship could contribute to slowing run-off, and reducing flood risk downstream.

Hebden Water Catchment

18% Upland Plateau

Area of Upland Plateau = 1074.3 Hectares

95% of the upland plateau can be classified as blanket bog. This is Britain's No. 1 globally significant habitat type, due to its rarity and its ability to store carbon. However much of the blanket bog habitat is degraded and its ability to sequester carbon has been diminished.

Grips (drainage channels) have been dug in 51% of the Upland Plateau

2% Reservoirs

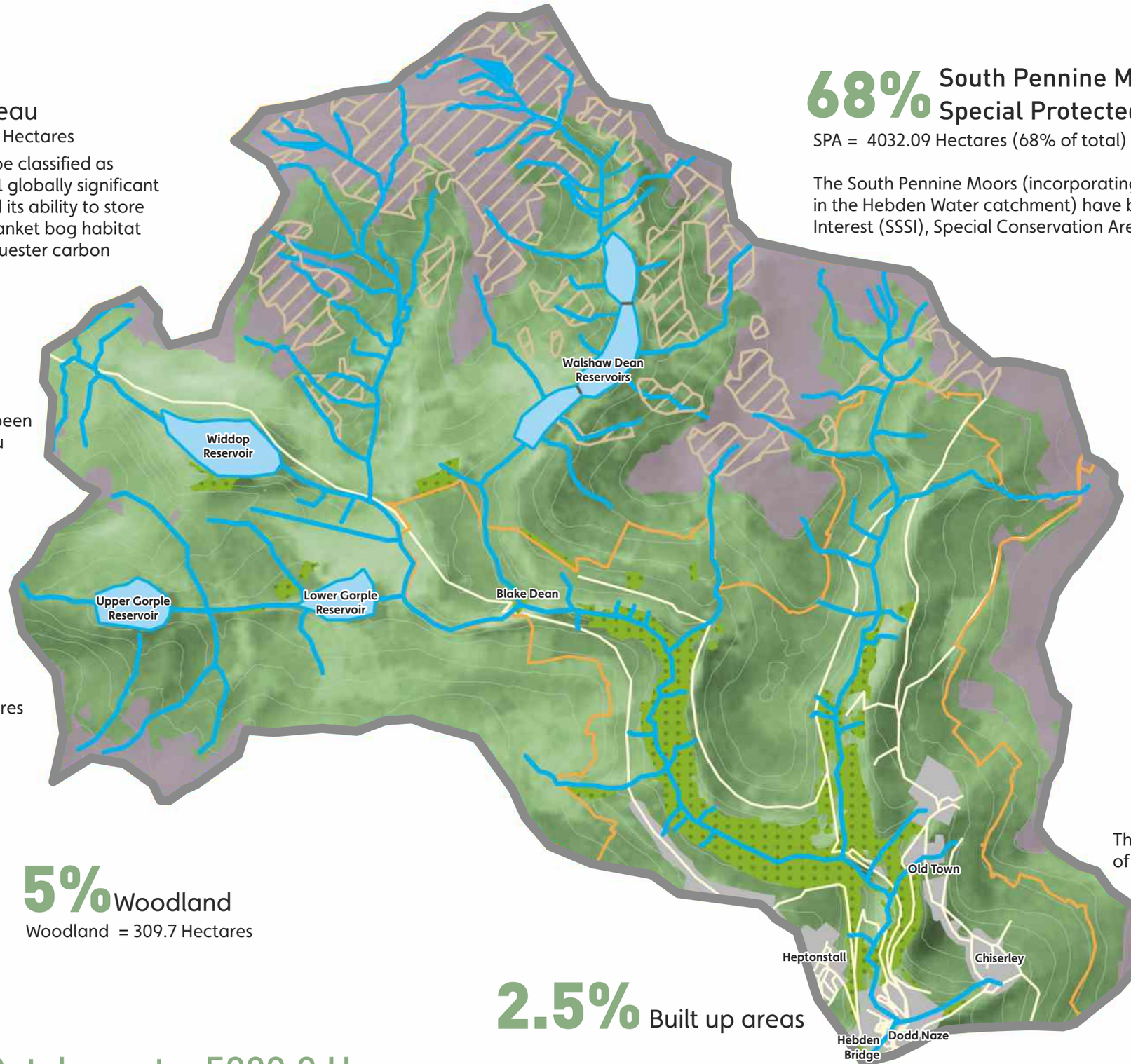
Area of Reservoirs = 128.16 Hectares

5% Woodland

Woodland = 309.7 Hectares

2.5% Built up areas

Area of Catchment = 5909.9 Ha



68% South Pennine Moors Phase 2 Special Protected Area

SPA = 4032.09 Hectares (68% of total)

The South Pennine Moors (incorporating Widdop, Walshaw and Wadsworth Moor in the Hebden Water catchment) have been classified as a Site of Specific Scientific Interest (SSSI), Special Conservation Area (SCA) and Special Protection Area (SPA).

Legend

- Hebden Water Catchment
- Roads
- Streams and Rivers
- Reservoirs
- Boundary of the SPA
- Upland Plateau (Slopes of 4 degrees or less at 400m or above)
- Woodland
- Built up areas
- Grips (drainage channels)

The Old Town area has the highest density of tracks and rights of way in the UK.

Note:- some categories are overlapping, and farmland types have not been included

Farm and Field

Farming is an important and traditional part of valley life in Calderdale. Much of the land can be used for raising livestock, hay and food for people. Food security demands that more food is produced locally. We need to find ways this can be done that sensitively address issues of climate change, bio-diversity and flooding.

Field drains are often unmapped or in poor condition. It is important to consider where they lead, for example housing may have been built over old drainage routes. It might be possible to divert storm water flows around newer settlements like Dodd Naze.

We are aware of studies being carried in Belford, Pickering and Holnicote, all aiming to take a "landscape scale" approach to flood alleviation. We hope to arrange day trips to visit some of these areas to see how capturing overland flow in ponds and wetlands could help to slow down the run-off in heavy rainfall events. Ponds, whether temporary or permanent, would also have wildlife benefits. Surface water flood modelling would be needed to establish the optimum locations.

Mob grazing is a method of grazing livestock in confined areas and moving them on to the next small area of fresh pasture every day. Research suggests that this method can reduce the impact of erosion and increase the depth of soils. This would have a positive effect downstream as soil can hold lots of water. The change in the grazing pattern means the animals don't just eat all their favourite plants first and so greater biodiversity is attained.

Calderdale is home to the rare twite, which is red-listed in the UK. Its habitat is the moorland edge and "in bye" land, where it feeds on seeds of plants like sorrel and dandelion. There are scarcely 100 breeding birds left, so it is important to manage land with their welfare in mind.

Lanes and Tracks

The network of lanes, tracks and packhorse trails is one of the area's greatest assets, attracting thousands of visitors each year.

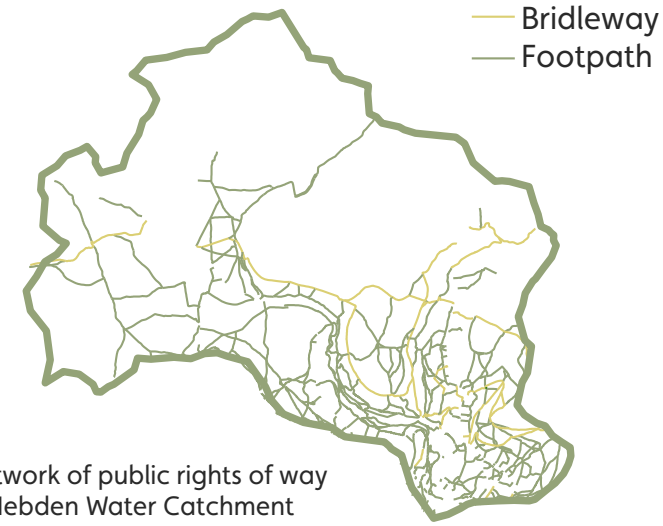
We are a "Walkers Welcome" town and the Hebden Water catchment is crossed by major routes – the Pennine Way, the Calderdale Way, and the Pennine Bridleway.

But in heavy rainfall events these tracks can be transformed into fast flowing streams, channelling water and debris into the town below. In the upland areas the creation of tracks can create erosion and alter the hydrology of the peat.

Chris Mayoh

Some pathways and tracks that become water channels in floods could be used to guide flood water away from residential and business properties into fields or attenuation ponds. These provide temporary storage to keep waters away from town and farms which would see the biggest economical impact during a flood, and reduce the rate of water reaching built up areas.

It will be important to ensure that new tracks are not constructed in upland areas. The Natural England Upland Science Review found that "tracks alter the structural integrity of blanket peat".



The network of public rights of way in the Hebden Water Catchment

Kate Tattersall

Woodland

Just over five per cent of the Hebden Water catchment is currently wooded, with over two thirds of the woodlands in the ownership of the National Trust, who intend to maintain Hardcastle Craggs as a wooded landscape in perpetuity. The Trust has a woodland management strategy aimed at removing some of the ageing and less healthy trees to make way for new growth. Careful felling of selected trees will be beneficial for wildlife and allowing sunlight through gaps in the canopy brings benefits for wildflowers and insect life. The felled trees will be replaced with native species.

The Forestry Commision recently worked with the Environment Agency on the "Woodlands for Water" project, aiming to identify areas where the creation of new woodlands could help to meet water quality objectives and mitigate flooding. They found that there was strong evidence to support woodland creation in appropriate locations to achieve water management and water quality objectives. Protecting river morphology, moderating stream temperatures, slowing down run-off, and intercepting sediments and nutrients were some of the benefits mentioned.

As part of the study a map of potential areas for tree-planting was drawn up; some 20% of the Hebden Water Catchment was deemed suitable.

We are aware of three Defra "slowing the flow demonstration sites", at Pickering, the Derbyshire Derwent and Holnicote in the South West, looking at new ways to manage riparian (riverside) woodland to reduce the risk of branches being swept downstream during a flood and causing blockages. The projects have used "leaky dams" to allow water through during normal conditions but hold water and woody debris back during floods. Initial results indicate that they can make the hydrograph shallower and reduce the flood peak

Reservoirs.

There are six reservoirs on the Western side of the catchment:- Gorple (Upper and Lower), Widdop, and Upper, Middle and Lower Walshaw Dean. Collectively they have a capacity of 8.2 million cubic metres, and play an important role in keeping taps running and rivers flowing, whatever the weather.

The reservoirs would provide some flood alleviation if levels were low (for example if there was an intense cloudburst following an extreme drought) but prior to the June 2012 event the reservoirs were at 97% capacity so there was only a minimal amount of water storage available. Drought conditions earlier on in the year had led to water shortage alarms, so there was a presumption to retain stock levels against a return to dry and hot weather.

Pre-emptive water release in advance of flooding would be problematic. Not all floods are predictable, as the July 2012 event showed, and some flood warnings turn out to be false alarms. Water companies have a legal requirement to let out a defined amount of water every day to maintain river levels, so releasing water needlessly could have adverse environmental impacts down the line.

The role of the reservoirs in supplying drinking water undlerlines the importance of water quality as a key issue which should inform land management practices in this part of the catchment. The Natural Englands Uplands Science Review found "strong evidence that moorland burning results in increased water colouration and/or dissolved organic carbon (DOC) in peatland watercourses" with effects at a catchment scale. Removing DOC from the water adds expense to water treatment, and could be avoided by adopting different management techniques on the uplands.

The Uplands

The land use and management of upland areas can have various impacts on hydrology, ecology and biodiversity, altering the functioning of peat lands found in the Hebden Water catchment.

Manmade drainage channels called grips were dug in the 1950s to drain upland areas in order to promote agricultural practices and grouse shooting. In other areas within the South Pennine Moors efforts have been made to monitor and block these grips in order to reduce the flow rate and volume of water reaching downstream areas by promoting surface vegetation and the formation of peat. It could be possible to remove or partially fill in these manmade scars and reduce hydrological connectivity, reducing the rate of flow of water downstream.

Burning is used to create a habitat for grouse breeding, feeding and raising chicks for the shooting season.The Natural England Upland Science Review found "strong evidence that burning affects the processes controlling carbon budgets of upland peatlands." The exposed peat left behind dries out more easily, making it more susceptible to erosion which in turn releases carbon into the atmosphere and into the waterways. Some local land-owners are shifting to cutting as a less environmentally damaging alternative to burning, and studies are being carried out at York University on the most effective techniques.

Although much of the blanket bog in the catchment is in a degraded state, Natural England's scientific review found no evidence that any of the UK's blanket peatlands were unrestorable, given time. A goal of promoting sphagnum vegetation (rather than heather) and "bringing back the bog" on the upland plateau areas of the catchment would have multiple benefits:- slowing run-off, improving water quality, and creating a "carbon sink."

Erosion Control

Heavy rains combined with exposed positions can leave bare scars on our hillsides that get worse with time, as more rain washes away the soil and scree. This has long-term implications on flooding downstream as rain water accelerates down the bare hillside and rivers fill with debris.

Prompt action to treat landslips will help to minimise sedimentation in the watercourses, and bare sloping hillsides can be treated with fascines. These are 6ft long bundles of sticks and twigs which are semi-buried along the contours of damaged hills and staked into position. The areas are then re-seeded to allow plants to recolonise the patch.

As the fascines decompose over a period of several years, they catch any bits of soil and small stones coming down the hill, slowly building up terraces that will hopefully regenerate.

Fascines could be locally sourced using side-branches trimmed during woodland management work.

Conclusions

Working on this booklet has been a learning experience, so what have we learned?

Ours is a "rapid response" or "flashy" catchment," which means that river levels rise very quickly in response to rainfall events. This flashiness is due to several factors:

- "connectivity" between the uplands and valley (ditches, roads and tracks funnelling the water down)
- lack of "interception" (a wooded landscape can intercept up to 30% of rainfall before it hits the ground, but our area is only 5% wooded)
- lack of "room for water." Hebden Water is channelled in its lower reaches, with no wide valley bottoms to act as flood plains, and there is limited capacity for water storage in the area's reservoirs. This highlights the vital role of the uplands.

Development patterns have amplified the flood risk. Hebden Bridge's situation at the confluence with the River Calder - i.e. at the "outlet" from a 59 square kilometre catchment – means that the town has been located at the riskiest geographical location available, and the river engineers of the past did us no favours by channelling Hebden Water to the West. This leaves the town vulnerable to the "rain rich" period predicted for our area, as the world warms.

It is impossible to remove this risk entirely, but land and river stewardship can play a role in slowing run-off, and preventing gravels and sediment entering watercourses. Together with action taken within Hebden Bridge itself, the raft of landscape interventions outlined in this booklet could make floods happen less frequently, and reduce the damage when they do occur. In flooding events, inches can count - there is a big difference between a flood that just shuts the road for a while, and one which overtops doorsteps and ruins lives. Slowing the arrival of the water and reducing the peak are both useful objectives in their own right.

It's not just about flooding. All the measures we suggest have multi-functional benefits, including improving water quality, creating carbon "sinks", improving habitats and supporting the local economy.

This booklet is not the end of the process. We hope it will be the beginning of a continuing dialogue between landowners, farmers, and the wider community, working together to achieve positive environmental outcomes for the catchment as a whole.

Coming up this Autumn..

The River and its banksides – a walk down Hebden Water with Professor Newson, on Sunday 29th September. The event is open to all, but places are limited so booking is required. Please contact:- sally.naylor@calderandcolneriverstrust.org

Grab a Grid - part of Calderdale's DEFRA funded Community Flood Resilience project. Volunteers are being recruited to do some simple surveying of flood and water issues in the uplands in the Calder valley so that we can gather and map information and look at what actions need to be taken. No experience is necessary but you will need time to visit your square kilometre of land at least twice during the project. If you're interested then please contact Dave Wilson – Dave.wilson @calderdale.gov.uk

Landowner Drop-in Event, Hebden Bridge Town Hall, Saturday 9th November, 11.00 – 2.00. Landowners and managers who are interested in getting involved with the process are invited to drop in for some or all of the event. We hope to have presentations on Woodlands for Water, Mob grazing, Moorland Restoration and more, plus an Open Forum. To receive a full programme, email charles.forman@environment-agency.gov.uk.

Some of our background reading.....

Natural England Uplands Evidence Review. The Impact of Tracks on the Integrity and Hydrological Function of Blanket Peat.

Natural England Uplands Evidence Review. Restoration of Degraded Blanket Bog.

Natural England Uplands Evidence Review – The effects of Managed Burning on Peatland Biodiversity, Carbon and Water

Natural England Uplands Evidence Review – Upland Hay Meadows. What Management Regimes Maintain the Diversity of Meadow Flora and Population of Breeding Birds.

Natural England Uplands Evidence Review – Moorland Grazing and stocking Rates.

South Pennine Moors: Integrated management Strategy and Conservation Programme

Moors For the Future: Sustainable Uplands & Moors for the Future Research Note No.14 (2007)

RSPB Scotland 2010: Peat bogs and Carbon a Critical Synthesis

DEFRA. Catchment Based Approach: Improving the quality of our water environment. A policy framework to encourage the wider adoption of an integrated Catchment Based Approach to improving the quality of our water environment. May 2013

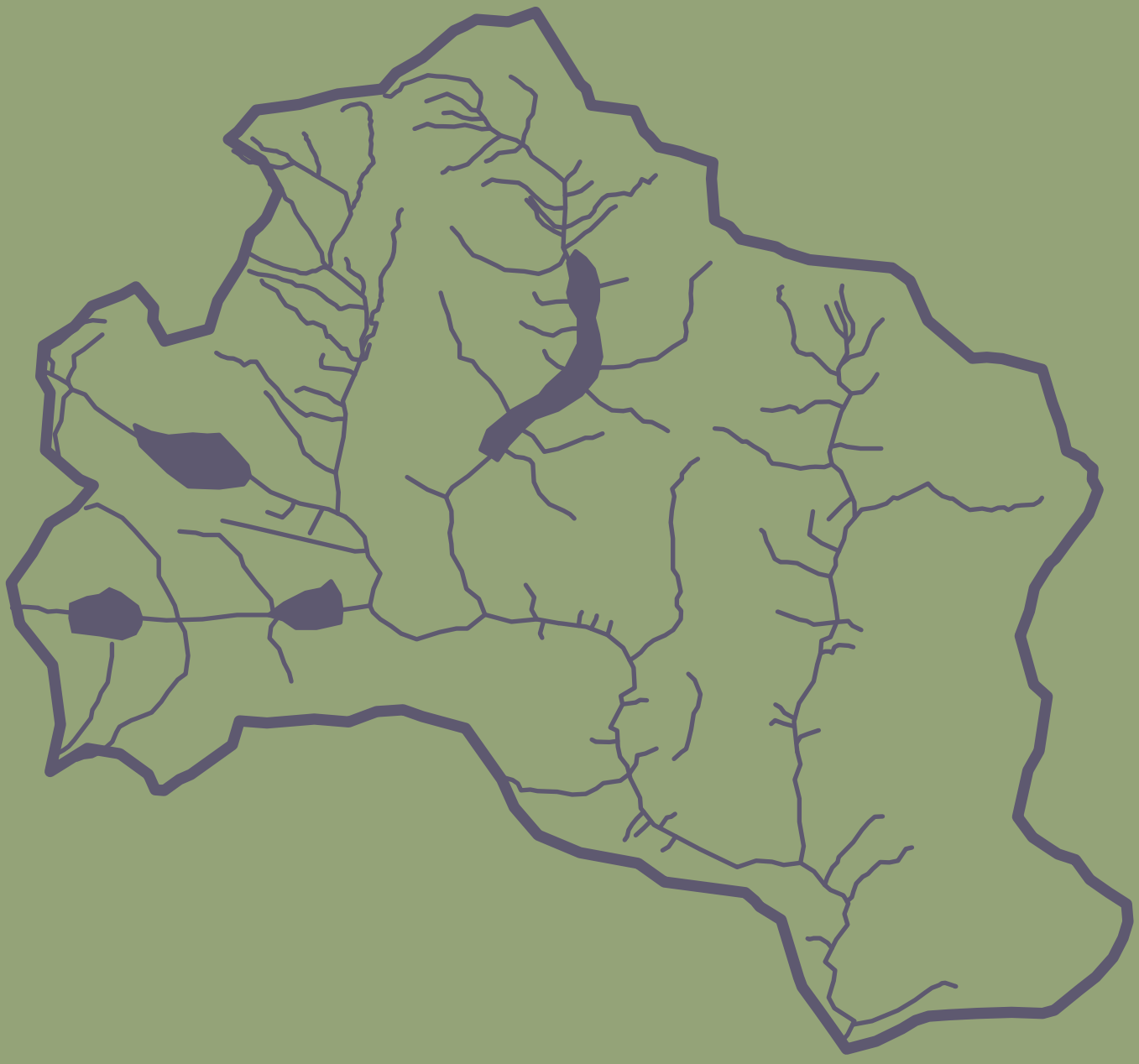
Woodlands for Water (July 2011). Woodland measures for meeting Water Framework Directive objectives. (Environment Agency)

Land Use Management Effects on Flood Flows and Sediments – Guidance for Prediction (CIRIA) 2013.

Calderdale Council Section 19 Report Flood Investigation Report 22nd June

Calderdale Council Section 19 Report Flood Investigation Report 6-9th July

University of York study https://sites.google.com/a/york.ac.uk/peatlandesuk/



We appreciate assistance from the following funders:-

DEFRA/Calderdale Council – funding for Professor Newson's visit, and three learning events
Environment Agency – funding for GIS map consultancy, via the SOURCE partnership.

Mapping – InTouch GIS Services email jongatward@ntlworld.com Mob 07806 816116

Printed on recyled paper by Lambert Print and Design (01422 843127).