

High Weald AONB

Integrated Catchment Management & River Restoration Study

Prepared for
High Weald AONB Unit
by
Land Use Consultants
&
The River Restoration Centre



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INTEGRATED CATCHMENT
MANAGEMENT & RIVER
RESTORATION
STUDY**

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By

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I. INTRODUCTION

Project Scope

- I.1. The High Weald AONB Unit and the southern region of The Environment Agency have sought advice on how the rivers in the AONB might be best managed in the future to sustain and enhance their natural physical characteristics. Of particular interest, is the relationship between management to control flooding and management to enhance natural riverine ecology and provide opportunity for sustainable catchment land management.

Existing River Management

- I.2. Historically, river management within the High Weald has been exercised to a greater or lesser degree to reflect the extent to which river conditions (notably out of bank flooding) compromise agricultural activity and/or human settlement and associated infrastructure on adjoining land. To this end, the natural form and hydrological function of the majority of main rivers in the area have and continue to be fundamentally influenced by river management practice which aims to reduce the frequency of out of bank flooding, and to rapidly conduct floodwaters to sea.
- I.3. In light of predictions for future sea-level rise, and changing weather patterns, flood defence will continue to be a key driver for river management in the future. This is particularly pertinent as recent trends in river flooding patterns show a disturbing increase in both frequency and peak flows that cannot be explained by any single phenomenon such as global warming.
- I.4. The recent spate of major flood events across the UK, has raised awareness and understanding of the benefits to society of attenuating rates of flood runoff. This can be achieved on a river catchment scale by changing approaches to land and river management, in addition to adopting site-specific flood alleviation engineering schemes which are frequently very costly to design and construct and have significant long-term maintenance requirements.

Opportunities for Future River Management

- I.5. A catchment-scale approach to sustainable land management to attenuate flood runoff can reduce the height at which river flood water levels rise. If attenuated, floods will take longer to build up and longer to subside but the most damaging peak levels could be reduced. Similarly, by deliberately allowing select areas of land adjoining rivers to flood and temporarily store flood water, pressure on more flood sensitive

sites along the river can be reduced. The recently published Curry Report discusses the future of UK agriculture, and recognises the value of catchment-scale land management initiatives that can be implemented by farmers to attenuate and manage floodwaters. It specifically recommends that, where applicable, farmers could be paid to use land as floodwater storage rather than for crop production and should be encouraged to develop farming practices that reduce the rate of flood run off into rivers.

- 1.6. In addition to contributing to flood defence requirements, sustainable catchment land management could provide a range of additional environmental benefits, notably increased biodiversity associated with less intensive agricultural land management, and new habitat creation associated with new flood storage areas (e.g. reed-beds, flood meadows, woodland and hedgerows). Such changes to landscape character could also provide other beneficial spin-offs in the long-term, such as increased opportunity for recreational enjoyment and the promotion of green tourism – the latter benefit is also cited by the Curry Report. Sustainable water management and an improved approach to integrate water management is also promoted by the Department for Environment Food and Rural Affairs (DEFRA)¹
- 1.7. By seeking to attenuate flood runoff by adopting sustainable approaches to catchment land management, additional indirect benefits to river form and function can be also be achieved. As highlighted previously, UK rivers have been historically managed to efficiently store and discharge floodwaters within bank. Frequently this involves lowering riverbed levels by dredging, and the straightening of rivers by removal of bends (meanders). In both instances, such actions will result in the removal and/or degradation of natural riverine features (e.g. silt bars, gravel shoals and riffles, woody debris etc.) and result in an associated decline or total loss of dependent aquatic flora, fauna and fisheries.
- 1.8. If catchment land management initiatives can be undertaken to reduce flood peaks, associated reductions in the extent and frequency of routine river channel maintenance operations (dredging and weed cutting) can be explored to reduce maintenance costs, encourage biodiversity and facilitate landscape change. Taking this further, the re-instatement of lost river features such as meanders and/or the lowering/select removal of constructed flood embankments could also help attenuate flood discharge (meander reinstatement to 'hold-up' flood flows), and to store flood waters on select floodplain areas by embankment lowering/removal. Both of these scenarios would also have additional associated environmental and economic benefits as highlighted previously.

¹ Directing the Flow - Priorities for Future Water Policy. DEFRA (November 2002)

- 1.9. The EC Water Framework Directive, is another significant driver that will need to be considered in relation to future of river management in the High Weald. The aim of the Directive is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater in order to:
- a) prevent further deterioration and protect and enhance the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on aquatic ecosystems.
 - b) promote sustainable water use.
 - c) aim at enhanced protection and improvement of the aquatic environment through progressive reduction of pollution of groundwater.
 - d) bring about progressive reduction of pollution of groundwater.
 - e) contribute to mitigating the effects of floods and droughts.
- 1.10. The Directive's principal aim is to ensure '**good ecological status**' of aquatic systems (rivers and dependent wetlands), and this will require the co-ordination of all water management activity in the broadest sense through the production of River Basin Management Plans.

Reporting

- 1.11. This report has been produced by Land Use Consultants with significant input from Richard Vivash of the River Restoration Centre (RRC). It is based on an assessment of readily available published material on existing rivers within the High Weald, and a rapid field assessment of rivers within the AONB, that focussed most closely on the River Rother.
- 1.12. This report supersedes the first stage report (November 2002), and takes account as far as was considered practicable, consultation comment received from the High Weald AONB Unit and the Environment Agency.

2. BACKGROUND TO CURRENT RIVER MANAGEMENT

- 2.1. This chapter sets a general background context for river catchment management and restoration within the High Weald AONB. It has drawn only on readily available Environment Agency reports and publications (notably Local Environment Agency Action Plans (LEAPS)), aerial photographs, and information gained from brief walkover field survey of select areas undertaken in the summer and autumn of 2002 by LUC.
- 2.2. A summary of the various river catchment attributes and issues recorded by this assessment within the AONB is provided in tabular form in Appendix I.

LOCATION

- 2.3. The High Weald AONB is located in the south east of England (**Figure 1: The High Weald AONB**). It includes parts of the counties of Kent, East Sussex, West Sussex and Surrey.

PHYSICAL LANDSCAPE

Geology

- 2.4. The Weald has a distinctive geology (**Figure 2: Geology**) which strongly influences the hydrology of the area as well as its landform and land use.
- 2.5. The sedimentary rocks of the High Weald were laid down as shallow marine and, later, inland river floodplain sediments - the most important strata being the iron-rich clays and sandstones of the Hastings Group. Around 110 million years ago the Weald landmass sank, and marine conditions returned to the area resulting in the formation of chalk beds. This continued until, around 70 million years ago, the landmass uplifted and led to the creation of the domed Wealden anticline.
- 2.6. Subsequent folding and faulting modified the landscape further. Differential erosion of the area, particularly over the last 1.8million years, has resulted in the removal of the chalk from the Weald, leaving only the outer chalk 'ring' of the North and South Downs. Further erosion of the elevated central dome led to the loss of the softer Weald Clay, revealing the older geologies below.
- 2.7. The Wealden Clay is much less permeable than the sandstone formations, which act as a minor aquifer, and influence the morphological and run-off characteristics of the AONB rivers. Elevated clay areas tend to shed rainfall rapidly with little infiltration, and therefore these watercourses display more 'flashy' characteristics than those elsewhere.
- 2.8. It appears that, in general terms, historic river management has focussed mainly on the need to manage river flooding, and has resulted in specific river reaches, most frequently in the middle and lower courses of a river, having been artificially deepened, straightened and/or embanked (e.g. Photo 1 & 2). It is also reported by the Environment Agency, that River Habitat Survey (RHS) data highlights that the region's most natural and unmanaged rivers are most often the minor headwater and tributary streams that occur in the upper river reaches (e.g. Photo 3).
- 2.9. Detailed field survey in combination with an assessment of old maps and RHS data would be needed to confirm the full extent and location of historic river management action within the AONB, and is considered to be an important prerequisite to informing future management to restore lost riverine features.

Landform and Elevation

- 2.10. The High Weald is a ridged landscape that follows an approximately east-west orientation (**Figure 3: Topography**). The principal ridgeline, the Forest Ridge, includes the highest point of the Weald at Crowborough Beacon c. 240m AOD. The Forest Ridge is a major watershed dividing the river systems of the south of the AONB that drain towards the south coast (the Ouse catchment), from those of the north that drain into the Thames Estuary (the Medway catchment).
- 2.11. The Battle Ridge is a spur that branches from the Forest Ridge and creates the watersheds of the Cuckmere and Pevensey Levels catchments. The Forest Ridge and the Battle Ridge combine to form the Rother catchment watershed.
- 2.12. The elevated and ridged landform of the High Weald is further subdivided by the presence of tributary channels that have eroded narrow steep-sided valley gorge features that are frequently grown-over by broad-leaved woodland that is unmanaged. These features are known as gills and are a distinct and valuable riverine biodiversity features within the High Weald (see Photo 3).
- 2.13. In contrast to the elevated and ridged landscape of the western AONB, the eastern-end is low-lying with large areas of land falling below 25m AOD that is susceptible to fluvial and tidal flooding (e.g. Photo 4 & 5).
- 2.14. Approximate riverbed gradients have been calculated across the AONB using topographical analysis in GIS (see Appendix 1). Typically, bed gradients of the upper river reaches situated on higher land are between 1:50-1:100, and contrast dramatically with the practically flat river beds (typically gradients of 1:1000-1:2000).that occur within the low-lying Rother catchment to the east.

HYDROLOGY

Catchments within the High Weald AONB

- 2.15. The distribution and location of the river catchments within the AONB are shown on **Figure 4: Catchments and Rivers**. They include:
 - Rother, (including the Rivers Rother, Tillingham and Brede);
 - Medway (Rivers Medway, Teise and Beult);
 - Ouse (Rivers Ouse and Uck);
 - Cuckmere (Cuckmere River); and
 - The Pevensey Levels (Wallers and Combe Haven).

2.16. The Rother catchment is the most significant river system within the High Weald, as 78% of the entire catchment area occurs within the AONB which represents 41% of the total AONB land area (see Table 1).

Table 1: Catchment Areas of the High Weald

Catchment	Area of whole catchment (ha)	Area of catchment within AONB (ha)	% of catchment within AONB	Catchment as % of AONB
Rother	76,315	59,830	78%	41%
Medway	169,631	48,086	28%	33%
Ouse	66,845	19,135	29%	13%
Pevensey Levels	27,829	8,057	29%	6%
Cuckmere	22,099	3,224	15%	2%
Adur	51,750	2,344	5%	2%
Arun	97,460	2,824	3%	2%
Mole	-	2,206	-	2%
Total	145,707			100%

Rother Catchment

2.17. **Location:** The Rother catchment is located in the east of the High Weald AONB, between the settlements of Mayfield (east), Hastings (south east) and Tenterden (north east).

2.18. **Sub-catchments:**

- River Rother (main river)
- River Tillingham (main river)
- River Brede (main river)
- Hexden Channel (secondary river)
- Newmill Channel (secondary river)

2.19. **Area outside the AONB:** This catchment drains in a general easterly direction to Romney Marsh (comprising Romney, Denge and Walland Marshes).

Medway Catchment

2.20. **Location:** The Medway Catchment is located in the north of the High Weald AONB, and incorporates the towns of Royal Tunbridge Wells, East Grinstead, Crowborough, Goudhurst and Tonbridge.

2.21. **Sub-catchments:**

- River Medway (main river)
- River Teise (main river)
- River Eden (headwater and some main river)
- River Beult (headwater)

2.22. **Area outside the AONB:** The catchment extends considerably northwards beyond the boundary of the AONB to the Medway Estuary around Chatham, and to Northfleet and Gravesend.

Ouse Catchment

2.23. **Location:** The Ouse Catchment is located in the southwest of the AONB, north of Haywards Heath incorporating Balcombe.

2.24. **Sub-catchments:**

- River Ouse (main river)
- River Uck (main river)

2.25. **Area outside the AONB:** The Ouse drains into the English Channel at Newhaven.

Cuckmere River Catchment

2.26. **Location:** The Cuckmere Catchment covers a small area around Heathfield in the south west of the AONB.

2.27. **Sub-catchments:**

- Cuckmere River (headwater)

2.28. **Area outside the AONB:** The Cuckmere River rises near Heathfield and flows southwards to discharge into the English Channel west of Eastbourne.

Pevensey Levels Catchment

2.29. **Location:** The Pevensey Levels Catchment covers a large area in the south of the AONB area to the north-west of Hastings.

2.30. **Sub-catchments:**

- Wallers Haven
- Combe Haven

2.31. **Area outside the AONB:** Wallers Haven and Combe Haven drain into the Pevensey Levels outside the AONB.

Adur Catchment

2.32. **Location:** The Adur Catchment covers a small area located in the southwest of the AONB, between Lower Beeding and Cuckfield.

2.33. **Sub-catchments:** None.

2.34. **Area outside the AONB:** Only the headwaters of the River Adur are present within the AONB. The Adur drain southwards to discharge into the English Channel at Shoreham-by-Sea.

Arun Catchment

2.35. **Location:** The Arun is located in the far west of the AONB.

2.36. **Sub-catchments:** None

2.37. **Area outside the AONB:** Only the headwaters of the Arun are present. The Arun drains southwards into the English Channel at Littlehampton.

Mole

- 2.38. **Location:** The Mole is located in the west of the AONB.
- 2.39. **Sub-catchments:** None.
- 2.40. **Area outside the AONB:** Only the headwaters of the Mole are present. The Mole drains northwards.

Rainfall

- 2.41. Rainfall is variable across the High Weald with higher rainfall patterns generally associated with the more elevated land areas to the west. Rainfall averages about 750mm per annum across the Weald, although typically half of this will be lost to evaporation (effective rainfall) and therefore does not enter the river system.
- 2.42. Rainfall varies considerably between years, with some catchments receiving only 570mm/annum in drought years increasing to 800mm/annum in wet years.

WATER RESOURCES

Abstraction

- 2.43. The need to supply potable water for human consumption and for irrigation of arable lands necessitates water abstraction across the High Weald. Some water is abstracted as groundwater from the Hastings Sandstone aquifer, but this is a minor aquifer. Most water is abstracted at surface water points, particularly from the Rivers Teise and Ouse.
- 2.44. Inconsistency of water supply (due to seasonal drought and flashy river flows) has led to the implementation of a number of large-scale engineering approaches to river flow regulation and associated reservoirs water storage. The largest of these reservoirs is Bewl Reservoir (within the Medway catchment) that has been in operation since 1977 and supplies a population of more than 500,000 in the Medway towns and West Kent.
- 2.45. The scheme was designed primarily to create high summer flows in the River Medway at the Maidstone (Springfield) public supply intake and by this means, sustain greater rates of daily abstraction with an overall improvement in yield. Water abstracted during the winter at intakes on the River Medway at Yalding and the river Teise at Smalbridge is pumped to Bewl Reservoir and stored for subsequent release back into the river at times of low flow in the Medway. Releases are also made to sustain a minimum residual flow of water to satisfy environmental and water quality objectives for the river and its estuary.
- 2.46. The principal surface water resources in the Rother catchment are also provided by pumped storage reservoirs. The largest is Darwell, which receives its water from the River Rother at an intake at Robertsbridge and is augmented with a transfer from Bewl Reservoir. The River Brede supplies the smaller Powdermill Reservoir.

- 2.47. Forecast demand growth information for future water supply needs in the AONB is not well documented. A more detailed analysis involving consultation with key Environment Agency and Water Company personnel would be required for a full assessment of the predicted demand for water supply in the AONB over a future 20 year time frame.
- 2.48. Similarly, a detailed assessment of the implications and effects of the various water supply infrastructure and flow regulation regimes that effect AONB rivers would also be needed to inform options for future river management and restoration.

Flows

- 2.49. As highlighted previously, the rolling clay dominated geology of the High Weald gives rise to 'flashy' river flows that can reach bank-full height over relatively short time periods following heavy rainfall. In the Medway catchment, flows are artificially regulated by flood control infrastructure, notably the Leigh Barrier.
- 2.50. The upper Rother catchment is reported to be susceptible to low summer flows that are thought to be exacerbated by surface water abstraction for public water supply at Robertsbridge. The walkover assessment confirmed that many of the minor AONB tributaries are likely to dry out on a regular basis due to natural processes, but on the whole, this does not appear to be a significant negative factor across the High Weald.

Flooding/Flood Risk

- 2.51. The low-lying land (0-25m AOD) to the east of the AONB that constitutes the Rother catchment is susceptible to fluvial and tidal flooding (see Figure 3). To counteract this risk, modern day bank raising coupled with channel re-sectioning has been undertaken in many of the lower reaches of the Rother, Brede, Tillingham and Wallers Haven, and has resulted in a regular trapezoidal channel form that is intensively managed (Photos 7-9).
- 2.52. River engineering works within the Rother catchment such as the installation of a tidal sluice gate/barrier at Scots Float, and floodplain drainage work, have pushed the historic tidal flood limit eastwards and therefore reduced the likelihood of direct tidal flooding.
- 2.53. Because much of the Rother catchment falls at or below sea-level, the area has a tendency to become tide-locked, meaning river floodwaters are unable to discharge into the sea. This can lead to large-scale out of bank flooding and excessive silt accumulation within the channel.

- 2.54. It is possible that increasing sea level and annual average rainfall levels as a result of future climate change could increase flooding risk, particularly within the Rother catchment.
- 2.55. For somewhat different reasons, some of the Medway (upstream of the Leigh Barrier) is susceptible to fluvial flooding as floodwaters are deliberately held back by the barrier and allowed to flood onto surrounding agricultural land in order to protect the more heavily settled landscape downstream.
- 2.56. Much of the eastern Rother coast, which is unprotected by cliffs or higher ground, is at risk form coastal flooding, and a range of coastal defences exist and are maintained by the Environment Agency. Banks of shingle and smaller areas of sand dune stretching from Littlestone-on-Sea to Camber and from Rye to Farlight Cove, provide a first line of coastal defence. Particularly vulnerable settlements include the coastal town of Rye and this area is further protected by concrete walls and clay embankments that are maintained by the Agency.
- 2.57. It has not been possible to explore proposals for future coastal management within the AONB as part of this study. However, the Eastern Rother LEAP (1999) identifies that managed retreat, involving setting back the line of actively maintained defence to a new line inland between the old and new defences, had not been considered to be an option for the Rother Area.
- 2.58. It will be important to ensure that future options for river management within the Rother catchment consider future proposals for managed coastal retreat.

Water Quality

- 2.59. Water quality is assessed by the Environment Agency using the General Quality Assessment (GQA) system, which divides water quality into the following classes:

Table 2: GQA Classes

Class A	Water of very good quality
Class B	Water of good quality
Class C	Water of fairly good quality
Class D	Water of fair quality
Class E	Water of poor quality
Class F	Water of bad quality

Chemical GQA

- 2.60. The Chemical GQA assesses the chemical quality of river water in order to determine water pollution levels. It reflects the degree of pollution at the time of sampling, and may not be wholly representative of baseline water quality conditions as pollutants may vary over temporal scales.
- 2.61. The rivers of the High Weald vary considerably in their respective water quality but, in general, tend to be of **fair** to **good** quality with some stretches being **very good** quality and some stretches of **poor quality**. Lower quality reaches tend to be associated with treated sewage discharge points and agriculturally derived pollution including run-off from dairy farm slurry spreading and inadvertent pollution from silage and slurry clamps, and the effects of agro-chemical fertilisers (leading to eutrophication) and pesticides. In some areas, naturally high concentrations of iron can lead to toxic effects and restrict aquatic macro-invertebrate diversity.
- 2.62. As described previously, the low-lying shallow gradient sections of the Rother catchment are also susceptible to increased silt deposition, which in turn can lower dissolved oxygen levels in the summer months when water levels are reduced and water temperatures are high.

Biological GQA

- 2.63. The Biological GQA assesses the health of rivers by the assessment of the diversity of aquatic macro-invertebrate taxa that live on the riverbed. This assessment provides a good picture of baseline water quality and compliments the Chemical GQA.
- 2.64. The Biological GQA results are similar to chemical GQA, with most rivers varying between **fair** to **good quality**, with some stretches being **very good** and some stretches **poor**.

LANDCOVER AND USE

- 2.65. The High Weald is a largely rural landscape with few significant settlements – the largest being the town of Tunbridge Wells and the former ports located at Winchelsea and Rye on the edge of the AONB. There are also numerous small ridge-top market towns and villages such as Cranbrook and Wadhurst.
- 2.66. The High Weald is a highly wooded landscape with both commercial coniferous and native broadleaf woodlands, and is one of the most densely wooded areas of the UK.

Agriculture is the dominant commercial land use, with arable (mostly cereals) and grazing pasture (mostly dairying and sheep) occurring across the whole AONB (e.g Photo (10-11)). Arable agriculture tends to occur most frequently on the more fertile low-lying land areas to the east, and arable fields tend to be relatively large and with fewer boundary elements than pasture fields, and ploughing often occurs close to river banks (Photo 11).

- 2.67. In addition to cereal production, an arc of land across the elevated rolling landscape of the Weald supports commercial fruit growing, including characteristic Kentish apple orchards, and hop production.
- 2.68. Arable agriculture is intensive, and frequently occurs close to riverbank.

Table 3: Landcover Proportion by Catchment

Catchment	Area of Settlement ha (%)	Area of Woodland (over 2ha) (%)	Area of 'other' including agriculture (%)
Rother	2,017ha (3%)	11,295ha (19%)	46,518ha (78%)
Medway	1,666ha (3%)	13,063ha (27%)	33,357ha (69%)
Ouse	563ha (3%)	5,357ha (28%)	13,215 ha (69%)
Pevensey Levels	259ha (3%)	1,852ha (23%)	5,946ha (74%)
Cuckmere	285ha (9%)	736ha (23%)	2,203ha (68%)
Adur	7ha (0%)	737ha (31%)	1,600ha (68%)
Arun	25 (1%)	1314ha (47%)	1,485ha (53%)
Mole	1 (0%)	1413ha (64%)	792ha (36%)
Total	(3%)	35,767ha (25%)	105,116ha (72%)

Agricultural Land Classification

- 2.69. The heavy clay of the Wealden soils produces argillic brown earth soils with impeded drainage, whereas the sandstone areas produce poor quality acidic soils. As a result, the average Agricultural Land Classification (ALC) of the High Weald is fairly low, largely Grade 3, with the clay soils being utilised for a mixture of arable and pastoral use, and the sandstone soils for commercial forestry (see **Figure 5: Agricultural Land Classification**).
- 2.70. The highest quality soils within the AONB (ALC Grade 2) are associated mainly with the reclaimed low-lying floodplain land within the Rother catchment.

Recreation

- 2.71. The High Weald is located in close proximity to a number of large urban centres including London and Brighton, and many people visit the area to participate in recreational pursuits.
- 2.72. Angling (coarse and game) take place throughout the Weald's main rivers and reservoirs, and the lower reaches of the Rother catchment are navigable to recreational boating.

HISTORIC INFLUENCES

- 2.73. The historic development of the High Weald landscape has been described in great detail elsewhere (e.g. *The Making of the High Weald*) and only those aspects most relevant to the current study are considered here.
- 2.74. In summary, the river channels of the low-lying land in the east of the AONB have seen significant modification over the centuries to convert floodplain wetlands and saltmarsh into productive agricultural land, and to protect it from fluvial and tidal flooding.
- 2.75. Records for reclamation of the River Brede valley, for example, exist as early as the late twelfth and early thirteenth centuries, and was probably initiated by merchants from Rye and Winchelsea, and entailed the creation of sea walls across the river to prevent tidal ingress.
- 2.76. The River Rother and its floodplain has also been subject to multiple and varied historic flood control and drainage operations, which includes the construction of the Knelle Damme sea wall across the northern end of Wittersham level in the thirteenth century. This structure restricted tidal flooding and led to considerable silting of the Appledore (northern) Rother Channel reducing its viability as a navigation route by boats, and ultimately led to the construction of a new river channel (the Craven Cannel) south of the Isle of Oxney in 1680-4.
- 2.77. Drainage and flood control works continue to the current day with extensive modern engineering works having taken place (in the 1960s and 70s) on the Tillingham, Brede and Rother that included bank raising works and channel resectioning (e.g. Photo 8 & 9)
- 2.78. The other main influence effecting the AONB watercourses was the iron industry, which developed to exploit the iron clays of the Hastings Group. The industry originated in the late Iron Age and in the late Medieval and post Medieval period many of the fast flowing upper tributaries were dammed to produce on-line lakes or 'hammer ponds'. These were used to power the waterwheels that drove the furnace forge bellows and iron hammers. As well as being historic features these have also developed distinct biodiversity interest and some are designated as Sites of Special Scientific Interest (SSSIs). In terms of their current impact on the functioning of the regions rivers, hammer ponds are likely to act as on-line waterbodies that trap sediment, but their contribution to geomorphological functioning is not well understood.

BIODIVERSITY

RE Target

- 2.79. The Environment Agency monitors water quality in all main rivers, setting targets for their ability to support aquatic life – the River Ecosystem (RE) classification:

Table 4: RE Target Classes

RE1	Water of very good quality suitable for all fish species.
RE2	Water of good quality suitable for all fish species.
RE3	Water of fair quality suitable for high class coarse fish populations.
RE4	Water of fair quality suitable for coarse fish populations.
RE5	Water of poor quality which is likely to limit coarse fish populations.
Unclassified	Water of bad quality in which fish are unlikely to be present, or insufficient data available by which to classify water quality.

- 2.80. River water tends to be of **fair to good** quality in the High Weald and therefore can support high-class coarse fish populations. However, no river reaches within the AONB achieve RE1.

Key Habitats/Features

River Channel and Floodplain

- 2.81. At present only a patchy and limited understanding of the relative ecological value and functioning of the AONB's rivers and their tributaries exists. However, a number of the regions rivers are known to support aquatic and wetland taxa that possess high individual nature conservation value by virtue of being nationally rare and/or subject to Biodiversity Action Planning. These include **otter**, **water vole**, **native (white-clawed) crayfish** and **black poplar** (a tree species that is characteristic of river floodplains).
- 2.82. While the relationship between physical in-channel features and biodiversity is only partially understood, it is generally accepted that physical habitat diversity is positively correlated to biodiversity. In summary, the more physical habitat features (silt bars, pools, riffles, slack water, eddies, shoals, point bars, side bars and riparian trees etc.)

- the river possesses the more species of aquatic animal and plant the river can support in the absence of other limiting factors such as water quality.
- 2.83. In general terms, morphologically 'natural' tributaries within the AONB (e.g. Photo 3) are likely to be more ecologically valuable than the highly modified and intensively maintained channels of the Rother catchment to the east (e.g. Photo 13 & 14).
 - 2.84. For example, the gill stream tributaries across the High Weald are distinct habitat features that have escaped mans influence due to their steep topography and general inaccessibility to machinery, and have developed into species rich broad-leaved woodlands particularly noted for their lower plant floras (lichens, liverworts and mosses). It is also considered likely (although not currently well understood) that ghyll streams make a distinct and valuable contribution to the overall ecological functioning of the High Weald rivers, and will possess rare and specialist invertebrate species with restricted distributions within the region.
 - 2.85. Floodplain wetland habitats are not a significant feature within the High Weald because of the clay rivers general capacity to keep floodwaters within bank through natural bed erosion and deliberate over-deepening, and because former floodplain habitats continue to be actively drained and kept dry by active pumping.
 - 2.86. The most ecologically valuable floodplain habitats would appear to be the water-filled ditches that drain the former floodplain wetlands of the Rother catchment. These aquatic habitats have good potential to support a range of taxa with high individual nature conservation value such as water vole and specialist aquatic macro-invertebrate species, including the shining ramshorn mollusc (*Segmentina nitida*) that is known to occur in ditches on the Pevensy Levels. The Pett Levels and Walland Marsh areas within the AONB (Rother catchment) are both designated as SSSIs because of their drainage ditch wildlife interest.

Wider Catchment

- 2.87. The AONB is noted particularly for its woodland habitats, which includes a large proportion ancient woodland (i.e. continuously forested since 1600) (see **Figure 6: Nature Conservation Designations**). The distribution of the previously described ghyll woodland and non-ancient woodland is shown on **Figure 7: Gills and Woodlands**.
- 2.88. In addition to woodland, heathland is a notable habitat type within the High Weald, and corresponds in distribution with the sandstone geology. Distinct assemblages of aquatic plant and animal species are likely to occur where acid water conditions prevail.

Protected Habitats

- 2.89. There are many areas throughout the High Weald that have been designated to protect their nature conservation interest (see Figure 6). These include in excess of **40 Sites of Special Scientific Interest (SSSIs)**, related to a range of wildlife interests but most notably woodland and heathland habitats.
- 2.90. Two candidate **Special Areas of Conservation (cSAC)** occur within the High Weald - one at Ashdown Forest, and the other at Rye Harbour near Hastings. Both are protected under the European Habitats Directive. The Ashdown Forest cSAC relates to a mosaic of woodland and heathland habitat, whereas the Rye Harbour cSAC relates specifically to the vegetation associated with coastal shingles.
- 2.91. There are two proposed **Special Protection Areas (pSPAs)** - at Winchelsea and Ashdown Forest - that are protected under the European Birds because they support populations of protected bird species in numbers that are nationally and internationally important. There is also one RAMSAR designated wetland of international importance, located on the Pevensey Levels, just outside of the AONB area that regularly supports over 20,000 wintering waterfowl.

Non Native (Alien) Species

- 2.92. Non-native plants and animals are found across the High Weald and, in some cases, threaten the survival of native species and habitats. Alien invasive plants associated within riverbanks in the AONB include **Japanese knotweed, Himalayan balsam, and giant hogweed**. **Australian stoncrop, parrots' feather and floating pennywort** are alien aquatic plants have also been recorded in more slow-flowing rivers and floodplain drainage ditch habitats.
- 2.93. Non-native invasive animal species particularly associated with the High Weald's rivers, and which threaten the long-term future of native species and can, in some instances, damage river banks include **mink, Chinese mitten crab and signal crayfish**.
- 2.94. The extent and distribution of aquatic alien species is not well known.

FISHERIES

- 2.95. The High Weald supports coarse and salmonid fisheries, including stretches of river that are designated by the EU Freshwater Fisheries Directive. Reaches of the Rivers Rother, Brede, Eden, Teise, Ouse, Cockhaise Brook and Wallers Haven have been designated as 'cyprinid' fisheries under the EU Fisheries Directive. While, Bewl

Water, Ardingly Reservoir and certain reaches of the River Rother are designated as 'salmonid' fisheries under the Directive.

Coarse Fisheries

- 2.96. There are a wide range of self-sustaining coarse fish present within the regions rivers, including bullhead, stoneloach, dace, chub, tench, bream, roach, pike, ruffe, perch, minnow, gudgeon, bleak, rudd, carp, grayling, barbel and eel.

Salmonid Fisheries

- 2.97. Salmonid species (salmon and trout species) only thrive in river waters of high chemical quality and geomorphological naturalness that lack barriers to fish migration. Salmonids are dependent upon silt-free riverbed gravels for spawning. The distribution of migratory salmonid species (namely sea-trout) within the AONB is restricted by the presence of water control structures that act as barriers to fish migration, and a general lack of suitable spawning substrates (silt free, well oxygenated gravel) in accessible river reaches.
- 2.98. Sea trout are found in the Cuckmere, Pevensey Levels, Ouse and Rother catchments, where they are noted for spawning on gravel-rich ford crossing. Salmon are not thought to be present in any of the catchments within the High Weald.
- 2.99. Non-migratory wild brown trout occur in most of the AONB catchments, and rainbow trout that have been stocked are also a notable feature, and an important still water target species for anglers fishing the regions reservoirs.

3. OPTIONS FOR FUTURE RIVER MANAGEMENT

Background

- 3.1. The River Rother is the only large river that is located virtually entirely within the High Weald AONB (see Figure 4) and is therefore best suited to highlighting the main concepts and principals behind options for future river management. Because of this, and the obvious limitations in field survey time imposed by the current study, this report focuses only on the River Rother. However many of the broad principles discussed can be equally applied to other rivers within the AONB.
- 3.2. The following chapter is primarily based on a rapid inspection of the River Rother catchment over the course of two short days, the 13th/14th November 2002. The inspection followed prolonged rain when the catchment was saturated, and rivers were running at high level or in flood. Some additional information was gained from ordnance survey maps and from brief consultation with Environment Agency (EA) and AONB personnel.
- 3.3. Because of the concise nature of the catchment appraisal undertaken, it is only possible to advise in general terms using similarly general topographic and other data. Nevertheless, this is considered sufficient to highlight some of the key opportunities and constraints that are evident. It is envisaged that more thorough appraisal of specific issues can be better targeted in the future as a result of this initial study.
- 3.4. The report examines the topography of the catchment and the related hydraulic characteristics and current flood management practices before considering possible concepts for modifying these aspects.

Catchment Topography

- 3.5. Topography is important because it is a fundamental physical characteristic that uniquely influences the way in which each river responds to rainfall and runoff. The rocks and soils within the catchment are similarly influential and these will also have influenced the nature of sediments deposited in the river valleys.
- 3.6. Chapter 2 provides an overview of topography and geology from which it is clear that clay is the dominant soil within the steeper catchment landforms and alluvium in the flatter valley bottoms. Tidal flat deposits extend well inland from Rye over the Rother Levels.

- 3.7. **Figure 8** shows the profile of riverside land levels over the Rother's entire length between Five Ashes (A267 road) and Scots Float Sluice (tidal barrier) near Rye, a distance of 43km and a descent of 100m.
- 3.8. The profile descends steeply down to Witherenden (B2181 road) where a major tributary, The Tide Brook, joins the Rother. The profile then moderates noticeably down to the town of Robertsbridge that is, unusually, the only major settlement located on the river.
- 3.9. Downstream of Robertsbridge the profile follows a gentle transition towards the tidal flats near Newenden (A28 road). The tidal flats now represent an extensive area of former marshland that has been comprehensively drained for agriculture.
- 3.10. The Rother is conveyed across the tidal flats in a man-made channel that closely follows the southern edge being the shortest, most direct route to the sea outfall at Scots Float. This channel is embanked on both sides to contain the Rother, and to sustain a shallow water gradient towards the sea during favourable low tide conditions.
- 3.11. Channels of this nature are known as highland carriers, because they convey upland water direct to sea, isolating it from surrounding tidal flats, or levels.
- 3.12. The profile of the lower reaches of the river, between Robertsbridge and Scots Float, is also shown on **Figure 8** at a larger scale in order to highlight the sensitive topographic relationship between the descending fluvial floodplain, the levels, and tidal conditions at the outfall.
- 3.13. The extent to which the river is managed for the efficient conveyance of floodwater varies considerably with the changing gradient, or profile, en-route to the sea. It is therefore convenient to examine river management in four reaches, each representatives of significantly different profiles. Those selected for the Rother are listed below and are located in plan on **Figure 9**.
- Upper Reach – a 10km length from the top of the catchment down to Witherenden.
 - Middle Reach – a 10km length from Witherenden down to Robertsbridge
 - Lower Reach – a 10km length from Robertsbridge down to Newenden
 - The Levels – a 13km from Newenden to Scots Float

Hydraulic Characteristics and Current River Management

Overview

- 3.14. Rainfall and runoff in the upper reach is gathered in a dense array of small, steeply incised, tributary streams that flow swiftly down towards Witherenden from a catchment of about 75km². Run-off characteristics will be 'flashy' because of the clay soils and the typical gradients of 1 in 60.
- 3.15. At Witherenden the river has developed a significantly wide floodplain (c.300m) built up from sediments washed down from above that deposit over millennia as the river becomes less steep and its speed of flow slackens. It continues flowing down to Robertsbridge at a fairly uniform gradient of c 1 in 500 over a middle reach floodplain that is typically 300m wide but varies between 200m and 400m. Although the speed of flow has moderated in the middle reach it is still noticeably swift and is sustained by several tributary flows en-route. The largest of these tributaries is the River Dudwell. The catchment area has doubled at Robertsbridge to c.150km².
- 3.16. In the lower reach, down towards Newenden, the gradient progressively slackens until it is flat but an average bed gradient of 1 in 2000 appears typical at the mid point around Bodium. This marked slackening of gradient also coincides with a marked increase in the width of the floodplain to c.600m.
- 3.17. In its natural state, the lower reach would be characterised by expansive slow-moving, floodwater continually swelled, and reluctantly driven forward, by the faster flowing floodwater, from above. Further tributaries join in the lower reach, notably just downstream of Bodium where the Kent Ditch enters from the north coincident with another stream from the south. These confluences probably mark the point where the freshwater, fluvial waters were historically influenced by tides and began to merge and to spread out towards the marshes.
- 3.18. These lower reach flood patterns are now heavily modified by riverside embankments that extend far upstream of the levels, at least to the B2244 road within 3km of Robertsbridge. Thus it is clear that the highland carrier across the levels intercepts fluvial flows within the lower reaches of river, and not at the natural interface with the levels, which is located around the Kent Ditch confluence.
- 3.19. This arrangement obviously serves to protect the wide fluvial floodplain from frequent inundation. This has enabled arable cropping to be sustained and helped to reduce road flooding at Bodium, in particular.

- 3.20. The highland carrier across the levels does not simply serve to convey flood waters but also stores these during periods when tide levels at the outfall are too high to permit discharge. When tide-locked, floodwater in the carrier will begin to pond and rise in level with the obvious risk that embankments can be overtopped, flooding the protected lands alongside.
- 3.21. A purpose built overspill point has been constructed alongside Wet Level at Blackwall Bridge to control this situation (**Figure 8**). The overspill is c.0.5m lower in level than the embankments, enabling a discreet compartment of land that is bounded by the sloping valley sides to be inundated. This increases the storage capacity of the highland carrier substantially.
- 3.22. The size of the highland carrier will have been optimised to convey reasonable volumes of floodwater at a reasonable speed when the gates at Scots Float Sluice are fully open during low tide. This ensures that silts and mud do not accumulate unduly as they are flushed through. The need to sustain 'flushing velocities' means that the carrier cannot be sized to provide all of the flood storage needed, so additional flood storage within the system is an essential feature.
- 3.23. The land protected by the highland carrier appears to vary in level, perhaps between 1m and 3m OD, with a suggested average of 2.5m which is 1m or more below the embankments. This land is drained by a system of deep drains that feed water to pumping stations alongside the highland carrier, where it is lifted clear. Over 20 pumping stations exist across the levels.
- 3.24. During summer, water is held in the highland carrier at a penning level of c.1.2m OD to create a linear reservoir that enables Rother water to be diverted out into the drains across the levels where it can be used for summer irrigation of the fields or simply to enable the drains to serve as wet fences, controlling livestock. Limited navigation on the highland carrier is supported by penning.
- 3.25. It is not clear at this stage whether or not circumstances arise whereby the levels can drain into the highland carrier under gravity, rather than by pumping. Gravity drainage is certainly evident in the lower reach of the river around Bodium which suggests it may also be sustainable in places at least down as far as Newenden. This aspect is important when considering alternative land management concepts.
- 3.26. The above summary for the highland carrier is restricted to fundamentals and makes no attempt to expand into the complexities of its role in respect of large areas of levels to the north and west of the Isle of Oxney. Whilst it is known that a great history of drainage works is available, time did not permit anything but a cursory

inspection. It should however be noted that the Hexden and Newmill channels both feed into the highland carrier downstream of Newenden and each will contribute significant flows.

- 3.27. A reasonable picture of the river Rother that encapsulates the above overview might be as follows:

A 40km long river that speeds water down from wooded upland gills to fill floodplain meadows over but half its course before it is rudely ushered into the confines of embankments that regiment its timely progress to the sea when once it spread and took a more leisurely and picturesque ramble to its ultimate marriage with the ebb and flow of tides.

- 3.28. None of the four reaches described can function in isolation from each other and management practice in one should be influenced by consideration of the other three. These influences are explained below:

Management Principles

- 3.29. River management has been historically exercised to a greater or lesser degree depending largely on the extent to which river conditions disrupted agricultural activities on adjoining land. Generally speaking, the larger the floodplain, the more intense the management. In the case of the Rother this culminated in total management of the river across the levels.
- 3.30. If the river adversely affects people and property, including roads and other infrastructure, management can be equally intense e.g. at Robertsbridge.
- 3.31. Flood protection of agricultural floodplain land has, in recent years, been substantially reduced as river maintenance is scaled back by the EA, and rivers that were enlarged in the post-war period are now very slowly recovering patterns of shoaling and vegetation. This is partially in response to economic factors but it also recognises that speeding up flood runoff by intensive channel maintenance increases the flood risk to people and property downstream, which is clearly undesirable.
- 3.32. The recent spate of major flood events across the UK has raised awareness and understanding of the benefits to urban communities and infrastructure of actively seeking to attenuate rates of flood runoff by various means. This involves reviewing land and river management practices across whole catchment areas. Typical

measures that are currently promoted through farming grants or are being piloted, include the following:

- Improved infiltration of rainfall into the ground rather than surface run-off, particularly, on arable land.
- Reducing livestock densities that otherwise denude land of vegetation.
- Planting and managing vegetation buffer strips alongside watercourses to reduce polluting runoff and soil loss.
- Woodland planting to reduce soil loss and runoff.
- Retention of in channel obstructions such as debris dams to reduce scour and subsequent channel enlargement.
- Re-planting of riverbank (riparian) corridors and fencing out livestock
- Physical river restoration involving replacing lost features such as gravel riffles, historic meanders and many other measures to re-create natural characteristics.
- Removing or lowering flood embankments to open up floodplains and increase flood storage.
- Obstructing floodplains with dense hedgerows and fencing to build up flood depths and increase temporary water storage.

3.33. All of the above measures can provide wider environmental and biodiversity benefits as well as involving diversification of land use in line with broad government strategies for agriculture.

3.34. The applicability of such measures to the Rother catchment depends largely on whether or not there is a need to attenuate flood runoff or to seek the associated environmental benefits.

3.35. The major flood risks noted during the inspection were to roads crossing the floodplains in the middle and lower reaches and to the lower part of the town of Robertsbridge. At Robertsbridge a flood alleviation scheme was under construction that is understood to involve floodwalls and embankments around the high-risk areas of development.

3.36. Measures to attenuate flood runoff would be beneficial because the effect of these is to reduce the peak rate of flow at the height of any flood, which is the main factor that determines how high flood water levels rise. If attenuated, floods would take longer to build up and longer to subside but peak levels would be reduced.

3.37. Recent trends in flood patterns show a disturbing increase in both frequency and peak flows, which cannot be satisfactorily explained by any single phenomenon such

- as global warming. Measures to offset the impact of this trend may therefore be regarded as a prudent strategy for the longer term whilst more immediate measures are implemented at for example, Robertsbridge. The effectiveness and sustainability of works at Robertsbridge can only be enhanced by flood attenuation measures upstream of the town.
- 3.38. Downstream of Robertsbridge in the lower reaches of the river and across the levels, where riverside embankments are dominant, flood attenuation would be equally beneficial.
 - 3.39. The effect here is to reduce the risk of embankment over-spill because of lower peak flows and therefore a delay in the rate at which floodwaters go into storage during tidelock periods. This delay provides more time to evacuate waters to sea during the intermediate low tide periods, reducing the overall storage needed.
 - 3.40. This assumes that flood conveyance down through the embanked reaches remains at present capacity, whereas consideration might reasonably be given to reducing conveyance in order to restore more ecologically attractive characteristics to the river channel, e.g. through in-channel restoration works, riparian planting etc.
 - 3.41. Although less river maintenance work would be needed under this scenario it would be necessary to offset the reduced conveyance by providing more flood storage capacity. This can be achieved by removing embankments in the lower reaches to restore floodwater to the natural floodplains and by creating additional over-spill areas along the highland carrier crossing the levels. The effect of floodplain restoration in the lower reaches, downstream of Robertsbridge, should be a general lowering of the maximum flood levels presently experienced that result from the confinement of the river between embankments. Floods that are spread over large areas do not build up as high as floods that are confined to narrow corridors.
 - 3.42. It is possible that by lowering flood levels downstream of Robertsbridge, floodwaters can be drawn clear of the town more readily, further increasing the effectiveness and sustainability of current flood alleviation works.
 - 3.43. The provision of more overspill points along the highland carrier could not only achieve a less intensive (and costly) channel maintenance regime but it is conceivable that some small reduction in the height of the embankments could be tolerated also. In practice, this could be achieved by simply relaxing the maintenance regime of the southside embankments.

- 3.44. There is, however, a practical limitation on flood storage by overspill from the highland carrier if water has to be pumped back into the carrier rather than draining back by gravity. Much depends on actual land levels and the intended land use over the flooded areas. An ultimate 'blue sky' scenario for the highland carrier might conceivably be the removal (or lowering) of the southern embankment entirely allowing a chain of washlands to develop up to the natural boundary defined by the indented profile of the near parallel valley slopes. Roads crossing this narrow corridor would, however, need to be raised in level and any riverside properties safeguarded.
- 3.45. Although the above offers a whole range of general principles and measures that appear to merit consideration as part of any strategy for future river management, the practicalities of implementing them can be a severe limiting factor.

Preliminary Management Suggestions

- 3.46. Brief consideration of alternative options to manage the River Rother has been given at the few locations it was possible to visit during the inspection. Some preliminary ideas have accordingly been indicated on the plans for each reach (**Figures 10-13**) and illustrate a number of the various options for flood attenuation highlighted above.

Conclusions

- 3.47. At least half (over 20km) of the River Rother's entire length, comprising the lower reach and levels below Robertsbridge, has successfully been canalised to support intensive agriculture on nearly all of the adjoining floodplains.
- 3.48. Although the impact of this success on the ecology and landscape of the river environment has not been specifically studied as part of this report it is reasonable to conclude (or perhaps is self evident) that these aspects are badly degraded as a result.
- 3.49. It appears from the inspection and evaluation undertaken that there is considerable scope for improving the present ecological (habitat) status whilst sustaining the fundamental objective of current river management.
- 3.50. This objective is to convey the Rother waters safely across the levels to the tidal outfall at Scots Float without undue inundation of the extensive low-lying land and infrastructure alongside. To achieve ecological improvement some riverside land would need to be restored to its natural function as floodplain washland and the river channel enhanced to support more hydraulic and habitat diversity.
- 3.51. The engineering concept involved would be to marginally shift the present balance between the quantity of floodwater conveyed directly to the outfall and the quantity diverted into temporary storage on the floodplains i.e. less conveyance, more storage.
- 3.52. Such a shift would be a reasonable basis for future strategy development by both the AONB Unit and the Environment Agency because it is beneficial to both the 'natural beauty' and 'good ecological status' of the river and its environs (see above paragraphs 1.9-1.10).
- 3.53. Other potential benefits include a reduction in the present level of land drainage and flood defence operating costs and a move towards extensification of rural land use in line with current government policy.
- 3.54. The river upstream of Robertsbridge does not appear to be intensively canalised and has a reasonably natural appearance based upon the very limited inspection undertaken.
- 3.55. It was however evident during the inspection, when flood conditions prevailed, that flood waters drain from the steep, clay covered, upper reach with significant speed

- and readily move forward through the middle reach with increasing volume towards the town and the canalised reaches below it.
- 3.56. This lively pattern of flood migration is characteristic of the topography and geology of the catchment and accounts, in part, for the regular flooding of roads and the significant flood risk to parts of Robertsbridge.
 - 3.57. Recent Europe-wide trends towards more frequent occurrence of damaging floods are particularly evident in small 'flashy' catchments of this type, which suggests that it is appropriate to consider measures to reduce the rate at which floodwaters are shed and conveyed downstream.
 - 3.58. Measures that attenuate the rate of flood run-off and conveyance would result in floods being of longer duration but less damaging because of reduced peak flows, helping to arrest or reverse current trends.
 - 3.59. Several diverse methods of flood attenuation that are appropriate to the catchment above Robertsbridge are described previously, but the common purpose of each is to contribute towards reducing the rate at which this part of the catchment delivers floodwater to the remainder.
 - 3.60. The potential benefits of flood attenuation measures include improvements to the effectiveness of flood defences at Robertsbridge and a general reduction in the flood threat to roads as well as reducing the pressure on the extensive flood defence infrastructure across the Rother Levels.
 - 3.61. The measures are all based upon restoring, where practical, the natural hydrological and geomorphological characteristics of the catchment and they therefore intrinsically contribute towards good ecological status and sustainable management practices.

NEXT STEPS

- 3.62. It will firstly be essential to engage the active participation of those with statutory responsibilities for flood defence and land drainage in developing any of the revised river management concepts suggested.
- Establish a discussion forum with the EA flood defence team and with the Internal Drainage Boards (IDB) for the Rother Levels. The IDB will have good landowner representation in the lower reaches.
- 3.63. The report has necessarily relied upon a good deal of subjectivity in drawing conclusions.
- Utilise the above forum to verify that there are no fundamental errors or omissions.
- 3.64. Modifying the existing relationship between conveying floodwater directly to sea via the embanked river channels, and spilling water into floodplain storage, depends on a proper understanding of the prevailing system before changes can be contemplated.
- Research any existing mechanistic hydraulic modelling of the Rother and develop this to generate a model that can verify the scope for change and the anticipated risks and rewards.
- 3.65. Attenuating the rate at which floods pass down towards Robertsbridge embraces changes in the way riparian corridors, waterways and floodplain land are managed. Such change will depend upon the active participation of many landowners and on organisations able to support change through technical advice and through financial support via agri-environment grants etc.
- Enlist the support of other organisations having established links with the farming community e.g. FWAG and DEFRA.
- 3.66. Experience of the techniques of attenuating flood flows through farm scale measures is limited at present but this is increasing through several initiatives that are planned or are in progress across the UK.
- Membership of the River Restoration Centre can provide regular information updates on relevant projects e.g. the Parrett Catchment Project, where EU funding has been secured to pioneer enhanced floodplain storage via lateral levees/hedging/fencing techniques (attenuates run-off onto the Somerset Levels).
- 3.67. Progress demands a strategic approach that is supported by all bodies showing an interest in the future of the AONB but action on the ground is normally initiated

through small-scale, opportunistic, projects that demonstrates the potential benefits of the strategy.

- Focus on promoting demonstration sites that are representative of each of the main measures suggested in this report as well as building a strategic framework for future policy and practice.

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APPENDIX I

APPENDIX 3

CATCHMENT: ROTHER/Sub-catchment Rother

REACH		Lower Rother	Mid Rother	Upper Rother
Location		River Rother, east of Newenden; Lower Hexenden Channel; Lower Newmill Channel.	River Rother between Witherenden Hill and Newenden; Lower River Dudwell from Buwash.	Headwaters and Secondary Rivers including The Brook, River Limden, Kent Ditch, upper Hexden Channel and upper Newmill Channel.
PHYSICAL LANDSCAPE				
Geology		Hastings Beds: sandstones, siltstones and clays.	Hastings Beds capped with alluvial drift.	Hastings Beds capped with alluvial drift and tidal flat deposits.
Elevation		Below 25m AOD.	Below 50m AOD.	Up to 150m AOD.
Landform		Flat to shelving, wide valley landscape.	Undulating with well-defined valleys.	Steeply incised with ghylls.
Channel Gradient		1 in 2000.	?	?
LANDCOVER AND USE	Description	Agricultural landscape with mixed arable and pasture (including sheep and dairy) in large and undivided fields - often farmed close to bank top.	Agricultural landscape including arable farmland and pasture (sheep and cows) set within smaller agricultural fields with hedgerows but often farmed to channel edge. Some ghyll woodlands.	Mostly grazing pasture (mainly sheep) within woodland, including ghylls. Small Wealden ridge-top towns and villages.
	Proportion	Woodland 19%, Settlement 3% Other 78%	-	-
	ALC	Predominantly Grade 3, some areas of Grade 2 agricultural land.	Predominantly Grade 3 agricultural land with some Grade 4.	Substantial areas of Grade 4 agricultural land.
HISTORIC INFLUENCES		Extensive modification of rivers and extensive floodplain drainage. Including construction of the Craven Channel, south of Isle of Oxney. Scots Float Sluice installed 1731. More recent bank raising works and instalment of Archimedean screw pumps to create flood storage area.	Modern engineering works (1960s) including raising of banks of Rother for floodwater containment in Robertsbridge area	Few significant modifications: some on-line ponds and lakes.
RECREATION		Footpaths alongside channel or at edge of floodplain including section of Sussex Border Path Long distance footpath.	Boat trips are provided along the channel; there are also footpaths and the moated National Trust Castle at Bodiam, which is a major visitor attraction.	Footpath along Upper Rother. Elsewhere many rights of way but, generally located away from the watercourses.
HYDROLOGY				
Rainfall		Average annual catchment rainfall: 757 mm/annum (Upper Rother receives 70mm/annum more than Lower). Average annual effective rainfall (after evaporation): 303mm/annum		
Water resources	Abstraction	Some agricultural surface water abstraction for spray irrigation.	Few abstraction points.	Public surface water abstraction (from Rother) at Robertsbridge supplies Darwell reservoir (also pumped from Bewl Water /Medway). Also a small number of groundwater abstractions.
	Flows	Typically flashy flows throughout the area. Generally slow flowing.	Typically flashy flows.	Typically flashy flows. Suffers from particularly low flows in drought conditions. Fast-flowing.
Flooding/flood risk	Tidal	Below mean high tide level and historically subject to tidal flooding. Now tidal only to Scots Float Sluice (north of Rye), therefore not at direct risk.	Non-tidal, as above mean high tide, therefore not at direct risk.	Non tidal and not at direct risk.
	Fluvial	Wet levels serves as a flood storage, but can only discharge intermittently between high tide therefore very susceptible to flooding (e.g. flooded in '83, '93, '99 and 2000).	Contained by embankments but potential susceptibility to over-topping. (recent flooding in 2000).	Small scale and localised out of bank flooding – but floodwater mostly contained within deep channels.
Water quality	Chemical GQA	Predominantly C.	Predominantly B and C except a stretch classified a 'E' associated with sewage discharge near Robertsbridge.	Highly variable: A-E as a result of numerous sewage discharges and agricultural run-off, exacerbated by low-flow situations.
	Biological GQA	Predominantly B.	Predominantly A, except C/E around Robertsbridge.	Highly variable A-C.
	Silting	?	?	?
BIODIVERSITY				
Key Habitats/features	RE Target	Fails to achieve RE3 target (i.e. up to RE4).	Mostly fail to achieve RE 2 target (i.e. up to RE3).	Mostly fail to achieve RE1/2 target (i.e. up to RE2).
	River channel and floodplain	Reclaimed from tidal marsh. Trapezoidal channel limits habitat value. Drainage ditches likely to be of high ecological value.	Trapezoidal channel limits habitat value. Drainage ditches may be of value.	Wooded ghylls are important habitats.
	Wider catchment	Few significant habitats.	Ancient woodland and hedgerows.	Ancient woodland, shaws and hedgerows.
	Protected (water-related) habitats	None: Adjoining Romney Marsh is very important habitat (SSSI).	None.	None.
	Key wetland BAP HAP targets	Water Vole known to be present.	<i>Water Vole?</i>	<i>Water Vole?</i>
Alien Species	Mink are present.	<i>Mink?</i>	<i>Ergasilus sieboldii</i> fish parasite found at Darwell.	
FISHERIES				
Coarse		Coarse species include roach and bream with some tench and eels in slow-flowing sections.	Coarse fish, particularly around Robertsbridge including chub and dace. Designated under EU Freshwater Fish Directive as 'cyprinid' between Crowhurst Bridge and Stonegate.	Coarse fish include bullhead, brook lamprey and stone loach.
Salmonid	Migratory	Runs of sea trout. Scots Float Sluice includes a fish pass but sometimes non-operational preventing fish migration.	As for lower Rother.	?
	Non-migratory	Designated as a salmonid fishery under EU Fish Directive.	Designated as salmonid to Robertsbridge under EU Freshwater Fish Directive.	Game fishing on Darwell reservoir.
Other notes				

CATCHMENT: ROTHER/Sub-catchment Brede

REACH		Lower Brede	Mid Brede	Upper Brede
Location		R. Brede, east of Brede.	R. Brede, between Sedlescombe and Brede.	R. Brede, west of Sedlescombe; and Brede tributaries.
PHYSICAL LANDSCAPE				
Geology		Hastings Bed: sandstones, siltstone and clays, capped with tidal flat deposits.	Hastings Bed: sandstones, siltstone and clays, capped with alluvium and head.	Hastings Bed: sandstones, siltstone and clays – relatively impervious leading to high run off.
Elevation		Below 25m AOD, with the main channel often below 3m AOD.	Below 25m AOD.	Up to 100m AOD.
Landform		Flat to shelving within a shallow valley bounded by 'whale-back' ridges.	Flat to shelving within a steeper valley form.	Includes steeply incised valleys within a hilly context.
Channel Gradient		1 in 2000	?	?
LANDCOVER AND USE	Description	Large intensively farmed arable and pastoral fields, relatively undivided and with little woodland cover. Settlement at Icklesham and Winchelsea.	Large, intensively farmed arable and pastoral fields, relatively undivided woodland cover on adjoining valley sides and ridges.	Smaller fields within a wooded context including numerous ghyll woodlands.
	Proportion	-	-	-
	Agricultural Land Classification	Mixed: including Grade 2 associated with tidal flat deposits to the east with Grade 3 and 4 to the west.	Grade 3.	Grade 3 with patches of Grade 4.
HISTORIC INFLUENCES		Reclamation of Brede or 'Ee' valley from saltmarsh in late twelfth and early thirteenth centuries. The Great Sea Wall or 'Damme' was constructed across the main channel. Bank raising works in 1960s.	Relatively unmodified.	Relatively unmodified.
RECREATION		Numerous public rights of way including footpaths, and the 1066 Long-distance country walk. Popular area with holidaymakers.	Some public footpaths present.	<i>Not a focus of recreational use?</i>
HYDROLOGY				
Rainfall		As defined previously (Rother Sub-catchment)		
Water resources	Abstraction	None	Public surface water abstraction at Powdermill Reservoir (served by Brede) and one other location. Two Public groundwater abstraction points.	
	Flows	<i>Typically flashy?</i>	?	?
Flooding/flood risk	Tidal	High tide has reached 5.3m AOD therefore most of Lower Brede floodplain susceptible to tidal flooding.	Currently beyond the upper tidal limit and therefore not directly susceptible to tidal flooding.	Not susceptible.
	Fluvial	Area of very high flood risk, embankments are vulnerable to overtopping.	Area of high fluvial flood risk.	Only small-scale and localised out of bank flooding.
Water quality	Chemical GQA	Predominantly Class D, with a small stretch of Class F related to sewage discharge near Winchelsea.. Slow-flowing stretches and still waters where nutrient rich discharges are causing eutrophication and excessive weed growth.	Predominantly Class B.	Mixed – class B and C.
	Biological GQA	No data available.	Class B.	Mixed – class A, B, C, with one point classified D, related to sewage discharge near Battle.
	Silting	?	?	?
BIODIVERSITY				
Key Habitats/features	RE Target	Fails to achieve target of RE3 (i.e. up to RE4).	Mostly complies with target of RE3.	Partly complies and partly fails to meet RE2 target.
	River channel and floodplain	Trapezoidal channel form and intensive maintenance limits habitat value. Floodplain drainage ditches likely to support a range of aquatic species.	Trapezoidal channel form and intensive maintenance limits habitat value. Floodplain drainage ditches likely to support a range of aquatic species.	?
	Wider catchment	None.	Ancient woodland.	Ancient woodland.
	Protected habitats	Includes part of pSPA site valued for Bewick's swan, breeding little and common terns and birds of prey. Also associated with cSAC at Rye Harbour that is valued for coastal shingle communities.	None.	None.
	BAP/HAP Species/Habitats present	Drainage ditches. Water vole likely.	<i>Water vole?</i>	<i>Water vole?</i>
	Alien Species	Fish parasite <i>Anguillicola crassus</i> affecting eel population. Mink.	?	?
FISHERIES				
Coarse		Coarse species include tench and eels. Designated as a 'cyprinid' fishery under EU Fisheries Directive.	Coarse fish species include chub and dace. Designated as a cyprinid fishery under the EU Fisheries Directive.	Bullheads, brook lamprey and stone loach present.
Salmonid	Migratory	Supports runs of sea trout from May to September. Spawning on gravel fords and tributaries.	Supports runs of sea trout from May to September. Spawning on gravel fords and tributaries.	Supports runs of sea trout from May to September. Spawning on gravel fords and tributaries.
	Non-migratory	?	Game fishing associated with Powdermill reservoir.	?
Other notes				

CATCHMENT: ROTHER/Sub-Catchment Tillingham

REACH		Lower Tillingham	Mid Tillingham	Upper Tillingham
Location		R. Tillingham, east of Udimore.	R Tillingham between Broad Oak and Udimore.	R Tillingham, west of Broad Oak, and tributaries.
PHYSICAL LANDSCAPE				
Geology		Hastings beds: sandstones, siltstones and clays, capped with tidal deposits.	Hastings beds: sandstones, siltstones and clays, capped with alluvial deposits.	Hastings beds: sandstones, siltstones and clays.
Elevation		Below 25m AOD, channel below 5m AOD.	Below 25m AOD, channel generally above 5m AOD.	Up to 100m AOD.
Landform		Wide flat to shelving floodplain within shallow valley.	Flat to shelving floodplain within steep valley.	Steeply incised valley landscape within rolling Wealden hills.
Approximate Average Channel Gradient		1 in 1,000	1 in 350	1 in 100
LANDCOVER AND USE	Description	Large intensively farmed arable and pastoral fields. Settlement of Rye – former port – at 'mouth' of river.	Large farable and pastoral fields continuing onto valley sides with some woodland and shelterbelts.	Pasture set within context of small ghyll woodlands.
	Proportion	As noted previously (Rother sub-catchment)		
	Agricultural Land Classification	Grade 3/4	Grade 3/4	Predominantly Grade 3.
HISTORIC INFLUENCES		Historic reclamation of floodplain from saltmarsh. Now tidal up to Tillingham Sluice. Small stretch with bank raising works and re-sectioning from 1970s.	Relatively unmanaged	Relatively unmanaged.
RECREATION		Some footpaths following edge of floodplain but most routes cross the river valley connecting to Rye.	Cross-Weald footpaths.	Cross-Weald footpaths.
HYDROLOGY				
Rainfall		As noted previously (Rother sub-catchment)		
Water resources	Abstraction	Groundwater abstraction at Rye.	None.	None.
	Flows	?	?	Flashy flows.
Flooding/flood risk	Tidal	Below limit of high tide therefore naturally very susceptible to flooding, although tidal limit currently at Tillingham Sluice.	Above tidal limit therefore not directly susceptible to tidal flooding.	Well above tidal limit therefore not directly susceptible to tidal flooding.
	Fluvial	Very susceptible as a result of low-lying character.	Very susceptible as a result of low-lying character.	Not susceptible.
Water quality	Chemical GQA	Grade C.	Predominantly Grade B.	Predominantly Grade C.
	Biological GQA	<i>Data not available</i>	Grade C.	Grade B.
	Siltation Issues	?	?	?
BIODIVERSITY				
Key Habitats/features	RE Target	Failed to achieve RE2 (i.e. up to RE3).	Some achieved RE2.	Failed to achieve RE2 (i.e. up to RE3).
	River channel and floodplain	Numerous drainage ditches	Drainage ditches and river channel.	River channel and associated woodland.
	Wider catchment	?	Ancient woodland including a small number of ghyll woodlands.	Large quantity of ancient woodland, including ghylls.
	Protected (water related) habitats	Close to pSPA site valued for Bewick's swan, breeding little and common terns and birds of prey.	None.	None.
	BAP/HAP species and habitats present.	Water vole.	?	?
	Alien Species	?	?	?
FISHERIES				
Coarse		Coarse fish present but no stretch covered by EC Freshwaters Fisheries Directive.	Coarse fish present but no stretch covered by EC Freshwaters Fisheries Directive.	Coarse fish present but no stretch covered by EC Freshwaters Fisheries Directive.
Salmonid	Migratory	Sea trout that are reported to spawn on gravel fords.	Sea trout	Sea trout?
	Non-migratory	Brown trout?	Brown trout?	Brown trout?
Other notes				

CATCHMENT: MEDWAY/Sub-catchments Medway and Eden

Reach		R. Medway	Medway/Eden tributaries	R. Eden
Location		R. Medway between Forest Row and Tonbridge.	Headwaters of the rivers Medway and Eden including Eridge Stream, Kent Water and Pippingford Stream.	River Eden between Hever and Penshurst.
PHYSICAL LANDSCAPE				
Geology		Hastings Beds – principally Ashdown Beds and Wadhurst Clay, overlain with alluvium and river terrace deposits. Includes localised aquifers.	Hastings Beds – principally Ashdown Beds, Wadhurst Clay and some Tunbridge Wells Sand, overlain with some alluvium.	Hastings Beds – principally Ashdown Beds, Wadhurst Clay and some Tunbridge Wells Sand in upper reaches, overlain by alluvium.
Elevation		Between 25 and 75 m AOD (25 and 50m AOD beyond Groomsbridge).	Up to 280m AOD.	Between 25 and 50m AOD.
Landform		Gently shelving wide corridor of low lying land.	Steeply incised with a complex network of ghyll valleys. Culminates in broad ridge of land between Crawley and Wadhurst that defines the catchment's southern watershed.	Gently shelving floodplain corridor.
Approximate Average Channel Gradient		1 in 900	1 in 50 - 1 in 100	1 in 1000
LANDCOVER AND USE	Description	Large-scale open arable landscape. Few settlements.	Mixed farmland including apple orchards and soft fruit with pasture (beef and dairy, some sheep). Woodlands and wooded ghyll valleys. Coniferous plantation and heath associated with elevated area around Crowborough. Densely settled- including town of Tunbridge Wells.	<i>Open arable landscape?</i>
	Proportion	Woodland 27%, Settlement 3%, Other 70%	-	-
	ALC	Grade 3 with small areas of Grade 4.	Ghylls are mostly Grade 4 within Grade 3 context.	Grade 4 floodplain in context of Grade 3 with localised pockets of Grade 2.
HISTORIC INFLUENCES		Few modifications. However, downstream river engineering works (Leigh Barrier) impact these upper reaches. Medway made navigable from 1531 and locks made between Maidstone and Tonbridge by 1746.	Presence of Hammer Ponds, formed by impounding of steep Wealden steams for the iron industry - provide water to drive waterwheels to power the bellows. Weir Wood reservoir constructed <i>date?</i>	No substantial modifications, although the construction of drainage ditches has allowed the floodplain to be cultivated.
RECREATION		Non-navigable above Leigh Barrier but canoeing possible. Angling popular. Footpath networks link with valley.	Vanguard Way cuts across the area.	Eden Valley walk. Numerous coarse fisheries.
HYDROLOGY				
Rainfall				
Rainfall varies across the catchment averaging 729mm/annum with higher rainfall (756mm/annum) in more elevated areas. This has been as low as 571 mm in drought years.				
Water resources	Abstraction	Limited groundwater abstraction upstream of Penshurst.	Surface Water abstraction from River Medway into Weir Wood reservoir.	Surface Water abstraction from River Eden for Reservoir at Bough Beech (outside AONB).
	Flows	Heavily regulated. Flows controlled by sluice gates and flood storage. Leigh Barrier (located outside AONB) is largest on-river flood storage area in UK. Also moderated by the 'Medway Scheme' (Teise tributaries) therefore less flashy than previously. Residual flow is set at 275Kl/day.	Flashy characteristics due to presence of Wealden Clay.	Flashy characteristics as a result of Wealden Clay.
Flooding/flood risk	Tidal	Tidal limit is Allington Lock (nr Maidstone) therefore not at direct risk.	Not at direct risk.	Not at direct risk.
	Fluvial	High flood risk. Leigh Barrier retains water in Medway Valley. 1968 floods caused massive damage to Tonbridge.	Only lower reaches subject to significant flood risk – high run off due to topography and geology.	High flood risk due to topography and surrounding clay catchment.
Water quality	Chemical GQA	Grade B (upper reaches) to Grade C (lower reaches). Area of Grade F downstream of Hartfield. Lower quality reaches due to sewage effluents and pesticides arising from orchards.	Generally good quality – Grade A and B (some C).	Grade C.
	Biological GQA	?	?	?
	Siltation Issues	?	?	?
BIODIVERSITY				
Key Habitats/features	RE Target	Better than RE3 target, some stretches fail to comply with RE2 upstream of Hartfield.	Variable – but largely comply with target.	Fails to comply with RE2 target (i.e. up to RE3).
	River channel and floodplain	?	?	?
	Wider catchment	?	Ghyll woodlands including large proportion of ancient woodland and heathland habitat.	?
	Protected habitats	None.	SSSI at Weir Wood. pSPA and cSAC at Ashdown Forest– relating to its importance as a heathland habitat.	?
	BAP/HAP present	Otter and black poplar recorded.	?	Otters. White-clawed crayfish. Various dragonfly species.
	Alien Species	Japanese knotweed, Himalayan Balsam, Giant Hogweed (particularly between Tonbridge and Maidstone) and Australian stonecrop. Mink, Chinese mitten crab, signal crayfish, terrapin, pumpkinseed and catfish present.	?	?
FISHERIES				
Coarse		23 species of coarse fish including roach, chub, barbel, bream, pike, perch, ruffe, minnow, bullhead, gudgeon, brook lamprey and stone loach. Stretch of R. Medway outside AONB designated under EU Freshwater Fish Directive.	Good coarse fish populations.	R. Eden – Edenbridge to confluence with Medway designated 'cyprinid' under EU Fish Directive.
Salmonid	Migratory	Allington Lock prevents upstream movement of fish (bypass work scheduled 2002)	Allington Sluice is a barrier to salmonid migration.	Allington Sluice is a barrier salmonid migration.
	Non-migratory	Brown trout dominate the Hartfield area.	Brown Trout found in Eridge stream and other Ashdown Forest streams.	Brown Trout?
Other notes				

CATCHMENT: MEDWAY/Sub-Catchments Teise and Beult

REACH		River Teise	Teise Tributaries	Beult Tributaries
Location		Between Lamberhurst and Horsemonden.	Headwaters, including Bewl Stream and Bewl Water reservoir.	Headwaters/secondary rivers of River Beult.
PHYSICAL LANDSCAPE				
Geology		Hastings Beds – principally Ashdown Beds and Wadhurst Clay overlain by alluvium.	Hastings Beds – principally Tunbridge Wells Sand.	Hastings Beds – principally Tunbridge Wells Sand.
Elevation		25- 50m AOD.	Up to 280m AOD.	Up to 150m AOD.
Landform		Low-lying flat valley landscape comprising a narrow valley enclosed within steep valley sides.	Steeply incised with a complex network of ghyll valleys.	Steeply incised with a complex network of ghyll valleys.
Channel Gradient		Deep (1.5m) and steep-sided (up to 5m). Some natural riffles. Typically 1 in 450.	1 in 100	?
LANDCOVER AND USE	Description	Open arable landscape with small-scale hop fields, small copses, hedgerows.	Mixed farmland including apple orchards and fruit, woodlands and wooded ghyll valleys, with some pasture.	Mixed farmland including apple orchards and fruit, woodlands and wooded ghyll valleys, with some pasture.
	Proportion	-	-	?
	Agricultural Land Classification	Grade 3.	Grade 3 with localised pockets of Grade 4 and Grade 2.	Grade 3.
HISTORIC INFLUENCES		No significant modifications.	The Bewl Water reservoir near Lamberhurst was constructed in 1977 and involved damming and drowning of the Bewl Stream. Hammer ponds are also present.	No significant modifications.
RECREATION		Coarse, game and mixed fishing on River Teise. No long-distance footpath networks.	Many activities on Bewl Water including sailing, canoeing, angling, windsurfing and rowing. There are few recreational footpaths.	Not a significant recreation area.
HYDROLOGY				
Rainfall		As noted previously (Medway sub-catchment)		
Water resources	Abstraction	Large-scale surface water abstraction (10 million cubic metres/year) pumped to Bewl Water.	'Medway Scheme' - strategic pumped storage and river transfer facility at Bewl Water Reservoir. Water abstracted during Winter at Smallbridge and Yalding and pumped to Bewl then released when required for abstraction near Springfield.	No abstraction.
	Flows	Large fluctuations led to the construction of Bewl reservoir which now regulates river flow.	Flows regulated by the Medway Scheme, and therefore are less flashy than previous.	Very flashy due to presence of impermeable Wealden Clay.
Flooding/flood risk	Tidal	Non tidal therefore not at direct risk.	Non tidal therefore not at direct risk.	Non tidal therefore not at direct risk.
	Fluvial	Subject to flooding.	Subject to small scale and localised flooding	Not at risk.
Water quality	Chemical GQA	Grade B and C	Mostly grade A (Bewl) and C.	Highly variable quality – Grade B to F, poor water quality associated with sewage treatment works.
	Biological GQA	?	?	?
	Siltation Issues	?	?	?
BIODIVERSITY				
Key Habitats/features	RE Target	Complies with RE2 target.	Highly variable targets/compliance.	Largely fail to comply with RE2 target (i.e. up to RE3).
	River channel and floodplain	?	?	?
	Wider catchment	Wooded valley sides/crests.	Relatively high proportion of ancient woodland.	Ancient woodland
	Protected habitats	?	Numerous SSSIs.	Downstream (outside AONB) 25 Km of Beult is designated as SSSI – one of few clay rivers retaining characteristic flora and fauna.
	BAP/HAP species/habitats present	Rivers and Streams, Open Water, water vole.	?	?
	Alien Species	As for Medway?	?	?
FISHERIES				
Coarse		R. Teise – Bartley Mill to Yalding designated as Cyprinid Fishery under EU Fish Directive. Includes roach, chub, bream, pike, eels, perch, ruffe, bleak, tench, carp, minnow, gudgeon, rudd and dace.	Bewl Water is stocked with coarse fish. Coarse fish present throughout tributaries.	R. Beult – Hadmans Bridge to Yalding (outside this reach) designated under EU Fish Directive.
Salmonid	Migratory	Allington Sluice is a barrier salmonid migration.	Allington Sluice is a barrier to salmonid migration.	Allington Sluice is a barrier to salmonid migration.
	Non-migratory	Managed as a game fishery: high class brown trout fishery with stocking and management.	Brown Trout in Bewl Water and feeder streams. Rainbow trout stocking from caged stock. Bewl Water designated as a salmon fishery under EC Fisheries directive. Raceways below dam used to propagate rainbow trout, salmon and sea trout.	Brown trout not thought to be present.
Other notes				

CATCHMENT: OUSE

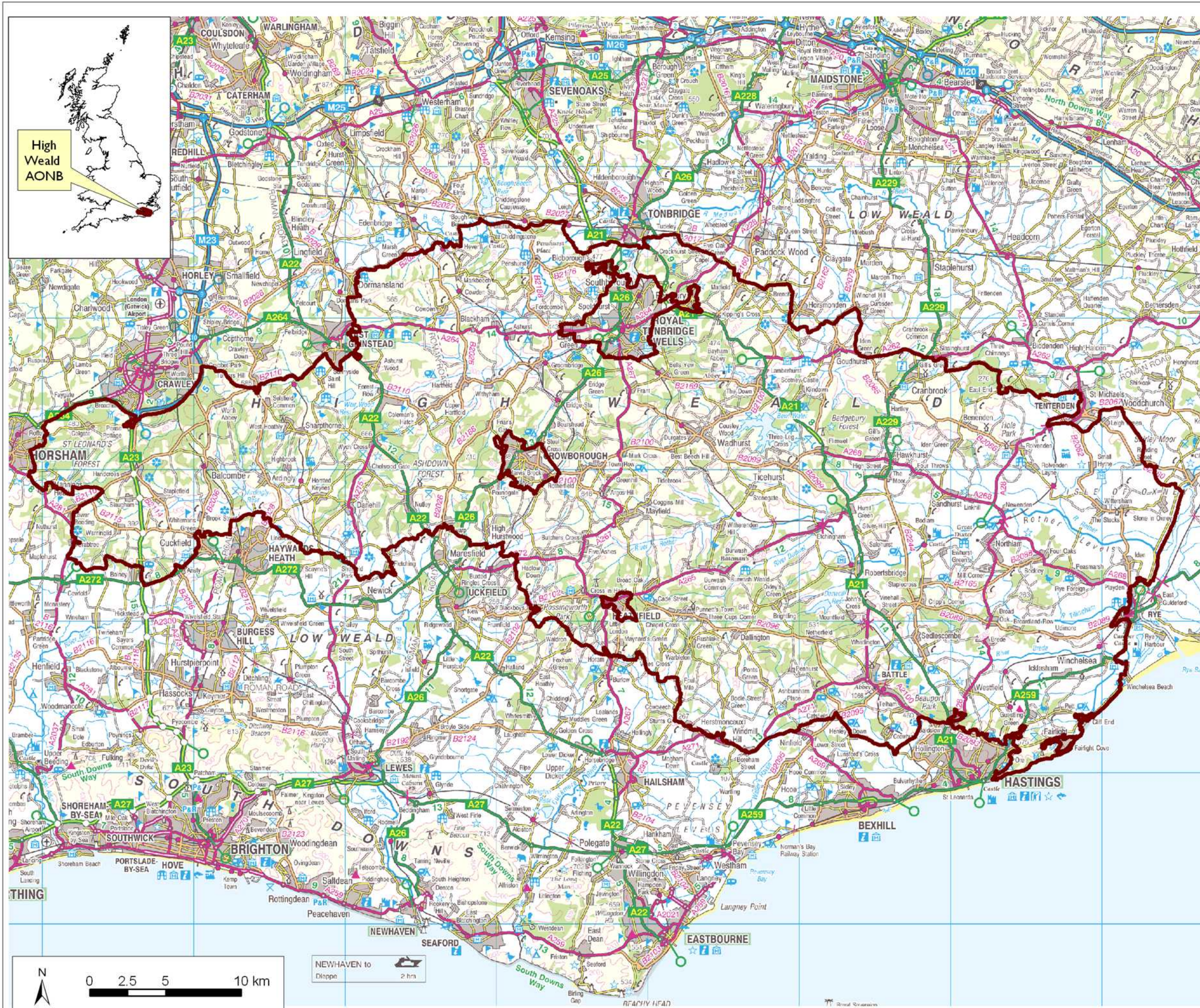
REACH		Upper Ouse/Cockhaise Brook	R. Uck	Uck/Ouse tributaries
Location		Upper Ouse river between Slaughtam and Newick (AONB boundary) including the Lower Cockhaise Brook from Ardingly to its confluence with the Ouse.	River Uck Between Butchers Cross and the AONB boundary at Buxted. (NB: the Uck joins the Ouse, outside the AONB at Isfield)	Headwaters of the River Ouse, Cockhaise Brook and River Uck. Area also includes the Ardingly Reservoir.
PHYSICAL LANDSCAPE				
Geology		Principally Tunbridge Wells Sand (Hastings Beds).	Principally Tunbridge Wells Sand (Hastings Beds).	Principally Tunbridge Wells Sand but with some areas of Ashdown Beds (Hastings Beds).
Elevation		Below 50m AOD.	Between 25 and 75m AOD	Above 25 and up to 280m AOD.
Landform		Narrow valley floodplain defined by steep valley sides.	Narrow valley floodplain defined by steep valley sides.	Steeply incised tributary valleys/ghylls within typically hilly High Weald landscape.
		Ouse 1 in 650 (Ouse), 1 in 225 (Cockhaise Brook)	1 in 400	1 in 75
LANDCOVER AND USE	Description	Gentle winding valley with arable fields with reduced hedgerows/hedgerow trees.	Densely wooded and forested. <i>Use of valley floor?</i>	Woodland, cattle grazing and some sheep grazing. Small fields surrounded by thick shaws and shelterbelts. On the sandy acidic soils around Ashdown Forest coniferous plantation and heath are present.
	Proportion	Woodland 28%, Settlement 3%, other 69%	?	?
	ALC	Grade 4 floodplain, Grade 3 valley sides.	Mostly Grade 3 with some Grade 4.	Predominantly Grade 3, with Grade 4 in the narrow valleys.
HISTORIC INFLUENCES		A number of water control structures occur within the Upper Ouse. The lower-lying coastal reaches (outside AONB) have been considerably modified, but with limited consequences for the Upper Ouse.	Little modified - small number of water control structures on the River Uck but outside AONB area.	Impoundment of Ardingly and Shell Brooks to create Ardingly Water (reservoir). Earlier impoundments created Hammer Ponds for the Tudor Iron Industry.
RECREATION		?	?	Stillwater angling, canoeing, windsurfing and sailing occur on Ardingly reservoir.
HYDROLOGY				
Rainfall				
Average annual rainfall of 838mm/annum of which 347mm/annum is effective rainfall.				
Water resources	Abstraction	Water pumped into Ardingly reservoir. Public Water abstraction (surface) from Cockhaise Brook.	None.	Some small agricultural groundwater abstractions/spray irrigation. Public Water supply abstraction from Ardingly Reservoir.
	Flows	Typically less flashy than elsewhere in the Weald due to sandy geology creating moderately well drained loams. Also water released from Ardingly reservoir at times of low flow to maintain acceptable levels.	Typically less flashy than elsewhere in the Weald due to sandy geology creating moderately well drained loams.	Less flashy than other Wealden tributaries due to loamy substrate. Water released from Ardingly reservoir at times of low flow.
Flooding/flood risk	Tidal	Non tidal therefore not at direct risk.	Non tidal therefore not at direct risk.	Non tidal therefore not at direct risk.
	Fluvial	Areas of flood risk associated with Upper Ouse and Lower Cockhaise Brook, including the outskirts of Haywards Heath.	Areas of flood risk, generally confined to narrow corridor adjacent to river corridor.	Not at flood risk – due to the combination of topography and filtration into underlying sandstone.
Water quality	Chemical GQA	Variable - Class A, B and C.: generally good quality.	Class B: good quality.	Class C and B: good quality.
	Biological GQA	Class A: high quality.	Class A: high quality.	Class B and A: high quality.
	Siltation Issues	?	?	?
BIODIVERSITY				
Key Habitats/features	RE Target	Complies with RE2.	Complies with RE2.	Fail to comply with RE2/3 (i.e. up to RE3).
	River channel and floodplain	Typical lowland river.	?	Steep-sided streams with on-line hammer ponds important for amphibians and aquatic macro-invertebrates insects.
	Wider catchment	Some ancient woodland	Some ancient woodland.	Ancient semi-natural and planted woodlands including ghyll woodlands and shaws. Heathland.
	Protected habitats	No water related interest.	No water related interest.	Ashdown Forest pSPA and cSAC. Tributaries above Ardingly reservoir form part of an SSSI.
	Key wetland BAP/HAP Species present	Native black poplar(?) and otter.	?	?
	Alien Species	Giant Hogweed, Japanese Knotweed, Himalayan Balsam, Australian Swamp Soncrop, Parrots feather. Catfish, Zander and Rainbow Trout. Floating Pennywort observed on Piltown Pond at head of Ouse. Fish parasite <i>Ergasilus</i> spp is present. <i>Phytophthora</i> affecting alder. Mink.	Fish parasite <i>Ergasilus</i> spp is present. Catfish, Zander and Rainbow Trout. <i>Phytophthora</i> affecting alder. Mink.	Fish parasite <i>Ergasilus</i> spp is present. Catfish, Zander and Rainbow Trout. <i>Phytophthora</i> affecting alder. Mink?
FISHERIES				
Coarse		Good quality mixed population including dace chub, roach, rudd, perch, pike, tench, gudgeon, minnow, carp, bullhead, stone loach, brook lamprey, bream, grayling, barbel and eel. Area of Ouse below Ardingly Reservoir and most of Cockhaise brook to confluence designated as 'Cyprinid' under EU Fish Directive.	<i>Likely to be as for Upper Ouse.</i> Area not designated under EU Freshwater Fish Directive. Juvenile fish may be drawn into water abstraction pipes at Cockhaise and Barcombe.	Coarse fish depend on many of the of tributary streams as spawning areas and/or nursery areas.
Salmonid	Migratory	Sea trout fishery, but thought to be declining (this is little understood). Weirs and sluices represent a barrier to salmonid migration.	Sea trout spawn in this reach.	Sea trout spawn in tributaries.
	Non-migratory	Native brown trout.	Native brown trout present. Alien rainbow trout present – have escaped from various fisheries.	Native brown trout present. Ardingly reservoir designated as a salmonid fishery under EU Fish Directive.
Other notes		There are a number of closed landfill sites found throughout the catchment		

CATCHMENTS: CUCKMERE RIVER AND PEVENSEY LEVELS

REACH		Cuckmere River tributaries	Upper Wallers Haven	Upper Combe Haven	Wallers/Combe Haven tributaries
Location		Upper reaches of the Cuckmere river including Vine Cross Stream, Waldron Ghyll and Summers Brook.	Upper Reaches of Wallers Haven including Nunningham Stream, Hugletts Stream, Ashbourne and Ninfield Stream.	Upper reaches of Combe Haven including the Powdermill Stream.	Small upper tributaries of the Upper Wallers Haven and Combe Haven streams.
PHYSICAL LANDSCAPE					
Geology		Ashdown Beds overlain by alluvium and head.	Ashdown Beds, overlain by alluvium and some head.	Ashdown Beds, overlain by alluvium.	Ashdown Beds and some Tunbridge Wells Sand.
Elevation		50-130m AOD	0-25m AOD	0-25m AOD	25-280m AOD.
Landform		Steep hilly headwaters within steep-sided valleys.	Valley landform rising sharply northwards.	Valley landform rising northwards.	Strongly articulated landform rising to a distinctive elevated ridge to the north.
Approximate Average Channel Gradient		1 in 75	1 in 150	1 in 200	1 in 60
LANDCOVER AND USE	Description	Distinct narrow floodplain with woodland. Settlement of Heathfield.	Steep wooded ghylls. Settlements such as Herstmonceaux	Steep wooded ghylls within mixed farmland context including un-intensive grazed pasture. Some settlements.	Open ridges supporting intensive arable in regular fields with narrow hedges. Pasture interspersed with wooded ghylls.
	Proportion	?	?	?	?
	ALC	Grade 3 and 4.	Grade 3.	Grade 4 with some Grade 3.	Grade 3 and 4.
HISTORIC INFLUENCES		Relatively unmodified in upper reaches. Below Milton Lock flood embankments, channel re-sectioning and ditching have occurred.	Not heavily modified except a small reach that is embankment. The adjoining Pevensey Levels were reclaimed from salt marsh with installation of weirs, pumps, sluices, high-embanked channels, irrigation ditches and pumping stations.	Relatively unmodified. Drains into Pevensey Levels (as described for Wallers Haven) although no land drainage pumping stations in this reach of the catchment.	Relatively unmodified.
RECREATION		Not widely used for recreation.	Not extensively used for recreation.	Tourists attracted to Battle and use footpaths in surrounding area.	Stillwater fishing associated with Powdermill stream.
HYDROLOGY					
Rainfall Annual average rainfall is 637-808mm/annum					
Water resources	Abstraction	No significant groundwater abstractions. Minor spray irrigation abstractions.	Many surface water abstractions that tap into Ashdown Sands minor aquifer in the summer to augment flow and water levels in Wallers Haven (where there is a major public surface abstraction point).	There are a number of small groundwater abstractions associated with Powdermill Stream.	No significant abstractions.
	Flows	The Cuckmere is a flashy river. Flows are fast due to the steep channel gradient.	Maintained by controlled release of abstracted water. Slow summer flows.	?	?
Flooding/flood risk	Tidal	Non tidal therefore not at direct risk.	Non-tidal therefore not at direct risk. Pevensey Levels are tidelocked and very vulnerable to flooding.	Non-tidal therefore not at direct risk. Drains into Pevensey Levels which are tidelocked and subject to flooding.	Non-tidal therefore not at direct risk.
	Fluvial	Not at risk due to elevated landform, although lower Cuckmere subject to fluvial flooding.	Ashbourne Channels (including confluence of Ashbourne and Hugletts Stream) vulnerable to flooding but extent and frequency limited.	Powdermill Stream at flood risk. Downstream areas at some risk (although less that within Wallers Haven catchment).	No significant flood risk.
Water quality	Chemical GQA	Class A and B.	Class A.	Class B.	No data available.
	Biological GQA	Class B.	Class B.	Class B.	No data available.
	Silting	?	?	?	?
BIODIVERSITY					
Key Habitats/features	RE Target	Complies with RE2 target.	Complies with RE2 target, except (naturally ferruginous) Hugletts Stream and lower reaches of Nunningham Stream	Complies with RE3 target.	No data available.
	River channel/floodplain	Typical acidic Wealden stream and wetland habitats. Good diversity of mayfly and caddis fly.	Typical acidic Wealden stream and wetland habitats.	Typical acidic Wealden stream and wetland habitats.	Typical acidic Wealden stream and wetland habitats.
	Wider catchment	Woodland including ancient woodland. Large number of ponds	Woodland including ancient woodland.	Woodland including ancient woodland.	Woodland including ancient woodland thought to be remnant of the High Weald Forest. Ponds.
	Protected habitats	SSSI associated with Vines Cross Stream.	SSSI associated with Ashbourne Stream. Pevensey Levels (adjoining) SSSI and Ramsar site. Important for bird species.	SSSI associated with Powdermill Stream.	No noted habitats.
	BAP/HAP species/habitats present	Catchment-wide species including water vole, otter, little whirlpool ramshorn snail, shining ramshorn snail and native (whire-clawed) crayfish.	As per Cuckmere.	As per Cuckmere.	As per Cuckmere.
Alien Species	Giant Hogweed, Japanese Knotweed, Himalayan Balsam <i>Crassua helmsii</i> , Floating Pennywort.	As per Cuckmere..	As per Cuckmere.	As per Cuckmere.	
FISHERIES					
Coarse		Includes roach, rudd, bream, common carp, tench, perch, pike, dace, chub, bullhead, stone loach, minnow, brook lamprey and eel. Not EU designated.	Ashbourne Streams and Hugletts Stream designated 'cyprinid' under the EU Fish Directive. Lower fish productively in engineered reaches.	Supports a coarse fishery. Not EU designated	Coarse fish present. Not EU designated.
Salmonid	Migratory	Sea trout occur and migration is facilitated by fish passes.	?	?	?
	Non-migratory	The upper streams are salmonid fisheries, but not designated by the EU Fish Directive. Native brown trout spawn in gravel beds of the headwaters.	Hugletts, Nunningham, Ninfield and Ashbourne Streams support salmonids.	Powdermill stream is a salmonid fishery.	?
Other notes		There are closed landfill tips within the catchment.	-	-	-

CATCHMENT: CATCHMENTS – ADUR, ARUN AND MOLE

REACH		ADUR TRIBUTARIES	Arun	Mole
Location		Small upper tributaries of the River Adur including the Cowfold Stream and Bolney Sewer.		
PHYSICAL LANDSCAPE				
Geology		Tunbridge Wells Sand (Hastings Bed Formation). Downstream of the AONB, geology becomes predominantly Wealden clay.		
Elevation		25-150m AOD		
Landform		Steep and hilly with incised tributary valleys/ghylls – typical Wealden landscape.		
Approximate Average Channel Gradient		1 in 100		
LANDCOVER AND USE	Description	Woodland, cattle grazing and some sheep grazing. Small fields surrounded by thick shaws and shelterbelts. On sandy acidic soils around Ashdown Forest coniferous plantation and heath present.		
	Proportion	Woodland 31%, Settlement 0%, Other 69%		
	Agricultural Land Classification	Grade 3 and 4.		
HISTORIC INFLUENCES		Unmodified.		
RECREATION		No significant recreational facilities/attractions.		
HYDROLOGY				
Rainfall		As defined previously (Rother sub-catchment)		
Water resources	Abstraction	No significant abstractions, although there is a public groundwater abstraction east of Bolney, outside the AONB.		
	Flows	Flashy downstream due to influence of clay but more controlled in upper reaches due to sandy substrate.		
Flooding/flood risk	Tidal	Non-tidal therefore not at direct risk.		
	Fluvial	Little flood risk – rapidly draining within bank.		
Water quality	Chemical GQA	Not recorded – Bolney Sewer downstream of AONB is Class C.		
	Biological GQA	Not recorded – Bolney Sewer downstream of AONB is Class A.		
	Siltation Issues	?		
BIODIVERSITY				
Key Habitats/features	RE Target	Not recorded – Bolney Sewer downstream of AONB is RE4		
	River channel and floodplain	Ancient woodlands including ghylls. No records of Black Poplar.		
	Wider catchment	Ancient woodland.		
	Protected habitats	None		
	Key wetland BAP/HAP Species present	?		
	Alien Species	?		
FISHERIES				
Coarse		Not covered by EU Freshwater Fisheries directive. However thought to be as per Ouse/Uck tributaries.		
Salmonid	Migratory	Considered unlikely		
	Non-migratory	Brown trout?		
Other notes				



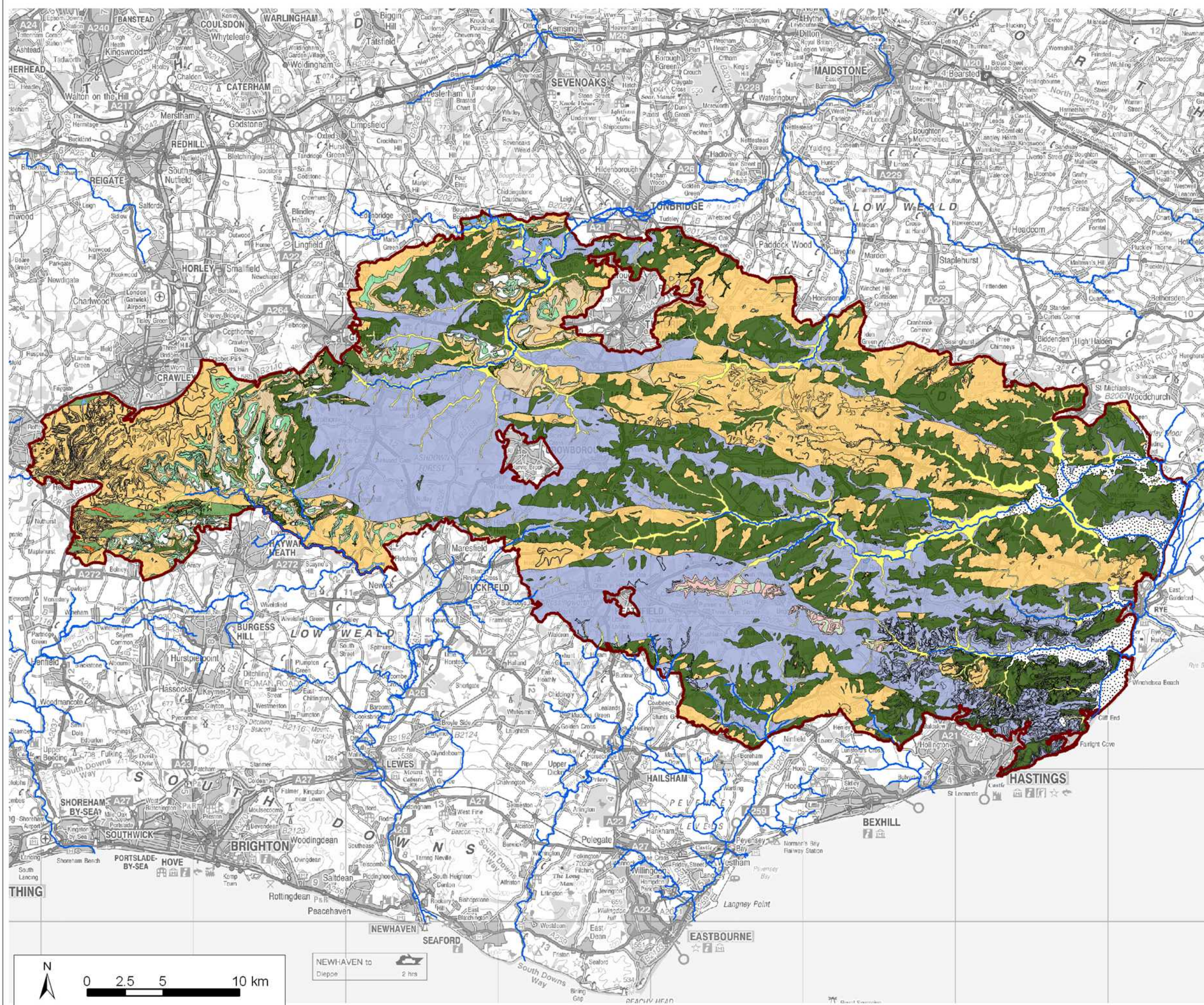
**Figure 1:
The High Weald AONB**

Key
 High Weald AONB boundary

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**Figure 2:
Geology**



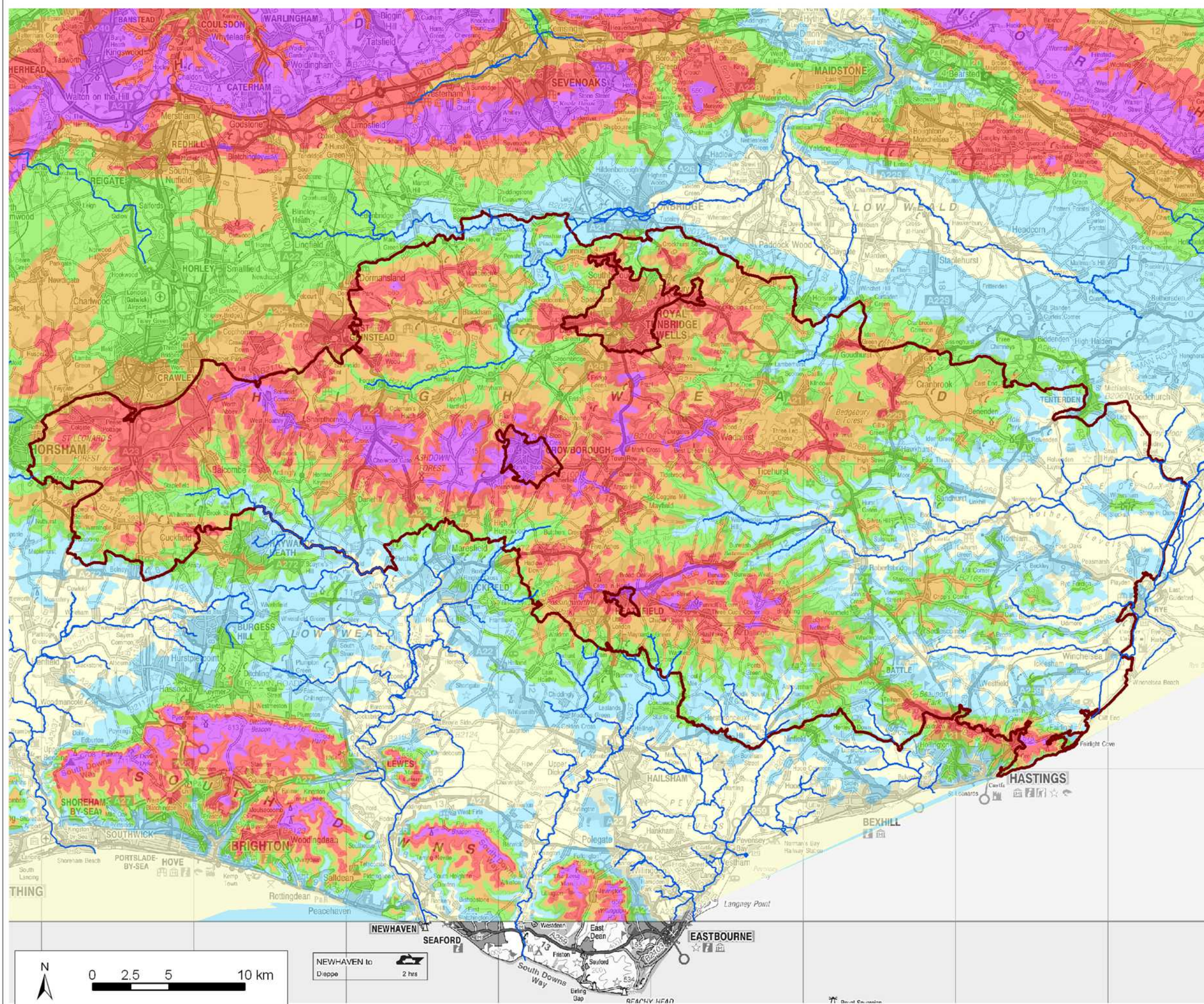
Key

- High Weald AONB boundary
- Main river
- DRIFT**
- Alluvium
- Head (undifferentiated)
- River Terrace Deposits, 1 - 4
- Tidal Flat Deposits
- SOLID**
- Weald Clay Formation
- Horsham Stone
- Upper Tunbridge Wells Sand Formation
- Upper Grinstead Clay
- Cuckfield Stone Member
- Lower Grinstead Clay
- Ardingly Sandstone
- Lower Tunbridge Wells Sand Formation
- Wadhurst Clay Formation
- Ashdown Formation
- JURASSIC**
- Greys Limestone Member
- Blues Limestone
- Purbeck Limestone Group

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**Figure 3:
Topography**



Key

High Weald AONB boundary

Main river

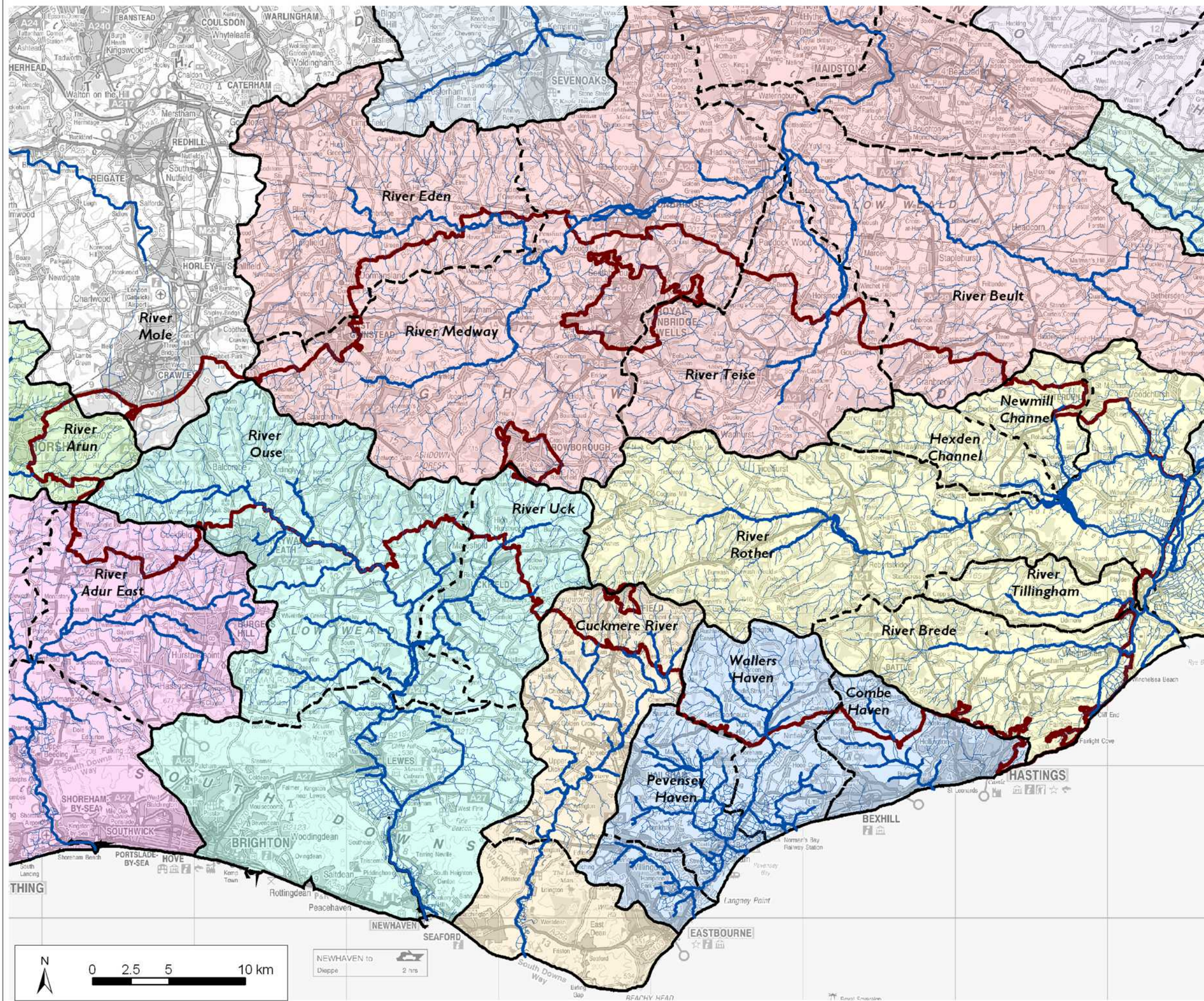
Elevation (m)

- 0 - 25
- 26 - 50
- 51 - 75
- 76 - 100
- 101 - 150
- > 151 (highest point 280 m)

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**Figure 4:
Catchments and Rivers**



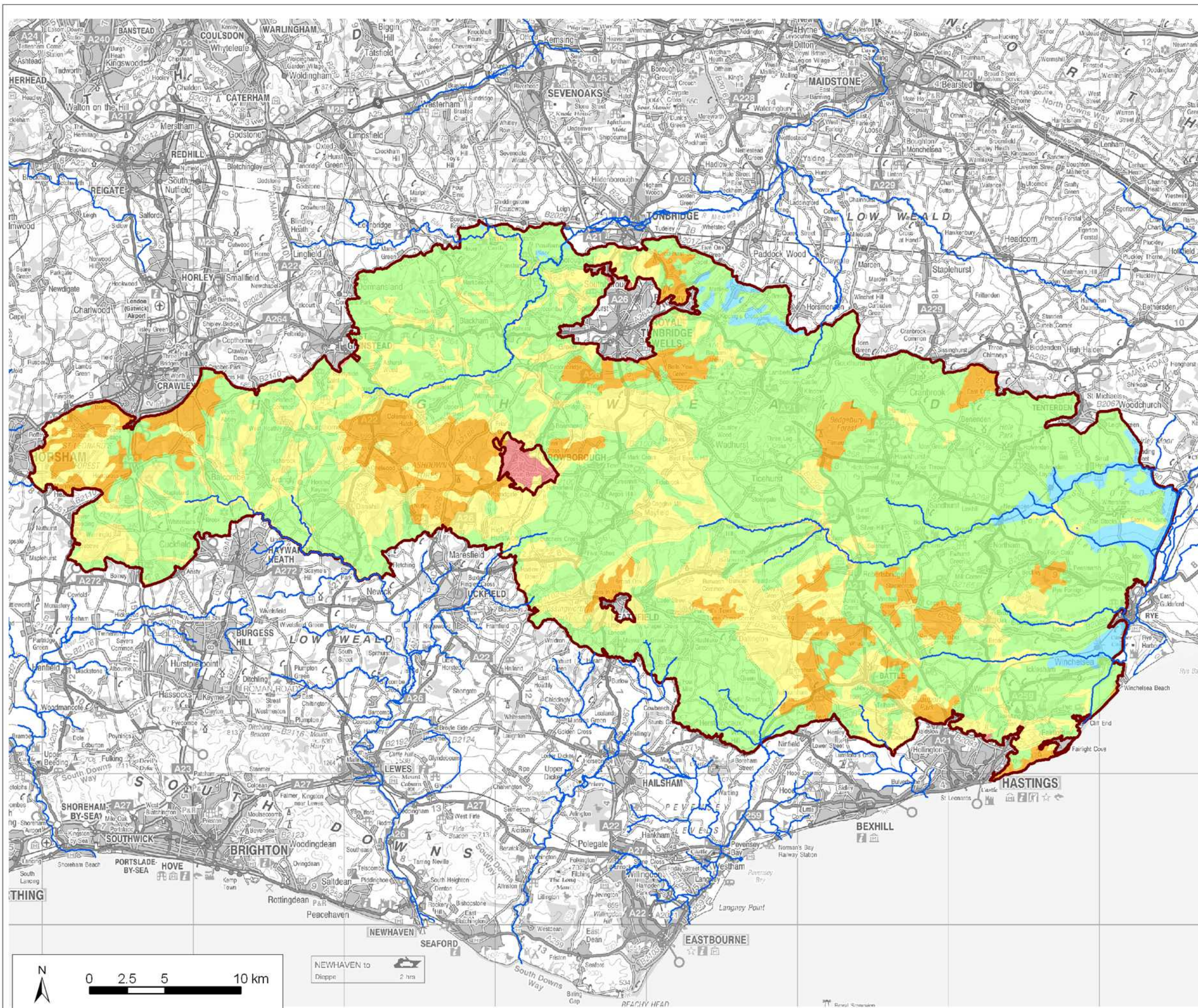
Key

- High Weald AONB boundary
 - Main river
 - Tributary
- Major Catchment Boundary**
- River Medway
 - River Rother
 - River Adur
 - Pevensy Levels
 - Cuckmere River
 - River Ouse
 - River Arun
 - River Mole
 - Tributary Catchment Boundary (with name)

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**Figure 5:
Agricultural Land Classification**



Key

High Weald AONB boundary

Main river

ALC Grade (no Grade 1 or 5 within AONB)

Grade 2

Grade 3

Grade 4

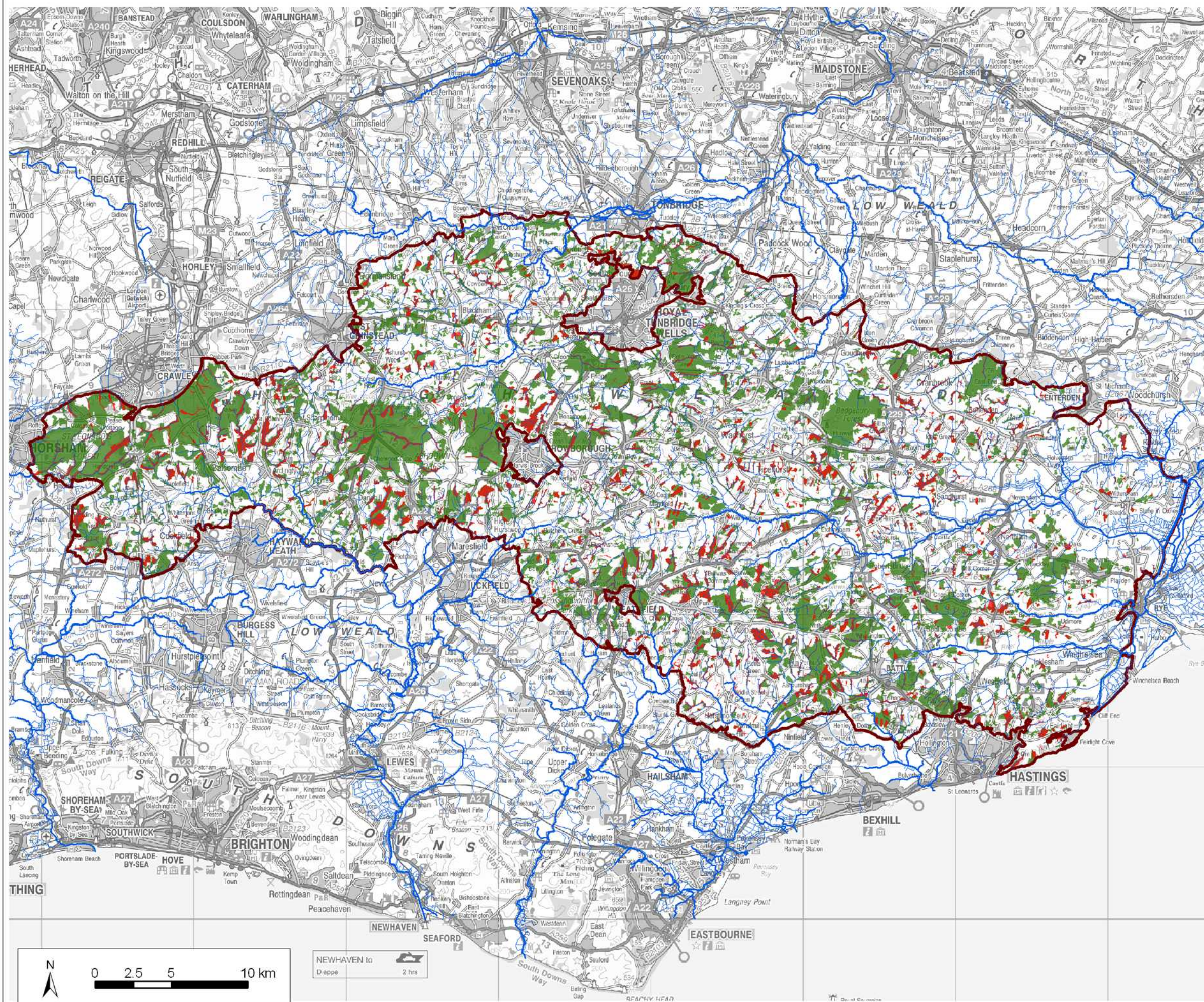
Non - Agricultural

Urban


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**Figure 7:
Gills and Woodlands**



Key

-  High Weald AONB boundary
-  Main river
-  Tributary
-  Gill
-  Woodland

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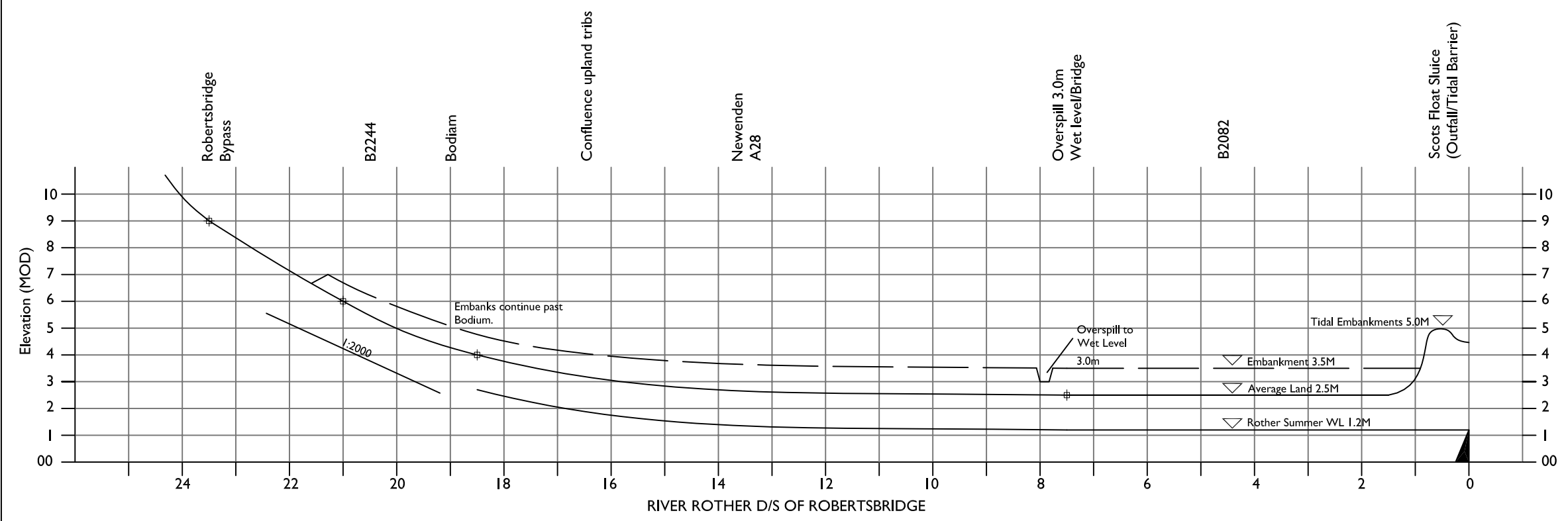
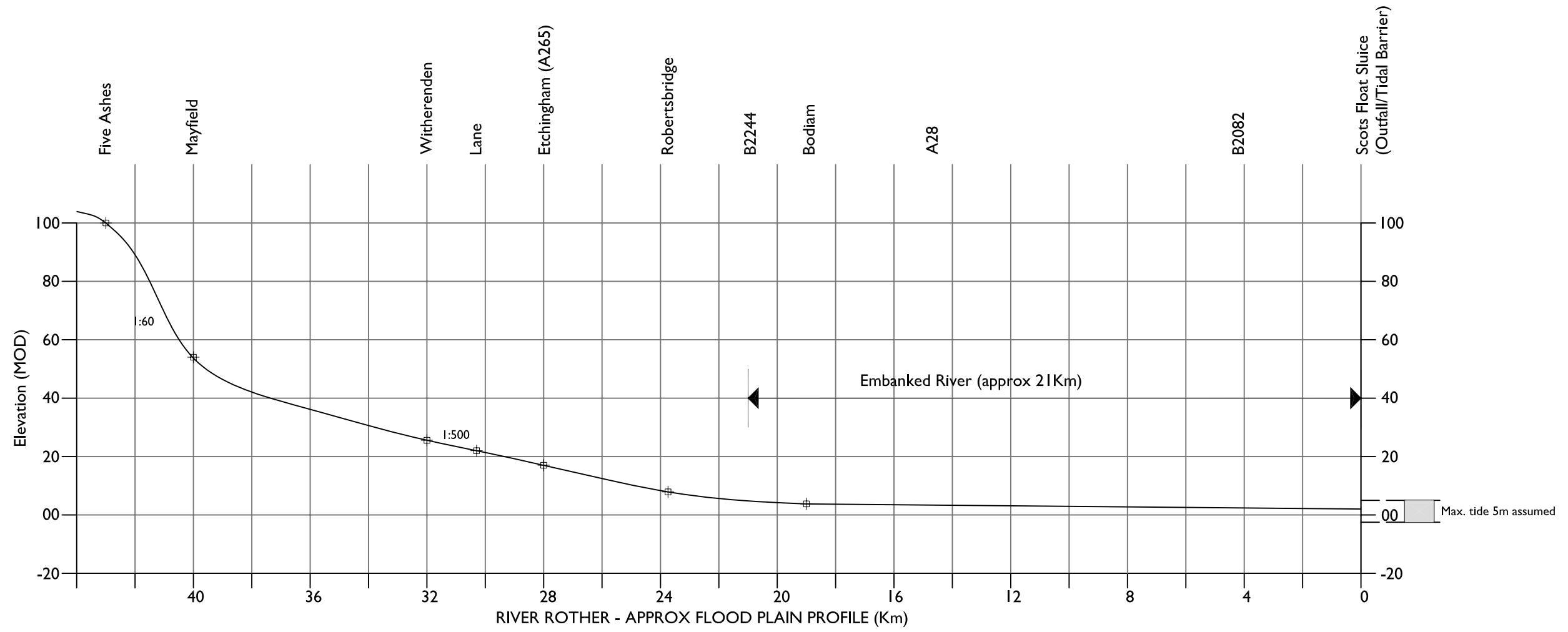
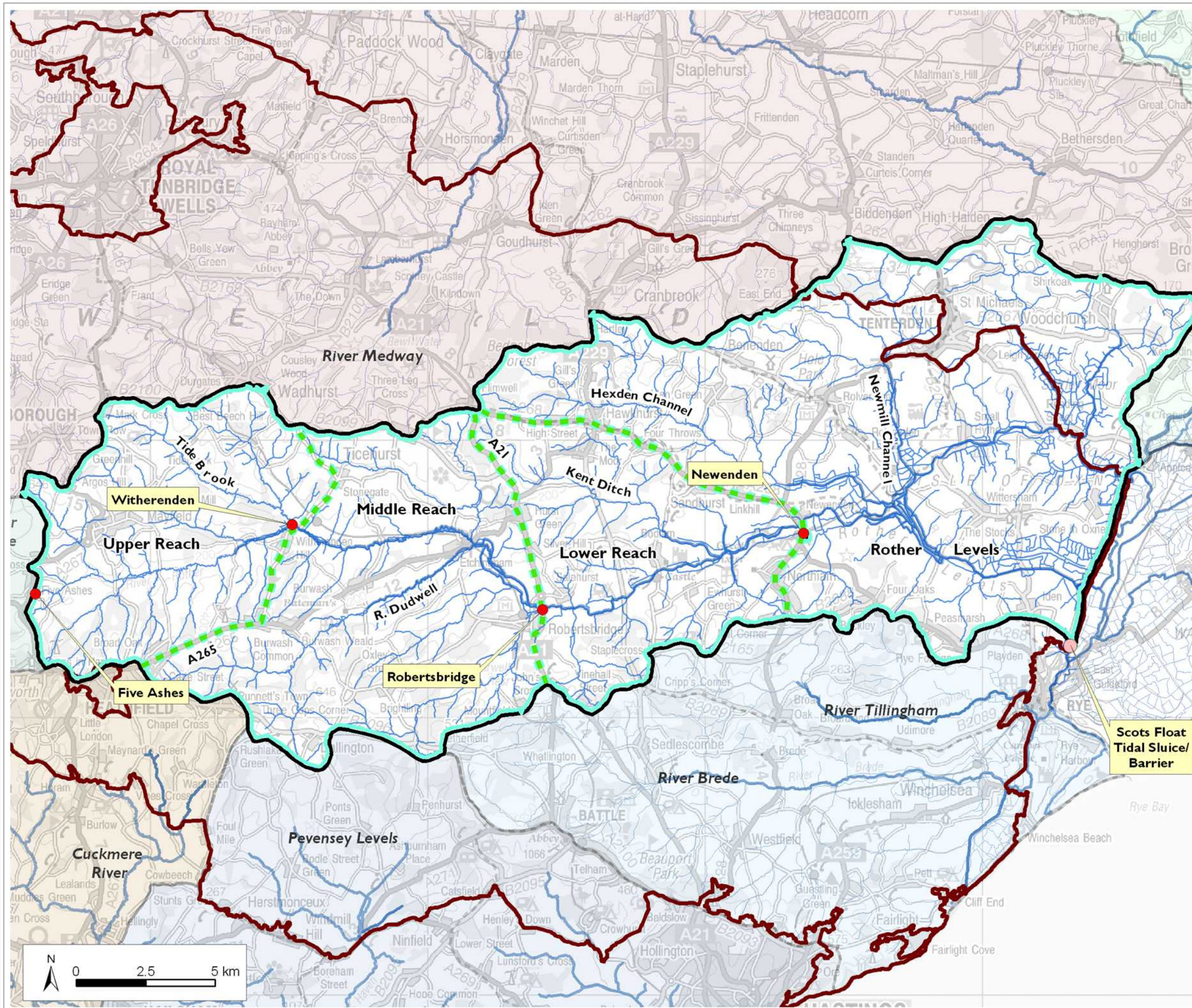


Figure 8.
Long Profile of the River Rother

Figure 9: River Rother - Catchment upstream of tidal outfall sluice



- Key**
- High Weald AONB boundary
 - Rother Catchment Boundary
 - Main river
 - Tributary
 - Catchment Boundary of each major reach of the Rother

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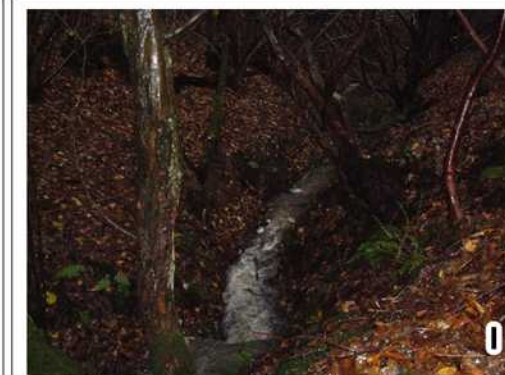
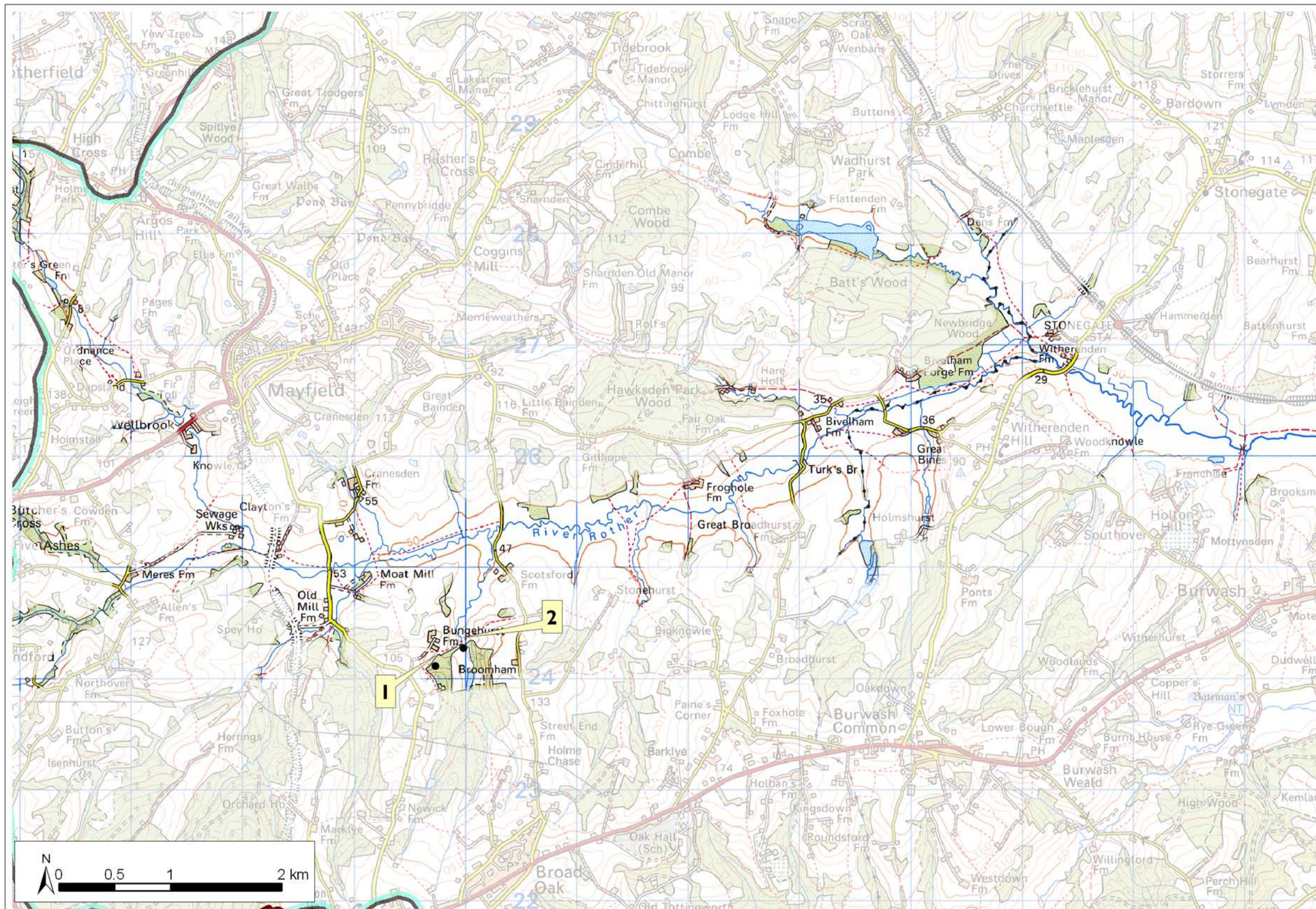


Figure 10: River Rother - Upper

1: Headwater tributary

Deeply incised self-regulating channel resulting from bed erosion (cutting down) into soft clays during spate flow events (Photo 1). Surrounding land use typically mixed pasture (Photo 2) and intensive arable (Photo 3), riparian corridor

frequently unmanaged 'gill' woodland that provides buffer against silt laden run-off from surrounding arable land. Grass pasture and woodland also reduce rate of flood run-off and associated downstream flood peaks compared with intensive arable. Woodland and grassland make little contribution to silt loading as

indicated by clear surface road run-off where these land use types are dominant (Photo 4).

2: Headwater tributary

Silt settles out forming discrete deposits and bars where bed gradient flattens out and velocities are reduced behind woody

debris dams (Photo 5); the value of these natural dams with respect to their contribution to sediment capture and as distinct aquatic ecological habitats is high. Encourage riparian woodland planting, and 'natural' unmanaged channels within the upper tributary reaches wherever practicable.

Key

 Rother Catchment Boundary

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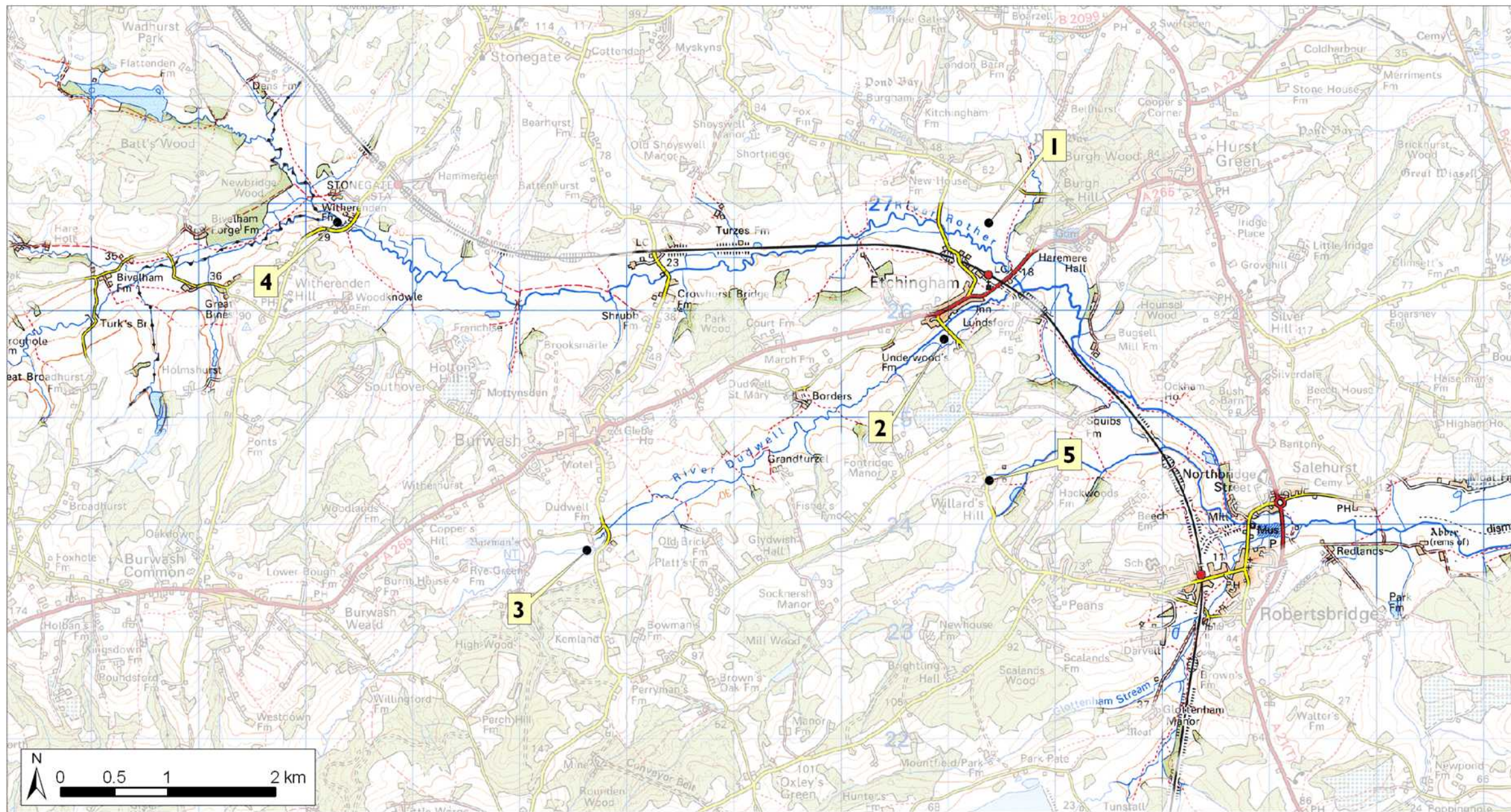


Figure 11: River Rother - Middle Reach

1: Rother floodplain - flood attenuation

Inspection was very limited but a significantly wide floodplain is evident at moderate grade of c. 1 in 500. Impeding the passage of floodwater down towards Robertsbridge has potential to reduce peak flow rates, enhancing the effectiveness of flood protection works. Floodplain restoration strategy suggested.

2: River Dudwell at Etchingham

Potential to create flood impedance upstream of lane; river channel throttle combined with dense hedge/flood fence along line of existing wire fence (Photo 1). Increases depth of flooding/storage reducing peakflow rate; road

3: River Dudwell at Burwash

Flood had cleared this higher reach during inspection but scope for flood impedance as 2 was evident eg. hedge thickening at Photo 2.

4: River Rother at Witherden

Location at top end of the middle reach near confluence of Tide Brook. The open floodplain upstream of road is expansive suggesting that flood impedance would be particularly effective. Investigation needed to locate suitable position for new flood fence/hedge as 2. Noted that roadside hedge has been removed to let floods pass freely over the road. Photo 3 - Road, Photo 4 - Upstream floodplain.



5: Arable riverside land below Willards Hill

A small tributary valley with arable land on the slopes down to the stream edge. Example demonstrates potential for rapid run off (Photos 5 and 6) and soil loss to

stream. Establishing buffer strips alongside and woody debris dams within the stream would alleviate the problem and enhance the wildlife corridor.

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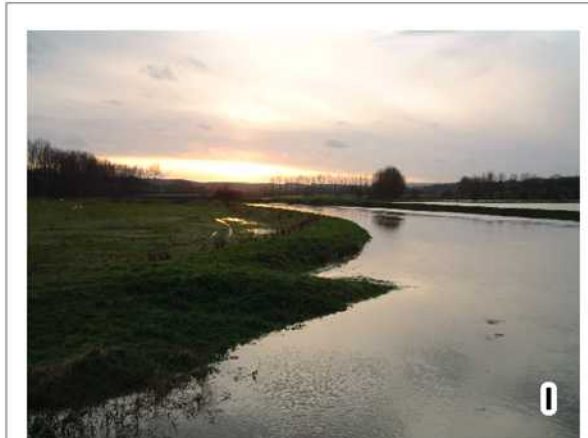
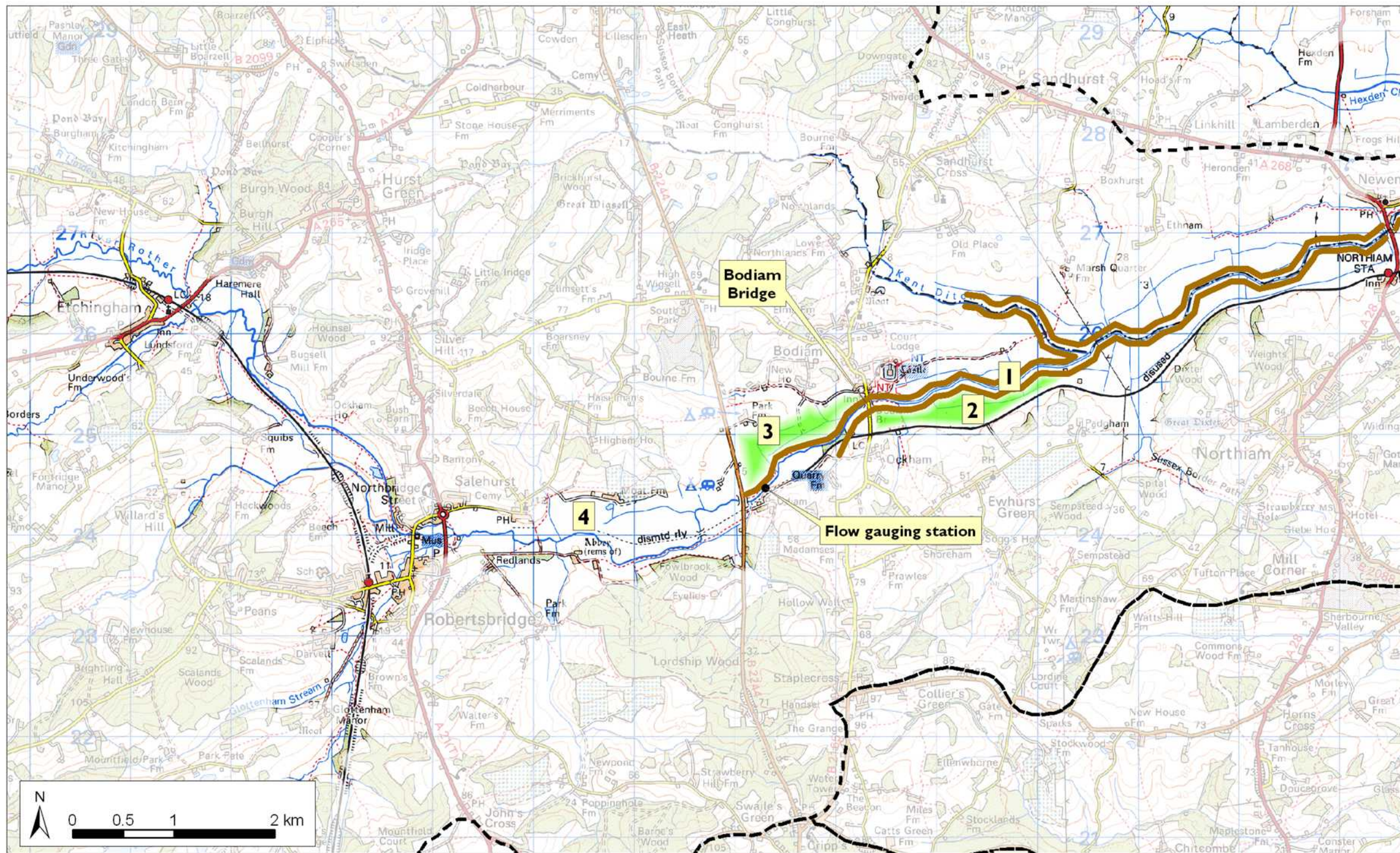


Figure 12: River Rother - Lower Reach

1: River Rother - embanked channel

The river is embanked both sides of Bodiam Bridge. This embanking represents an extension of the embanked highland carrier referred to in Figure 13. The extension protects the fluvial floodplain and feeds water into the carrier. Additional embanking may exist further upstream than indicated towards Robertsbridge. Floodwater levels are intrinsically higher if contained in embankments than if allowed to spread over floodplain land.

2: Southern embankment below Bodiam

This embankment could be removed or lowered to restore seasonal inundation of floodplain (green); increased flood storage and lower flood levels result enabling more water to be drawn through the road bridge, reducing road flooding. At least 2km of floodplain probably needed to achieve this, but more is desirable. N.B. Embankment

3: Northern embankment above Bodiam

This protects arable land on the floodplain but removal or lowering could be considered if land is restored to flood meadow grassland (green). Retain short length at each end to protect gauging station and Bodiam recreation field. Similar benefits as 2 but also potentially contributes to drawing water clear of Robertsbridge; see 4.

4: Floodplain below Robertsbridge

This reach was not inspected but view downstream from bypass during flood suggested obstructions to free flow of floodwater were prevalent; O.S. map also indicates some embanking. Floodplain restoration here could help draw water out of Robertsbridge, enhancing the effectiveness of the flood protection works. Photo 2 - Floodplain downstream of bypass road.

Photo 3 - View from bypass downstream in summer compared with Photo 4 -View from bypass in flood in winter

- Key**
- Embanked River
 - Tributary Catchment Boundary

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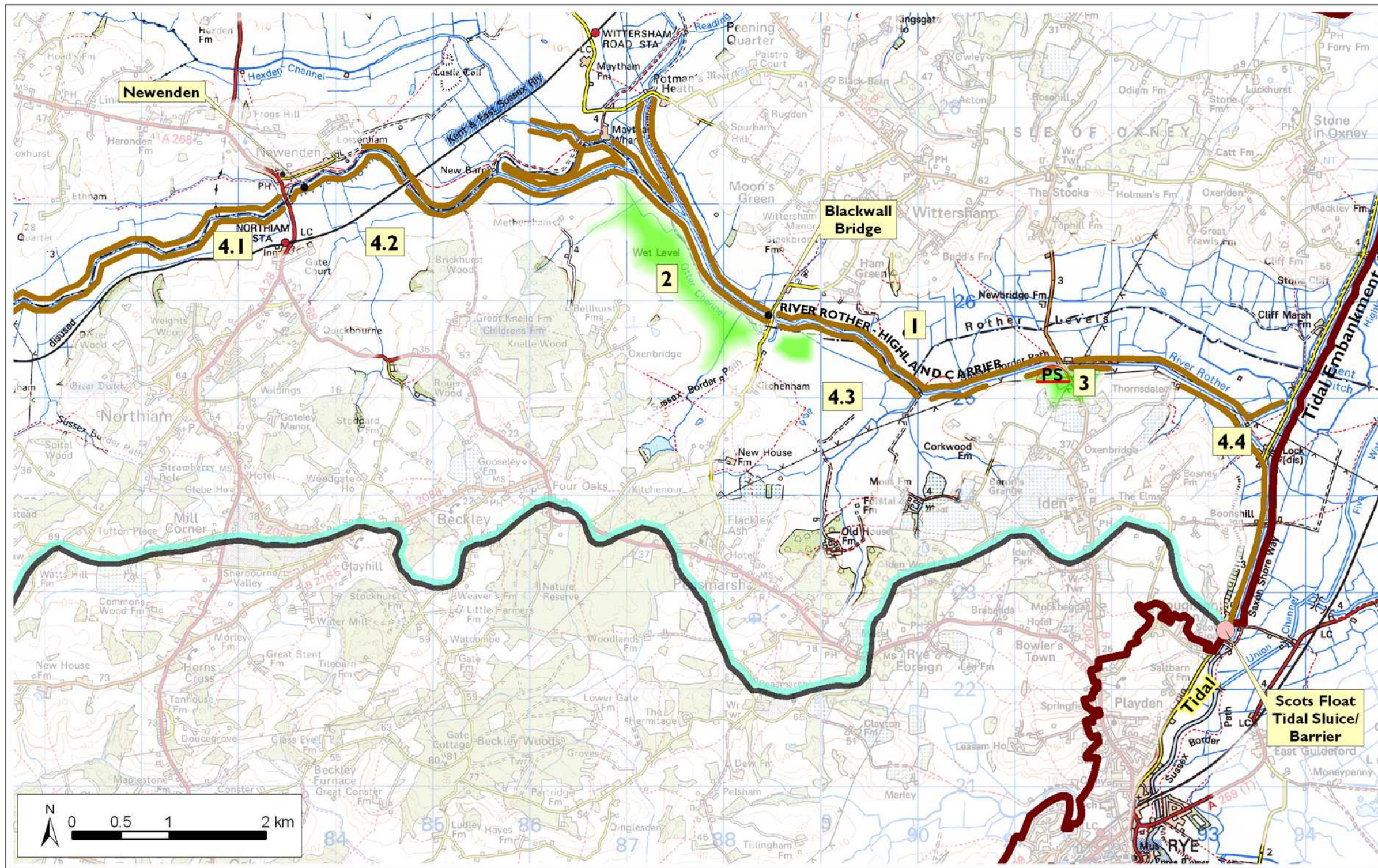


Figure 13: River Rother - The Levels

1: River Rother - highland carrier

Man-made embanked channel across the southern edge of the levels; carries highland water direct to the tidal outfall; stores water when outfall is tide-locked. Consider reducing conveyance capacity by less intensive channel maintenance and riparian planting. New overspill storage on south side needed to compensate. Notes 2-4 refer. Photo 1 - Highland carrier in flood.

Photo 2 - Summer water level in highland carrier

2: Wet Level - existing flood storage

When highland carrier is near full of stored floodwater overspill into wet level occurs (green); water evacuated by deep drains leading to pumping station. Area could support valuable wetland habitat through carefully prepared Water Level Management Plan (WLMP). Photo 3 shows

overspill, PS and high river level.

3: New Bridge - new flood overspill potential




A small isolated area of pump drained arable land that is characteristic of the intended profile of the catchment along the southern edge of the highland carrier. Potential to develop as additional flood overspill area (green) with enhanced wetland habitats but short length of adjacent roads needs to

be raised above flood level. Photo 4 - Main drain to PS and arable field.

4: Southern edge washlands - general potential

Areas denoted 4.1 - 4.4 conceivably have potential for creating much more open washland and associated wetland habitats along the relatively narrow southern edge of the highland carrier. Achieved by lowering embankments throughout to sustain WLMP's suited to grazing marsh agriculture

Key

-  High Weald AONB boundary
-  Rother Catchment Boundary
-  Embanked River (highland carrier)

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Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6



Photo 7





Photo 8



Photo 9



Photo 10



Photo 11



Photo 12



Photo 13



Photo 14