Opportunity mapping for trees and floods

Final Report to Parrett Catchment Project
Wet Woodland Group, December 2003

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1. Background

A series of severe flooding incidents in recent years has placed the issue of flood prevention and mitigation high on the public agenda. It is becoming increasingly clear that the problem can no longer be solved by building ever higher flood defences and instead the emphasis must be on restricting development in the floodplain and pursuing ‘softer’, more sustainable methods of flood control. One aspect that has been attracting increasing attention is the potential for land use and woodland in particular to mitigate damaging floods. Woodlands and woodland management practices have long been associated with affecting both the quantity and timing of stream flows, and there is a widespread belief that woodland can help to reduce and smooth flood peaks. There are four main ways that woodland could assist flood control:

a) Delayed floodplain flows: The restoration of floodplain woodland is thought to offer the greatest potential for flood mitigation, as well as a range of other environmental, economic and social benefits (Kerr & Nisbet, 1996). This is principally due to the greater hydraulic roughness presented by the trees and fallen dead wood, which helps to retain more water on the floodplain and thus to reduce flood flows downstream. To be effective, any flood embankments would need to be removed to allow the floodwaters to spread out and interact with the woodland, promoting the formation of multiple channels, backwater ponds and debris dams. Opportunities to restore floodplain woodland, however, have been hampered by a number of related concerns. These include the threat of increased flooding due to the backing-up of floodwaters upstream and the blockage of downstream bridges and culverts by woody debris. The risk of such problems arising depends on local factors such as the presence of housing and transport links, and the capacity and location of flow controlling structures. Other constraints on planting floodplain woodland include the need to conserve important open wetland habitats, maintain appropriate access to the main river channel, protect buried archaeology, maintain a navigable channel for boat traffic, and ensure that the woodland will not significantly reduce summer low flows and thus water supplies.

b) Delayed channel flows: The natural development of woody debris dams that occurs within stream channels flowing through riparian woodland, typically at intervals of 7 to 10 times the channel width (Linstead & Gurnell, 1999), can increase flood storage and help to delay flood flows. Unfortunately, such material has been routinely removed from streams in the past due to concerns that the dams could form impassible barriers to fish movement and contribute to the blockage of downstream culverts and bridges during floods. It is now increasingly recognised that most woody debris dams allow fish access provided that they do not become sealed by silt or finer material. Restricting their development to narrower channels, for example <5 m wide, can reduce the risk of them failing and causing debris problems.

c) Delayed soil runoff: While the question of whether woodland soils possess a greater ‘sponge effect’ than other land uses continues to be debated around the world, there is general agreement that this is most likely to hold in soils degraded by poor agricultural practice. Soil compaction leading to rapid surface run-off due to overstocking and repeated cultivation was implicated as a causal factor in the autumn 2000 floods. It is thought likely that woodland planting would help to tackle this problem by improving soil structure and organic matter levels. Recent research at Pontbren in upland Wales has shown water infiltration rates to be much higher under young woodland compared to open grazed pasture (Bird et al., 2003).

d) Increased water use: Trees have the ability to use significantly more water than shorter vegetation. This largely results from the greater wind turbulence created by woodland canopies, which drives the interception process. Interception losses are greatest for mature conifer woodland and can be responsible for reducing the actual amount of water reaching the ground by as much as 40% or more. The overall impact on flood flows, however, depends on the interaction of many factors, including woodland type, climate, soil, geology and scale. Research indicates that the contrasting effects of different tree species, ages and woodland practices act to lower the water use at the woodland level, reducing the scope for influencing downstream flooding (Nisbet, 2001). An additional concern is the possibility that any benefit in terms of lessening flood flows could be outweighed by the threat to dry weather flows, particularly in catchments where water demand already exceeds supply.

The River Parrett in Somerset, Southwest England, is one of a number of major river systems in the country that face a serious and recurrent flooding problem (Map 1). The Parrett Catchment Project was set up in 2000 to formulate a strategy and integrated catchment plan for improving flood management. A key objective of the strategy is to explore how new woodland can help to reduce surface run-off and alleviate downstream flooding. This study draws on current understanding of the various ways that woodland can affect the generation and propagation of flood flows to identify areas within the River Parrett catchment where woodland planting could be used to aid flood control.

Main Objective:

To provide a suitability map(s) that identifies those areas within the River Parrett Catchment where the planting of woodland could be expected to aid flood control.

2. Approach

The availability of digitised data covering all of the potential constraints and opportunities for woodland planting in the Parrett Catchment allowed the construction of a suitability map using a geographical information system. Arcview was selected as the most common GIS software held amongst user organisations and version 8.0 provided the greatest flexibility in terms of data manipulation. The study was steered by the Parrett Catchment Project Wet Woodland Group, comprising representatives from the Parrett Catchment Project Team, Forestry Commission, Environment Agency, English Nature and Somerset County Council. These members held all of the relevant data sets and provided access for the purpose of this study. The types and sources of data that were used to construct the various maps are listed in Table 1.

3. Methods

3.1 Identification of suitable areas for restoring floodplain woodland.

Since floodplain woodland was viewed as providing the greatest potential for flood mitigation, effort focused on identifying areas where its restoration was both feasible and desirable. The starting point was to define the limits of the fluvial floodplain, which was based on the Environment Agency's Indicative Floodplain Maps for 2000. These display the 1:100 year flood risk envelope for rivers in the absence of flood defences and the 1:200 year envelope for coastal areas across England and Wales. The extensive nature of the inundated area within the Parrett Catchment is displayed in Map 2.

The next step was to identify all buildings, roads and railways within the floodplain that would be potentially at risk from the backing-up of floodwaters associated with the restoration of floodplain woodland. These data sets were provided by the OS Master Map but required some manipulation to address the increased threat of inundation. Ideally, a buffer area should be delineated around individual buildings, based on the difference in micro-elevation between these and the area of potential planting on the adjacent floodplain. However, it was not practicable to do this at the scale of the whole Parrett catchment and therefore as a compromise, arbitrarily fixed buffer zones, 100 m wide, were created around these constraints. Main roads and railways were expected to be raised above the floodplain on embankments and thus a decision was taken not to delineate a linear buffer along these. A buffer could have been left along minor roads but this was not done due to the difficulty of separating the different road classes in the data base. Landfill sites and the Royal Navy Air Base at Yeovilton were also identified as limiting factors.

Table 1 Sources of GIS data used to derive the suitability maps.

Data set	**Source**	**Received from:**
River Parrett Catchment 1:100 year Fluvial Floodplain	Environment Agency	Bridgewater (Luci Crowhurst)
Prediction of Sediment Delivery to Watercourses from Land: Phase II & Soil structural conditions in the Tone and Parrett catchments.	Environment Agency	Bath (Grant McMellin), Reading (Anthony Williamson) & Bridgewater (Andy Baines)
HOST soil classification & National Soil Map	National Soil Resources Institute, Cranfield	
Rivers Buildings Roads Rail	OS Master Map	FC, Mapping & Geographical Information Unit (MGIU)
Slope categories	Digital Elevation Model	
National Parks Area of Outstanding Natural Beauty (AONB)	Countryside Agency	Defra
SSSI National Nature Reserves (NNR) Special Areas of Conservation (SAC) Special Protection Areas (SPA) Ramsar Ancient Woodland Natural Areas	English Nature	Information delivery team, Geographic Information Unit via EN web site.
County Wildlife Sites (CWS)	Somerset Environmental Records Centre	
RSPB Reserves	RSPB	
BAP Woodland Habitats	English Nature	Devon (Ben Totterdell)
Existing Woodland	National Inventory of Woodlands and Trees (NIWT)	Woodland Surveys, Forest Research
Agricultural Land Classification	Defra	
Scheduled Monuments Record Registered Battlefields Historic Parks and Gardens	English Heritage	Data Team
Landfill Sites	Environment Agency	Bridgewater (Francis Farr-Cox)
RNAS Yeovilton	Digitised from OS 1:10 000 Raster	FC MGIU
Foss Way	Digitised from Roman Britain historical map, OS	

The same approach that was applied to buildings was adopted for all archaeological sites, since only point data were available showing the centre of each registered monument or artefact listed under the Scheduled Monuments Record. A buffer are of 100 m was thought to be sufficient to protect individual sites from any disturbance or soil drying associated with woodland establishment. It was not practicable to include non-scheduled sites but the presence of these would need to be considered when assessing selected areas. Other related constraints that were included comprised battlefields, historic parks and gardens, and the route of the Foss Way, which cut across the catchment. The latter was digitised from the Roman Britain Historic map (Ordnance Survey, 1994) and a 1 km buffer created along its entire length to ensure that any associated archaeological remains would be protected.

The final set of constraints concerned designated conservation sites, most of which formed nationally important open wetland or woodland habitats. Relevant data sets included those covering Ramsar, SAC, SPA, NNR, SSSI, RSPB and County Wildlife Sites. The area of existing woodland was also highly relevant in showing where there were opportunities to extend established stands and create a woodland habitat network along the floodplain. The National Inventory of Woods and Trees, Ancient Woodlands and the Biodiversity Action Plan Woodland Habitats formed the main sources of woodland data.

Map 3 shows the distribution of all of the above constraints within the fluvial floodplain.

3.2 Identification of suitable areas for riparian woodland

A map of the river system was created from the OS Master Map inland water theme, which was edited to remove all the bodies of standing water and drainage ditches. The resultant map did not form a continuous network but a fragmented series of polygons along the river system (Map 4). Some of the rivers appear to disappear as they enter the floodplain due to their flow being diverted into the drainage system of rhynes and ditches. The potential area for riparian woodland was identified as a 30 m wide zone on either side of the whole length of the river system that lay outside of the fluvial floodplain. Areas within the floodplain were excluded on the basis of the likelihood that the river channel was too wide to create stable debris dams and therefore riparian woodland would be less able to slow down flood flows. Other constraints, including designated conservation sites, scheduled archaeological sites, existing woodland and urban areas were then added, leaving the remaining stretches of river as being potentially suitable for new riparian woodland.

3.3 Identification of areas within the wider catchment where woodland could best aid flood control

In view of the fact that all woodland, but particular conifers may help to reduce flood flows due to higher evaporation rates, planting anywhere in the catchment could be potentially beneficial. Consequently, the starting point was to identify all land where there were no constraints to woodland planting. The main constraints included designated conservation sites, scheduled archaeological sites, existing woodland, landfill sites, roads and urban areas (Maps 5 & 6). This involved using the same data sets as those applied in 3.1. Data sets were also obtained for the Exmoor National Park, AONB's and Natural Areas, although these are not considered to preclude woodland planting and therefore were not included as formal constraints. The location of these designations is shown in Map 1.

The acknowledged role of woodland as a soil improver, able to increase soil infiltration rates and reduce direct surface run-off, was thought to be a more important factor for aiding flood control than the potentially greater water use of woodlands. An attempt was therefore made to identify those soils in the catchment that were most vulnerable to damage under agriculture and thus would benefit greatest from woodland planting. Large parts of the catchment were known to be vulnerable to erosion and several soil data sets were available from previous studies.

Four data sets were considered to be particularly useful in highlighting problem soils. The first was the Hydrology Of Soil Types (HOST), a national soil classification exercise undertaken by the Institute of Hydrology, Soil Survey and Land Research Centre and Macaulay Land Use Research Institute (Boorman et al., 1995). This was based on the National Soil Map at a scale of 1:250,000, which combines soil series into distinctive map units. The HOST classification deals primarily with the storage and transmission of water in the soil, based on conceptual models of the hydrological processes taking place within the soil and, where appropriate, the substrate. These models have three physical settings:

- a soil on a permeable substrate in which there is a deep aquifer or groundwater (i.e. at >2 m depth)
- a soil on permeable substrate in which there is normally a shallow water table (i.e. at <2 m depth)
- a soil (or soil and substrate) which contains an impermeable or semi-permeable layer < 1 m from the surface.

Each is sub-divided according to the variation in key soil properties, wetness regimes, the geology of the substrate and perceived rate of flow, giving a total of 11 models and 29 HOST classes. Further development work allowed Standard Percent Runoff (SPR) values to be estimated for each HOST class, describing the percentage of rainfall that contributes to quick response runoff. Those HOST classes with a SPR >25% were selected as representing seasonally waterlogged soils that were likely to make a marked contribution to flood flows and thus would benefit most from the improvements in soil structure and soil drying that can be expected under woodland (Table 2).

Table 2 The Standard Percentage Runoff (SPR) value and poach class for each of the HOST classes within the Parrett Catchment.

HOST Class	SPR %	Poach Class	Physical Description
0			Unclassified (Urban)
1	2.0	1	Free draining over chalk
2	2.0	1	Free draining over limestone
3	14.5	1	Free draining over sandstone, sands or gravels
4	2.0	1	
5	14.5	1	
6	33.8	2	Unconsolidated, free draining over loamy drift, by-pass flow common
8	44.3	2	Unconsolidated, impermeable layer within 100 cm, by-pass flow common
9	25.3	2	Unconsolidated, gleying < 40cm from surface, by-pass flow common
10	25.3	3	
11	2.0	2	Drained peat
16	29.2	2	Slowly permeable, no gleying within 100 cm
17	29.2	2	Impermeable – hard, no gleying within 100 cm
18	47.2	2	Slowly permeable, gleying within 40-100 cm
20	60	2	Impermeable – soft, gleying within 40-100 cm
21	47.2	3	Slowly permeable, gleying within 40-100 cm
23	60	3	Impermeable – soft, gleying within 40-100 cm
24	39.7	4	Slowly permeable, gleying < 40cm from surface
25	49.6	4	Impermeable – soft, gleying < 40cm from surface

The HOST classification has also been used by others to estimate the vulnerability of lowland grassland soils to poaching by livestock (Harrod, 1998). Poaching leads to surface compaction and waterlogging, increasing the risk of rapid surface run-off. This scheme was therefore applied to the soils in the wider Parrett catchment and those classed as high or very high (no soils in the extreme class) selected as being the most vulnerable to damage (Tables 2 & 3).

Table 3 Vulnerability of lowland grassland soils to poaching as predicted by HOST class.

HOST poach class	HOST classes	Vulnerability
1	1 – 5	Slight
2	6 – 8, 11, 16 – 20, 22	Moderate
3	10, 14, 21, 23	High
4	9, 13, 24, 25	Very high
5	12, 15, 26 - 29	Extreme

The second data set was the recent mapping of annual erosion vulnerability and sediment delivery to watercourses by McHugh et al. (2002). They used data from erosion monitoring studies on upland, lowland grassland and arable soils to calculate the probability of erosion of a given magnitude occurring for different soil-slope combinations. These values were then combined with an index of the degree of connectivity of eroding soils to local watercourses, to derive maps illustrating the risk of annual erosion vulnerability and sediment transfer to watercourses across England and Wales, for different return periods. Since the main interest was in soil vulnerability rather than the risk of eroded sediment moving to streams (which is influenced by factors such as particle size and surface roughness), the erosion vulnerability rather than sediment delivery map was selected as being most appropriate. The data for 1-in-10 year erosion events were available as a 1 km^2 raster image split into 9 classes with values ranging from 0 to 5.0 m^3 ha^{-1} yr^{-1}. The top two classes were chosen to define the area at greatest risk of erosion, encompassing soils with an annual potential erosion vulnerability of >0.5 m^3 ha^{-1} yr^{-1}. The Parrett catchment has some of the most vulnerable soils in the country with 5.5% of the catchment (93 km^2) falling within this upper erosion band. New feature polygons were created for these areas.

A third data set comprised the assessment of soil structural conditions in the Tone and Parrett catchments during February and March 2003 by Palmer (2003). He surveyed changes in soil structural conditions in 200+ field sites between 2002 and 2003, and used this information to classify soils according to four levels of structural degradation (severe, high, moderate and low). Occurrences of severe degradation involving capped top soils and extensive rill erosion were limited to two soil landscape classes derived from the 1:250,000 scale National Soil Map: soft siltstone and fine-grained sandstone plus terraces; and loamy soils over mudstone. Soils within both of these landscape classes were therefore selected as representing those at greatest risk of structural degradation by agriculture.

The final data set was slope class obtained from a Digital Elevation Model. Three classes were selected as representing conditions that were conducive to soil damage or erosion by different agricultural practices. These were 3-7 degrees, 7-12 degrees and >12 degrees. The 3 degree boundary is considered to be the critical angle at which rill erosion begins, 7 degrees the upper limit for land suitable for arable farming, and 12 degrees the upper limit for agricultural ploughing (McHugh et al., 2002).

The SPR and poaching data are overlain in Map 7, while the data on erosion vulnerability, structural degradation and slope are displayed in Map 8.

4. Results

4.1 Identification of suitable areas for restoring floodplain woodland.

Map 3 was used as the basis for searching for suitable sites for the restoration of floodplain woodland as an aid to flood control. To be effective at retaining flood flows, new woodland would have to be located above a flood risk site, be of a reasonable size, span a significant part of the width of the floodplain, and be free of other constraints. These conditions and in particular the widespread nature of conservation constraints such as SSSI's and County Wildlife Sites, severely restrict the opportunities for establishing sizeable patches of floodplain woodland within the Parrett catchment. Table 4 shows that some 30% of the fluvial floodplain is designated on conservation grounds, 12% is occupied by buildings and less than 2% is covered by existing woodland. Another issue is the probable complexity of land ownership in the wider sections of floodplain (>1 km wide), making it unlikely that everyone would sign up to a large restoration scheme. This leaves the narrower floodplain in the middle and upper reaches as providing the greatest opportunity for floodplain woodland.

Overall, it was possible to identify 27 major (>50 ha) sites that matched all of the criteria, with the occasional exception of some tracks and one or two minor roads (Map 9). This amounted to an area of 2968 ha or 13% of the fluvial floodplain for possible restoration of floodplain woodland. In addition, a further 67 medium (10 – 50 ha) and many small sites (<10 ha) hold some potential for planting in the upper reaches of the catchment, representing another 1912 ha or 8% of the floodplain. A large proportion of these is separated by buildings or roads, particularly along the River Tone and its northerly tributaries, but also the River Isle and River Yeo. While the restoration of an individual site would have a minimal impact, collectively they could exert a significant effect on flood flows and thus on downstream flooding. The planting of floodplain woodland at the confluence of two main tributaries could be particularly effective at retaining flows.

Table 4 Area of Fluvial Floodplain and proportion affected by different constraints to the creation of new floodplain woodland.

	Area (ha)	**% Fluvial Floodplain**
Fluvial Floodplain	22, 893	
SSSI *SSSI(Wood)*	4, 278 *0*	18.69 *0*
CWS *CWS(Wood)*	2, 705 *256*	11.80 *1.12*
NIWT Woodland	138	0.60
Wet Woodland	22	0.10
Other BAP Woodland	30	0.13
SAM + 100m Buffer	129	0.56
Site of Battle of Sedgemoor	210	0.92
Foss way + 1km Buffer	898	3.92
Historic Parks and Gardens	116	0.51
RNAS Yeovilton	33	0.15
Buildings + 100m buffer	2, 769	12.10
Urban Areas	261	1.14
Roads & Railways	536	2.34
Landfill Sites	24	0.10
Open Water	1,108	4.84

4.2 Identification of suitable areas for riparian woodland

Map 4 shows that there is significant potential for the establishment of new riparian woodland along most of the minor tributaries. Of a total area of 2560 ha of riparian zone (defined as the land lying within 30 m of either bank of streams draining to the fluvial floodplain), some 2216 ha (87%) were identified as being suitable for planting. Only 186 ha (7%) were occupied by existing woodland, although this excludes stretches of stream fringed by bankside trees. Much planting would therefore be required to create a riparian woodland habitat network throughout the river system. There appear to be few other potential constraints to woodland planting in the riparian zone, with a small number of SAM's, a minor area of 20 ha designated on conservation grounds and 102 ha occupied by towns and villages.

4.3 Identification of areas within the wider catchment where woodland could best aid flood control

Table 5 provides a breakdown of the existing woodland in the Parrett catchment, the distribution of which is displayed in Map 5. Only 9714 ha (9481 ha under NIWT, plus an estimated 38 ha Ancient Woodland and 195 ha of BAP Woodland not included under NIWT) or 5.8% of the catchment is under woodland, two thirds of which is broadleaved. Much of this is located in the upper reaches, especially within the Quantock Hills, Blackdown Hills and the Dorset AONB. The current ability of woodland to influence the volume of run-off through its effect on water use is therefore very small.

Map 6 shows the widespread nature of the constraints to further woodland planting in the Parrett catchment. A total of 40.8% is excluded, much of which involves urban areas and designated conservation sites in the floodplain, roads, existing woodland and the Foss Way. This leaves a considerable proportion of the catchment potentially available for planting. New conifer woodland would maximise any water use effect on flood flows, especially if it was managed under a continuous cover regime. However, there may be landscaping constraints to conifer planting in the AONB's and possibly within some of the Natural Areas (Map 1). It is expected that a large area of conifer woodland would need to be planted to have a detectable effect on flood peaks, amounting to at least 20% woodland cover within the main Parrett or tributary catchments. Broadleaved woodland is unlikely to exert a significant water use effect on flood flows, especially during the dormant season.

Table 5 Quality and character of existing woodland in the Parrett Catchment.

	ha	% Catchment	% Σ NIWT
Catchment	167 601		
All NIWT Interpreted Woodland types	*9 481*	*5.66*	
Broadleaf	5 600	3.34	59.07
Conifer	3 078	1.84	32.46
Felled	251	0.15	2.64
Mixed	124	0.07	1.31
Shrub	92	0.05	.97
Young Trees	336	0.20	3.55
All Woodland Biodiversity Action Plan priority habitats	*3 205*	*1.91*	*33.80*
Lowland Beech and Yew woodland	129	0.08	1.36
Lowland Mixed Deciduous woodland	2 730	1.63	28.80
Upland Birchwoods	0.3	0.00	0.00
Upland Mixed Ashwoods	261	0.16	2.75
Upland Oakwoods	84	0.05	0.89
Wet woodland	262	0.16	2.76
SSSI (wood)	1 634	0.98	17.24
Woodland Trust owned	88	0.05	0.93
CWS (wood)	4 411	2.63	46.52
Ancient Woodland Inventory	3 681	2.20	38.82
Potential New Riparian Woodland	2 216	1.32	
Potential New Floodplain Woodland	4 880	2.91	

The main benefit of woodland for tackling flood flows in the wider catchment is likely to be through greater soil protection helping to delay soil run-off. Most of the catchment is classified as having imperfectly or poorly drained soils that are liable to generate rapid surface run-off and suffer from poaching (Map 7). Much of the remaining area comprises soils at risk of severe structural degradation or with a high vulnerability to erosion (Map 8). These indices cross all slope classes, although the steeper upland areas in the Quantock hills and Exmoor tend to be more resistant to soil degradation. Of the 87,153 ha (52% of catchment) of land lying outside of the fluvial and coastal floodplain that was identified as being suitable for woodland planting, some 84,486 ha (50% of catchment) involves soils with a SPR of >25%, 55,574 ha (33% of catchment) soils with a SPR>25% and a high or very high vulnerability to poaching, 58,041 ha (35% of catchment) soils at risk of severe structural degradation, and 8,953 ha (6% of catchment) soils with a high vulnerability to erosion. There is therefore considerable scope for woodland planting to aid soil protection and help to reduce the generation of rapid surface run-off, with benefits for flood control and water quality.

5. Conclusions

Data sets were obtained from partners covering a wide range of potential constraints to new woodland planting within both the floodplain and wider catchment of the River Parrett in SW England. These were integrated along with data on soil sensitivity using GIS to identify suitable sites where woodland could aid flood control. The restoration of floodplain woodland is considered to offer the greatest potential for delaying flood flows, although opportunities are very limited in the main floodplain of the lower part of the catchment. There is greater scope in the middle and upper reaches, with a total of 27 large (>50 ha), 67 medium (10-50 ha) and many small sites (<10 ha) being identified, equating to 4880 ha or 21% of the entire fluvial floodplain. Further work is now required to select a sample of these for more detailed consideration. The establishment of one or more large demonstration sites would help to promote the concept of floodplain woodland and allow the benefits and threats to be quantified.

Most of the riparian zone is non-wooded presenting considerable scope for future planting. Some 2216 ha or 87% were identified as being suitable for establishing riparian woodland, with potential benefits for flood control providing that woody debris dams are allowed to form. This would be in addition to a wide range of other benefits to the freshwater environment, including the retention of diffuse pollutants draining from the adjacent land and the provision of increased shade and shelter.

Significant opportunities also exist in the wider catchment for new woodland to contribute to flood control. Of the area identified as being suitable for planting, around 55,574 ha or 33% of the catchment are classified as having imperfectly or poorly drained soils that are liable to generate rapid surface run-off and suffer from poaching. Some 58,041 ha or 35% of the catchment comprises soils at risk of severe structural degradation, while 8,953 ha or 6% of the catchment has soils with a high vulnerability to soil erosion. Woodland planting could be expected to largely remove the risk of soil compaction and poaching, and by improving soil structure and soil infiltration rates, help to reduce and retard soil run-off and thus flood flows.

6. Recommendations

a) Map 9 is used to select two or three sites for the possible restoration of floodplain woodland. These sites should be subjected to more detailed assessments including the use of hydraulic models and LIDAR data to estimate the effect of woodland planting on flood flows and the extent of the backing–up of flood waters. The site with the greatest potential for flood retardation and least risk to local properties should then be advanced for possible planting and funding sought. The establishment of such a site could be used as a demonstration to help promote the concept of floodplain woodland, as well as a focus for research work to enable the benefits and threats to be better quantified.

b) Local guidelines are produced to aid the selection of sites for the planting of floodplain woodland.

c) Maps 4 and 8 are used to promote the planting of riparian woodland as an aid to flood control and as a means of tackling diffuse pollution, including the trapping of sediment in run-off from the most erosion prone soils.

d) Maps 7 and 8 are used to target soils in the wider catchment that would most benefit from woodland planting in terms of reducing direct surface run-off and soil degradation via compaction, poaching or erosion.

7. Acknowledgements

This work was funded by the Parrett Catchment Project, the Environment Agency and Forestry Commission.

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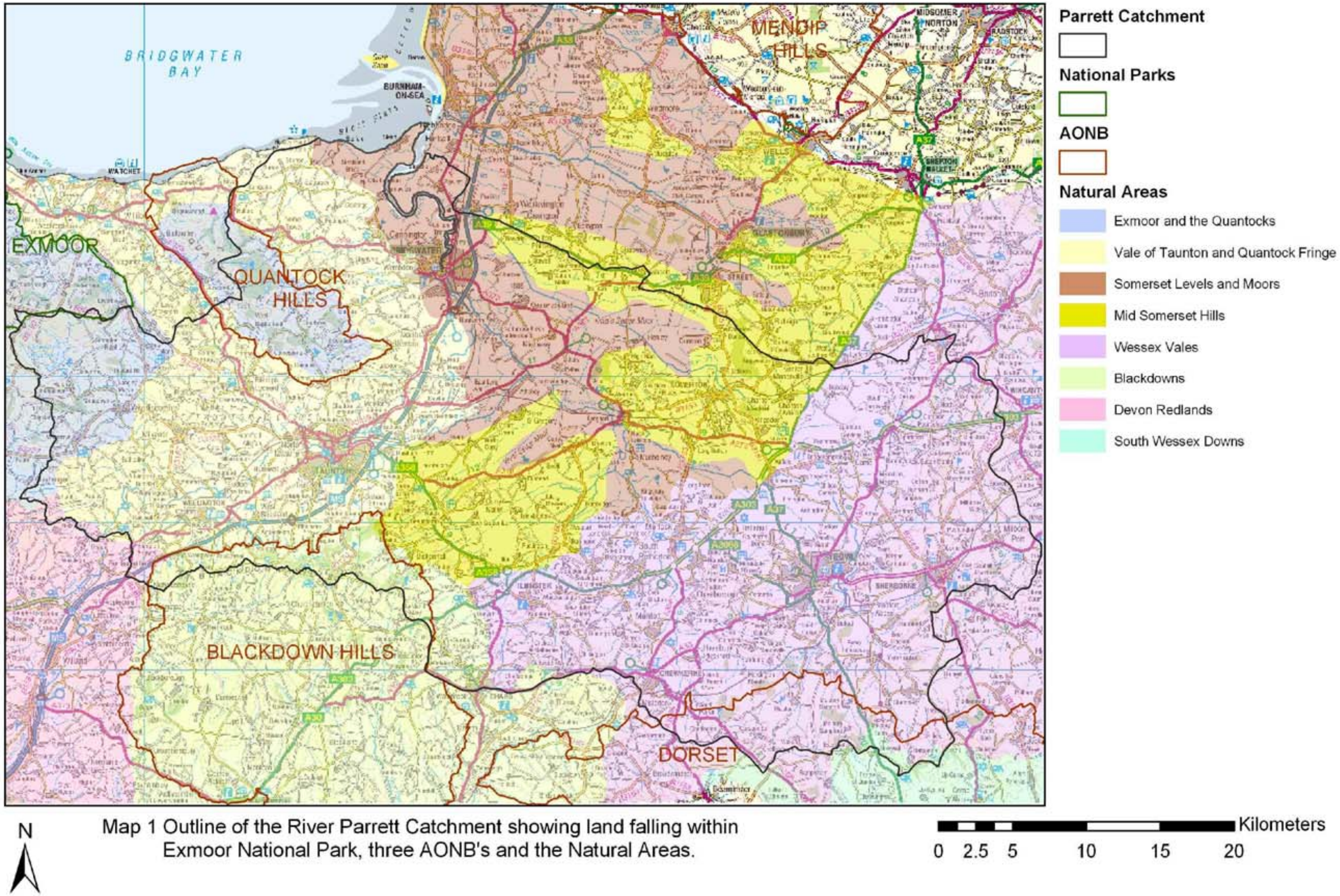
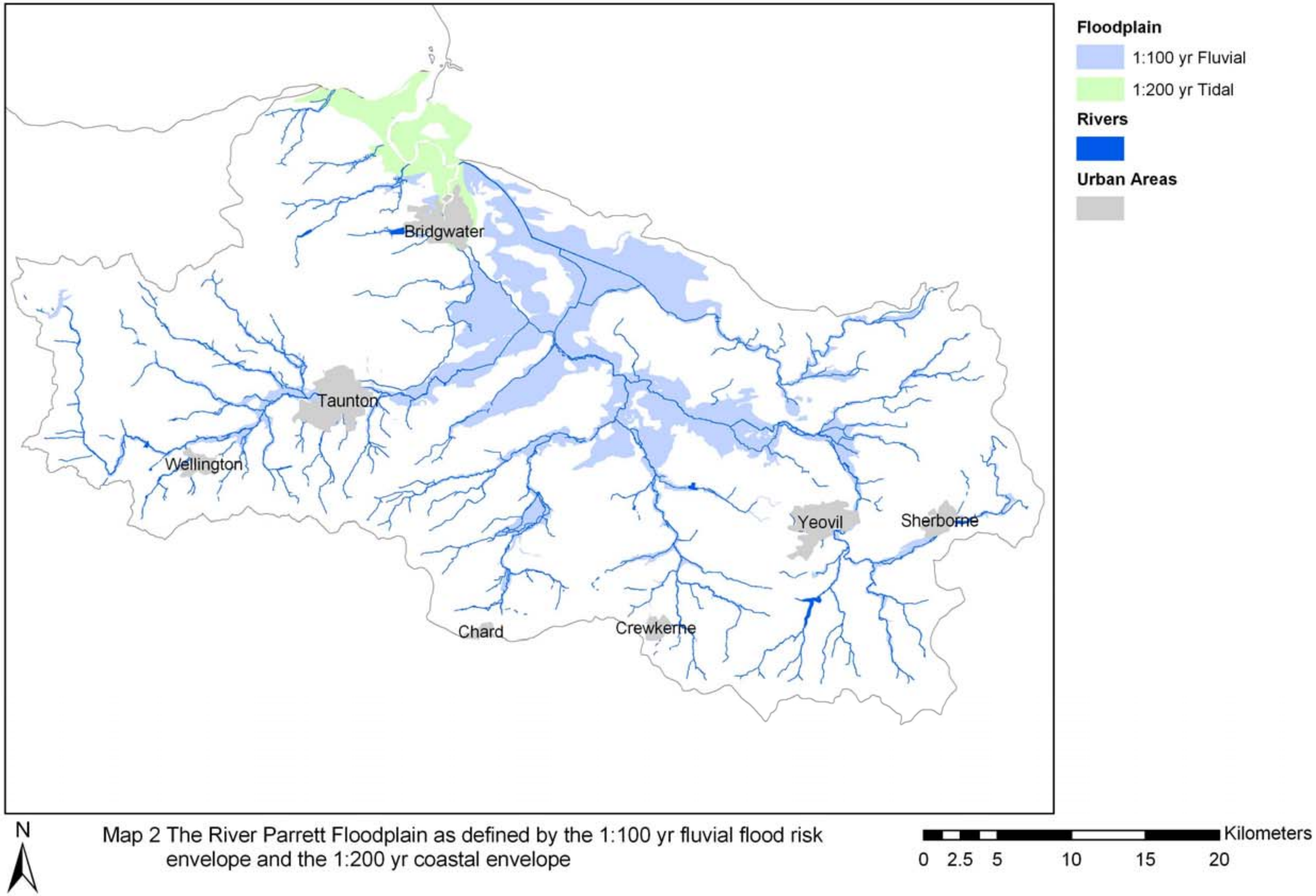
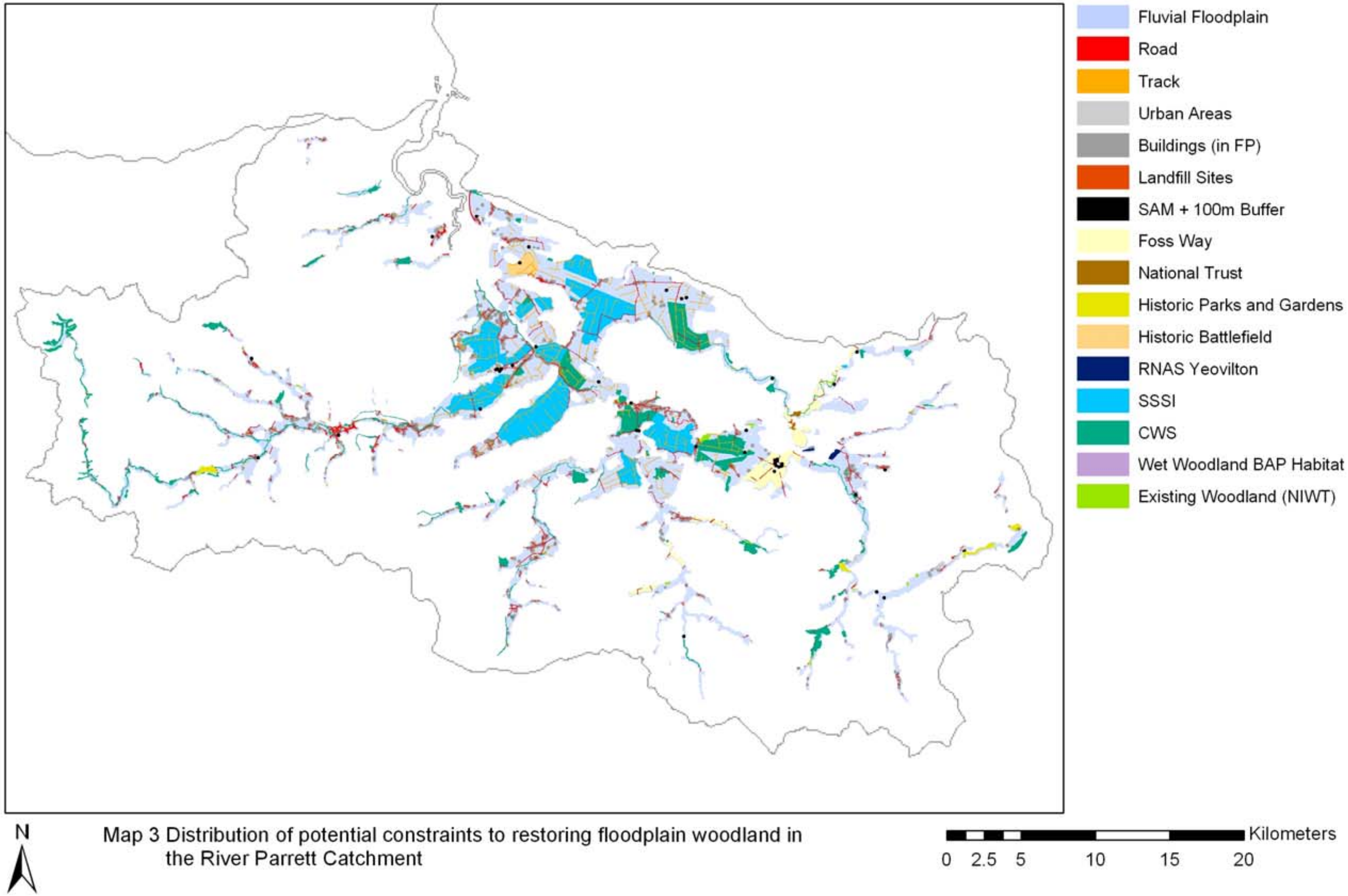


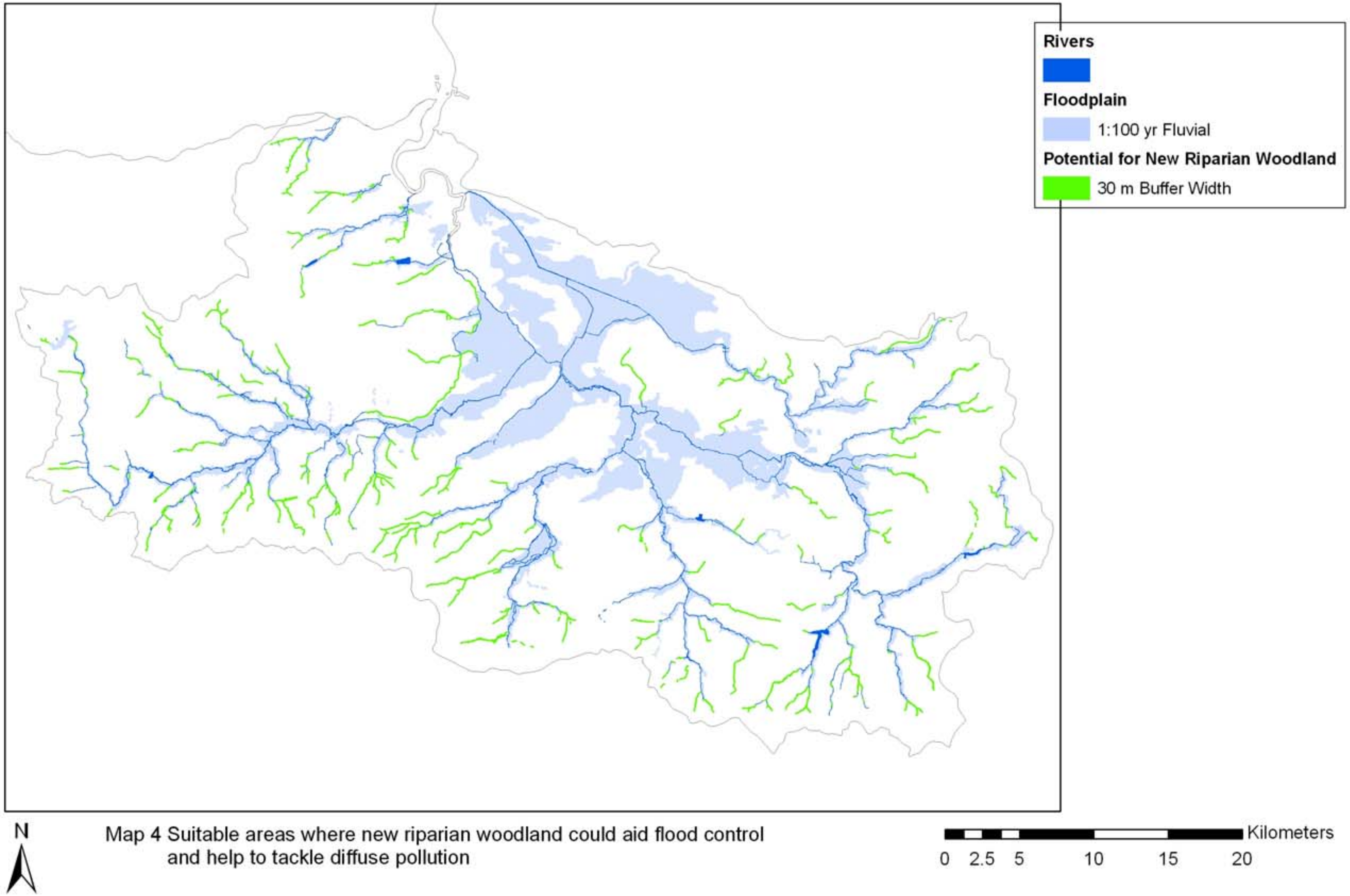
Map 1 Outline of the River Parrett Catchment showing land falling within Exmoor National Park, three AONB's and the Natural Areas.



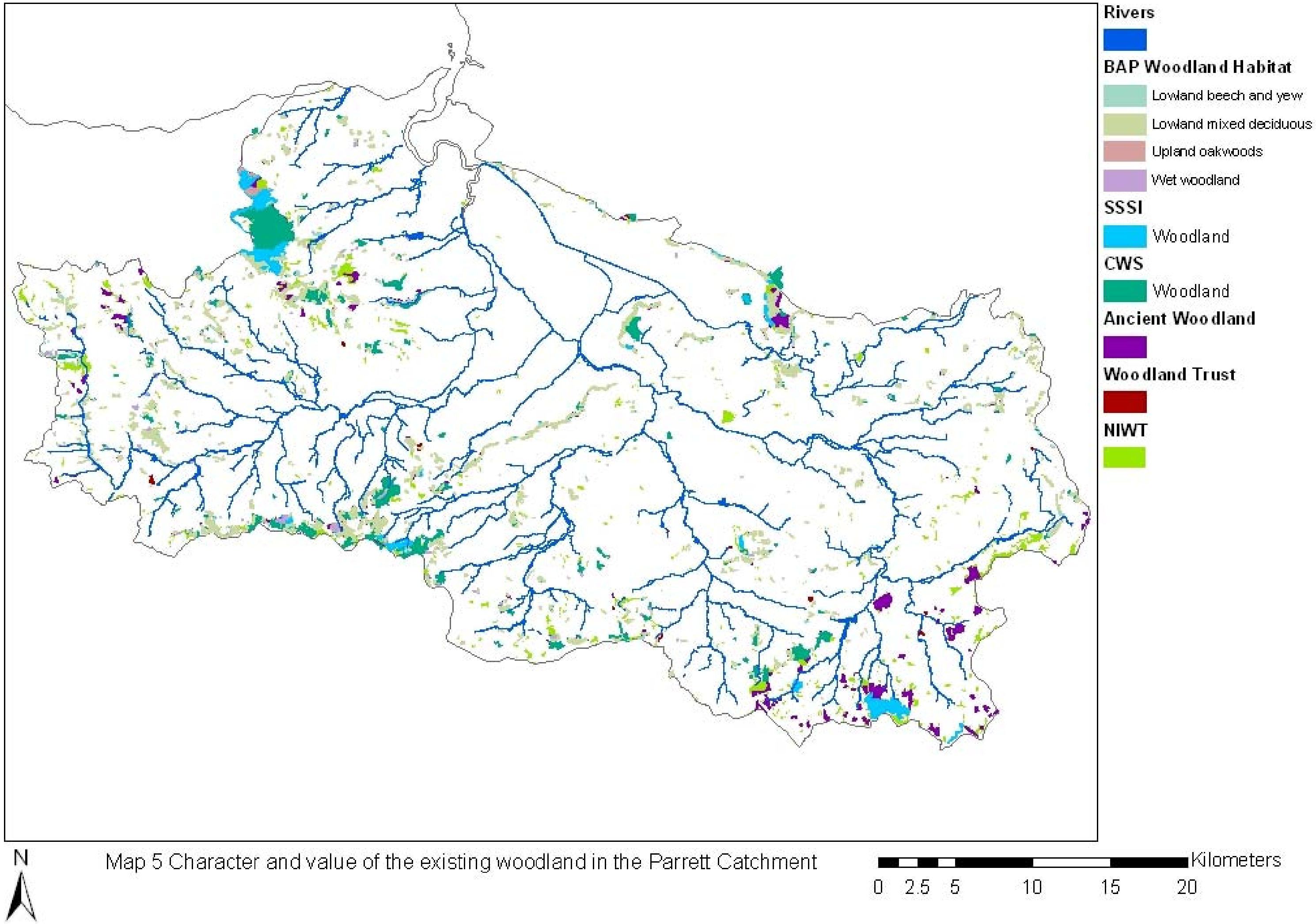
Map 2 The River Parrett Floodplain as defined by the 1:100 yr fluvial flood risk envelope and the 1:200 yr coastal envelope



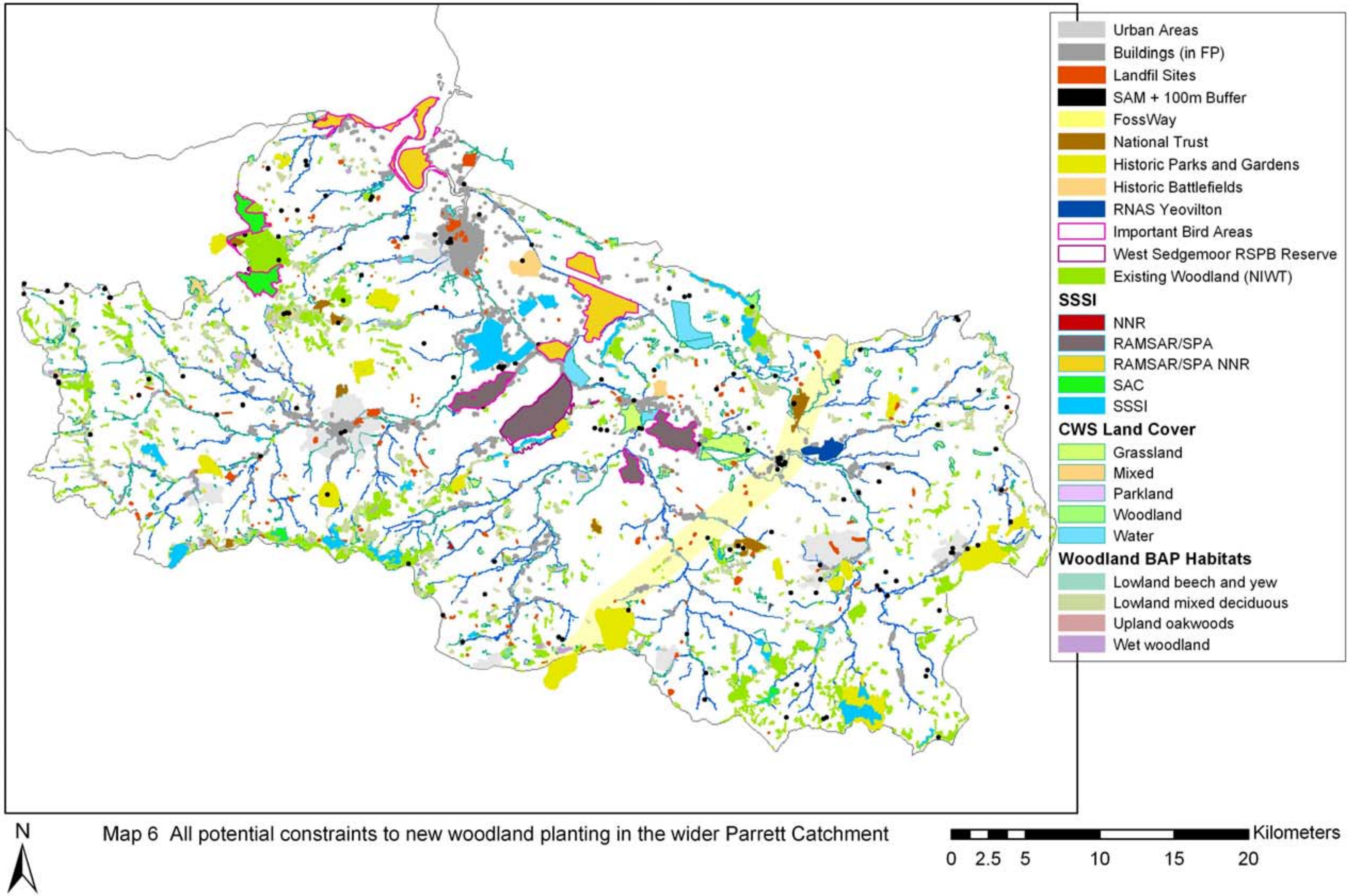
Map 3 Distribution of potential constraints to restoring floodplain woodland in the River Parrett Catchment



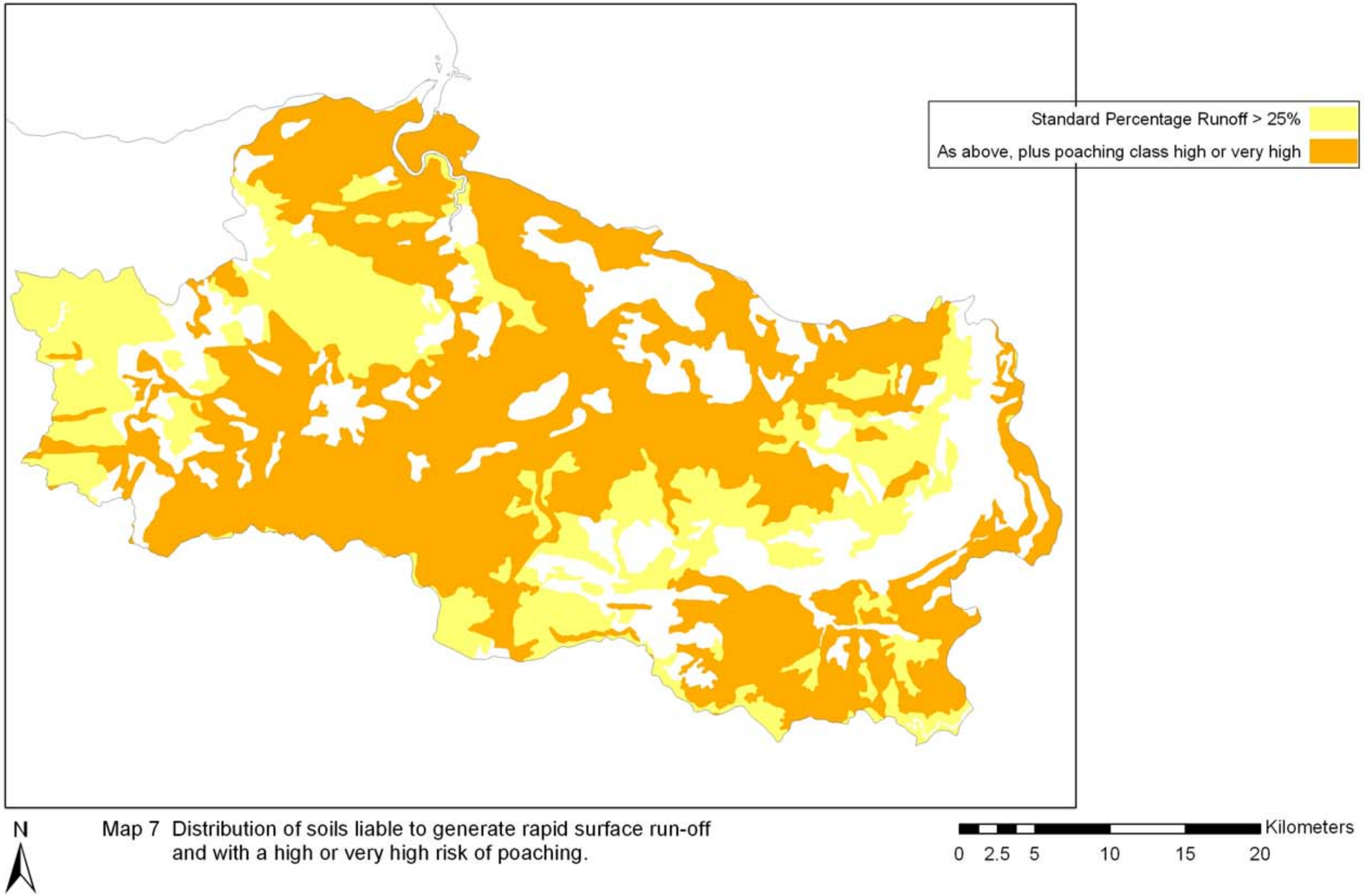
Map 4 Suitable areas where new riparian woodland could aid flood control and help to tackle diffuse pollution



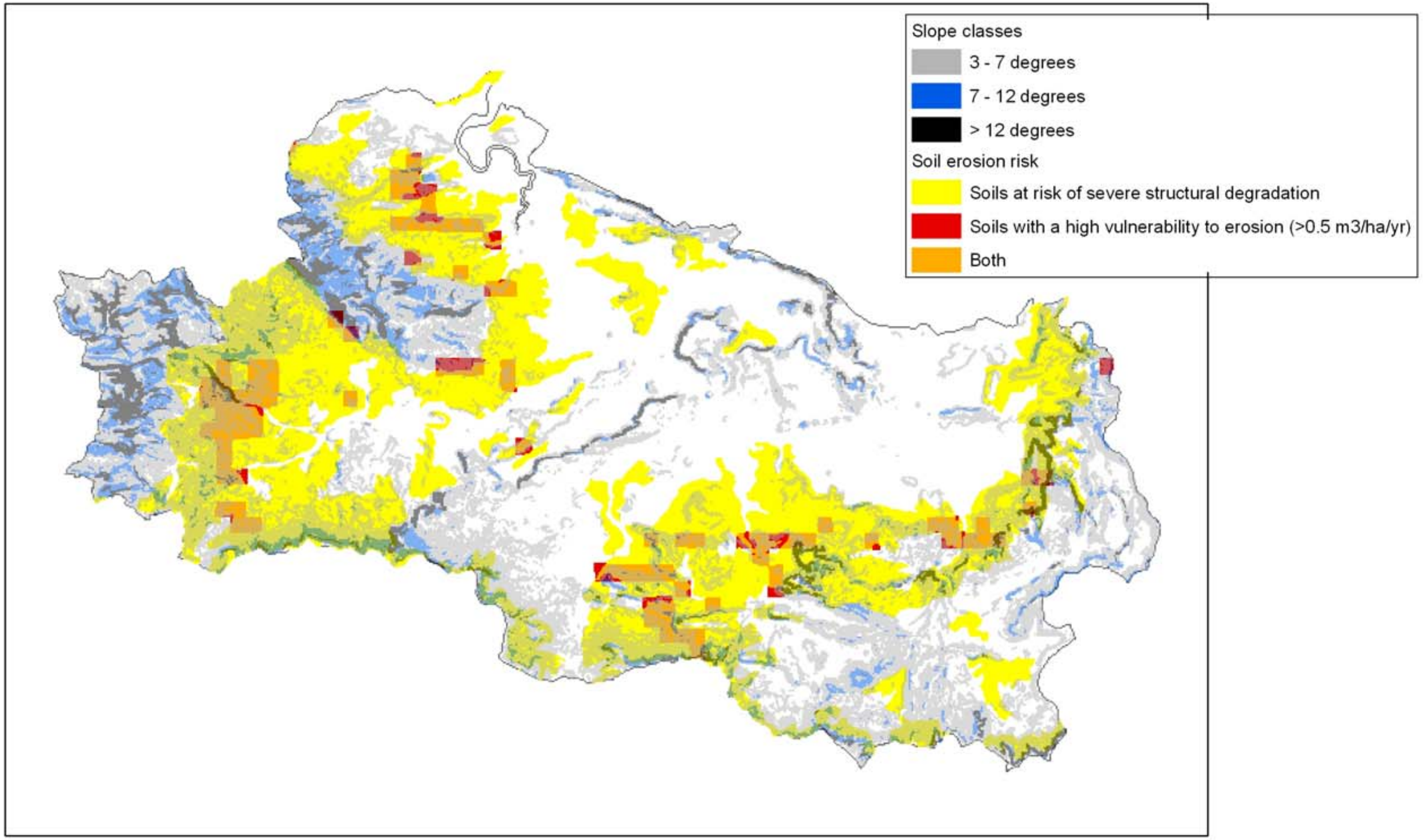
Map 5 Character and value of the existing woodland in the Parrett Catchment



Map 6 All potential constraints to new woodland planting in the wider Parrett Catchment



Map 7 Distribution of soils liable to generate rapid surface run-off and with a high or very high risk of poaching.



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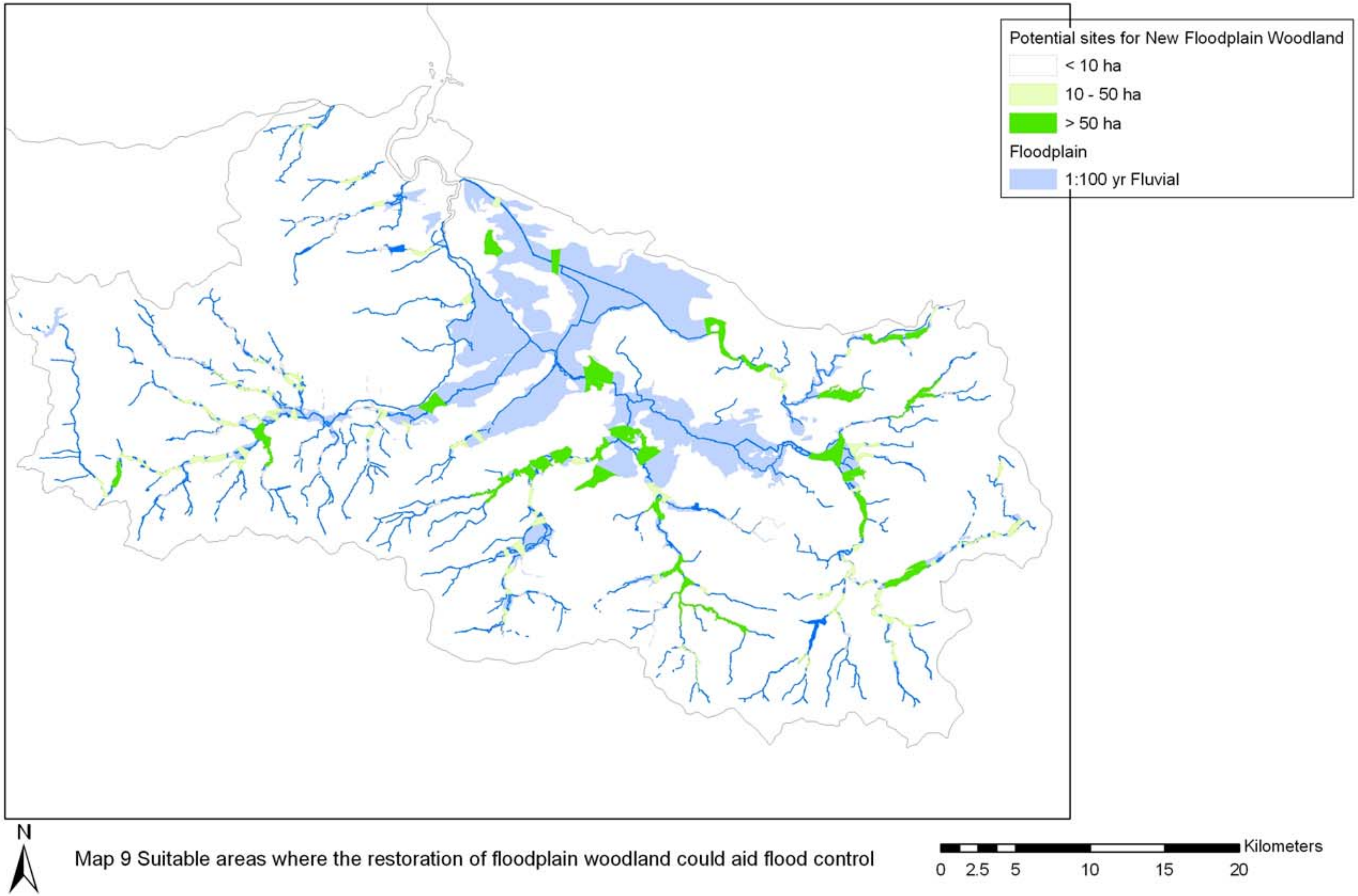
Map 8 Distribution of slope classes and soils at risk of severe structural degradation or with a high vulnerability to erosion

Kilometers
0 2.5 5 10 15 20



Map 9 Suitable areas where the restoration of floodplain woodland could aid flood control