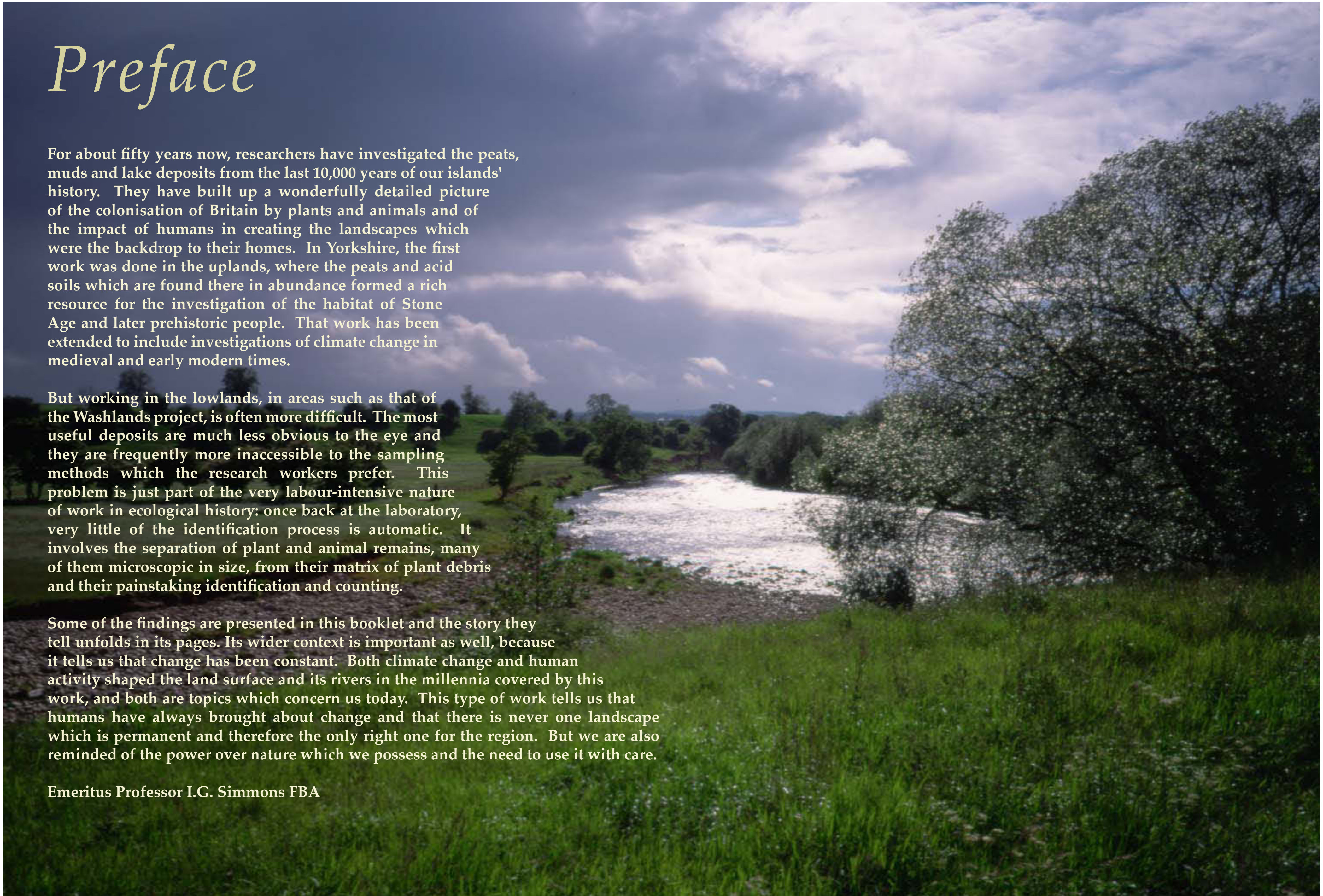
The Swale - Ure Washlands

Landscape History and Human Impacts



Preface

For about fifty years now, researchers have investigated the peats, muds and lake deposits from the last 10,000 years of our islands' history. They have built up a wonderfully detailed picture of the colonisation of Britain by plants and animals and of the impact of humans in creating the landscapes which were the backdrop to their homes. In Yorkshire, the first work was done in the uplands, where the peats and acid soils which are found there in abundance formed a rich resource for the investigation of the habitat of Stone Age and later prehistoric people. That work has been extended to include investigations of climate change in medieval and early modern times.

But working in the lowlands, in areas such as that of the Washlands project, is often more difficult. The most useful deposits are much less obvious to the eye and they are frequently more inaccessible to the sampling methods which the research workers prefer. This problem is just part of the very labour-intensive nature of work in ecological history: once back at the laboratory, very little of the identification process is automatic. It involves the separation of plant and animal remains, many of them microscopic in size, from their matrix of plant debris and their painstaking identification and counting.

Some of the findings are presented in this booklet and the story they tell unfolds in its pages. Its wider context is important as well, because it tells us that change has been constant. Both climate change and human activity shaped the land surface and its rivers in the millennia covered by this work, and both are topics which concern us today. This type of work tells us that humans have always brought about change and that there is never one landscape which is permanent and therefore the only right one for the region. But we are also reminded of the power over nature which we possess and the need to use it with care.

Emeritus Professor I.G. Simmons FBA

Introduction

The 'Swale-Ure Washlands' is the name given to a low-lying area between the eastern fringe of the Pennines and the North York Moors, drained by the rivers Swale and Ure. Large amounts of sands and gravels were deposited in the washlands when the ice melted at the end of the last Ice Age (about 15,000 years ago). Today, these washland sediments form a rich agricultural resource, support a wide range of wetland and terrestrial habitats and are extensively quarried by the aggregate industry.

Traces of human activity can be found all the way back to the last Ice Age, preserved as artefacts buried in the river sediments and in prehistoric constructions such as the henges at Thornborough, the Devil's Arrows at Boroughbridge and the Roman road of Dere Street (the current A1).

Because of the character and history of the area, a major research project was funded by English Heritage as part of the Aggregate Levy Sustainability Fund. The work has been completed by a research team in the Geography Department at the University of Durham, working closely with the Lower Ure Conservation Trust and North Yorkshire County Council, as well as researchers from the Institute of Geography and Earth Sciences, University of Wales, Aberystwyth, and independent specialists.

The project studied the river and landscape evolution of the area and the impact of human activity since the last Ice Age, and this booklet outlines our main findings. It opens with an introduction to the landscape context of the washlands, and then explains the main techniques we have used to reconstruct environmental change. Examples of our work are presented in a chronological sequence, starting with the evidence from the end of the Ice Age and finishing at the end of the Medieval Period.

We hope this booklet provides an interesting introduction to the rich past of the Swale-Ure Washlands. We have produced it as part of our commitment to raising local awareness of the value of this landscape for understanding the changing relationship between people and the environment in this area since the last Ice Age.

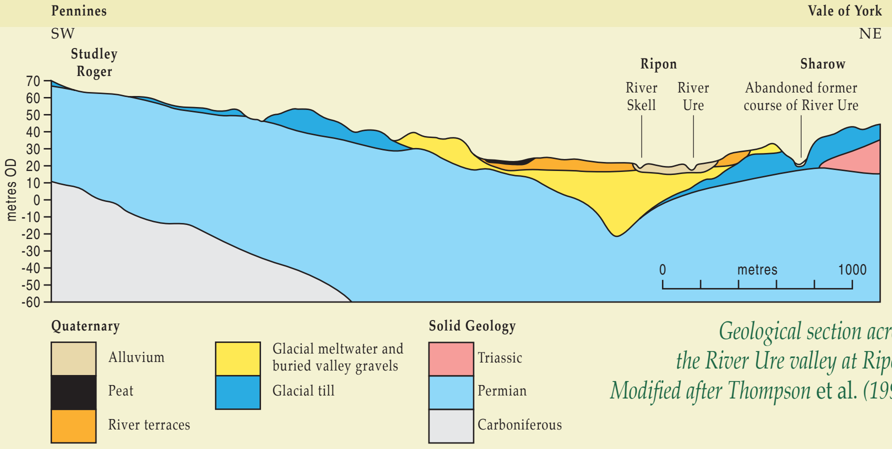
The Swale-Ure Washlands showing the main rivers and sites studied in this project

The Landscape Context

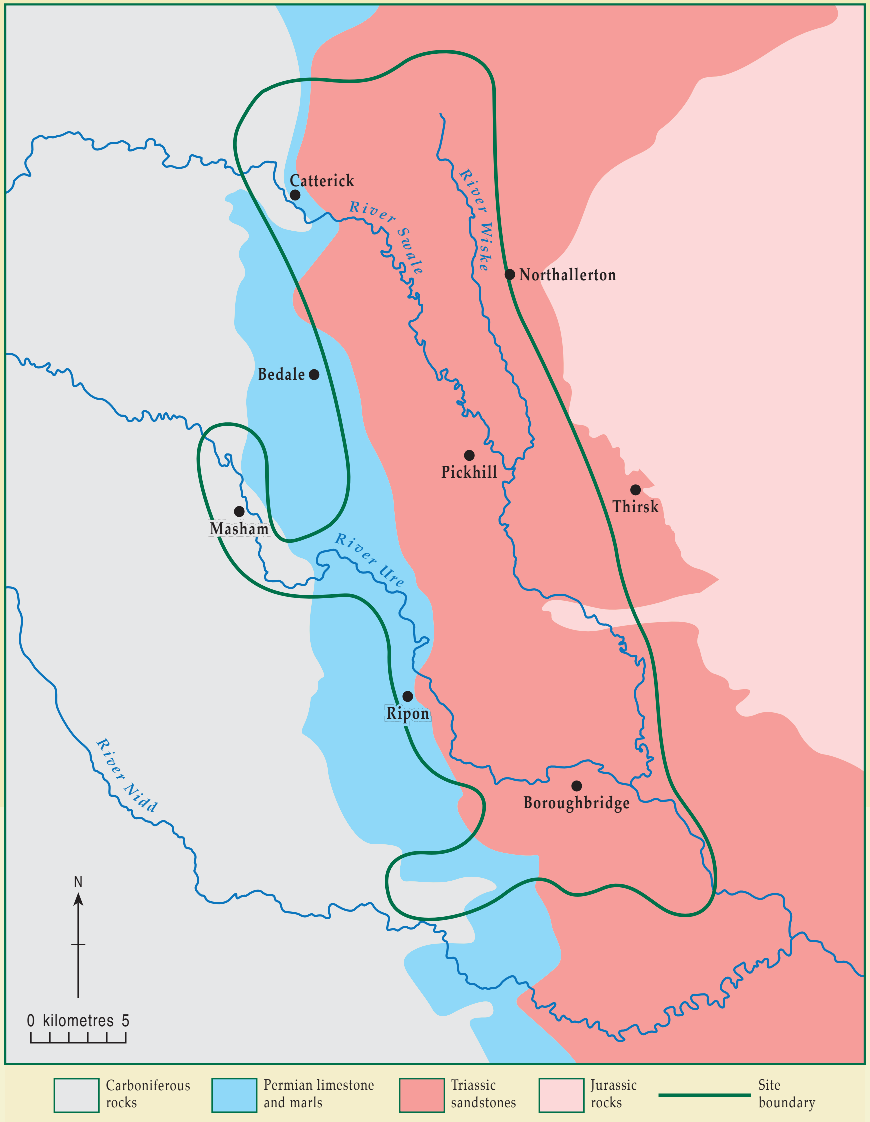
The landscape of the Swale-Ure Washlands is strongly influenced by the underlying geology. In the west of the region, Carboniferous sedimentary rocks (deposited 360-300 million years ago) dip gently eastwards from the eastern Pennines. These are the grey rocks found in areas such as Masham. However, just west of Ripon and running northwards towards Bedale and Catterick, these Carboniferous rocks disappear beneath younger rocks of Permian and Triassic age (300-200 million years ago). These are mainly limestones of a much paler grey colour, as can be seen in the light-coloured building stones at Fountains Abbey.

The limestones formed in an ancient sub-tropical sea. This sea underwent cycles of flooding and evaporation, which was associated with the deposition of layers of gypsum, a type of mineral called an evaporite. Because gypsum is soft and easily dissolved by groundwater, its presence in the washlands, in particular along the Ure Valley, is revealed today by small subsidence hollows called sink-holes, under which the gypsum has dissolved away and the overlying ground has collapsed. Often these sink-holes have become waterlogged and acted as traps for sediment, which may have accumulated in them over hundreds and thousands of years. As part of this project, we chose to analyse two such sink-holes, one at Nosterfield and another at Sharow (near Ripon), because of the thick sequence of sediments preserved in each and the long history represented.

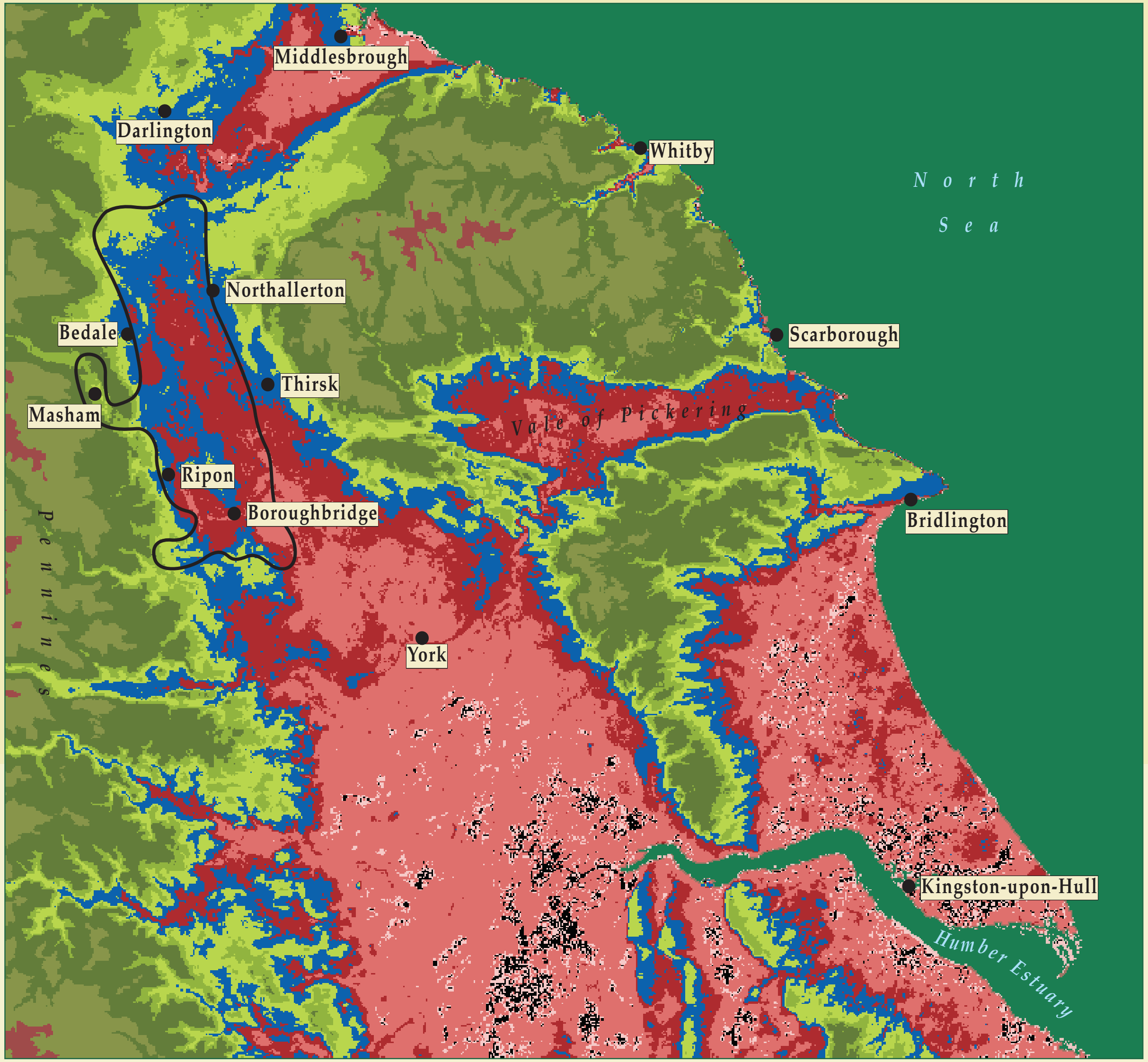
Further to the east, near the A1, the Vale of York lowlands are underlain by red sandstones that formed on land under desert conditions during the Triassic period. However, these are rarely seen at the surface because they are covered by thick overlying deposits produced by the last glaciation and deglaciation of the area.



Geological section across the River Ure valley at Ripon. Modified after Thompson et al. *(1996)*



Simplified geology map of the Swale-Ure Washlands



A map of the eastern Pennines, the Vale of York and the North York Moors, showing height above sea level. Pink represents low-lying land in the Vale of York, the Humber Estuary and the Holderness coastal plain. Red picks out slightly higher ground. The small arc of red to the immediate east and west of York marks the end point of the last ice sheet (see page 12). Blue and green depict progressively higher ground, turning to deep red on the highest summits of the North York Moors and the eastern Pennines. The large lowland in the North York Moors, known as the Vale of Pickering, supported a very large lake during the last Ice Age. The Swale-Ure Washlands study area is defined by the black line

Image data courtesy of EDINA DIGIMAP

Field Mapping

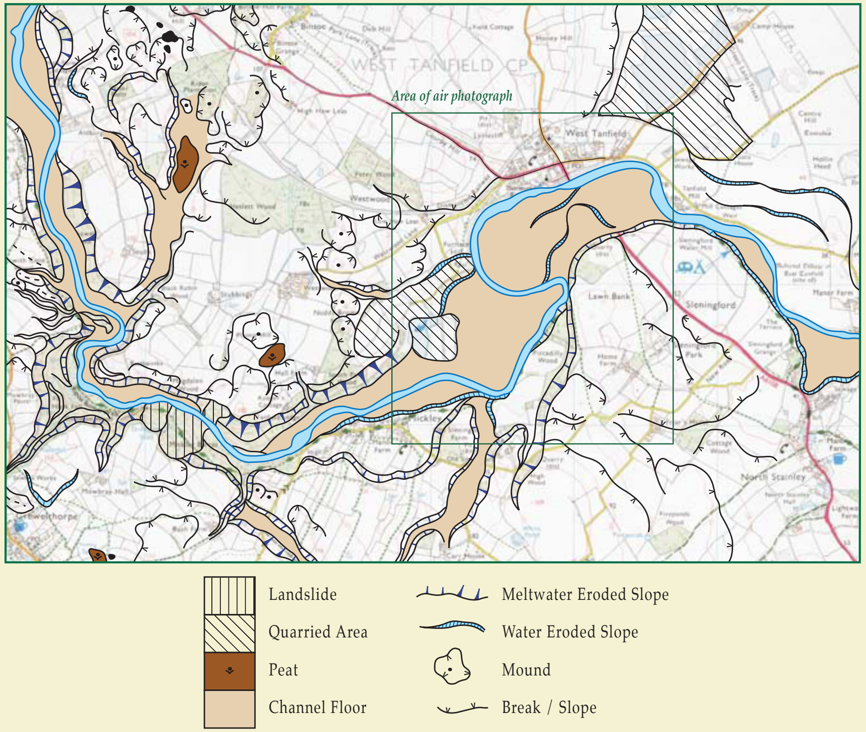
Field mapping is the first of the methods that we used in this project. The present landscape is like a jigsaw puzzle made of many different pieces, each a unique landform and each formed by a particular set of processes. The different pieces were created many hundreds or thousands of years ago, when processes such as glaciers and rivers operated in a quite different way to the present day. We can discover how the landscape was formed by mapping these landscape pieces, and by comparing them with those forming today in different environments.

We mapped landforms (known as the geomorphology) of the region to help us to understand how the washland landscape has evolved through time. We did this firstly by examining an extensive collection of aerial photographs from the region, held by North Yorkshire County Council and English Heritage, to identify major landforms such as river terraces, valleys and ridges.

We then undertook a detailed programme of field mapping – basically walking the ground with an Ordnance Survey map and marking onto this the important features identified in the landscape.

The area of the washlands is over 800 km^2 and therefore producing the map was a time-consuming process – over 1000 km have been walked over many weeks to create the map. We chose to map a few key areas in particular detail, notably in the west of the washland, in the Ure Valley, where there is the most important evidence of environmental change since the last Ice Age. A small example of the projects' work is shown below.

Air photograph taken in 1994 of the area surrounding West Tanfield (Copyright English Heritage)



Geomorphological map based on interpretation of air photographs and field mapping

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Facing page: The heavily wooded slopes of Hackfall Gorge, near West Tanfield, formed by meltwater, draining down the Ure Valley at the end of the last Ice Age

The Story of the Gravels and Sands

Lowland rivers carry and deposit sediments ranging from coarse and finer gravel, through sand, to silt at the finer extreme. Gravel and sand are generally deposited on or in the riverbed, often as bars and other features that the river continuously builds and moves. A good example of a gravel bar forming today is seen on the facing page. Finer sands and silts, sometimes even clays, are laid down in standing floodwater outside the river channel or in floodplain depressions such as ox-bow lakes, where, after floods have subsided, the remaining water becomes completely still, allowing finer-grained material to drop from suspension.

The gravels and sands, which are extensive in the Swale-Ure Washlands, make excellent commercial aggregate, especially where they contain little silt. In more upstream locations, where the rivers were close to the front of the former glaciers, boulder and cobble-sized material is common. This coarse material is problematic for gravel companies since it requires screening out or crushing.

Analysis of the gravel content can provide information about changes in river patterns, since the geology of the component pebbles can be matched with outcrops in the upper valley. The Pennine rocks are well represented amongst the washlands gravels (see examples below), as is more locally derived material, including the less durable Permian limestones of the Ripon area. Occasionally more exotic rocks are seen, which have been transported by ice from further north or through the Stainmore gap from the north-west.

In this project, we were able to examine in detail large exposures of gravel in several quarries in the Swale-Ure Washlands. In some cases, such as at Marfield, near Masham (see photograph top right), the gravels reach thicknesses of 20 m or more. Elsewhere, we mapped and sampled the gravels and sands from smaller exposures revealed in riverbank sections created by river erosion (see photograph bottom right).

Examples of different Carboniferous rocks found in the gravels of the River Ure:
(a) Crinoidal chert
(b) Coral limestone
(c) Sandstone
(d) Chert
(e) Crinoidal limestone

Marfield quarry near Masham. Project personnel recording a thick sequence of glacial till and river sands and gravels

Riverside exposure of gravels upstream of Ripon. They overlie a tilted block of lake clays (grey coloured), and pinkish glacial till

The Finer Sediments

Finer-grained sediments, such as clays, silts and organic muds, are common in the study area. The nature and thickness of these sediments tell us about the conditions in which they were originally deposited. As sediment accumulates over time, it traps and preserves some of the plants and animals living on or close to the site at the time. Today, we can retrieve sediments from beneath the ground surface and find within them prehistoric pollen, snails, beetles and even mammal remains. Careful sieving of the sediment separates these different fossil specimens, which can be identified in the laboratory and compared with their contemporary counterparts to help us to build a picture of the conditions under which they were laid down. We can also date these sediments using radiocarbon dating or the occurrence of archaeological finds of a known age within them.

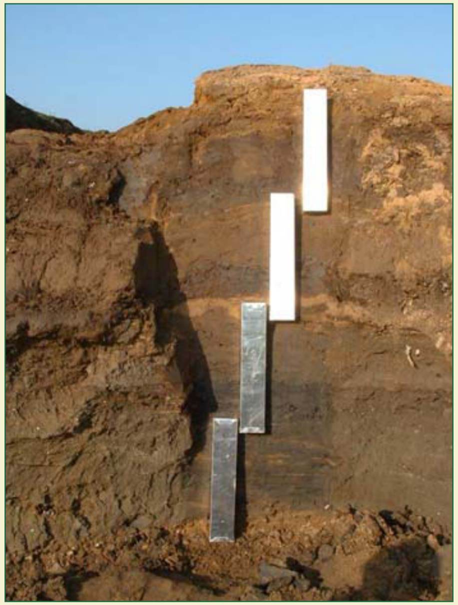
The oldest sediments occur at the greatest depth in these settings, with younger deposits lying successively higher in the sequence. Sometimes these sediments are exposed by quarrying and can be recorded and sampled. Often, however, these sediments lie buried below the ground surface and can only be reached by hand coring or with a mechanised drill. By sampling these deposits every few centimetres, we can develop a history of changing environmental conditions through time. This can, in turn, cast light on past climate change, patterns of river activity (including flood history) and human impact on the washland landscapes.

In this study, we tried to collect sediments to cover as much time as possible since the end of the last Ice Age. Because it is rare to find an uninterrupted sediment sequence at just one site, and because we wanted to get an impression of environmental change across the whole washlands area, we needed to sample about a dozen sites in detail. Some sites were chosen because they contain evidence from the period immediately following the retreat of the ice, well before humans began to have a strong impact on the landscape. Others were chosen because they lie close to areas of known prehistoric human activity, in particular the monument complex at Thornborough and Nosterfield, and therefore could provide specific information about the impact that prehistoric people had on the landscape.

Evidence from the Sediments

Pollen
Microscopic pollen grains carry the reproductive material of flowering plants from the male (anther) to the female (stamen) parts of the flower. Produced in great quantities, they are transported by wind or insects. Some are deposited and preserved in waterlogged sediments. Virtually indestructible, the pollen grains have remained undisturbed in the washland sediments until extracted by our project (see photograph right). Identifiable to plant type by their surface structure and the apertures in it, the relative abundance of each pollen type at each depth in the sediment can be used to reconstruct the nearby vegetation at the time they were deposited.

Molluscs
Wetland sediments in areas of low acidity, calcareous soils, often preserve shells of snails and other molluscs. These include the remains of molluscs living on the land but washed in to the wetland, as well as the aquatic types living in the wetland itself. Usually identifiable to species, many mollusc types are diagnostic of particular habitats, such as woodland, grassland or wetland, and tolerate limited ranges in temperature and other climatic variables. Molluscs are therefore very good indicators of past ecological conditions.

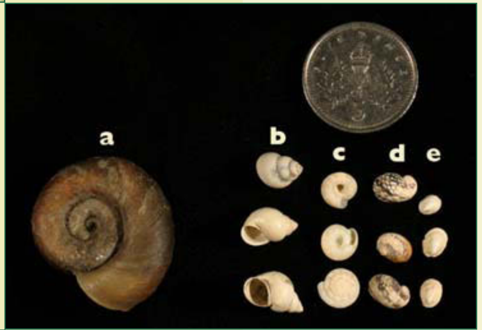


Sampling organic sediments at Ripon South. Sample boxes are 0.5m long

Seeds
Plant macrofossils can provide detailed records of the local vegetation, especially those, such as the seeds of blackberry (right), that are sufficiently distinctive for their identification at species level. They are most often derived from plants growing either on the wetland itself or on the land around its edges, although the seeds or fruits of some plants can be carried long distances on the wind.

Insects
Insect body parts, usually heads and wing-cases, are often found in waterlogged sediments and many are identifiable to individual species. Many insects have narrow habitat tolerances and well-known life-styles, so their remains are very reliable indicators of local environments. Capable of migrating quickly in response to environmental changes, insects such as beetles or midges are precise indicators of even small climate fluctuations.

A hazel pollen (Corylus avellana) *stained under high magnification (x400)*



Snails from the River Ure sediments
(a) Planorbis corneus
(b) Bithynia tentaculata
(c) Discus rotundatus
(d) Theodoxus fluviatilis
(e) Ancylus fluviatilis

A blackberry pip (Rubus fruticosus *agg.) (x400)*

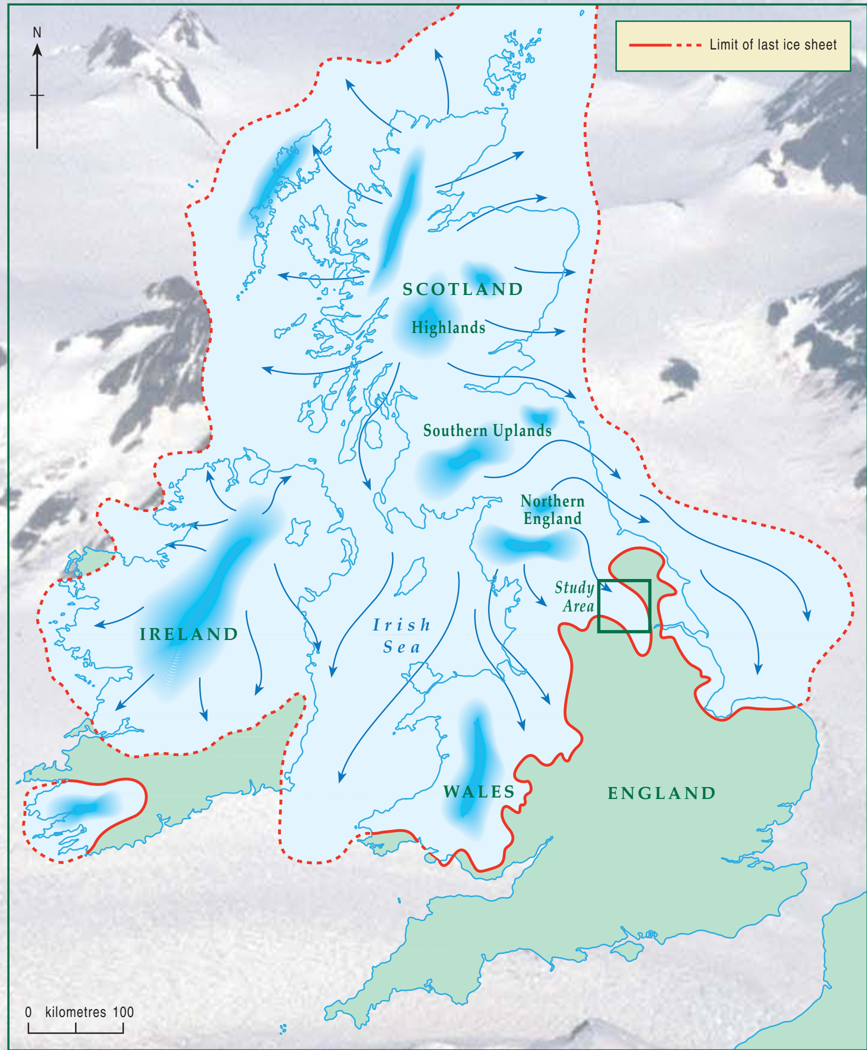
Beetle wingcases

The Last Ice Age

At the maximum of the last Ice Age, about 23,000 to 19,000 years ago, a large ice sheet covered much of Great Britain. This ice sheet had four centres: one located over western Scotland, a second in the Lake District, a third over the Welsh uplands and a fourth over northern England and the western Pennines. The diagram on the right uses dark blue shading to indicate where we believe were the highest parts of the last ice sheet over the British Isles, with ice flow lines also suggested. At its greatest thickness, the ice sheet over the Pennines was several hundred metres thick, nourished by moisture and snowfall from the North Atlantic Ocean.

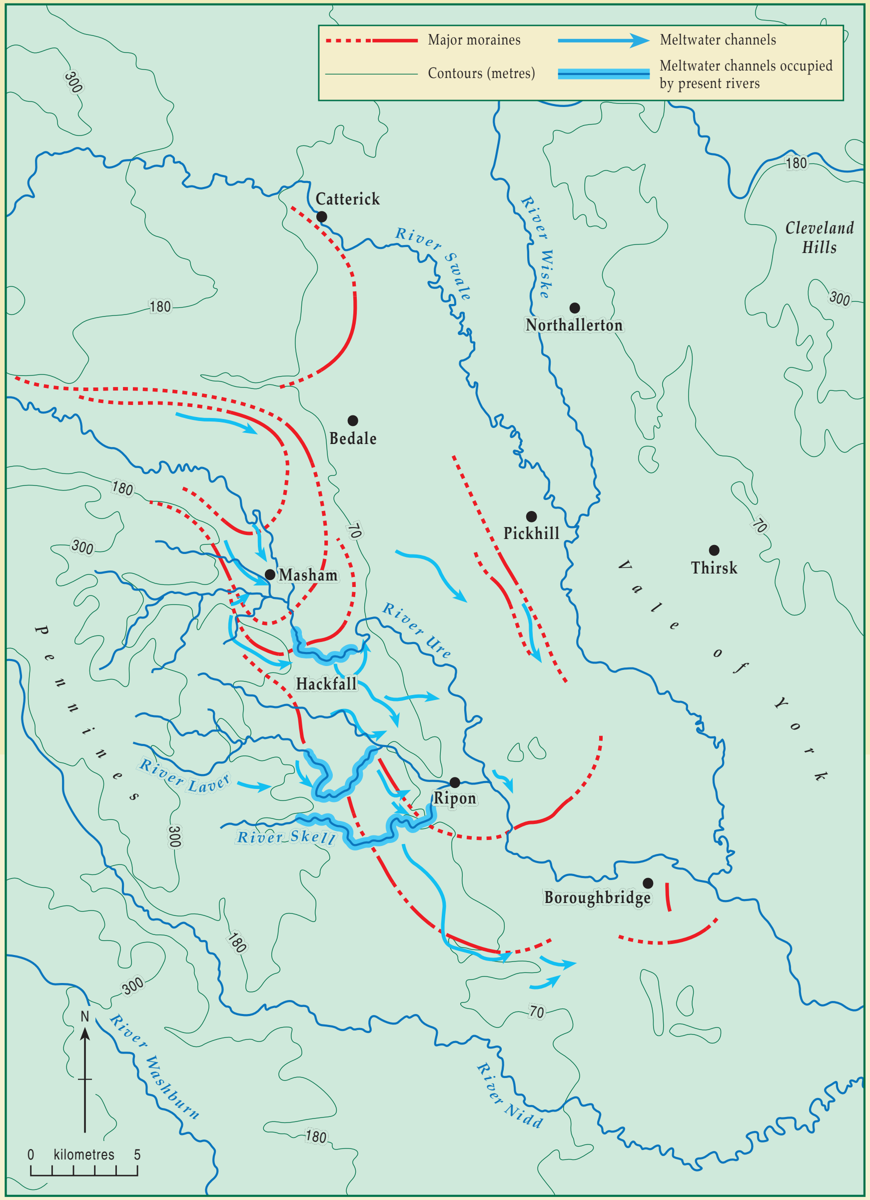
Although most of northern England was covered by ice at this time, the ice was not thick enough to override the North Yorkshire Moors. This area stood clear of the surrounding ice sheet throughout the last Ice Age. A large tongue of ice filled the Vale of York, reaching a short distance to the south of where the city of York is today.

The ice sheet had a major influence on the landscape of the Swale-Ure Washlands. Glacial erosion scoured deep valleys, such as Wensleydale and Swaledale, whilst the ice smeared much of the landscape with a veneer of glacial sediment known as till. In places, this till has been pushed into ridges, called moraines. Elsewhere there are extensive deposits of sands and gravels laid down by rivers flowing beneath the ice or issuing from the ice sheet margin. These are known as fluvio-glacial sediments.



Maximum ice sheet limits from the last Ice Age. The Swale-Ure Washlands contained a tongue of ice that extended down the Vale of York. The solid line marks our most confident ice margin position. The dashed lines are less certain positions

The Ice Retreats



Major moraines and meltwater channels mapped by this project in the Swale-Ure Washlands. The lobate shapes record the retreat of the ice as it melted

As the Earth's climate began to warm at the end of the last Ice Age, so the British ice sheet began to melt, thin and retreat northwards. The ice in the Swale-Ure Washlands area was probably only a few hundred metres thick at the peak of the last Ice Age, and was close to the final margin of the ice sheet, so retreat here would have occurred somewhat earlier than in surrounding regions. Initially, the Vale of York ice tongue retreated northwards, pausing occasionally to deposit moraines across the valley floor. Meltwater poured from the melting ice sheet and deposited extensive spreads of fluvio-glacial sands and gravels across the wide floor of the Vale of York. Numerous lakes were dammed between the moraines within the vale.

As the ice retreated and thinned further, there came a time when the ice coming from the Pennines down the Ure Valley split away from that in the Vale of York. The evidence for this is preserved in a series of moraines, mapped as part of this project, recording how the Ure Valley ice retreated into the Pennines. Spectacular channels were cut across the landscape of the Ure Valley, such as at Hackfall near West Tanfield, by huge volumes of meltwater that issued from this shrinking Ure Valley glacier.

The landforms created during the period immediately following the retreat of the ice sheet are important because many of the building blocks of the present landscape originate from this time. This includes the glacial moraines on which many villages are built, the fluvio-glacial sediments that are worked by the aggregate industry today and the widespread lake deposits forming the flat fertile floor of the Vale of York.

The Early Rivers

The rivers of the Swale-Ure Washlands at the end of the last Ice Age were very different to those of today. Most importantly, they carried large volumes of water released by the melting of the ice sheet and the valley glaciers. Their flow also varied much more than today, with larger peak floods in the spring as the snows of winter melted.

Another difference was that the rivers had more energy and therefore transported greater amounts of sediment. Flowing in multiple channels, they carried mainly gravel and sand, which they deposited on mobile bars that separated the channels. They were unstable, migrating frequently across the valley floor in response to flow variations and thus supporting only limited vegetation. Rivers of this sort, characterised by large volumes of sediment and unstable, multiple channels, are known as 'braided' rivers. We see examples of such rivers today in glaciated landscapes, such as in Iceland and Greenland which serve as contemporary analogues.

This retreating ice margin in Greenland is a good analogue for the Ure Valley c.15,000 years ago

Early river channel at Masham (shown by brown vegetation) abandoned c.20m above the present valley floor

Ure Valley upstream of Masham showing a high level river terrace (the channel is cut into the surface of this terrace)

A typical early river gravel, possibly deposited by meltwater, now exposed in a gravel quarry

The energy of the rivers was sufficient to erode the valley floor. This process may have been accelerated by uplift of the land as the heavy ice load, which had formerly depressed the Earth's crust during the last Ice Age, was removed. This uplift left the older river deposits high and dry, up to 20 metres above the present floodplain. We can see old river channels today, such as those at Marfield (Masham) or at Nosterfield, well above present river level. As the rivers have cut down, they have left a series of near-horizontal steps in their valley sides, called 'river terraces' (see photographs left), which are relics of the valley floors at different stages in this down-cutting process. The higher they are above today's river level, the longer ago such terraces were formed.

The Yorkshire 'Lake District'

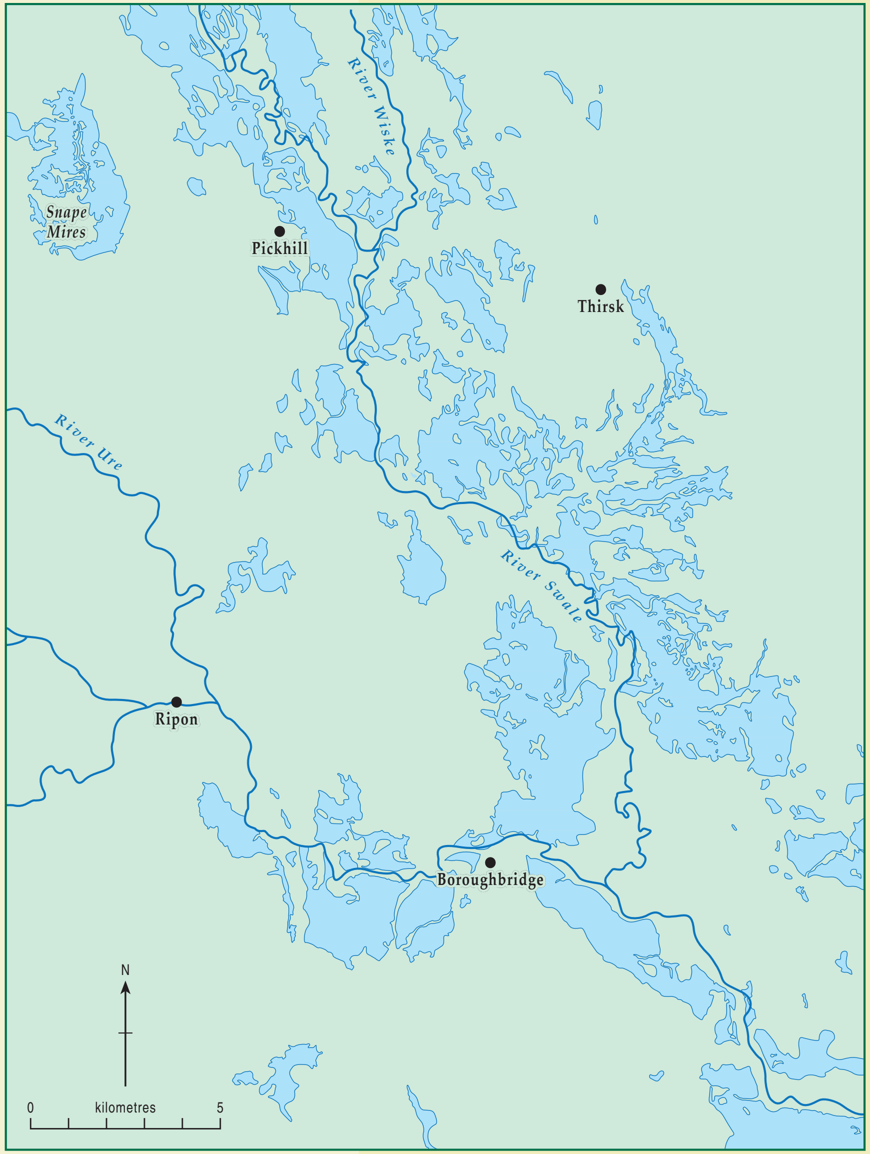
At the peak of the last Ice Age, during the spring and summer seasons, huge amounts of water were released from the melting ice. Some of this was retained in extensive glacial lakes that developed across the washlands and the Vale of York, trapped between high ground, newly formed moraine ridges and sometimes the ice itself. The largest of these lakes covered many square kilometres. When the ice retreated at the end of the glaciation, new lakes would have appeared in areas once covered by ice, connected by the early post-glacial rivers, including the Swale and Ure.

Different sizes of sediment accumulated on the lake beds in different seasons: finer sediment, such as clays, in the winter, under a cover of ice, and coarser sands and silts in the spring and summer, from meltwater rivers. This annual cycle of coarse and fine-grained sedimentation resulted in laminated deposits which are extremely important for assessing the lifespan of the lake and for dating the sediments (see photograph below).

In the Swale-Ure Washlands, geological investigations undertaken by the British Geological Survey have revealed laminated lake deposits of 10 metres or more in thickness. For example, Snape Mires, in the north of the study area, is underlain by 16 metres of such sediments, suggesting that this still boggy area was once one of the larger lakes in the washlands and lasted for perhaps as long as 14,000 years.

As the ice retreated and the climate warmed, plant life flourished and the increased productivity within the lakes produced thick organic muds. The lakes gradually infilled with sediments and the open waters became colonised by marshland vegetation and then eventually by wet woodland. Thick deposits of peat accumulated as the lakes infilled further and dried out. Little visible evidence of them remains today and much of the peat from their uppermost layers has been cut for fuel or drained for agriculture. However, we still see their imprint on the landscape in the large areas of flat land in the lower reaches of the Ure Valley and in the Vale of York.

Laminated glacial lake sediment



Former glacial lakes in the southern part of the Swale-Ure Washlands, shown in darker blue and based on mapping by the British Geological Survey

Arctic Conditions Return

Shortly after ice retreated from the Vale of York, from about 14,000 years ago, temperatures began to warm as Yorkshire finally emerged from the Arctic temperatures of the last Ice Age. However, this warming proved short-lived and temperatures cooled again between about 11,500 and 10,500 years ago, with a switch back to a harsh Arctic climate. This may have been caused by the cooling of the North Atlantic Ocean, with less heat being brought by the Gulf Stream from the tropics to our latitudes.

This cooling was too short-lived for ice to return to the Pennines, but semi-permanent frozen ground developed in the Swale-Ure Washlands. Spectacular evidence for this is recorded by fossil ice wedges revealed by quarrying. These wedges begin life as thin fingers of ice in cracks in the land surface. Over time, they thicken and deepen, eventually reaching several metres in depth. When the ice melts, the space becomes filled with sands and silts that collapse from above or are washed or blown in from the floodplain. Today, the fossil imprints of these features – called ice wedge casts – are identified by this infilling. As such wedges only develop where the mean annual temperature is below about -7ºC, these casts are excellent evidence for former Arctic conditions in the Swale-Ure Washlands (see photograph, bottom right).

During this cold interval, the warmth-loving plants that had established themselves during the initial melting were driven south again and replaced by cold-loving and wind-tolerating vegetation such as juniper, dwarf willow and crowberry. One plant in particular, the mountain aven or *Dryas octopetala* (see photograph below), gives this interval its name – the 'Younger Dryas' – because it grew in these conditions.

Patterned ground in modern Arctic Norway. This is the surface expression of the ice wedge features shown below

A modern ice wedge (narrow white feature) exposed in a large river bank section in western Canada. The ice wedge here is approximately 3m in length

Fossil ice wedge cast exposed in a gravel quarry in the Ure Valley (Nosterfield)

Examples of plants growing in the washlands during the Younger Dryas

Dryas octopetala *(mountain aven)*

Salix herbacea *(dwarf willow)*

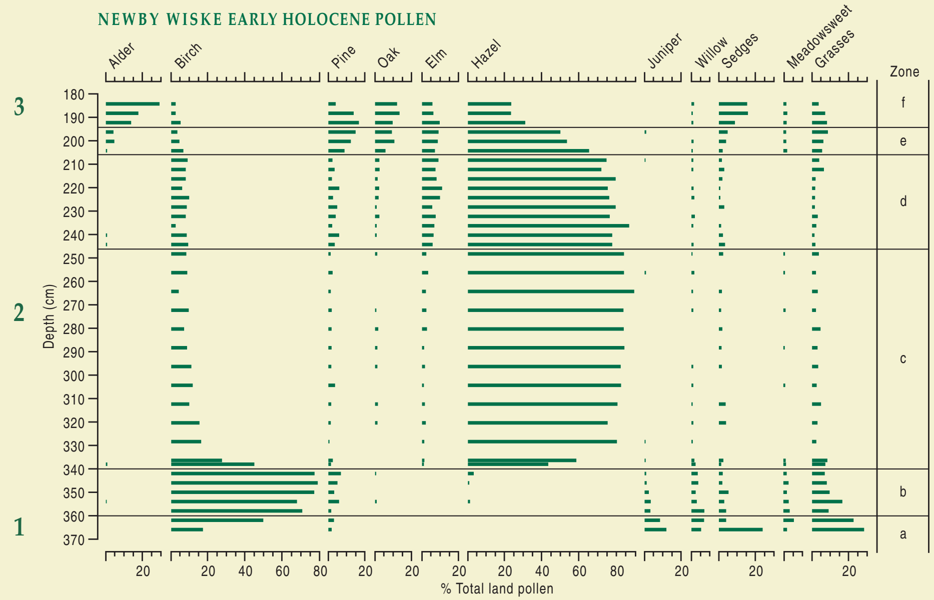
The Climate Warms

The cold Younger Dryas was followed, a little over 10,000 years ago, by much higher temperatures that have persisted to the present day. This warm period in which we live is termed the 'Holocene', meaning 'entirely recent', to distinguish it from the earlier phases of geological history. Looking at the history of climate over the past 2 million years (termed the 'Pleistocene'), we can see that the Holocene is the latest in a series of 'interglacials', that is, unusually warm periods in the midst of mostly glacial conditions. This suggests that, unless human-induced warming prevents it, another ice age will occur in the future.

In the early part of the Holocene, from about 10,000 to 6,000 years ago, conditions were warmer and drier, than those of today with summer temperatures up to 3ºC higher. This warmth allowed the expansion of temperate woodlands across the washlands. Our information from this period comes mainly from pollen diagrams, such as the one completed from sediments at Newby Wiske, near Northallerton, which shows the changes in abundance of several major plant types between about 10,000 and 7,000 years ago.

The base of the pollen diagram (*zone a* on the right) shows that at the very start of the Holocene the plant cover was still open, with abundant grasses and sedges, and substantial growth of shrubs like juniper (see photograph 1) and willow. Birch was the only local tree and was rare. Meadowsweet, a herb that likes warmer conditions, increased at this early stage. In *zone b*, however, a massive increase in birch reflects the establishment of woodland, and all the herbs and shrubs common in *zone a* decline as they were affected by the increasingly dense shade cast by the spreading woods. At about 9,500 years ago, hazel migrated into the area and took over from birch as the main woodland tree (*zone c*). Its very dense shade (see photograph 2) suppressed the growth of herbs and smaller shrubs almost entirely, in particular juniper and meadowsweet.

The dominance of hazel persisted until about 8,500 years ago, when taller deciduous trees like elm and oak began to spread (*zone d*). This trend continues in *zone e*, showing that oak, elm and pine became much more important in the local forest. Alder began to expand at this time also and, in *zone f* (after about 7,000 years ago), alder replaced pine as the climate became wetter (see photograph 3). At this time, after successive immigration of the main trees, all the major components of the mid-Holocene deciduous forest were established. The local woodland remained stable for the following 2,000 years, until the first farmers made small clearings in it for agriculture.



1

Juniper

2

Hazel woodland

3

Alder woodland

The Early Postglacial Rivers

After the Younger Dryas, the early postglacial rivers in the washlands were sluggish and generally inactive, with multiple channels choked with vegetation. In this respect they seem to have behaved differently to rivers in previous interglacials, which typically flowed in single meandering channels. This contrast may be linked to the kinds of animals that lived on the floodplains during previous interglacials compared with those of the Holocene.

Elephants, rhinoceroses and large ungulates were common on our floodplains during warm periods before the Holocene. Just as their surviving southern cousins do today, they smashed down trees and maintained areas of open habitat. However, by the start of the Holocene, many of these large game animals were extinct. Without the large elephants, in particular, the early Holocene forest was dense and unbroken, choking the rivers and forming a habitat that supported a lower diversity of animal life compared with previous warm intervals. The reason for this huge loss of large animals remains hotly debated, but most scientists think that the increasingly sophisticated hunting methods of our prehistoric ancestors, perhaps coupled with climatic pressures at this time of rapid warming, pushed these large animals into extinction.

During this period, peat-rich sediments would have accumulated extensively on the floodplains of the washlands. However, many of the peaty sediments formed during this phase have been washed away during periods of increased water flow in later times. Indeed, those surviving peaty sediments discovered during this project are typically thin, truncated remnants that lie many metres below the present floodplain surface.

The early to mid Holocene river valleys may have been attractive areas for settlement and exploitation in Mesolithic and early Neolithic times, offering water supply and patchy wetland habitats. Evidence of many dryland and wetland archaeological sites and activity areas from this interval probably lie within the Swale and Ure Valleys. Most, however, will remain concealed beneath the thick alluvial sediments of later periods unless revealed by river erosion or modern human activities.

River running through dense woodland - not an elephant in sight!

Modern analogue of early postglacial wet, vegetation-choked valley floor through dense woodland

The Start of Agriculture

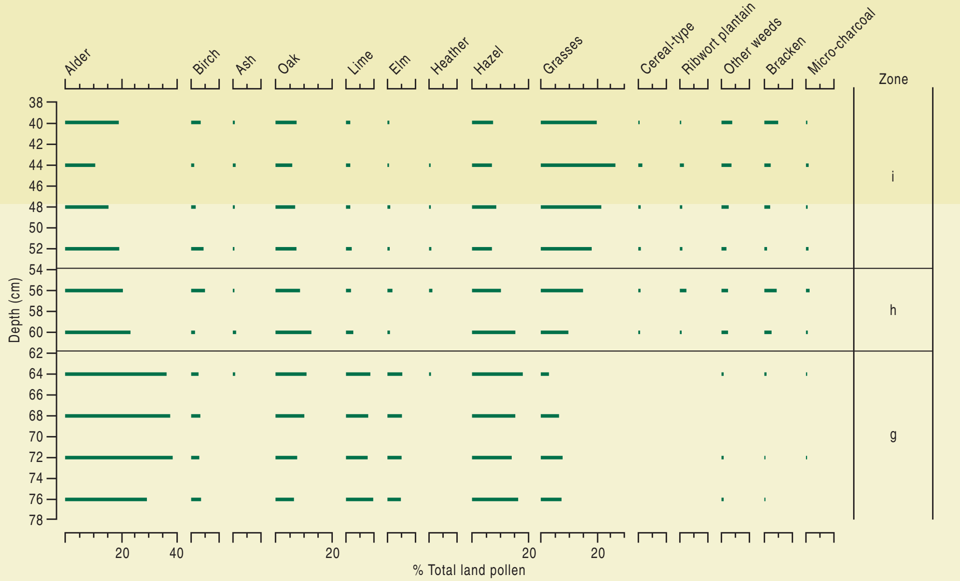
People of the Mesolithic (Middle Stone Age) culture occupied the washlands and the surrounding region from the beginning of the Holocene. Well adapted to the densely wooded landscapes of this time, they lived by hunting wild animals and birds, by fishing and by collecting a wide range of wild vegetable foods such as fruits, nuts and roots. Except perhaps around their settlements, where they may have felled trees, there is little evidence that these hunters caused any significant reduction in the woodland cover other than by the use of fire. Evidence from charcoal fragments, which are often found in sediments of this age, suggest that fire may have been used to aid hunting by driving animals or for opening up the forest. It may also have spread accidentally from campfires, and natural wildfires caused by lightning strikes probably also occurred.

Archaeological evidence for Mesolithic activity within the washlands is restricted to occasional small flint scatters, such as those found close to Thornborough. These are all that remains from tool manufacture, probably undertaken by small mobile family groups. The density and extent of settlement during this period remains unclear, however, mainly because there has been only a limited amount of archaeological research undertaken within the region. If comparisons with other regions are valid, it is likely that evidence for Mesolithic activity will be well preserved on the sand and gravel terraces of the Ure and the Swale.

A major change occurred around 6,000 years ago, when the first evidence of agriculture appeared. Farming would have been brought to the region by Neolithic (New Stone Age) settlers but parts of this new system of producing food may well have been first adopted by some of the existing Mesolithic inhabitants. Even when farming was established, hunting and gathering of wild food would have remained important. Environmental evidence of the shift to farming comes from pollen diagrams, showing the percentage changes in abundance of several major plant types at about 5,500 years ago.

The Newby Wiske pollen diagram to the right is from a section above that on page 17. It shows that dense, stable deciduous forest existed around the site in the early Holocene. Oak, elm, lime and alder were the dominant trees with abundant hazel, probably as a tall understory shrub (*zone g*). There is very little herb pollen, suggesting only restricted breaks in the forest cover. In *zone h*, alder, hazel, lime and elm percentages fall, while ash, a tree that invades woodland clearings, increases. Grasses, ribwort plantain, heather, bracken and a range of other weeds become much more common, and charcoal abundance rises. Cereal-type pollen grains are recorded for the first time, showing the arrival in the region of arable farming.

In *zone i*, elm pollen percentages fall further and tree pollen generally stays low, while grasses and other weed types continue to increase. This change, which is called the 'elm decline', has been recognized at many sites regionally and nationally. It records the creation of open areas within the forest and the spread of grasses, weeds and other non-tree vegetation.



Pollen diagram from Newby Wiske showing the elm decline in zone h

The presence of cereal-type pollen suggests that Neolithic farmers probably caused the change by clearing areas of trees, particularly elm and lime on the better soils, for cultivation and grazing domesticated animals. After the elm decline, farming seems to have continued within a still wooded, but more open landscape. Other factors, such as climate, soil change or a disease outbreak, could also have contributed to the fall in tree populations.

As well as cereal cultivation, livestock husbandry was an important part of Neolithic farming, with cattle as the most important animal, domesticated for meat, milk and hides. Beasts would have been allowed to graze and browse through nearby open woodland during the summer and would have been stalled and sustained with fodder such as hay, leaves and ivy over the winter. Skeletal remains of Neolithic cattle show that they were large animals. Cow bones found near the base of the peat deposits at Newby Wiske, pictured below, may date from this period of early farming.

A typical small woodland clearing. Created by Mesolithic people, such clearings would have been attractive to a range of wildlife including red deer, making hunting them easier. Note the bracken growing on the woodland floor: its frequency rises in zone h *of the Newby Wiske pollen diagram*

Mr Peter Richardson holding the skull of a cow, possibly Neolithic in age, recovered from peat at Newby Wiske

Cereal-type pollen is recorded in zones h *and* i *in the Newby Wiske diagram. Here we see examples of prehistoric crops that have been produced today by plant historians in cooperation with archaeologists*

The Later Neolithic and Early Bronze Age

Although settlement has taken place in the washlands since the early Mesolithic, we have no evidence of monuments – such as earthworks, enclosures and burial complexes - from either the Mesolithic or early Neolithic periods. However, things changed significantly during the later Neolithic and Bronze Ages as the washlands became a centre for a significant concentration of monuments. This concentration of activity seems to be located at the conjunction of an important north-south route through the region linked to the Swale and the Ure rivers. This suggests that, from the late Neolithic onwards, there was a growing local population which may well have been considerably increased by visitors on ritual and other occasions.

As noted earlier, by the later Neolithic, pastoral and arable agriculture was important, although hunting and gathering probably played an important part in subsistence and ritual. In the later Neolithic, from around 5,700 years ago, a series of major monument complexes were built along a probable north-south route corridor, around the river crossing at Boroughbridge, along the eastern valley slope of the River Ure and at the Swale crossing in the Catterick area.

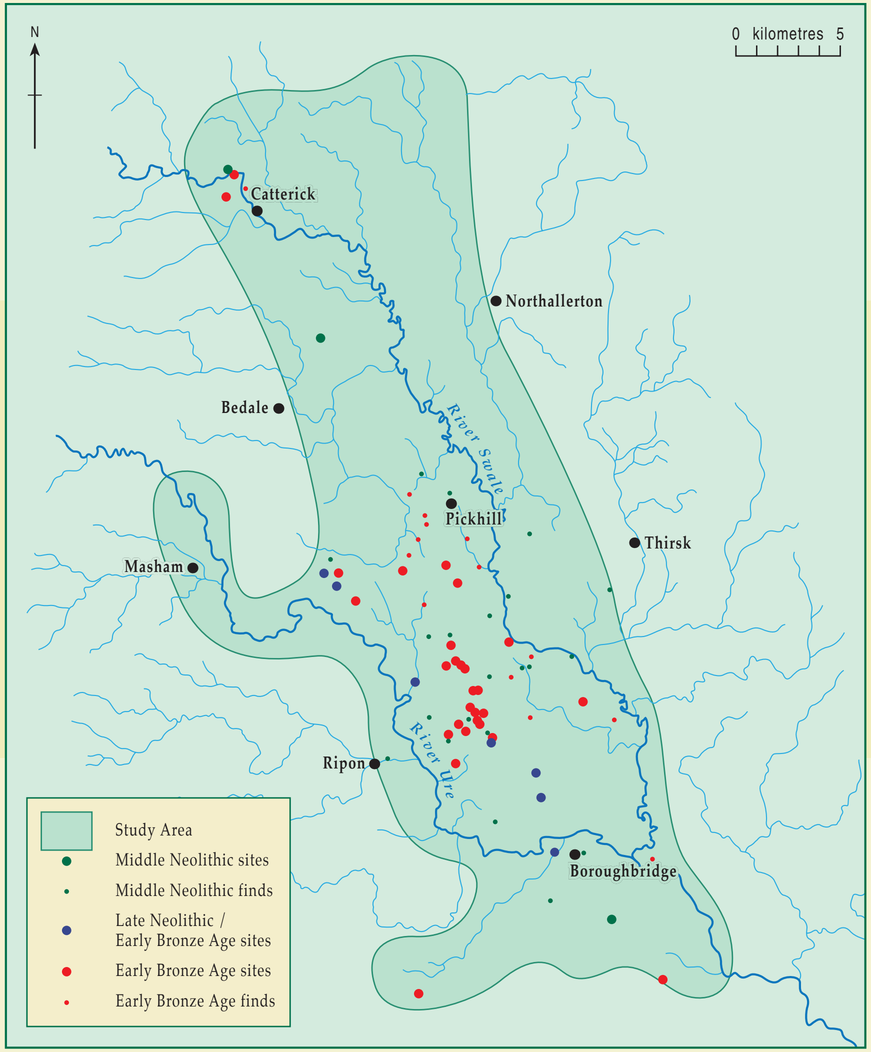
The monuments within the washlands include linear earthworks of the 'cursus' type - perhaps processional ways, although they may also have worked as boundaries - and alignments of pits and standing stones (such as the Devil's Arrows, Boroughbridge, photograph right), as well as the better known 'henge' circular earthwork enclosures such as those at Thornborough (photograph on facing page). This pattern of monument complexes at the conjunction of routes and rivers is repeated south of the washlands on the River Aire at Ferrybridge and on the River Wear to the north, and probably elsewhere in Yorkshire and the North-east.

Despite the scale of the later Neolithic monument complexes, the location of later burial mounds suggests that use of the earlier sites was not fully sustained in the early Bronze Age. From perhaps 3,900 years ago, the distribution of the round barrows (Bronze Age burial mounds, see photograph on facing page) shows a markedly eastern trend, such that they are much more concentrated on the ridge that divides the Ure from the Swale. If these burial mounds also mark a communications route in the same way as the earlier monuments may, their distribution suggests that, while maintaining the same crossings of the Ure and Swale, the path followed a more direct north-south alignment from early in the Bronze Age. Thus it may be claimed that the route of the Roman Dere Street (the present A1) may initially have been established during the early Bronze Age.

The Devil's Arrows, Boroughbridge

Part of one of the Thornborough henge circular earthwork enclosures. Archaeologists believe these may once have been covered with gypsum, which would have made them appear as brilliant white landmarks. This, and the other settlement sites clustered in the area between Pickhill and Boroughbridge, are on the drier uplands, avoiding the boggy ground associated with the old glacial lakes (see map on page 15 for comparison)

A Bronze Age burial mound (tumulus) at Blois Hall Farm, near Ripon



Late Neolithic to Early Bronze Age sites and find distribution. This map, and those that follow, are based on a collation of all published and unpublished information from the Swale-Ure Washlands. Note how the Late Neolithic / Early Bronze Age sites are located on the eastern slope of the Ure Valley, with the later Early Bronze Age sites closer to the River Swale

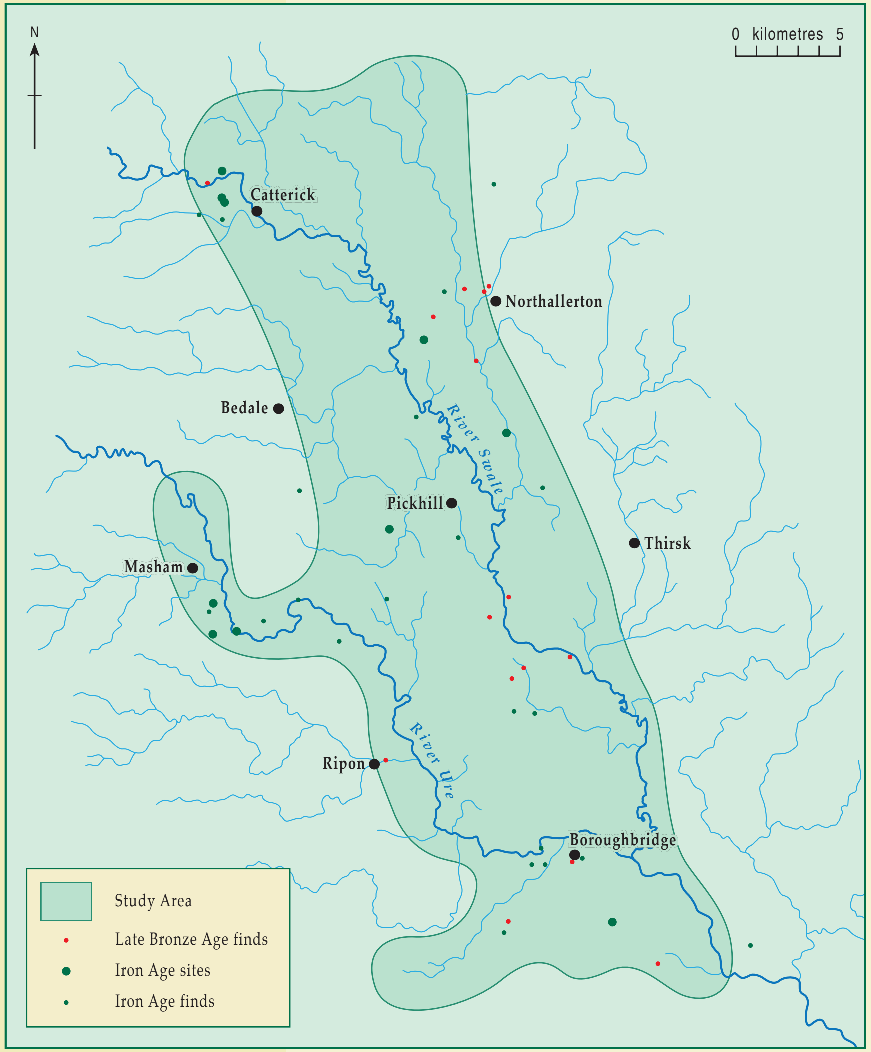
The Later Bronze Age and Roman Periods

From the middle Bronze Age, the tradition of barrow burial was abandoned and interest in the earlier monuments is no longer evident. Within the washlands, as elsewhere in lowland North Yorkshire, the local population now relied upon successful mixed farming settlements which continued through the Iron Age. The widespread discovery of beehive-shaped querns for grinding corn (they occur in 23 locations within the washlands) suggests that when the area became the subject of Roman administration, in the later part of the first century AD, it was well able to contribute to Imperial taxation. It is tempting to envisage the Iron Age countryside as much like that of medieval England, with scattered villages and isolated settlements based on farmsteads of round houses and other buildings set within rectangular enclosures. However, the landscape was still heavily wooded, with a largely dispersed population using a wide variety of arcane and probably macabre ritual sites.

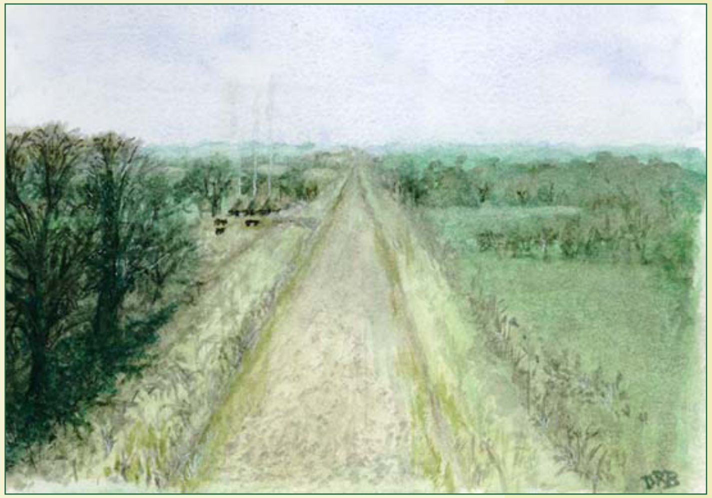
A series of Iron Age forts in the washlands provided a springboard for the Roman advance to northern England and Scotland. This was accompanied by the establishment of a formal road system which included the consolidation of Dere Street and the extensive use of the river system. Civil settlement developed around these military bases, notably at Aldborough and Catterick, while an altogether more sophisticated and Romanised element of society is reflected in a cluster of high status rural estates on the eastern foothills of the washlands. During the 2nd and 3rd century AD, this rural area appears to have been one of the most prosperous in the north of England. Rural establishments which might merit the title 'villa' are present at Middleham, Well, Langwith House, Snape and North Stainley. However, as in the rest of the country, the region experienced an economic decline which seems to have set in well before the end of the Roman period. From the 3rd century onwards, settlement may have become less urban-based and more dispersed, a pattern more nearly that of the pre-Roman Iron Age.

Iron Age quern re-used as a modern gate post

Roman mosaic, Well, North Yorkshire

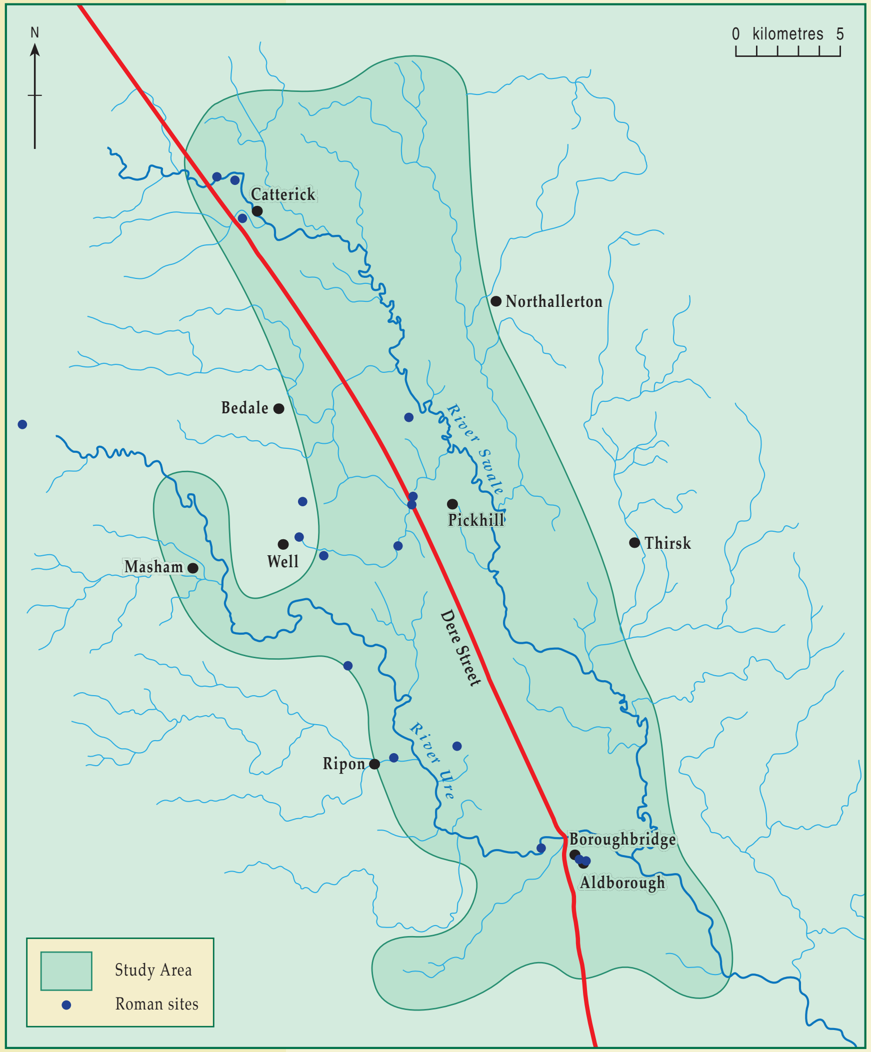


Late Bronze Age and Iron Age sites and finds in the Swale-Ure Washlands



Artist's impression of Dere Street looking north from near Thirsk

The much wider A1 today viewed from the same point



Roman sites in the Swale-Ure Washlands

The Medieval Period

Following the collapse of the Roman administration, the majority of the local population continued to live in the washlands, adopting new and much less archaeologically 'visible' lifestyles. New economic and political structures accompanied this cashless society, with the development of several post-Roman petty kingdoms, notably the Kingdom of Craven in the south and an early form of Richmondshire in the north. A thin general distribution of burials during the early medieval period (AD 400 - 1066), suggests scattered, pagan, Saxon rural settlements in a countryside that was perhaps very much like that of the pre-Roman Iron Age. The few house sites of this date discovered at Catterick perhaps more accurately reflect the concentration of 20th century archaeological endeavour rather than the urban aspirations of the washlands population of this period.

In many places in rural North Yorkshire, there is evidence, from the 9th and 10th centuries, for Viking influence in the form of occasional burials and sculptured stone monuments. Amongst the few burials at this time in England is a male from Wensley, to the north-west of the washlands, a burial with a Viking-style sword and spearhead from Camp Hill (Burniston), and a ninth-century female burial with a tortoise brooch from Bedale. These burials, and the occurrence of Anglo-Scandinavian style sculptured stone, represent the only physical evidence for Viking settlers in the washlands area, yet the development of the Viking trading town at York almost certainly had an influence on the economic development and material culture of the region.

The washlands area was of considerable significance in the ecclesiastical development of the west of Yorkshire. Catterick was an early religious centre until AD 653, after which Ripon emerged as the base for the early church in the region. This is reflected in the high quality stone monuments which indicate an early ecclesiastical focus in many of the settlements. Indeed, Ripon may have been the base for the master craftsman – 'the Uredale Master' – who created the more significant religious sculptures found at Cundall, Masham (see photograph right), and West Tanfield. These suggest that it was in the last two centuries before the Norman Conquest that most of the familiar settlement pattern of the washlands was first established.

Masham cross

The later medieval (AD 1066-1500) landscape and below-ground archaeology of the washlands remains a neglected resource, by comparison with the spectacular castles and monasteries (such as Fountains and Jervaulx) of north Yorkshire outside this study area.

The mostly modest villages in the washlands area, however, have origins in the immediate post-Conquest period, if not before. They are set in a landscape which, away from the arable core of the washlands, retains the earthwork remains of the agricultural systems which sustained them during the medieval period. A dispersed population may have increasingly moved into nucleated villages and developing market towns from the 12th century onwards, whilst evidence from other rural settlements suggest the development of planned villages from this time. Boroughbridge received a town charter in 1156, and Thirsk was another early establishment, and towns including Topcliffe, Pickhill, Burniston, Masham, Bedale and Northallerton acquired market status during the 13th century.

Communications by water during this period appear to have been more constrained than previously. Silting of rivers was encouraged by erosion associated with agriculture, with lead and copper mining in the Pennines, and the extraction of iron from the North York Moors. Although historical documents provide us with an impression of the countryside at this time, the detail of individual components, including the church centres, remains to be examined and related to the surrounding countryside.

Masham market place. Masham gained its town charter in the 13th century

Of Rivers and Shoes

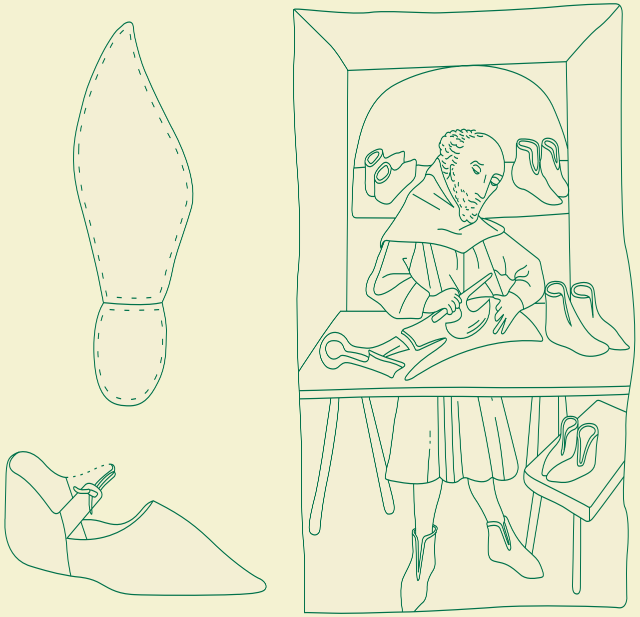
Occasionally the washland sediments yield surprising insights into past activity. During our mapping and analysis of the quarry exposures downstream of Ripon, we found first one, and then, with the aid of the Brown and Potter quarry staff, a further half-dozen shoes preserved in a lens of sands and gravels (see photograph below right). Above these sands and gravels is a two-metre-thick bed of sand and silt, which is rich in animal and plant remains, including complete antler racks from red deer and bones from cows and pigs.

The shoes are especially interesting, since they are very well preserved yet rarely found in river sediments. Their number is also intriguing – why are there so many in one small area? To help identify them, and to establish their age, we sent them to shoe-expert Rebecca Shawcross of the Northampton Museum and Art Gallery.

Rebecca was able to tell us that shoes, such as the one shown here, comprise a sole and the remains of a strap. The two pieces illustrated are from the quarter, the back part where the heel and ankle fit. The narrow waist of the sole, its pointed toe and slightly asymmetrical sole indicate that the shoe dates from the late 14th century. The shoe is of quite a large size and so probably belonged to a man. It would have been stitched entirely by hand.

Towards the end of the 14th century, almost every type of shoe had a pointed toe. The most extreme was called a 'poulaine'. Toe length depended on status and wealth, with the upper classes and ultimately the king wearing shoes with the longest toes – reputedly the maximum was about 60 cm (24 inches)! To prevent the shoe from drooping, the toe was stuffed with moss or straw.

Brown and Potter quarry section (Ripon South). The medieval shoes were recovered from the gravels in the centre of this picture (see asterisk). The gravels are overlain by a 2m thick cap of sands and silts, from which we recovered numerous animal bones, including a 1.5m wide rack of antlers



A contemporary illustration of Medieval shoe-making

The first of the shoes recovered from the quarry at Ripon South

Human Impact on the Rivers

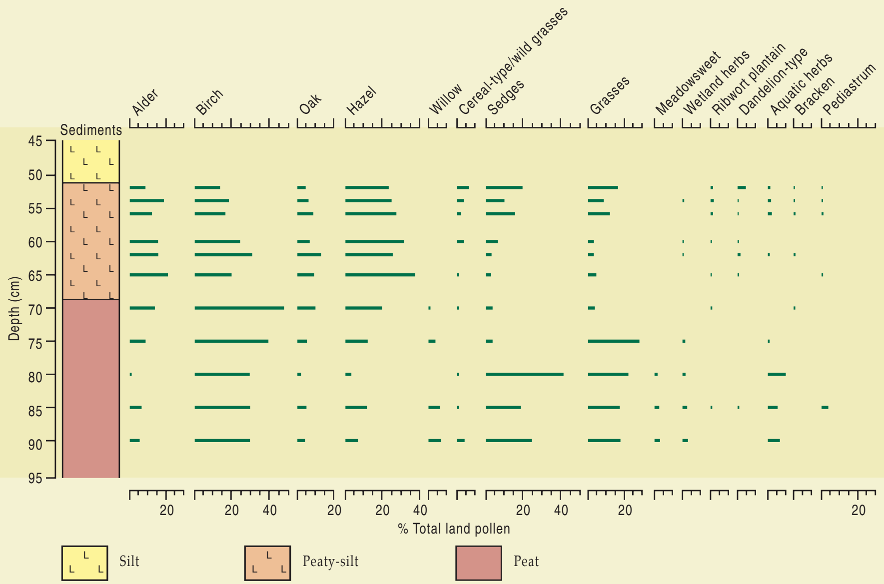
Today, many bank sections of the middle and lower reaches of the Ure and Swale are composed of yellow-brown sands and silts that form a thick blanket over earlier, peaty deposits and old land surfaces. This cap of sediment is evidence of a widespread change in river processes and considerably increased rates of sediment deposition across the washlands. This increased deposition has produced the washlands' present soil characteristics, and seems to be associated with human impact on the landscape during the last five thousand years, both locally and further upstream in the Swale and Ure catchments.

At many of the sites we have studied, pollen evidence shows an increase in plants that favour disturbed sites shortly before, or at the same time as, silts and sands were being washed into the rivers. The diagram from Thornton's Plantation, Pickhill (see right), shows this. Below 70 cm, the pollen indicates marshland vegetation dominated by local wetland herbs, grasses, sedges and birch. Above 70 cm, where alluvial silt is recorded, the vegetation changed to local alder swamp, typical of alluvial floodplains. In addition there are increases in cereal-type pollen as well as in ribwort plantain and the dandelion family, indicating local pastoral and arable agriculture. Pollen of hazel and oak would have blown in from drier land further away, after removal of local tree cover. It is likely that, at least around this site, increased alluvial sedimentation was a direct result of farmers clearing the land, thus causing soil to be eroded from their fields and redeposited by the rivers as alluvium.

Undertaking excavations through the alluvial floodplain of the River Ure. Thick deposits of sands and silts bury older peaty sediments in many places

From the Neolithic and Bronze Age onwards, further local deforestation caused soils to be washed into the river system and later deposited downstream at times of wetter climate when river flow was greater and flooding occurred. In Late Iron Age and early Roman times, rapid and widespread forest clearance, coupled with a wetter climate, greatly increased such alluvial deposition throughout the Vale of York. In the Medieval period, between about AD 1000 and 1300, more cultivation in the Swale-Ure catchment led to further major erosion of soils, which were then redeposited in the washlands when the climate worsened after AD 1300, and again in Tudor times.

Metal mining has also contributed to alluvial deposition in the Swale-Ure Washlands, easily traceable by the presence of contaminant minerals like lead and zinc. The miners generally processed their materials in riverside settings, making use of the water for washing and grading and leaving mounds of spoil to be reworked by the rivers in subsequent floods. Mining has been a major factor since about AD 1000, continuing with greatly increasing rates of deposition into modern times, with most of the sediment retained in the washland system.



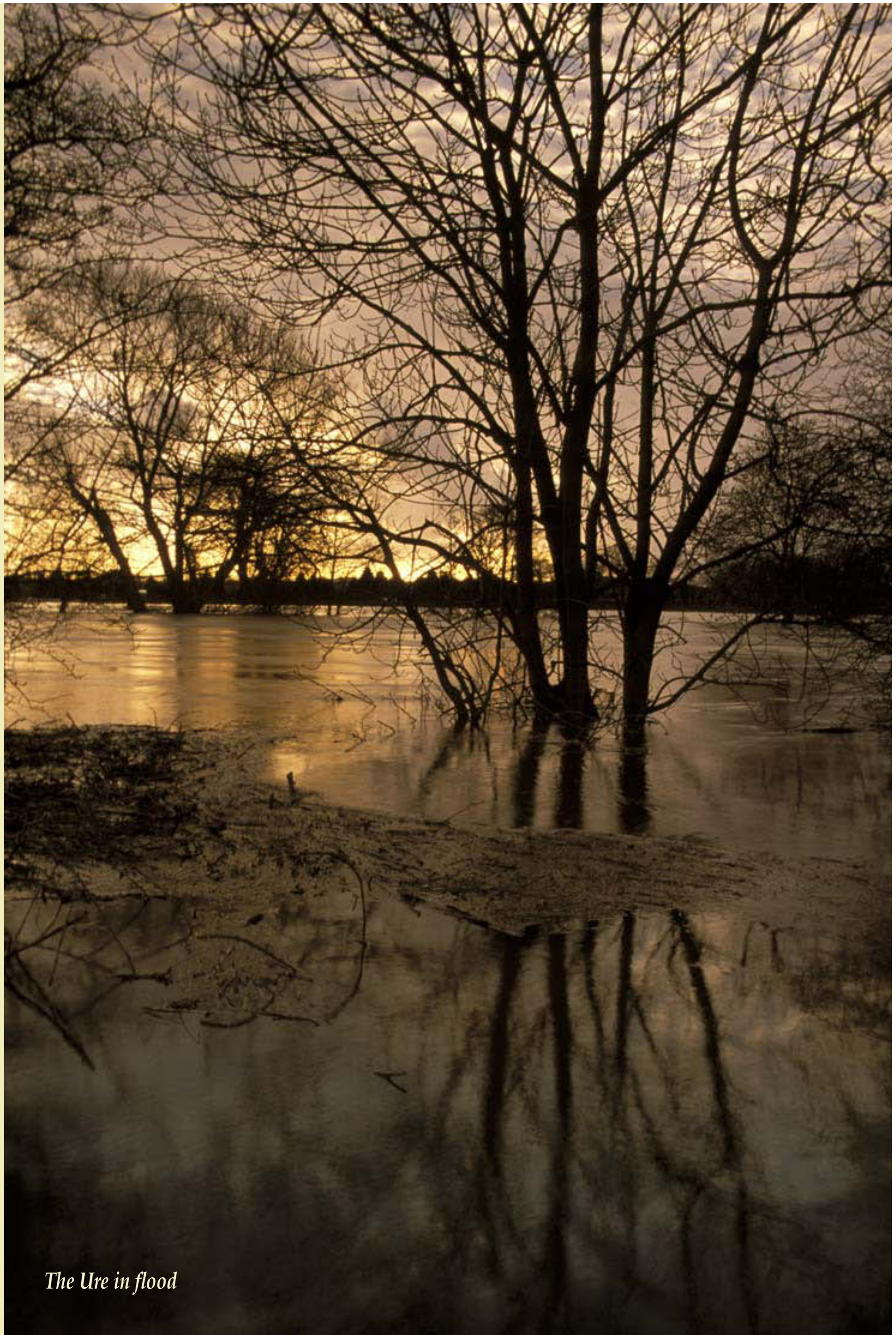
Pollen diagram from Thornton's Plantation, Pickhill

Conclusions

Since the last Ice Age, the two main rivers of the washlands – the Swale and the Ure – have flowed continuously across this changing landscape. After emerging from beneath the ice they were characterised by high energy and abundant sands and gravels. As time passed, they stabilised and flowed through extensive wetlands with only limited human impact. With the advent of agriculture, the rivers began to transport sand and silt loosened from the soils by the first ploughs. A shift to a wetter climate from about 5,000 years ago also promoted increased flooding. As populations grew and technology improved, so the axe and the plough brought further transformations to the washland landscape and to the rivers. More and more sediment washed from the immediate uplands and also from much further upstream. This process continued to increase with, for example, the development of metal mining in the Pennines.

Today, many processes combine to destroy or bury the archaeology of the washlands. Deep ploughing and sub-soiling can damage and flatten near-surface landforms and archaeological sites, whilst soils washed into the rivers are redeposited downstream in thick slugs of sediment, blanketing and burying archaeological sites deep below the present surface. The extraction of minerals from the floodplains, principally sands and gravels, also removes and destroys archaeology, landforms and sediments. Urban expansion, road schemes, and flood defence construction all threaten the fragile and important landscape and sediments of the Swale-Ure Washlands.

In many ways our work has only scratched the surface of the landscape history of the washlands. We have been able to sample only a dozen sites across the region, mostly in the Ure Valley but also a scattering in the Swale Valley. Each site provides a narrow window into the past, which is an opportunity for us to catch a glimpse of the former washland landscape and, if we are lucky, the activities of its people. No single site can cover the entire period since the last Ice Age, nor can any site on its own represent the wetland history of the washlands. So, a continuing challenge for us and others is to collect further data from additional sites, covering new time periods and new depositional environments. Only then will we be able to place the local patterns and processes identified here in terms of the wider processes of climate change, landscape history and the dynamic interaction between environment and society since the end of the last Ice Age.



The Ure in flood

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