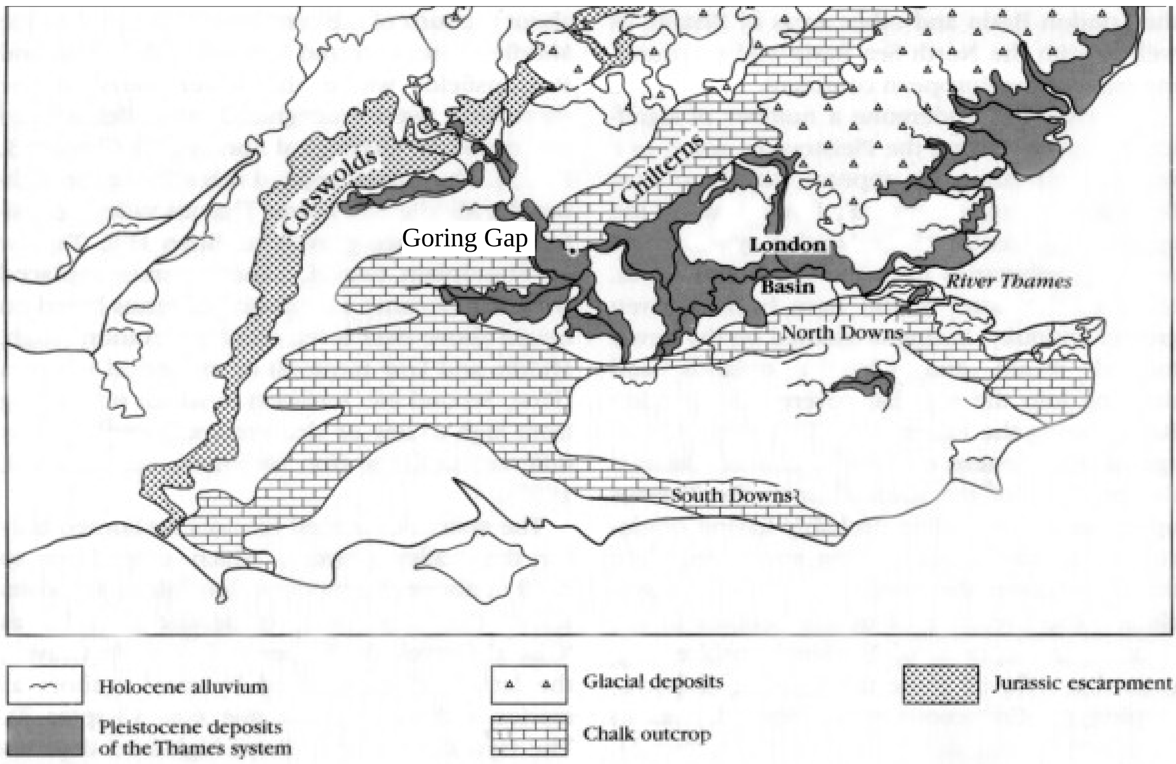
Paper on the physical evolution of the River Box and its valley
by Roger Loose MA(Cantab) February 2026.

Introduction:
The landscape on either side of the River Box today is low, gently undulating plateau. Even though the river has carved a significant valley through it, the land surface gives no hint of the once considerably greater relief. A concealed rock surface underlies thick glacial deposits of Chalky Boulder Clay, sands and gravels that are up to 30 metres deep. This rock surface was carved by weathering and water erosion over millions of years before the ice ages. It lies on a solid rock basement of Chalk which is itself underlain by older harder rocks. We do not see the Chalk at the surface here because it is covered with younger London Clay and recent glacial deposits. Only near Bury St Edmunds and to its north and west is the chalk really close to the surface.

Approximately 40-60 million years ago Alpine mountain building and folding created a basin shaped downfold called the London Syncline, the rim of which has formed the Chalk hills of the Chilterns and the North Downs.



Extracted from The Pleistocene of the Thames by D.R. Bridgland 1994.
This map is a simplified geology of the London Basin, its surrounding Chalk Hills and rivers, and shows the Goring Gap where the Thames enters it.

Later, over 55 million years, sedimentary rocks infilled this basin on top of the underlying 65 million years old Chalk basement. These included the 50-55 million year old Reading Beds which originally held the very hard “sarsens”, 160 of which we see scattered around the parish today. These were uncovered near the surface and moved by humans from the fields of the valley bottom and the flanks of the River Box and its tributaries.

Stage 1. Before the Anglian Ice Sheet arrived over South Suffolk:
Before the Anglian Ice Sheet arrived the London basin was crossed by the proto-Thames on a very different course to that we know today. It is so called because the ice sheet later diverted its course south to its current position. At that time it drained a large area of the Cotswolds, West Midlands and Eastern Wales. It entered the London syncline/basin in the west at the Goring Gap through the Chalk hills. It then took a course well to the north of its present one through the Vale of St Albans, Ware, north of Harlow, Chelmsford and Colchester, to Clacton and out to the "North Sea" to meet with the waters of the proto-Rhine as shown on the following map.

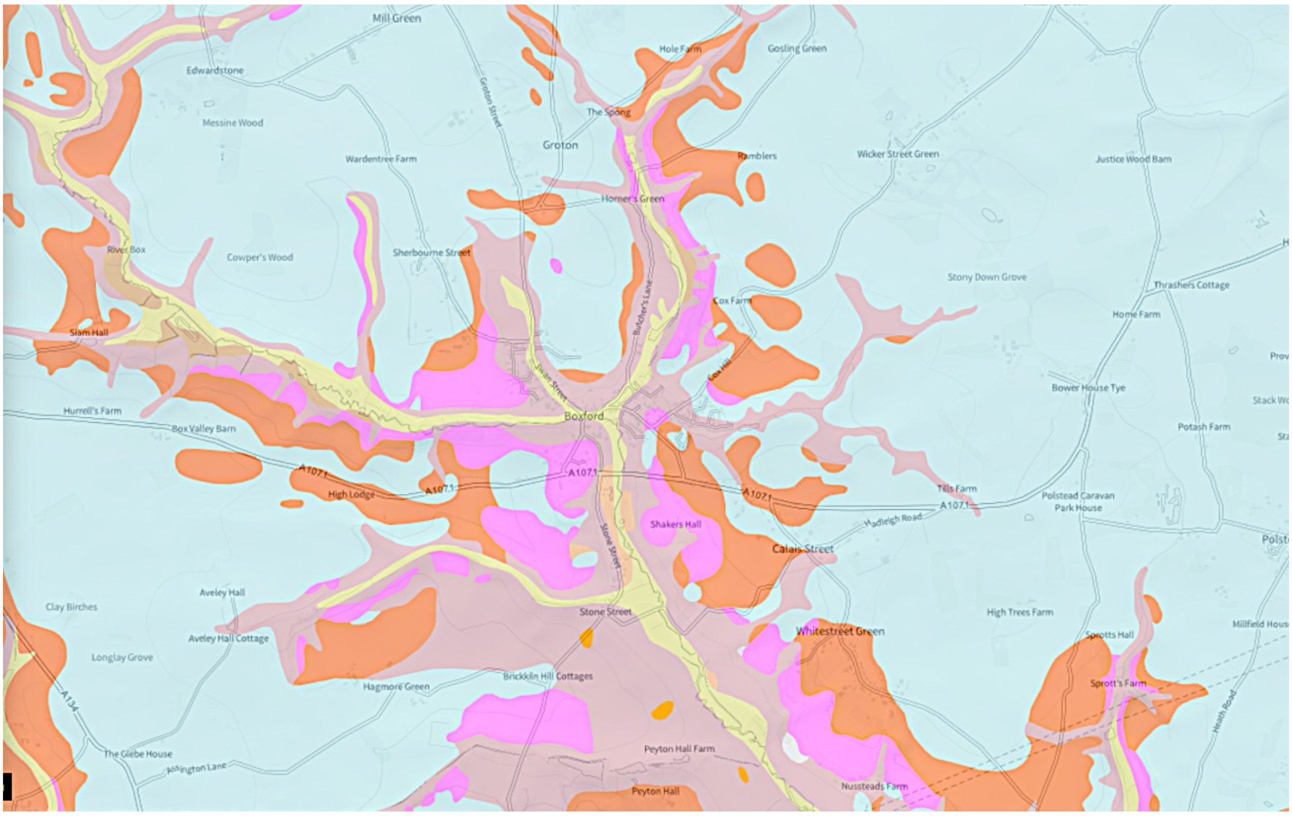
Extract from Quaternary 2022 (see details in Sources at the end)

The syncline opens out and flattens considerably to the north-east as the Chalk escarpment fades into the covered, broad, Chalk dip slope in North Essex and Suffolk. In our part of Suffolk the Chalk basement is only gently tilted (approximately 1 in 200) from NW to SE. This tilt explains why the rivers of South Suffolk and North Essex still flow from NW to SE today.

For millions of years rainfall on this tilted surface had gathered together in linear channels and weathering and river erosion would have produced downcutting and valleys. It is impossible to know the exact drainage pattern then, but it is highly likely that a river followed something close to the present course of the River Box. It would have been a much more powerful river than it is today. All the rivers of NW Essex and South Suffolk including the River Box would have drained SE down this slope to join the proto-Thames as tributaries.

About 2.6 million years ago a period of global cooling began - the Quaternary Period - which we are still in. Alternating cold (glacial) and warmer (interglacial) phases led to numerous "ice ages" in this epoch, which is named the Pleistocene. Geologically, we are currently considered to be in an interglacial phase of the possibly ongoing ice ages.

South Suffolk would have often experienced Tundra-like conditions with a little or no vegetation, freeze-thaw and permafrost before, during and after each "ice age". About 1.8 million years ago, prior to the arrival of the Anglian ice sheet, large amounts of sand and gravel were deposited by the braided, and much larger Thames catchment and its tributaries across Essex and Suffolk on wide river terraces to form the Kesgrave Beds. These overlaid the earlier rocks of the area and for the most part lie under the later glacial deposits today, but patches are found along the flanks of the Box Valley just beneath the subsoil.



Extract from the British Geological Society Viewer. Kesgrave Beds shown in lilac.

These sedimentary river deposits are sand and gravel and range from coarse to fine-grained. They form beds and lenses of deposits reflecting the channels, floodplains and levees of the proto-rivers. They contain much quartz from their source on the much older rocks of the West Midlands, Welsh Borderland, south-western Pennines, and from volcanic rocks of northern Wales.

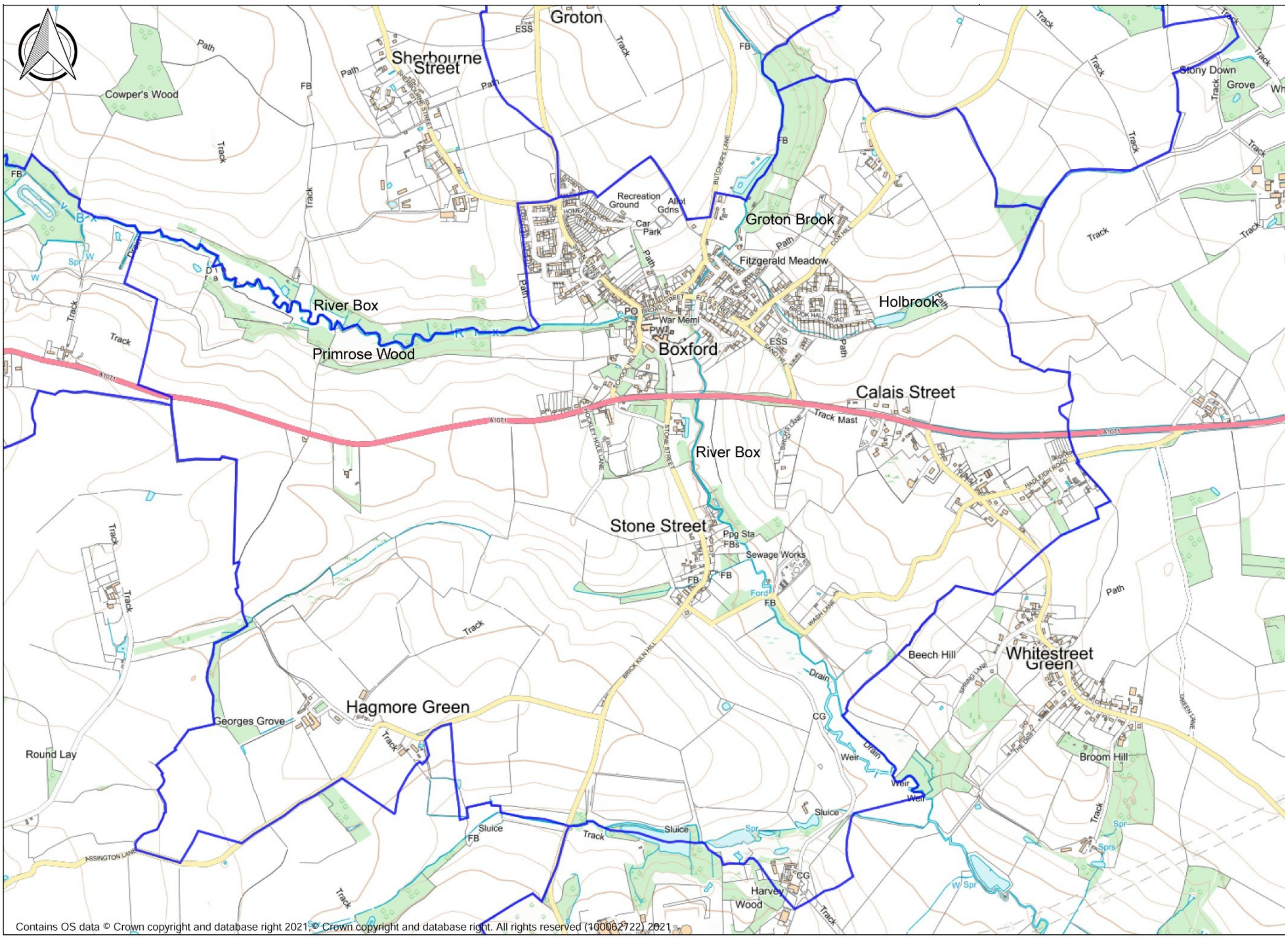
Stage 2 The Anglian Glaciation:

The most extreme ice age, the Anglian Glaciation, occurred 450,000–424,000 years ago when the planet entered a particularly cold phase. Precipitation fell mainly as snow rather than rain, particularly in the mountains of Scotland and Norway. Huge glaciers merged into one large ice sheet which spread south across England and the North Sea under the weight of ice accumulated and gravity, almost reaching London and the Bristol Channel. It spread south and east to form an ice front at the Vale of St Albans, Ware, Brentwood, Maldon, Colchester, Ipswich and Hollesley, where melting and forward movement were roughly in balance. Two lobes of the ice sheet protruded south from the ice front across the Vale of St Albans, blocking it, permanently diverting the River Thames from its original course to that we know today.

We can tell that this moving ice sheet originated in Scotland and Norway from the rock waste it carried south and deposited. Some of these so called “erratic” rocks and pebbles can be linked to a particular rock strata in the highlands of Scotland and Norway as well as Northern England. The ubiquitous flints in our fields are also erratics torn from the chalk just to our north as the ice moved over it.

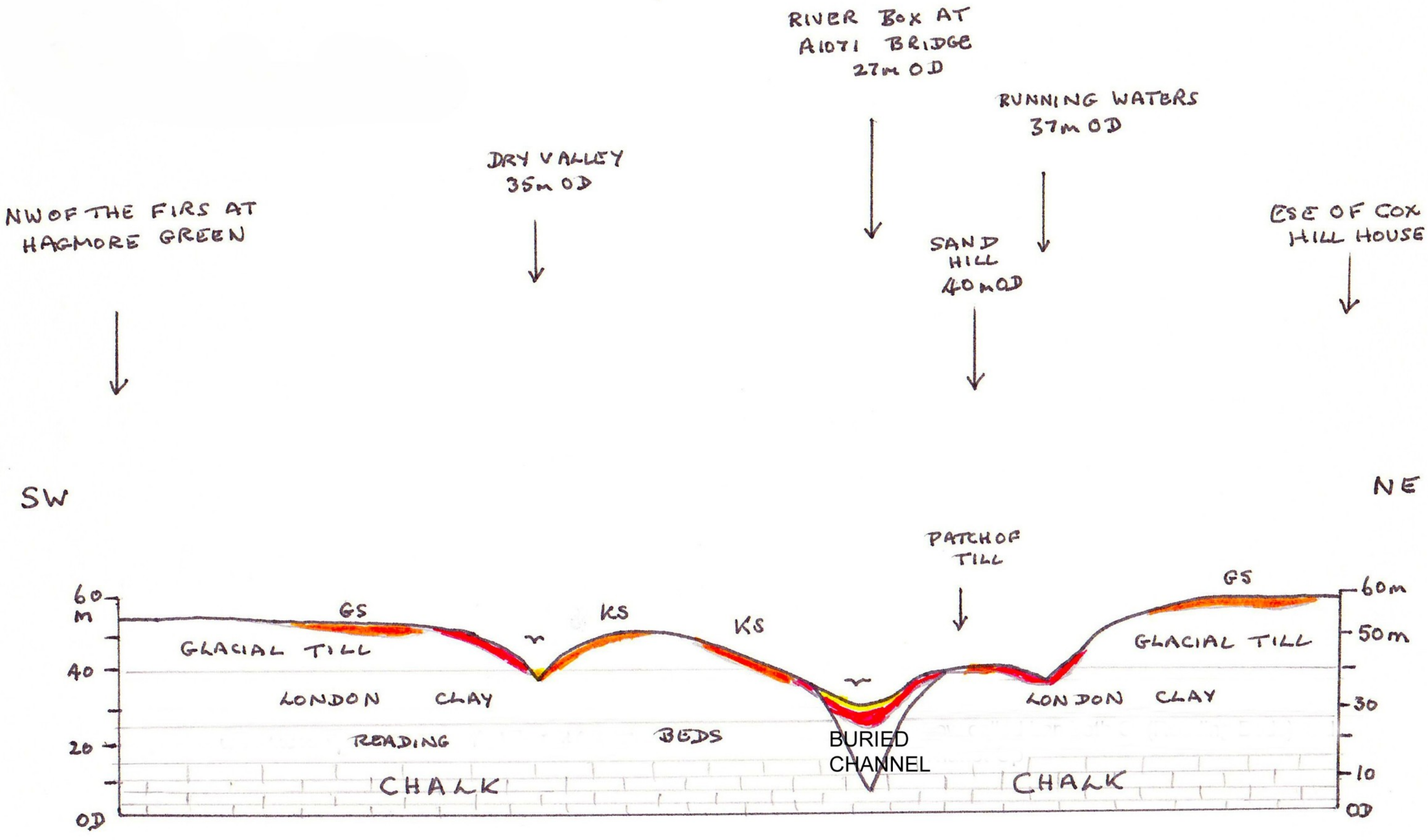
The Anglian ice sheet covered the whole of Suffolk and much of Essex in ice up to 1000m thick. This meant that the whole of the Boxford area was covered in thick moving ice. Meltwaters beneath would have escaped SE and become concentrated in tunnels and channels beneath the ice, deeply eroding the older rocks below. The rock carrying Anglian ice sheet abraded and eroded the underlying rocks it crossed north of here and ground them down into everything from fine clay to sand and coarse gravels. Meltwaters flowed above and beneath it, depositing sand, silt and gravel.

This is when the present course and valley of the River Box were firmly established and over deepened as the waters were running to a much lower sea level from a landscape under the ice which was at a higher level than today. We cannot know whether these waters were following a pre-existing valley, but it seems likely. Meltwater was concentrated in a tunnel under the ice sheet and it eroded a very deep channel as the waters flowed SE towards the ice front. This left a very deep "tunnel" valley after the ice melted. Boreholes along the valley floor indicate that this over-deepened valley stretches from close to the western boundary of the parish at the west end of Primrose Wood to far down stream. It is likely that the valley of its northern tributary, the Groton Brook*, which joins it in the centre of the village by the Causeway, is also over deepened for a short distance from Horners Green.
(* I have used the name Groton Brook throughout for this otherwise unnamed stream.)



None of this is visible today as it was later deeply filled with gravel and glacial till and much more recently alluvium to form the valley floor we see today. Alluvium is the unconsolidated clay, silt, sand and gravel deposited by the river as sediment in the bed of the stream or on its floodplain.

In addition to the great thickness of chalky boulder clay deposited by the ice, the associated meltwater deposited silt, sand and gravel on, within and below the ice sheet and gouged out a deep subglacial trough along the line of the pre-existing valley. The meltwater beneath the ice had great erosive power because it was under hydrostatic pressure to a lower sea level. This greatly over deepened the Box channel to produce what is called a "tunnel" valley. (see the buried channel in the cross section below)



SKETCH GEOLOGICAL SECTION THROUGH THE BOX VALLEY

KEY:
OD means Ordnance Datum: metres above sea level as defined by Ordnance Survey.

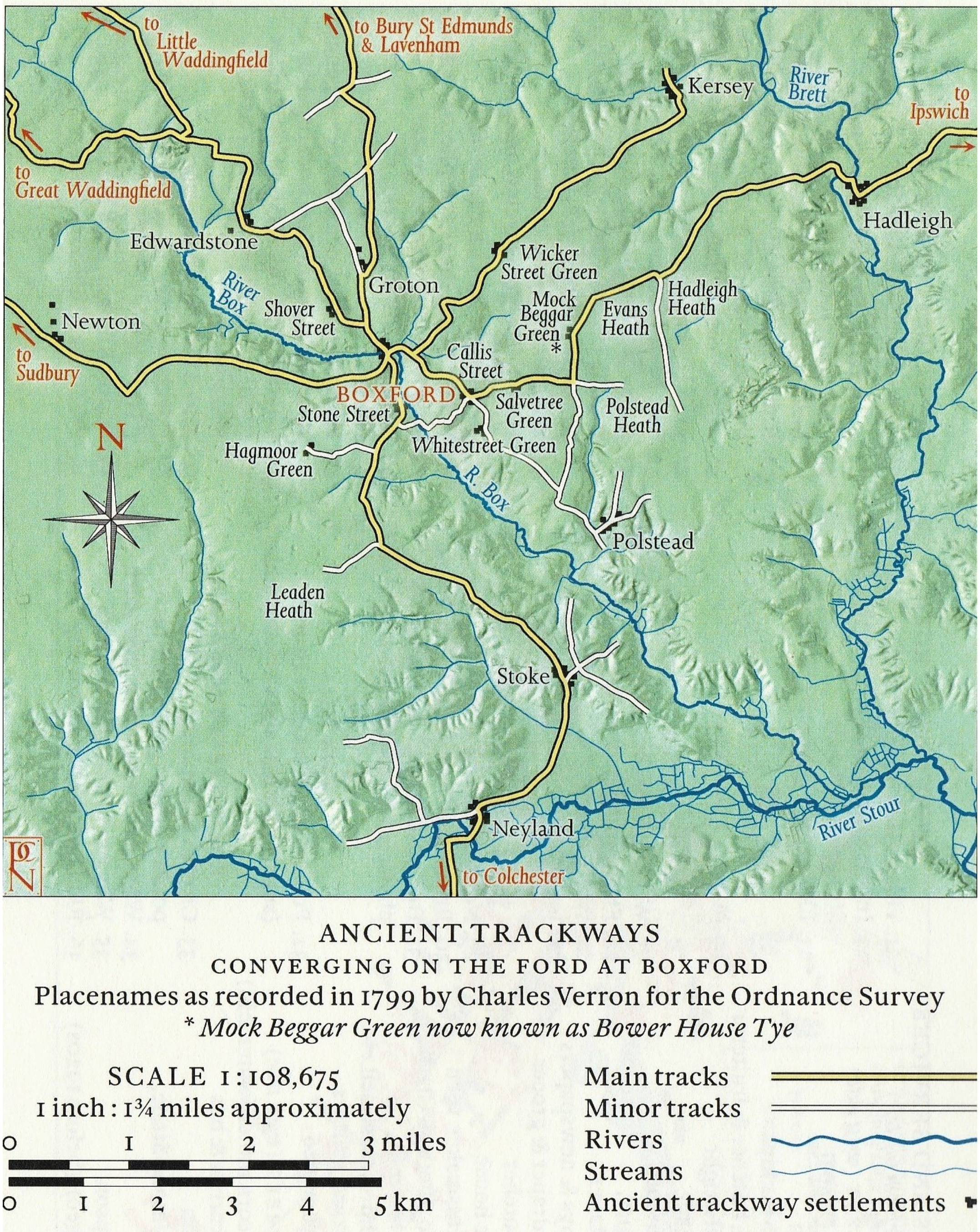
YELLOW indicates alluvium laid down on the valley floor by the river flooding and soil creep after the ice age.

RED indicates "Head". Poorly sorted and poorly stratified, angular rock debris and/or clayey hillwash and soil creep, mantling the hillslope and valley. This filled the buried channel after the ice age.

ORANGE indicates sands and gravels. (GS: Sands of glacial origin, KS: Kesgrave Sands and Gravels) These lie on top of and beneath layers of Glacial Till, much of which is Chalky Boulder Clay.

The buried channel under the present valley floor was cut down through the London Clay that underlies the Boxford area and into the Chalk beneath to a height of only 6 metres above present sea level. This was possible because sea level would have been at least 120 metres lower during the Anglian glaciation as so much water was locked up in ice on land around the world. This gave the meltwater/river a much greater fall and erosional power. During the interglacial periods that followed, sea level was even higher than today and the river would have been very sluggish, filling its valley with gravel, sand, silt and alluvium. Notice that the top surface of the Chalk is only 15 metres above present sea level (OD) at Boxford. At the Post Office you are 27 metres above sea level and the Chalk is only 12 metres beneath your feet.

MAP OF RIVER BOX AND ITS TRIBUTARIES TODAY



The River Box today rises a short distance from Little Waldingfield and at first flows SE through a broad, shallow valley. At the western end of Primrose Wood the River Box turns easterly and flows through a narrower valley up to the bridge in the village centre. From the bridge the valley begins to open out but the river is confined within a narrow man made channel. At the Causeway it turns abruptly south at its confluence with the Groton Brook from where the valley broadens considerably down to Stone Street. This right angular sudden turn south is unexpected. There is no obvious or geological or physical reason for it. The most likely explanation is that the Groton Brook was for a time during the ice ages the more powerful stream and the River Box only a tributary of it. The Groton Brook may have had a much larger meltwater catchment than the Upper Box at some point. Only since the ice ages might the Upper Box have developed the much larger catchment. After the A1071 the River Box gradually resumes a more SE course following the original tilt of the underling rocks.

Stage 3: The ice ages after the Anglian Glaciation.
Global average temperatures rose as this very cold period came to an end and rain replaced much of the snowfall on the ice sheet source in Northern Scotland and Norway. The ice sheet therefore lost its energy and stopped moving. It began to decay dropping huge amounts of rock waste and clay as it did so. Much of the low plateau to the north and south of the Box valley is now covered with a 15 to 30 metre thick mask of Chalky Boulder Clay, sands and gravels formed from the ground up rocks.

A borehole was made in April 1935 for the Boxford Waterworks at Cox Hill House which lies at 61 m. above sea level on the clay covered plateau. It was 80 m. deep and struck Chalk at 48 m. down, only 13 m. above present sea level. As expected the top of the Chalk here is 7 m. higher than that under the over-deepened valley floor. From the surface of the borehole, the first 24 m. is boulder clay with glacial sands and gravels beneath it. Then 24 m. of London Clay and Reading Beds lie below that before the Chalk is reached.

Meltwaters flowed from the decaying ice sheet deposited sand, silt and gravel ("Head"), especially in and along the Box valley. As Boxford was so near the front of the ice sheet at its maximum, it would have experienced huge volumes of meltwater moving downslope and re-depositing sand and gravel and resorting the glacial deposits. This process, called solifluction, is a slow, downslope flow of water-saturated soil and sediment. This is common in cold, periglacial areas where a frozen layer (permafrost) prevents deep drainage and causes the surface layer to become waterlogged and slide over the impermeable ground. The over-deepened Box valley was rapidly deeply buried. For example, in the valley in a borehole between the Causeway and Ellis Street, 23 metres of Head fills the "tunnel" valley and sits on top of the Chalk at only 6 metres above present sea level.

After the "retreat" of the Anglian ice, surface drainage resumed. Any irregularities which may have been present on the surface deposits were removed by erosion to produce a monotonous plateau either side of the Box Valley. Continued downwarping of the North Sea Basin has since tilted this surface slightly more towards the east.

The cold periods that followed the Anglian glaciation produced smaller ice sheets which never again reached Suffolk. In the Wolstonian Glaciation (200,000–125,000 years ago) ice covered much of the Midlands. The Devensian Glaciation (72,000–12,000 years ago) was the most recent major glaciation. At its peak 20,000 years ago, ice up to 1km thick covered Scotland, Wales, and northern England, stopping near Wolverhampton and the northern edge of Norfolk.

Tundra-like conditions therefore persisted over South Suffolk for long cold periods, especially during the Devensian, when the ice sheet reached just south of the North Norfolk coast but no further. The bare surface of Suffolk allowed the strong winds to pick up fine silty clays and sand with a high chalk content and deposit them again. They were washed down slope into pools and are 12-15m thick in places. They were excellent for local brick making. There is a patch of this “brickearth” to the north of Ellis Street and west of Cox Hill just below the soil, where a brick and tile kiln existed until the early 1900s. Many of the old red brick walls and buildings in the village are built from these bricks.

During these later glacial and warmer interglacial periods running water and surface creep would have washed the glacial materials downslope into the Box Valley further filling in the now buried channel.

Stage 4: After the ice ages.

The landscape we recognise today around Boxford was completed over these last 12,000 years. Valley infilling continued more slowly with loose materials gradually moving downslope and the river flooded frequently covering the valley floor with the finer materials we call alluvium. These consist of unconsolidated soil, silt, sand, gravel, and clay transported by running water. They and springs account in particular for the fenny and marshy places along the Box Valley.

Gravelly and sandy valley sides with well drained soils rise quite rapidly from the valley floor to the very gently undulating boulder clay covered plateau above, with its heavier soils containing many flints brought from the Chalk to the north. Since Anglo Saxon times man has increasingly firmly shaped this landscape with farms, fields, hedges, woodland and tracks. The river and its valley have guided the shape and development of our village, particularly its layout, which started at the ford/bridge and soon sought the drier ground of the valley sides. In Anglo Saxon times, the river was called the Amalburn. It is not known when it was first called the River Box. The village was known as Kodenham after its manor in Norman times, but by 1286 it had become Boxford, named after its many box trees. The river may have been known as the Box by then too or perhaps this came much later.

The course of the River Box has become ever more firmly established, but the climate has varied, albeit much less than before, with warmer and wetter periods. The medieval warm period from 1170 to 1310 was followed by an up to 60% wetter period up to the 1600s. As a result the base flow of the river would have been deeper and wider at times permitting a degree of navigation and use for transport. At this time there was a grain mill up river towards Newton and it is said that grain was transported downstream from there. Over the centuries the channel of the river through the village centre has been straightened, narrowed, walled and “canalised”. The watermill was partly responsible for this. This stood just above Boxford bridge for perhaps 700 years before it was burnt down in 1934. Its sluice and millpond were destroyed by a flood in 1935. In the early 1900s the millpond was used for boating and skating and an ice festival was held on it.

There is some evidence that the Caen limestone brought from Normandy in the late 15th century for the south porch of St Mary's Church came up river on flat bottomed barges from the Stour and was unloaded on a wooden platform below the church. There were certainly water-driven fulling mills with wooden hammers on the river and the Groton Brook during the 14th and 15th centuries to support the prosperous cloth trade. Fulling cloth is a traditional textile finishing process, especially for wool. It involves cleaning, shrinking, and thickening woven fabric by pounding, it with water, and sometimes with fuller's earth, soap, or urine, to cause the fibres to mat and interlock. This creates a dense, smooth, water-repellent material with a felted surface, improving its warmth and durability. However the river flow was not sufficient to provide significant water power here when the industry became more mechanised. This is one of the many reasons why the cloth trade declined here and migrated to Yorkshire. The river water has been much used for leather tanning and malting water over the centuries too.

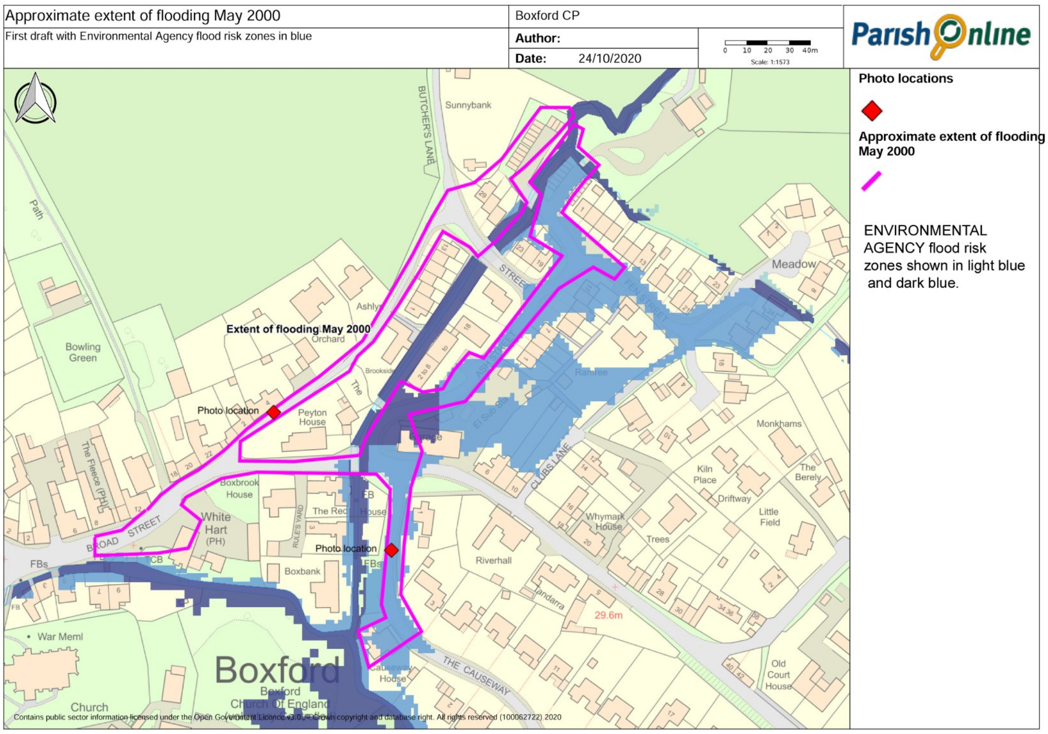
Upstream from Boxford, over the last 75 years, there has been significant licenced abstraction of water for farming and irrigation, from the river and boreholes into the aquifer beneath. The underlying Chalk and rock aquifer have been depleted and water levels within it have fallen. This has greatly decreased the volume and average depth of the river. As a result springs and seepage along the valley are much reduced leading to a lower base flow in the river for much of the year. Increasingly, fertiliser, pesticides, weedkillers and farm sludge leaking into it have polluted it. It is mostly agricultural run off of nitrates and phosphates. There also is a sewage treatment works close to the headwaters at Little Waldingfield. The heavy rainfall from Storm Babet in October 2023 led to raw sewage being released into the river. It is to be hoped that modifications since will prevent a further discharge. Pollution is undoubtedly affecting the quality of the water and the amount and variety of wild life. The Essex River Watch describes its Ecological Status as only "Moderate", in the middle of a 5 point scale ranging from "High" to "Bad".

The History of Flooding in Boxford

Damaging floods have occurred in the centre of the village since it was first settled. The site of the early village by the bridge, where the valley narrows considerably and there is no floodplain, was chosen to limit flood damage. However, there are historical and recent records of the flooding affecting the Post Office, Broad Street and The White Hart when the River Box has overflowed its banks. Equally damaging have been the occasions when the brook descending from Horner's Green and Groton and its tributary descending from the Brook Hall Road area have overflowed. Although these streams have relatively small catchment areas, they can produce a very fast, high run-off during a short burst of intense rainfall. Climate change is already making such periods of intense rainfall heavier and more frequent.

In 1845 a "barrel" drain was placed under the length of Swan Street, mainly to take storm water down to the River Box and stop floods coming off the fields and down the hill from Groton. Despite this, the worst flood recorded was on 18th September 1888 when water rushed through the village causing considerable damage to houses and The White Hart. It is not clear whether this was the result of the River Box overflowing or all three possible sources. The river itself was by this time normally confined by walling to its present quite deep channel through the village centre along Broad Street, but it would seem that this has not always been sufficient to prevent bank overflow.

In May 1924, after a big storm, water from the Groton Brook rushed down Butcher's Lane one and a half feet deep. In 1935 a flood destroyed the Box millpond and retaining sluice gates and threatened the village. In 1939 the village centre was flooded again. After a very snowy winter, the big thaw in March 1947 flooded the White Hart and Post Office Stores when the River Box overflowed. More recently “flash floods” through the village seem to be the result of short but intense rainfall in a major thunderstorm bringing more water down from Groton than the brooks, culverts and drains and Swan Street can cope with. This happened in 1992 when water, soil and stones ended up in Broad Street and the Post Office Stores.



The flash flood of May 2000 described locally as a “cloudburst” brought water lapping at the steps of the Fleece and into two houses in Ash Street, in some places two feet deep. In Butcher's Lane it flowed like a river a foot deep, escaping into Broad Street and flooding a 200 yard length of the street and finally escaping into the River Box by the Old Gaol.

PHOTOS May 2000 flood – Butcher's Lane and the Causeway:

The water arrived in the village at 7.00 pm following a storm over Groton 90 minutes earlier. It was reported that the water rose five feet at one place in half an hour, probably when a blockage higher up collapsed. The White Hart was flooded and needed new carpets throughout. A one foot deep flow down Ash Street escaped partly through Riddellsdell's garage, over Ellis Street, down The Causeway and through gardens into the river. Fire crews from Sudbury, Nayland and Hadleigh were called to help with pumping out.

Since then Babergh District Council and the Environment Agency have taken steps to increase the watercourses' capacity. There have been improvements to the channels and bridges at Fen Street, Ash Street and Ellis Street and the Environment Agency has improved the River Box channel through to Stone Street hamlet. The building of the Station Field estate in 2016 required an underground attenuation system to slow drainage to the stream. Since all these various works there have been several times that the river and Groton Brook have reached the “bankfull” stage (close to overflowing).

During the night of Storm Babet in October 2023 the River Box did overflow a little way into Broad Street by the Old Gaol. With climate change already bringing much more frequent, intense rainfall, recent channel works may not be sufficient in the longer term to prevent a repeat of flooding in the village.

CODA:
The Pleistocene epoch of ice ages ended about 12,000 years ago when global climate became more equable. This is very recent in a geological sense. Hence the view that we might still be in an interglacial period! The ice ages demonstrate just how extreme the natural climatic variations of our planet can be. The recent Holocene epoch has had a more stable climate and since it began 12,000 years ago, Homo Sapiens has continuously occupied the UK, having first emerged in Africa 300,000 years previously. Until 200 years ago the impact of mankind on the planet was very limited, but since the 1950s in particular, we have entered a human-dominated era, characterised by rapid and significant planetary alteration. So much so that it is now proposed that we call the present period the human-dominated Anthropocene.

The average temperature across the world has risen by at least 1 degree Celsius since 1850 and at an ever steeper rate recently. This may not sound much, but we are already feeling its effect in more extreme weather. As the atmosphere, earth and sea heat up we are already seeing more storms and intense rainfall as warmer air holds more moisture. We may be approaching several “tipping points” resulting, for example: from the cessation of the North Atlantic Drift circulation, reduced Polar ice sheets and sea ice cover, dieback of the Amazon forest or melting permafrost. Any of these could result in a sudden and very rapid increase in temperature, the intensity of rainfall and a rise in sea level. These, together with the degradation of the planet through resource extraction, industrial farming methods, the still rising use of fossil fuels and production of greenhouse gases, threaten our very existence in a myriad ways. We need to be much more aware of how fragile our climate and world are and take dramatic steps to rethink our use of the planet and mitigate these changes.

Sources:
Geo Essex https://www.geoessex.org.uk/the-early-ice-age/

The British Geological Society Viewer. http://bit.ly/4kwMKAF

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A Review of Event Deposits in Lake Sediments Volume 5. Issue 3 | September 2022 MDPI. https://bit.ly/4rDsy2o

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