

## Peat subsidence at the Holme Post

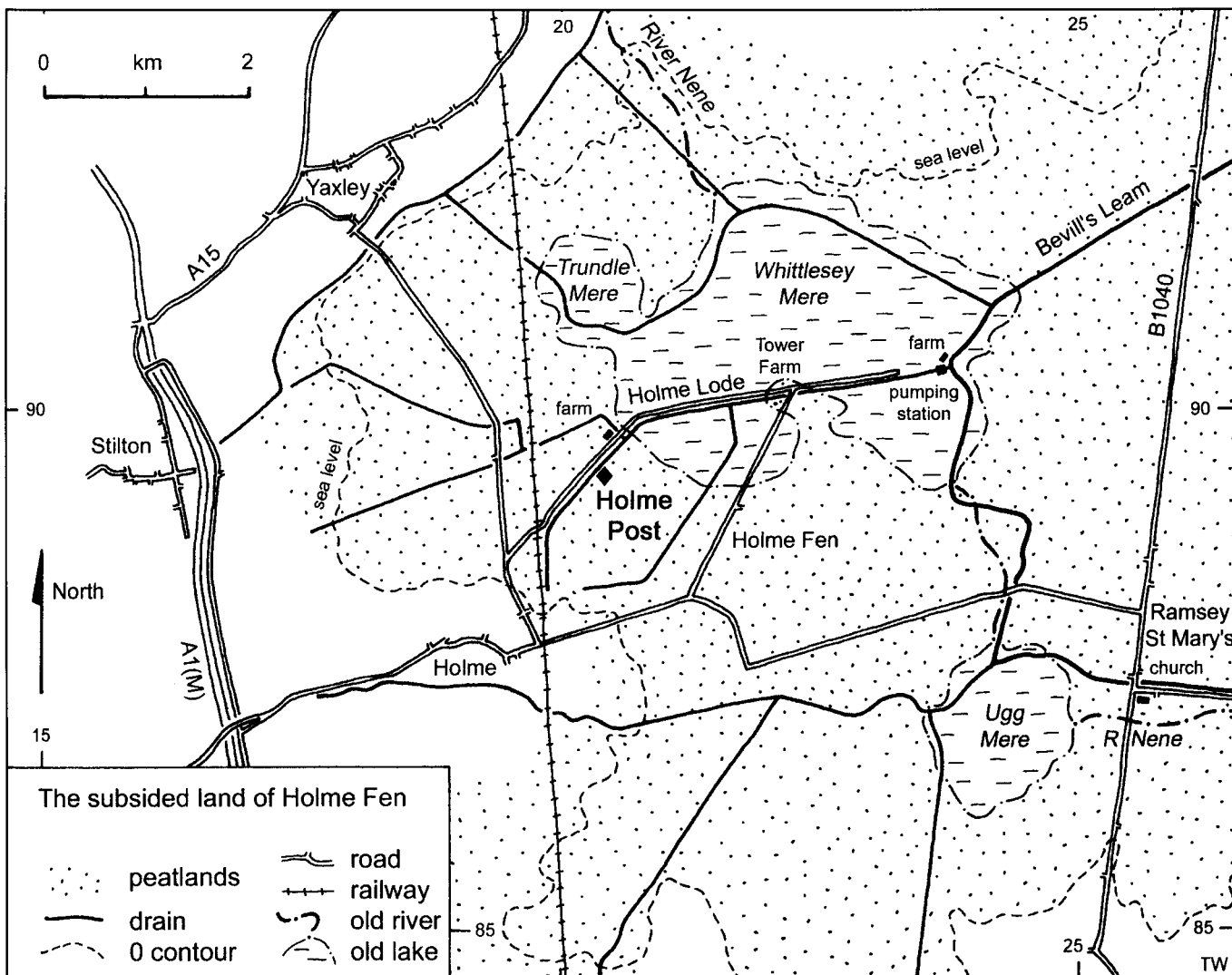
The fenlands along the eastern borders of the East Midlands are Britain's largest area of peat soils. Prized by the farmer as a rich organic soil, peat is dreaded by the engineer because it is weak and compressible and is highly shrinkable when it is drained. When the natural marshes of peat lands are drained to make them useable and inhabitable, the ground surface subsides. It's a phenomenon known worldwide, and the world's finest record of land subsidence on peat is provided by the Holme Post, just 9 km due south of Peterborough cathedral.

The fens occupy a large swathe of lowland that broadly follows the outcrop of the Jurassic Oxford

Clay. South and inland from the zone of estuarine sedimentation adjacent to the Wash, peat growth has dominated surface processes throughout post-glacial times. The black fens originated as a sea of waterlogged vegetable matter, but only really earned their name when they were drained to expose the black peat soils that could be farmed.

## Drainage of the fens

Some small areas of the fens were drained by the Romans, but the main engineering works that drained huge areas date largely from the 1600s. Cornelius Vermuyden brought his experience from Holland to control the River Ouse and drain the Bedford Levels in 1630 and 1650. Control of the River Nene was ahead of its time. The river's original course took a great loop southwards from Peterborough, until the Bishop of Ely, John Moreton, had the channel cut straight through to Wisbech before 1600.



**Figure 1.** Outline map of major past and present features around the Holme Fen. The old meres are shown as they were before 1800, and features that no longer exist are labelled in italics. The extent of the peatland is approximate, and only main drains and relevant roads are marked.

Bevill's Leam and the Twentyfoot River were cut in later years to drain a swathe of new farmland south of the Nene (that was already in Moreton's channel). Ground subsidence, that followed the fen drainage, was soon recognised as inevitable and relentless. Pumping stations were built to raise water into the rivers from the new drains on the subsiding peat, and the rivers had their levels maintained between new embankments in order to ensure their gradients to the coast.

Holme Fen lies just east of the villages of Holme, Stilton and Yaxley, that all lie on clay "upland" only slightly higher than the drained fen. The sea-level contour almost follows the western margin of the peat fens (Fig. 1). Before drainage, the fens contained many shallow lakes, of which Whittlesey Mere was one of the largest. The River Nene originally flowed through this mere, then south to Ugg Mere, before turning east towards the Ouse. By 1851, silting and peat expansion had reduced Whittlesey Mere to about 400 ha and only a metre deep. In that year the mere disappeared, when new drains carried waters to a pumping station and up into Bevill's Leam. The drainage turned both the mere and the Holme Fen into useable farmland, but subsidence followed.

### The Holme Post

In anticipation of the ground subsidence, the landowner had an oak pile driven through the peat and firmly embedded in the underlying clay; he then cut the top level with the ground in 1851 and used it to monitor the peat subsidence. A few years later, the oak post was replaced by a cast iron column, that was similarly founded on timber piles driven into the stable clay, with its top at the same level as the original post. This is the Holme Post that survives today (at NGR TL203895). As it was progressively exposed it became unstable, and steel guys were added in 1957, when a second iron post was also installed 6 m to the northeast. Both posts are standing today.

The post now rises 4 m above the ground, and provides an impressive record of the ground subsidence (Fig. 2). Sea level is close to the collar that links the steel guys, and this is now the lowest land in Britain. It is readily accessible, beside the one road that loops across Holme Fen east of the railway (Fig. 1). Though the subsidence has now slowed to a rate that is only recognisable over a decade or more, a series of isolated observations clearly records the ground movement since the peat was drained (Fig. 2).

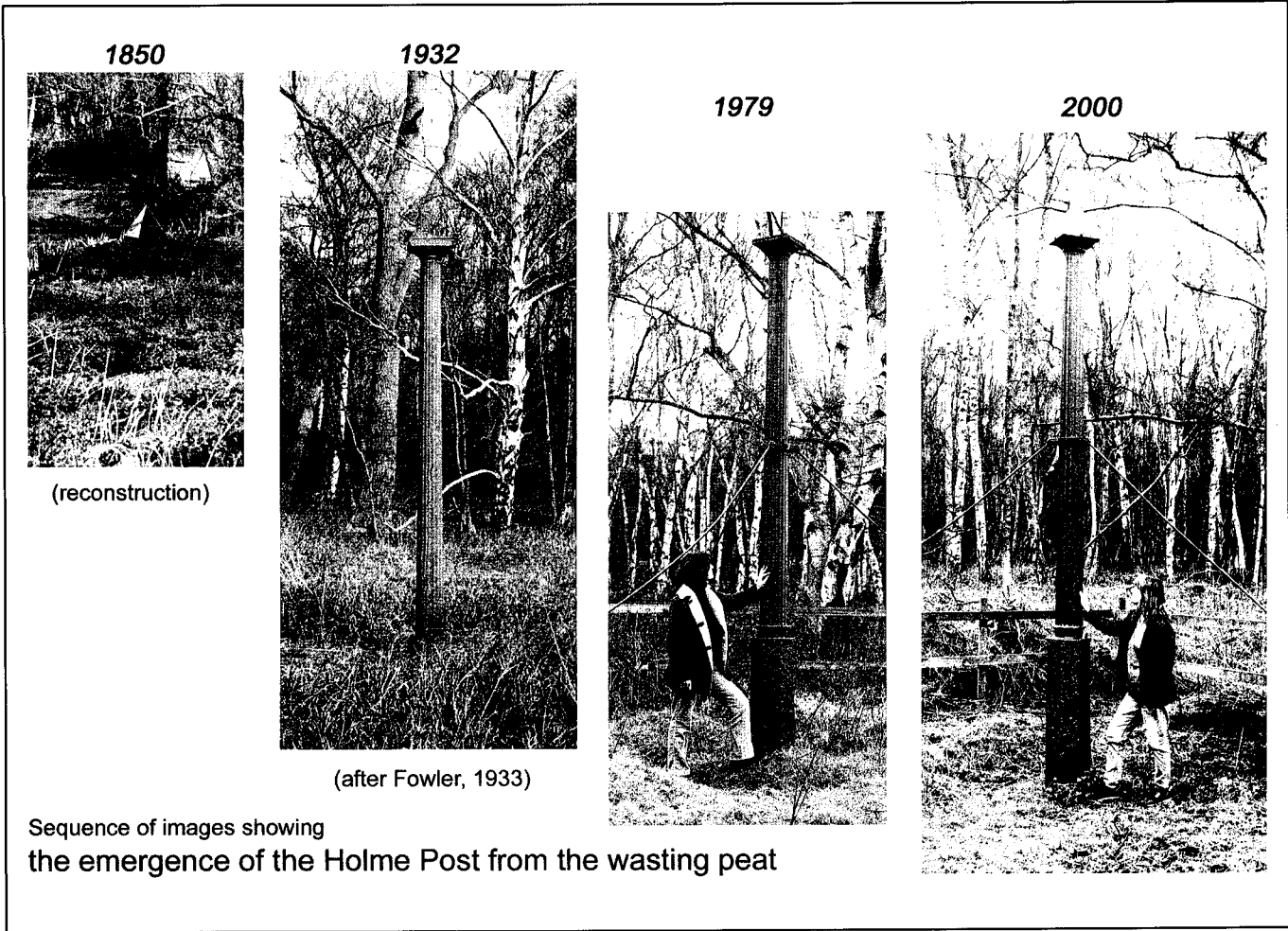
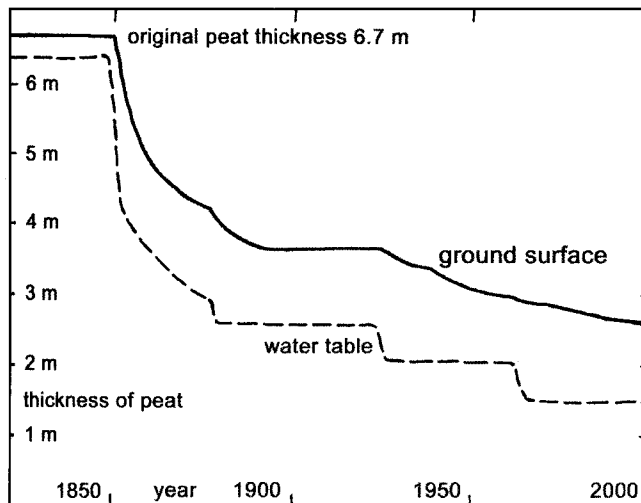


Figure 2. The Holme Post, today and in the past.



**Figure 3.** The record of ground subsidence on the peat over 150 years at the Holme Post, correlated with water table levels that declined in response to the successive stages of pumped drainage.

There is a clear correlation between the ground subsidence and the land drainage. The ground in Holme Fen subsided by nearly 2 m in the first decade after its initial drainage, and thereafter subsided at a declining rate. In the period 1890-1925, there was no measurable subsidence while birch woods progressively replaced the arable farmland. Since then renewed pumping has lowered the water table and induced further slow subsidence. This appears to continue today, but is on a smaller scale than the annual ground level fluctuations of about 50 mm (as the land absorbs and loses water).

### Peat subsidence

Ground subsidence on peat (without any loading compression due to buildings) is due to a combination of consolidation and wastage. Consolidation causes the rapid initial movement; the loss of water pressure allows the extremely porous peat to collapse and restructure, thereby increasing its density but greatly reducing its volume. The peat of Holme Fen subsided by 1.8 m when the water table first declined by 2.8 m. This subsidence, that was 65% of the water table decline, is typical of initial subsidence rates recorded worldwide; the ratio fell to 30% after subsequent phases of renewed drainage of the partly consolidated peat.

Wastage is a subsidence process that is unique to peat soils. Drained peat simply oxidises into various gases and therefore disappears, in a perfectly natural process of biodegradation. Saturated peat is stable because oxygen cannot reach it. But sadly, as soon as unusable wetland is drained to create farmland, it immediately starts to disappear by wastage. This causes surface lowering of about 10 mm/year at Holme Fen, but greater wastage rates occur where the water table is deeper (exposing more dry peat) and in warmer climates (where oxidation is more

rapid). In drained land, wastage continues until all the peat is gone. Peat is a wasting asset – it can be drained and farmed only at the cost of its inevitable destruction. The area of peatlands in the Fens is less than half of what it was 400 years ago, but fortunately the exposed underlying clay can support productive agriculture.

Peat creates unusual problems for engineered structures due to its subsidence and also its negligible strength when saturated. Older farmhouses in Holme Fen stand on timber piles that are founded in the underlying clay. Piled buildings remain stable while the ground subsides around them; because of this, Ramsey St Mary's has one of the many fenland churches now entered up a flight of steps. Also on piles, both Tower Farm and the farmhouse beside Holme Lode (Fig. 1) post-date the fen's initial drainage and rapid subsidence, so they stand only a little above the surrounding ground. The Whittlesey Mere pumping station (rebuilt in 1961) and the farm beside it are both stable on the silty sediments along an old channel of the Nene at the edge of the mere. Drained peat does have a low bearing capacity, and many later buildings are founded on rafts that impose minimal loading on the peat.

Roads across the peat were traditionally built on banks of faggots, peat and bundles of brushwood, so that they literally floated on the mire. The East Coast railway crosses the western edge of Holme Fen. It was built, just before the fen was drained, on a low embankment of faggots and peat sods; this was constructed slowly while it settled into the mire, squeezing and densifying the peat without rupturing it, until it could bear the load of the ballast and the trains. A hundred years later the track was still subsiding by 10-20 mm/year, but it now appears to rest on a buried mass of fill that reaches to the clay, having squeezed the peat out to the sides. At the level crossing on the approach to the Holme Post, the track is in excellent condition, though now well above fen level; and amplified vibrations from a passing train are a reminder of how unstable the peat is on either side of the line.

### Literature

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Tony Waltham  
 Nottingham Trent University