DISCOVERING BRITAIN

Royal Geographical Society with IBG

Shaping the landscape

A self-guided walk around Ludlow in Shropshire

Explore a different side of a Shropshire market town
Discover how icy torrents of water reshaped the landscape
Find clues to the power and extent of natural forces
See how humans have made use of the geological legacy

www.discoveringbritain.org

the stories of our landscapes discovered through walks

Contents

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Cover image: Ludlow in frost from Whitcliffe Common © Shropshire&TelfordTSB, Flickr (CCL)

Shaping the landscape

Discover the dramatic impact of glaciers in Ludlow

There is much more to Ludlow than meets the eye. This walk tells the story of the most dramatic events ever to affect this picturesque Shropshire market town.

Visit beautiful viewpoints, stroll along tranquil riverbanks, explore medieval streets and enjoy lush meadows whilst discovering how the landscape was utterly transformed by natural forces.

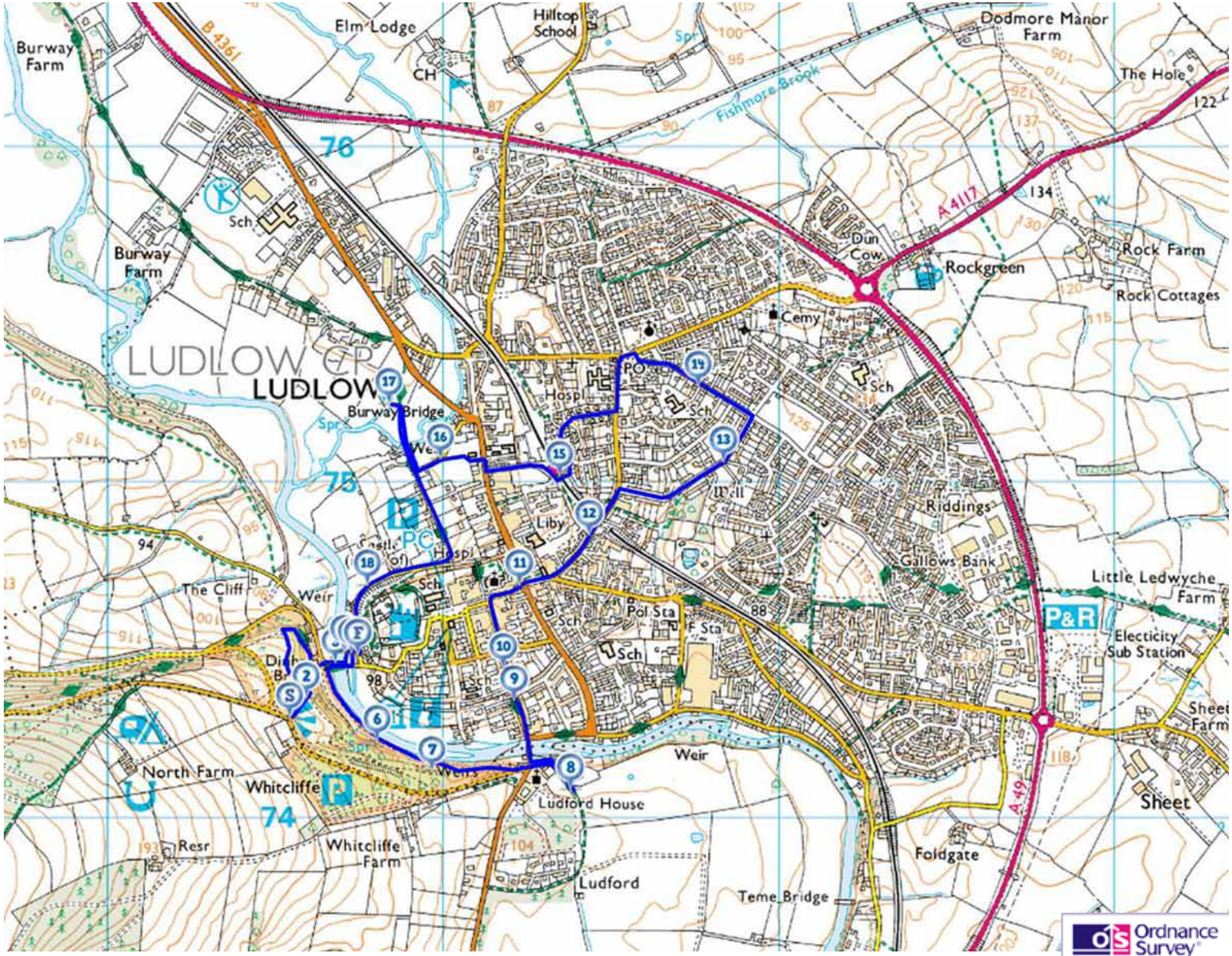
This is the story of ice and water. Three glaciers came very close to this area and the water that melted from them reshaped the landscape. Rivers changed direction, gorges were cut out by torrents of icy water and vast amounts of sediment were dumped.

Along the riverbanks and across the town – in street names and road layouts, in sewers and churchyards, in building stones and cobblestones – there are clues to what happened tens of thousands of years ago.

Find out how humans have made use of the landforms created by melting glaciers and how the area's geological history still affects life in Ludlow today.

Top: Early morning mist along the River Teme in Ludlow © Ian Capper, Geograph (CCL)
Bottom: Cobbled verges in Upper Broad Street © Michael Rosenbaum

Route overview



Practical information

Location	Ludlow, South Shropshire
Start point	Viewpoint, Whitcliffe Common, Whitcliffe Road, Ludford, Ludlow (postcode of nearest building SY8 2HB)
Finish point	Dinham Millennium Green, Linney, Ludlow, SY8 1EG
Walk distance	3 ½ miles
Shorter option	Stops 13 and 14 can be omitted, thereby reducing the route by 1 mile
Level	**Gentle** – An easy walk around the town and riverbanks; there are steps in several places along the route (between Stops 2 and 3, between Stops 6 and 8, and at Stop 15)
Terrain	The walk is largely on pavements and well-defined tracks paved with gravel or floored by bedrock, for which strong shoes are adequate.
Conditions	The tracks floored by bedrock can be very slippery when wet. The town can be busy both with people and traffic.
Suitable for	**Families** **Pushchairs / Prams** - provided the parents can carry these up the few steps en route **Disabled/Mobility impaired** - there are steps as noted above; the steps at Stop 15 can be avoided by taking the footpath above the tunnel mouth at the south end of the station **Dogs** - although they need to be under control throughout
Refreshments	Ludlow has a reputation as a gastronomic centre so there is an excellent range of cafes, restaurants and pubs all with a strong emphasis on local produce. Particularly recommended are: **Green Café** - Castle Mill, Dinham Millennium Green (Stop 5 or after Stop 19) (closed Mondays) **The Olive Branch** - 2 Old St, Ludlow (Stop 11) – vegetarian **The Café** - 6 New Road, East Hamlet (between Stops 14 and 15)

Toilets

Castle Street car park north of the Market Square in the town centre (a slight diversion en route from Stop 10 to Stop 11)

Tesco and Aldi supermarkets (between Stops 15 and 16)

Linney Riverside Park (Stop 18)

Places to visit

There is plenty to see and do in Ludlow if you have the time to explore including:

Ludlow Castle (11th century) in its imposing position above the River Teme with its ruins dating back to the Norman, Medieval and Tudor periods

Ludlow Museum with exhibitions telling the story of Ludlow plus a celebration of Ludlow's contribution to international geology

St Laurence's Church dating back to the 12th century and with an impressive tower, affording an excellent panorama

Ludlow Market which has operated on the same site for over 900 years and offers shoppers a fantastic choice of products from small and artisan producers and sellers (regular markets on Mon, Weds, Fri and Sat; local farmers markets on second and fourth Thursday of the month, plus specialist markets on Sundays)

Titterstone Clee for those wishing to take in the bracing air of the hill tops to the east of Ludlow that are visible from Stop1; you can drive almost to the summit or else take the Kidderminster bus alighting at Clee Hill village and walking.

Tourist information

Ludlow Visitor Information Centre, Castle Street
Mon to Sat 10 am to 5pm (year round)
Sun 10.30am to 5pm (April to Oct only)
Tel: 01584 875 053
Email: ludlow.tourism@shropshire-cc.gov.uk
Websites: www.ludlow.org.uk www.shropshiretourism.co.uk

Getting there

Car

Ludlow is on the A49 12 miles north of Leominster and 28 miles south of Shrewsbury. Whitcliffe Common is on high ground just to the west of Ludlow town. There is free parking at Whitcliffe Common either in the small roadside layby or an off-road car park in the wood about 200 metres from the start point.

- Coming from the north along the A49, bear left on the first slip road signposted 'Ludlow' and continue straight through the town. At the south end this main road crosses the river (narrow bridge controlled by traffic lights) and immediately after turn first right (signposted Wigmore); the viewpoint is 750 m from this junction.

- Coming from the south along the A49, bear left on the first slip road signposted 'Ludlow' and continue straight towards the town. 300 m after passing the 30 mph sign and before the river bridge take the first left (signposted Wigmore); the viewpoint is 750 m from this junction.

Train

The nearest railway station is Ludlow (just under 1 mile from start point). Ludlow is on the Welsh Marches Line with direct connections southbound to Hereford and South Wales and northbound to Shrewsbury, North Wales, Chester and Manchester. There are generally one or two trains per hour (Mondays to Saturdays), hourly on Sundays.

If arriving by train note that Stop 15 is at the station. If you wish first to walk to Stop 1 then turn left out of the station up the hill towards the town centre. At the traffic lights turn right along Upper Galdeford and at the end by the supermarket continue straight into pedestrianised Tower Street. At next road junction, cross straight over and follow King Street which becomes High Street.

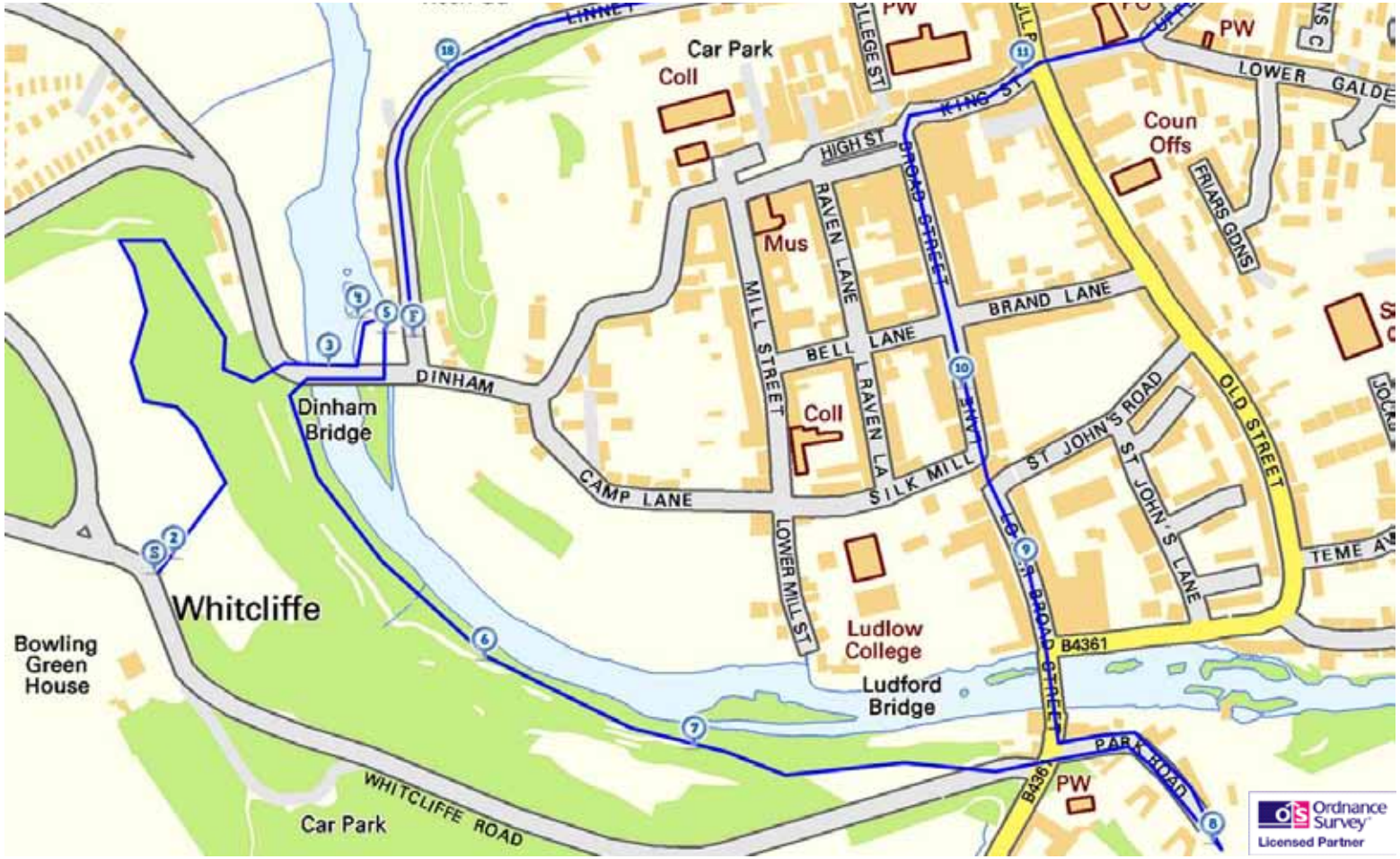
Walk through Market Square towards the castle. In front of the castle turn left along Dinham with the walls on your right. Follow the lane around the perimeter of the castle. At the bottom, cross the bridge over the river. On the far side of the bridge, go through the gap in the stone wall on the left and take the footpath straight ahead up the steps. Follow the footpath upwards through the woodland. Immediately after the second set of steps, turn left along the footpath which brings you out at the open ground of Whitcliffe Common. Go up the grassy slope to the viewpoint at the information board.

Bus

Ludlow is served by various local and regional buses within the Welsh Marshes and West Midlands. Most are infrequent but there are 2-hourly services from Kidderminster, Shrewsbury and Hereford (Monday to Saturday only).

Alight at the Market Square, the terminus for most bus services (except those to/from Kidderminster, which leave from the Old Post Office in Corve Street). To walk from Market Square to the start of the walk follow the instructions given above.

Detail of first and last part of route



Stopping points

Start	Viewpoint on Whitcliffe Common
2.	Viewpoint on Whitcliffe Common
3.	Dinham Bridge
4.	River bank beside former Castle Mill
5.	Former Castle Mill
6.	The Bread Walk
7.	Whitcliffe Quarry
8.	Ludford Park, end of Park Road
9.	Lower Broad Street
10.	Upper Broad Street
11.	The Bull Ring
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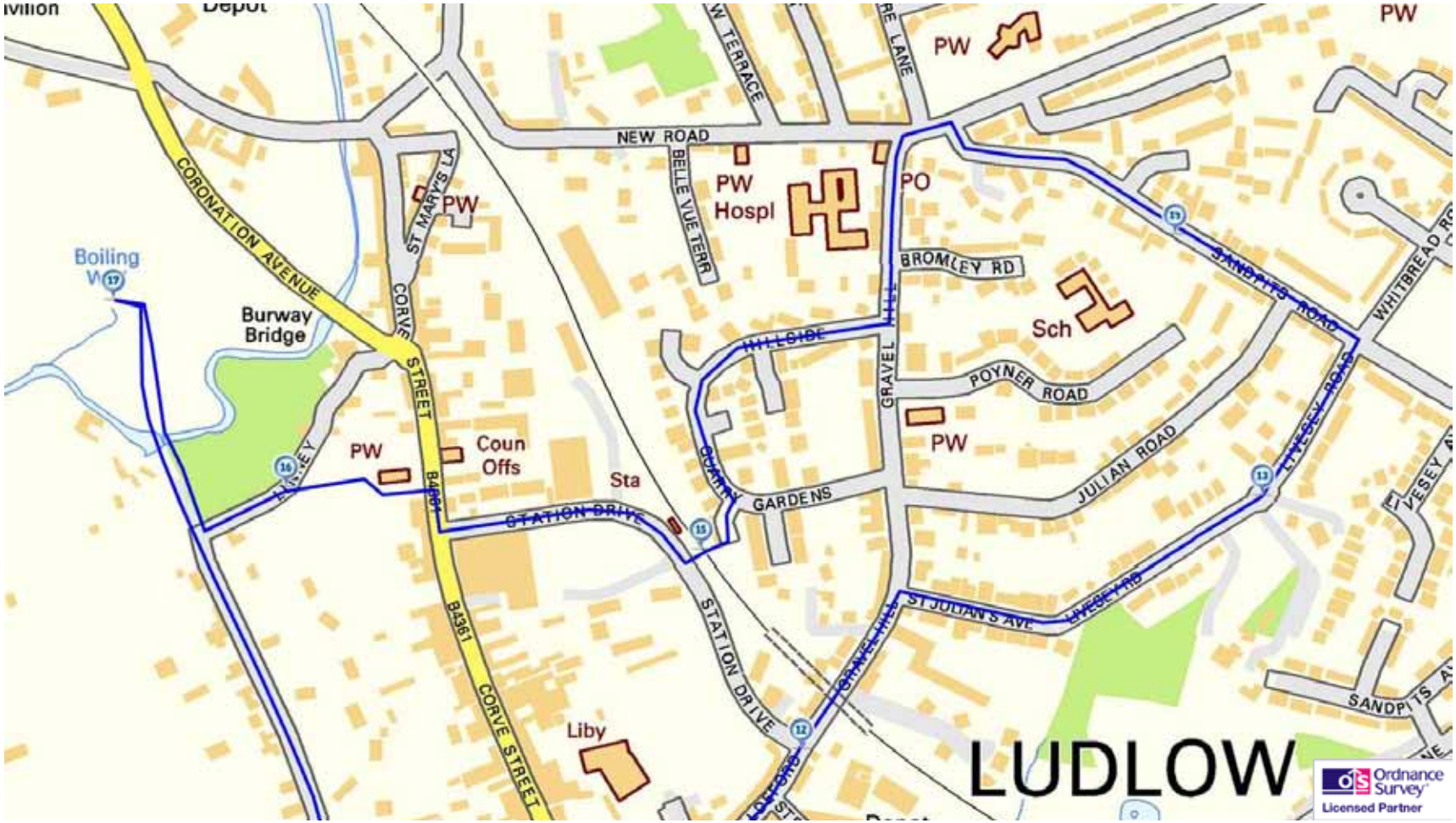
18.	Linney Riverside Park
Finish	Dinham Millennium Green

Detail of middle part of route



Stopping points

12. Junction of Upper Galdeford, Gravel Hill and Station Drive
13. St Julian's Well, Livesey Road
14. 19 Sandpits Road, opposite Poyner Close
15. Ludlow Railway Station
16. Linney, at rear entrance to St Leonard's churchyard
17. The Boiling Well

1. Welcome to Ludlow
Viewpoint on Whitcliffe Common

Ludlow is located within a region known as the Welsh Marches. In modern usage, this name refers to an area along and around the border between England and Wales.

The town of Ludlow lies on a bend in the River Teme. It's also set within an area of lowland at the foot of the Clee Hills that are visible rising up in the distance.

With an eleventh-century castle, medieval town walls and almost 500 listed buildings, the town is a popular place to visit. It has also become a gastronomic centre promoting quality local produce.

Ludlow and the Clee Hills from Whitcliffe Common
© Michael Rosenbaum

We'll see each of these features of the town along the route but this walk focuses on something quite different. Shropshire is also well-known among geologists and physical geographers for its natural landscape and geological diversity. There's the spectacular hill of The Wrekin made of volcanic rock (but not a volcano!), the limestone escarpment of Wenlock Edge that formed under a tropical sea, the rounded plateau of the Long Mynd and the rugged Stiperstones ridge, and dramatic features such as Carding Mill Valley. The geology has been recognised through the designation of the Shropshire Hills as an Area of Outstanding Natural Beauty and hosts a number of Sites of Special Scientific Interest. All in all, it's a geologist's paradise!

On this walk around Ludlow to the south of the county we're going to find out how the landscape has been shaped by dramatic natural forces during quite recent times – geologically speaking – specifically by the cold conditions of the Ice Age during the last half million years. We'll discover how ice and water have shaped the valleys that make this area so picturesque. We'll see evidence of the Ice Age in the range of stones and soils that glaciers and their meltwaters left behind. We'll also find out how this has influenced human occupation around Ludlow, providing sites suitable for settlement, water to drink, stones for building, and most recently a landscape which attracts visitors from afar.

This walk was created by Michael Rosenbaum, a geologist who has lived in Ludlow for the last 10 years.

Directions 1
Remain at the viewpoint.

2. Advance and retreat

Viewpoint on Whitcliffe Common

Most people are familiar with the term 'Ice Age' but it would perhaps be more accurate to say 'Ice Ages'.

Over the last half million years there was not a single long cold phase but a series of cold periods, or 'glaciations', each of which saw the ice advance and then retreat.

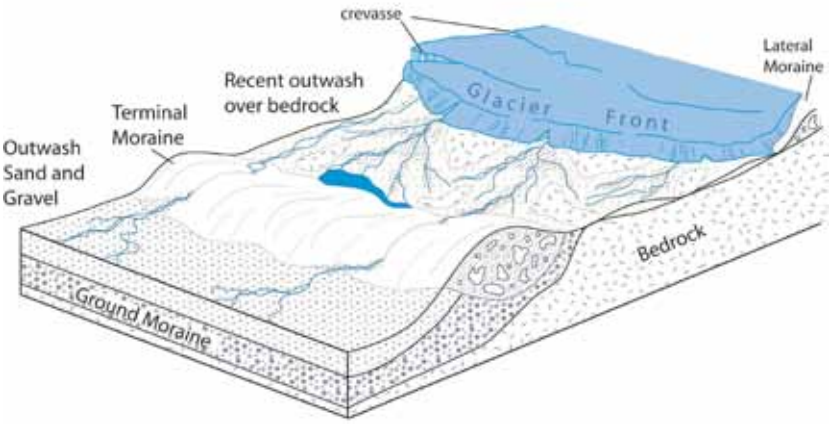
Across the British Isles there is clear evidence of at least two such major glaciations.

The most extensive was the 'Anglian' about 450,000 years ago; it covered virtually the whole of this region of the Welsh Marches, including Ludlow.

The second, and last, cold phase was the 'Devensian'; it began about 120,000 years ago and ended about 11,000 years ago. However, the last glaciers had probably melted away from South Shropshire by about 18,000 years ago.

Position of ice over the British Isles
23,000 years before present
© Prof Chris Clark University of Sheffield

During the beginning and middle of a cold period, glaciers expand and begin to move; they are said to be 'advancing'. Towards the end of a cold period, glaciers melt more and shrink; they are said to be 'retreating'. (This is a slight misnomer: glacial ice never moves backwards; rather the glacier melts faster than new ice can move to replace it and therefore gives the impression of moving backwards).



Landforms created by a retreating glacier
© Trista L Thornberry-Ehrlich, Colorado State University

As glacial ice melts it obviously turns into water which is known as 'glacial meltwater'. Stones and sediments that were on top of the glacier or trapped within the ice are released. The 'meltwater' carries them down rivers and deposits them downstream.

This material deposited by glacial meltwater is known as 'fluvio-glacial sediment'. Fluvial, from the Latin word for river, is a word used to refer to all processes and landforms relating to streams and rivers.

There is no direct evidence to show that any of the Devensian glaciers actually reached Ludlow but three of them came very close – one from the Irish Sea to the north, one from the west through the Clun Valley and one from the Wye Valley to the south.

Being near the front end of these glaciers meant that Ludlow was strongly affected by meltwater and that is exactly what this walk will reveal. Along the route we will discover a shifting network of river channels, rocks gouged out by torrents of water and great deposits of sediment.

Meltwater from a glacier in Norway
(the front end of the glacier is at the top right of the picture)
© Michael Rosenbaum

Take the opportunity of looking out across the town. On the middle horizon beyond the church tower is a relatively new housing estate on the eastern side of Ludlow, known as the Sandpits Estate. We shall be visiting this later in the walk. The new houses sit on apparently level ground, but at a much higher level than the centre of town or the Teme valley. Now look around you. The ground on the top of the common is also fairly level and is at about the same elevation as the Sandpits Estate. The significance of this will become apparent later in the walk.

Whitcliffe Common with level ground to the right
© Michael Rosenbaum

Directions 2

From the viewpoint, walk downhill across the common in the direction of the castle. When you reach the edge of the wood you will find a well-defined path. Turn left and follow it for about 150 metres to a T-junction. Turn right down the steps and follow the path downhill through the woodland. The last part of the footpath goes down some rather steep and uneven steps, so take care! Go onto the bridge and stop in the centre. Be careful as there is only a very narrow pavement.

3. Erosion and deposition
Dinham Bridge

From here on the bridge over the River Teme we can begin to find out how glacial meltwater shaped this landscape. First we need to appreciate the two basic processes that happen in all rivers: erosion and deposition.

‘Erosion’ is the wearing away of the land at the banks and on the bed of a river by both regular and exceptional flows of water. ‘Deposition’ is the dumping of material carried by the water, ranging from fine particles to larger cobbles.

We can see evidence of both erosion and deposition caused by glacial meltwater from here.

All rivers are subject to the twin processes of erosion and deposition, as here in the nearby River Corve

The steep path that you have just followed down through the woods is one clue to the scale of the erosion that has happened here. A river once flowed across the landscape at the level of the viewpoint up on Whitcliffe Common where we have just come from. So how did the modern river end up down here?

Sparse winter vegetation reveals the steep sides of the river gorge

To understand the erosive power of river water you need to appreciate that, during an Ice Age, the global sea level drops because so much water is locked within ice sheets and glaciers. This means that rivers have a greater gradient to travel down before they reach the sea, known as the ‘base level’. In turn this gives them more energy and means that they are able to cause more erosion.

During the Anglian cold period some 450,000 years ago, imagine torrents of icy meltwater pouring across this landscape, quite possibly underneath a glacier.

The force of the water, as well as the gravel and cobbles carried along by it, were strong enough to carve out this deep river gorge.

Towards the end of the subsequent Devensian cold period just 30,000 years ago, the shape of the gorge was modified yet again.

The river gorge downstream from Dinham Bridge
© Ian Capper, Geograph (CCL)

The main ice sheet collapsed releasing huge volumes of glacial meltwater flowing from the glaciers further north and west, even though these did not themselves reach as far as Ludlow.

Low water reveals gravel banks in the river channel
© Michael Rosenbaum

When the flow of a river slows it can no longer carry along so much material suspended in the water, so it is deposited.

If the water level is fairly low, look for a clump of trees in the river channel on a gravel island. This is an example of the material dumped by glacial meltwater.

The larger deposits of sand and gravel are actually quite useful to humans as we shall discover later in the walk.

Directions 3
Continue across Dinham Bridge and down onto Dinham Green below. Go across the Green to the corner of the Green Café and stand on the riverside adjacent to the weir.

4. Human intervention

River bank beside former Castle Mill

Erosion and deposition are not just processes of the past – they are ongoing. And once humans put buildings and infrastructure beside rivers, the ongoing natural processes can pose a threat to land and property.

Mill Street weir
© Michael Rosenbaum

Although we are unlikely to see the same volumes of water as generated by melting glaciers, the town does face fluctuating water levels and periodic flooding events. Erosion of the river bank in Ludlow is mitigated in two ways.

The first strategy has been to construct weirs across the river to regulate the water flow as here at Dinham Weir.

Half a dozen weirs have been constructed in Ludlow since medieval times but just four survive; the others have been destroyed by river erosion but can still be recognised by stones in the river bed. All four surviving weirs have had to be rebuilt during the last decade otherwise they would no longer be able to regulate the river water flow and much more serious erosion would result.

Stone revetments beside the Green Café
on the former site of Castle Mill
© Michael Rosenbaum

The second technique to reduce the impact of erosion is to construct 'revetments', essentially walls or reinforced earth banks along the river side. Look below the wall here by Castle Mill and you will see some examples – large blocks of stone placed in 2008. Obviously the type of stone used to reinforce the river bank needs to be very strong and more resistant to erosion than the rock naturally found by the river bank. In fact, these blocks come from nearby Clee Hill (which we saw from the viewpoint) and are made from a type of stone that is very strong and dense.

Directions 4
Go back to the other side of the mill building facing the Green. If the middle door is open in the main building you can see the water wheel.

5. Harnessing the flow
Former Castle Mill

Have you noticed that the water flow in the river here is quite fast, creating rapids in places? This indicates that the river bed has a profile out of equilibrium with the landscape.

In fact it has yet to fully adjust to the change in 'base level' that occurred during and after the Ice Age.

This characteristic of the river's rapid flow caught the attention of the early inhabitants of Ludlow: it was potential power that could be harnessed.

Dinham Bridge and Castle Mill (1890-1900)
From Views of the British Isles by Detroit Publishing Company

The first record of a mill to grind corn on this site is 1331 though it's likely that one existed here much earlier. Later there were two more mills which, in 1368, were deemed the most important corn mills in the town.

In Victorian times the corn mill gave way to a water-powered Iron and Brass Foundry then, early in the twentieth century, the building housed the turbine of the new Ludlow Electric Light Company.

River rapids as seen from Ludford Bridge
© Michael Rosenbaum

On this site by the river was once Castle Mill. A 'race' diverted some of the river water to the mill and its fast flow was used to drive a wheel.

This provided mechanical power for machinery used in the iron forge (the building now occupied by the restaurant called Mr Underhills).

Other weirs powered mills that were used to grind corn or to make paper.

The River Teme diverted into Castle Mill race
© Michael Rosenbaum

After the area fell into disuse, local residents campaigned to restore the mill and create an open space for people to enjoy.

The centrepiece of the restored mill is a new water wheel and its active use to generate hydro-electric power. Once again the potential energy of the rapidly-flowing River Teme is being used to produce natural power to serve the community. And it's all thanks to the glacial meltwater that shaped this landscape.

The Green Cafe on the former site of Castle Mill
© Michael Rosenbaum

Dinham Millennium Green
© Jeremy Bolwell, Geograph (CCL)

Directions 5

Note: The Green Café is highly recommended. However, we come back to this location at the end of the walk so you may prefer to return for refreshments then.

When you are ready, retrace your steps back across Dinham Bridge. On the other side, turn left along the lower riverside path which is known as the Bread Walk.

This path, opened in 1850, was originally laid closer to the water but was damaged by floods 30 years later in another example of ongoing river erosion – and was reconstructed in its present location.

Follow the path for about 300 metres until you reach a prominent rock exposure with a bench at the far end of it, shortly before the path starts to rise gently.

Rocky outcrop on the Bread Walk

6. Through the keyhole
The Bread Walk

By Dinham Bridge and Castle Mill we discovered how water, both past and present, has eroded the rock beside the river. However, erosion is not the only way in which rock wears away over time. We have stopped here to see the process of 'weathering'.

Erosion and weathering are sometimes confused but there is a straightforward distinction between the two processes. Erosion involves the movement of rocks, soil and minerals by agents such as water, ice, snow, wind, waves and gravity. Weathering happens in situ when rocks, soil and minerals are affected by factors such as heat, frost, pressure or even living organisms.

This rock exposure has been shaped by the natural process of 'chemical weathering'. This occurs when chemicals found in the atmosphere (e.g. air or rain water) or ground react with chemicals found in the rock and cause it to break down.

Keyhold-shaped cavities
© Michael Rosenbaum

The rock here is a type called 'calcareous siltstone'. The chemical reaction that has happened here is that the 'calcite' in the rock has been dissolved by water that is naturally stored in the rock (which is known as 'groundwater'), a process called 'decalcification'.

Look for cavities in the rock that are big enough to put a hand inside and have a curious keyhole shape. These holes have also been dissolved by water but their creation relates to our story of fluvio-glacial erosion. Earlier we discovered that the river once flowed at a much higher level - where the viewpoint on Whitcliffe Common is today. As the river level was higher, so too was the natural groundwater level. Then quite suddenly (in geological terms) the Anglian glacial meltwater carved out the river gorge. The river bed was suddenly lowered and, in turn, the groundwater level would have also fallen rapidly thereby deepening the holes in the rock and creating the keyhole shape.

Directions 6
Continue along the Bread Walk. Pass the end of the weir on the left and go up the uneven stone steps. At the top of the steps are two benches. Stop here and look back into Whitcliffe Quarry. The quarry has been disused for two centuries and stones may fall from the quarry face so do not approach the rock. Keep to the path!

7. Stress and relaxation
Whitcliffe Quarry

This is Whitcliffe Quarry where the natural rock has been extracted for use as building stone. Look along the quarry face to where it suddenly juts out. Can you see that there are cracks or 'fractures' in the rock?

Whitcliffe Quarry
© Michael Rosenbaum

The large extent, open nature and orientation of the main fractures are actually unusual for this kind of rock. It is believed that their creation is another thing related to the erosion of the river gorge during the Anglian period.

The rapid erosion of the gorge by glacial meltwater triggered a process called 'stress relaxation'.

When some of the rock was removed by erosion, the rock left behind was not subject to so much 'confining stress' and began to 'relax'.

Stress relief fractures visible at Whitcliffe Quarry
© Michael Rosenbaum

This caused the rock material to expand and, in doing so, small fractures opened which loosened the rock mass as a whole.

In turn, the open fractures enabled (and often encouraged) groundwater to penetrate which caused weathering and further weakened the rock adjacent to the fractures.

The extensive natural fractures made this an attractive site for quarrying; they are a point of natural weakness in this solid material so make extracting the stone an easier job.

Wedges could be hammered into the cracks in the 'bedding planes' (which dip gently eastwards) and 'joints' (which are generally vertical).

Large blocks of stone could then be prised away from the rock face, then split and shaped on the quarry floor according to demand.

This kind of stone was also more valuable because it had not been damaged by explosives or heavy machinery.

Once stone had been quarried the remaining rock face once again was subject to further stress relaxation, opening up more cracks which have been further weakened by weathering. Even tree roots have taken advantage of these cracks, as you can see.

View across the weir to Whitcliffe Quarry (1933)
Photograph by J Rhodes
CP14/028 Reproduced with the permission of the British Geological Survey © NERC. All rights reserved

Many older buildings within the town are constructed of stone excavated from this or similar quarries elsewhere within Whitcliffe. This quarry went out of use in the early-eighteenth century as fashions changed and people preferred to use brick for building houses.

Buildings in the town constructed using locally quarried stone
© Michael Rosenbaum

Directions 7
Continue along the Bread Walk. When you reach a junction of paths, keep left and follow the main path. At the end, go down the stone steps and along the pavement to the main road. Carefully cross the road and go straight ahead into Park Road. Follow the lane to the end where you will find a cemetery. Stand by the fence and look out to the field beyond.

8. Capture and diversion

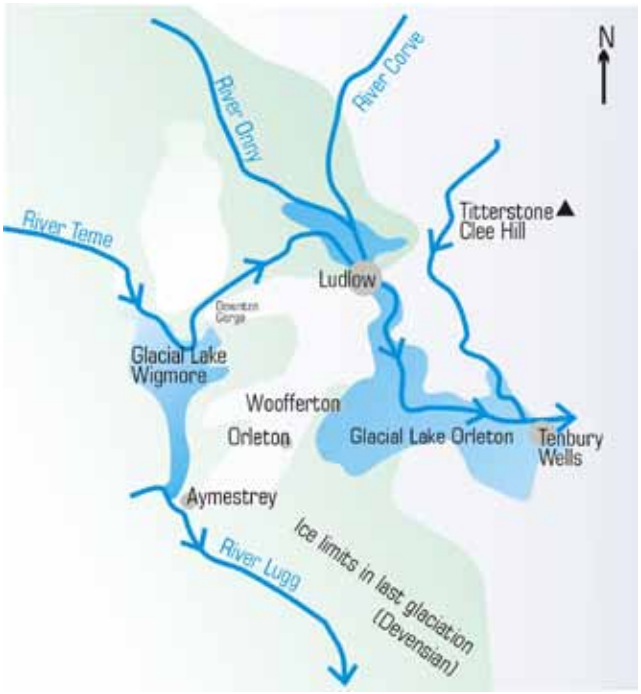
Ludford Park, end of Park Road

The rivers that flow across the landscape today are not necessarily in the positions that they have always been. For example, the River Teme that we have been walking alongside was located about 10 kilometres west of here during the Anglian glacial period.

It was probably joined by the River Onny and they both flowed into the River Lugg which made its way almost due south towards Leominster. Meanwhile the River Corve probably flowed to the east of Ludlow.

This changed during the Devensian period. Sometimes the sheer mass of a glacier can block a river valley. This is what happened to the original River Teme when it was located to the west of here: glacial ice flowing north from the Wye Valley blocked its southward passage. The river was still flowing but the water had nowhere to go so it started to form a temporary lake, Glacial Lake Wigmore.

Likely drainage pattern prior to the Anglian glaciation
Michael Rosenbaum © Shropshire Geological Society



River diversions caused by glacial advance during the Devensian glaciation
Michael Rosenbaum © Shropshire Geological Society

Eventually the lake level rose so much that the water found an overflow to the east. This was probably a channel that had initially been carved by meltwater flowing underneath an earlier glacier.

However, the sudden torrents of water escaping from the lake eroded an enormous gorge: Downton Gorge. This diverted the course of the River Teme permanently.

This new River Teme intercepted the River Corve and pulled it away from its course – a process known as 'river capture'. The combined power of these rivers contributed to further eroding the gorge that we saw earlier.

After flowing through Ludlow, the river then took a south-eastward path to eventually meet the River Severn at Worcester.

Downton Gorge, created when Glacial Lake Wigmore overflowed
© Michael Rosenbaum

Here in the field beside this quiet Remembrance Garden we can see evidence of this dramatic sequence of river capture and diversion.

River terraces visible from the Garden of Remembrance
© Michael Rosenbaum

Red-brown mudstone overlain by fluvioglacial terrace sand and gravel exposed on river bank
© Michael Rosenbaum

In this large field are two substantial 'terraces' of fluvio-glacial sediment. The higher terrace was created when water was flowing southwards on its original course towards Leominster; the lower terrace was created once the river had changed its course and was heading southeast towards Worcester.

Directions 8

Retrace your steps along Park Road. At the main road, turn right and cross Ludford Bridge. Take care as the pavement is narrow. Continue straight up Lower Broad Street. Stop just before the archway of Broad Gate.

9. Gates and gradients

Lower Broad Street

So far we have discovered how the Ice Age shaped the physical landscape – particularly how the flow of glacial meltwater eroded the river gorge and deposited vast amounts of material. Now we enter the town and can find out how the physical landscape has influenced the settlement including its layout, construction and water supply.

When the Normans established Ludlow they worked with the natural 'topography' or lie of the land. On a hill by a bend in the River Teme they established a castle, a church and market. The settlement grew around, deliberately laid out as a grid of streets which are still evident today. The town's walls and four main gates – including Broad Gate here – were constructed in the early-1200s.

While the steep slopes up to the heart of the town made for a good defensive site it became more of a practical constraint in later times.

By the eighteenth century, Broad Street was the route of the important mail coach from London. However, the steep gradient leading up from Ludford Bridge and the low headroom beneath Broad Gate caused problems for the horse-drawn vehicles.

Lower Broad Street (c. 1900)
Unknown source

Thomas Telford (whose public career had begun in the 1780s as County Surveyor in Shrewsbury but was destined to become a world-famous civil engineer) was commissioned in 1828 to report on how best to tackle the problem.

In order to allow the new tall mail coaches to access the town Telford recommended lowering the road level beneath Broad Gate by almost one metre, lessening the gradient uphill and placing the spoil as an embankment downhill. Telford's works also involved improving the street drainage. Although his engineering works solved the problem at the time, you can see that the gate is now not well suited for modern traffic entering the town.

Directions 9
Go through Broad Gate and continue up Upper Broad Street. Stop after a short distance, opposite the grand stone frontage of No.27.

10. Clues in the cobbles

Upper Broad Street

Look either side of the road at the cobbled verges between the parking bays and the pavements above.

You may think that these are just a decorative feature but they were actually part of Telford's works to reconstruct Broad Street. The cobbled slopes prevented vehicles and animals from approaching too close to the buildings.

Look carefully and you will see that the cobble stones are quite smooth and rounded. These have not been rounded by tools or machinery but are naturally rounded.

Upper Broad Street (c. 1880)
From 'Victorian Ludlow' published by
Ludlow Historical Research Group

Wherever you see rounded stones – whether pebbles on a beach or cobble stones like this – it is usually an indication that they have been in a watery environment. Given enough time, any angular materials will become rounded by erosion in moving water. These cobbles are likely to have been gathered from the river bed that we saw earlier and thus are another example of fluvio-glacial sediment.

Any geologist looking at these cobbles will spot that there is quite a variety including examples of the three main categories of rock – sedimentary, igneous and metamorphic. The interesting part is that they can each be matched to particular locations; for example there are 'tuffs' which originate in the vicinity of the Breiddens on the border between northwest Shropshire and Wales.

We can presume that they were plucked from their original location by ice, then carried along below, inside or on top of a glacier. Next they were carried along by glacial meltwater until they were deposited in the river channel. Thus this roadside feature can tell us something about origin and direction of some of the glaciers that melted into the River Teme!

Directions 10
Continue up Upper Broad Street. At the top, in front of the Butter Cross (the building with the clock tower), turn right along King Street. Continue along the narrow street until it widens slightly and you are surrounded by several black-and-white timber-framed buildings. This is known as the Bull Ring.

11. Sewer secrets
The Bull Ring

King Street that we have just walked along follows a ridge – the highest point of the original Norman town.

Here at the junction, if you turn right onto Old Street you will go downhill back to the River Teme (parallel to Broad Street); if you turn left into Corve Street you will also soon go downhill too.

In the Middle Ages Ludlow was a prosperous town. There were weekly markets for the sale of livestock, wool and cloth. The Bull Ring here was where cattle were bought and sold.

Tolsey House in the Bull Ring
Painting by Louise Rayner (1865)

Trench being dug on Gravel Hill (1905)
From 'Victorian Ludlow' published by
Ludlow Historical Research Group

But it's something beneath the streets that is of interest to us.

During mid-Victorian times, when the sewers of the town were being excavated, river deposits were found here. This is a major indication that the valley floor was once up here.

In fact up here at the Bull Ring we're over 25 metres higher than the current river level so that just shows how much erosion of the surrounding ground there has been since this point was the valley floor!

Directions 11
At the junction, cross carefully and go straight across into Tower Street which is pedestrianised. After a narrow section, the street widens. Bear left here along Upper Galdeford. After about 150 metres, stop at the traffic lights at the junction with Station Drive.

12. Clues in the names

Junction of Upper Galdeford, Gravel Hill and Station Drive

Here on the corner of Upper Galdeford and Station Drive notice the cobbled area in front of a relatively recent housing development.

This is the same concept that Telford implemented on Broad Street that we saw earlier, of restricting vehicles and pedestrians from coming too close to the buildings.

However, the cobbles here at the corner are not locally sourced from the Teme but rather are flints imported from southern England since builders' merchants nowadays more commonly stock this kind of gravel than locally-sourced stones.

Protective cobbled area
© Michael Rosenbaum

Gravel Hill road sign
© Michael Rosenbaum

Now look at No.2 Gravel Hill, one of the pair of houses that face down Station Drive. You will see a sign with the road name: Gravel Hill. The names of neighbourhoods and streets are often excellent clues to the geography and history of a place.

Look on the map and off Gravel Hill you will see roads called Quarry Gardens and Sandpits Road which we shall be visiting soon. These are all clues to the underlying geology. We'll find out more about it at the next two stops.

Directions 12

Note: It is possible to make a short cut here, omitting Stops 13 and 14 and thereby saving about one mile of walking. If you wish to do so, turn down Station Drive. The railway station is on the right after about 150 metres. Go onto the footbridge over the railway line and continue with Stop 15.

To proceed with the full walk continue straight along Gravel Hill. After about 100 metres, just where the road begins to bear round to the left, turn right into St Julian's Avenue. After about 150 metres the road bends to the left and becomes Livesey Road. Continue for a further 200 metres uphill until you reach a big chestnut tree in the middle of the road (on a slight bend to the left).

13. Sand and springs
St Julian's Well, Livesey Road

What lay beneath our feet at the last stop - at Gravel Hill - was a surface layer of gravel; what lies beneath our feet here is sand.

Sand and gravel are both 'permeable' materials. This means water can drain through them as there are gaps between the grains.

However, beneath the sand is a rock called Raglan Mudstone which is 'impermeable' meaning that water cannot easily move through.

Where a permeable layer meets an impermeable layer, the water cannot continue to move downwards under the influence of gravity; instead it pops out as a spring.

St Julian's Well creates a traffic island
© Michael Rosenbaum

The stone well house over St Julian's Well
© Michael Rosenbaum

This is what feeds St Julian's Well here. The well was a vital source of water for Ludlow during medieval times as it was clear (filtered by sand) and reliable (tapping into a huge body of water-saturated sand).

From here a metal lead conduit led to a public pump in the Bull Ring in the town centre near where we stopped earlier. The stone well house is still extant, from which the magnificent chestnut tree now grows.

On the other hand, the permeable deposits on top of impermeable deposits create problems for house basements since this causes the groundwater to flow into them, causing flooding.

Directions 13
Continue up Livesey Road for about 200 metres. At the crossroads turn left into Sandpits Road. After about 200 metres look for a cluster of Victorian red brick houses on the right hand side. Stop beside the last two (No.17 and 19) which have their gable ends facing the road and are opposite the pedestrian entrance to Poyner Close.

14. The road to the sand pits

19 Sandpits Road, opposite Poyner Close

Gravel Hill that we walked along earlier used to be called “The road to the sand pits”; and here we are now on Sandpits Road. Not surprisingly, this road gets its name from the former working of sand in the vicinity.

We are now in the area of the town that we saw from the viewpoint on Whitcliffe Common. It is a relatively flat area of land that is much higher than the present River Teme. In fact, we’re at about 115 metres above sea level here while the river is at about 75 metres.

This higher ground is actually an enormous ribbon of sand. It was deposited by a predecessor of the River Corve that once flowed through here.

Roadworks on Whitefriars reveals the sand deposit immediately beneath the surface
© Michael Rosenbaum

As we discovered earlier, when the River Teme diverted its course it ‘captured’ the River Corve and the two proceeded southwards together, further eroding the valley and lowering the valley floor by 40 metres. This explains why this fluvial deposit of sand is located so much higher than present-day river levels. As with the sewer deposits that we heard about earlier, it is further evidence of the erosion of the surrounding landscape since the Ice Age.

The sand that was once dug from here provided construction material around the town and for shop floors (it is absorbent). The access road to the sand pits came between house Number 17 (Rose Cottage) and Number 19.

Active sand pit at Condover in Shropshire, similar to the one once in Ludlow (left) and former access road to the sand pits (right)
© Michael Rosenbaum

Single-storey homes on the site of the sand pits
© Michael Rosenbaum

A sheltered housing development was subsequently built on the site of the former sand pits (between Whitefriars and Clee View if you look on the map).

It made good engineering sense to build these on previously-excavated ground as single-storey homes since the relatively loose and weak ground material would not have been particularly good as a foundation for more substantial buildings.

Directions 14

Continue along Sandpits Road for about 250 metres to the T-junction with Henley Road. Looking right across to the large Roman Catholic church of St Peter (constructed in 1935 using local Oreton Limestone from the other side of Clee Hill) you can more clearly appreciate the level ground. This was once the valley floor!

Once the valley floor

Turn left onto Henley Road and immediately left again at the mini-roundabout into Gravel Hill. There is a convenience store and (opposite) the 6 New Road café. After about 200 metres, just past the entrance to Ludlow Community Hospital, turn right down Hillside. Note that the old hospital building is the former Victorian workhouse, built of local sandstone.

The road descends quite steeply: you are going down into one of the former brick pits that supplied many of the bricks for the Victorian expansion of Ludlow east of the railway line. The brick clay was obtained from the Raglan Mudstone Formation, at 400 million years much older than the Ice Age deposits we have been considering! Toward the bottom of the hill is a cul-de-sac on the left. Look over the fence of the house immediately below (No.29 Hillside) and you can make out the steep back of the gardens: the former quarry face.

Houses in former brick pit

As Hillside rounds the next bend it becomes Quarry Gardens. As it curves to the left and begins to go back uphill, turn right towards a row of garages. Go round the corner at the end of the garages onto the footbridge at the railway station linking the two platforms. Descend to the first platform (Platform 2) either by the steps or by using the ramp.

15. Cobble construction

Ludlow Railway Station

This railway route, known as the Welsh Marches Line, is an important link between North and South Wales. The first section from Shrewsbury to Ludlow opened in 1852. The short tunnel that you can see from here subsequently opened the line southwards to Hereford.

But we're not here to look at the tunnel. Instead look at the retaining wall for the ramp between the footbridge and the tunnel. You will notice that it is faced with rounded cobbles. Back on Upper Broad Street we discovered that the rounded shape of stones indicates transportation by water. So once again we see fluvio-glacial deposits being used as a construction material.

Cobble stones at the station
© Michael Rosenbaum

Cobbles set in cement
© Michael Rosenbaum

These cobbles are of rock types that are geologically old, from the Lower Palaeozoic period 400 to 500 million years ago. They come originally from rock outcrops further north. They were moved from their place of origin by glaciers then transported by meltwater and finally deposited just to the north of Ludlow. They were quarried at Bromfield, a village two miles northwest of Ludlow, where the company Bromfield Sand and Gravel has an extensive working that is still operational today, providing material for the construction industry.

Directions 15

Go back up onto the footbridge using the ramp or steps. From the top, notice the curved shape of the roof on Tesco supermarket which is deliberately designed to mimic the hill beyond of Whitcliffe and Mortimer Forest; quite a contrast to the angular lines of Aldi!

Descend from the footbridge onto Station Drive. If you cannot manage the steps, go back up the ramp and turn right to follow the footpath across the top of the tunnel mouth at the south end of the station, and then right again to reach the other platform.

Turn right along the road and follow it as it bears round to the left between two supermarkets. At the traffic lights just beyond, cross the road carefully and turn right for a few metres and then left through the stone arch into St Leonard's churchyard. Follow the path around the left side of the old chapel and through the churchyard. Go through the arch onto Linney, a narrow lane with high stone walls on either side.

16. The professor's pebbles

Linney, at rear entrance to St Leonard's churchyard

This may just look like a bend in a narrow lane but it marks another significant location in our story of Ludlow in the Ice Age.

In the early twentieth century, the gravels just across the road from the churchyard were being excavated. This working is now within a private garden, heavily wooded, behind an old stone wall.

Professor William Watts (then Head of the Geology Department at Imperial College London) examined the gravels and found that a few of their stones had come from far afield, once again giving clues as to the origin and direction of glaciers and meltwater.

Professor William Watts
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Eskdale granite pebble
Courtesy of GeoLancashire

He found igneous pebbles (andesite and Criggion dolerite) originating from the Breidden Hills to the northwest of here between northwest Shropshire and Wales, as well as igneous rocks from the Lake District (Eskdale granite and Ennerdale granophyre). Deposits elsewhere in Shropshire tell a similar story of glaciers that came from the west and from the north.

We'll find out more about these deposits at the next stop, and how they came to be mixed together.

Directions 16
With your back to the churchyard gate, go straight ahead along Linney, downhill. Where the lane bends sharply to the left, turn right along a track. At the end of the track, go through the kissing gate and follow the path to a footbridge over the River Corve. Follow the footpath across the field which takes you over another small footbridge and to another kissing gate. Go through the gate and turn left alongside the hedge. About 20 metres beyond you will find some wet ground which is a spring known as the Boiling Well.

17. A raised bench

The Boiling Well

You would have noticed as you walked along Linney from the churchyard that the lane went downhill. Look across the field here and you can see the land rising. In fact, you are seeing the same slope from a different angle just 100 metres further on. The difference in height is only about five metres but it's another important piece of evidence of Ice Age Ludlow.

The slope in the road and field is the edge of a massive sheet of fluvio-glacial sediment

What we see here is the edge of quite a large flat area of land that stretches away to the north. It's another sheet of fluvio-glacial sediment formed of material deposited by glacial meltwater. The technical term for this landscape feature is a 'sandur'; this one is known as the Bromfield Terrace.

We came across the term 'terrace' earlier when we saw two levels of fluvio-glacial deposits on the river banks at the other side of the town. Another term for a terrace is a 'raised bench'.

St Leonard's churchyard is located on the Bromfield Terrace and it was in these deposits that Professor Watts found such an interesting array of pebbles and stones, as we heard at the last stop.

But how did we get rocks from North Wales mixed in with rocks from the north, including the Lake District? Evidence from north Shropshire shows that there were two different glaciers, one from North Wales and another from the north, across what is now the Irish Sea.

These interacted around Shrewsbury and some of their meltwaters flowed south, through the Stretton Valley and on south through Craven Arms towards Ludlow. Thus the different types of pebbles and stones became mixed together in the fluvio-glacial rivers and their sediments.

The Bromfield Terrace deposits being commercially excavated by Bromfield Sand and Gravel Company
© Michael Rosenbaum

As we discovered earlier at Gravel Hill, water can easily flow through – or 'permeate' – the loose deposits of fluvio-glacial material. This boggy section of field at the bottom of the Bromfield Terrace is a demonstration of this. Look carefully at this spring and you will see bubbles, hence its popular name, The Boiling Well.

The Boiling Well
© Michael Rosenbaum

Directions 17

Retrace your steps across the field, over the bridge and back to Linney. At the corner of Linney continue straight ahead. After about 200 metres, the road bends round to the right and up a sharp hill. There is no pavement alongside the road around the bend so it is safer to use the ramp and steps on the left and join the pavement above. Cross back over to the pavement on the right hand side of Linney; do not take the left footpath. Look out for tennis courts on the right, followed by the driveway to the rugby club. Stop by the low wall overlooking the football pitch and children's play area.

18. Water sports

Linney Riverside Park

This recreation ground is Linney Riverside Park. As you can tell from the name it's by the river.

The flat land commonly found beside rivers is known as a 'floodplain'. As the term indicates, such areas are prone to natural flooding during periods of high river flow.

Because of this risk of periodic flooding, floodplains are not very suitable land for building. Thus, you will often find floodplains in towns and cities used for public parks and recreation grounds.

This is certainly the case here in Ludlow, as you can see, where this land is used for football, rugby, tennis and general leisure activities.

The high discharge through the permeable fluvio-glacial deposits of the Bromfield Terrace that we heard about at the last stop, plus the risk from high river levels means that this park is often flooded, particularly in the winter months.

Ludlow Castle Bowling and Tennis Club
in ordinary conditions and under water!
© Ian Capper, Geograph (CCL)

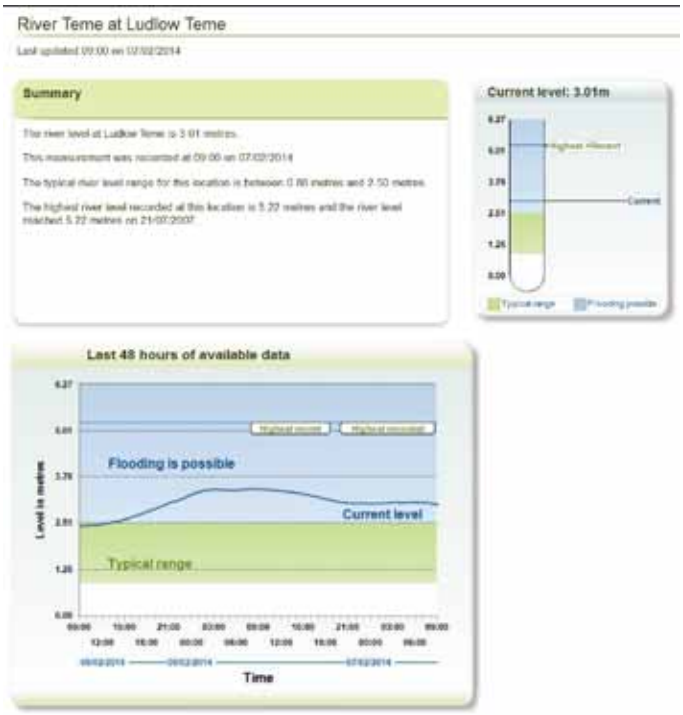
Flooding at Linney Riverside Park in February 2014 - football pitches (left) and car park (right) under water
© Michael Rosenbaum

We have almost come full circle and are just a short distance from Castle Mill and Dinham Bridge which we visited at the beginning of the walk.

There we saw the weir and revetments that are two methods used to reduce the erosion of river banks, particularly during times of high water flow.

However, the erosional damage to these structures means that they require periodic maintenance and occasional rebuilding.

This weir was rebuilt at the end of 2013 and the opportunity was taken to include a salmon leap (the fish jump here each November).



Water measurements for the River Teme (07 Feb 2014)
Environment Agency website

The swollen River Teme at Castle Mill and weir (the metal railings at the far side are the salmon leap)
© Michael Rosenbaum

Directions 18
Continue along Linney for about 200 metres until you reach Castle Mill and Dinham Millennium Green on the right.

19. A dramatic story of landscape transformation
Dinham Millennium Green

Today the Green is a pleasant and peaceful riverside spot, much enjoyed by locals and visitors alike. It's difficult to imagine that great torrents of icy water once crashed through here. This walk has told the remarkable story of Ludlow in the Ice Age when dramatic forces reshaped the landscape entirely.

Dinham Millennium Green - now a peaceful spot

Two main glacial periods affected this area – the Anglian and the Devensian – and created a landscape shaped primarily by meltwater. Anglian ice smothered Ludlow and its meltwater created this gorge. Though Devensian ice didn't actually cover Ludlow itself, the front ends of several glaciers were close by and their meltwater further shaped the landscape.

Central to the story were the twin processes of erosion and deposition. What is so exciting is that, although these events occurred tens of thousands of years ago, they left their mark and we can still see it in the landscape today – from deep river gorges to vast terraces of sand and gravel. Experts have been able to look at the landforms created by erosion and the layers of deposited material to understand more about where the glaciers came from. However, many details of our glacial history still wait to be discovered and more research is needed.

The landscape formed by fluvio-glacial meltwater has been put to good use by humans. The Normans made use of the hilltop site above the river gorge for their castle. Rocks exposed in the river gorge were quarried and used as building stone. Fluvio-glacial deposits of sand and gravel were – and still are – widely used as construction materials. Meanwhile the join between permeable and impermeable rocks created springs which provided clean reliable water for the town.

I hope that this walk has given you a different perspective on this picturesque market town. What delights me is that features that a local person may pass every day without noticing, or which a visitor may not see – such as a dip in the road, some stones beside the pavement or a boggy meadow – are part of a dramatic story of landscape transformation. I hope you have enjoyed reading the landscape in this way too.

Directions 19
This is the end of the walk. You may like to stop for refreshments at the Green Café. To return to the start point, turn right at the end of Linney, go across Dinham Bridge and retrace your steps up through the woods to Whitcliffe Common. To go into the town centre, turn left at the end of Linney up Dinham which leads up to the castle.

Credits

This walk was created by **Professor Michael Rosenbaum** who provided the commentary and photographs. It was based on material previously published in the Proceedings of the Shropshire Geological Society, accessible online at www.shropshiregeology.org.uk

Michael would particularly like to acknowledge the work of **Dr Peter Cross** whose PhD studies in the 1960s did so much to focus attention on the fascinating glacial history of the area

Grateful thanks also to **Ludlow Museum Resource Centre** (and Curator **Daniel Lockett**) for access to records of scientific studies in the vicinity

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Further information

Shropshire Geology
www.shropshiregeology.org.uk

Friends of Whitcliffe Common
www.friendsofwhitcliffecommon.org.uk

Ludlow Mill on the Green
www.ludlowmillonthegreen.co.uk

Shropshire Tourism
www.shropshiretourism.co.uk

Ludlow
www.ludlow.org.uk

Ludlow Museum
www.shropshire.gov.uk/museums/ludlow-museum

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