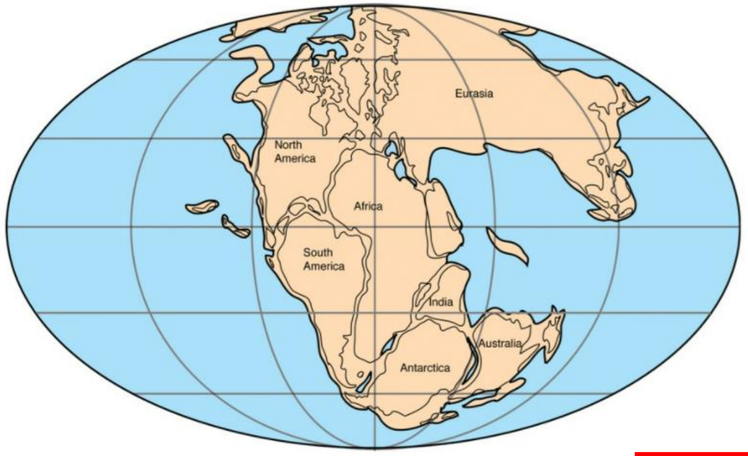
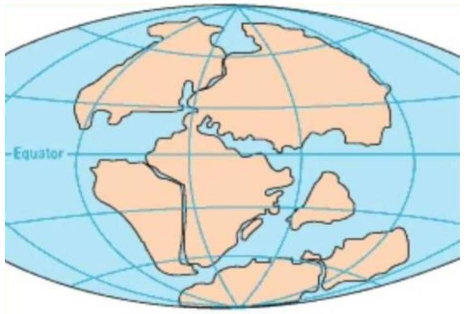
Flooding from Groundwater

Guy Parker
The Environment Agency

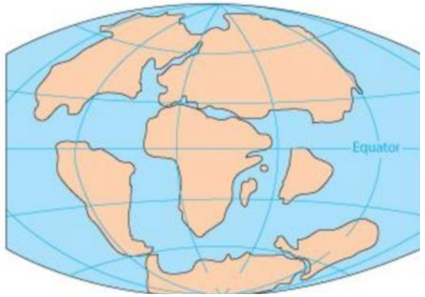
Pangea



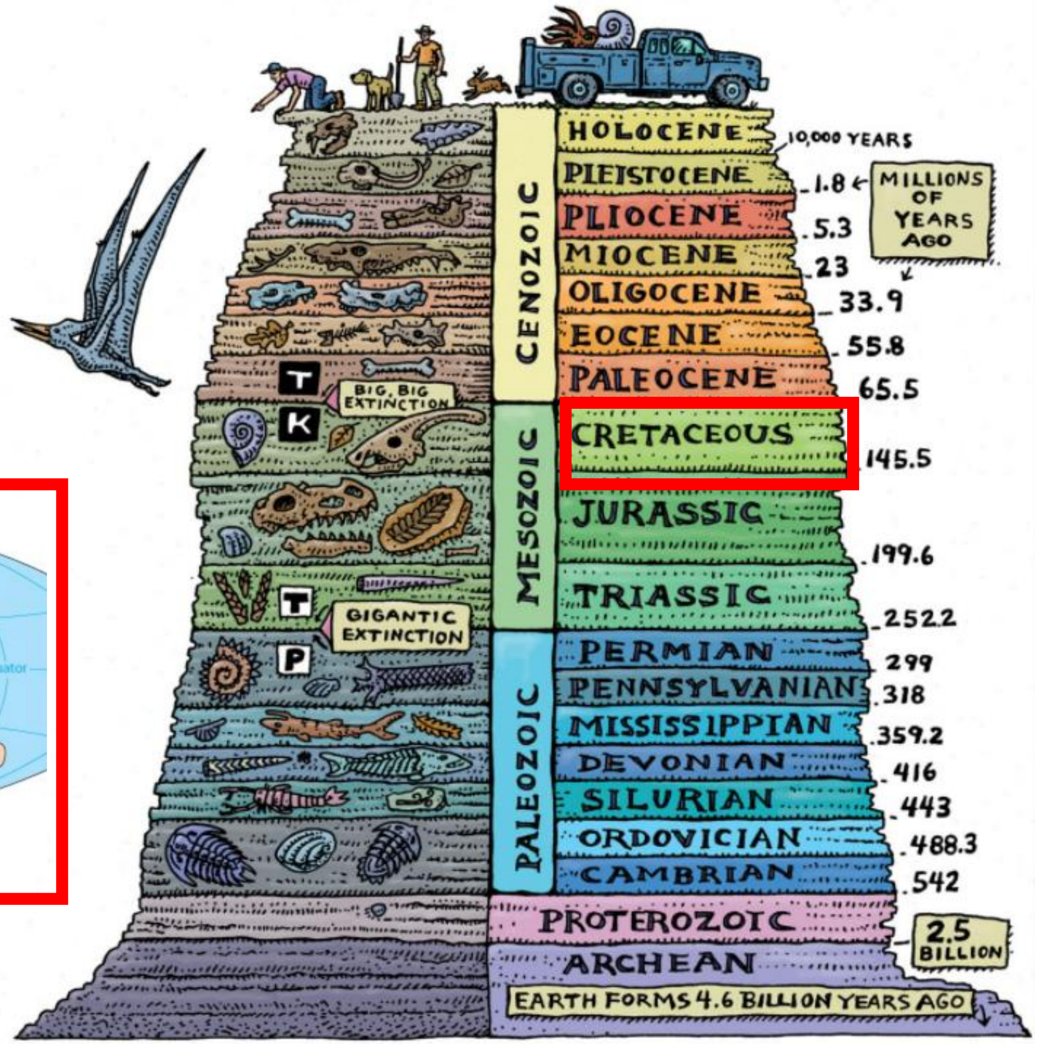
Triassic



Jurassic



Cretaceous



Cambrian	Devonian	Permian	Triassic	Jurassic	Cretaceous	Palaeocene	Miocene	Pleistocene	Holocene

500m 400m 300m | 200m 150m | 50m 2m 0

Palaeozoic	Mesozoic	Cenozoic

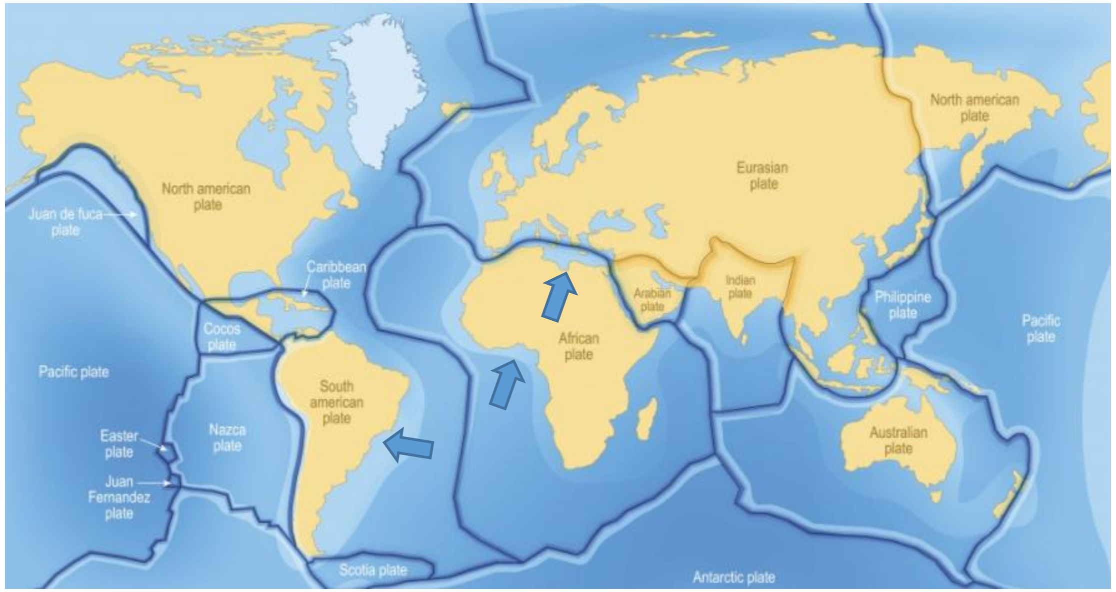
Environment Agency

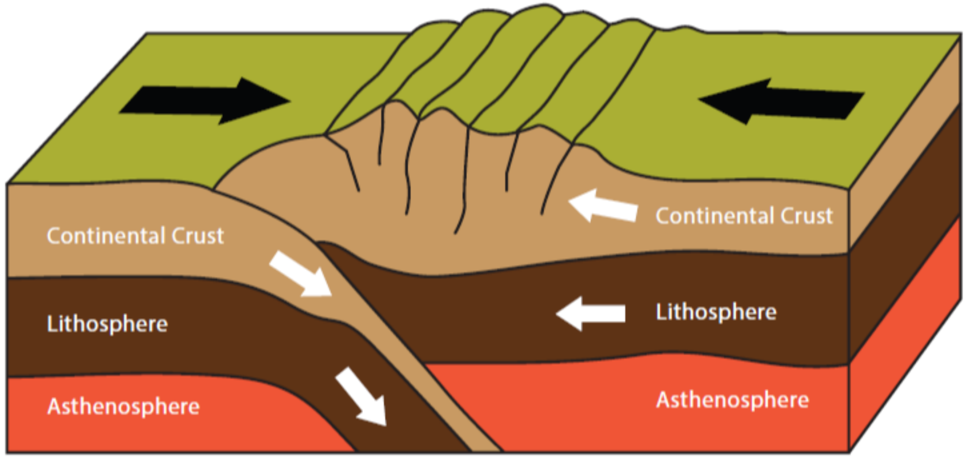
The ‘impact’ of Africa on the Chalk downs of England

Continental Drift

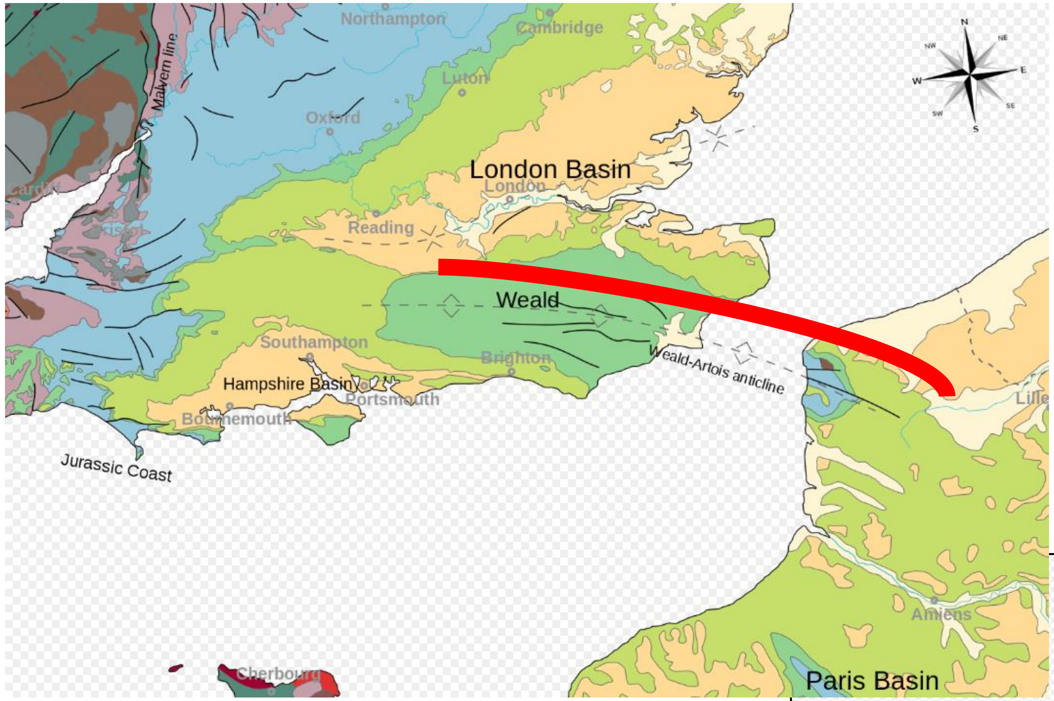
About 50 million years ago the African plate started to crash into Europe forming the Alps & Pyrenees

In Britain, a series of low clay capped, chalk hills began to emerge forming what is now the Dorset, Wiltshire, North & South Downs and the Chilterns.

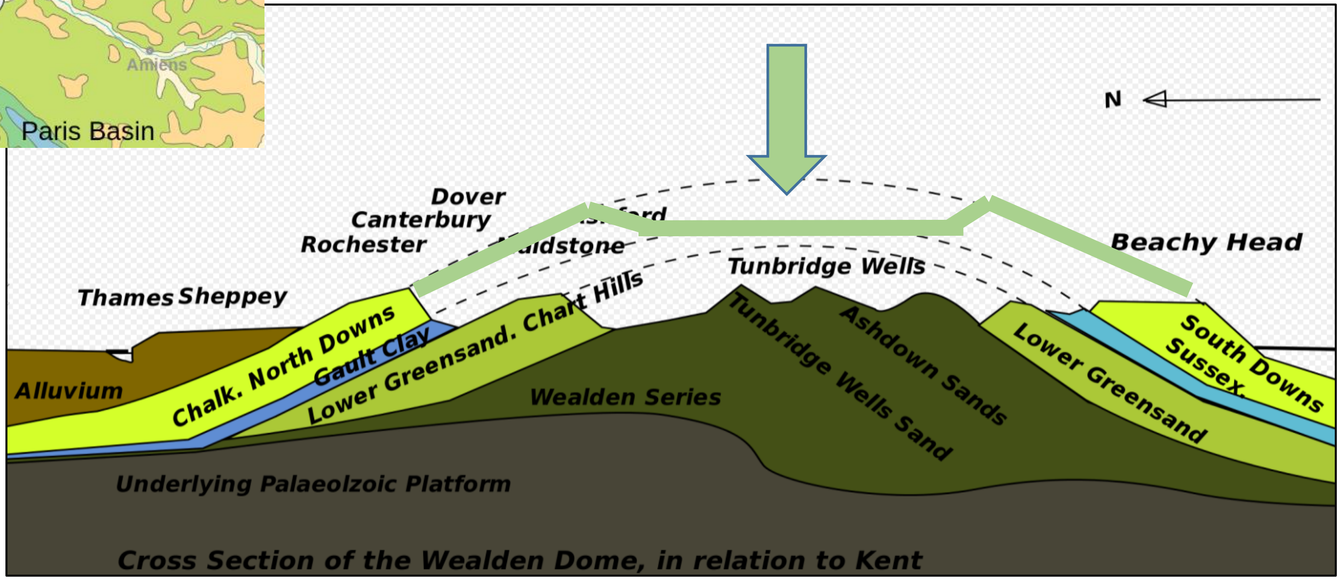




The Weald is at the heart of Island Britain



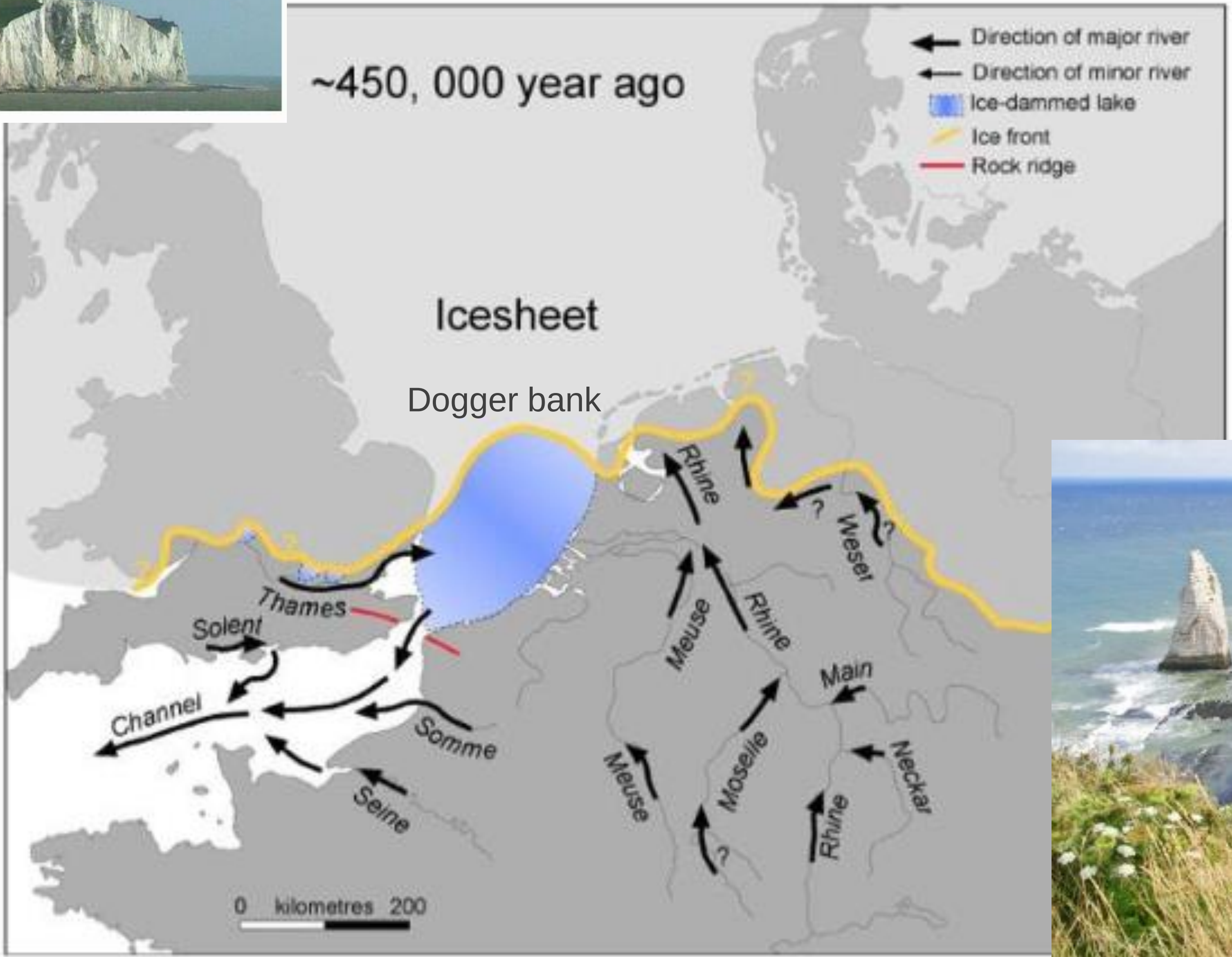
500,000 years ago, the Weald wasn't as developed as it is today and what is now the scarp of the North Downs formed a ridge of Chalk hills which connected Britain with the continent.



The Weald – Artois anticline

Environment Agency

Many of Europe’s major rivers flowed into the North Sea creating a freshwater lake, blocked at the southern end by the ridge of Chalk.



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The straight of Dover cuts through the Weald – Artois anticline.

The Channel Tunnel was bored through the West Melbury Marly Chalk, a thick and extensive chalk unit that underlies the area.

The sea broke through 160,000 years ago – at about the time early humans arrived.

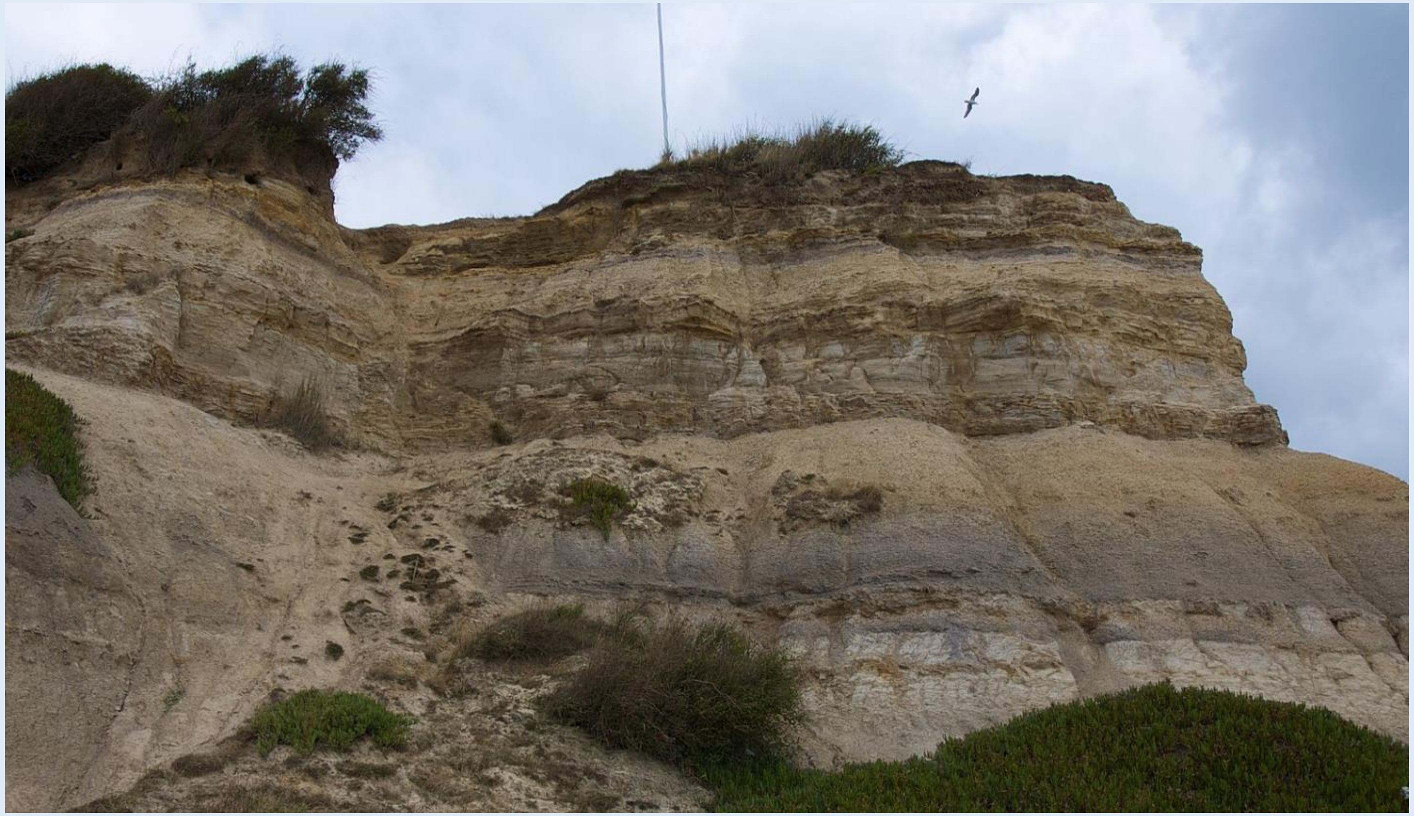
During the last ice age, lowered sea levels connected Britain to Europe once again.

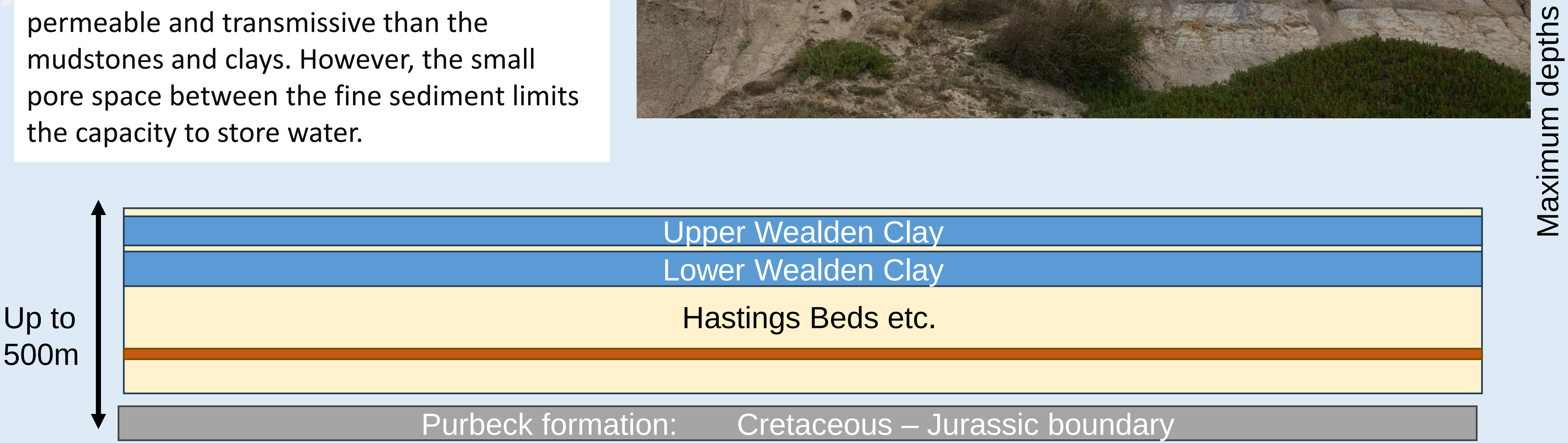
Environment Agency

Wealden Group

The Wealden Group consists of sedimentary rocks that were deposited during the Early Cretaceous period. This group includes sandstones, siltstones, mudstones, and clays including significant deposits of ‘Iron Stone’.

The permeability and transmissivity of these rocks can vary depending on factors such as lithology, degree of compaction, fracturing, and cementation. The sandstones are more permeable and transmissive than the mudstones and clays. However, the small pore space between the fine sediment limits the capacity to store water.

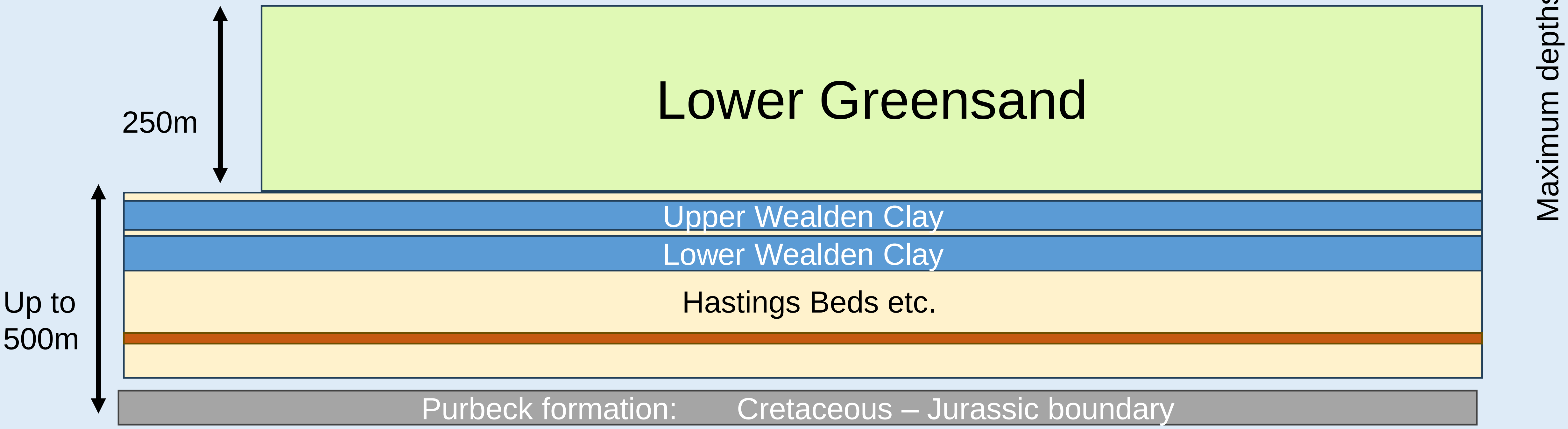




The Lower Greensand Group was deposited during the latter part of the Early Cretaceous Period between 125 &110 million years ago.

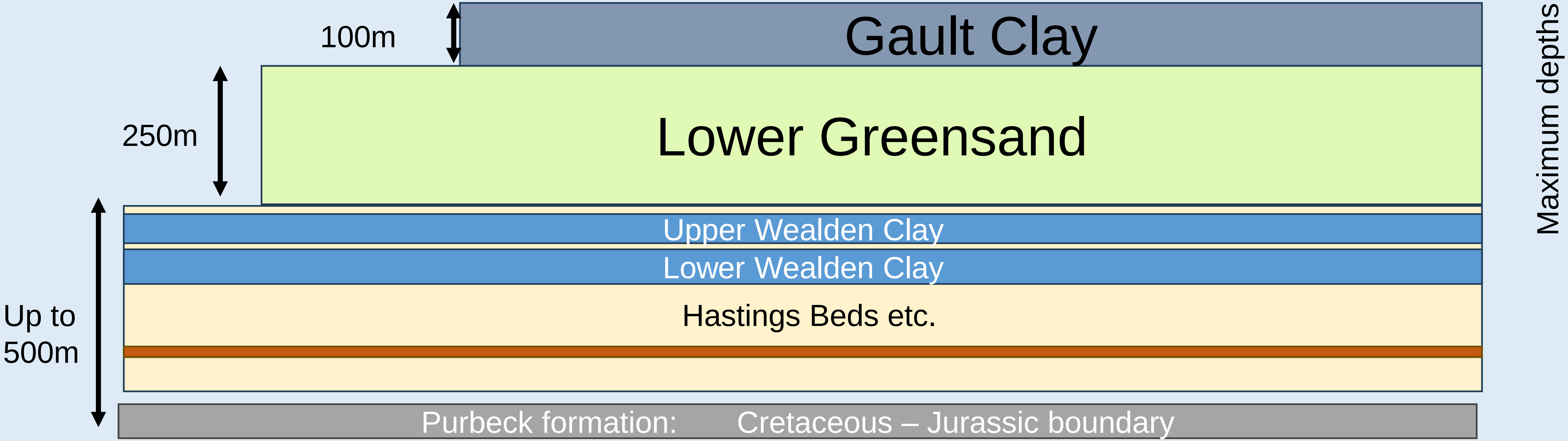
It was deposited in shallow marine conditions and is comprised mainly of sandstones with rubble like characteristics.

It is a major aquifer with a porosity of about 30%..



Gault

Gault is a stiff blue clay deposited in a calm, fairly deep-water marine environment during the Lower Cretaceous Period.
It is a hard, brittle rock with fine fissures with limited permeability. When exposed at the surface it can become very malleable and ‘sticky’. Used for brick making.

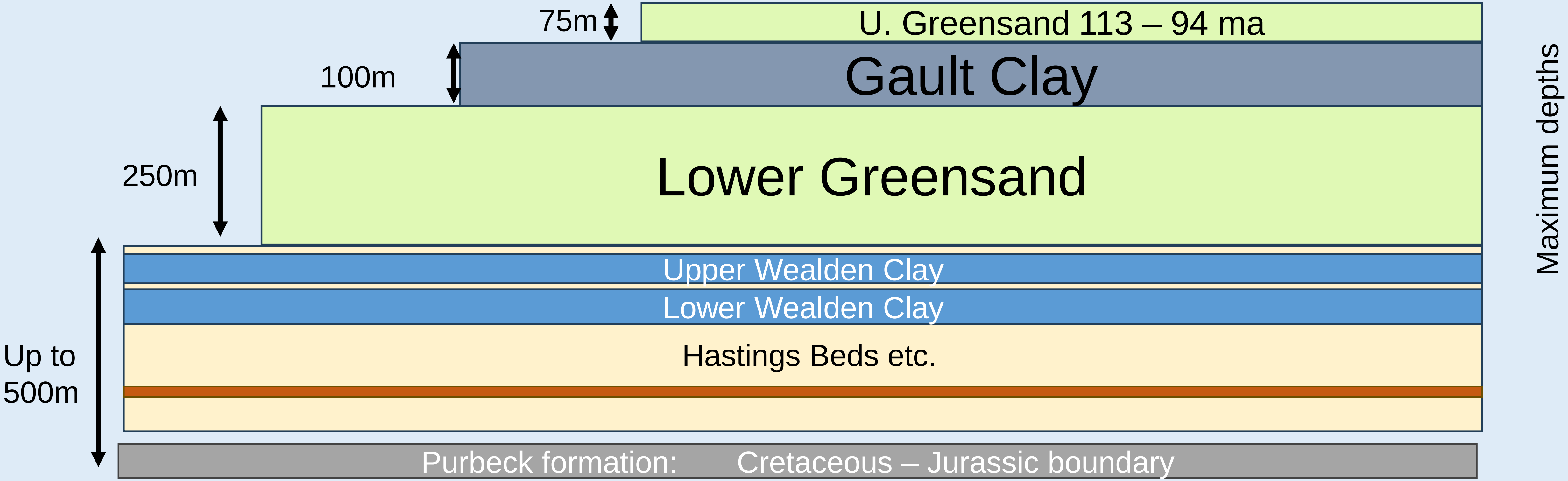


Upper Greensand

A glauconite (which makes it appear green) sandstone.

In general, the Upper Greensand can exhibit moderate to good permeability and transmissivity characteristics. It often consists of sandstone and sandy marl layers, which can be relatively porous and allow for the movement of water.

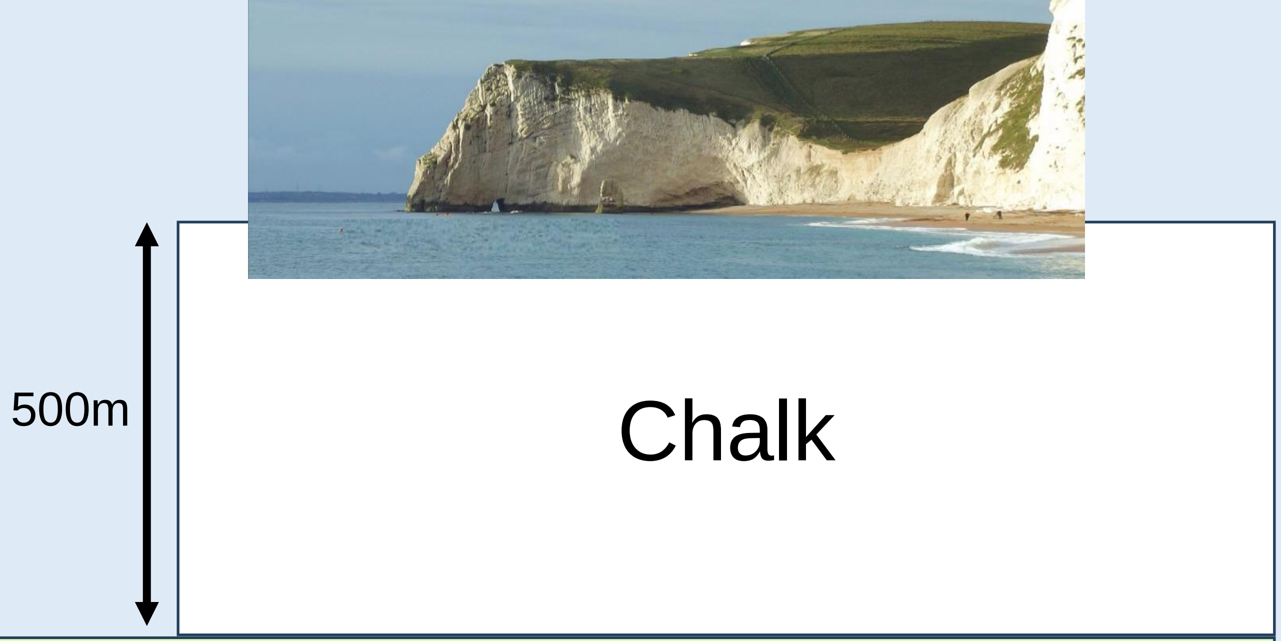
It is ‘fed’ by overlaying Chalk and so is often saturated.

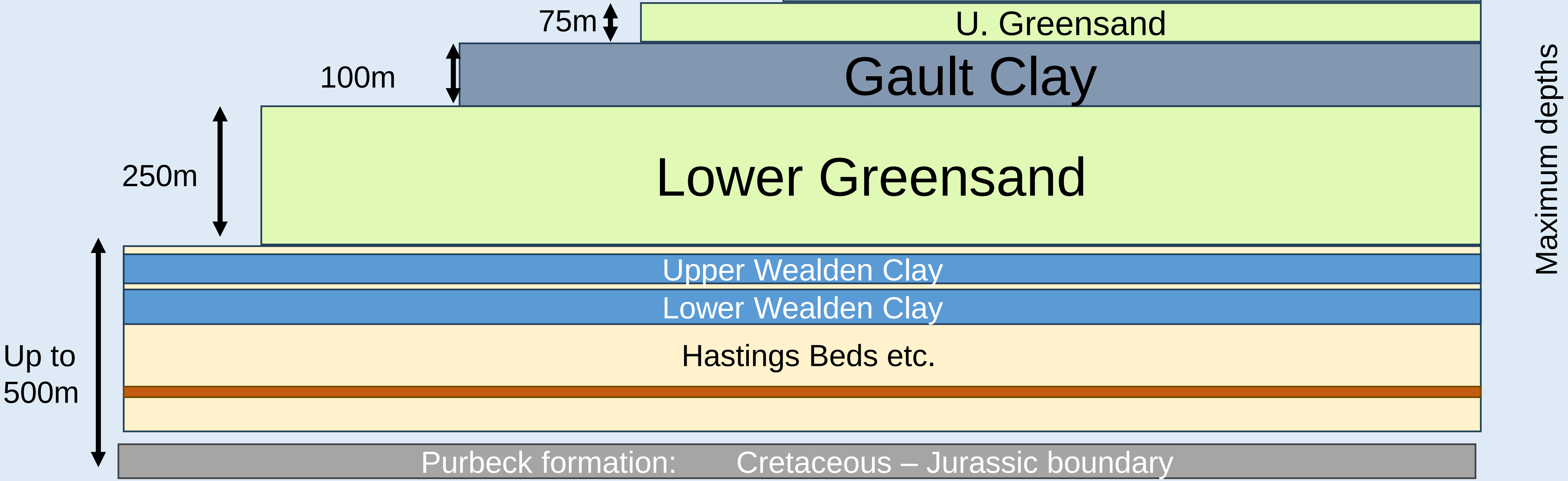


Chalk

Chalk is a form of limestone composed of the mineral calcite and originally formed deep under the sea by the compression of microscopic plankton, known as coccoliths, that had settled to the sea floor.

It is unusual in that it is both porous and heavily fractured near the surface. It is the most important aquifer in the British Isles.





Groundwater Flooding

permanent

The Hydrogeology

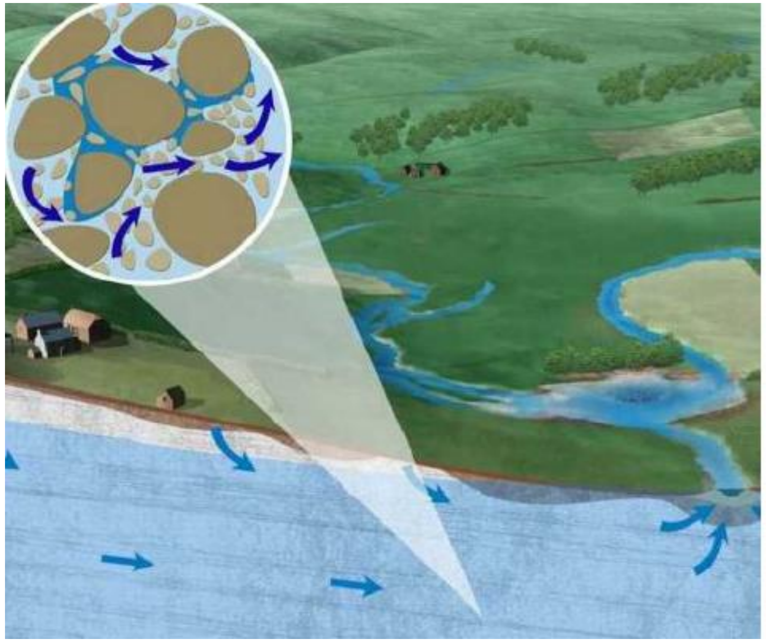
Guy Parker
The Environment Agency

Granular - Porosity

Fissures - Permeability

The water in chalk flows primarily through the fractures & capillary action.

Intergranular flow is limited due to small pore space, however storage is quite high at around 40%



Stress fractures are enlarged by erosion (dissolution) and periglacial freeze / thaw processes.

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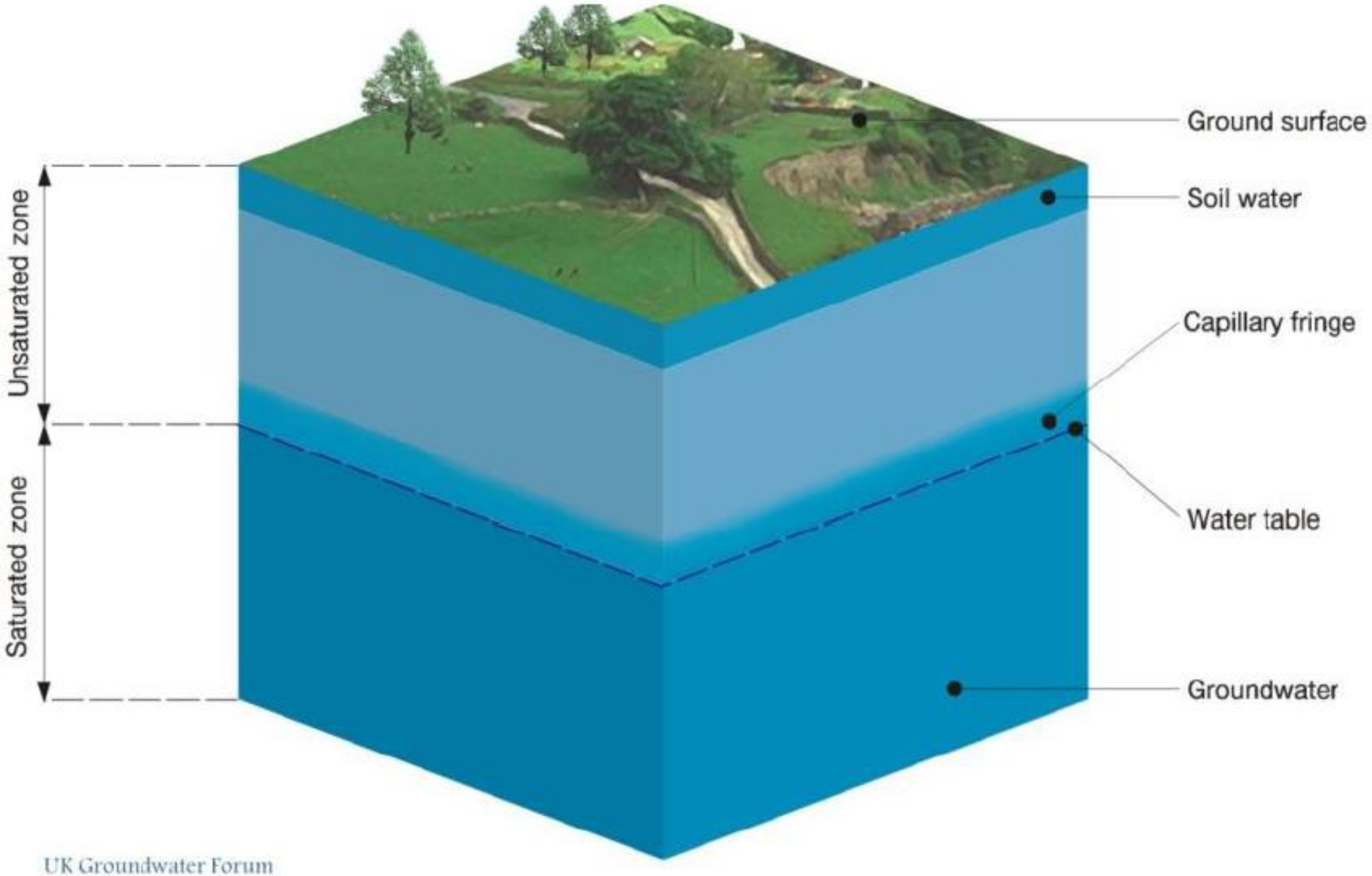
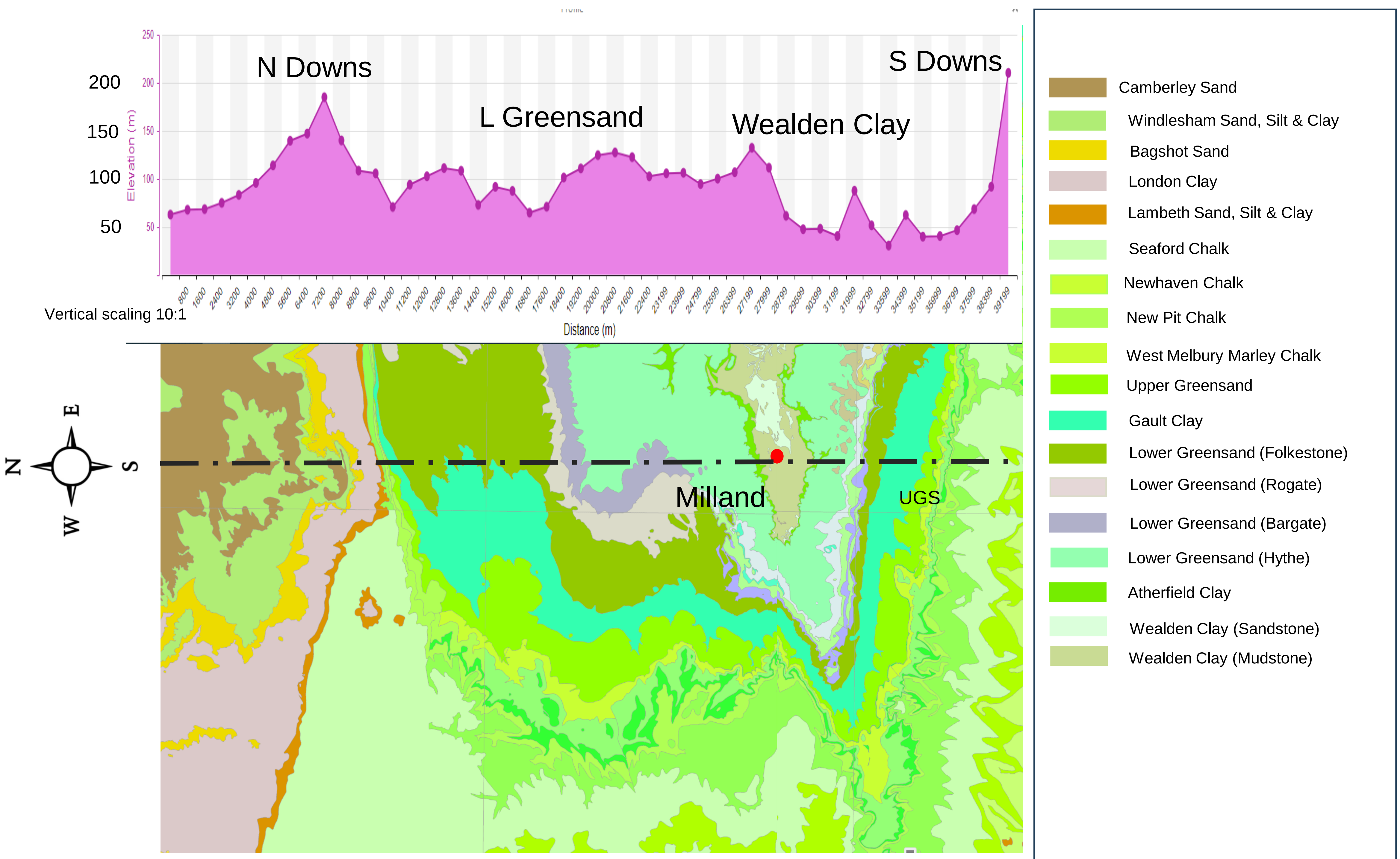


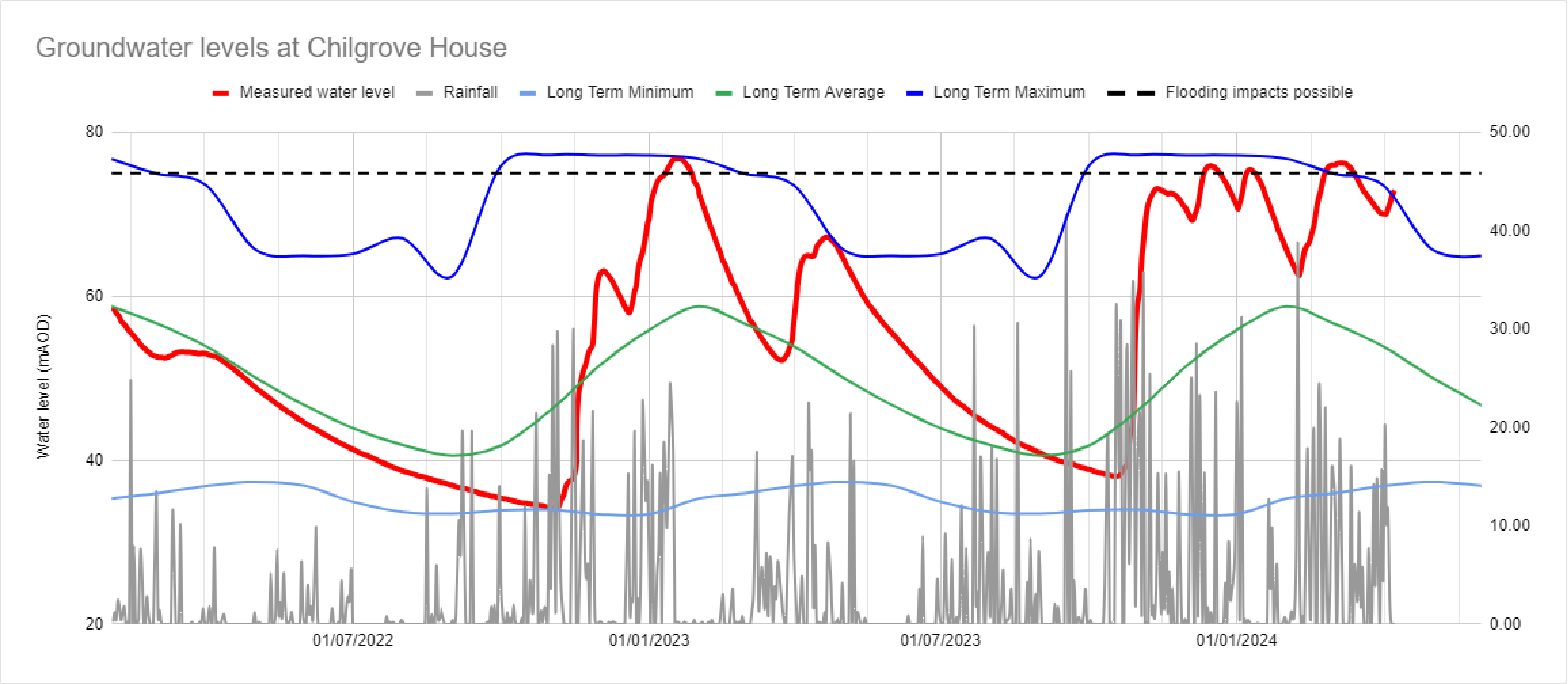
UK Groundwater Forum

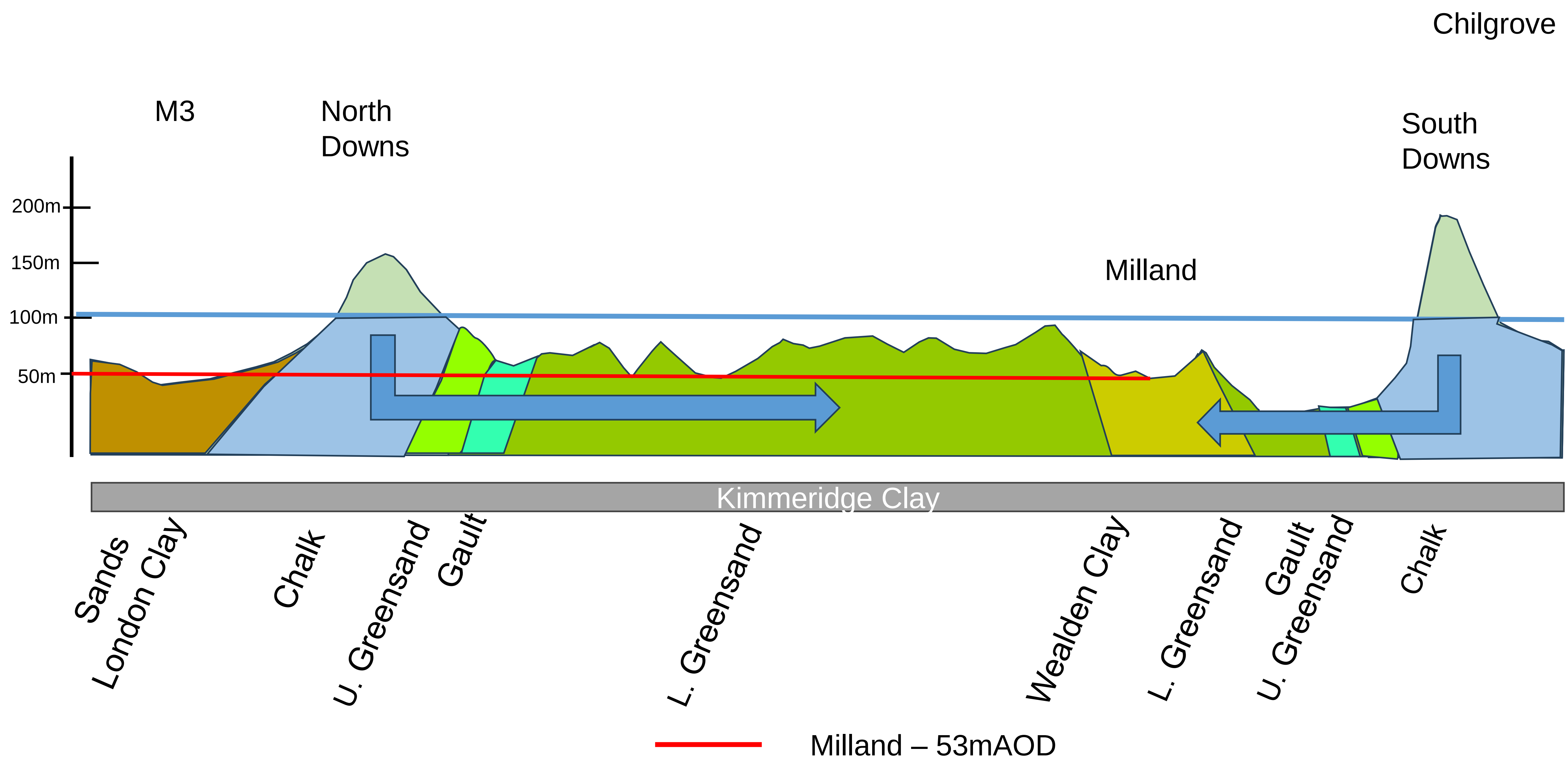
Environment Agency

A Cubic metre of rock with 40% porosity will hold 400 litres of water


N Downs
L Greensand
Wealden Clay
S Downs
200
150
100
50
Elevation (m)
250
200
150
100
50
800 1600 2400 3200 4000 4800 5600 6400 7200 8000 8800 9600 10400 11200 12000 12800 13600 14400 15200 16000 16800 17600 18400 19200 20000 20800 21600 22400 23199 23999 24799 25599 26399 27199 27999 28799 29599 30399 31199 31999 32799 33599 34399 35199 35999 36799 37599 38399 39199
Distance (m)
Vertical scaling 10:1
N
E
S
W
Milland
UGS
Camberley Sand
Windlesham Sand, Silt & Clay
Bagshot Sand
London Clay
Lambeth Sand, Silt & Clay
Seaford Chalk
Newhaven Chalk
New Pit Chalk
West Melbury Marley Chalk
Upper Greensand
Gault Clay
Lower Greensand (Folkestone)
Lower Greensand (Rogate)
Lower Greensand (Bargate)
Lower Greensand (Hythe)
Atherfield Clay
Wealden Clay (Sandstone)
Wealden Clay (Mudstone)

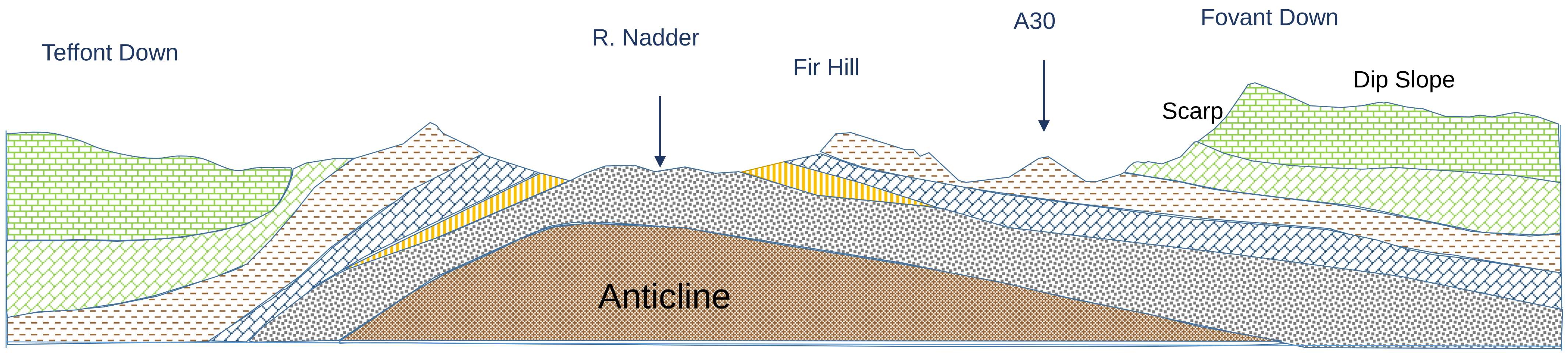
The water table in the chalk (N & S Downs) reaches over 100m above sea level (AOD).
Milland is at about 50m AOD – leaving upwards of 50m of hydraulic head.

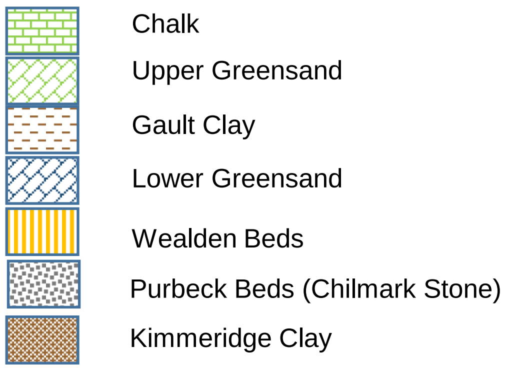


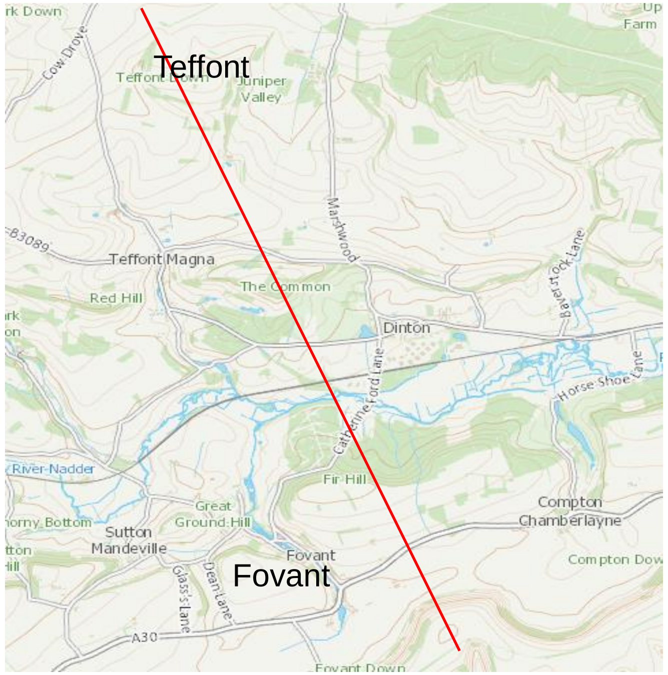


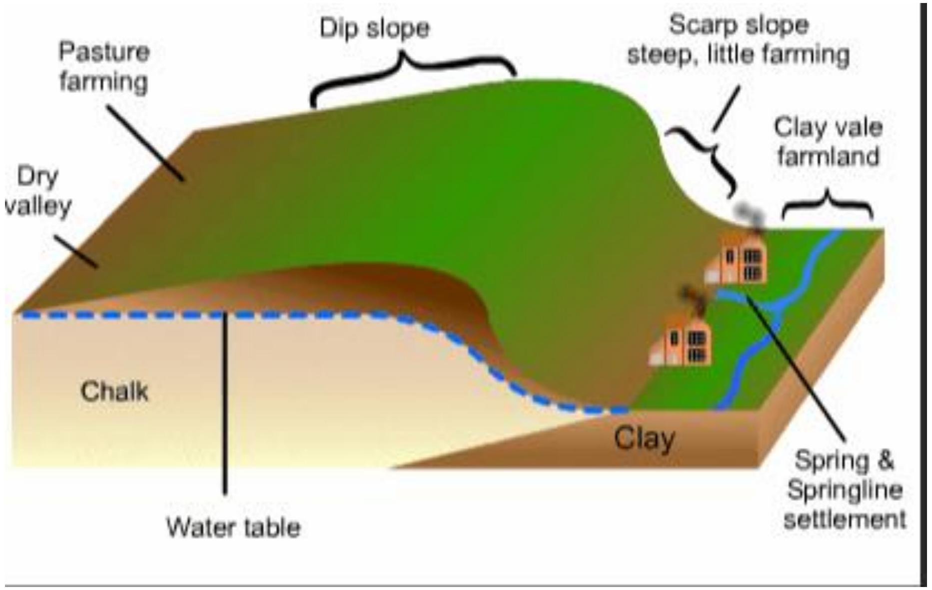
Chilgrove
M3
North Downs
South Downs
200m
150m
100m
50m
Milland
Kimmeridge Clay
Sands
London Clay
Chalk
U. Greensand
Gault
L. Greensand
Wealden Clay
L. Greensand
Gault
U. Greensand
Chalk
Milland – 53mAOD

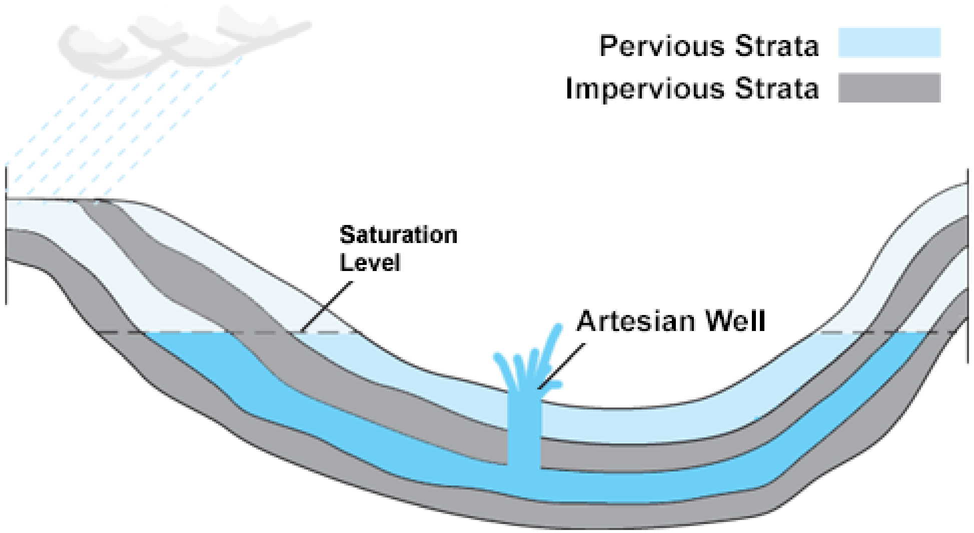
Vale of Wardour (Nadder Valley) Cross Section











An Artesian Borehole

An Artesian Borehole

Groundwater Flooding

Groundwater
Who does what?

Guy Parker
The Environment Agency

Cabinet Office
Civil Contingencies Unit
Local Resilience Forum (LRF)

SUSSEX**RESILIENCE**FORUM

Category One Responders:

- Local Authorities
- Police
- Fire & Rescue
- Ambulance
- HM Coastguard
- NHS Hospital Trusts
- Public Health England
- The Environment Agency

Category Two Responders:

- Transport (National Highways, Network Rail etc.)
- Utilities (Power, Gas, Water, Communications etc.)
- Health & Safety Executive
- The Met Office

Others represented at LRF:

- The Voluntary Sector (Red Cross, Raynet, Sussex 4x4 etc.
- The Military*

*Military aid to the civil authorities (MACA).
Military operations conducted in the UK and Crown Dependencies involving the employment of Defence resources as requested by a government department or civil authority.

Groundwater Flooding - Who does what?

The Environment Agency (EA)

- Under the **Flood and Water Management Act 2010,** the EA has a **strategic overview** of all sources of flood risk.
- The EA is responsible for the management of flood risk from **main rivers and the sea**
- In Hampshire and West Sussex the EA will develop, provide and maintain the warning service for flooding from rivers and the sea as well as from groundwater on the Chalk.

Groundwater Flooding - Who does what?

Flood Risk Management Authorities (FRMAs)

FRMAs are required to:

- Have plans in place to respond to emergencies including floods.
- Coordinate flood risk management and account for flood risk when acting as the planning authority in their area.
- Manage the risk of flooding from surface water, **groundwater** and ordinary watercourses.
- Lead on community recovery from flooding.
- Maintain a register of flood risk assets and surface water risk.

Groundwater Flooding - Who does what?

Highways Authorities

Highways Authorities:

- Are responsible for providing and managing highway drainage and roadside ditches.
- Must ensure that road projects do not increase flood risk.
- National Highways is responsible for motorways and major trunk roads.

Groundwater Flooding - Who does what?

Water Companies

Water and sewerage companies are:

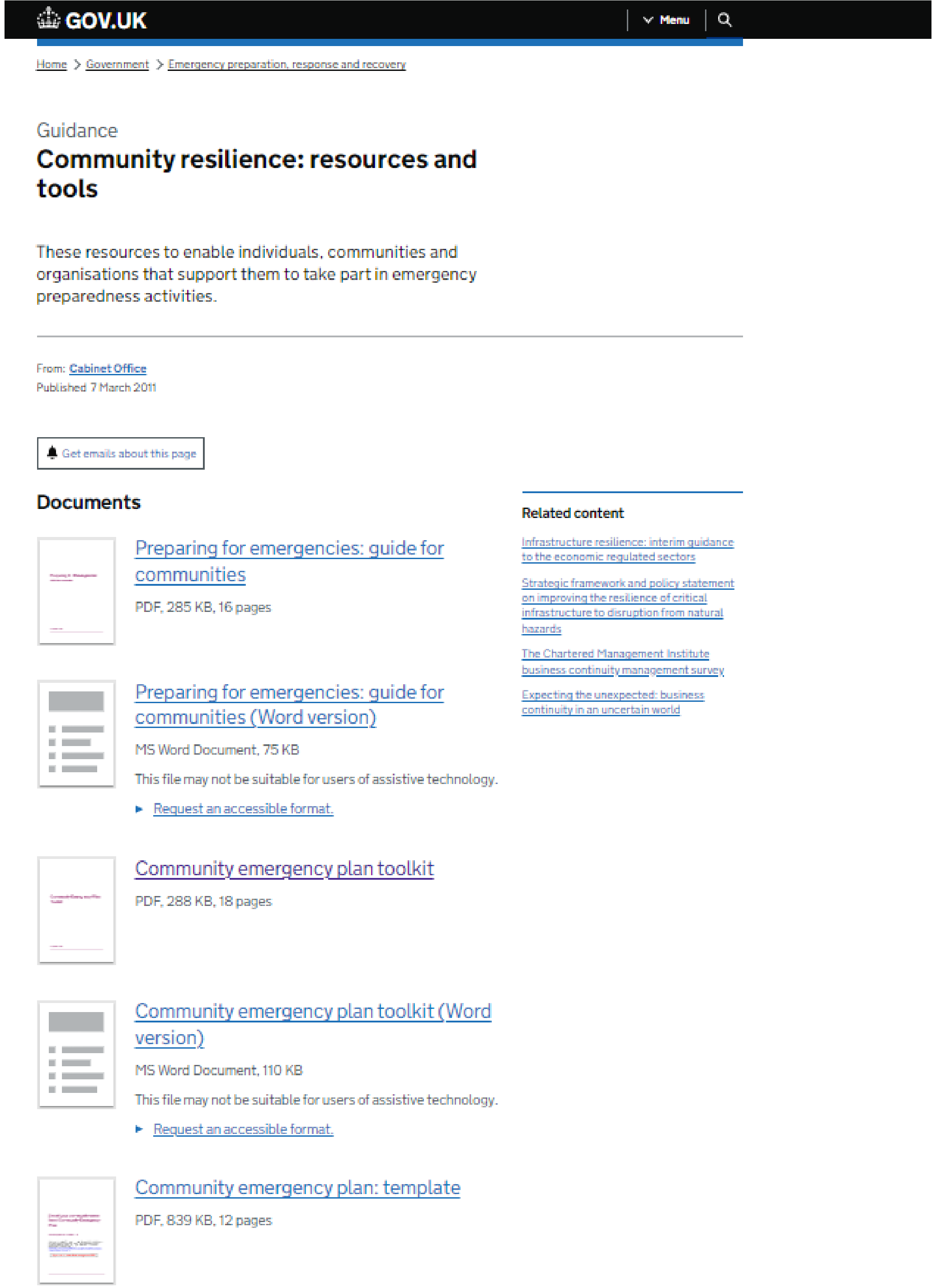
- Responsible for managing the risks of flooding from foul or combined sewer systems.
- Responsible for providing drainage from some buildings and yards.

Local Communities

There is no statutory responsibility for town and parish councils to plan for, respond to, or recover from emergencies. However, having some sort of Emergency Plan

- Parish Council
  - Community Emergency Volunteers
  - Flood Warden
  - Flood / Winter plan
  - Stores: sandbags, 2-way radios etc.

- Individuals
  - Flood Plans
  - Property level resilience
  - Sign up for any warnings available



GOV.UK Menu

Home > Government > Emergency preparation, response and recovery

Guidance

Community resilience: resources and tools

These resources to enable individuals, communities and organisations that support them to take part in emergency preparedness activities.

From: Cabinet Office
Published 7 March 2011

Get emails about this page

Documents

Preparing for emergencies: guide for communities
PDF, 285 KB, 16 pages

Preparing for emergencies: guide for communities (Word version)
MS Word Document, 75 KB
This file may not be suitable for users of assistive technology.
Request an accessible format.

Community emergency plan toolkit
PDF, 288 KB, 18 pages

Community emergency plan toolkit (Word version)
MS Word Document, 110 KB
This file may not be suitable for users of assistive technology.
Request an accessible format.

Community emergency plan: template
PDF, 839 KB, 12 pages

Related content

Infrastructure resilience: interim guidance to the economic regulated sectors

Strategic framework and policy statement on improving the resilience of critical infrastructure to disruption from natural hazards

The Chartered Management Institute business continuity management survey

Expecting the unexpected: business continuity in an uncertain world

Flood and Water Management Act 2010

UK Act of Parliament

The Flood and Water Management Act 2010 is a UK Act of Parliament relating to the management of the risk concerning flooding and coastal erosion. The Act aims to reduce the flood risk associated with …

Riparian Owner's Responsibilities

Riparian owner's responsibilities for the stretch of watercourse they own - Ad Medium Filum

You <u>must</u>:

Let water flow naturally

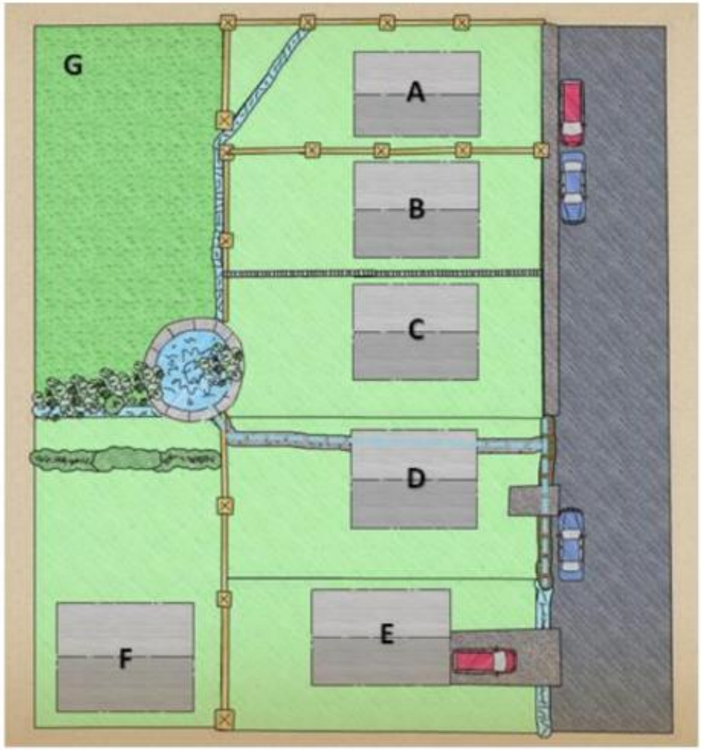
Remove blockages, fallen trees or overhanging branches from your watercourse, if they could reduce the flow or cause flooding to another landowners' property. You may be liable else.

You should:

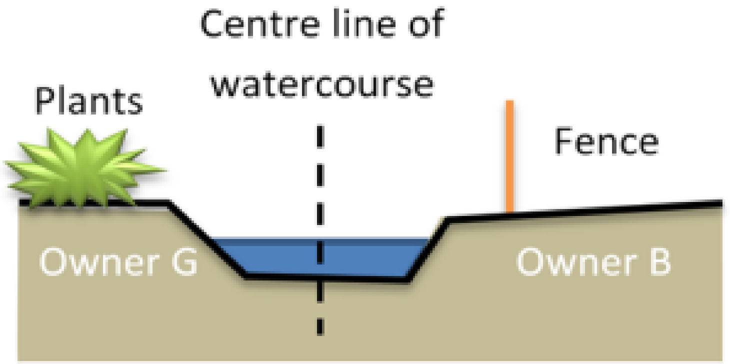
•leave all other trees, branches and shrubs - they can help prevent flooding by varying the shape and flow of the channel, and reduce erosion

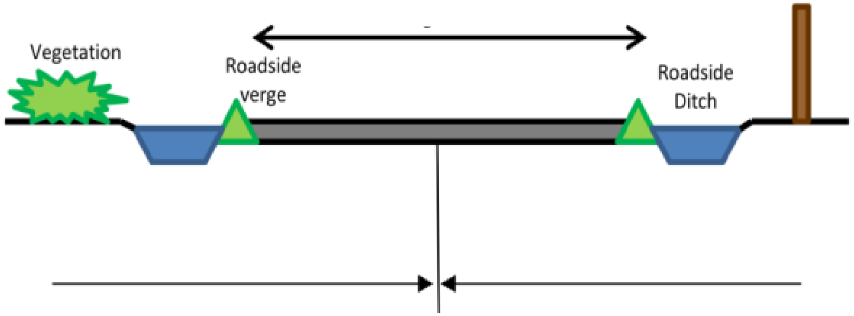
•keep any trash screen, weir, mill gate or other structure clear

Report an incident 0800 80 70 60



Ad Medium Filum





Land boundaries reach to the middle of the **river** or the **road**

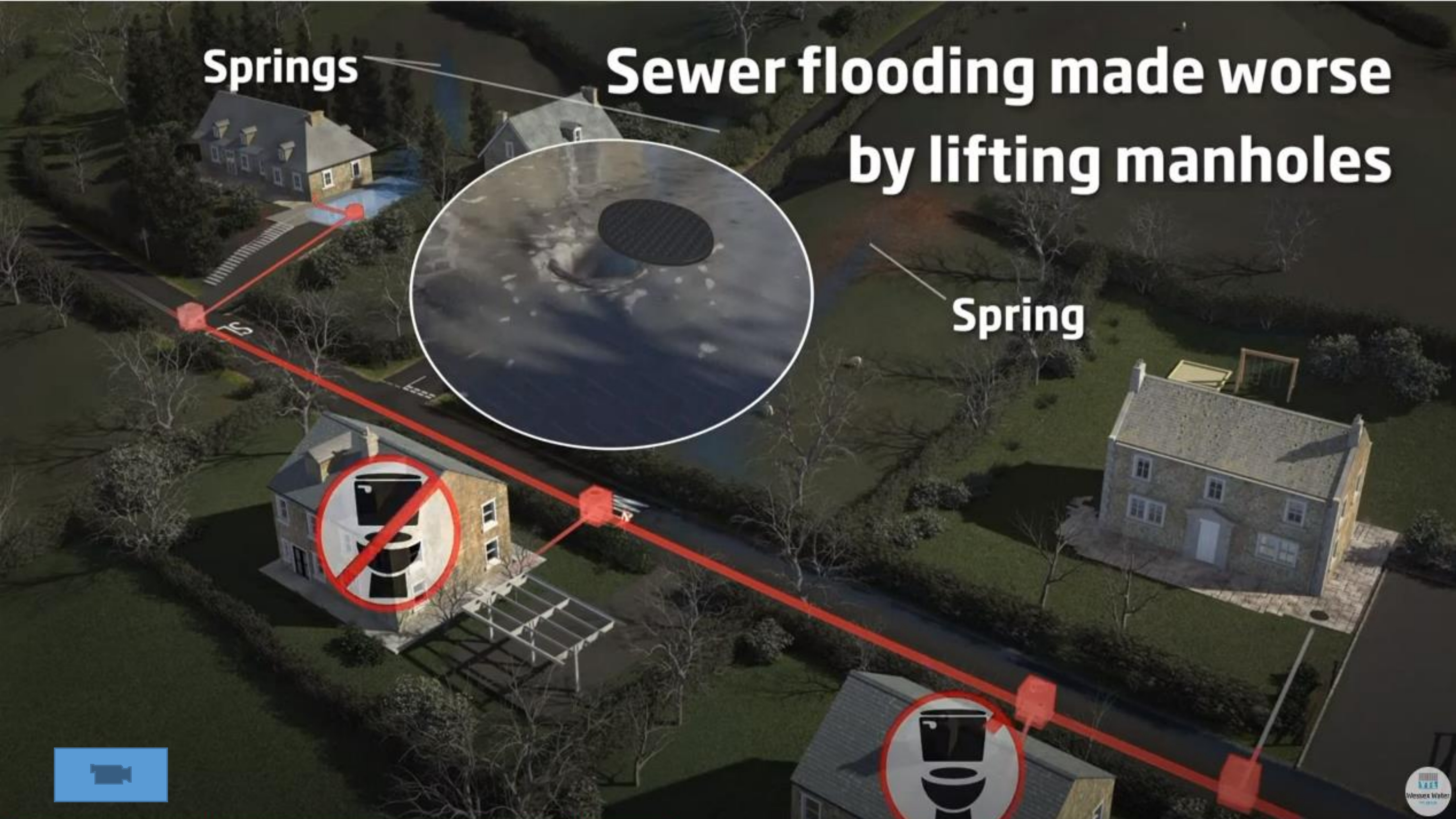
- House A is responsible for the all of the watercourse running through their garden
- House B is responsible for the watercourse behind the fence at the bottom of their garden
- House C is responsible for the watercourse behind the fence AND the pond
- House D is responsible for the culverted (piped) watercourse buried in the ditch in front of their land AND the underground pipe which runs beneath their property to the pond
- House E is responsible for the open ditch in front of their house AND the piped section under their access bridge
- House F is responsible for the watercourse at the end of their garden behind their hedge
- Landowner G is responsible for both the watercourses running along the edges of their land AND the pond

Groundwater Flooding

Flooding Impact

Guy Parker
The Environment Agency

Environment Agency


Sewer flooding made worse by lifting manholes
Springs
Spring

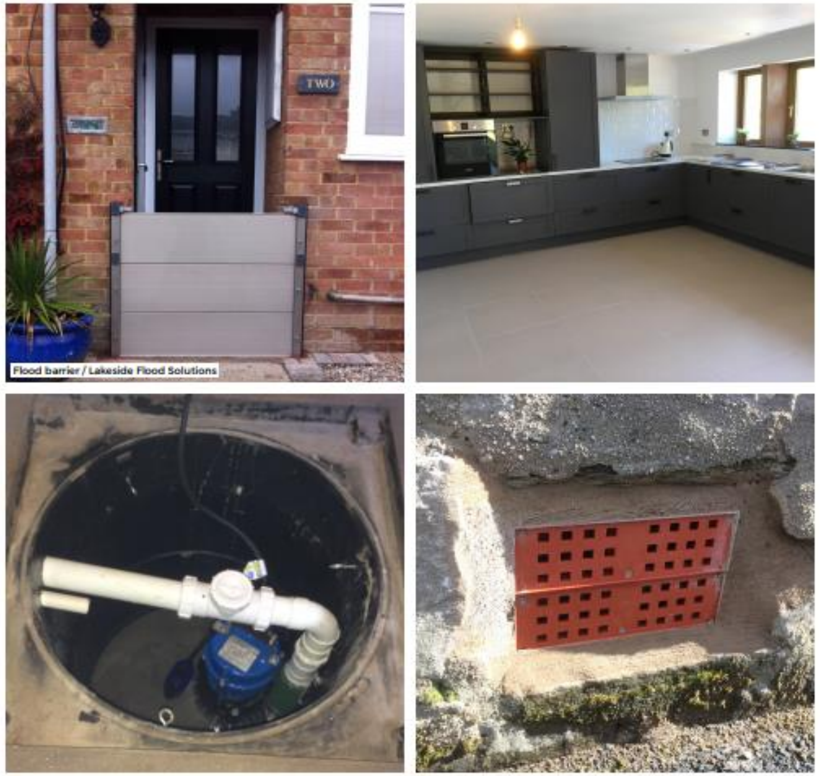
Groundwater Flooding

Groundwater Flood Resilience

Guy Parker
The Environment Agency

THE FLOOD HUB

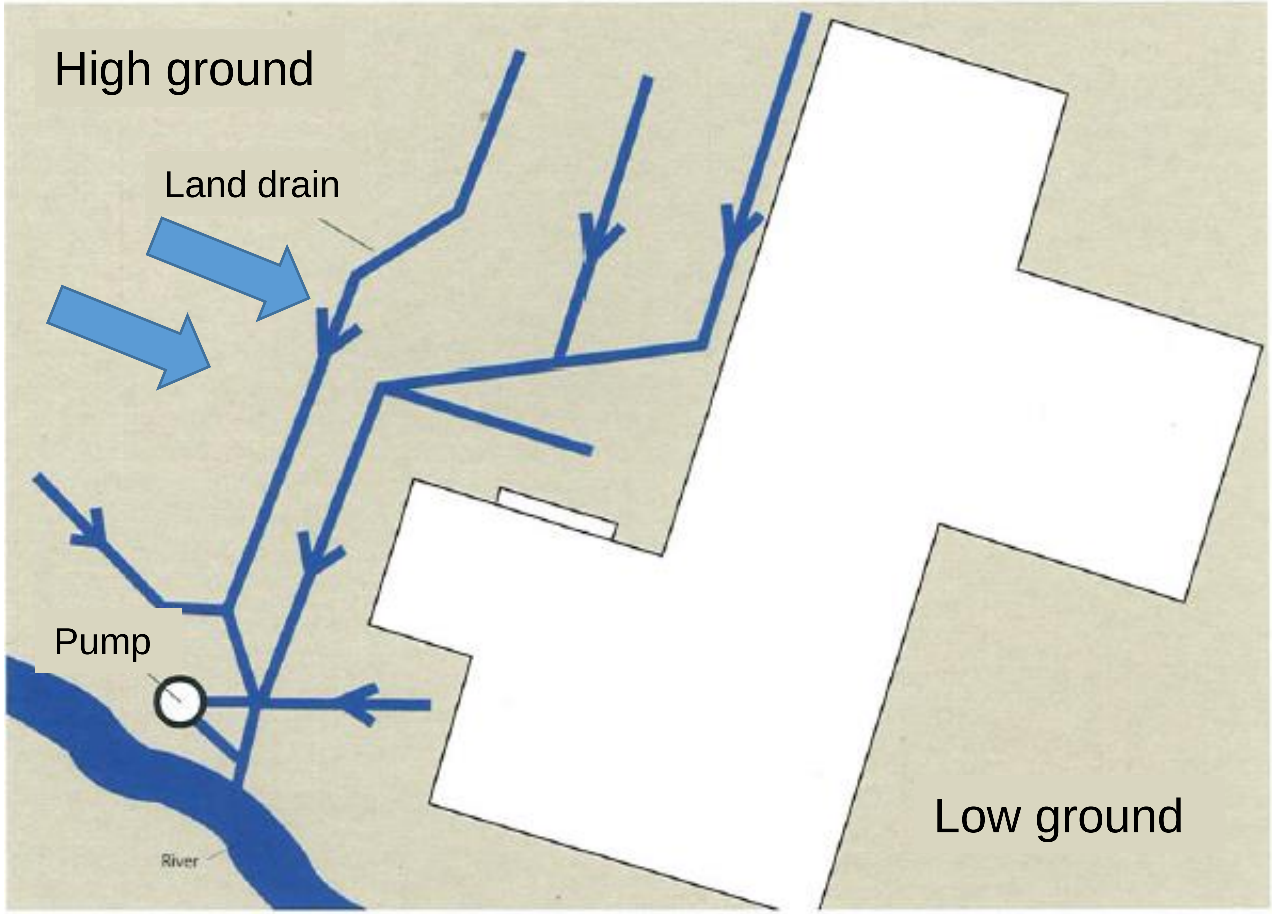
Property Flood Resilience (PFR) Booklet

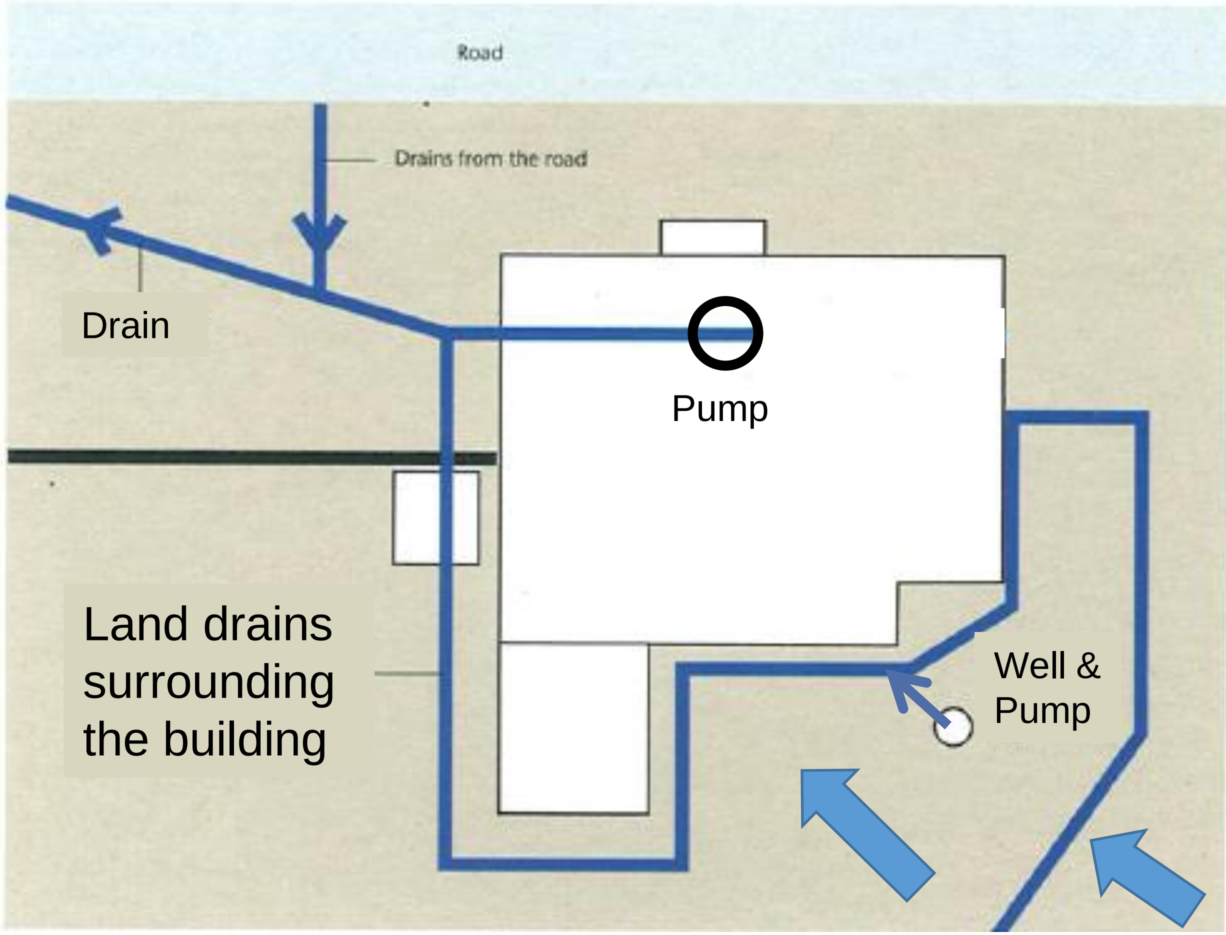


newground
your community is our business
This resource has been produced by Newground who work in partnership with the Environment Agency
Environment Agency

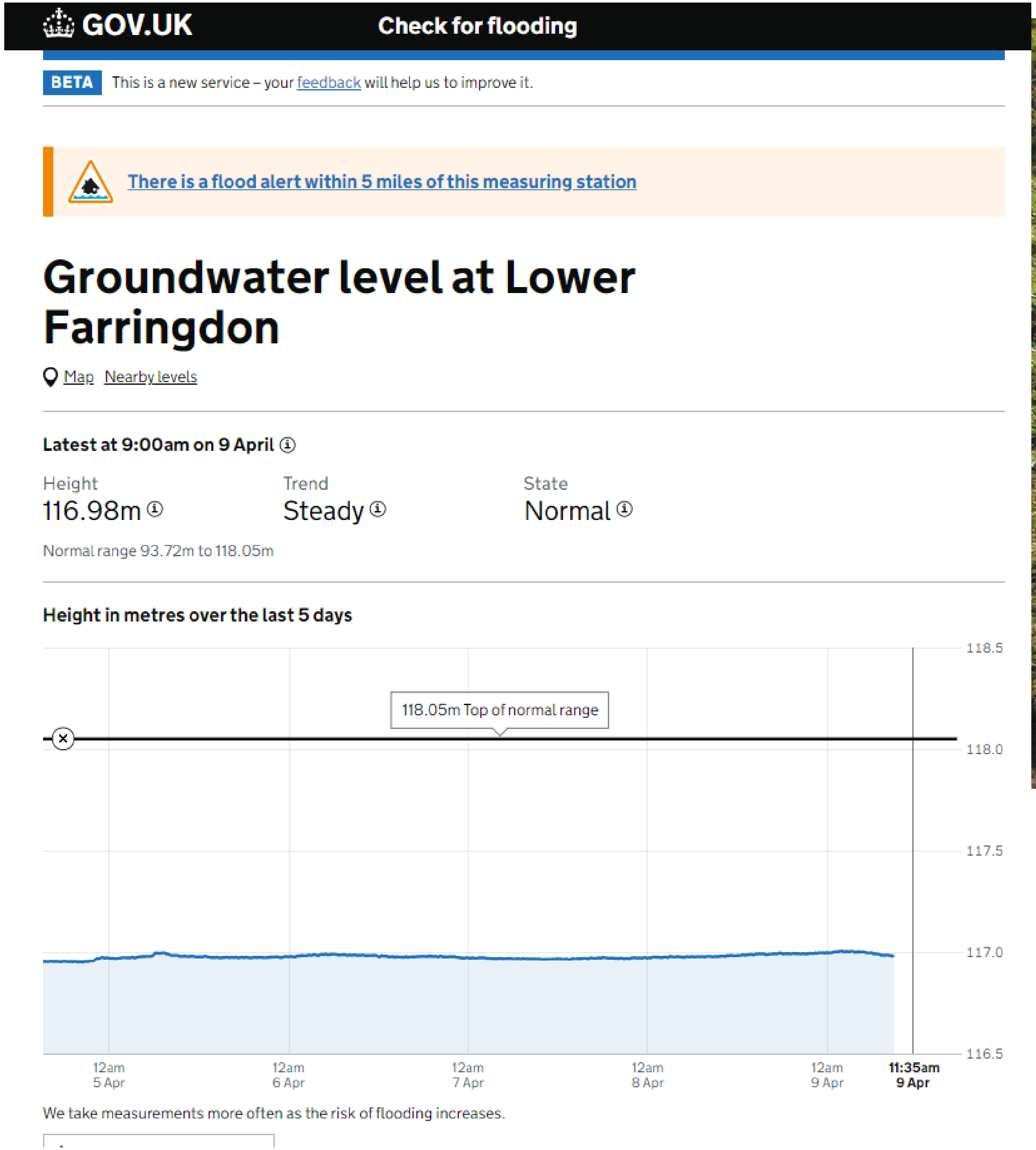
Houses with cellars and basements are the first to be affected. Pumped water inevitably adds to the problem of flooded highways.

Property Flood Resilience





Often issue with what to do with pumped water. It must NEVER go into the sewage network.


GOV.UK Check for flooding

BETA This is a new service – your feedback will help us to improve it.

There is a flood alert within 5 miles of this measuring station

Groundwater level at Lower Farringdon

Map Nearby levels

Latest at 9:00am on 9 April

Height	Trend	State
116.98m	Steady	Normal

Normal range 93.72m to 118.05m

Height in metres over the last 5 days

We take measurements more often as the risk of flooding increases.

And telemetry was installed, giving continuous data at over 60 locations.

Groundwater Flooding

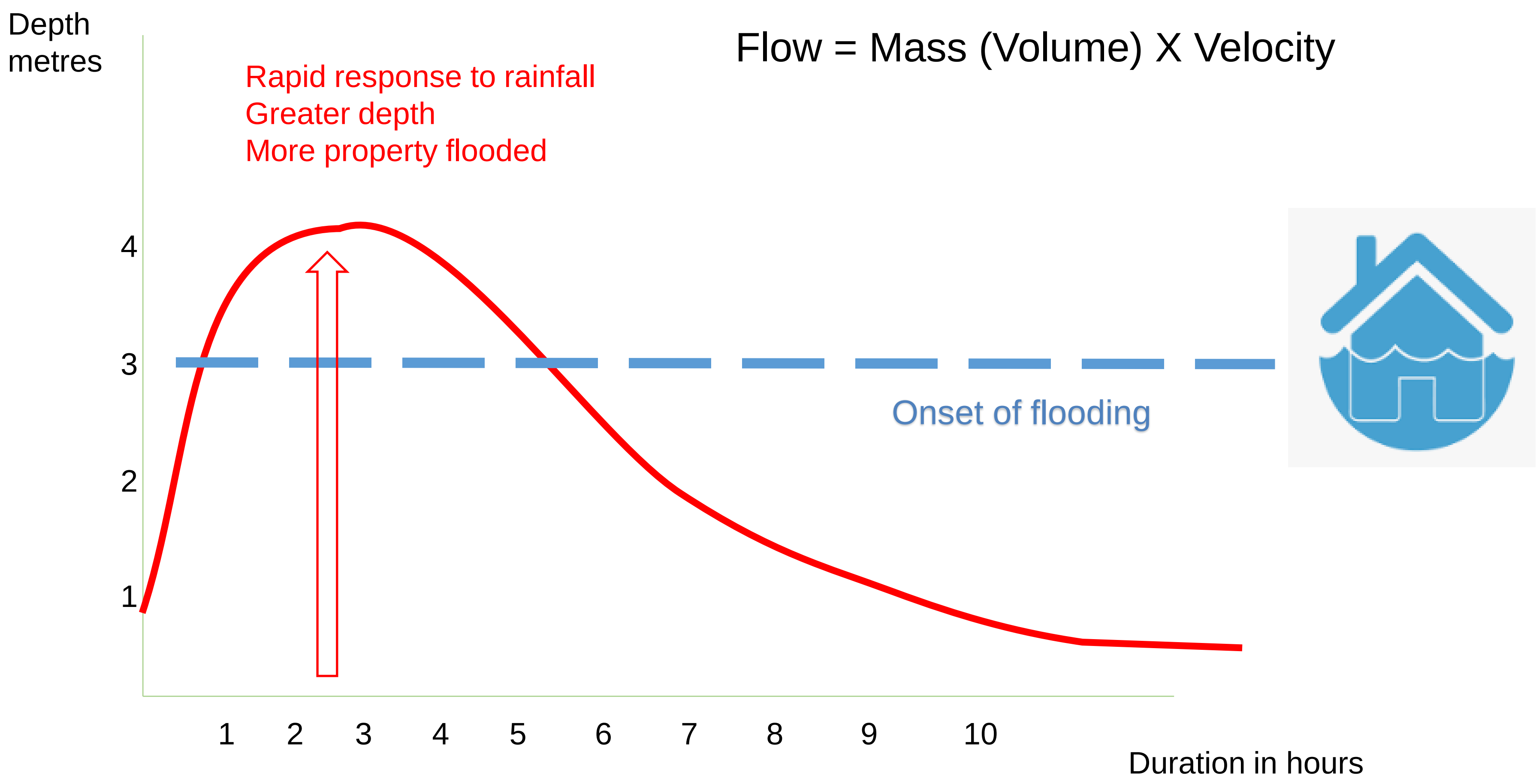
Natural Flood Risk Management

Guy Parker
The Environment Agency

Surface water flooding

- Thunderstorms
- Road flooding / muddy flooding / blocked gullies
- Autumn harvest and bare soils
- Clay cap and Compacted soils
- Field run off
- Soil erosion
- Run off down tracks
- **Overly efficient drainage**

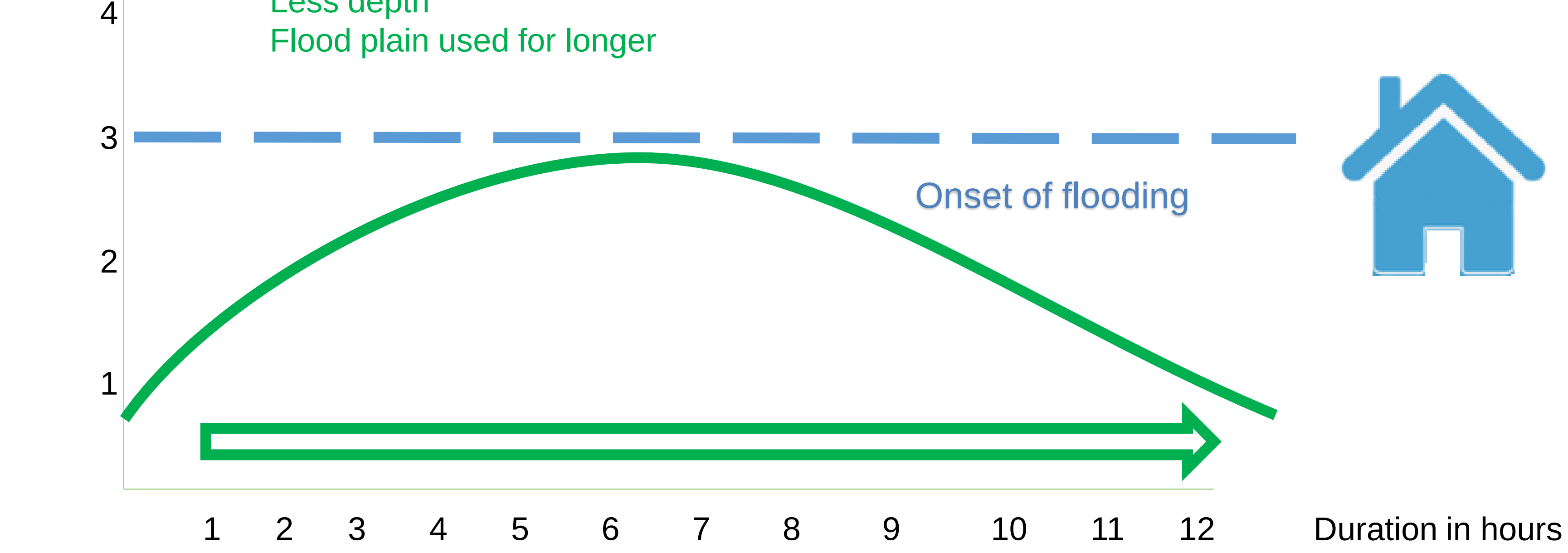
How Natural Flood Management Works



Environment Agency

How Natural Flood Management Works

A post-war drive for increased agricultural production to meet concerns over food security led to a “drainage at all costs” approach. This involved straightening watercourses, removing hedges and woodland and dredging to speed up drainage.



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Typical Issues

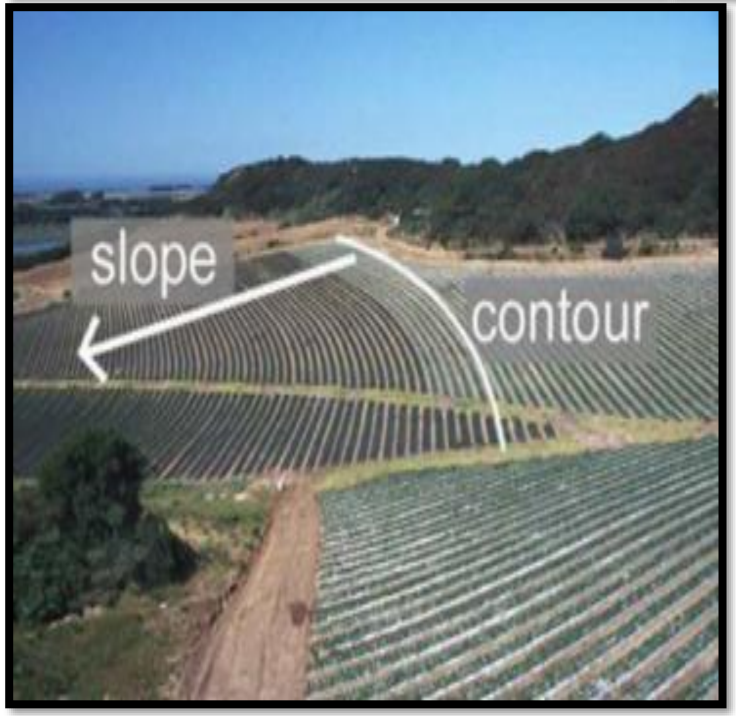
- Thunderstorms
- Road flooding / muddy flooding / blocked gullies
- Autumn harvest and bare soils
- Clay cap and Compacted soils
- Field run off
- Soil erosion
- Tracks
- Overly efficient drainage




Examples of NFM Measures

To Increase infiltration of rainfall

- Land management and crop choice
- Contour ploughing
- Herbal Layes
- Sub soiling / aeration
- Tree Planting / woodland creation



Examples of NFM Measures

To *'slow the flow'* instream

- Leaky woody barriers
- River Restoration
- Using the floodplain
- Restoring meanders

Focus on smaller streams and headwater tributaries

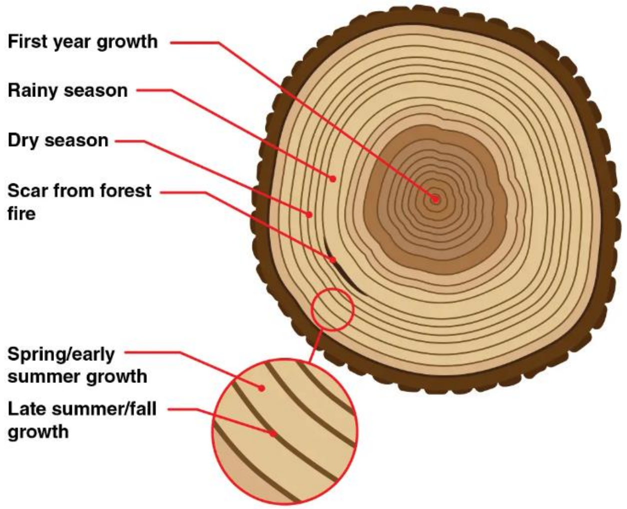
Rivers are naturally about twice as long as the straight-line distance between source and mouth. Many have been shortened by removing meanders.

Environment Agency

Groundwater Flooding

Groundwater & Climate Change

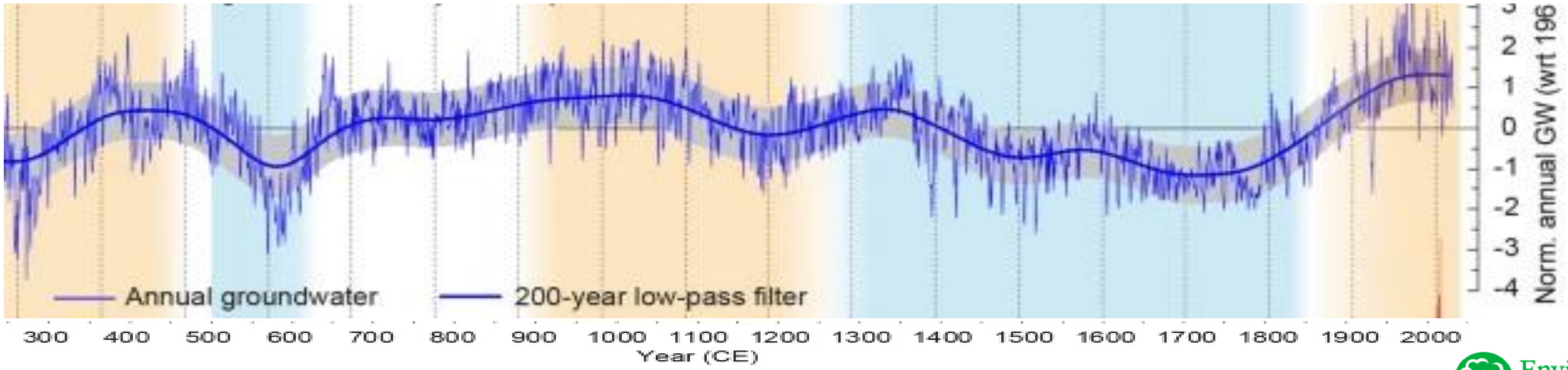
Guy Parker
The Environment Agency



Using a combination of carbon dating and tree ring width we can build a groundwater model ranging over 2000 years.

1100-year-old Big Belly oak in the Savernake. Methuselah in California is about 4500y.

Beams from the Temple Mount in Jerusalem felled 3000 years ago.



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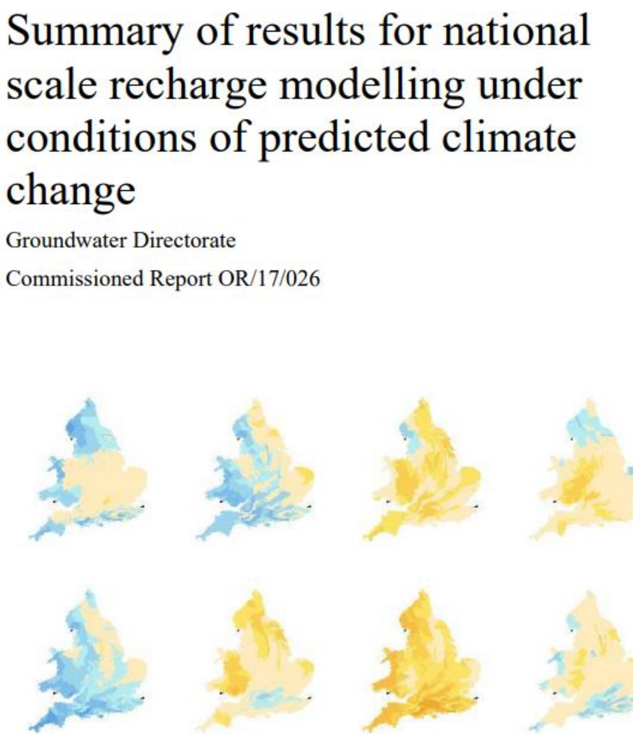
A possible outcome of climate change on recharge of the Chalk Aquifer in Wessex

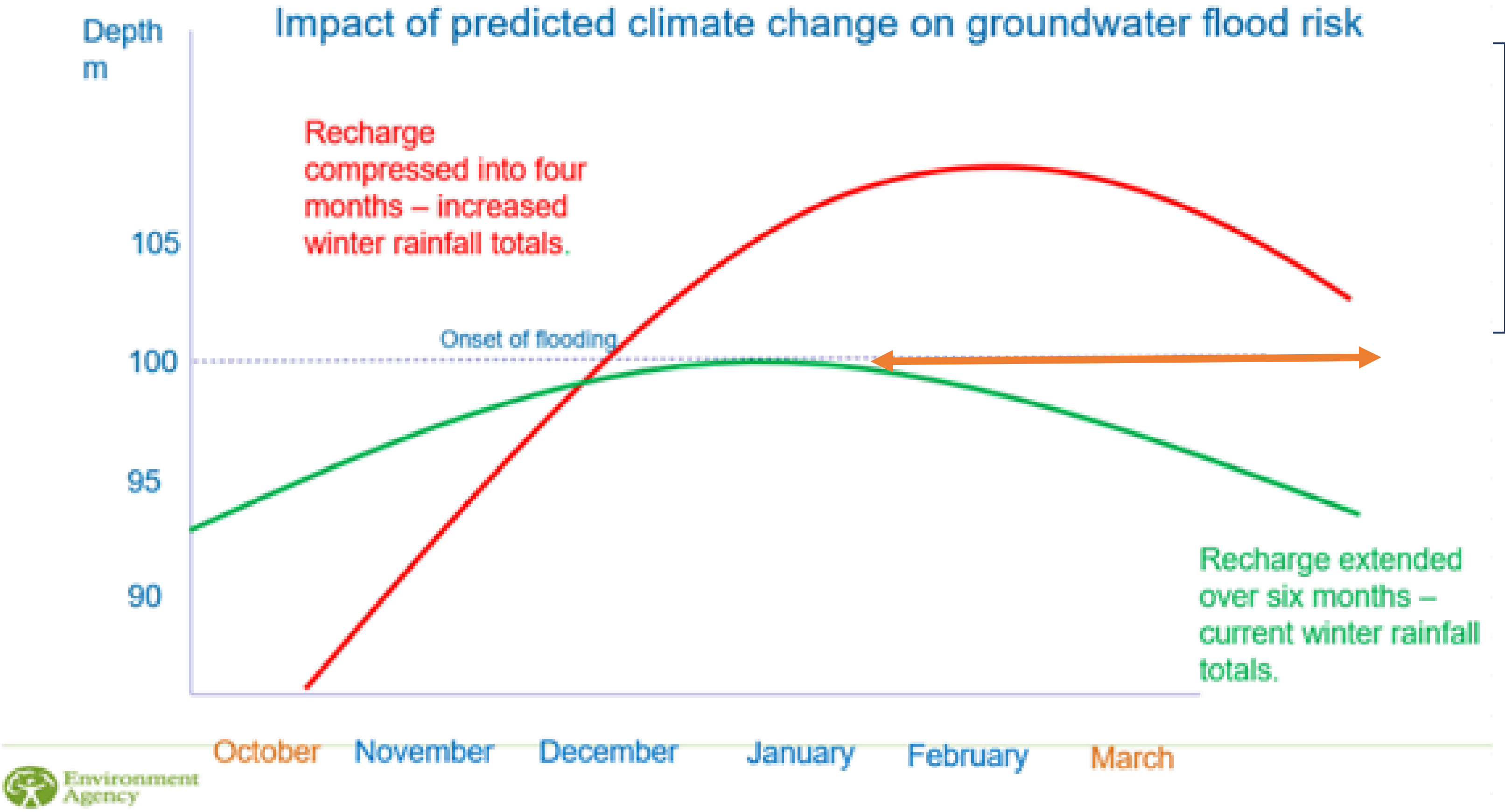
British Geological Survey
Expert | Impartial | Innovative

Flood Hydrograph
- More recharge in shorter time slot
- Bigger flood hydrograph
- Longer duration / greater impact floods


Summary of results for national scale recharge modelling under conditions of predicted climate change

Groundwater Directorate

Commissioned Report OR/17/026



Environment Agency

A possible outcome of climate change on recharge of the Chalk Aquifer in Wessex

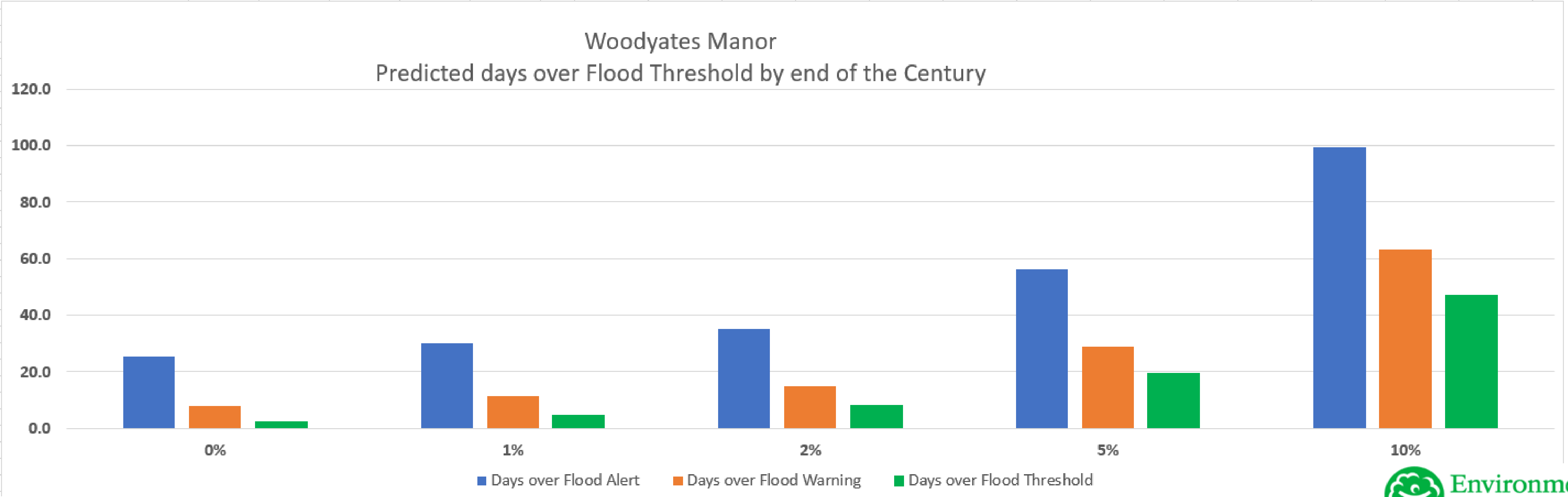
Woodyates	mAOD				
Flood Alert level	98				
Flood Warning level	103				
Impact Threshold	105				
Increase in Recharge	**0%**	**1%**	**2%**	**5%**	**10%**
Days over Flood Alert	25.5	30.3	35.2	56.2	99.4
Days over Flood Warning	8.0	11.4	15.1	28.9	63.2
Days over Flood Threshold	2.3	4.6	8.1	19.2	47.2

> Daily groundwater levels for the period 1992 to 2023 were increased by values of 1,2,5 & 10% for November to February. They were reduced by the same values for March and October. The remaining summer months were left the same.

> Days which exceeded Flood Alert (99m) and Flood Warning (103m) and Impact - the onset of flooding (105m) were counted for each year and averaged over the full 33 year period.

> Summer recharge on the Chalk is limited through natural evapo-transpiration.

Climate change will lead to an increase in extreme summer rainfall events, as evidenced by unseasonal recharge in July 1955 & July 2012. For this reason any reduction in summer recharge has been discarded from the model.



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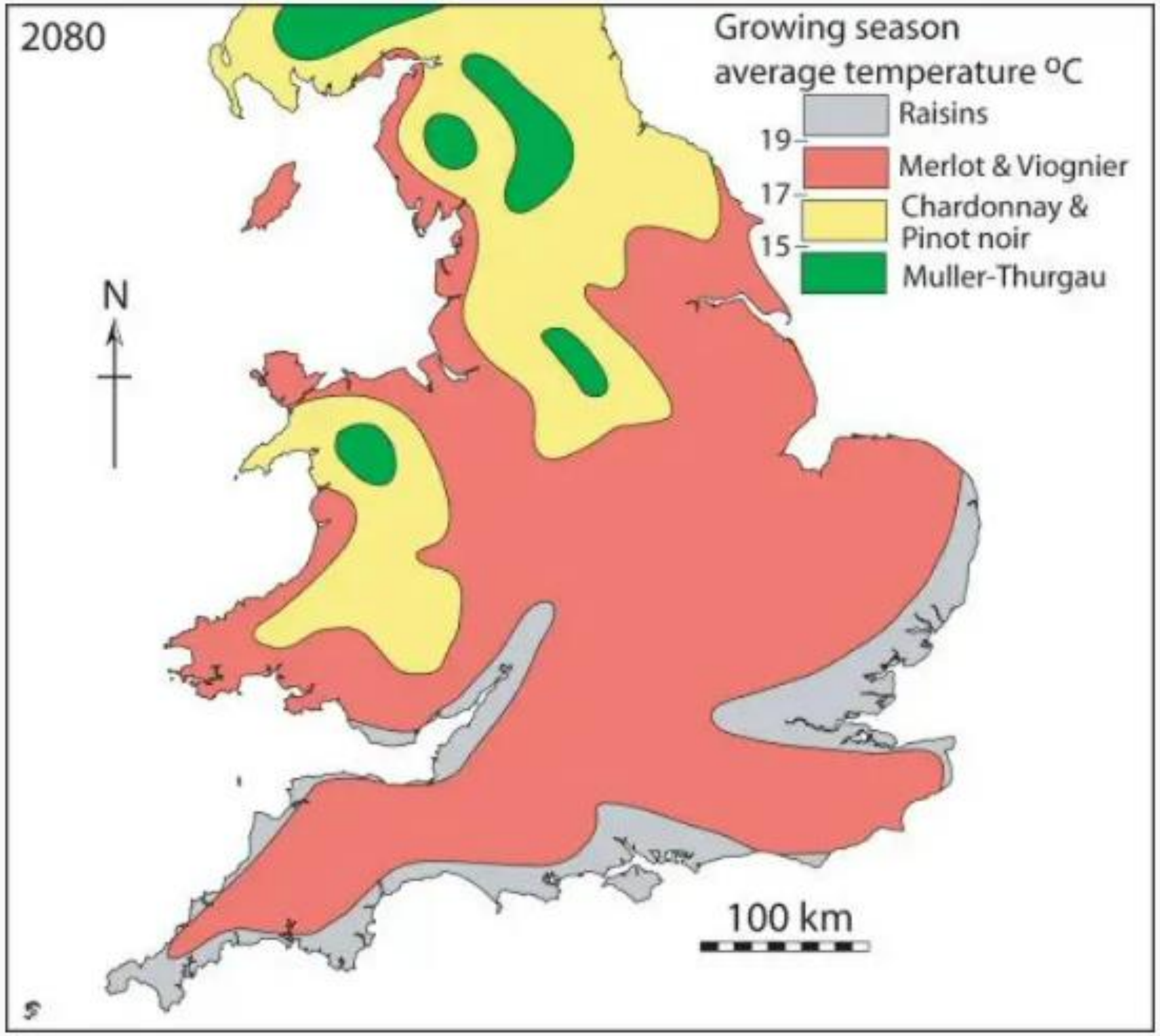
Obviously there has to be a bright side to all this.



Where grapes can be grown in the UK by 2080.

Image: UK's Department for the Environment, Food and Rural Affairs, via cees-edu.org

Champagne houses including Taittinger and Pomeroy, are buying up land to plant vineyards. The south of England now has a similar climate to that of the Champagne region in the early ’80s and ’90s.

There are over 800 commercial vineyards in the UK covering nearly 4,000 hectares

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