The Clay Research Group

RESEARCH AREAS

Climate Change ◆ Data Analysis ◆ Electrical Resistivity Tomography
Time Domain Reflectometry ◆ BioSciences ◆ Ground Movement
Soil Testing Techniques ◆ Telemetry ◆ Numerical Modelling
Ground Remediation Techniques ◆ Risk Analysis
Mapping ◆ Software Analysis Tools
Artificial Intelligence

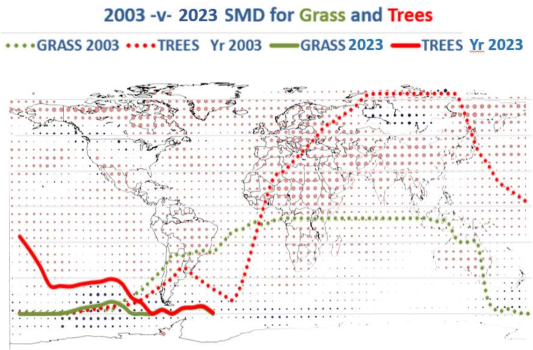
May 2023
Issue 216

The Clay Research Group

CONTENTS

Soil Moisture Deficit Update

The Soil Moisture Deficit for both grass and trees is significantly lower than for the surge year of 2003, reflecting the heavy rainfall over recent months.



SMD Data provided by the Met office. Tile 161, Medium Available Water Capacity with grass and tree cover

Contributions Welcome

We welcome articles and comments from readers. If you have a contribution, please Email us at: *clayresearchgroup@gmail.com*

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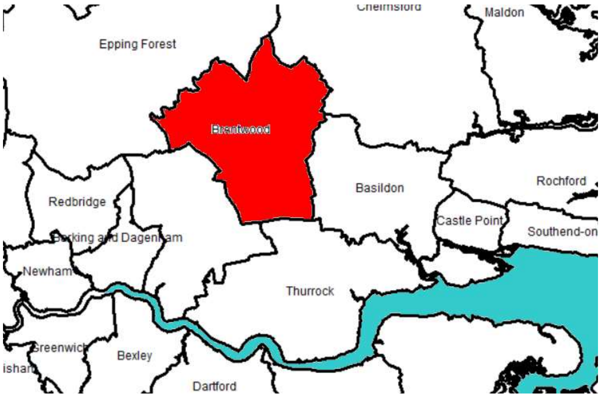
District and Sector Risk

Brentwood is the topic of the 'Risk by District' series in this month's edition. Brentwood is situated in Essex and has superficial deposits of Till overlying outcropping London clay and Barton, Bracklesham and Bagshot beds.

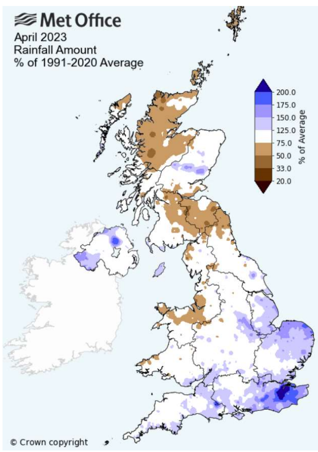


The maps are built from a data sample covering four claim years, including one surge and three 'normal' years.

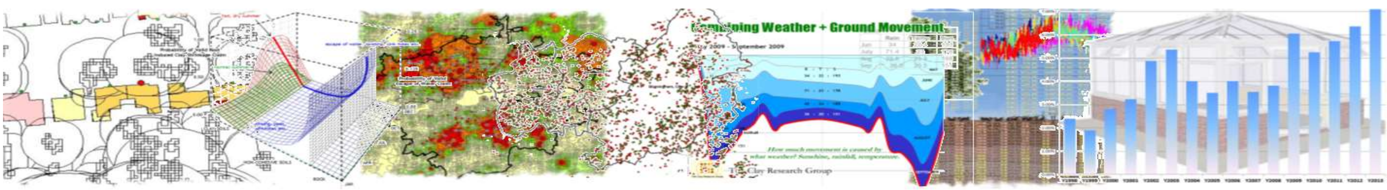
April Weather Update

Anomaly maps produced by the Met Office compare the weather in a selected month with those from previous periods.

The map, right, shows a slight increase in rainfall to the south east of the UK in April 2023 when compared with the 1991 – 2020 average.



In last month's edition the Met Office anomaly map revealed that March was a particularly wet month across the UK.



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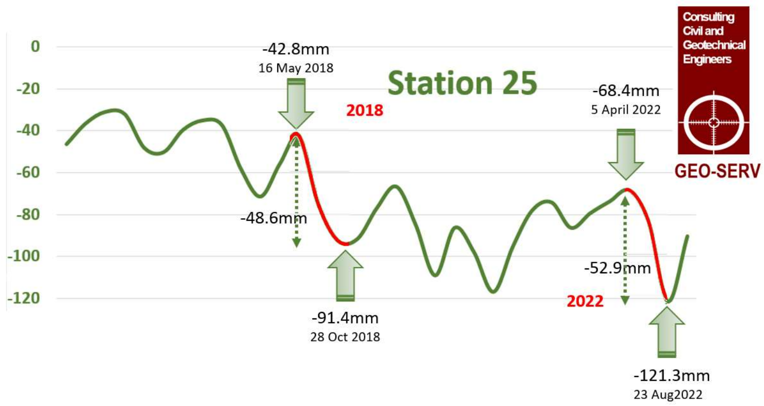
Ground Movement and Surge
Aldenham Willow

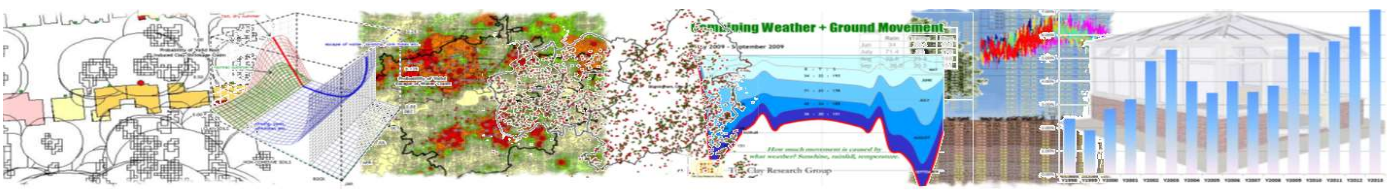
Below, two extracts of ground movement relating to Stations 21 and 25 of array 2 of the willow situated at the Aldenham School research site in NW London, covering the period November 2015 – March 2023.

The plots capture (red line) movement associated with the two surge years, 2018 and 2022.

At Station 21, above, 30.2mm of subsidence was recorded in 2018 between May and September (readings are generally taken at two-month intervals), and 44.5mm between April and August 2022. 2019 and 2020 have similar values.



At Station 25, 48.6mm of subsidence was recorded from May to October in 2018, and 52.9mm between April to August in 2022. Movement in the intermediate years was 42.3mm in 2019, 30.5mm in 2020 and 8.3mm in 2021, reflecting the problems associated with predicting the risk of root induced clay shrinkage. The interval between readings varies by year and the above are approximations only.



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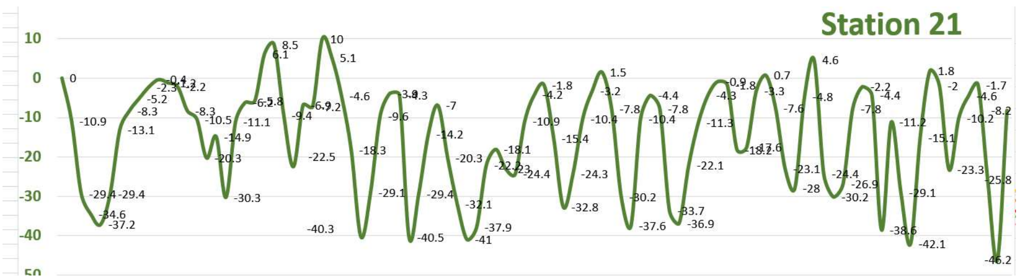
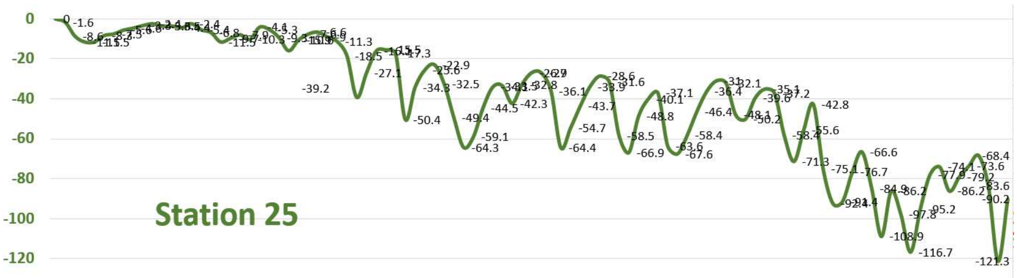
Ground Movement and Surge
Aldenham Willow

Over the longer term, plotting ground movement since May 2006 reveals a difference between the two stations.

Below, station 21 has subsided by a maximum of 46.2mm in the summer of 2022, with a fairly regular pattern of seasonal movement over time.

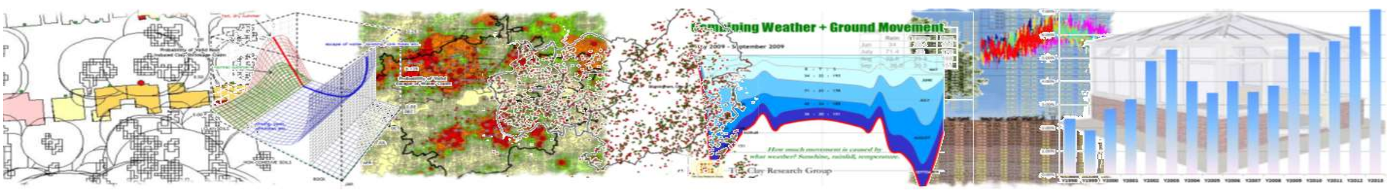


Below, a pattern of gradual subsidence at station 25, reaching a peak value of 121.3mm in the summer of 2022.



Stations 21 and 25 are 8mtrs apart.

Next month, moisture uptake by the willow looking at individual stations and comparing 2006 and 2007.



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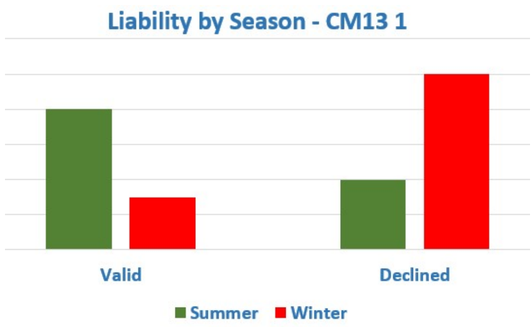
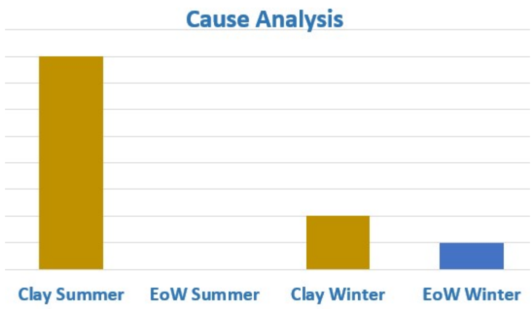
BRENTWOOD Area Sector Level Sample. Using Past Claims Data to Infer Geology and Derive Probability of Cause and Liability





CM13 1 – The table below lists the probability of both causation and liability by season, which reflects the underlying geology, at postcode sector level. There is a high probability that valid claim will be due to clay shrinkage in the summer and high probability of a declinature in the winter – a characteristic associated with outcropping London clay.

valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
0.660	0.010	0.33	0.15	0.08	0.77

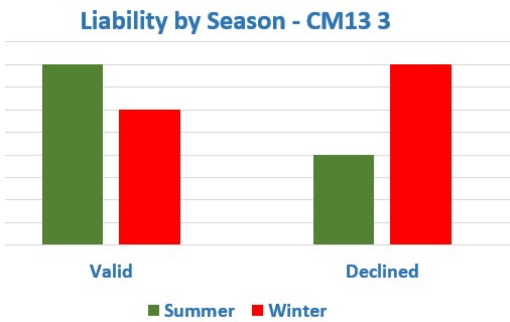
Declinature rates increase significantly in the winter, although valid claims are still likely to be caused by clay shrinkage.

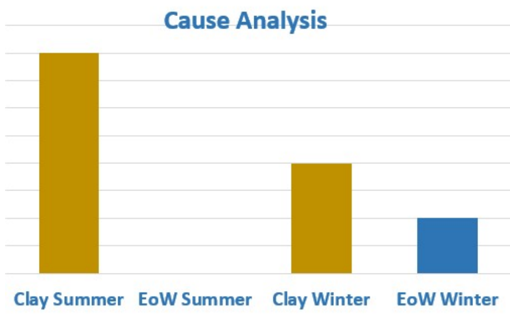
CM13 3 – A similar profile to CM13 1 above, with clay shrinkage being the most likely cause of damage in the summer months, and a high probability that a claim is likely to be declined in the winter.

Below, sector data.

valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
0.66	0.00	0.34	0.28	0.14	0.58

The ‘valid summer clay’ values reflect the extent of outcropping London clay, as does the reversal in values by season.





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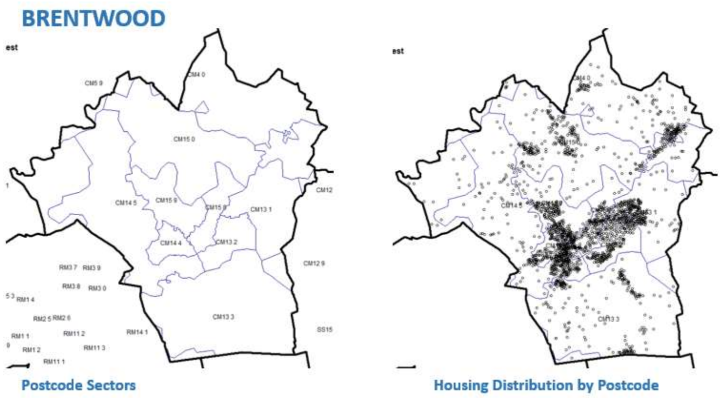
Subsidence Risk Analysis – BRENTWOOD

Brentwood is situated in Essex and occupies an area of 153km^2 with around 30,600 households and a population of around 77,100.



Distribution of housing stock using full postcode as a proxy. Each sector covers around 2,000 houses on average across the UK and full postcodes include around 15 – 20 houses on average, although there are large variations.

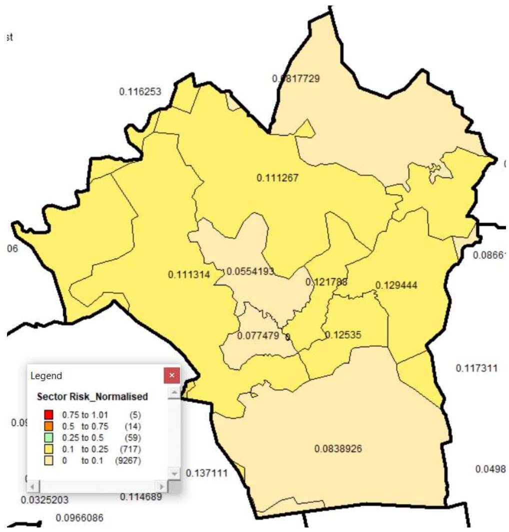
Sector and housing distribution across the district (left, using full postcode as a proxy) helps to clarify the significance of the risk maps on the following pages. Are there simply more claims in a sector because there are more houses?

Using a frequency calculation (number of claims divided by private housing population) the relative risk across the borough at postcode sector level is revealed, rather than a 'claim count' value.

From the sample we hold, sectors are rated for the risk of domestic subsidence compared with the UK average – see map, right.

Brentwood is rated 11th out of 413 districts in the UK from the sample analysed and is around 2.44x the risk of the UK average, or 0.632 on a normalised 0 - 1 scale.

There is an increased risk to the south of the borough as can be seen from the sector map, right, which corresponds with outcropping London clay.



Brentwood district is rated around 2.44 times the UK average risk for domestic subsidence claims from the sample analysed. Above, risk by sector compared with normalised UK values.

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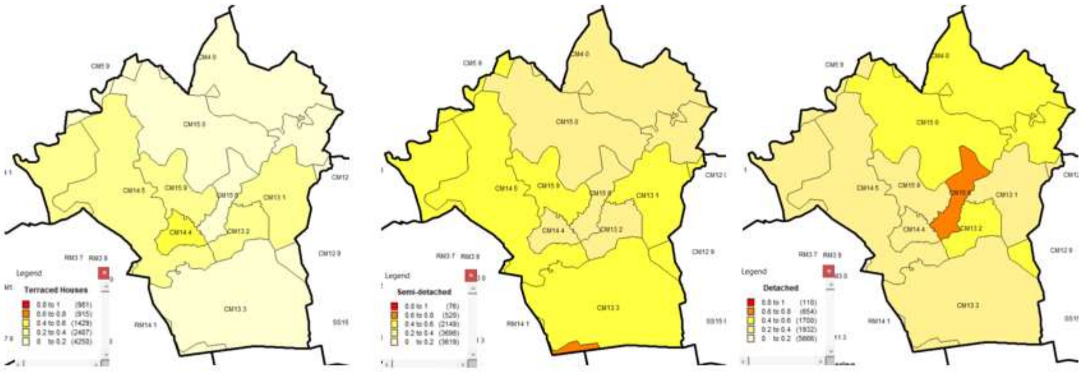
BRENTWOOD - Properties by Style and Ownership

Below, the general distribution of properties by style of construction, distinguishing between terraced, semi-detached and detached. Unfortunately, the more useful data is missing at sector level – property age. Risk increases with age of property and the model can be further refined if this information is provided by the homeowner at the time of application.

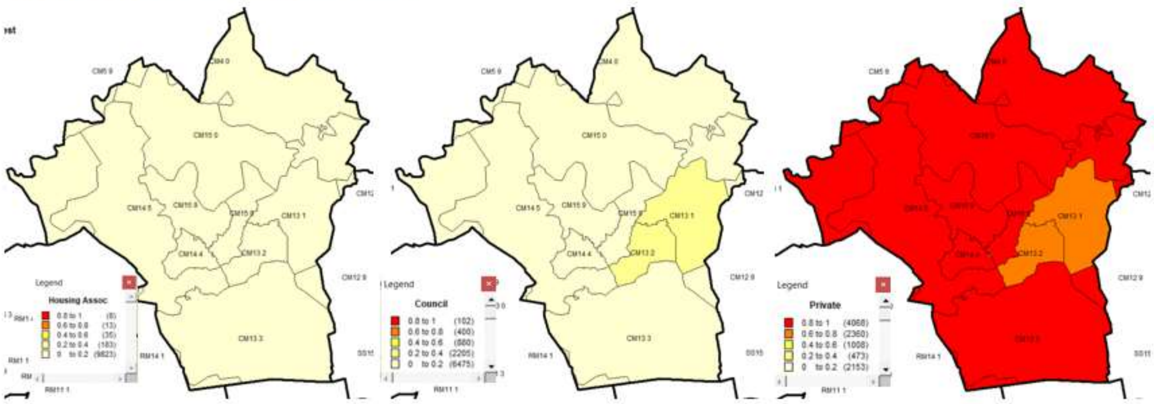
BRENTWOOD - Distribution by House Type



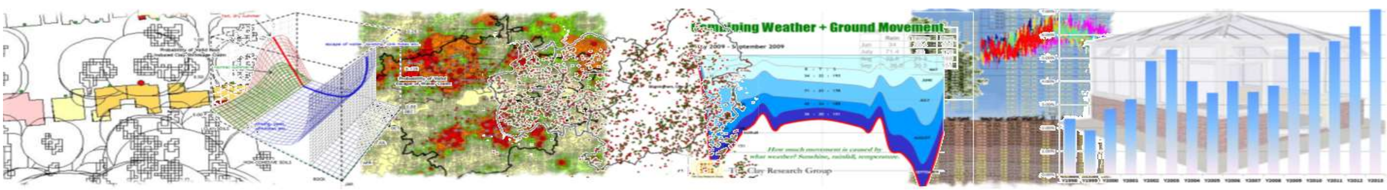
Terraced **Semi-Detached** **Detached**

Distribution by ownership is shown below. Terraced properties are the dominant class with private ownership increasing to the south of the borough. See page 10 for distribution of risk by ownership.

BRENTWOOD - Distribution by Ownership



Housing Association **Council Ownership** **Private Ownership**



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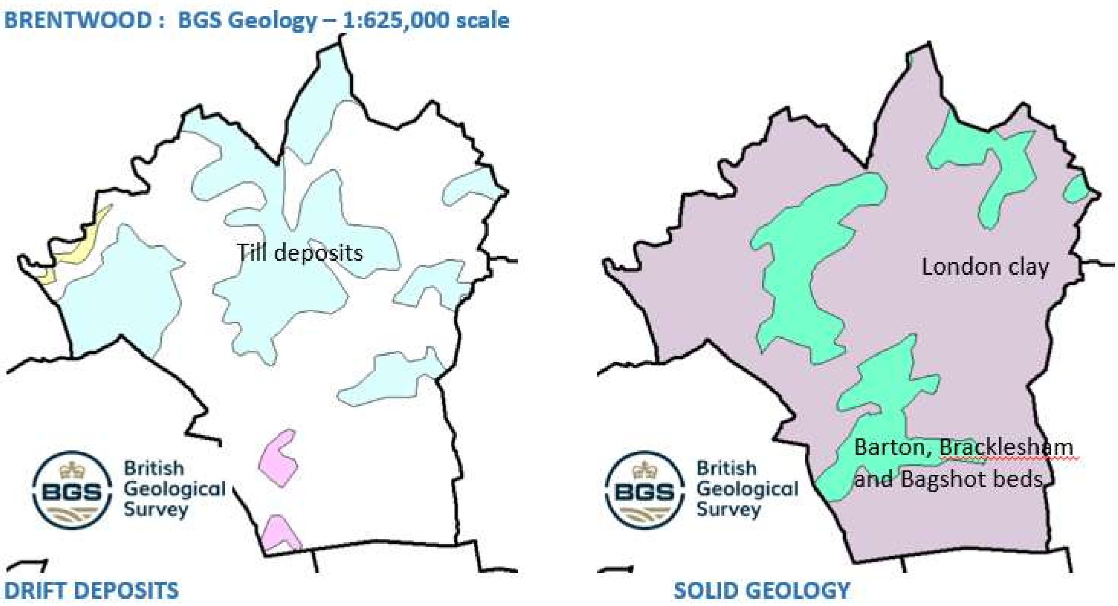
Subsidence Risk Analysis – BRENTWOOD

Below, extracts from the British Geological Survey low resolution 1:625,000 scale geological maps showing the solid and drift series. View at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html for more detail.

See page 10 for a seasonal analysis of the sample which reveals that, at district level, there is an 80% probability of a claim being valid in the summer and of the valid claims, there is a greater than 80% chance that the cause will be clay shrinkage.

In the winter the likelihood of a claim being valid falls to around 30% and if valid, there is around a 90% probability the cause will be due to an escape of water – leaking drains etc. Maps at the foot of the following page plot the seasonal distribution.



Above, extracts from the 1:625,000 series British Geological Survey maps. Working at postcode sector level and referring to the 1:50,000 series delivers far greater benefit when assessing risk.

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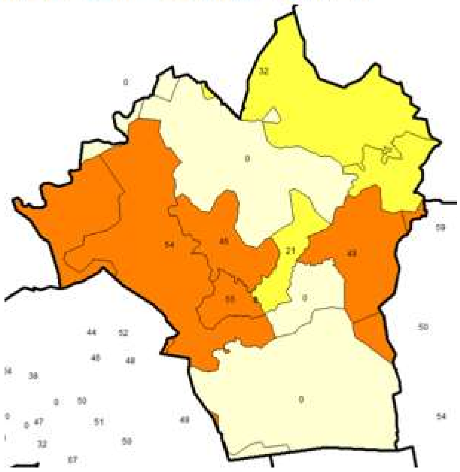
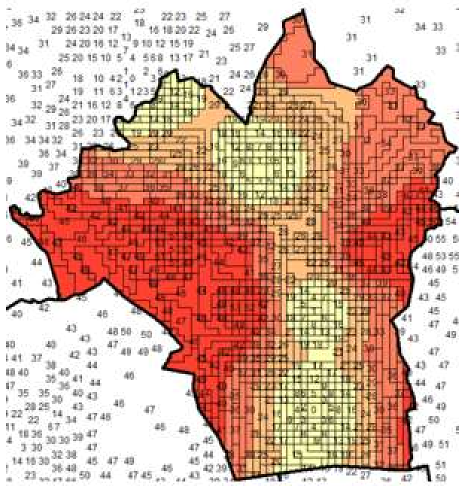
Liability by Geology and Season

Below, the average PI by postcode sector (left) derived from site investigations and interpolated to develop the CRG 250m grid (right). The higher the PI values, the darker red the CRG grid.

BRENTWOOD – Soil Plasticity Index



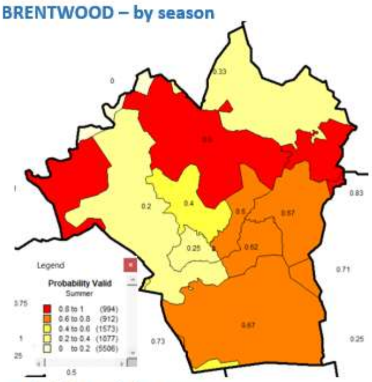
Soil PI Averaged by Sector



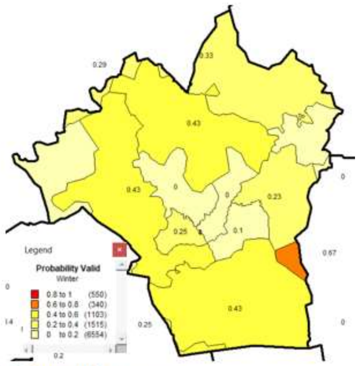
PI Interpolated on 250m CRG grid

Zero values for PI in some sectors may reflect the absence of site investigation data - not necessarily the absence of shrinkable clay. A single claim in an area with low population can raise the risk as a result of using frequency estimates.

BRENTWOOD – by season



Probability Valid, Summer

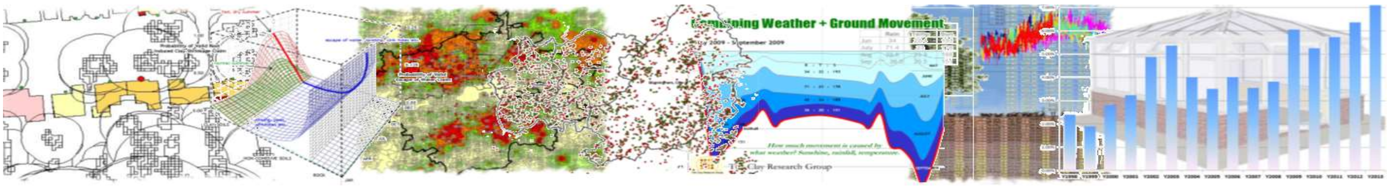


Probability Valid, Winter

The maps, left, show the seasonal difference from the sample used.

Combining the risk maps by season and reviewing the table on page 10 is perhaps the most useful way of assessing the potential liability, likely cause and geology using the values listed.

The ‘claim by cause’ distribution and the risk posed by the soil types is illustrated at the foot of the following page. A high frequency risk can be the product of just a few claims in an area with a low housing density of course and claim count should be used to identify such anomalies.



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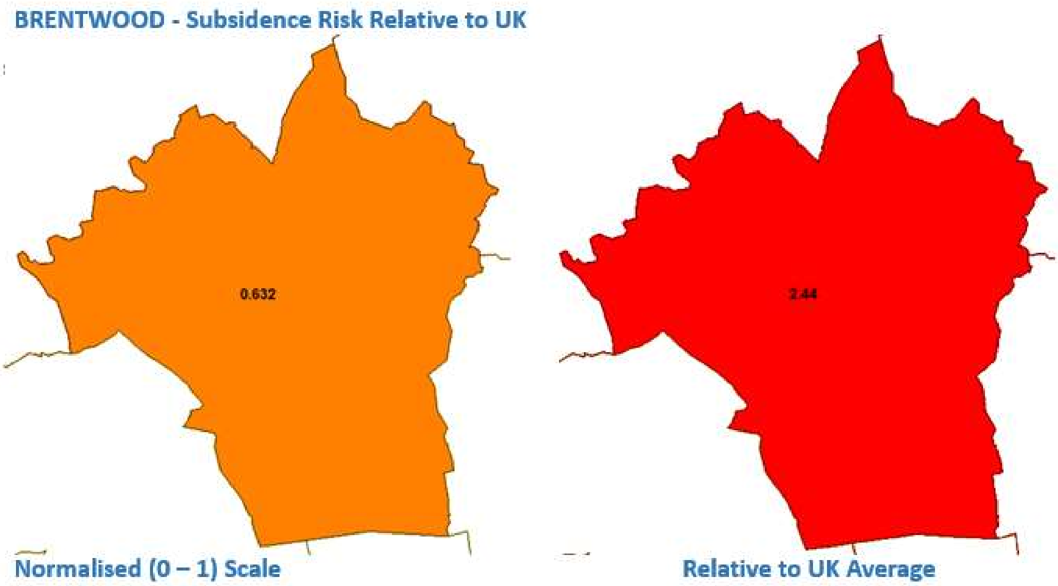
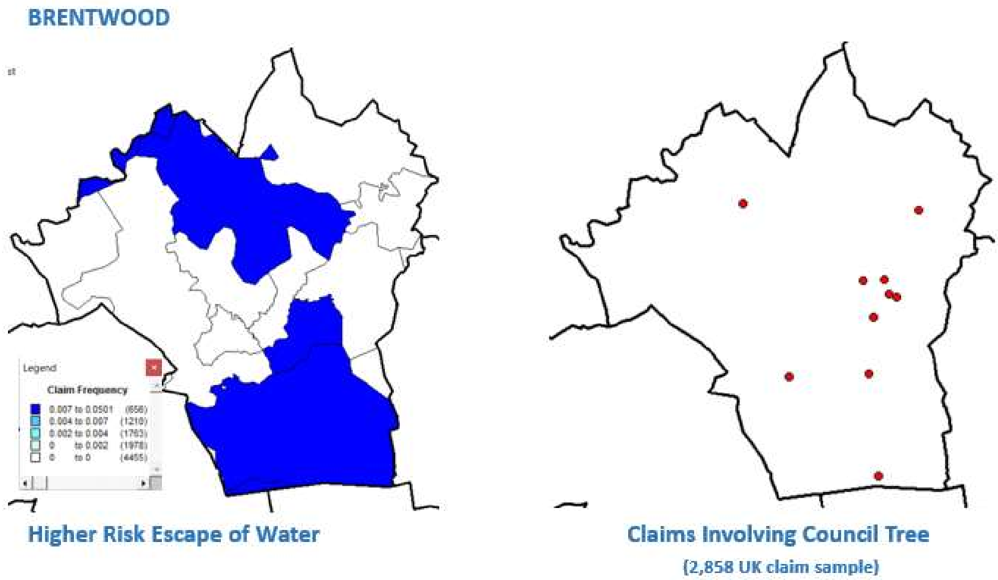
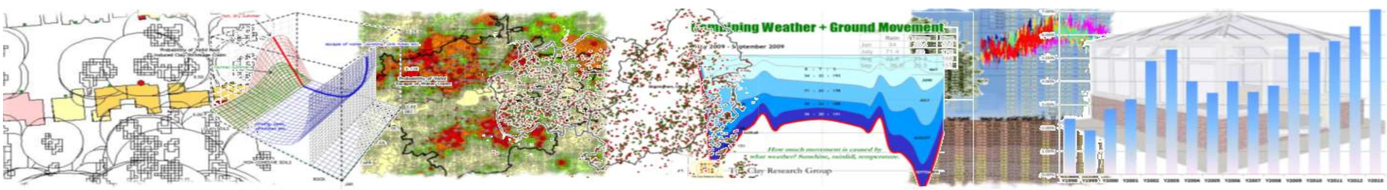
District Risk -v- UK Average. EoW and Council Tree Risk.



Below, left, mapping the frequency of escape of water claims coincides with the presence of non-cohesive Till deposits. As we would expect, the 50,000 scale BGS map provides a more detailed picture. The CRG 1:250 grid reflects investigations relating to actual claims.

Below, right, map plotting claims where damage has been attributable to vegetation in the ownership of the local authority from a sample of around 2,858 UK claims reflecting the presence of outcropping clay soil and private housing.





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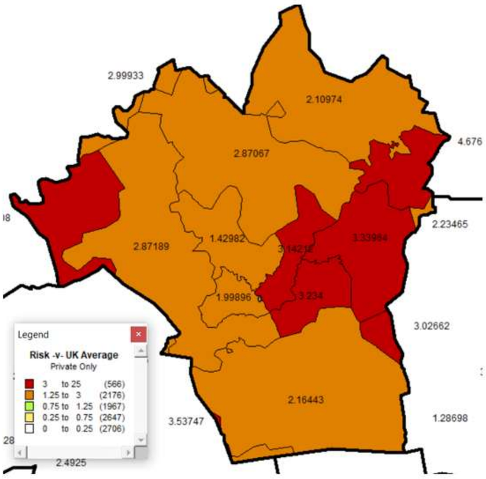
BRENTWOOD - Frequencies & Probabilities

Below, mapping the total housing stock by ownership. Claims frequency including council and housing association properties delivers a misleading value of risk as they tend to self-insure.

BRENTWOOD – Risk Relative to UK Sector Average



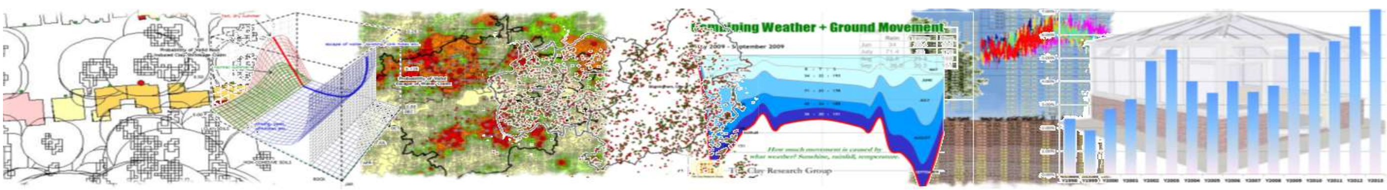
Relative to UK Average – private only

On a general note, the reversal of rates for valid-v-declined by season is a characteristic of the underlying geology. For clay soils, the probability of a claim being declined in the summer is usually low, and in the winter, it is high.

Valid claims in the summer are likely to be due to clay shrinkage, and in the winter, escape of water. For non-cohesive soils, sands, gravels etc., the numbers tend to be fairly steady throughout the year.

Liability by Season - BRENTWOOD

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Brentwood	0.687	0.093	0.22	0.04	0.27	0.69



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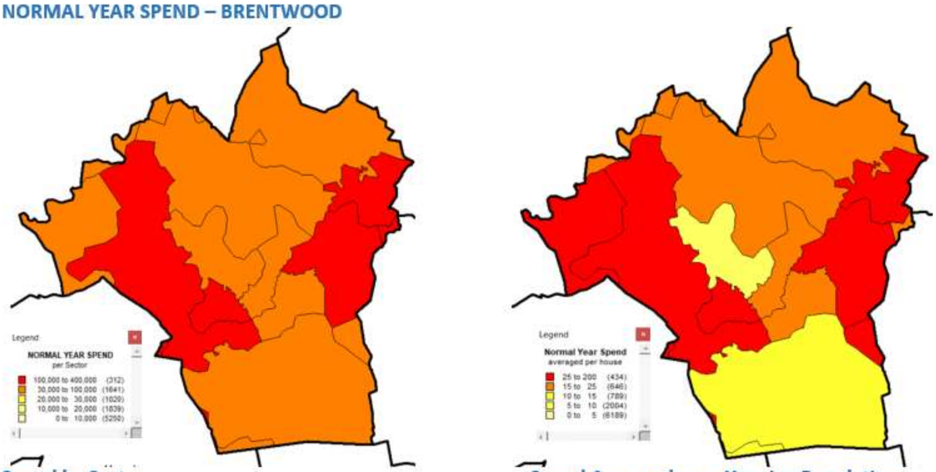
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Surge & Normal Years

The maps below show the aggregated claim cost from the sample per postcode sector for both normal (top) and surge (bottom) years. The figures will vary by the insurer's exposure, claim sample and distribution of course.

NORMAL YEAR SPEND – BRENTWOOD

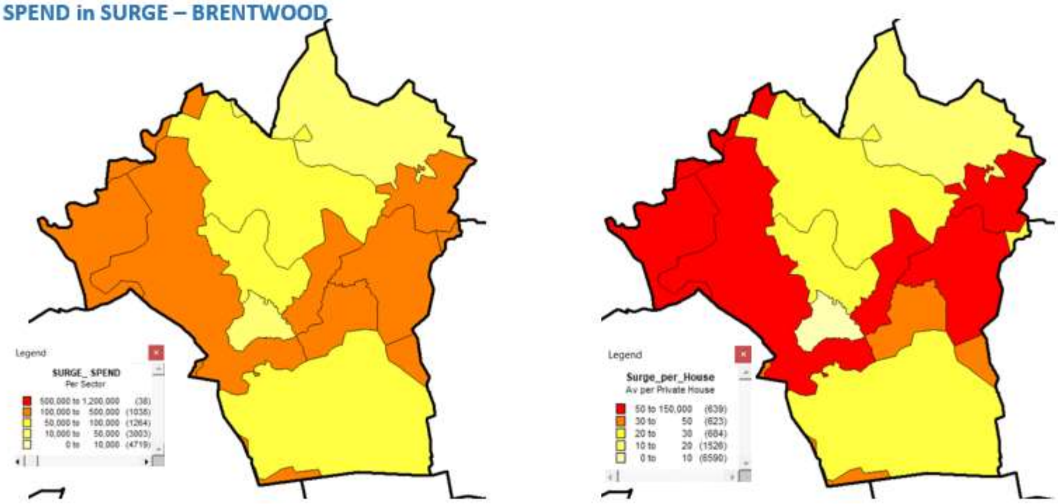


Spend by Sector

Spend Averaged over Housing Population

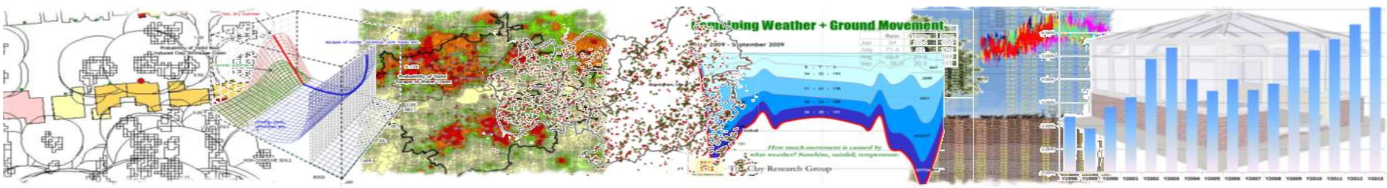
It will also be a function of the distribution of vegetation and age and style of construction of the housing stock. The images to the left in both examples (above and below) represent gross sector spend and those to the right, sector spend averaged across housing population to derive a notional premium per house for the subsidence peril. The figures can be distorted by a small number of high value claims.

SPEND in SURGE – BRENTWOOD



Spend by Sector

Spend Averaged over Private Housing Population



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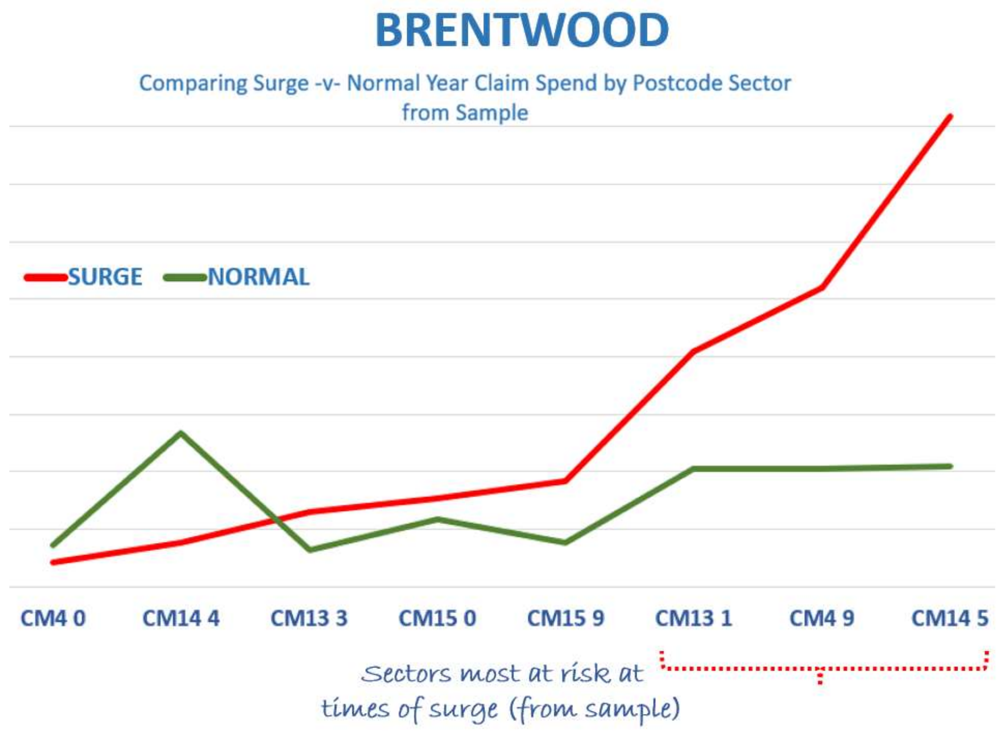

The above graph identifies the variable risk across the district at postcode sector level from the sample, distinguishing between normal and surge years. Divergence between the plots indicates those sectors most at risk at times of surge (red line).

It is of course the case that a single expensive claim (a sinkhole for example) can distort the outcome using the above approach. With sufficient data it would be possible to build a street level model.

In making an assessment of risk, housing distribution and count by postcode sector play a significant role. One sector may appear to be a higher risk than another based on frequency, whereas basing the assessment on count may deliver a different outcome. This can also skew the assessment of risk related to the geology, making what appears to be a high-risk series less or more of a threat than it actually is.

The models comparing the cost of surge and normal years are based on losses for surge of just over £400m, and for normal years, £200m.