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

July 2020
Edition 182

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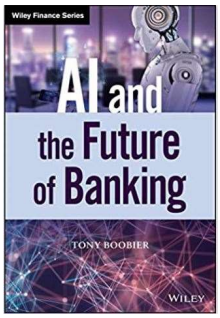
Tony Boobier Update

Congratulations to Tony Boobier on the publication of his third book entitled 'AI and the Future of Banking', available online from Amazon.



Tony is qualified in engineering, insurance, supply chain management and marketing. He is "an award-winning, former worldwide executive at IBM focussing on data, advanced analytics, financial services and is an international public speaker."

Covid Interrupts Levelling

Level readings have been temporarily suspended at the Aldenham research site due to the Covid lockdown.

Met Office Forecast

"For July and July-August-September as whole, above-average precipitation is slightly more likely than below-average precipitation. The probability that UK-average precipitation for July-August-September will fall into the driest of our five categories is between 20% and 25% and the probability that it will fall into the wettest of our five categories is 25%."

In summary, fairly even odds of the weather being wetter or drier.

Met Office Research Paper

Researchers from the Met Office, supported by 39 different institutions, have a paper accepted for publication in the Journal of Geophysical Research entitled "Development of an updated global-land in-situ based dataset of temperature and precipitation extremes: HadEX3" plotting and analysing data from 36,000 stations around the world from 1901 to 2018. Search at:

Journal of Geophysical Research - Atmospheres.

Contributions Welcome

We welcome articles, comments and thoughts from readers. Updates on current practice and procedures, suggestions on how risk can be managed, reports on interesting cases and input from experts in the various fields involved.

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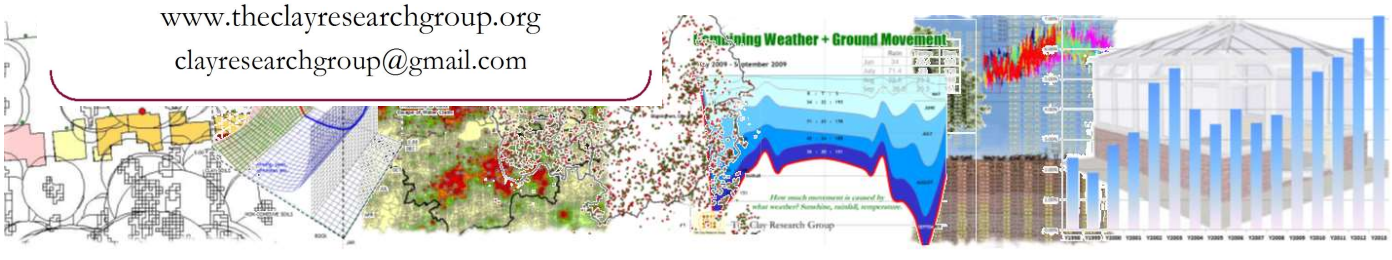

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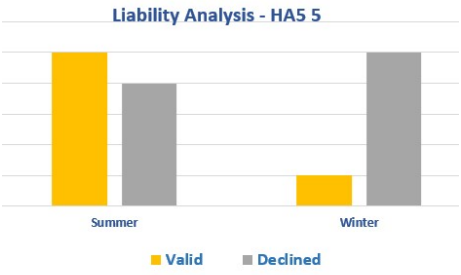
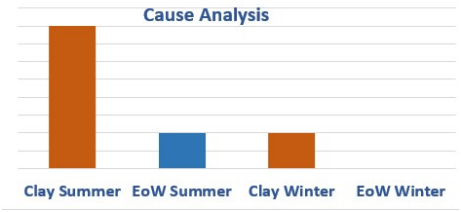
Using Past Claims Data to infer Geology and Derive Probability of Liability and Cause

... cont. from previous editions





HA5 5 – This is a high-risk sector with a predominantly clay shrinkage claim population as can be seen from the lower of the two graphs (left). There is a balanced probability of a claim being valid or declined in the summer, and in the winter the prospect of a claim being declined increases as a proportion of the total.

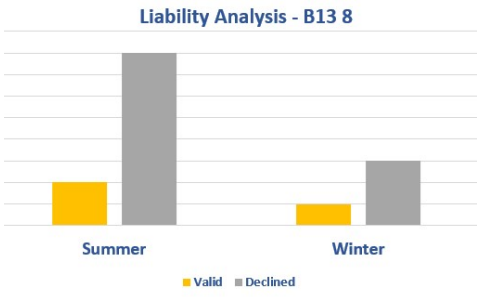
The chance of a valid claim being due to clay shrinkage is nearly four times that of escape of water. Referring to the BGS 1:50,000 series maps reveals the solid geology to be predominantly outcropping London clay.

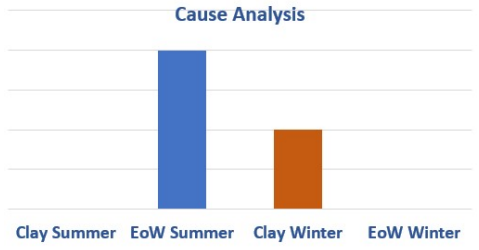
Total spend on valid claims from sample in this postcode sector exceeds £61k.

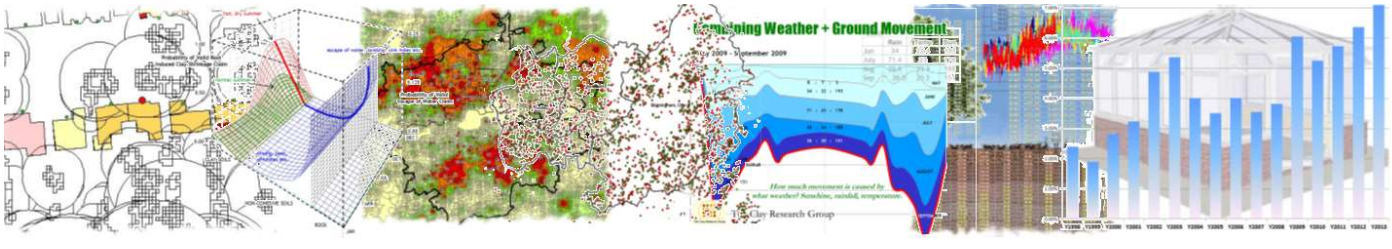
B13 8 – This is a lower risk sector with a predominantly escape of water claim population as can be seen from the lower of the two graphs (left). There is a high probability of a claim being declined in the summer, and in the winter the prospect of a claim being declined decreases as a proportion of the total.

There is a far higher chance of a valid claim being due to an escape of water than clay shrinkage. Referring to the BGS 1:50,000 series maps reveals the geology to be outcropping mudstone with superficial deposits of sand and gravel.

Total spend on valid claims from sample in this postcode sector is just below £35k.







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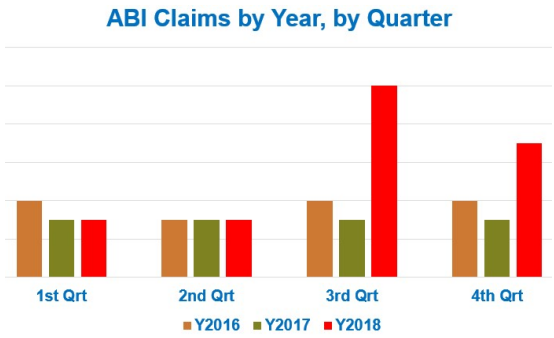
Profiling the 2018 Surge

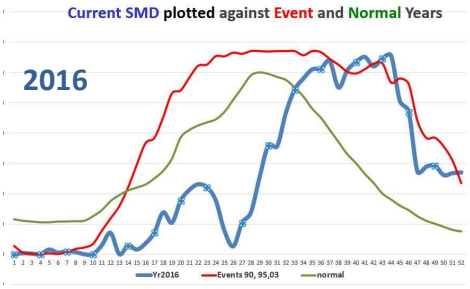
The surge in claims in the third quarter of 2018 provides a useful tool to look at causation – i.e. weather patterns. What are the drivers that can trigger a short, sharp increase in domestic subsidence claims?

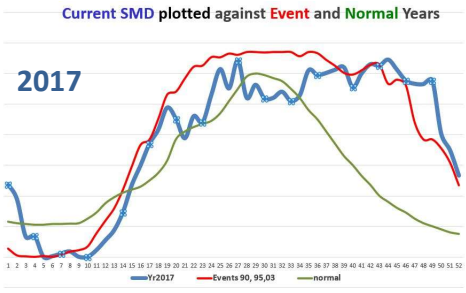
Right, graphs showing claim notifications in 2016, 2017 and 2018. The two former years had relatively low claim numbers with notifications at around 3 – 4k every quarter.

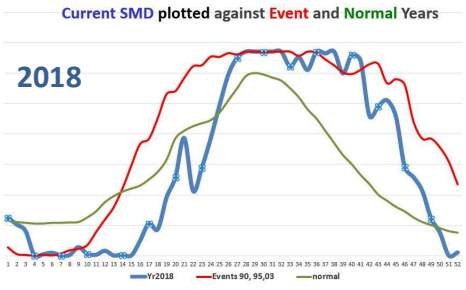


In contrast, 2018 saw 3k claims in the first two quarters jumping to 10k claims in the 3rd and 7k claims in the fourth quarters.

Below, plots of the SMD for the three years.





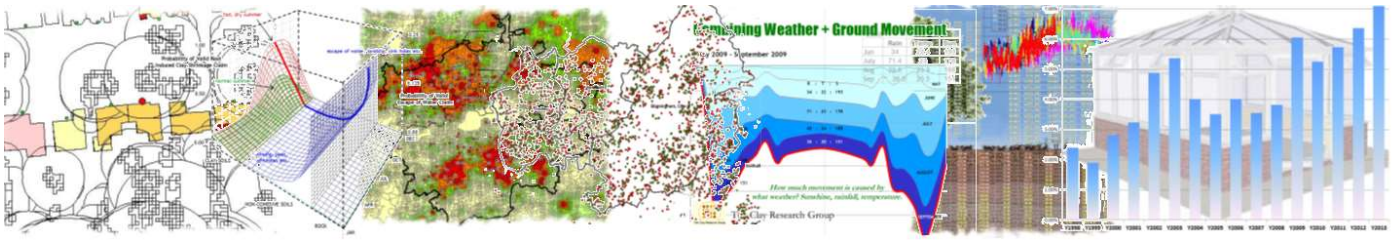


Top, 2016 reveals a late rise in soil drying – perhaps too late to influence claims numbers bearings in mind the cause of event years and surges lies in root induced clay shrinkage claims. Persistent dry summers are usually associated with surge.

Centre left, the SMD for 2017. The values didn't reach the event year profile (red line) until late in the year and the plot for 2017 reveals intermittent showers characterised by the irregular profile of the blue line.

Bottom, the SMD profile reaches its peak (maximum values for SMD, grass cover and medium available water capacity = 134mm) at the beginning of July – a notoriously vulnerable month in terms of moisture uptake by vegetation from our earlier studies.

… *continued*



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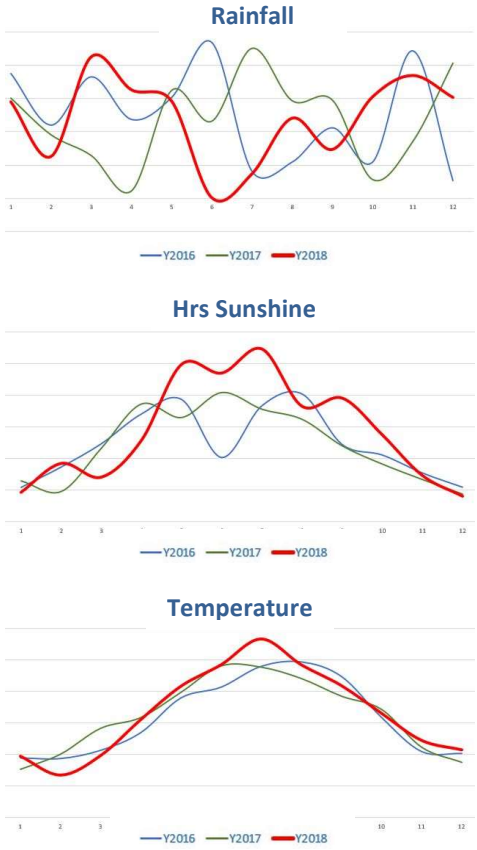
Profiling the 2018 Surge *... continued*

Below, weather profiles for rainfall, sunshine and temperature as published by the Met Office from readings taken at their Heathrow weather station.



In 2018 rainfall graph dips noticeably in June and July. Rainfalls drops to a similar level in the two comparison years, taking place in April (2016) and later for 2017, the dips are slightly less and a month later.

The sunshine record for 2018 is literally 'head and shoulders' above the two preceding years and the temperature a little warmer, peaking in July.

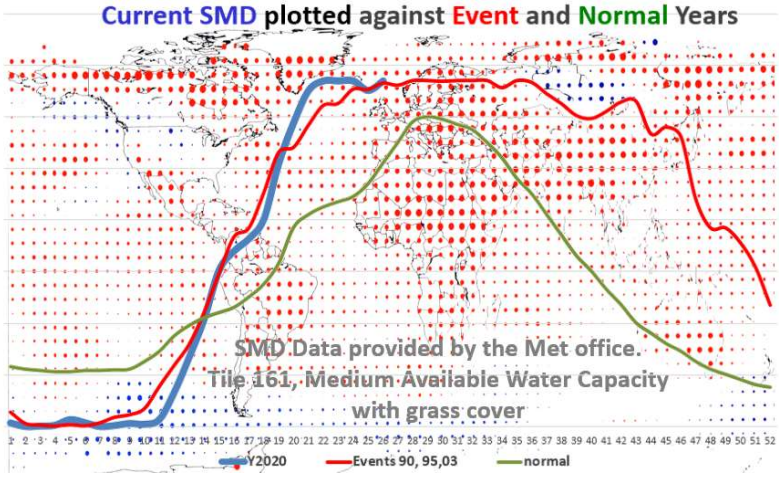
In summary, 2018 had a drier July with more sunshine and a higher temperature than 2016 and 2017.

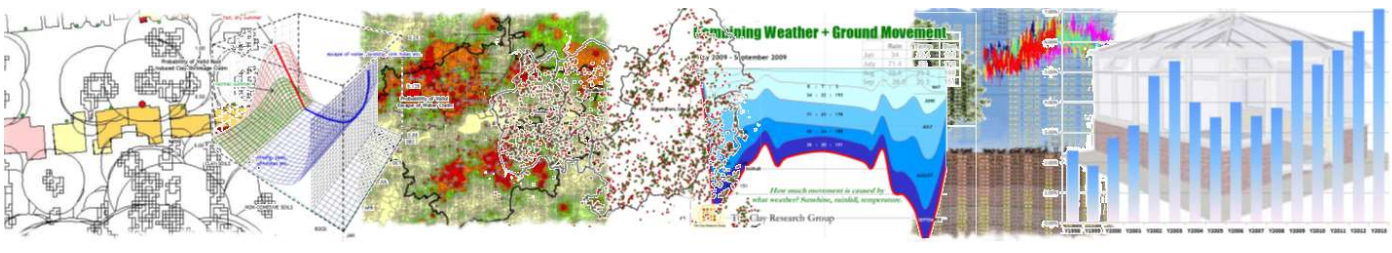
Combined with past research the link between weather and root induced ground movement is clear.

Below, the current SMD supplied by the Met Office for tile 161, grass cover.

The profile is currently following the average for Event years 1990, 1995 and 2003 which suggests a high risk, although intermittent rainfall that we are experiencing may mitigate against a full-blown surge.

See Page 1 for Met Office forecast.





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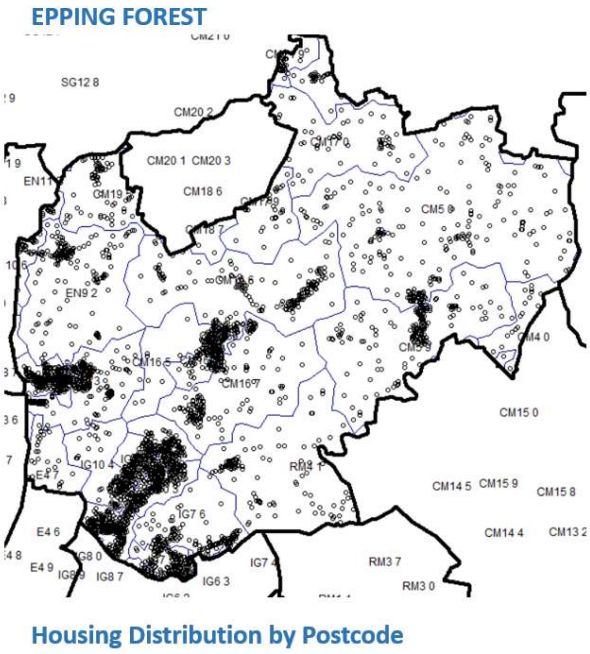
Subsidence Risk Analysis – EPPING FOREST

Epping Forest district (as opposed to the forest) is situated in Essex and occupies an area of around 339km^2 with a population of over 130,000.



Distribution of housing stock using full postcode as a proxy. Each postcode in the UK covers on average 15 – 20 houses, although there are large variations.

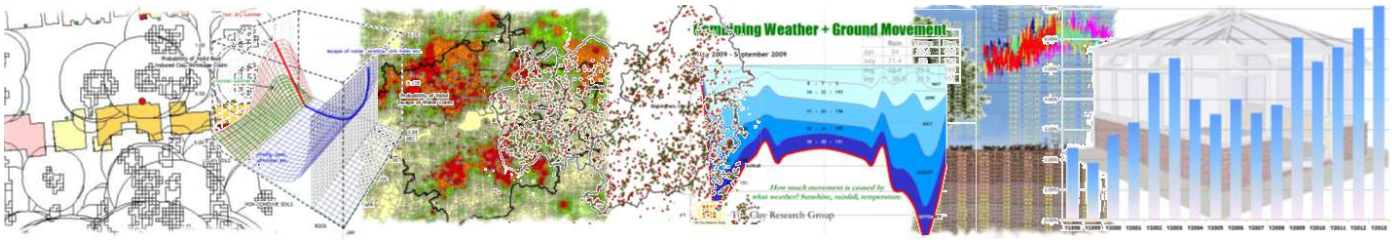
Districts are rated for the risk of domestic subsidence compared with the UK average – see map, right.

The highest risk rating is a value of 4 and Epping is rated as being 2.86 times the UK average risk, putting it in 6th place.

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 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.

Layout of the district used for risk analysis above. Epping has an estimated population of around 130,000 and an area of 339km^2.



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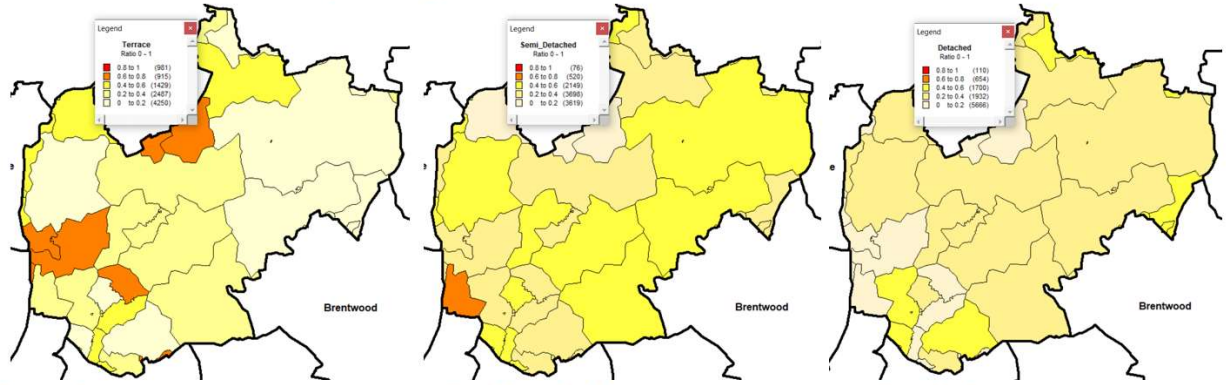
EPPING FOREST - Properties by Style and Ownership

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 from a visual assessment using Google Street View, we rate Epping district at around 0.5 (variable across the district) on a scale of 0 – 1. This assessment could be refined using insurer's portfolio data.

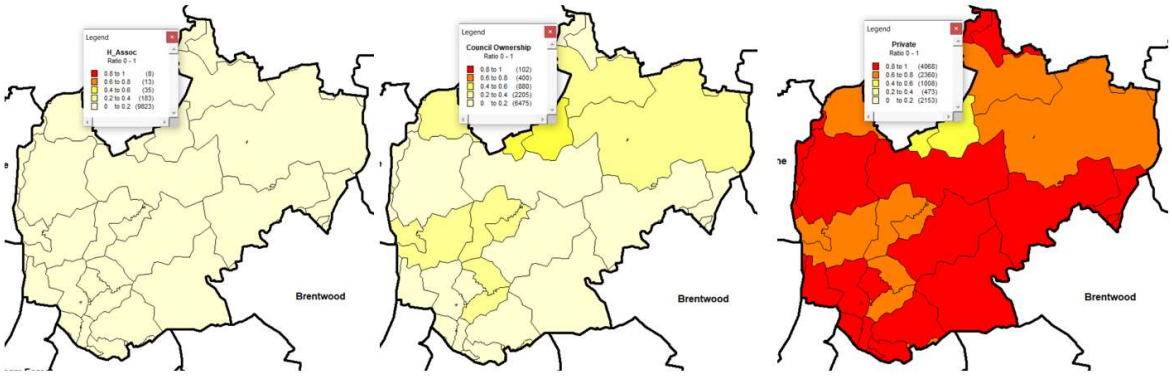
EPPING FOREST - Distribution by House Type



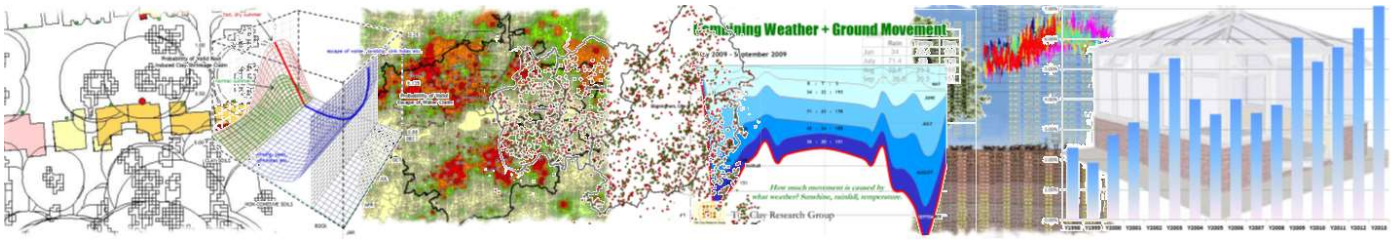
Terraced | Semi-Detached | Detached

Distribution by ownership is shown below. The maps reveal predominantly privately-owned properties across the borough.

EPPING FOREST - Distribution by Ownership



Housing Association | Council Ownership | Private Ownership



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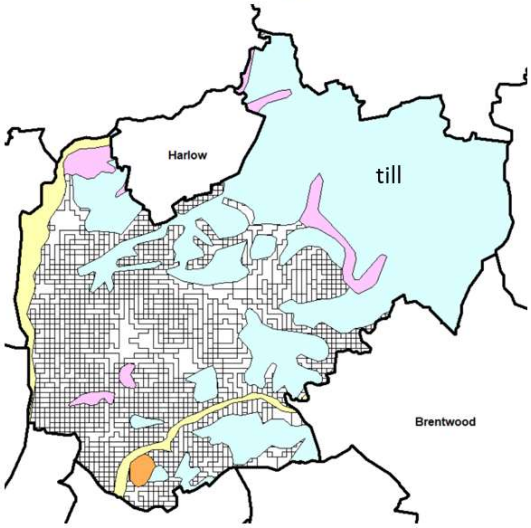
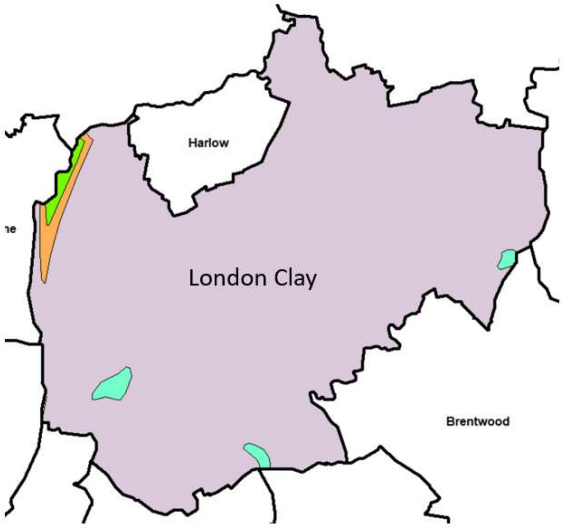
Subsidence Risk Analysis – EPPING FOREST

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.

EPPING FOREST : BGS Geology – 1:625,000 scale low resolution mapping



DRIFT

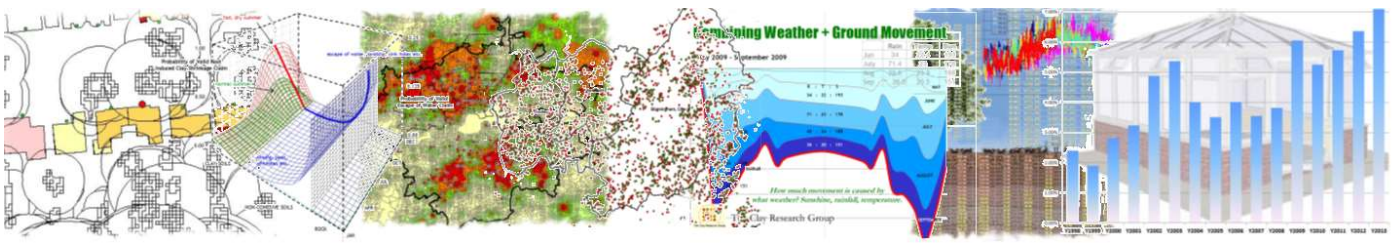


SOLID

See page 10 for a seasonal analysis, which reveals that, in the summer there is slightly less than 80% probability of a claim being valid, and of the valid claims, there is a greater than 70% probability that the cause will be due to clay shrinkage.

In the winter the situation reverses. The likelihood of a claim being declined exceeds 80%, and the most likely cause is an escape of water – a leaking drain most likely or water service.

The analysis reflects the presence of the underlying London clay and the shallow thickness of the superficial deposits.



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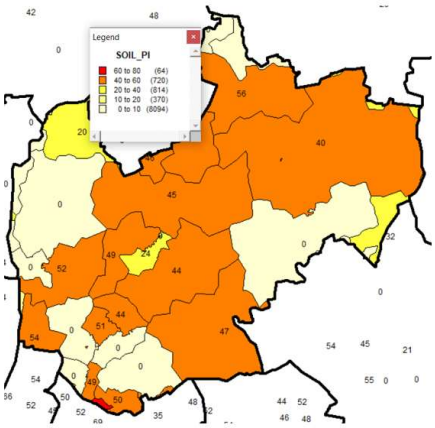
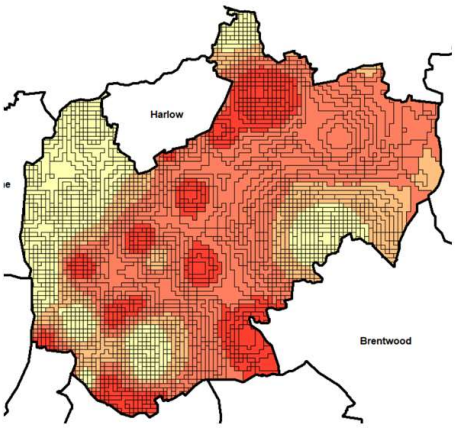
Liability by Season and Geology

Below, the average PI by postcode sector (left) derived from site investigations and interpolated to develop the CRG 250m model grid (right). The presence of a shrinkable clay in the CRG models reflects the solid geology indicated by the BGS maps, with London clay (average PI of around 40%) across the entire area and Till to the north east. The higher the PI values, the darker red the CRG grid.

EPPING FOREST – Soil Plasticity Index



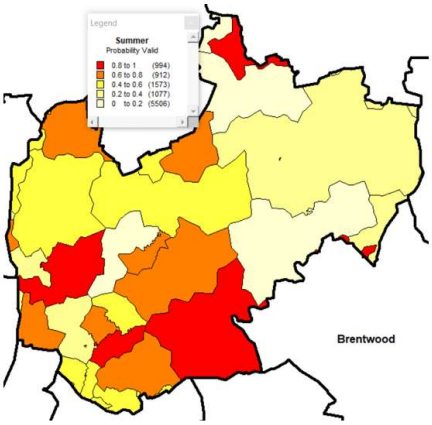
Soil PI Averaged by Sector



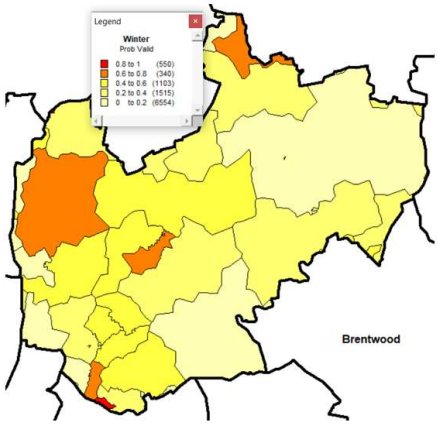
PI Interpolated on 250m CRG grid

Zero values for PI in some sectors reflects the absence of site investigation data, not necessarily the absence of shrinkable clay. The widespread influence of the shrinkable clay plays an important role in determining whether a claim is likely to be valid or declined by season. A single claim in an area with low population can raise the risk as a result of using frequency estimates.

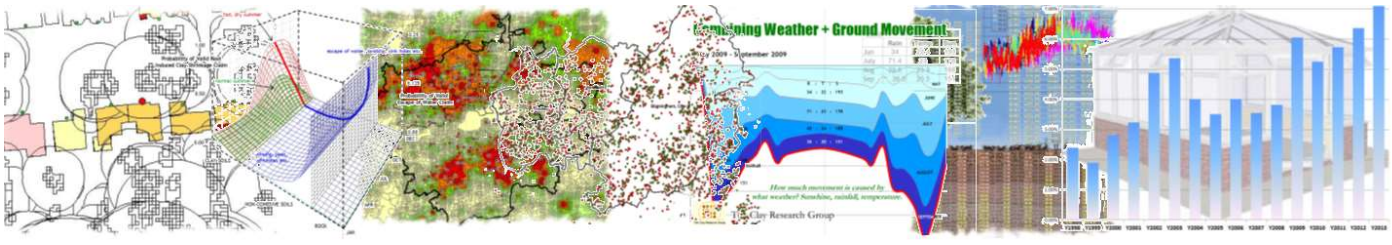
EPPING FOREST – probability of valid claim by season



Probability Valid, Summer



Probability Valid, Winter



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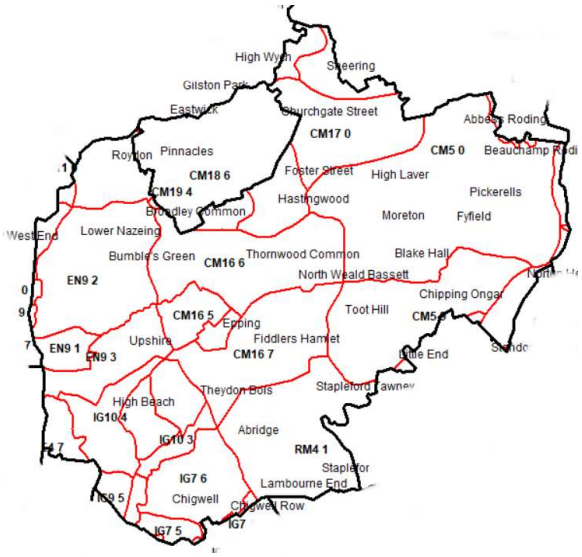
District Layout. EoW and Council Tree Risk.

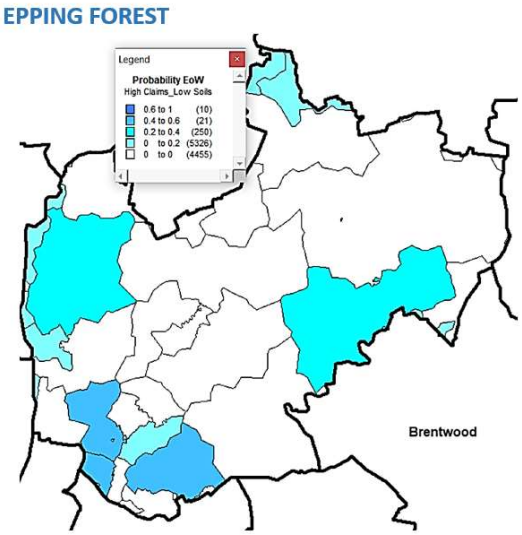


The district of Epping covers quite a large area and consists of many small villages (see map, left) in contrast to previous studies.

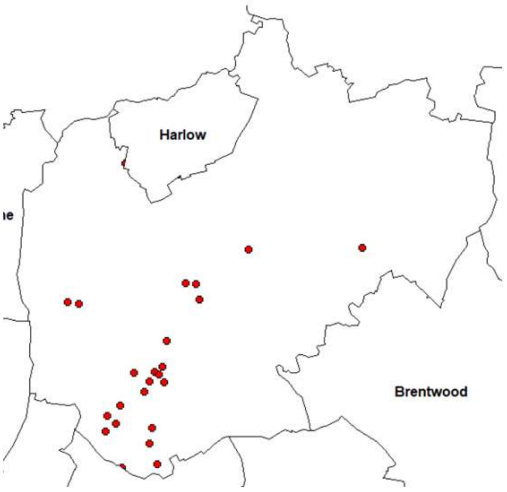
A review using Google Earth is useful in providing context and exploring the differences in property ages and styles of construction across the district.

In this study, risk values are often based on small housing population densities.

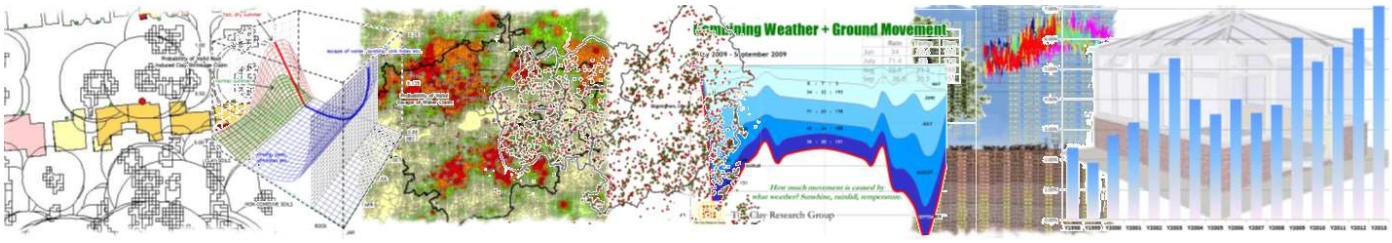
Below, left, mapping the frequency of escape of water claims from the sample reflects the presence of shallow, non-cohesive drift deposits or even shallow foundations on backfill given the age of some of the housing stock. Below, right, dots on the 'Council Tree Claims' map represent properties where damage has been attributable to vegetation in the ownership of the local authority which coincide with the clay formation.



Escape of Water Frequency Distribution



Local Authority Street Tree Claims



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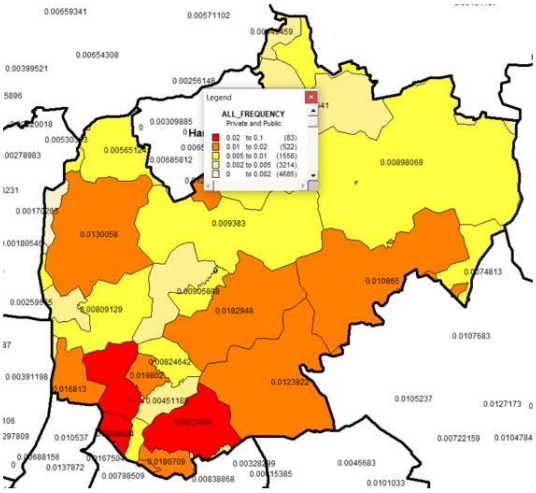
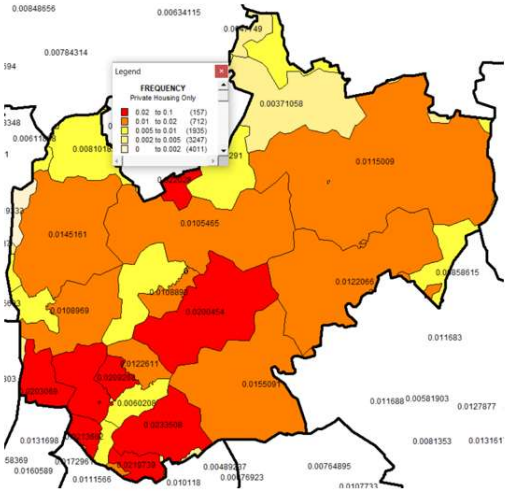
EPPING FOREST - Frequencies & Probabilities

EPPING FOREST - Postcode Sector Subsidence Risk (frequency) by Ownership



Combined Public and Private Frequency



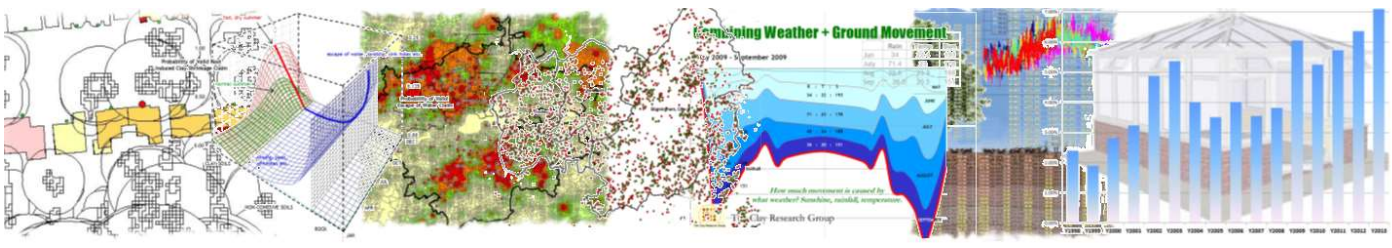
Private Only

The maps and figures reveal a district with a clear seasonal signature, reflecting the geology – i.e. the presence of shrinkable clay soils.

The chances of a claim being declined in the summer are relatively low – just over 20% - and if the claim is valid, there is a high probability (greater than 70%) that the cause will be clay shrinkage. In winter, the repudiation rate exceeds 80% - and if the claim is valid, it is likely that the cause will be water related. The probabilities of causation reverse between the seasons.

Liability by Season - EPPING FOREST

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Epping Forest	0.732	0.053	0.215	0.01	0.16	0.83



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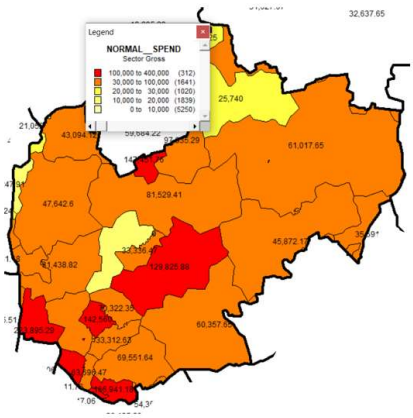
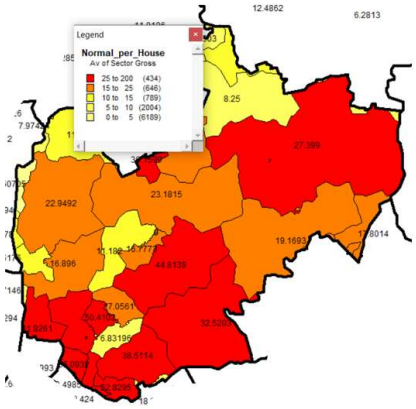
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Surge & Normal Years

The maps below show the aggregated claim cost from the claim 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.

NORMAL YEAR SPEND – EPPING FOREST



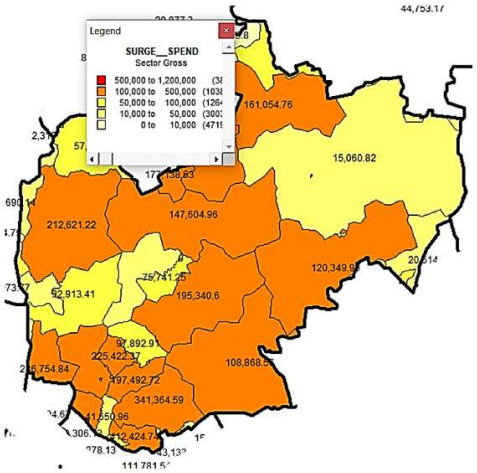
Spend by Sector



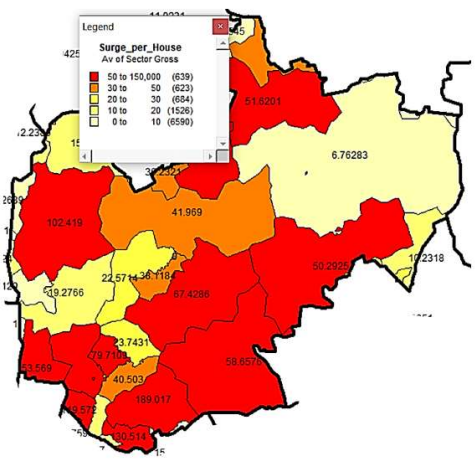
Spend Averaged over Housing Population

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 the odd, single, high value claim.

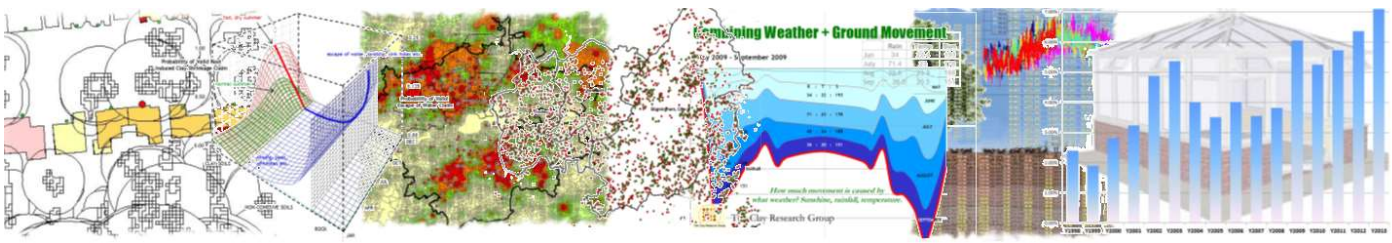
SPEND in SURGE – EPPING FOREST



Spend by Sector



Spend Averaged over Housing Population



The Clay Research Group

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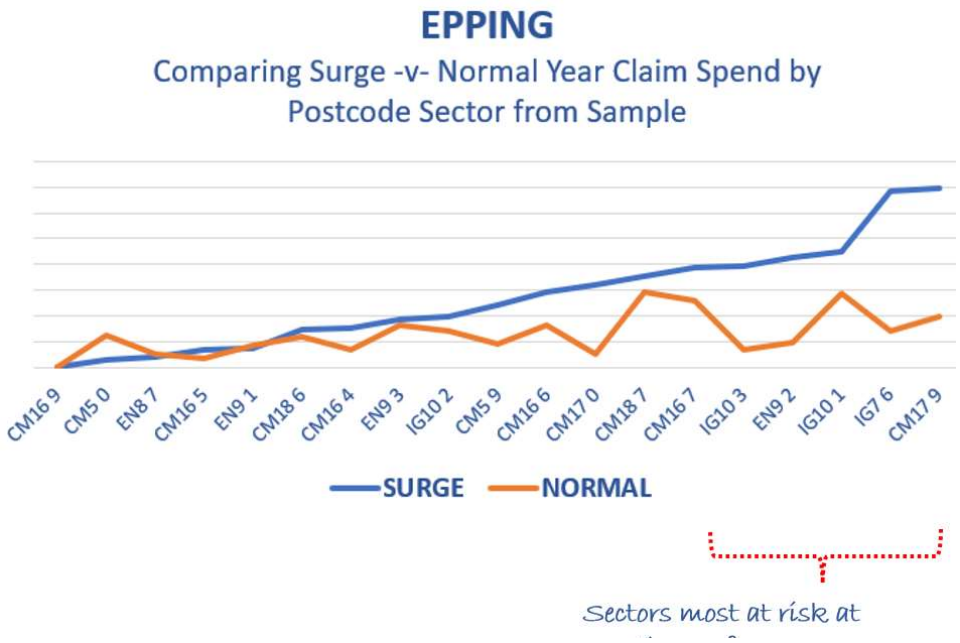

The above graph identifies the variable risk across the district distinguishing between normal and surge years by postcode sector. Divergence between the plots indicates those sectors most at risk at times of surge (red line).

It is of course the case that a single expensive claim (a sinkhole for example) can distort the outcome using the above approach.

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 can 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 is based on losses for surge of just over £400m, and for normal years, £200m.