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

March 2022
Issue 202

The Clay Research Group

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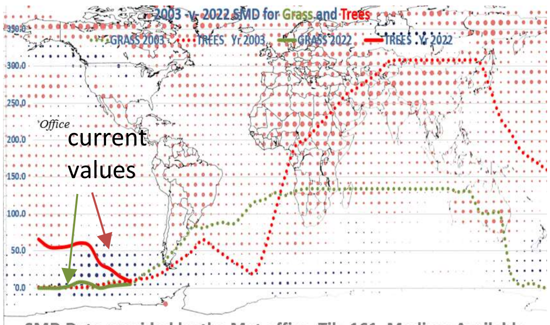
Issue 202, March 2022

Soil Moisture Deficit

Below, the SMD values provided by the Met Office for both grass and tree cover, comparing them with the 2003 event year.



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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TDAG Zoom Meeting

TDAGs next meeting is scheduled to be held on 15th March commencing at 15.00hrs. Topics include:

1. White Rose Urban Forest Action Plan – making it happen
2. Glenn Gorner, Natural Environment Manager, Leeds City Council
3. Futurebuild feed-back from Urban Tree Knowledge Hub
4. Some TDAG tasks in hand – how can we progress them?
5. Any Other Business

Access the meeting via Zoom using the following link:

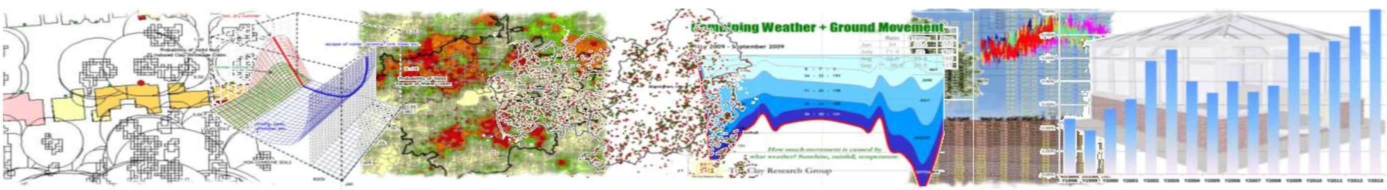
https://us02web.zoom.us/j/83660992437?pwd=VnYxUDRjNXAwcmliNU1BYnJPb3lKZz09

Claim Distribution in Surge

The number of claims in both normal and surge years varies of course and the use of averages sometimes disguises the true position rather than clarifies it.

On the following page we take a look at claim distribution in surge years to better understand the real issues relating to high-risk sectors and the importance of the geology.

The outcome doesn't reveal anything new but it does highlight some issues that we may not have taken into account previously.



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Surge -v- Normal Years. Claim Distribution by Geology.

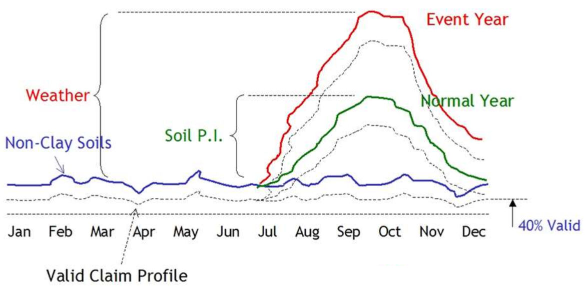
At times of surge, claim numbers increase significantly in the summer months as the graph below reveals.

The increase when comparing 2002 (a normal year) with 2003 (surge year) is a factor of around 3 – 3.5.

The graph below shows the percentage of valid claims in the sample. In a normal year, around 40% might be valid. That number can increase to around 80% in surge.

The blue line plots escape of water notifications, the green line a normal year and the red line, a surge year.

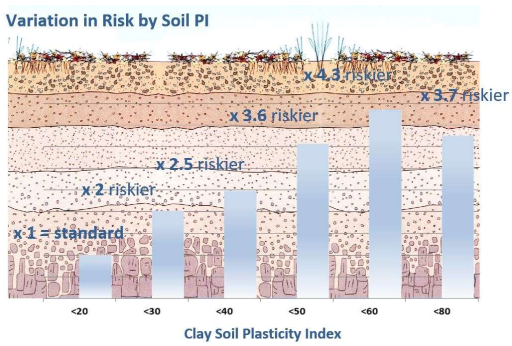
The dotted line plots the valid claim profiles.



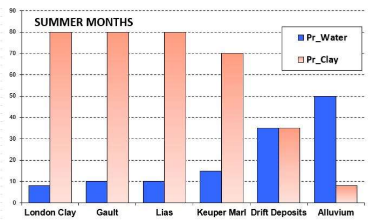
The above graph illustrates the broad difference between event and normal years, with that difference linked to the summer months and the soil characteristics – and of course, the presence of vegetation.

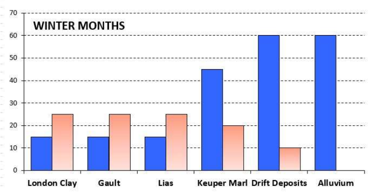
What isn't always made clear when looking at the figures is the relationship with the underlying geology. The following graphs have been taken from earlier editions of the newsletter.

The graph below links risk with the plasticity index of clay soils.

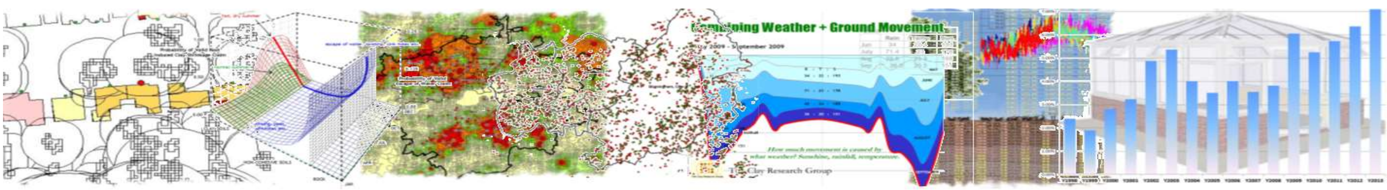


Non-shrinkable soils show little change in claim numbers at times of surge. Clay soils are the vulnerable series, and that vulnerability varies by the shrink/swell potential of the soil. Below, a bar graph comparing the probability that the cause of damage will be either clay shrinkage or escape of water, by season, for a range of soil types.





Referring to datasets of past claims (see example on page 10) it can be seen that high probabilities of a valid claim in the summer with low declinatures changing to low probabilities in the winter and high declinatures are a characteristic of clay shrinkage claims.



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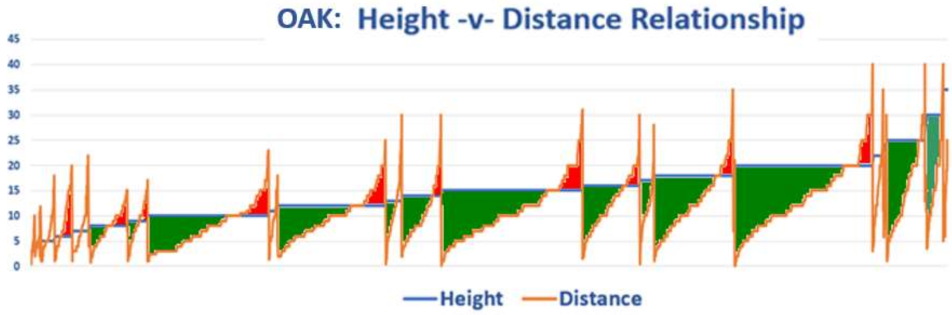
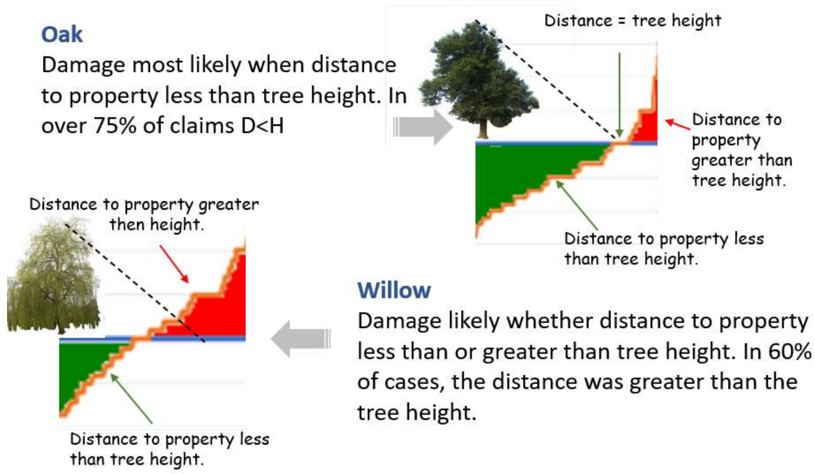
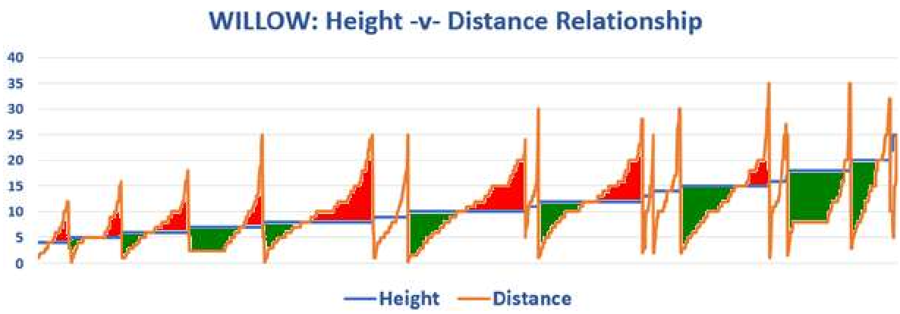
HEIGHT -v- DISTANCE by SPECIES

Top graph, the height (H) compared with the distance to the damaged building (D) for the oak tree sample reveals that in around 75% of claims ‘D’ is less than tree height – the area shaded green in the graphs below. The profiles are similar for most height bands.







In contrast, the willow (above) appears to have more extensive root cover as illustrated by the areas shaded red, illustrating where the distance to the damage exceeds the tree height.

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HEIGHT -v- DISTANCE by SPECIES … continued

Below, plots of the H/D ratio for the plane, poplar and conifer, revealing less extensive root systems (at least in the context of subsidence claims) than the willow, from the claim sample.

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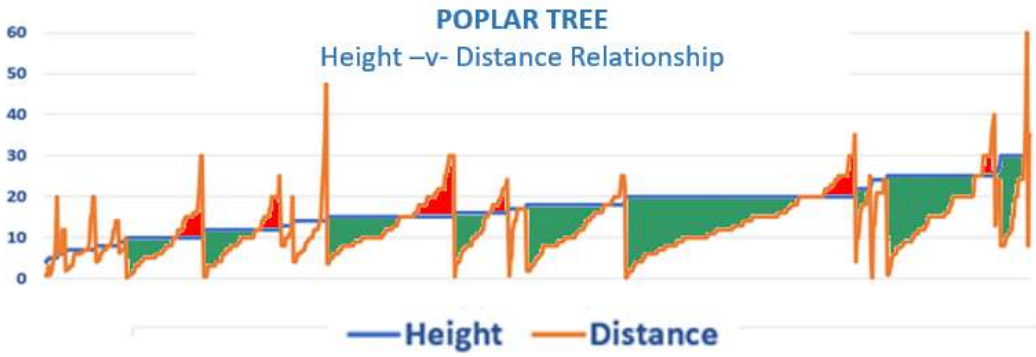

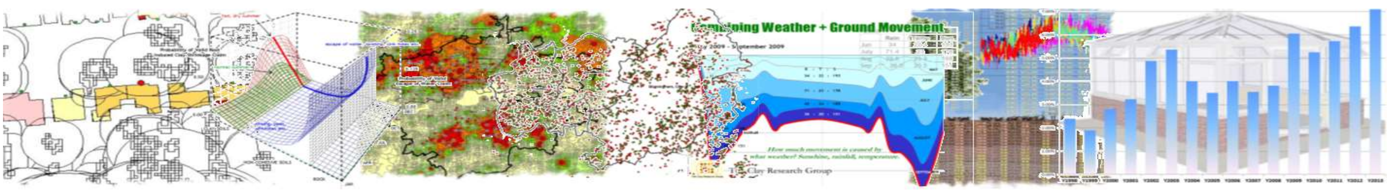

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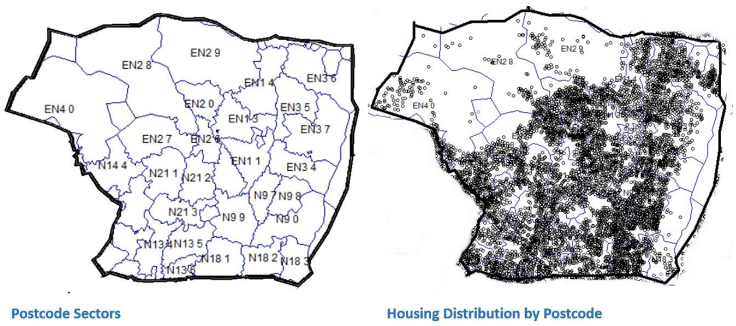
Subsidence Risk Analysis – ENFIELD

The borough of Enfield is situated in the north of London and occupies an area of 82km^2 with a population of around 156,000.



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

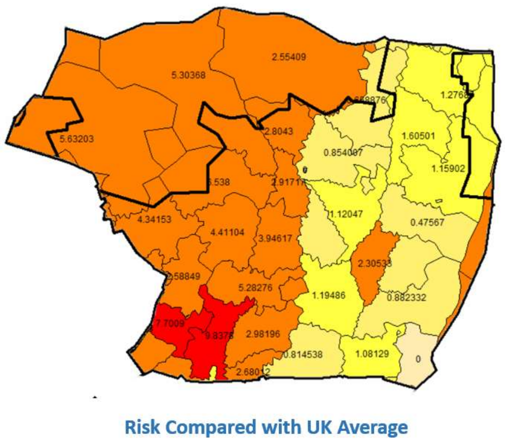
Housing distribution across the district (left, using full postcode as a proxy) helps to clarify the significance of the risk maps on the following pages. Are there simply more claims in a sector because there are more houses?

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

Enfield is rated 20th out of 413 districts in the UK from the sample analysed and is around 2.3x the risk of the UK average, or 0.59 on a normalised scale.

The distribution varies considerably across the borough as can be seen from the sector map.



Risk compared with UK Average.
Enfield district is rated around 2.3 times the UK average risk for domestic subsidence claims from the sample analysed. Above, risk by sector.

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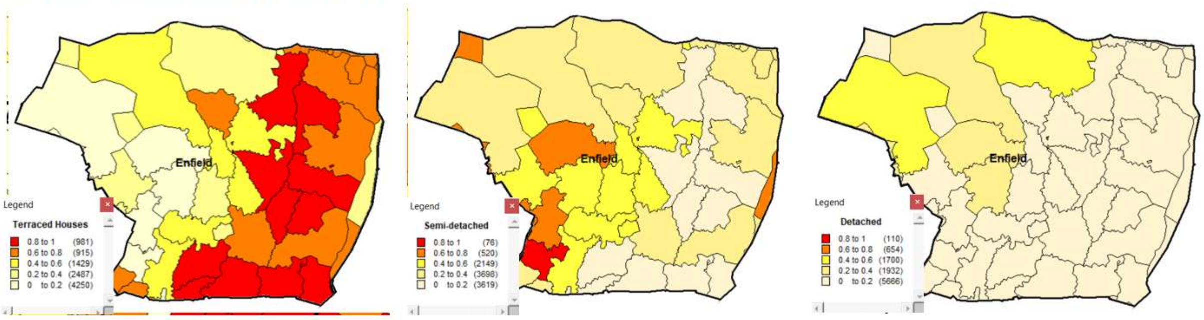
ENFIELD - Properties by Style and Ownership

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.

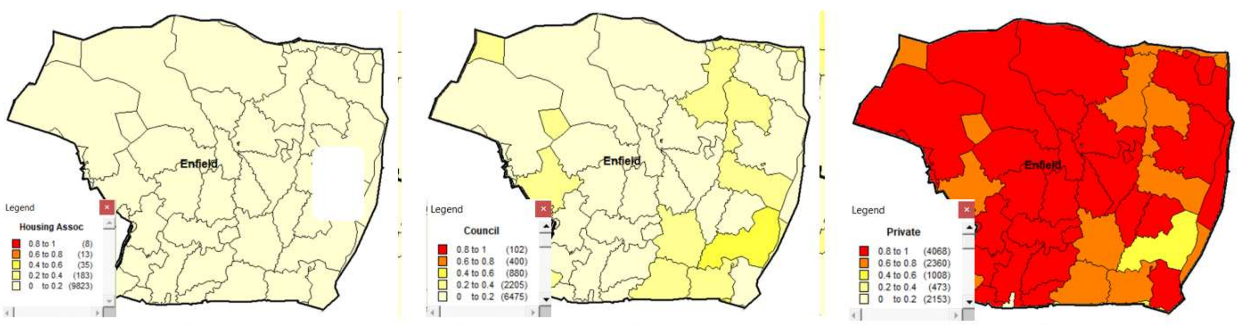
ENFIELD - Distribution by House Type



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

Distribution by ownership is shown below. Privately owned properties are the dominant class and are spread across the borough.

ENFIELD - Distribution by Ownership



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

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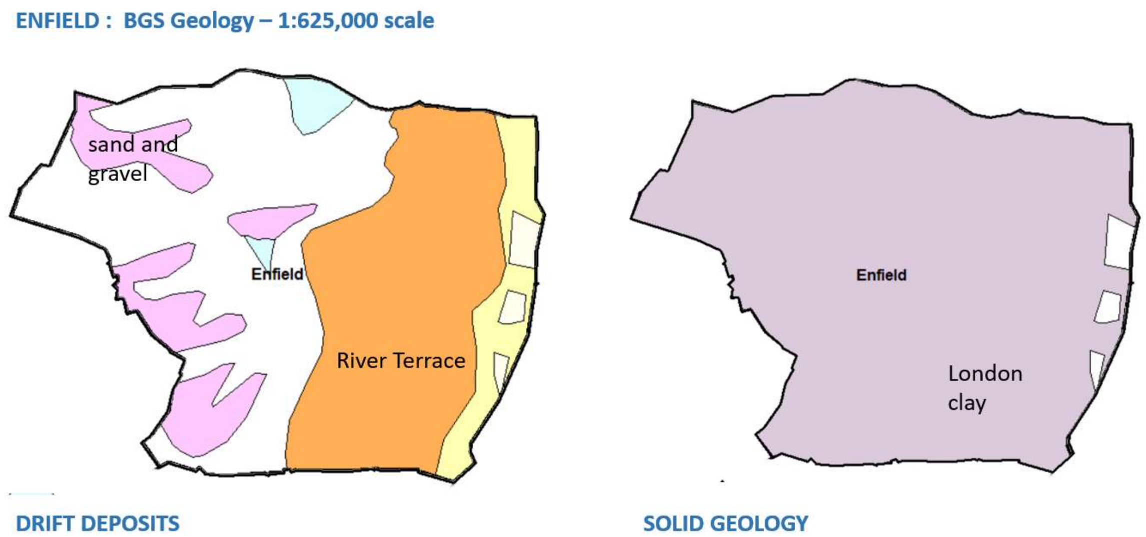
Subsidence Risk Analysis – ENFIELD

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 we hold which reveals that in the summer there is around an 80% probability of a claim being valid, and of the valid claims, there is a high probability (nearly 90% in the sample) that the cause will be clay shrinkage.

In the winter the likelihood of a claim being valid is much lower at less than 2% and if valid, there is greater than 80% probability the cause will be due to an escape of water. Maps at the foot of the following page plot the seasonal distribution.



1:625,000 series British Geological Survey maps. Working at postcode sector level and referring to the 1:50,000 series maps deliver far greater benefit when assessing risk. The geology delivers a fairly equal distribution in terms of causation with clay shrinkage being the dominant cause in the summer, and escape of water in the winter.

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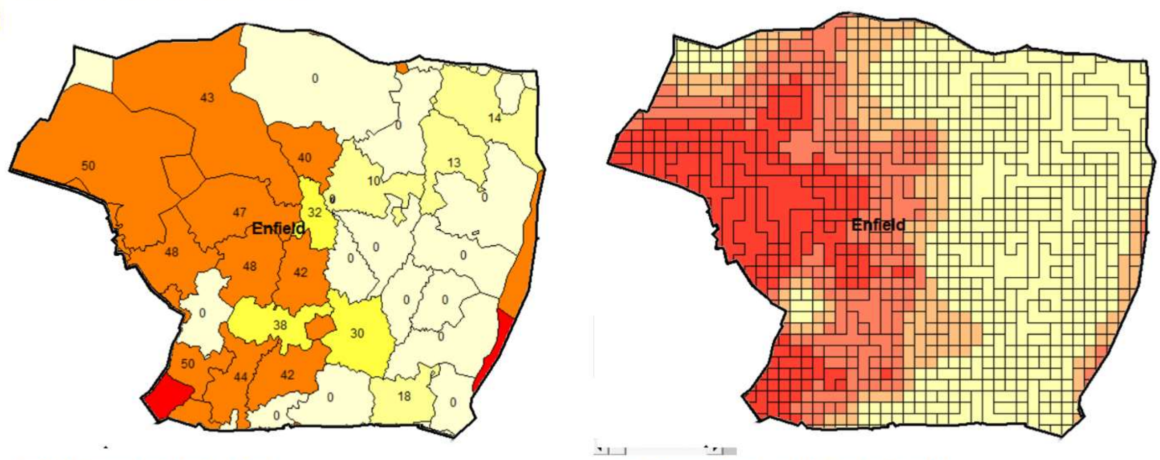
Liability by Geology and Season

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.

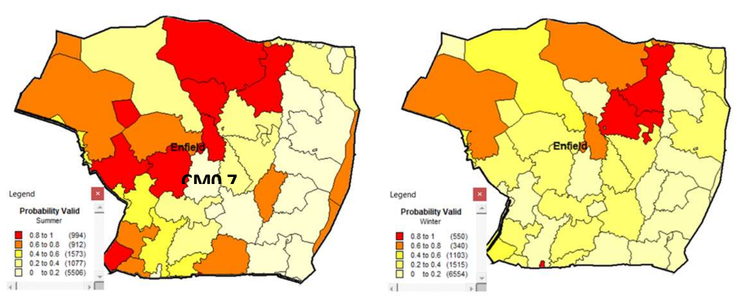
ENFIELD – Soil Plasticity Index



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.

ENFIELD

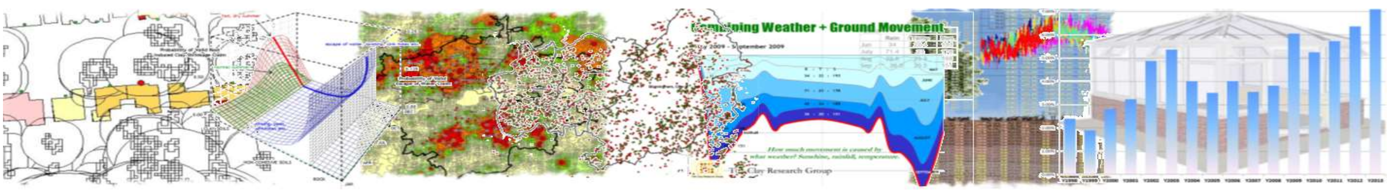


Probability Valid, Summer | **Probability Valid, Winter**

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

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

The claim distribution and the risk posed by the soil types is illustrated at the foot of the following page. Escape of water related claims are associated with the river terrace deposits and clay shrinkage claim, the outcropping shrinkable London clay. 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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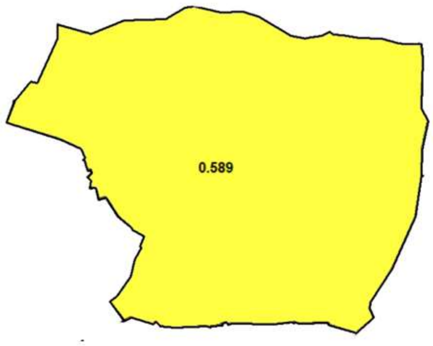
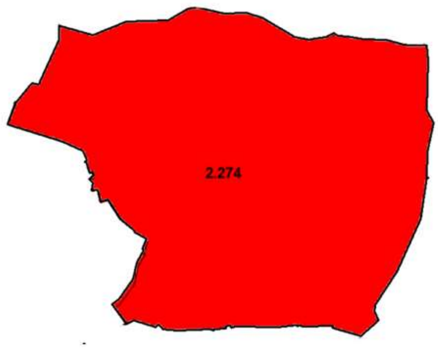
District Risk -v- UK Average. EoW and Council Tree Risk.

ENFIELD - Subsidence Risk





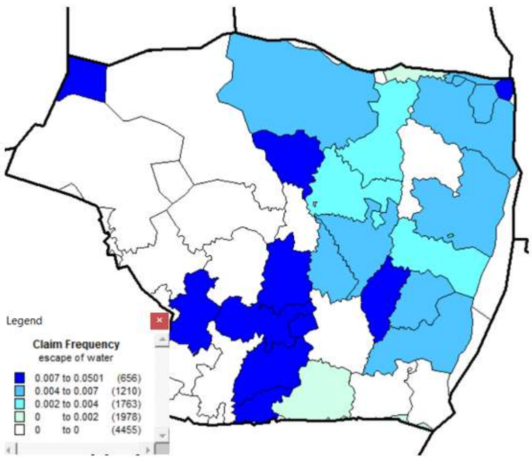
Normalised (0 – 1) Scale

Compared with UK Average

Below, left, mapping the frequency of escape of water claims reflects the presence of, non-cohesive soils – alluvium, sands and gravels etc. The absence of shading can indicate a low frequency rather than the absence of claims.

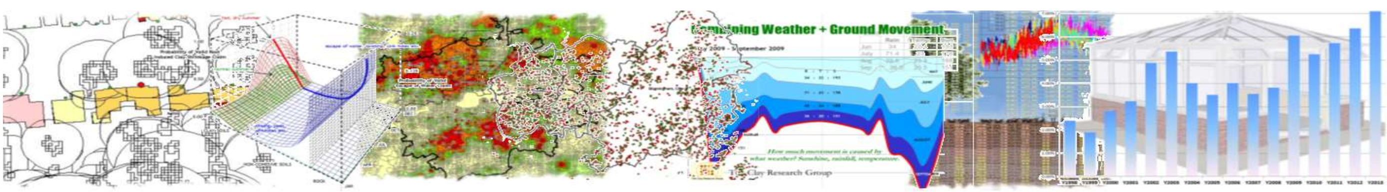
Below right, map plotting claims where damage has been attributable to vegetation in the ownership of the local authority from a sample of around 2,700 UK claims. The location coincides the presence of shrinkable clay soils – see both BGS (page 7) and CRG (page 8).

ENFIELD



Higher Risk Escape of Water

Claims Involving Council Tree
(2,700 UK claim sample)



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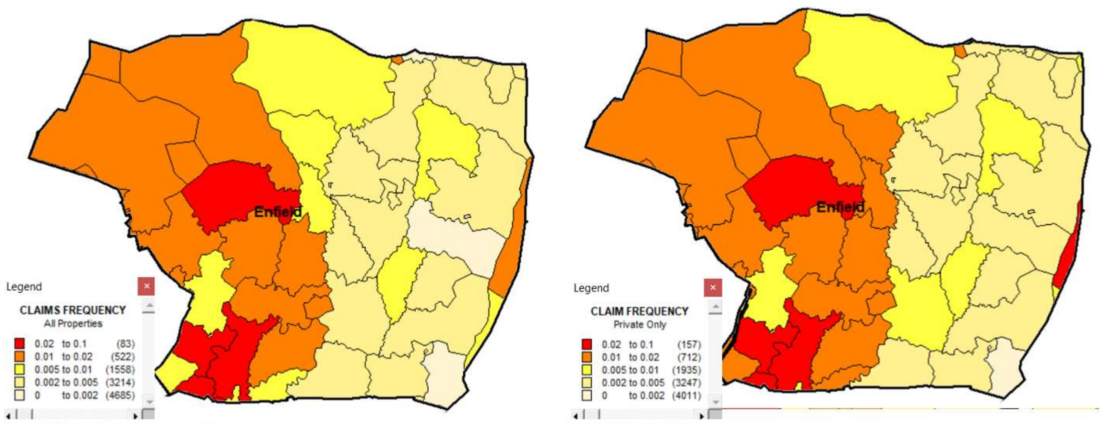
ENFIELD - Frequencies & Probabilities

Mapping claims frequency against the total housing stock by ownership (left, private, council and housing association combined and right, private ownership only), reveals the importance of understanding properties at risk by portfolio. There are a few sectors in the ‘private only’ map with an increased risk. There is little difference in Enfield due to the fairly regular distribution of housing by ownership.

ENFIELD - Postcode Sector Subsidence Risk (frequency) by Ownership



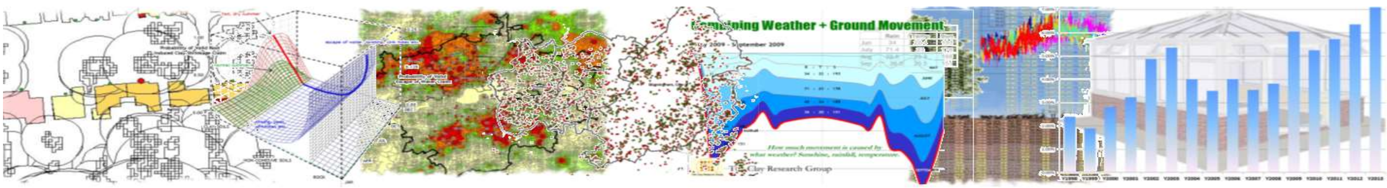
Combined Public and Private Frequency

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 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 lower throughout the year.

Liability by Season - ENFIELD

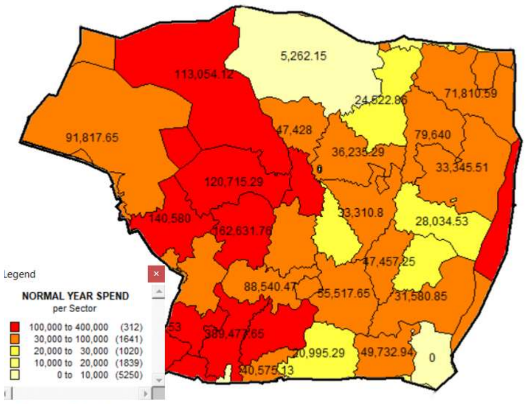
District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Enfield	0.702	0.079	0.219	0.02	0.15	0.83



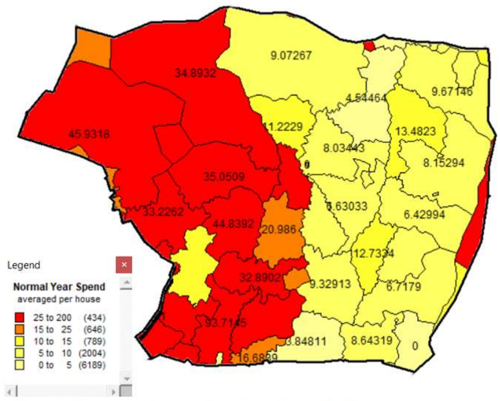
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Surge & Normal Years

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.

NORMAL YEAR SPEND – ENFIELD



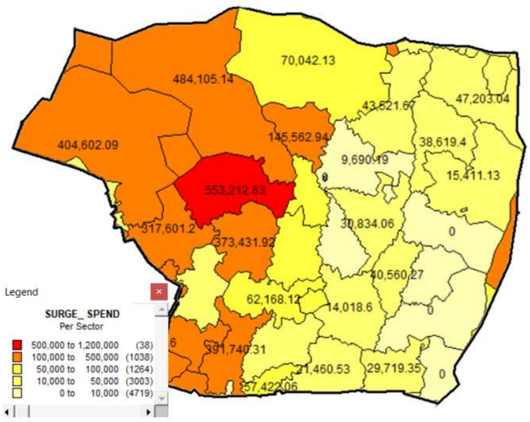
Spend by Sector



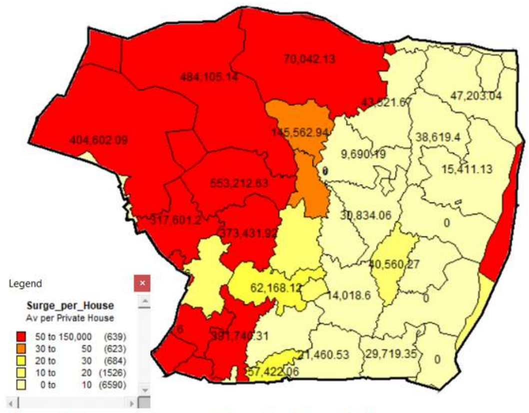
Spend Averaged over Housing Population

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.

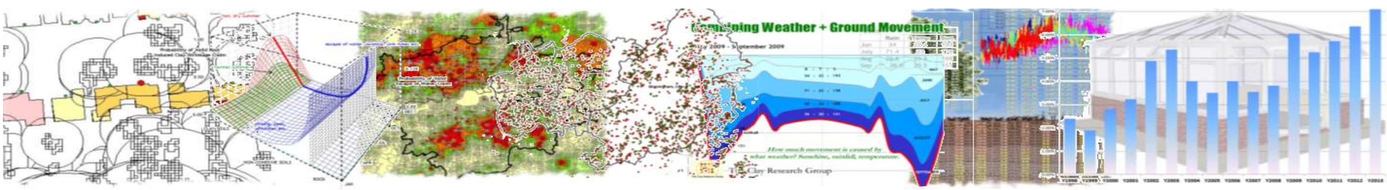
SPEND in SURGE – ENFIELD



Spend by Sector



Spend Averaged over Housing Population



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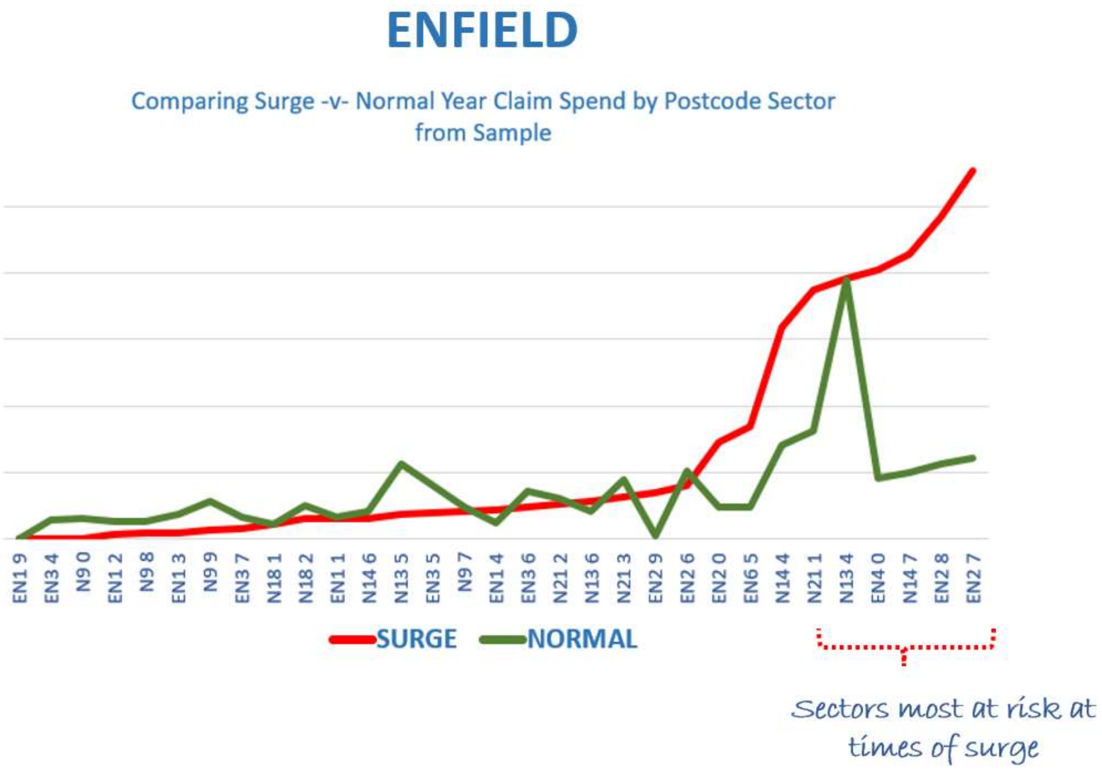

The above graph identifies the variable risk across the district at postcode sector level from the sample, distinguishing between normal and surge years. Divergence between the plots indicates those sectors most at risk at times of surge (red line).

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