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

December 2020
Edition 187

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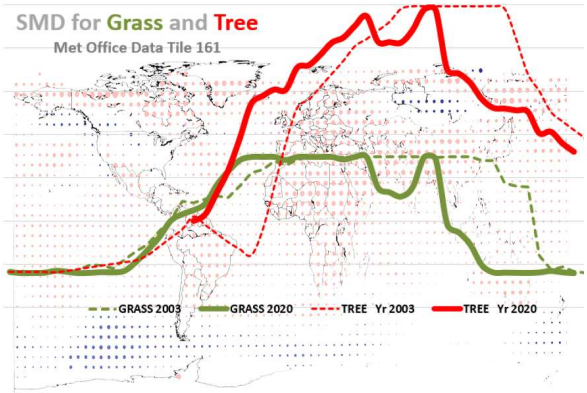
CONTENTS

Issue 187, December 2020

SMD – 2020 Review

Below, SMD data for both grass (green) and trees (red) for 2020. Dotted lines plot data for the 2003 surge year.



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

The initial threat of a surge earlier in the year passed following heavier, intermittent rainfall from the middle of August.

2020 in Top Three Warmest Years

The World Meteorological Organisation estimates that, globally, 2020 will be one of the warmest since records began, falling just behind 2016 and 2019.

NOAA report "Nine of the 10 warmest years on record have occurred since 2005."

Risk by District Series

This month we re-visit Brent, one of the high-risk districts in terms of domestic subsidence, to align the risk data with the current series. The original review was published in Issue 71, April 2011.

Next month's edition re-visits Haringey, initially covered in Issue 72, May 2011.

CRG Website Update

Visitor numbers to the CRG website nearly doubled in 2020, and now exceed 3,000 a month. The numbers of 'hits' – that is, the number of files downloaded from the server – is now just under 20,000 a month.

Contributions Welcome

We welcome articles and comments from readers. If you have a contribution please Email us at:

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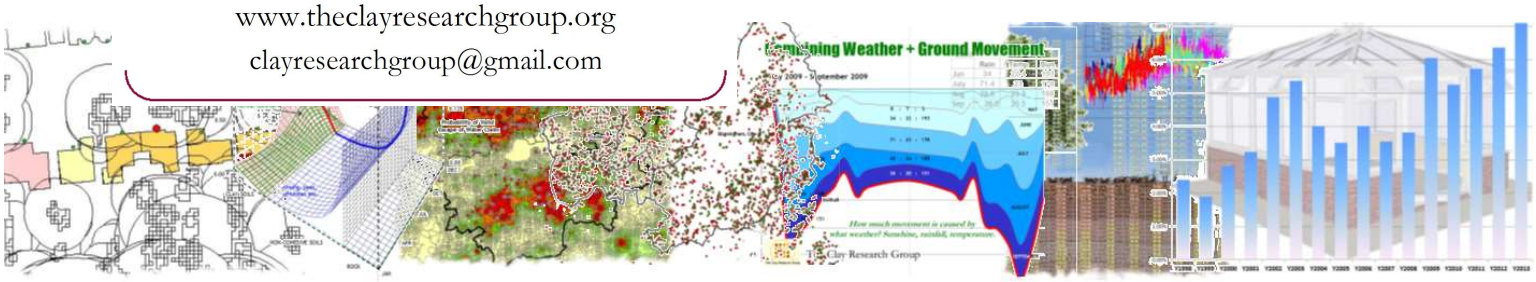

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Intervention Technique Update

The Intervention Technique is a method patented and used by Innovation Group to reduce water uptake by trees in the summer months to resolve root induced clay shrinkage claims.

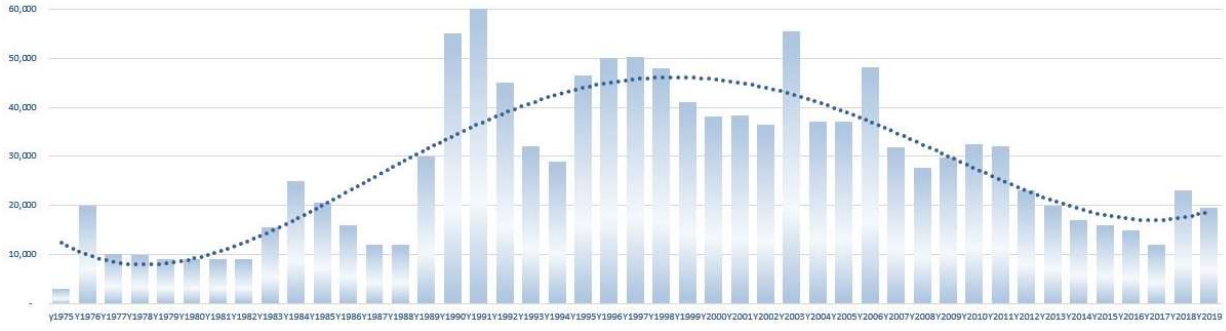
The latest update from Dr. Allan Tew suggests that it has been used on around 500 claims and delivered savings of around £12 – 15m. Additional benefits have included a prompter claim settlement – the 'see and fix' approach – as well as removing the need for alternative accommodation on the more complex claims requiring underpinning. A less obvious cost benefit but with environmental benefits has been allowing the retention of 500 trees that otherwise would have been lost.

Abscisic Acid – A Surprising Role

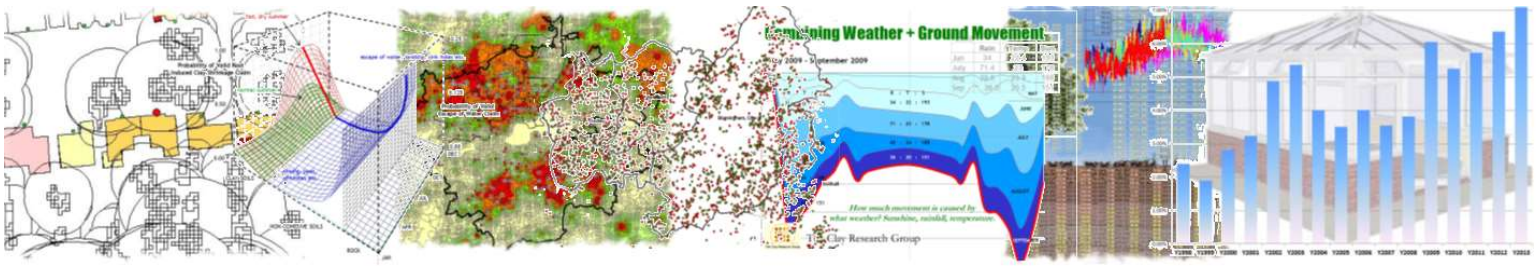
Abscisic acid (ABA) is a naturally occurring plant hormone and plays an active role in the Intervention Technique described above. It also forms the subject of a United States patent claiming to be able to combat cancer.

The patent says "ABA is able to produce a hyperpolarization condition on plasma membrane through a decrease of intracellular Na+ and K+. Such phenomenon is produced in cancer cells by mediation of ion channel and activation of the signalling G-protein pathway. ABA aborting sustained depolarization in malignant tissue will produce a change in the configurational state of cell from a damage to a normal state." https://patents.google.com/patent/US20060292215A1/en

ABI Data - Claim Notifications



ABI data over-estimates the number of valid claims by not taking into account subsequent declinatures following investigation but the graph reveals the general trendline. There will be a higher percentage of valid claims in surge years (around 70%) and lower percentage in normal years (50% or less).



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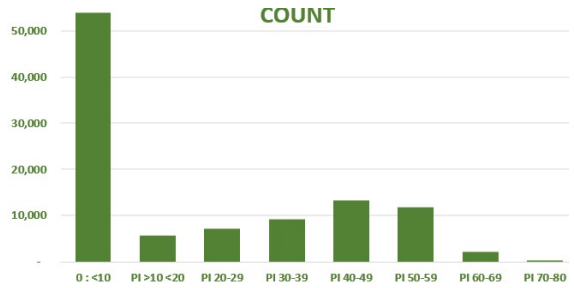
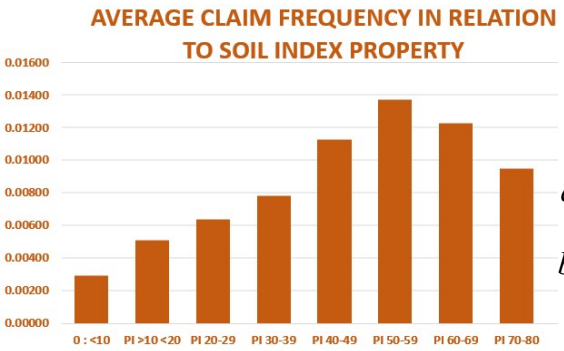
Count, Frequency and Spend

A sample of over 100,000 subsidence claims with a total recorded spend of nearly £400m have been analysed using different techniques (frequency, count of claims, spend and probability of claim validity) and the outcomes are shown below. No claims were recorded in 19% of UK postcode sectors and around 20% of the sectors had a PI greater than 10%.

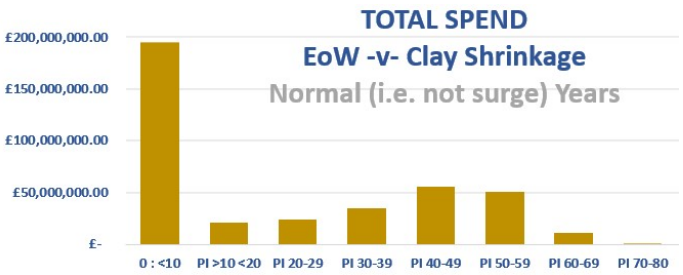
A simple 'count of claim' analysis (right) suggests that clay soils are a lower risk than houses built on non-cohesive (sands, gravels etc.) soils.

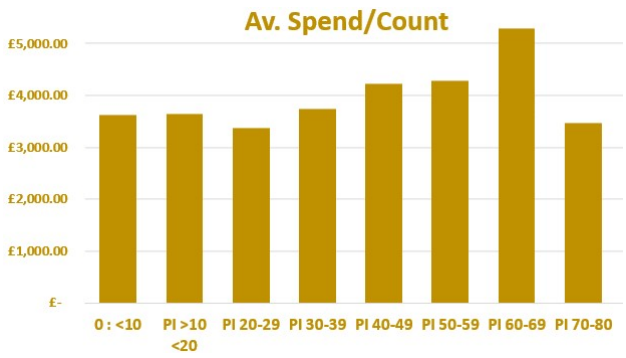




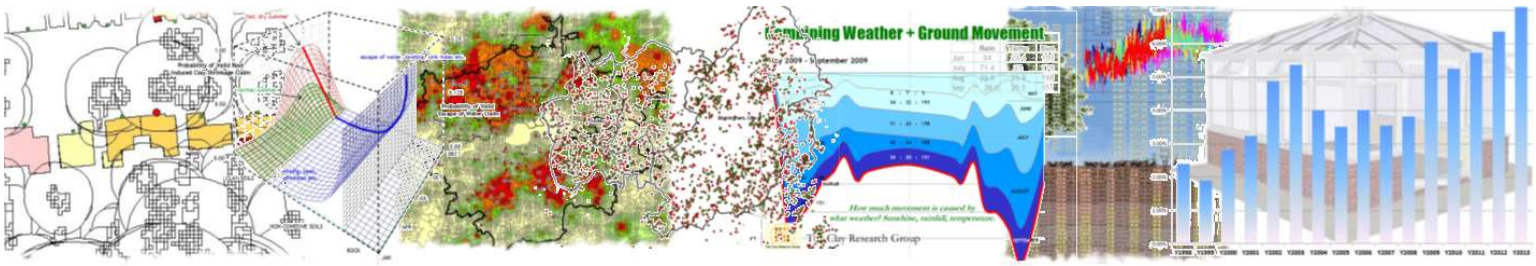
Frequency data – the number of valid subsidence claims divided by the number of private homes - reveals the highest risk to be in the PI range of 50 – 59%. The difference between 'count' and 'frequency' is due to properties on non-cohesive soils covering a much larger area.

The gross 'spend by geology' reflects the fact there are more claims on non-cohesive soils than cohesive, accounting for a larger gross spend, but spread over a much larger area.





The total spend per postcode sector based on soil shrink/swell characteristics, divided by the claim count, delivers an average cost illustrating the increased risk posed by clay soils. Settlement costs have been omitted for commercial reasons – graph provides indication of relative values.



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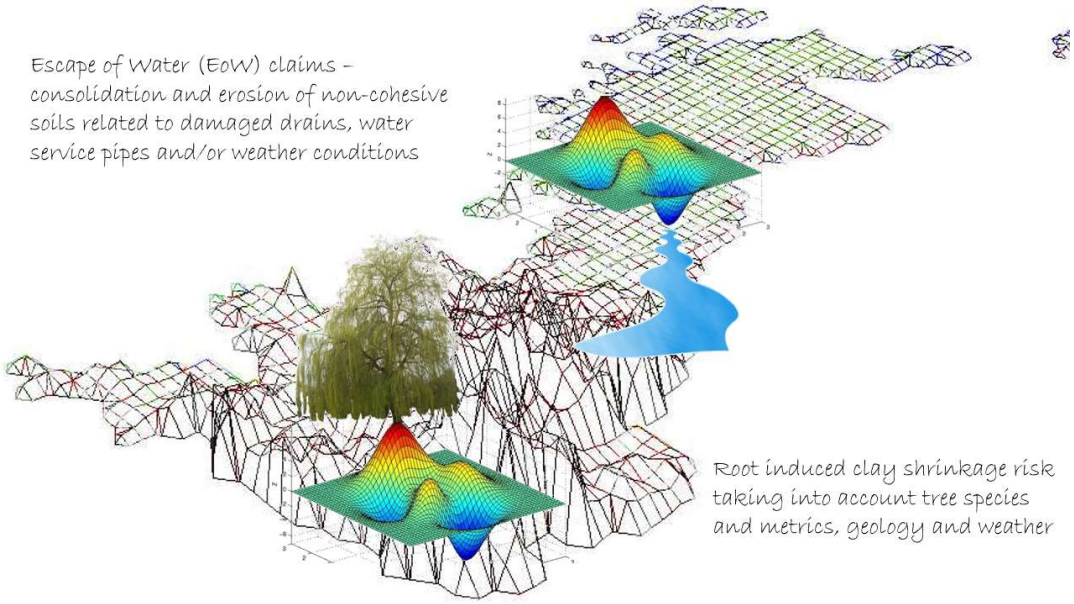
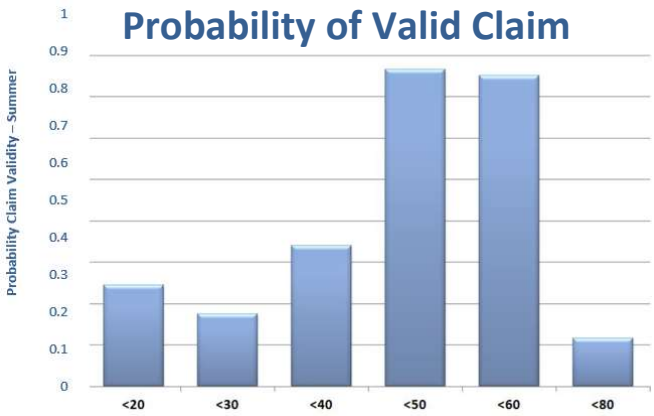
Visualising the Data

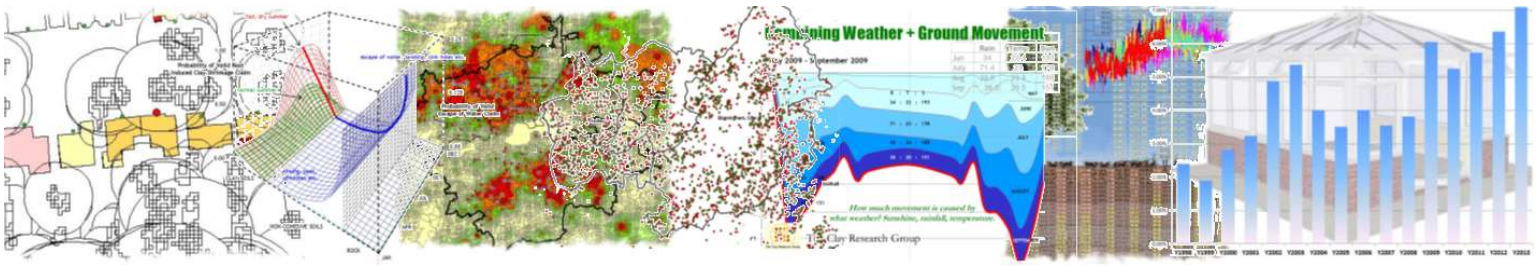
How, what, where and when? Data from the graphs on the previous page combine to answer the questions, plotting the variable risk trees present with roots growing in clay soils and leaking drains in non-cohesive soils.



Although there are more EoW claims across the UK, clay shrinkage claims deliver a higher frequency than their non-cohesive counterpart. As we might expect, the gross spend for claims on non-cohesive soils is higher than for clay soils, but that is because clay soils only cover around 20% of the UK. The 'spend by count' analysis reveals that clay related claims are more expensive.



The probability of a claim being valid varies by season and increases with the soil PI as shown, left. Values reflect surge year.



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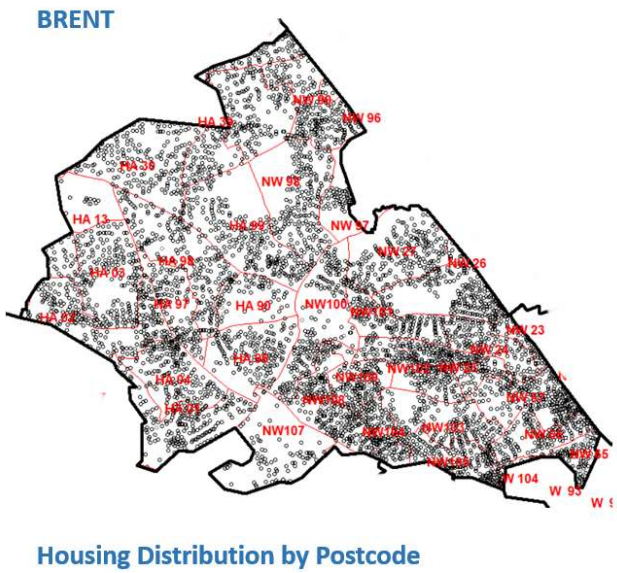
Subsidence Risk Analysis – BRENT

Brent occupies an area of around 43km^2 with a population of around 335,000.



Housing Distribution by Postcode

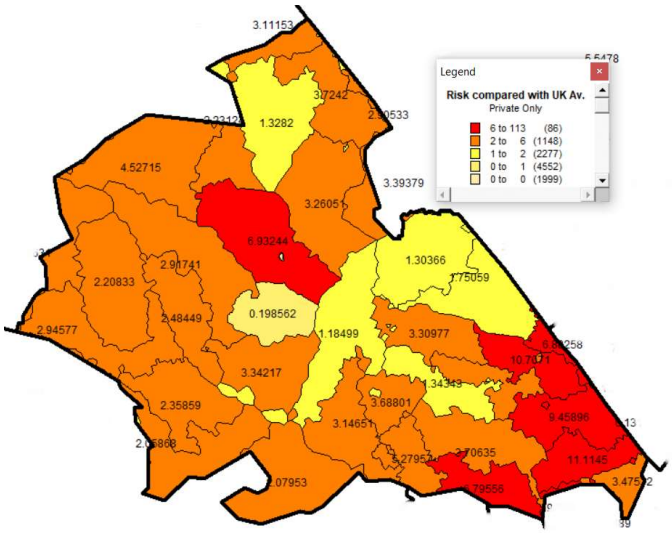
Distribution of housing stock using full postcode as a proxy. Each postcode in the UK covers on average 15 – 20 houses, although there are large variations.

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?

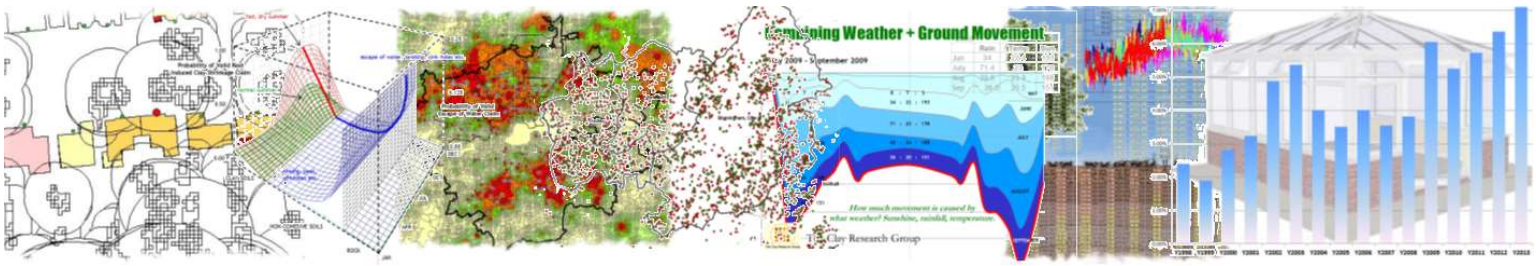
Using a frequency calculation (number of claims divided by private housing population) the relative risk across the borough at postcode sector level is revealed, rather than a 'claim count' value.

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

Brent is rated as high risk, particularly to the south-east of the district, with some sectors exceeding 10x the national average from the sample analysed.



Brent is ranked as a high risk in the UK in terms of 'risk by district' for domestic subsidence claims from the sample analysed. Above, values at postcode sector level compared with UK average.



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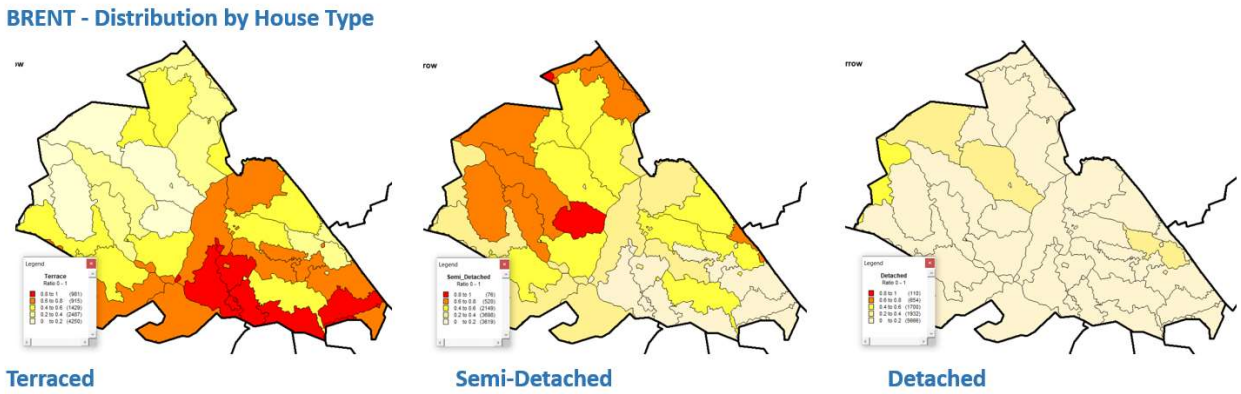
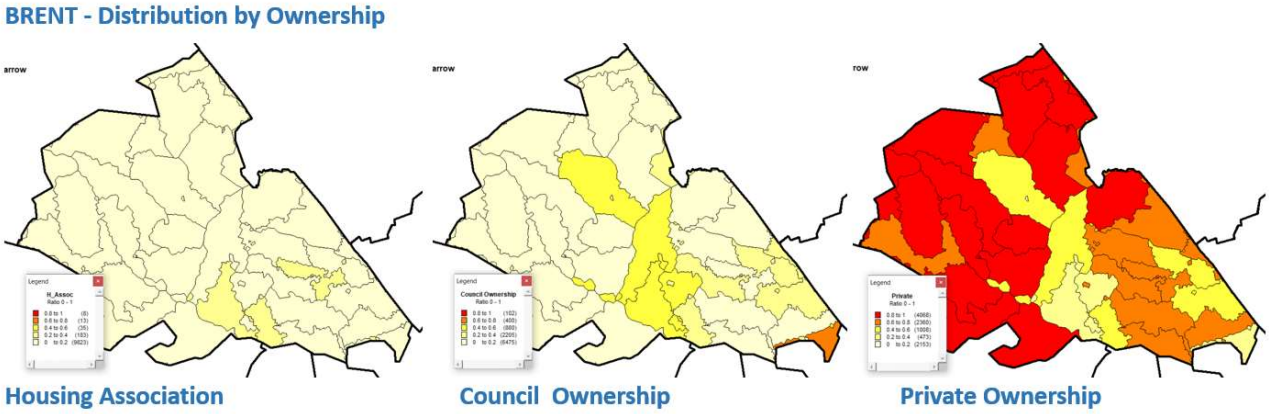
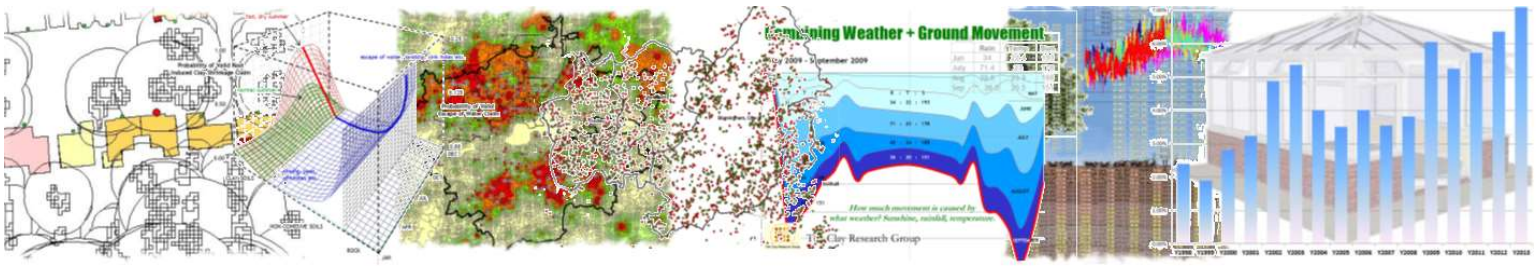
BRENT - Properties by Style and Ownership

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 policies allow insurers to assign a rating to individual properties.



Distribution by ownership is shown below. The maps reveal predominantly privately-owned properties across the borough with a high number of terraced to the south east of the borough.





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Subsidence Risk Analysis – BRENT

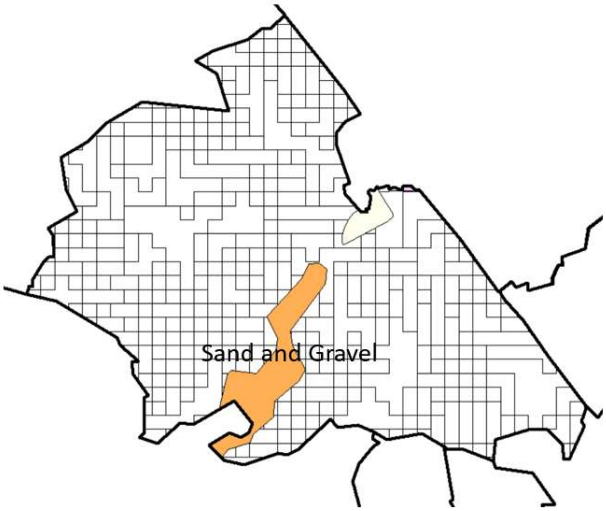
Below, extracts from the British Geological Survey low resolution 1:625,000 scale geological maps showing the solid and drift series. View at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html for more detail.

See page 11 for a seasonal analysis 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 (90% in the sample) that the cause will be due to clay shrinkage.

In the winter the situation reverses. The likelihood of a claim being declined exceeds 80%.

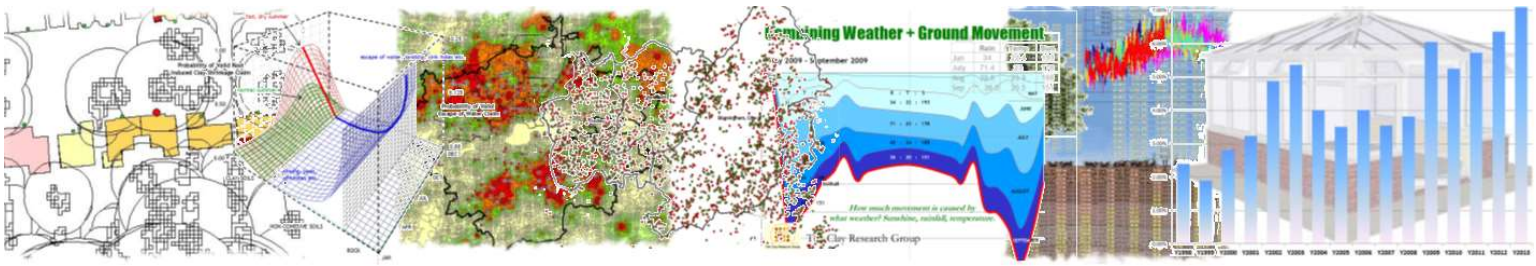
The analysis reflects the influence of the underlying London clay series and the apparent shallow thickness of the superficial deposits.

BRENT : BGS Geology – 1:50,000 scale



DRIFT DEPOSITS

SOLID GEOLOGY



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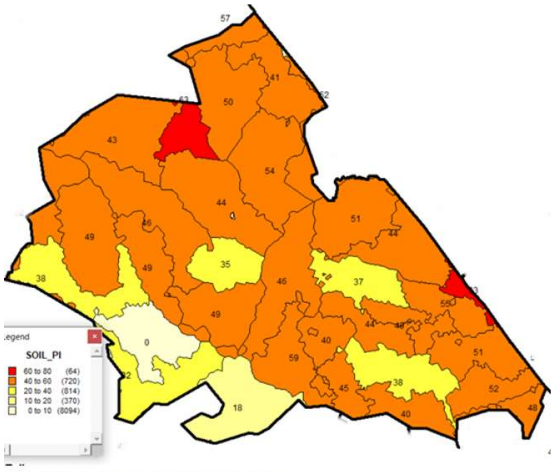
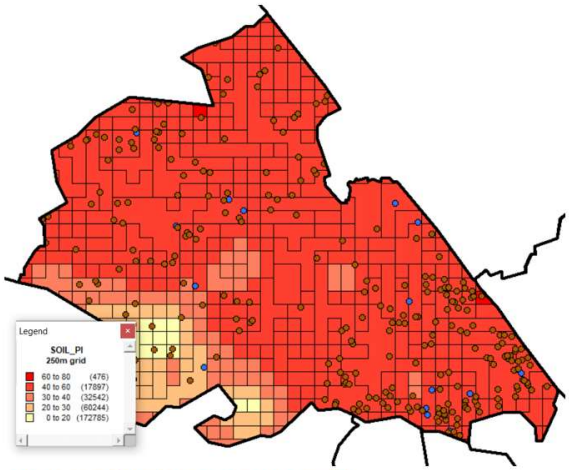
Liability by Season and Geology

Below, the average PI by postcode sector (left) derived from site investigations and interpolated to develop the CRG 250m grid (right). The presence of a shrinkable clay in the CRG model matches the BGS maps on the previous page with clay having an average PI of around 50% where it exists. The higher the PI values, the darker red the CRG grid.

BRENT – Soil Plasticity Index



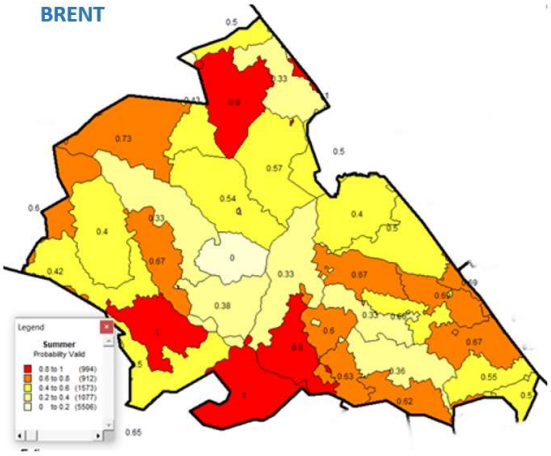
Soil PI Averaged by Sector



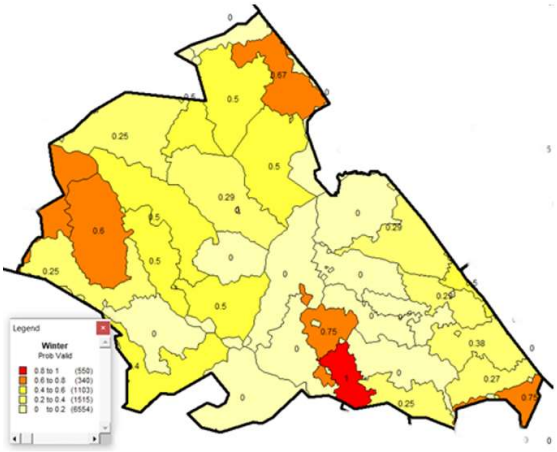
PI Interpolated on 250m CRG grid

Zero values for PI in some sectors may reflect the absence of site investigation data - not necessarily the absence of shrinkable clay. 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.

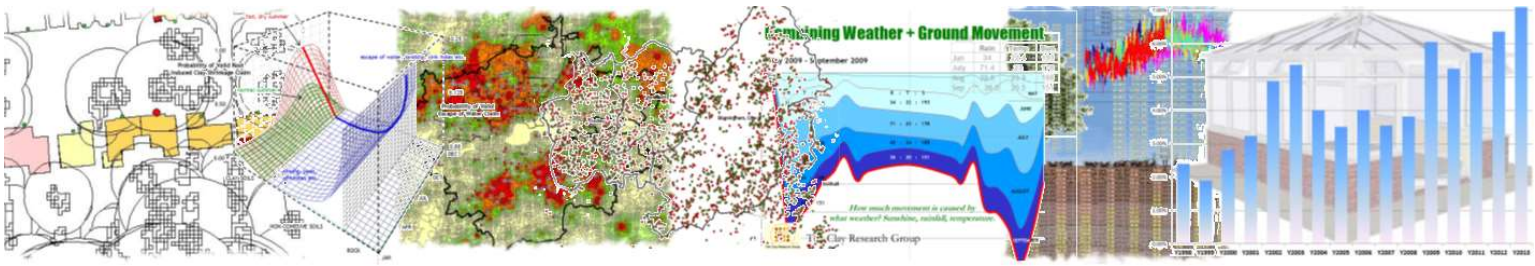
BRENT



Probability Valid, Summer



Probability Valid, Winter



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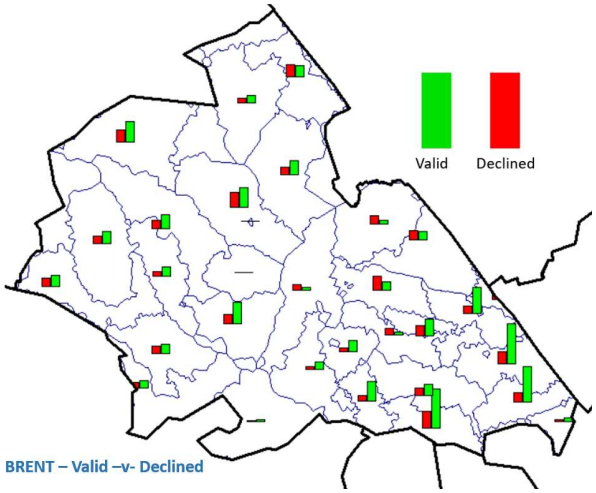
District Layout. Liability, EoW and Council Tree Risk.



BRENT – Valid –v- Declined

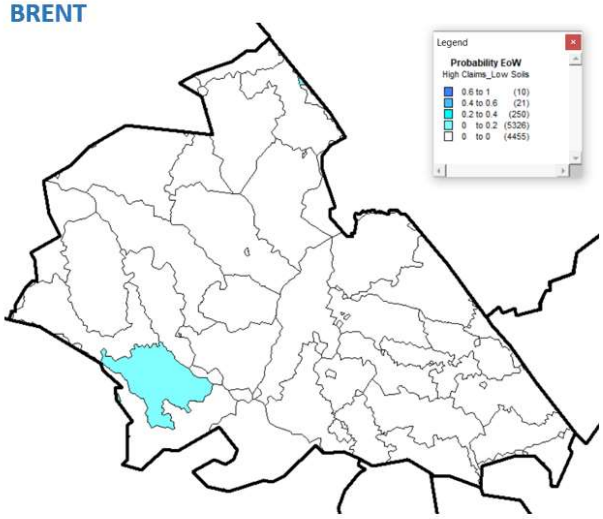
Left, annual valid-v-declined data which changes significantly when considering seasonal data – see page 11.

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

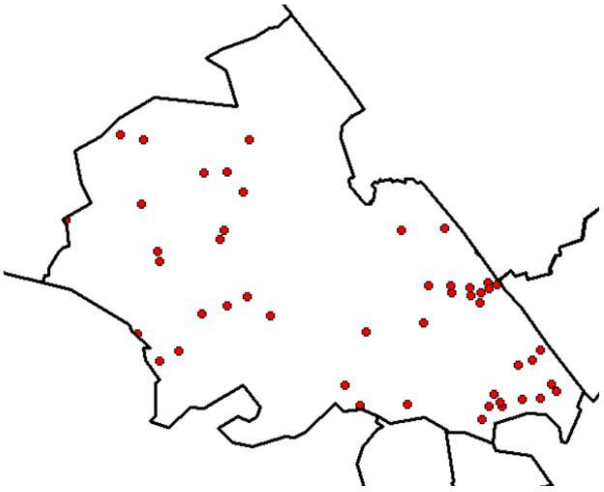
In this study, risk values are often based on small housing population densities.

Below, left, mapping the frequency of escape of water claims from the sample reflects the presence of the non-cohesive drift deposits (sand and gravel). Below, right, 'Council Tree Claims' map plotting claims from a small sample of around 2,700 UK claims where damage has been attributable to vegetation in the ownership of the local authority.

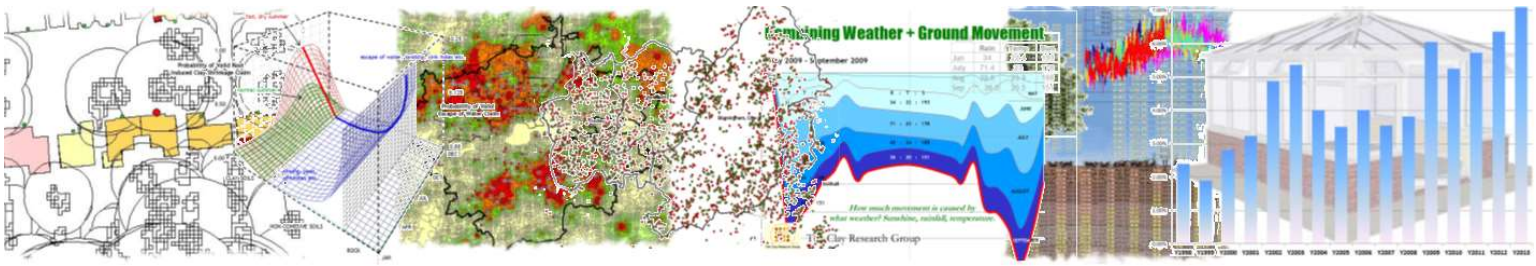
BRENT



Higher Risk Escape of Water



Claims Involving Council Tree



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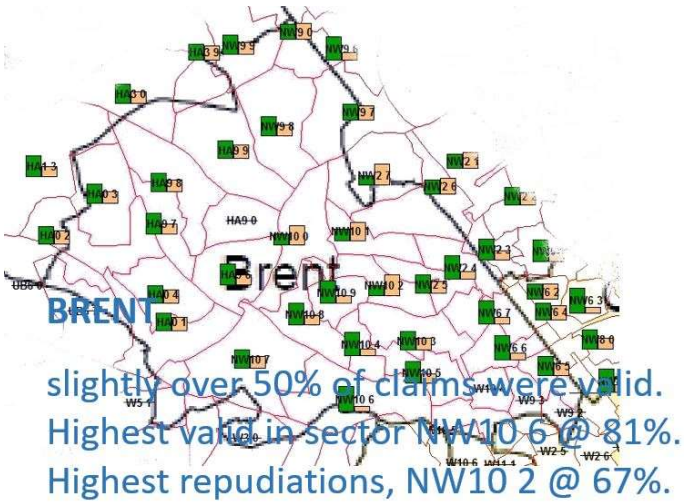
Council Tree Records

The number and location of subsidence claims involving council trees from a larger sample - data provided by the London Borough of Brent and appears in an earlier edition of the CRG newsletter.

Council Tree Claims from Brent's Records

Count of Claims by Postcode

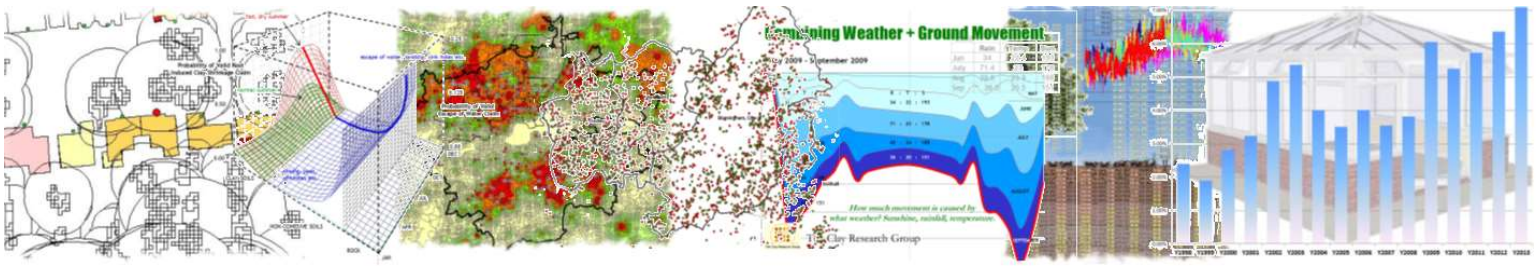
The diameter of the red dots is related to the count of claims in the full postcode, not the sector. For more information download editions 164 and 165.



Valid -v- Declined

Left, percentage of valid claims (green) compared with declinatures by postcode sample.

The sample indicated that around 50% of claims across the district for a normal year were valid, with the highest rate of valid claims (81%) in sector NW10 6 and the highest rate of declinatures (67%) in NW10 2.



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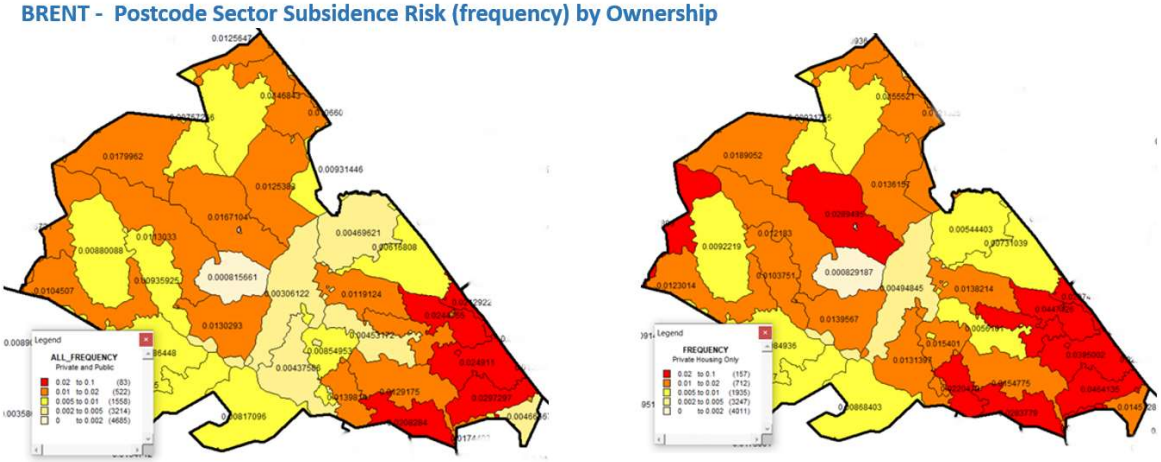
BRENT - Frequencies & Probabilities

Mapping claims frequency against the total housing stock, left (council, housing association and private) and private housing only, right, reveals the importance of understanding risk by portfolio.

BRENT - Postcode Sector Subsidence Risk (frequency) by Ownership



Combined Public and Private Frequency

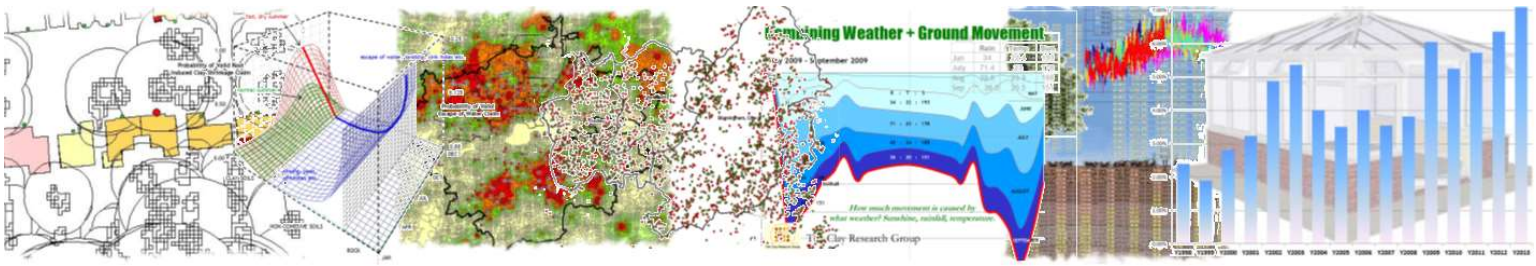
Private Only

The reversal of rates for valid -v- declined by season is a characteristic of the underlying geology. The probability of a claim being valid in the summer is just under 80%, and in the winter, it falls to less than 20%. Valid claims in the summer are likely to be due to clay shrinkage, and in the winter, escape of water.

The probabilities of causation reverse between the seasons and the values are typical signatures of an outcropping, highly shrinkable, clay soil.

Liability by Season - BRENT

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Brent	0.760	0.026	0.214	0.01	0.16	0.83



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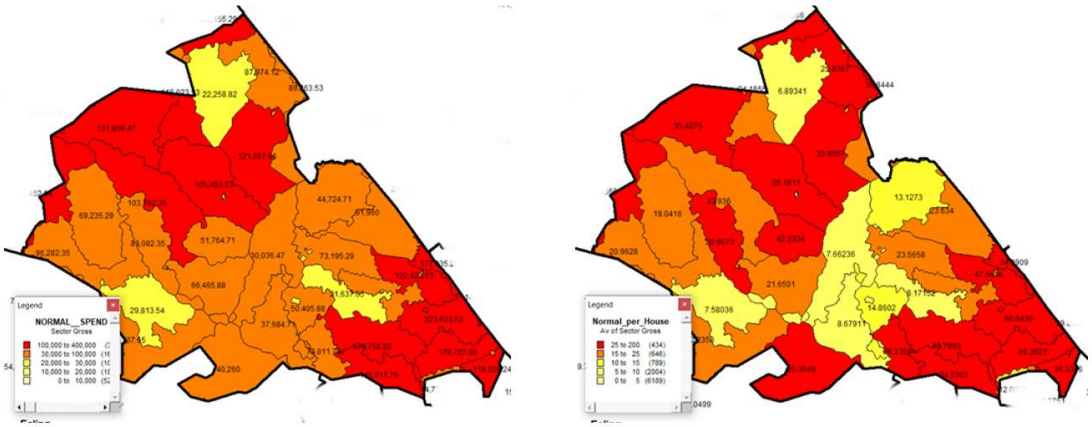
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Surge & Normal Years

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.

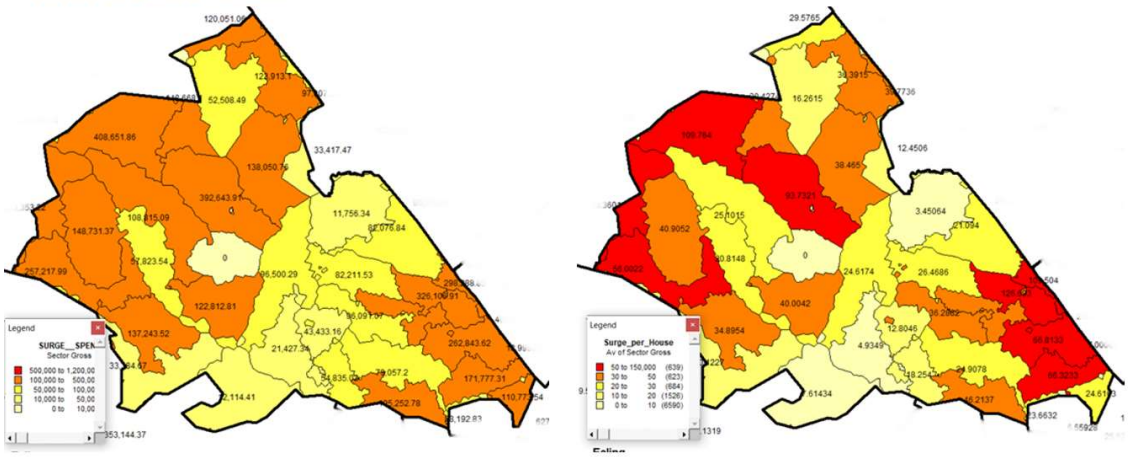
NORMAL YEAR SPEND – BRENT



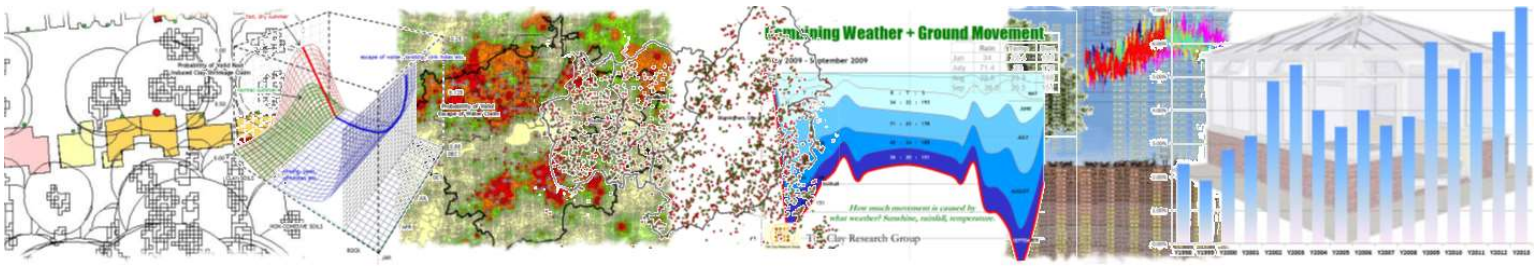
Spend by Sector **Spend Averaged over Housing Population**

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 – BRENT



Spend by Sector **Spend Averaged over Housing Population**



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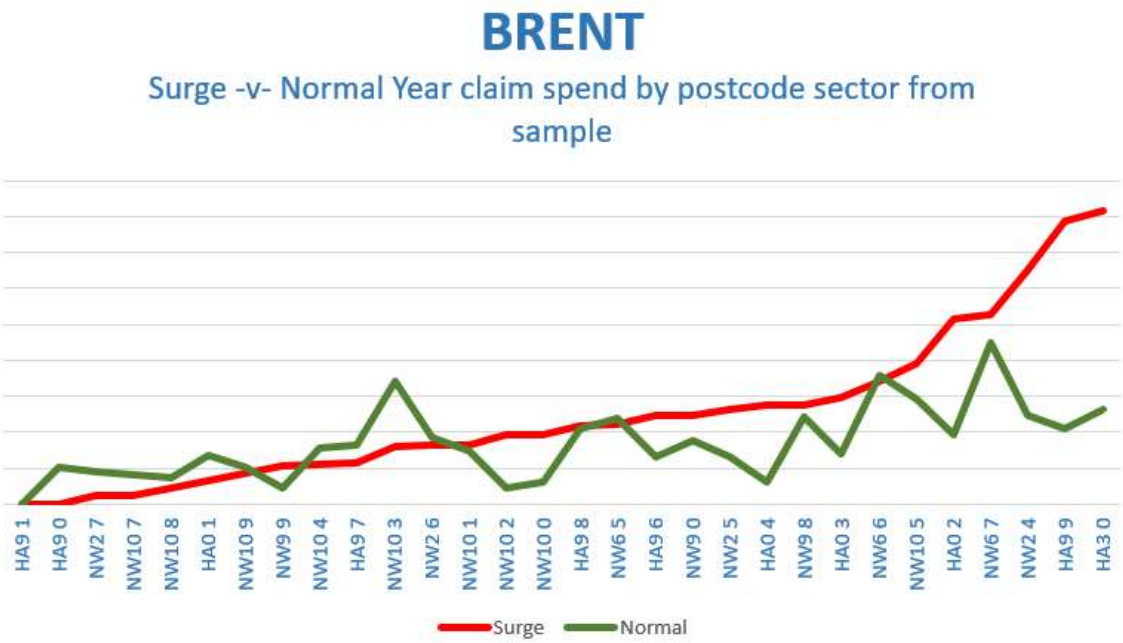
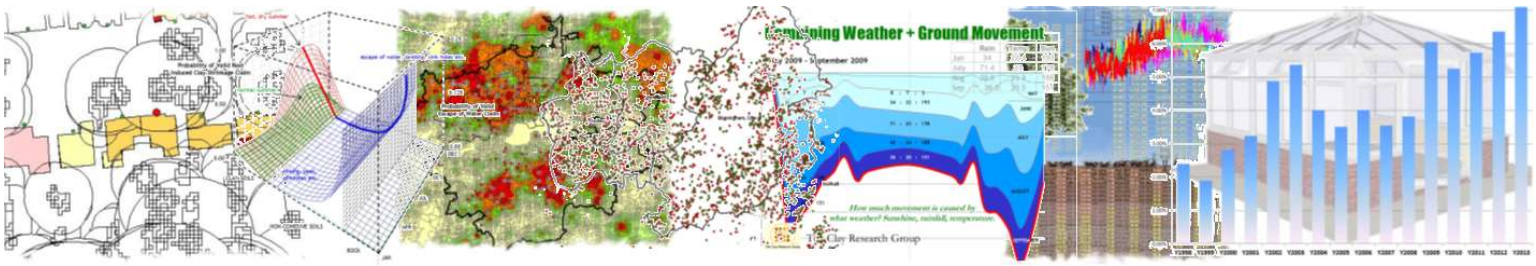


The above graph identifies the variable risk across the district at postcode sector level, distinguishing between normal and surge years. Divergence between the plots indicates those sectors most at risk at times of surge (red line).

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 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.



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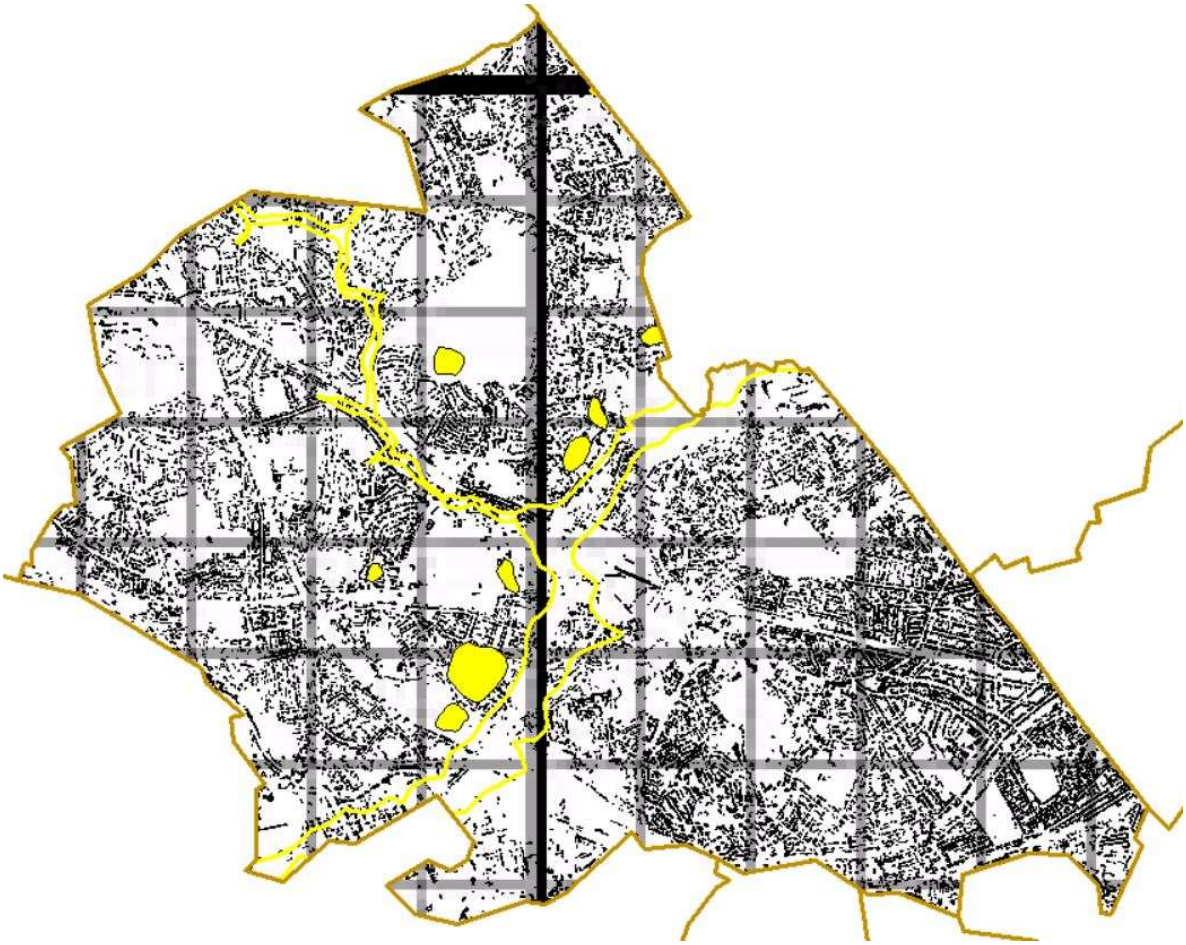
Modelled Root Overlap – Public and Private Trees

Below, a map showing the modelled root encroachment beneath domestic properties (grey shading) in the district of Brent using a value of 1.2 x the tree height.



Density of shading (i.e. tree root overlap) increases towards the south east and corresponds to a higher claim distribution – see page 9.