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

February 2024
Issue 225

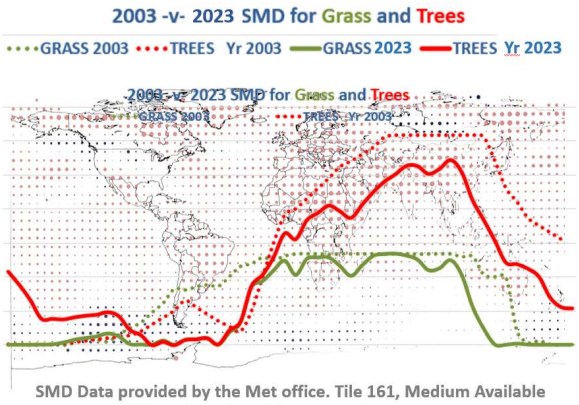
The Clay Research Group

CONTENTS

Issue 225, February 2024

SMD Update

Soil Moisture Deficit readings plotting variations in moisture content in the ground in 2023 at tile 161 and comparing them with the surge year, 2003.



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

Reigate and Banstead is the subject of the 'Risk by District' series in this month's edition. Situated in Surrey, it has superficial deposits of clay with flints overlying predominantly chalk – see Page 6.

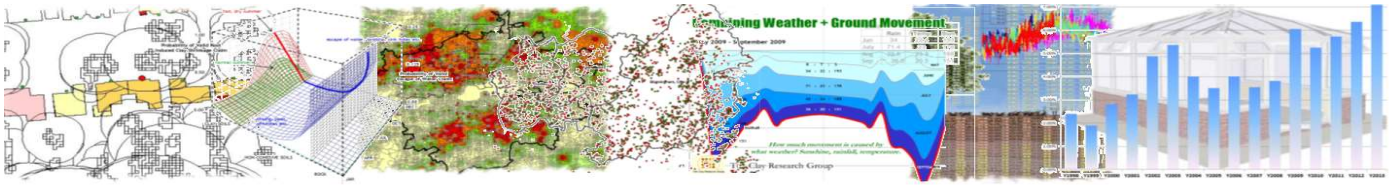
The risk maps are built from a data sample covering four claim years, including one surge and three 'normal' years.

Warmer Weather but Fewer Claims?

It seems perverse that the number of root-induced clay shrinkage subsidence claims has been falling steadily since 2003 and 2006 – see graph on following page - given the rising temperatures.

Is this because the more troublesome trees have been dealt with? Data from Camden Council suggests tree maintenance is helping. For the period 2002 – 2007 they received an average of 100 claims per year, for 2008 – 2013 that fell to an average of 49 claims per year. In 2014 they received 23 claims, 2015, 10 claims and in 2016, 2 claims.

https://opendata.camden.gov.uk/stories/s/Camden-Tree-Statistics/ad58-u6q7/



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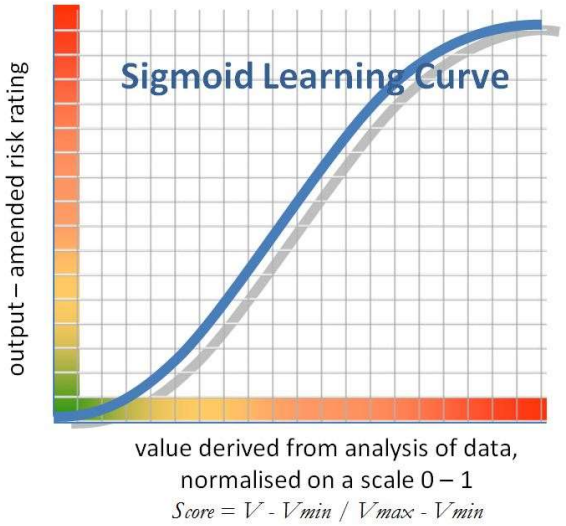
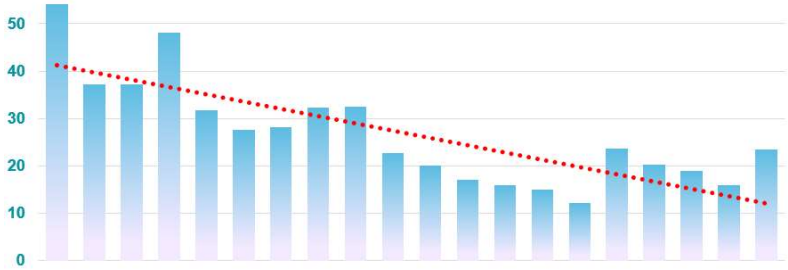
Sigmoid Learning Curve

The Sigmoid Learning Curve, or Activation Function, is the method used by Ai systems to learn from experience and adjust risk factors as necessary. 'Experience' in this context is data gathered from previous claims.



For example, at an underwriting level, how do insurers take account of the reducing number of claims over the last 20 years? In 2003, ABI data record 54,000 subsidence claims. Numbers have reduced gradually, falling to 23,000 in 2022 as shown by the graph below.

The trendline recognises intermittent surges, indicating their frequency.

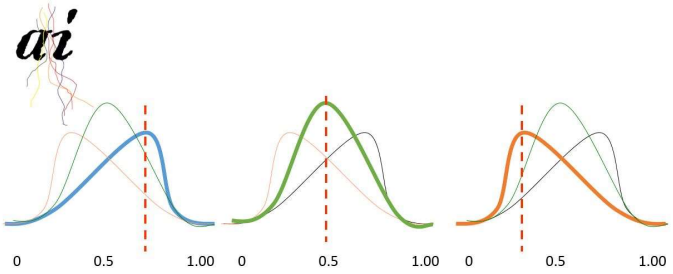


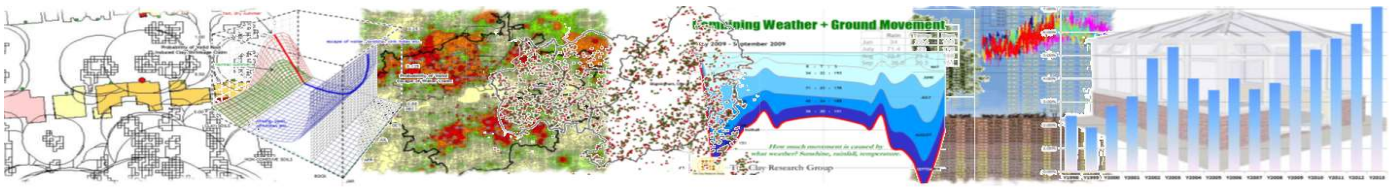
The Ai system is programmed to select just how many years best estimate the future. Should it take an average of the last four, five or maybe ten years to determine the subsidence element of the premium?

Each peril has a unique range of functions that reflect the risk based on past experience and the likely return interval of a surge in claims.

On a practical level, the subsidence peril has unique factors relating to geology, trees, age of property, weather etc. For example, it allocates a risk factor by tree species and metrics (height and distance from building) from past experience. With a live feed from the Met Office it can take account of current weather – rainfall, hours of sunshine and temperature – to refine the estimate and combine past site investigations and soil test results to rate the influence on the geology.

The calculations are undertaken continually as fresh data are added. Risk factors are determined by distribution analysis – see chart right. In this example, the initial risk value, left, was around 0.65. Over time it changed to 0.35, taking account of experience.





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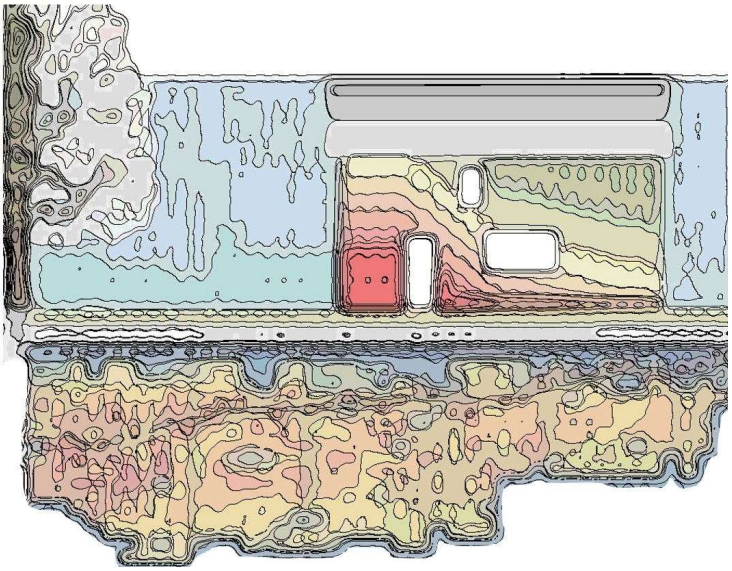
Sigmoid Learning Curve

The image, right, captures the nature of the Ai approach in FNoL and diagnosis.

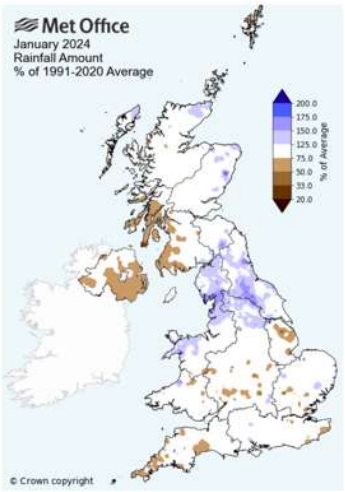


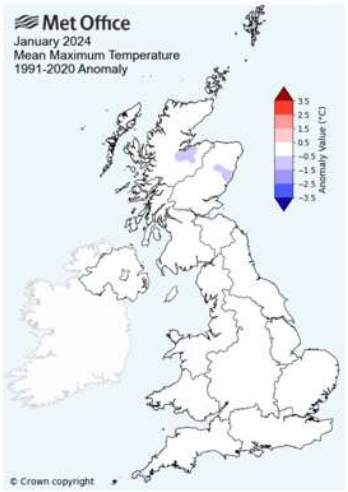
Modelling the interaction between trees, soils, climate and buildings is of course sensible and something all professions do when handling claims, but the nature of the components is at best a little blurred as the image conveys.

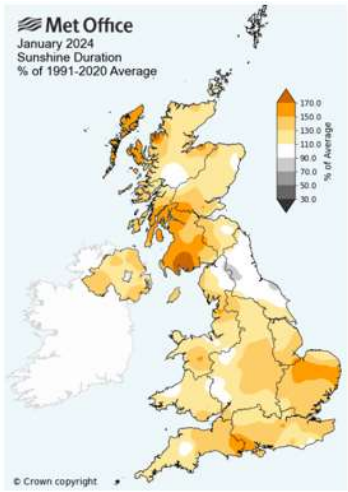
We agree with Giles Biddle, Tim Freeman and others. Without doubt precise levels are the best method of diagnosing causation and determining the most appropriate repair.

Met Office January 2024 Update.
Anomaly Data, 1991 – 2020

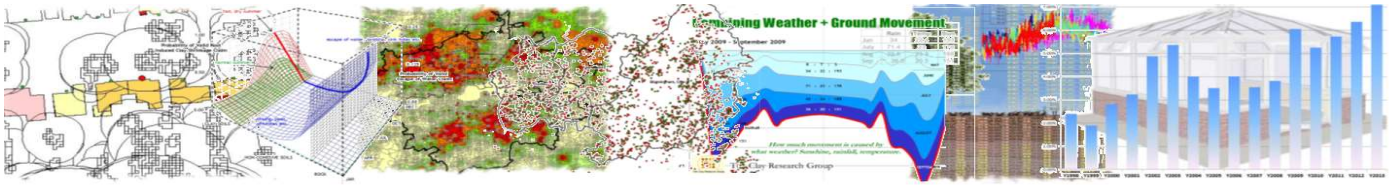
Anomaly maps from the Met Office web site for the month of January 2024 reproduced below. The month was similar to the 1991-2020 average, with increased hours of sunshine across the country.







https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-actual-and-anomaly-maps



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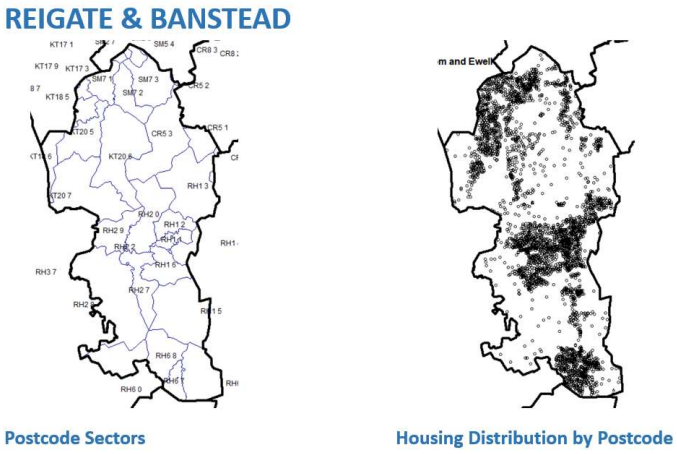
Subsidence Risk Analysis – REIGATE and BANSTEAD

The Reigate and Banstead district is located in east Surrey, occupying an area of 129km^2 with a population of around 148,000.



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.

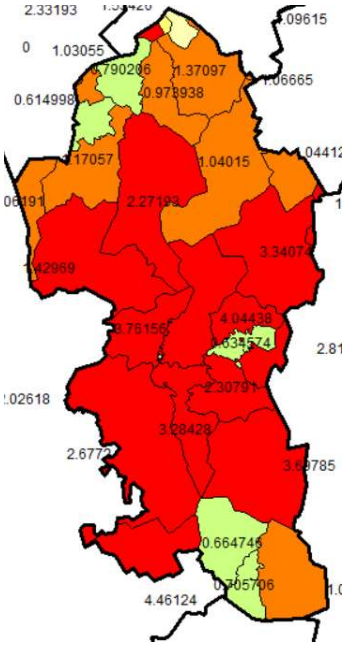
From the sample we hold, sectors are rated for the risk of domestic subsidence compared with the UK average – see map, right.

The district is rated 56th out of 413 districts in the UK from the sample analysed and is around 1.6x the risk of the UK average, or 0.431 on a normalised 0 - 1 scale.

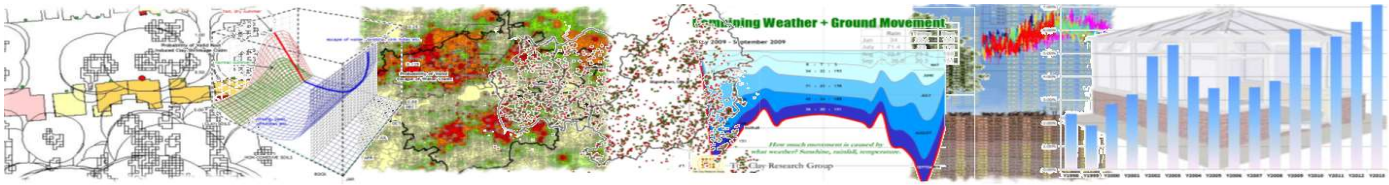
There is a varied risk across the borough as can be seen from the sector map, right, which reflects the results of site investigations – see CRG map on page 7.

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.



Sector risk compared to UK average from the sample analysed including all properties by ownership.



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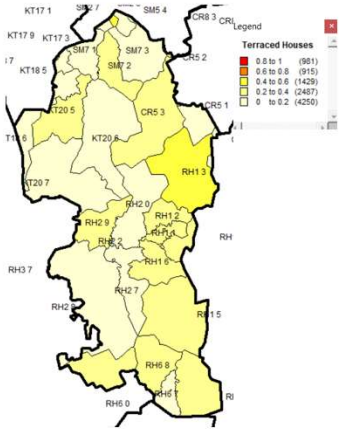
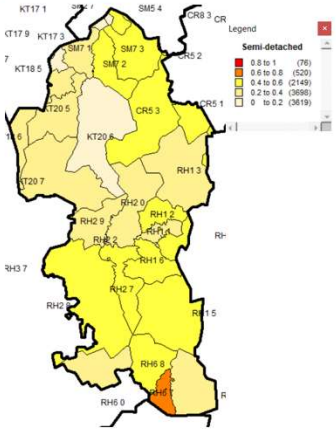
REIGATE and BANSTEAD - Properties by Style and Ownership

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 taking out the policy.

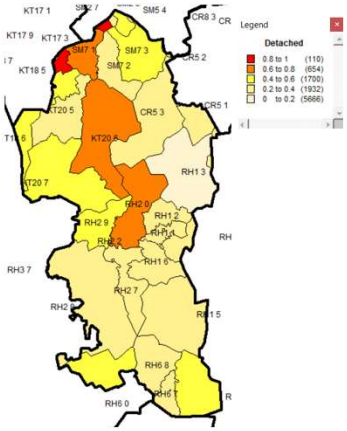
REIGATE & BANSTEAD - Distribution by House Type



Terraced



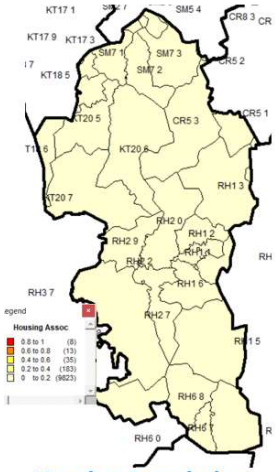
Semi-Detached



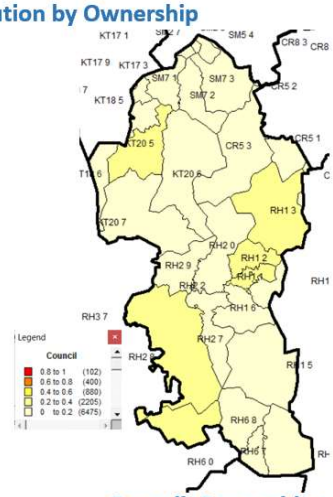
Detached

Distribution by ownership is shown below. Detached, private properties are the dominant class ownership across the borough.

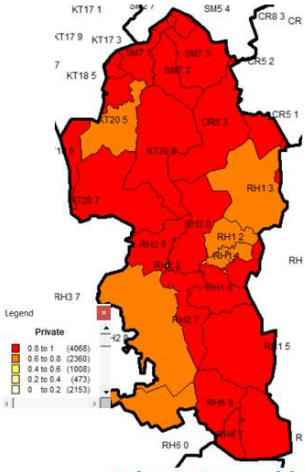
REIGATE & BANSTEAD - Distribution by Ownership



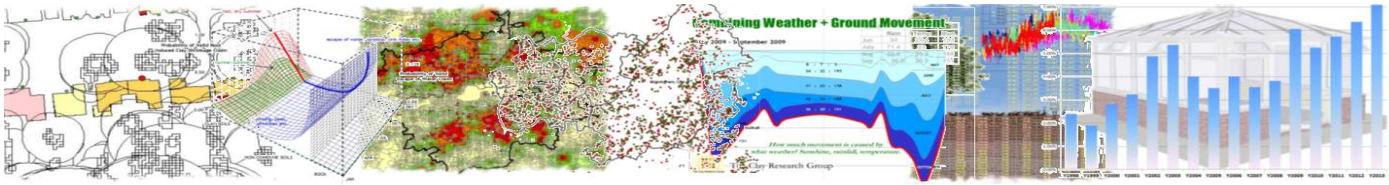
Housing Association



Council Ownership



Private Ownership



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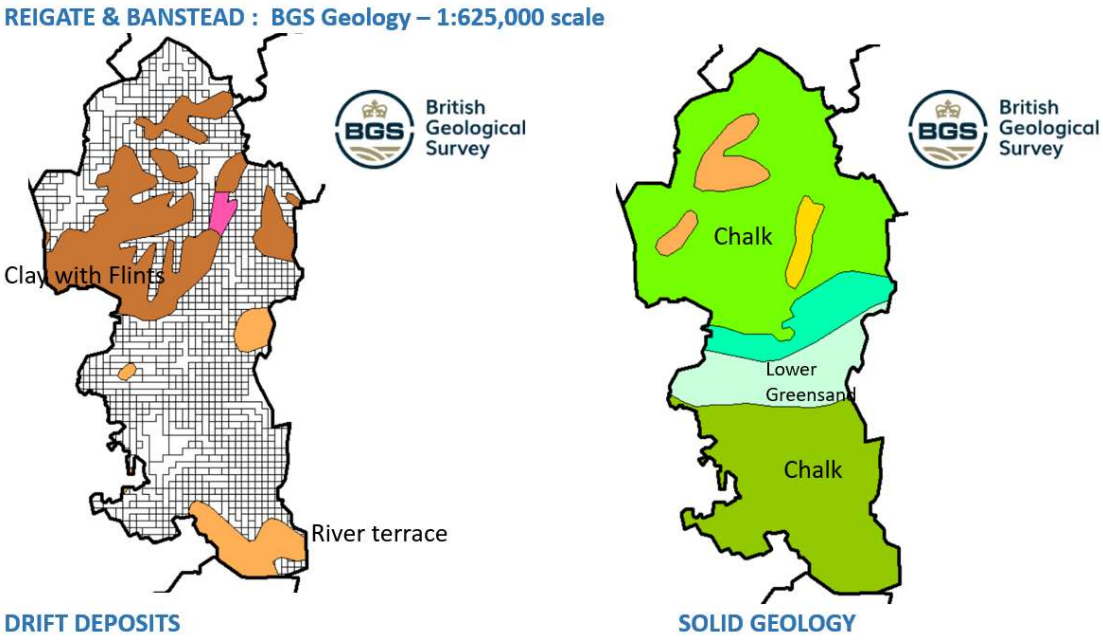
Subsidence Risk Analysis – REIGATE and BANSTEAD

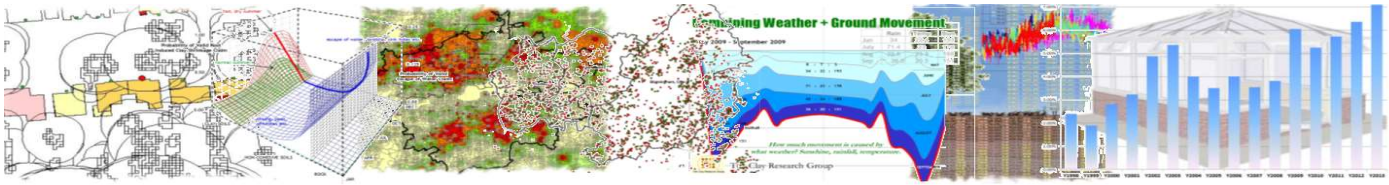
Below, extracts from the British Geological Survey low resolution 1:625,000 scale geological maps showing the solid and drift series. View at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html for more detail.

See page 10 for a seasonal analysis of the sample which reveals that, at district level, there is around a 70% probability of a claim being valid in the summer and, of the valid claims, there is around a 80% chance that the damage will have been caused by clay shrinkage, with escape of water accounting for the remaining 20%. In the winter the likelihood of a claim being valid is around 45%. Of the valid claims there is a 20% chance of the cause being clay shrinkage and 80% chance of the cause being an escape of water.

Maps at the foot of the following page plot the seasonal distribution with shrinkable deposits encountered following investigations associated with claims.



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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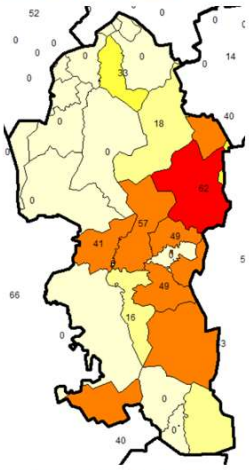
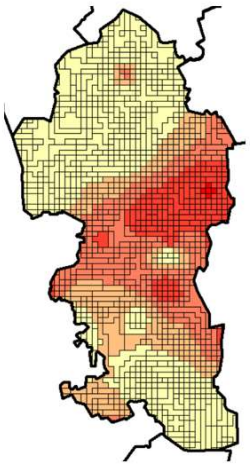
Liability by Geology and Season

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.

REIGATE & BANSTEAD - Soil Plasticity Index



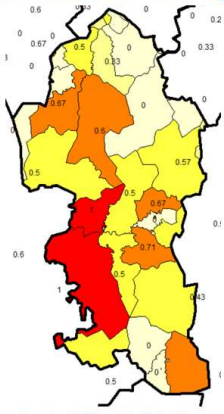
Soil PI Averaged by Sector



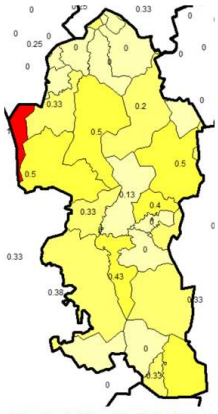
PI Interpolated on 250m CRG grid

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.

REIGATE & BANSTEAD – by season



Probability Valid, Summer



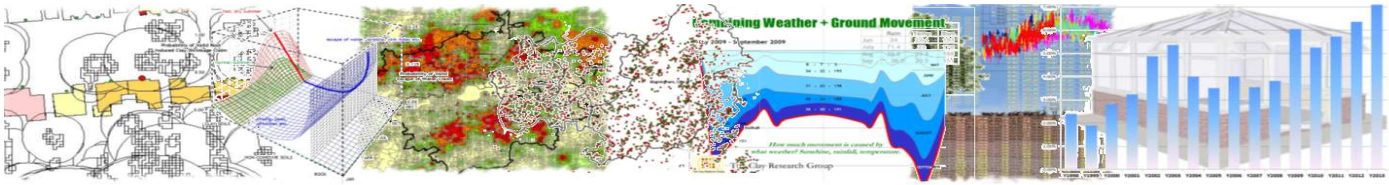
Probability Valid, Winter

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

Combining the risk maps by season and reviewing the table on page 9 is perhaps the most useful way of assessing the potential liability, likely cause and geology using the values listed.

Clay is recorded as a significant cause of subsidence in the summer months which reflects the distribution of the housing population relative to the London and Weald clay series.

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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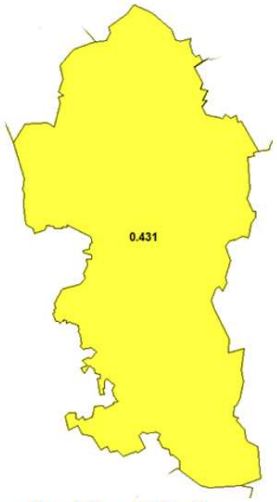
District Risk. EoW and Council Tree Risk.

REIGATE & BANSTEAD - Subsidence Risk Relative to UK Values



Normalised (0 – 1) Scale

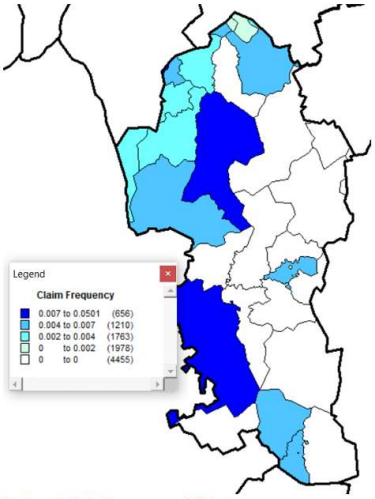
Relative to UK Average

Below, left, mapping the frequency of escape of water claims confirms the presence of non-cohesive soils. As we would expect, the 50,000 scale BGS map provides a more detailed picture.

The CRG 1:250 grid reflects claims experience.

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. The low numbers are attributable to the geology being largely non-cohesive. Tree claims tend to follow the CRG 1:250 scale map on page 7.

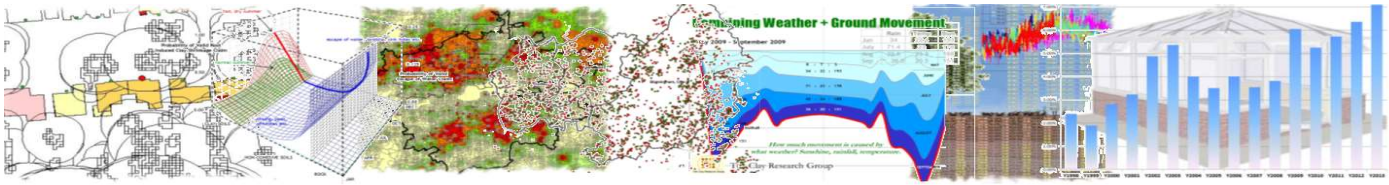
REIGATE & BANSTEAD



Higher Risk Escape of Water

Claims Involving Council Tree

(2,858 UK claim sample)



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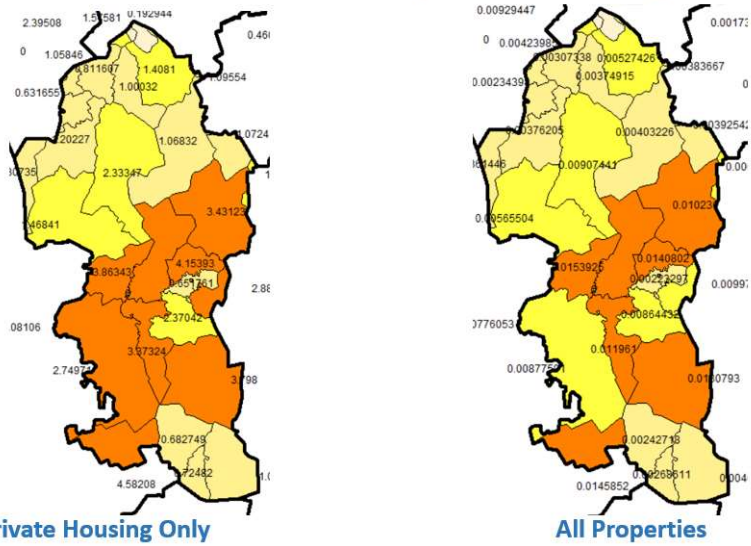
REIGATE and BANSTEAD - Frequencies & Probabilities

Below, mapping the risk of subsidence by ownership. Claims frequency including council and housing association properties delivers a misleading value of risk as they tend to self-insure. The following show the normalised risk, taking account of the private housing population – that is, the rating compared with the average value for each category.

REIGATE & BANSTEAD - Sector Risk Compared with UK Average

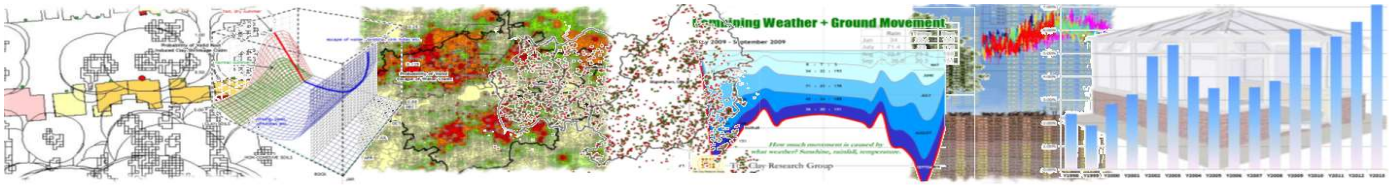


On a general note, a reversal of rates for valid-v-declined by season is a characteristic of the underlying geology. For clay soils, the probability of a claim being declined in the summer is usually low, and in the winter, it is high.

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 - REIGATE & BANSTEAD

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Reigate and Banstead	0.610	0.152	0.238	0.09	0.36	0.55



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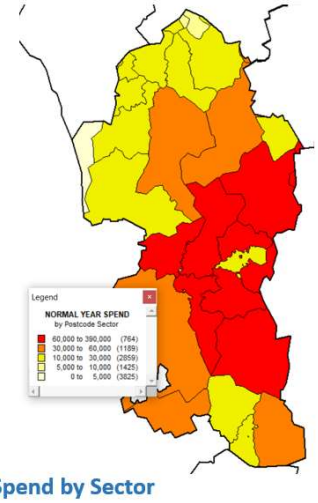
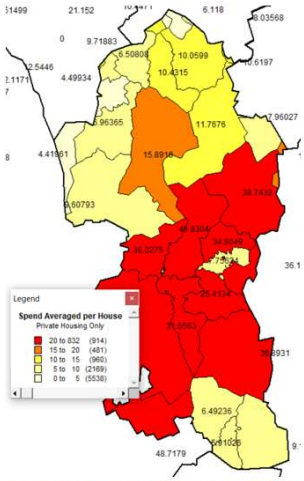
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Surge & Normal Years

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 – REIGATE & BANSTEAD



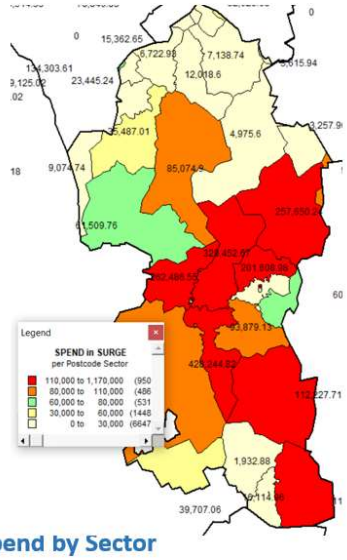
Spend by Sector



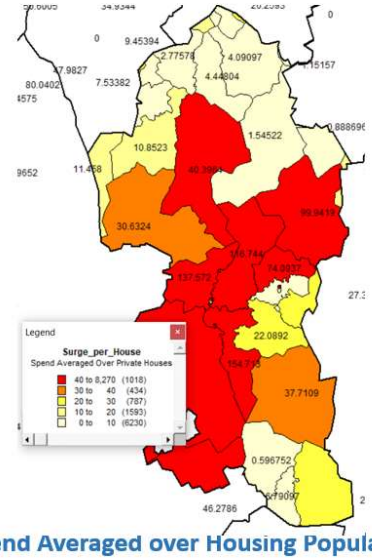
Spend Averaged Over Private Housing Population

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.

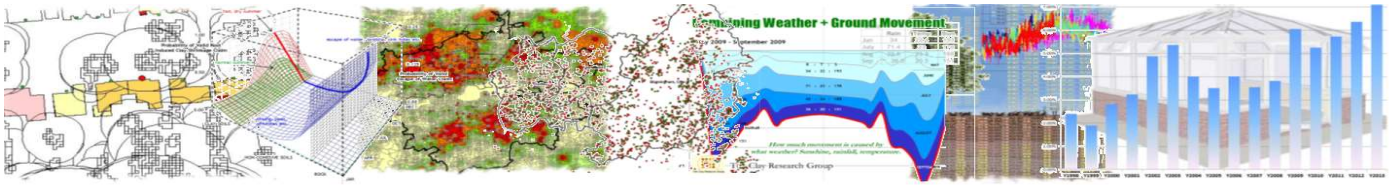
SPEND in SURGE – REIGATE & BANSTEAD



Spend by Sector



Spend Averaged over Housing Population



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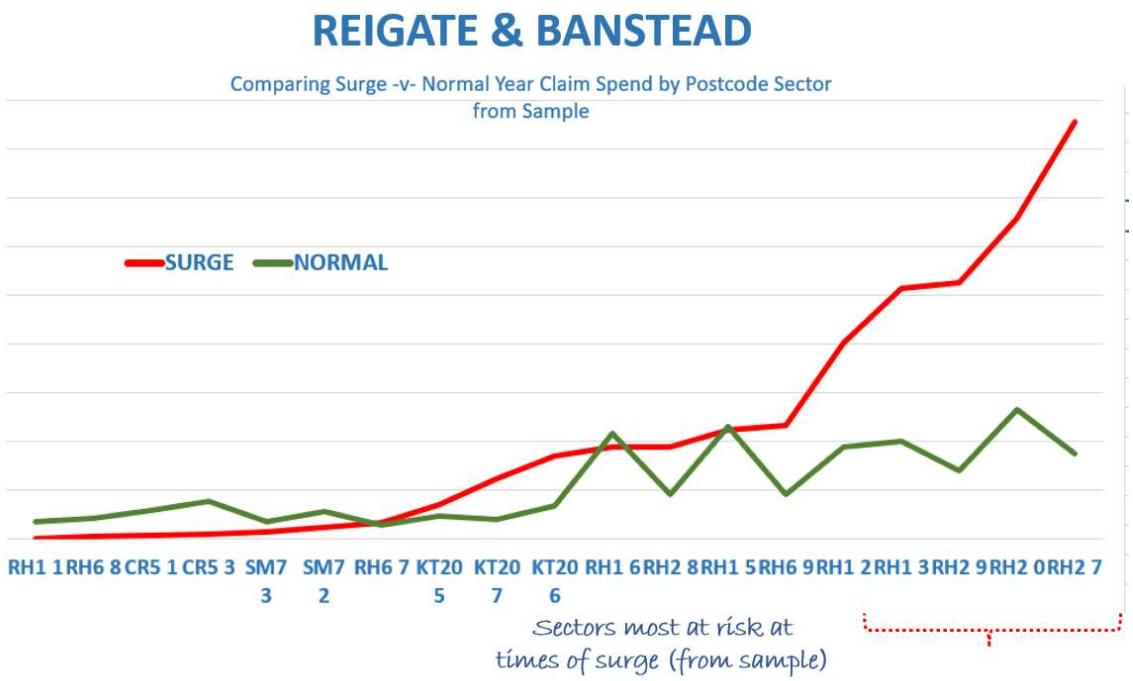

The above graph identifies the variable risk across the district at postcode sector level from the sample, distinguishing between normal and surge years. Divergence between the plots indicates those sectors most at risk at times of surge (red line).

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