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 2022
Issue 211

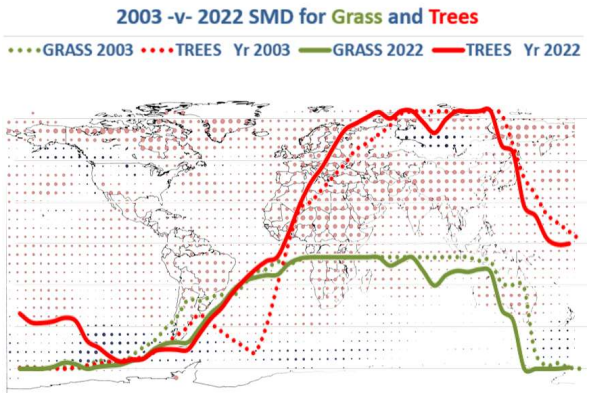
The Clay Research Group

CONTENTS

Issue 211, December 2022

Soil Moisture Deficit

Below, SMD values provided by the Met Office from the Heathrow weather station for both grass and tree cover.



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

The 2022 profiles follow the 2003 event year profiles. Claim numbers at the moment appear to be exceeding those of 2018.

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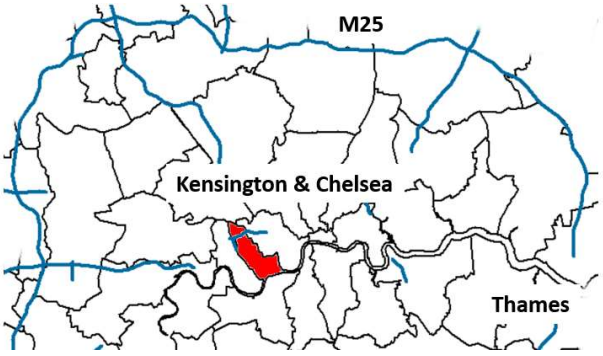
District and Sector Risk

Kensington and Chelsea is the topic of the District Risk series in this month's edition and increased resolution is provided with an example at postcode sector level.



BGS Update

The BGS continue their research into the potential risks associated with climate change in relation to geological series. "Our latest research focusses on climate change impacts, to develop a series of geohazard-climate datasets that build on BGS's experience of static geohazard datasets." Visit the following web page to see what advice the BGS provide relating to subsidence

https://www.bgs.ac.uk/news/six-ways-to-prepare-your-home-for-climate-change-related-subsidence/

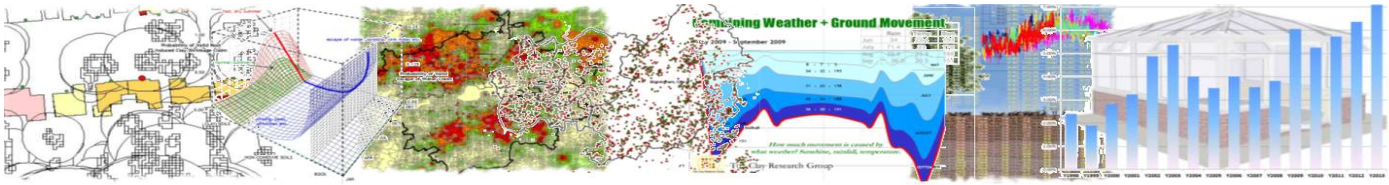
Research Update

We understand that a student studying for a DPhil at Oxford University is undertaking research into how the risk of subsidence can be modelled on clay soils taking into account the effects of climate and vegetation.

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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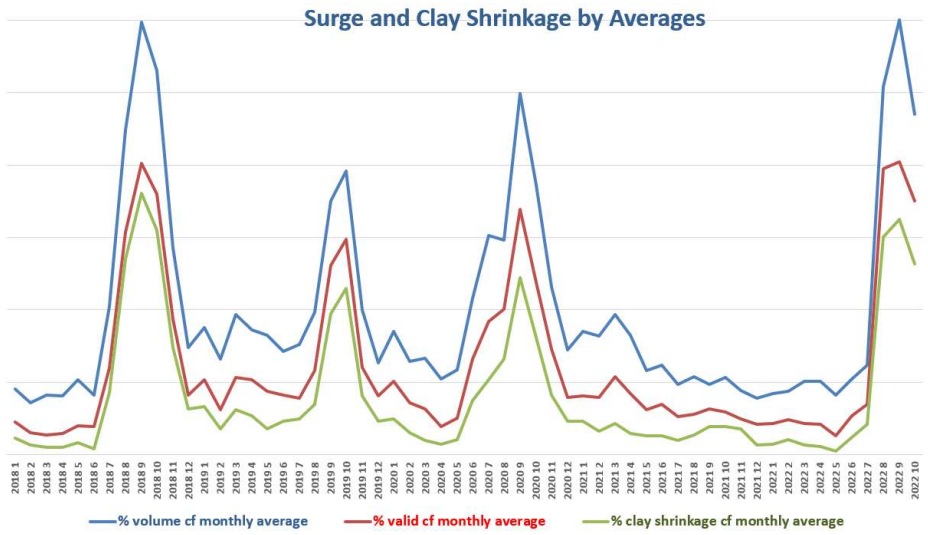
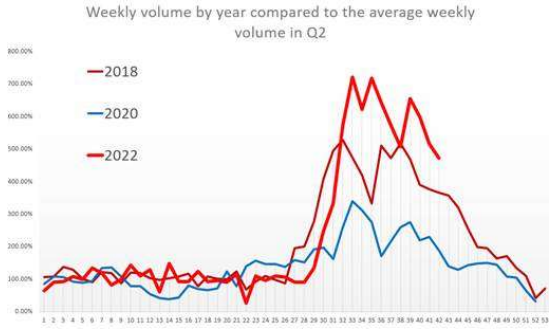
Claims Volume, Liability and Cause – 2018 - 2022

Below, graphs plotting subsidence claim data for the period January 2018 to October 2022, showing (blue) the average by month, (red) valid claims as a percentage of the total and (green) number of valid claims due to clay shrinkage. All values are calculated as a percentage of the average for the period.



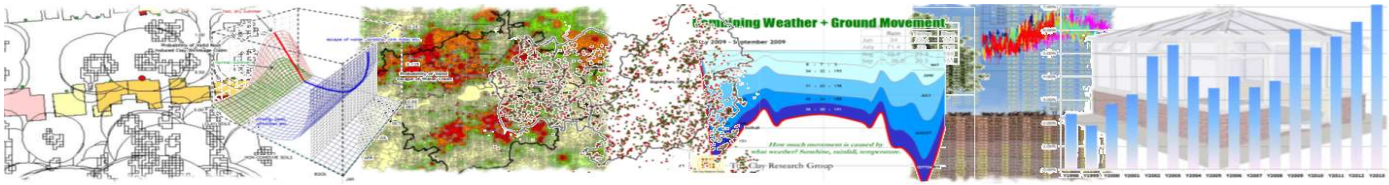
2018 and 2022 are surge years when comparing values with the preceding years. What is evident is that the percentage of valid claims increases in surge years, reaching around 70%. In normal years, the percentage can fall as low as 30%. Of the valid claims, clay shrinkage is the dominant cause by a significant amount.

Right, using a similar approach (i.e. averages) the claim volume is plotted for the years 2018, 2020 and 2022 and it can be seen that numbers in the current year have been higher than the last surge in 2018.



Claim numbers by year, comparing 2018, 2020 and 2022.

Our thanks to Richard Rollit, Technical Director, Innovation Group for allowing the reproduction of an article that appeared in the November edition of the Innovation Group Bulletin.



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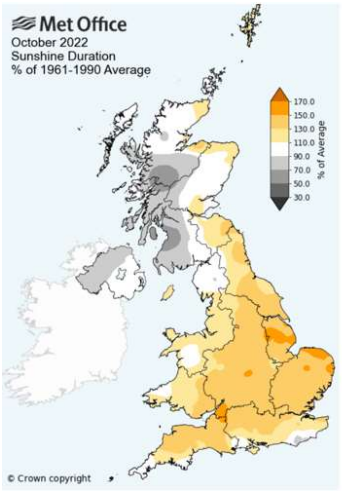
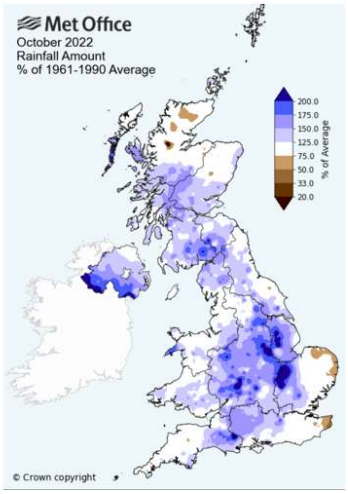
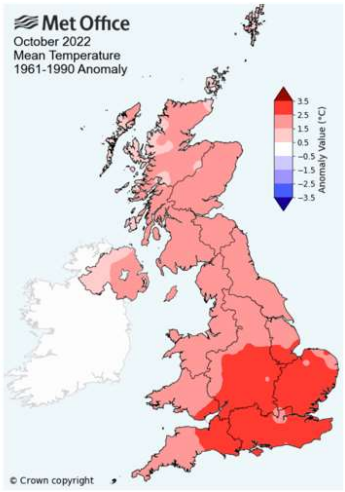
Met Office Anomaly Data, October 2022

Below, maps from the Met Office web site showing sunshine, rainfall and mean temperature anomaly data for October 2022 when compared with the 1961-1990 period.

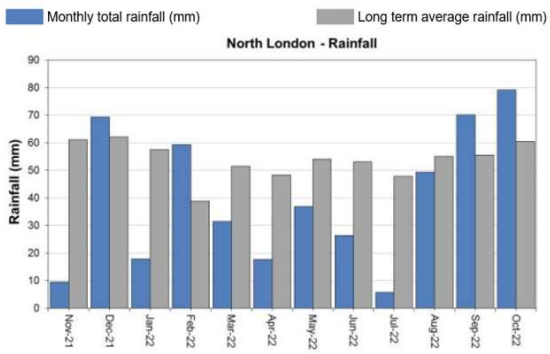


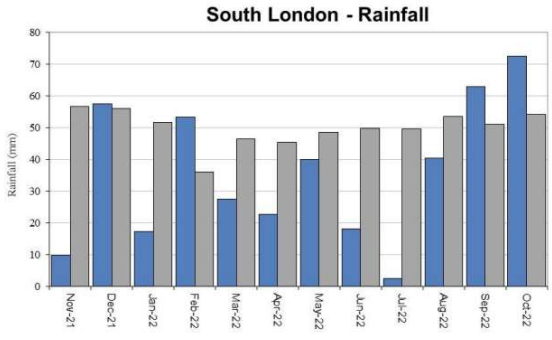




Department of the Environment Rainfall Review

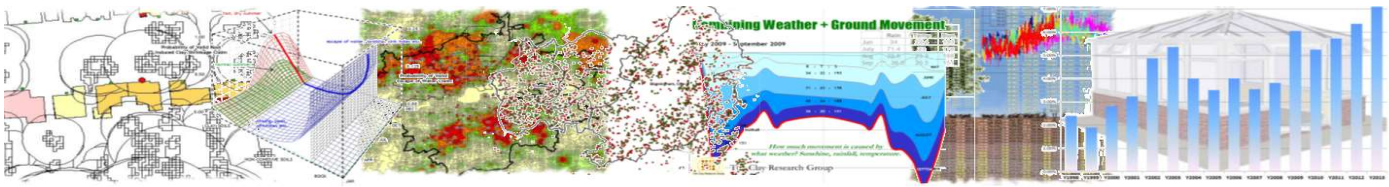
The charts below, reproduced from the DoE web site (https://www.gov.uk/government/publications/water-situation-local-area-reports) plot monthly rainfall data. Extracts below for North and South London showing the substantial reduction in rainfall from March through to July. Data provided by the Met Office.





Electrokinetic Soil Treatment

Thanks to Richard Rollit, Technical Director of Innovation Group for explaining the work being undertaken by a team under the direction of Allan Tew, Head of Engineering, outlining research they are undertaking on the use of Electrokinetic Stabilisation (EKS) to resolve the problem of subsidence caused by root induced clay shrinkage.



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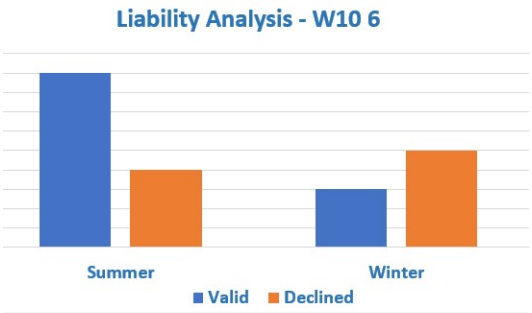
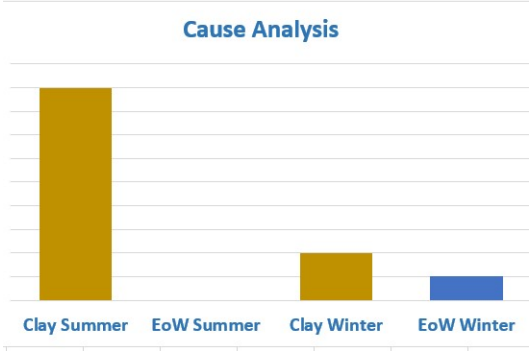
The objectives are (a) to deliver a faster resolution to such claims, (b) at a reduced cost whilst (c) retaining the tree. All contribute towards the goal of reducing the carbon footprint by avoiding the felling of often large trees with substantial canopies and reducing the environmental impact of underpinning or piling (i.e. machinery, concrete etc.)

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



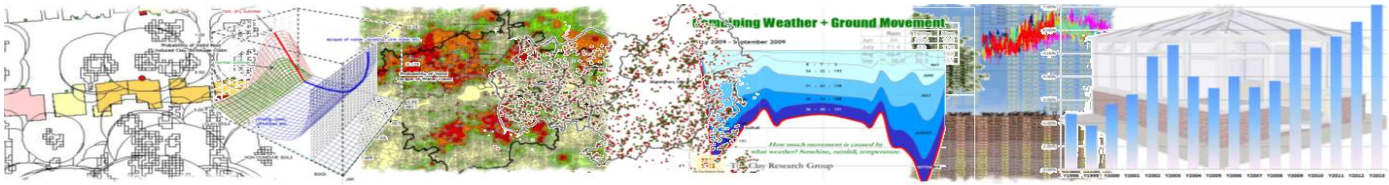


W10 6 – from the sample we hold, 70% of subsidence claims were accepted as valid in the summer and around 20% in the winter.

It is rated 9.8 times the UK average risk at postcode sector level and 0.45 on a normalised scale.

The BGS maps on page 7 show a solid geology of outcropping London clay to the north of the borough and drift deposits of River Terrace to the south. W10 6 is situated on London clay.

As might be expected from the underlying geology, clay shrinkage is the dominant cause of subsidence in the sector.



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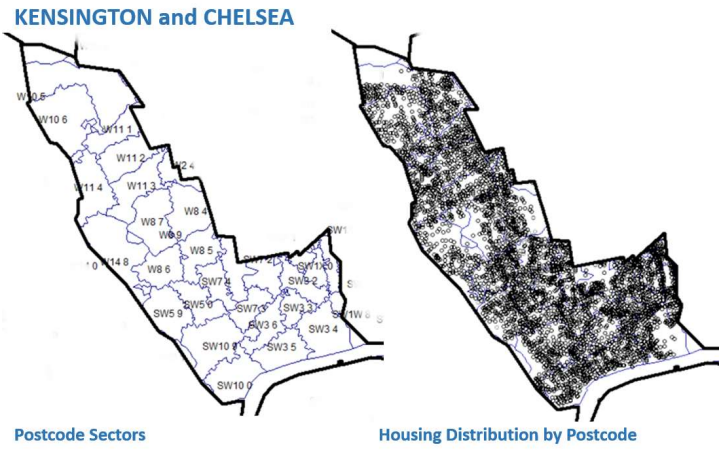
Subsidence Risk Analysis – KENSINGTON & CHELSEA

Kensington and Chelsea is situated on the north bank of the Thames and occupies an area of 12.12km^2 with a population of around 156,200.



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.

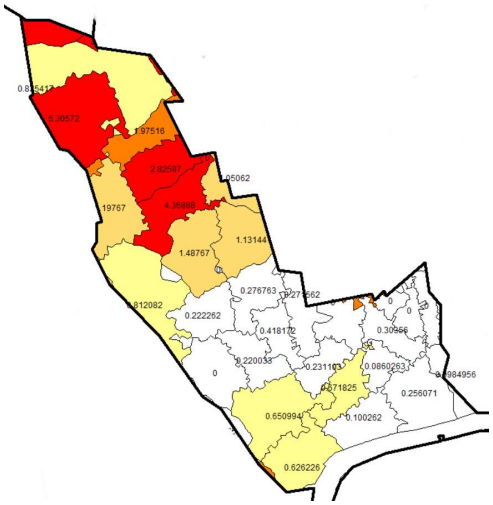
Sector and housing distribution across the district (left, using full postcode as a proxy) helps to clarify the significance of the risk maps on the following pages. Are there simply more claims in a sector because there are more houses?

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.

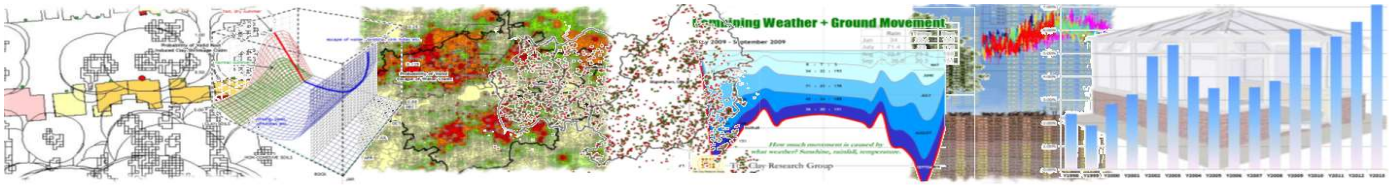
From the sample we hold, sectors are rated for the risk of domestic subsidence compared with the UK average – see map, right.

Kensington and Chelsea is rated 53rd out of 413 districts in the UK from the sample analysed and is around 0.95x the risk of the UK average, or 0.25 on a normalised scale.

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



Kensington and Chelsea district is rated around 0.95 times the UK average risk for domestic subsidence claims from the sample analysed. Above, risk by sector.



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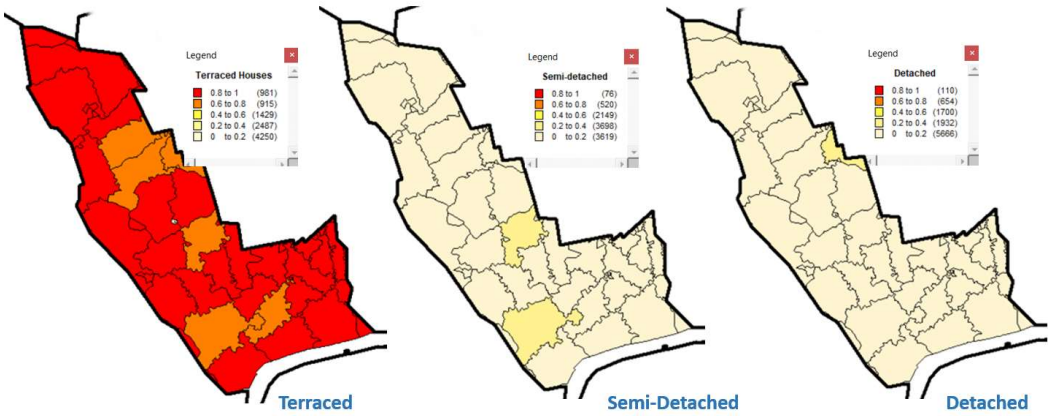
KENSINGTON & CHELSEA - Properties by Style and Ownership

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.

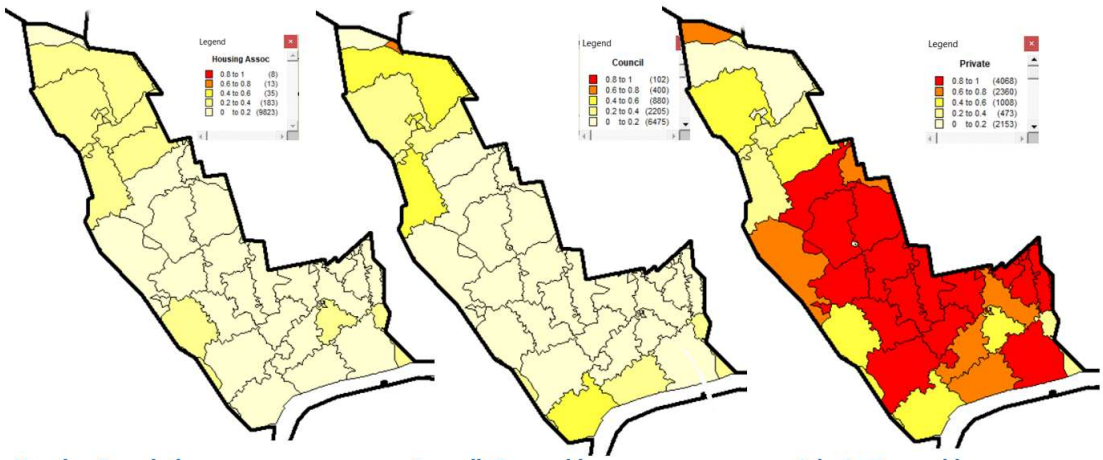
KENSINGTON and CHELSEA - Distribution by House Type



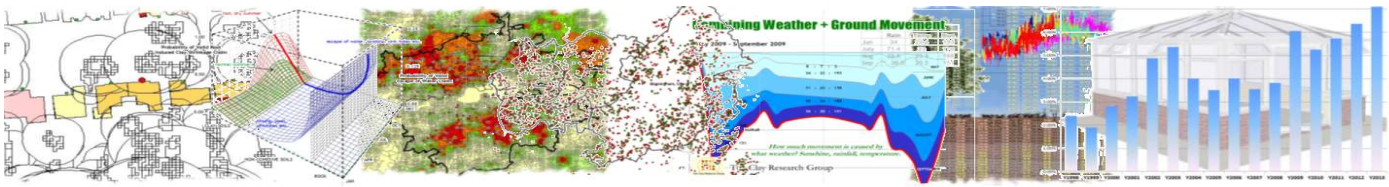
Terraced Semi-Detached Detached

Distribution by ownership is shown below. Privately owned, terraced properties are the dominant class and are spread across the borough. See page 10 for distribution of risk by ownership.

KENSINGTON and CHELSEA - Distribution by Ownership



Housing Association Council Ownership Private Ownership



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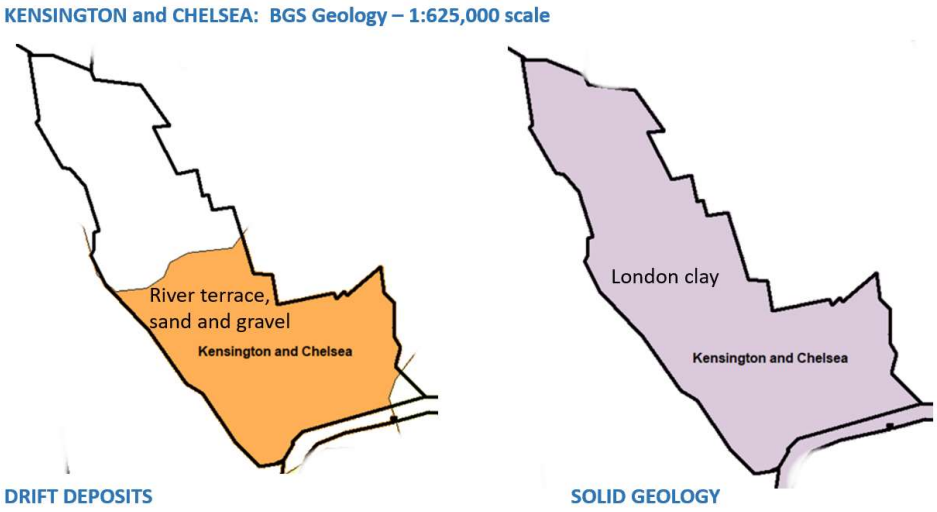
Subsidence Risk Analysis – KENSINGTON & CHELSEA

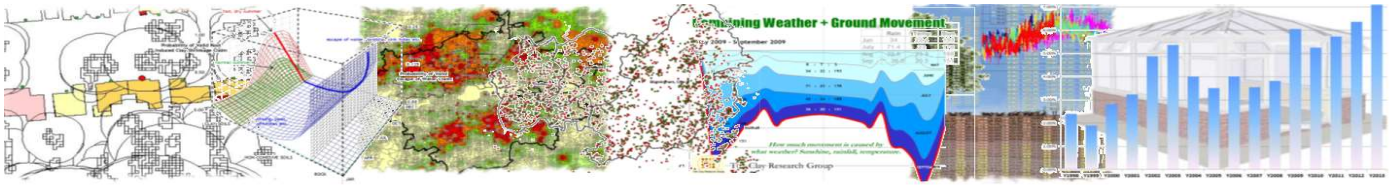
Below, extracts from the British Geological Survey low resolution 1:625,000 scale geological maps showing the solid and drift series. View at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html for more detail.

See page 10 for a seasonal analysis of the sample which reveals that, at district level, there is a greater than 70% probability of a claim being valid in the summer and of the valid claims, there is a high probability (greater than 80% in the sample) that the cause will be clay shrinkage.

In the winter the likelihood of a claim being valid is low at around 30% - and if valid, there is a 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. Clay shrinkage is the dominant cause of valid claims in the summer and escape of water is the dominant peril in the winter months.



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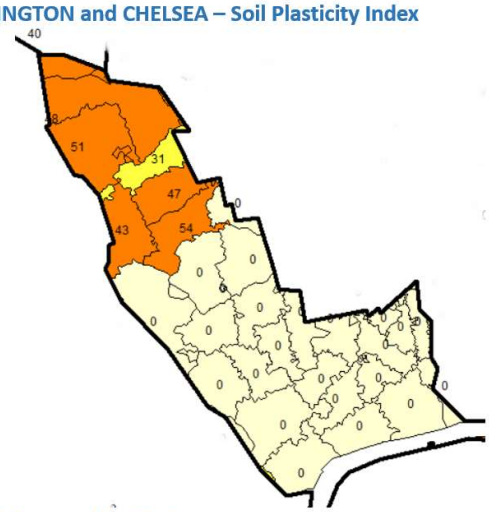
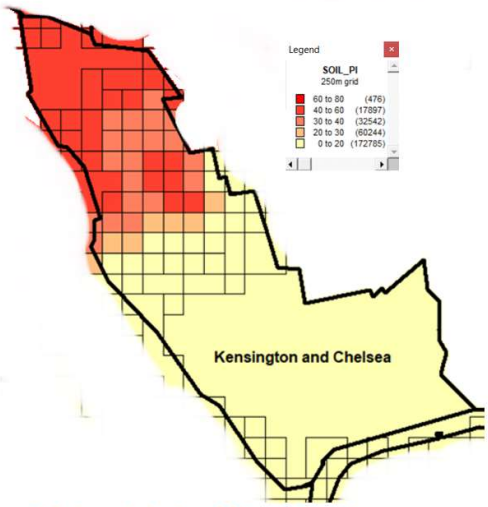
Liability by Geology and Season

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. Claim investigations reveal a small zone of clay to the south of the borough which we assume relates to a shallow depth of drift deposits in the area.

KENSINGTON and CHELSEA – Soil Plasticity Index



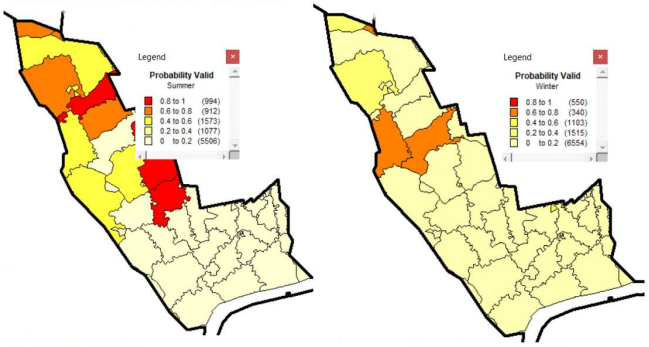
Soil PI Averaged by Sector



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.

KENSINGTON and CHELSEA – by season



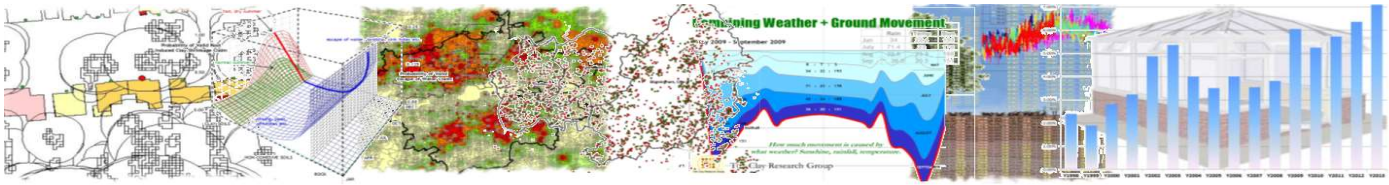
Probability Valid, Summer

Probability Valid, Winter

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

Combining the risk maps by season 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 are illustrated at the foot of the following page. Escape of water related claims are associated with the superficial deposits or simply shallow foundations on poor ground and the dominant clay shrinkage claim, the outcropping 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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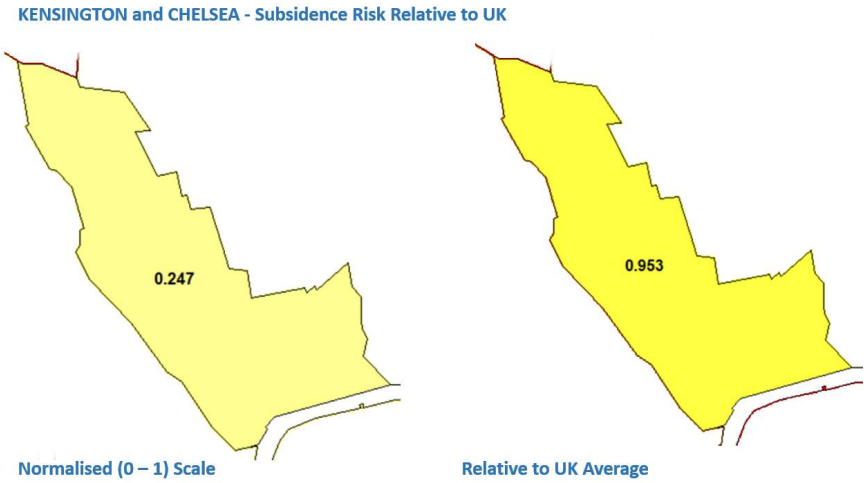
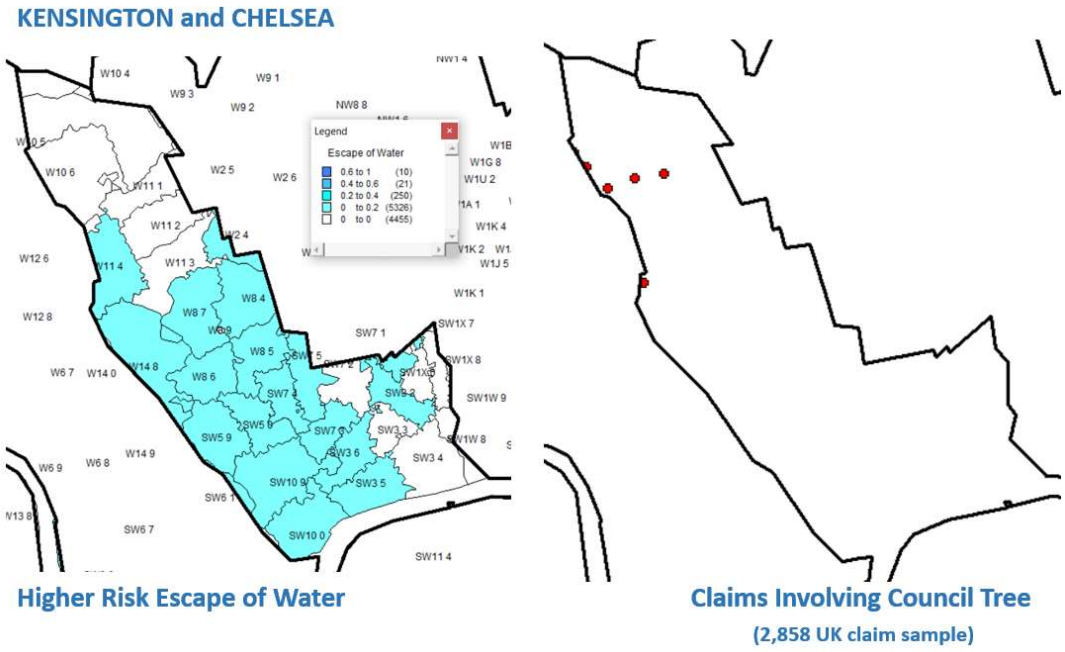
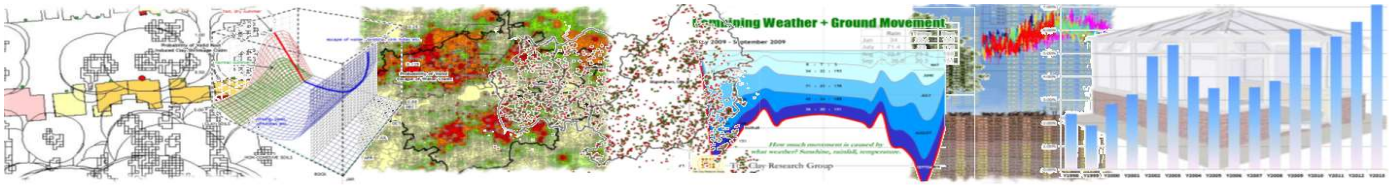
District Risk -v- UK Average. EoW and Council Tree Risk.



Below, left, mapping the frequency of escape of water claims reflects the presence of non-cohesive soils – River Terrace deposits of 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 2,858 UK claims. The location corresponds with the presence of outcropping London clay soil.





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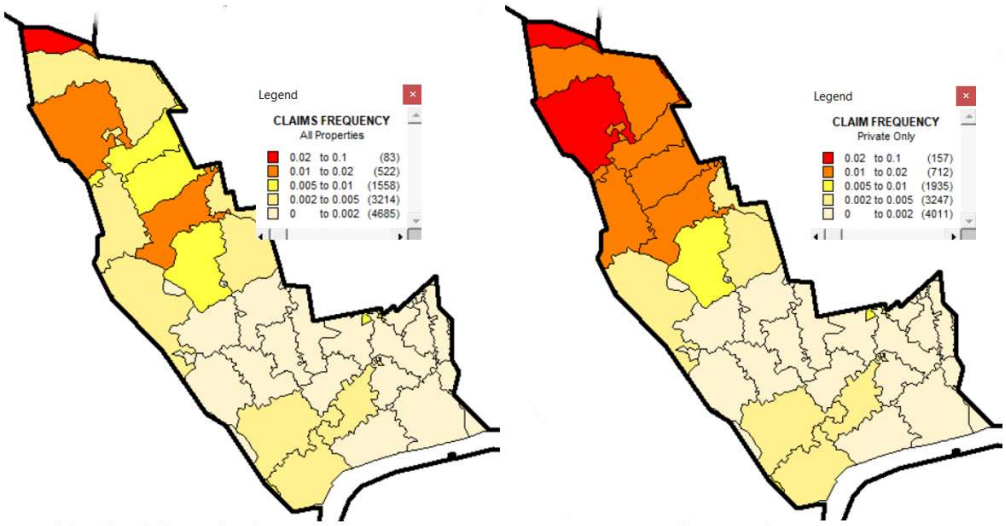
KENSINGTON & CHELSEA - Frequencies & Probabilities

Mapping claims frequency against the total housing stock by ownership (left, private council and housing association combined and right, private ownership only revealing an increased risk), the importance of understanding properties at risk by portfolio.

KENSINGTON and CHELSEA - Postcode Sector Subsidence Risk (frequency) by Ownership



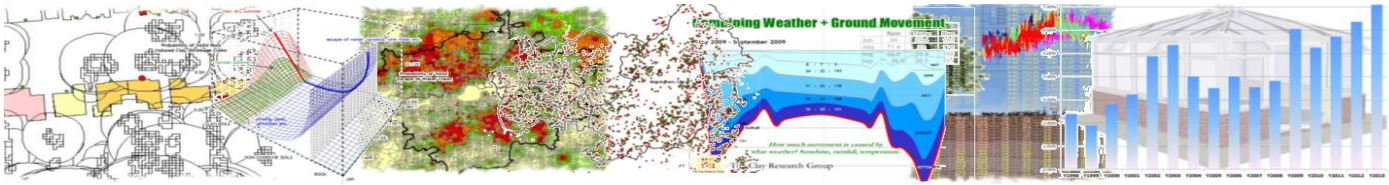
Combined Public and Private Frequency

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 fairly steady throughout the year.

Liability by Season - KENSINGTON and CHELSEA

DISTRICT	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Kensington and Chelsea	0.680	0.097	0.222	0.04	0.27	0.69



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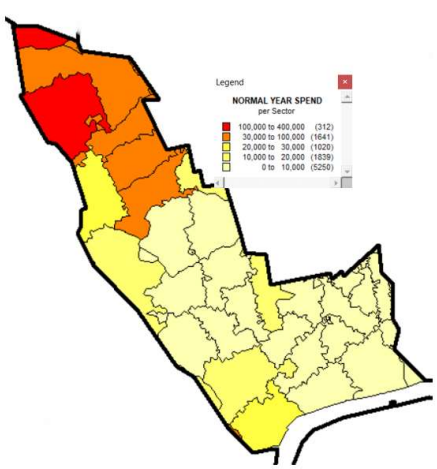
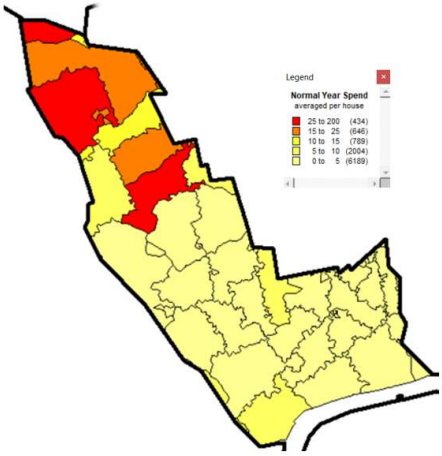
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Surge & Normal Years

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.

NORMAL YEAR SPEND – KENSINGTON and CHELSEA



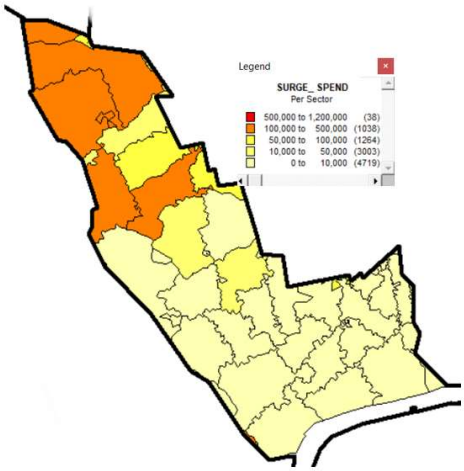
Spend by Sector



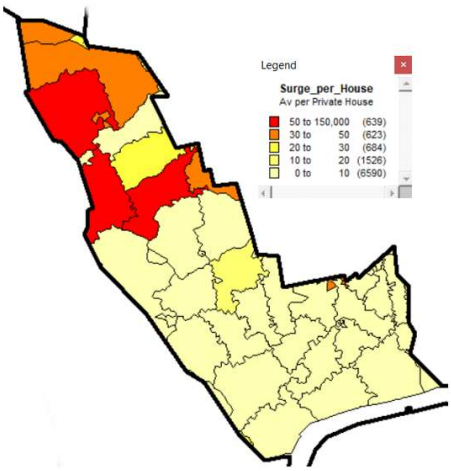
Spend Averaged over Housing Population

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.

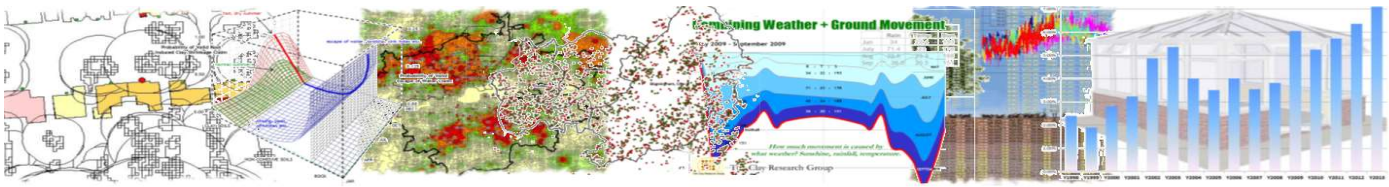
SPEND in SURGE – KENSINGTON and CHELSEA



Spend by Sector



Spend Averaged over Housing Population



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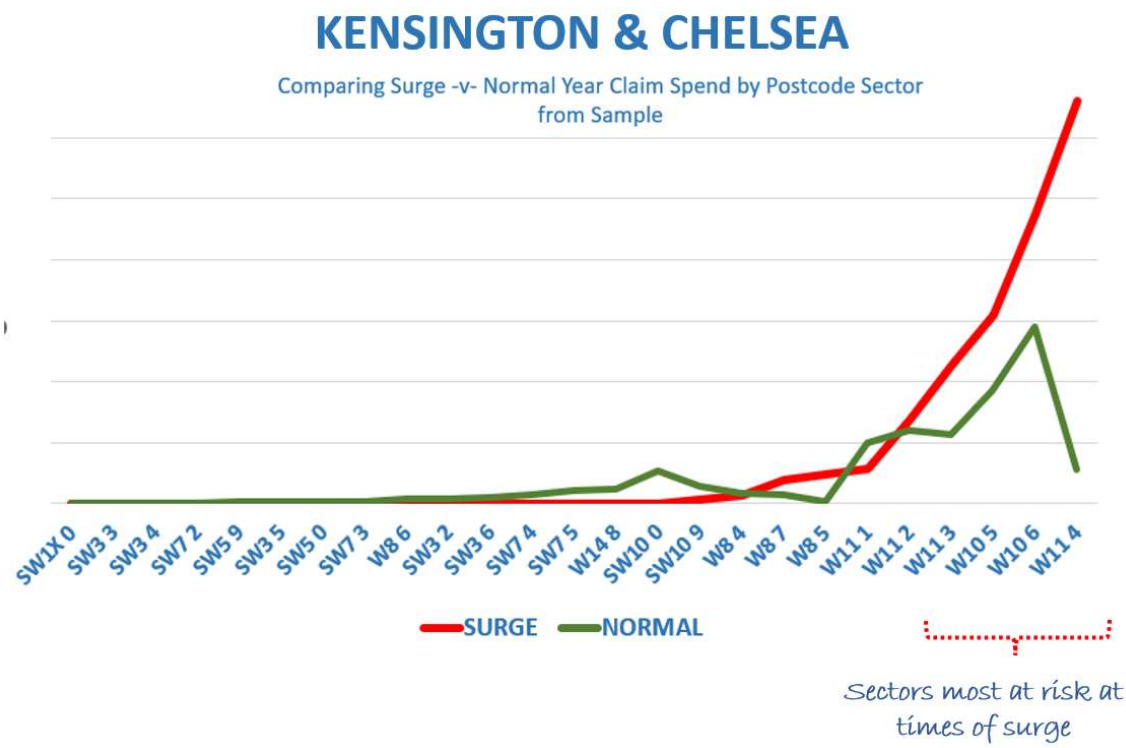

The above graph identifies the variable risk across the district at postcode sector level from the sample, distinguishing between normal and surge years. Divergence between the plots indicates those sectors most at risk at times of surge (red line).

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.