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

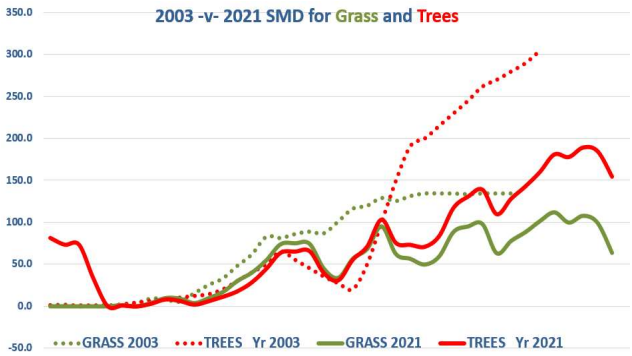
October 2021
Issue 197

The Clay Research Group

CONTENTS

Soil Moisture Deficit

Below, the SMD values provided by the Met Office for both grass and tree cover, comparing the 2003 event year (dotted lines) with 2021.



Soil Moisture Deficit data supplied by the Met Office for tile 161, medium available water capacity soils for grass cover and medium available water capacity for trees.

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2020 Climate Update

Dr McCarthy of the Met Office said: "Interestingly, the exceptionally warm start of the month at one time threatened to push September's average temperature figures above August's, but the recent unsettled weather and drop to more average conditions have driven the figures slightly below August's, but still well above the long-term average."

Tree Discovery in Africa

Thanks to Keiron Hart of Tamla Trees for bringing the following article to our attention relating to the discovery of 7 billion trees previously uncounted.

https://www.weforum.org/agenda/2021/10/7-billion-trees-discovered-africa-deforestation?utm_source=twitter&utm_medium=social_scheduler&utm_term=One+Trillion+Trees&utm_content=07/10/2021+08:00

Subsidence Forum

The Subsidence Forum have hosted a series of webinar's with introductions by the Subsidence Forum Chair, Sarah Dodd of DACBeachcroft.

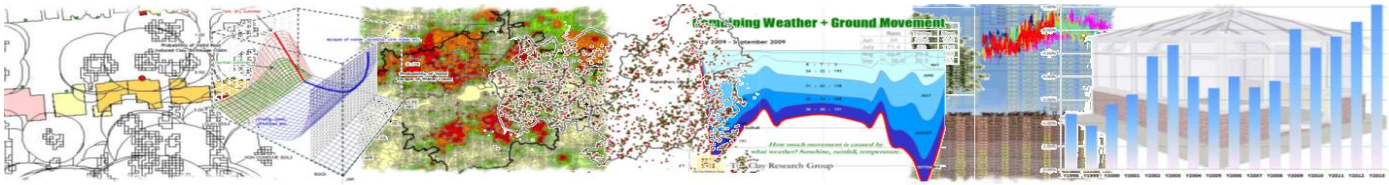
The series included talks by Sarah on tree root nuisance and presentations by Shire, Optera, Helifix, Geobear etc. Webinar's for 2021 took place on the 1st, 8th and the final one is scheduled for the 15th October. To learn more visit:

https://www.subsidenceforum.org.uk/

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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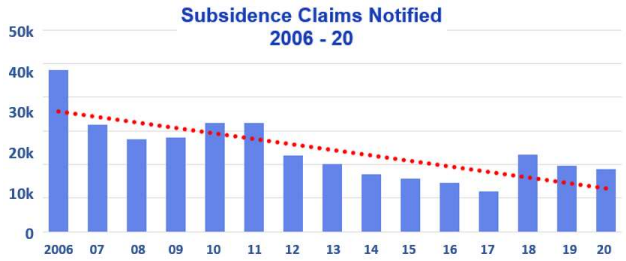
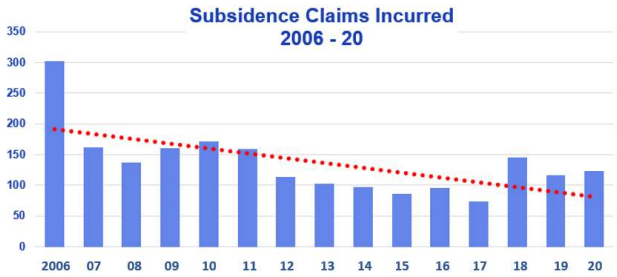
Subsidence Claims – 2006 - 2020

Right, graphs plotting ABI data relating to domestic subsidence claims for the period 2006 to 2020.

The trendline reveals reducing claim numbers and the subsidence peril accounts for around 3- 4% of insurers' spend.

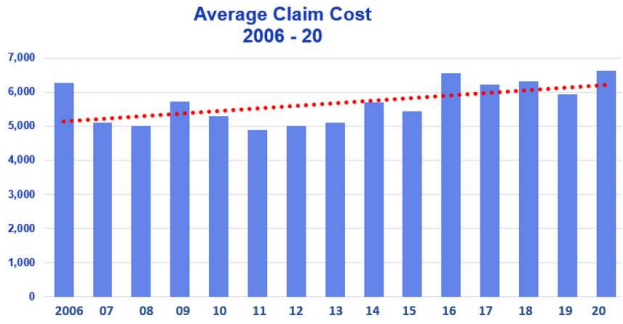




Left, total incurred costs (figures shown in millions) are falling, following the claim count data shown above. The figures reflect the initial estimate on claim notification, not the final incurred values following investigation, monitoring and repair.

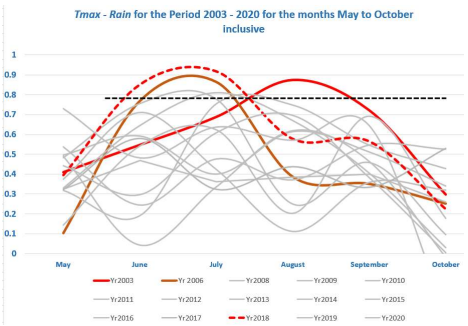
Right, average claim cost using the above data, and bearing in mind the comments above (incurred costs) relating to the fact the values are initial estimates prior to a final decision on liability.

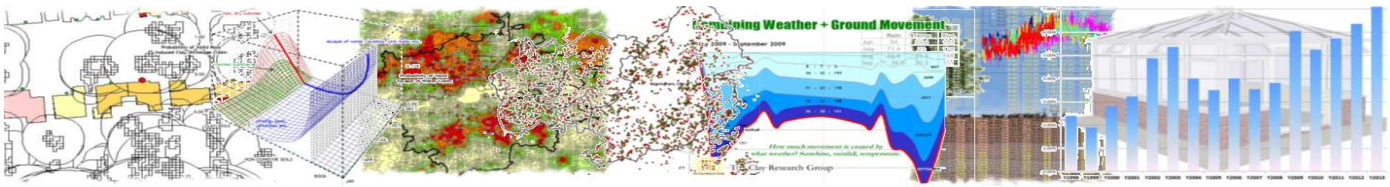
Although the trendline shows an increase, there has been little change in the average claim cost since 2006 taking account of inflation.



Weather Elements and Surge

The decline in claims since 2006 is likely to be associated with a reduction in those related to root induced clay shrinkage. The graph, right, plots the outcome for the formula *Tmax – Rainfall* that we have explored in past editions. Values for years with high claim numbers (2003, 2006 and 2018) exceed those for normal claim years following 2006, revealing the elements involved. 2018 is interesting because although is classed as an event, numbers were relatively low.





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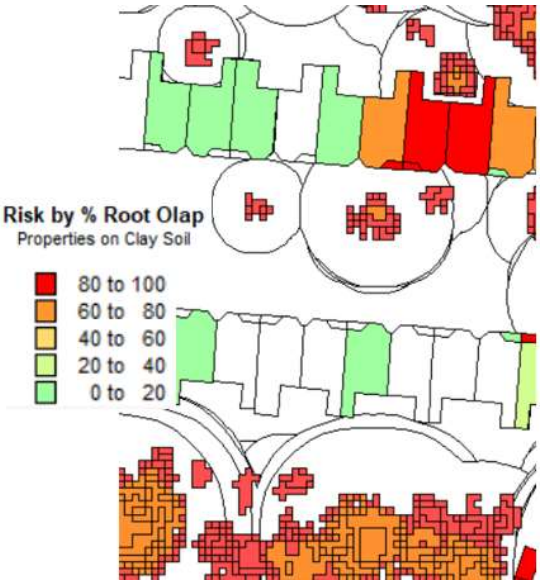
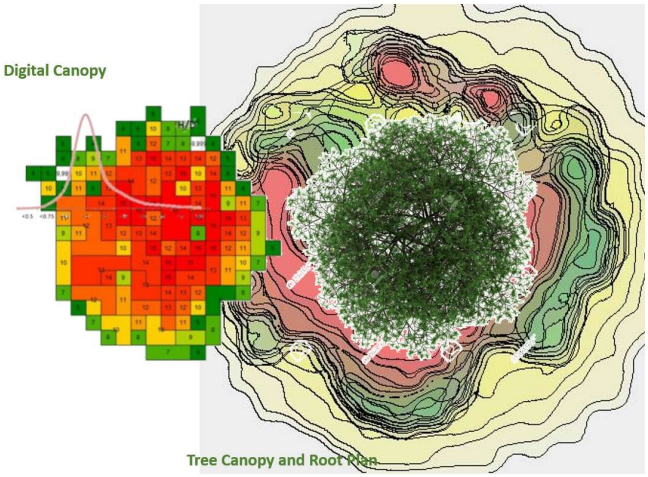
Conditional Probabilities

Right, an extract from a map showing housing vulnerability associated with root induced clay shrinkage.

The legend lists the modelled root overlap beneath the building by percent. The tree grid plots the height across the canopy.

Below, taking account of the soil shrink/swell characteristics according to the risk posed by variations in PI.

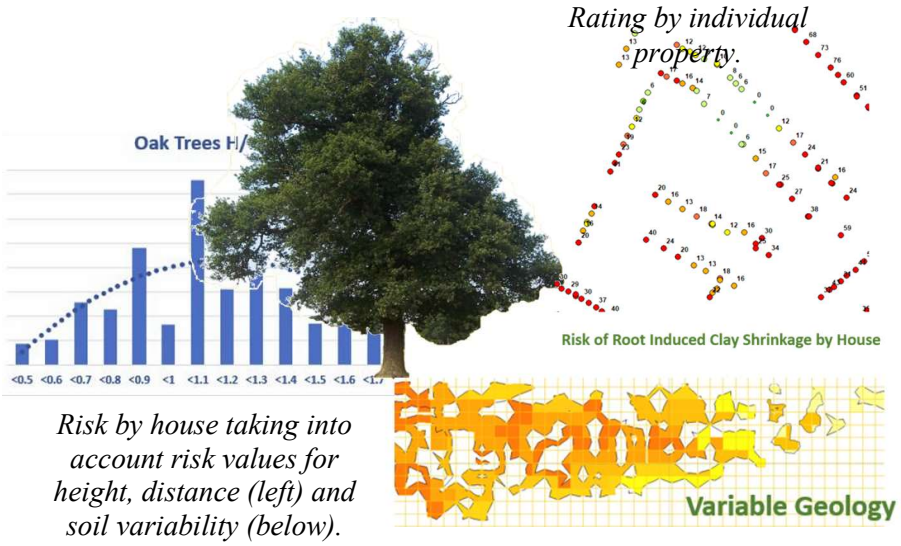




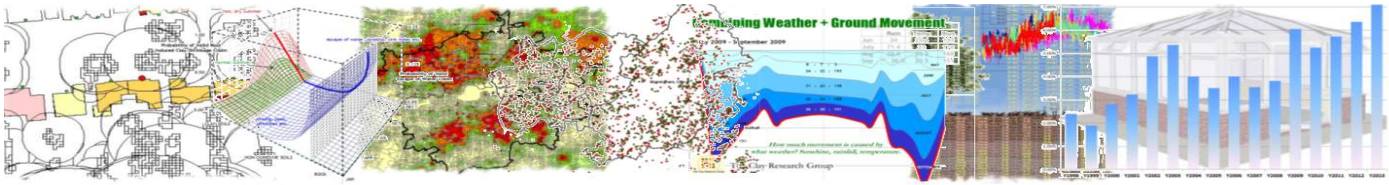
Below, taking account of the H/D ratio which, although variable, share some characteristics across species. Software is available to identify species in certain areas as well as conversations with the homeowner on claim notification.

Account is also taken of variations within the soil matrix – variable PI and lenses of non-shrinkable material for example.

The modelled output is shown to the right of the image.



Risk by house taking into account risk values for height, distance (left) and soil variability (below).



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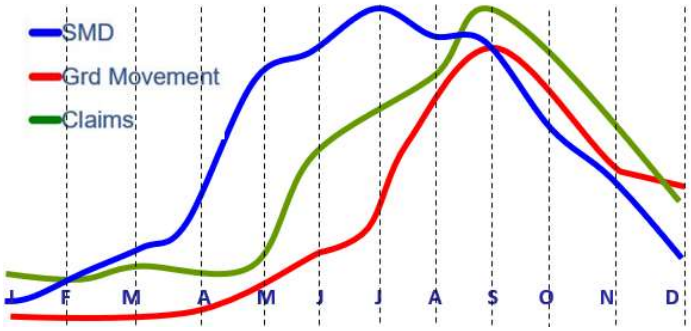
SMD, Ground Movement and Claim Notification

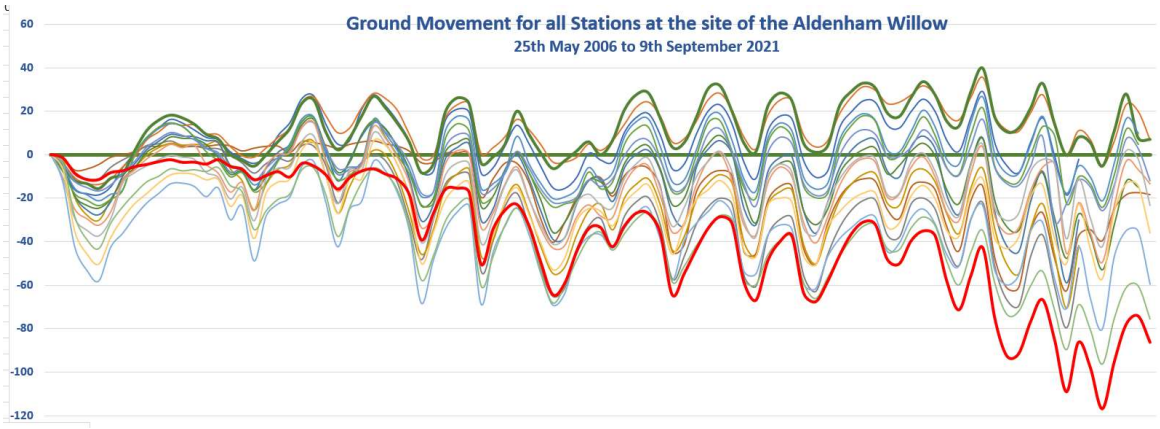
The Ai module uses Soil Moisture Deficit (SMD) values to assist in predicting claim numbers, although it is recognised that this has been unreliable since 2006. Prior to this, the relationship between the SMD, ground movement and claims followed the idealised pattern shown right.



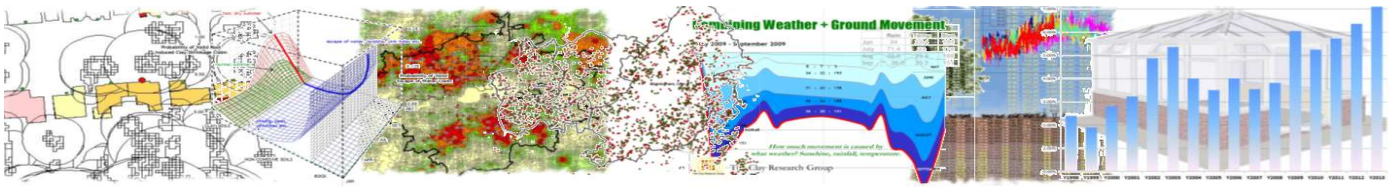
Of greater value to the prediction of surge was the prediction of a normal year, characterised by periods of rehydration following heavy rainfall. Prior to 2006 the model delivered had an 80% probability of delivering a correct prediction.

Ground Movement Update – Aldenham Willow

GeoServ Limited, funded by Crawford & Co, have provided an update of the precise level monitoring readings at the site of the Aldenham willow. There have been gaps between readings due to COVID but the patterns reveal the overall trend in seasonal movement with maximum subsidence taking place at station 25, furthest from the willow, and maximum recovery at station 1, nearest to the tree.



Next month, updated values across the two arrays showing maximum recorded movement and change over time. More next month.



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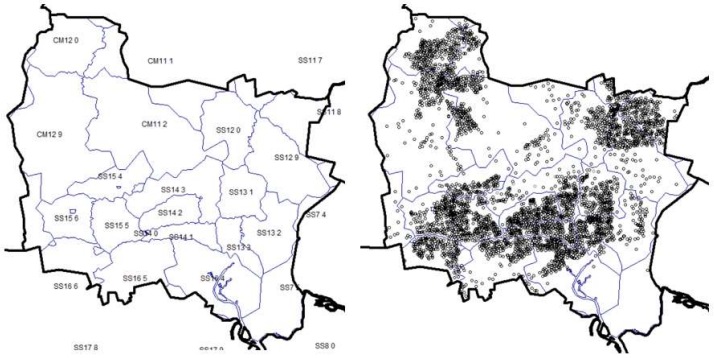
Subsidence Risk Analysis – BASILDON

Basildon occupies an area of 110km^2 with a population of around 185,000 and was originally covered issue No. 163 of the CRG newsletter, December 2018. It is re-visited here to bring it in line with the current series and allow comparisons between districts in terms of the risk of subsidence.



Postcode Sectors | Housing Distribution by Full 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.

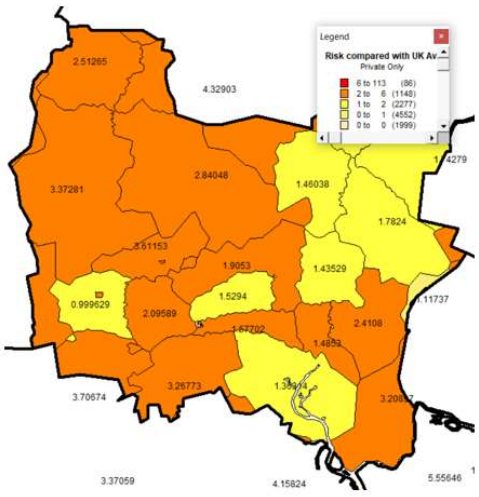
From the sample we have, sectors are rated for the risk of domestic subsidence compared with the UK average – see map, right.

Basildon is rated 26th out of 413 districts in the UK from the sample analysed and is around 2x the risk of the UK average.

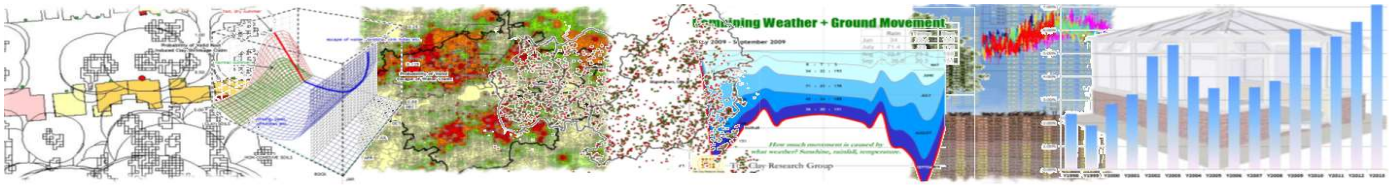
The distribution varies considerably across the borough as can be seen from the sector map.

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.



Risk compared with UK Average.
Basildon is rated around 2 times the UK average risk for domestic subsidence claims from the sample analysed based on the high frequency to the north of the borough. Above, values at postcode sector level compared with UK average.



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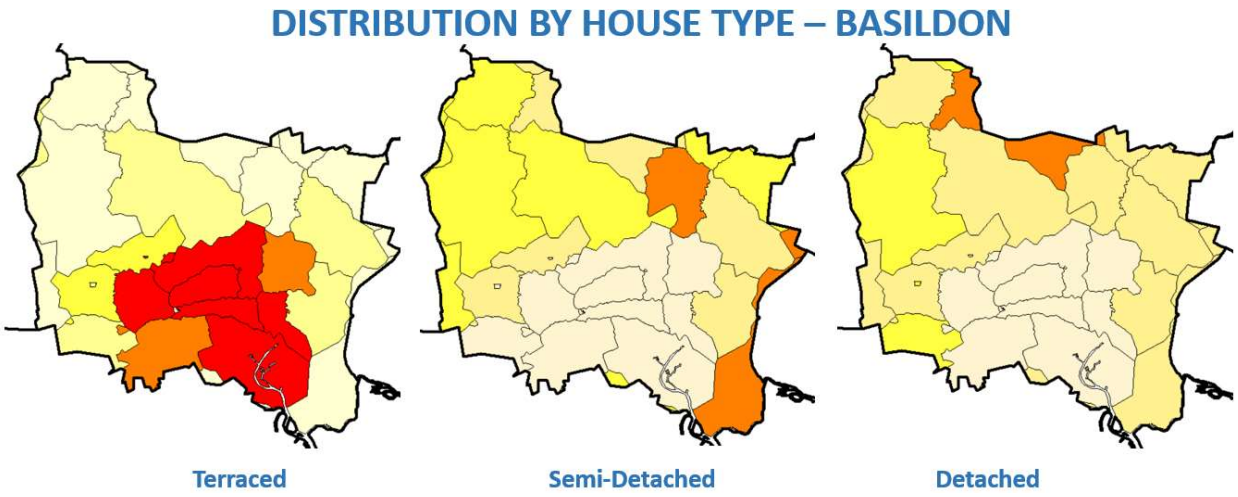
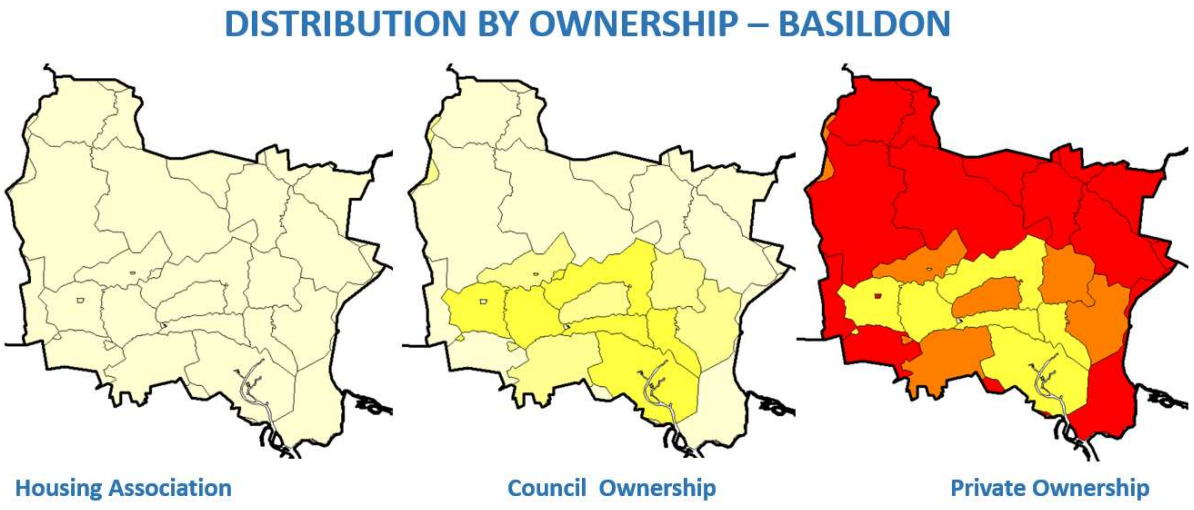
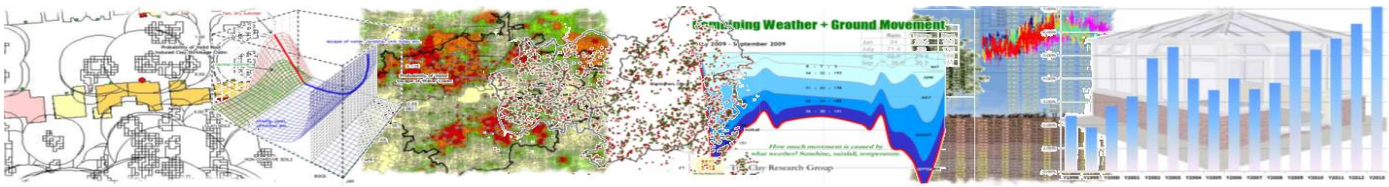
BASILDON - Properties by Style and Ownership

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. Privately owned properties are spread across the borough.





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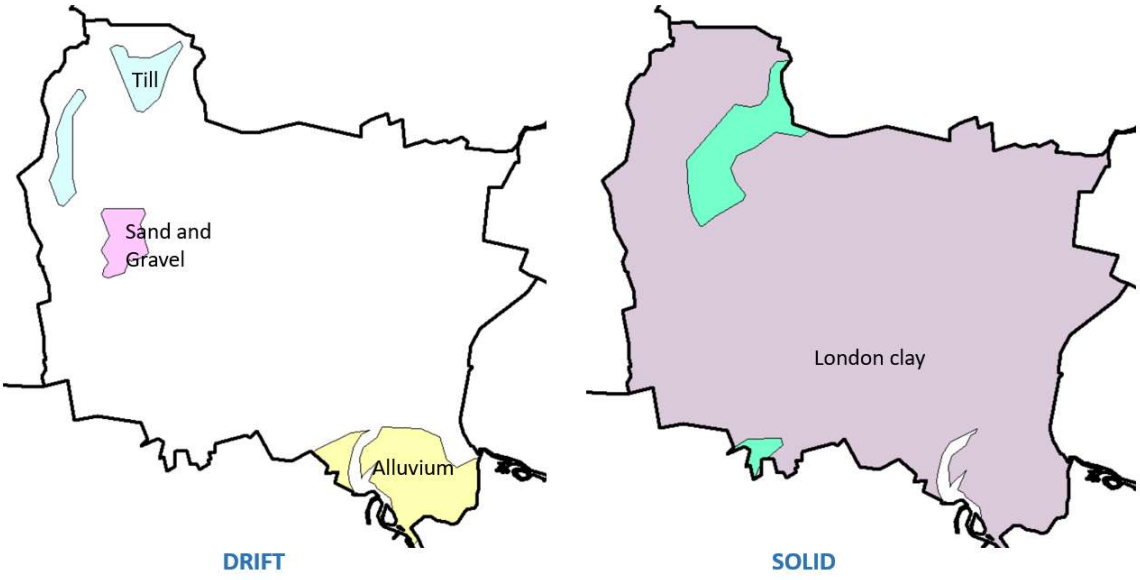
Subsidence Risk Analysis – BASILDON

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.

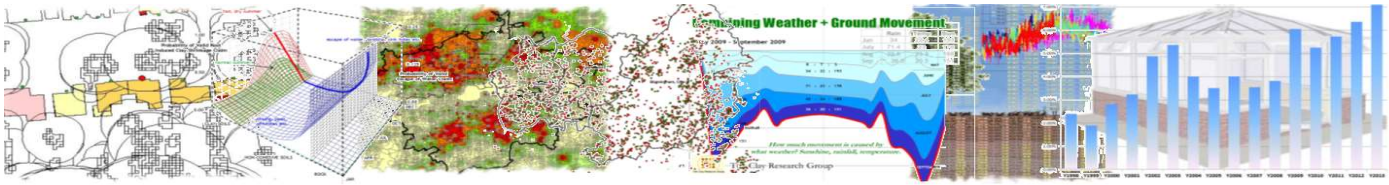
See page 10 for a seasonal analysis of the sample we hold which reveals that in the summer there is around a 70% probability of a claim being valid, and of the valid claims, there is a high probability (greater than 90% in the sample) that the cause will be clay shrinkage.

In the winter the situation reverses. The likelihood of a claim being declined is around 80% and if valid, there is greater than 90% probability the cause will be due to an escape of water. The data at the foot of Page 8 shows the seasonal distribution.

1:625,000 scale British Geological Survey Maps



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.



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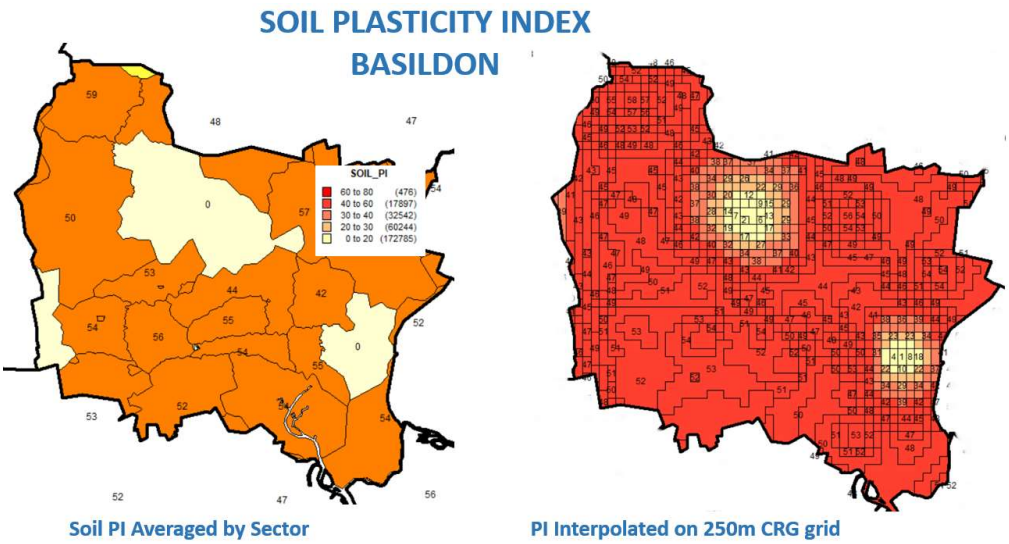
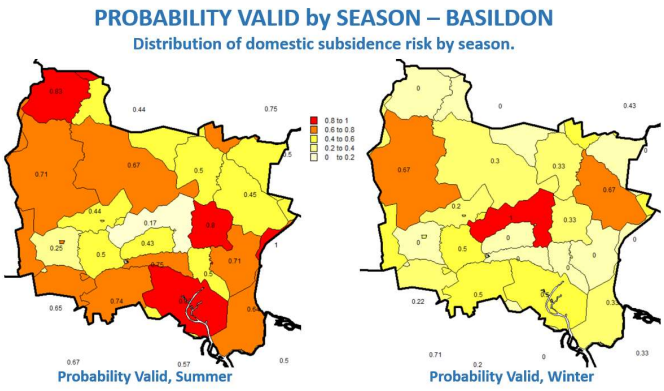
Liability by Geology and Season

Below, the average PI by postcode sector (left) derived from site investigations and interpolated to develop the CRG 250m grid (right). The presence of a shrinkable clay in the CRG model differs from the BGS maps on the previous page suggesting a variable thickness of drift and higher concentration of clay in some areas. The higher the PI values, the darker red the CRG grid.

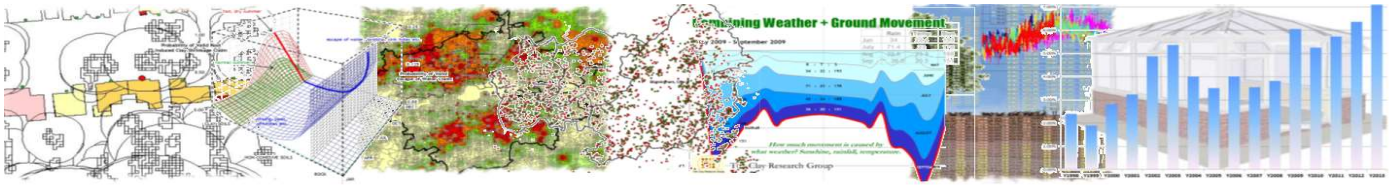


Zero values for PI in some sectors may reflect the absence of site investigation data - not necessarily the absence of shrinkable clay. The widespread influence of the shrinkable clay plays an important role in determining whether a claim is likely to be valid or declined by season. A single claim in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



Mapping the risk by season (table at foot of page 11) is perhaps the most useful way of assessing the most likely cause, liability and geology using the values listed.

The maps left show the seasonal difference from the sample used. An enhanced version using a different approach is shown on the following page.



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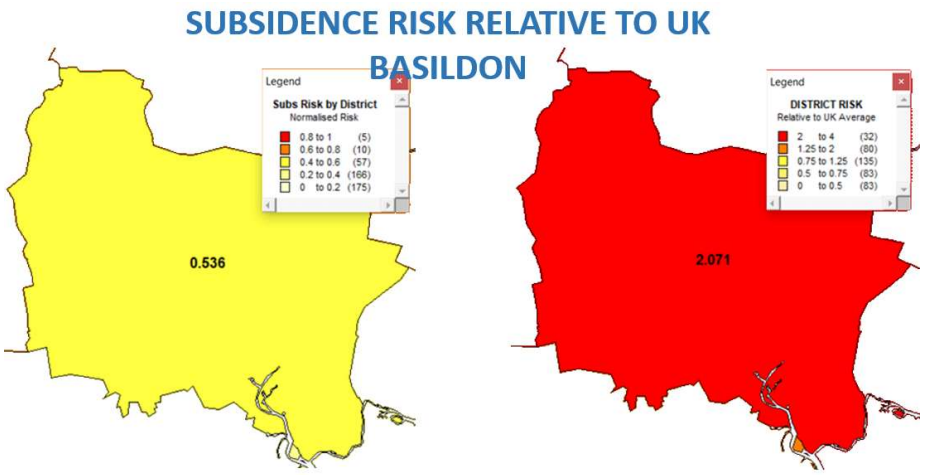
District Risk -v- UK Average. EoW and Council Tree Risk.

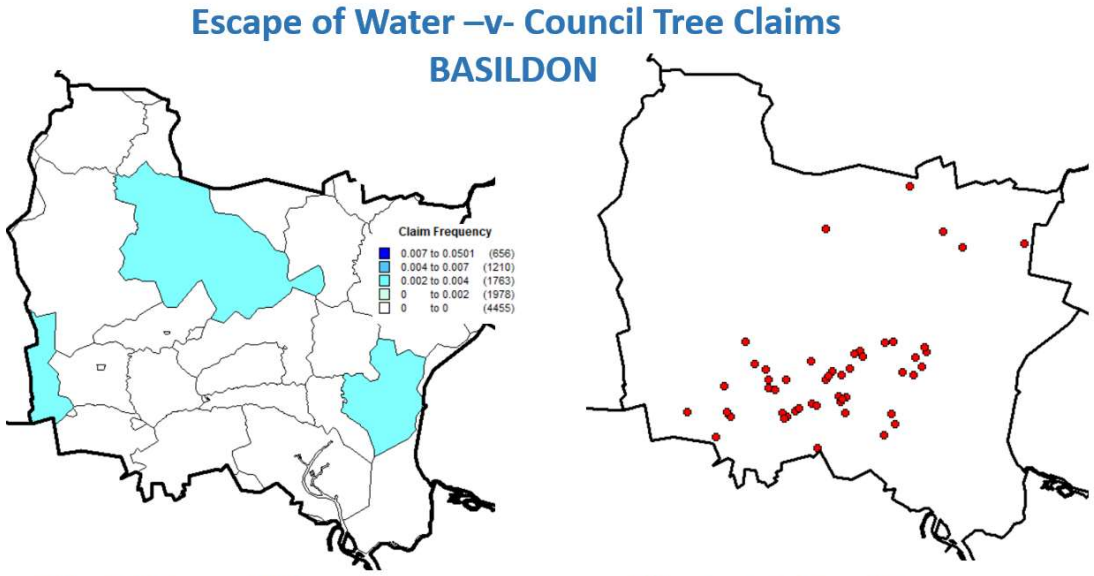


Normalised (0 – 1) Scale

Compared with UK Average

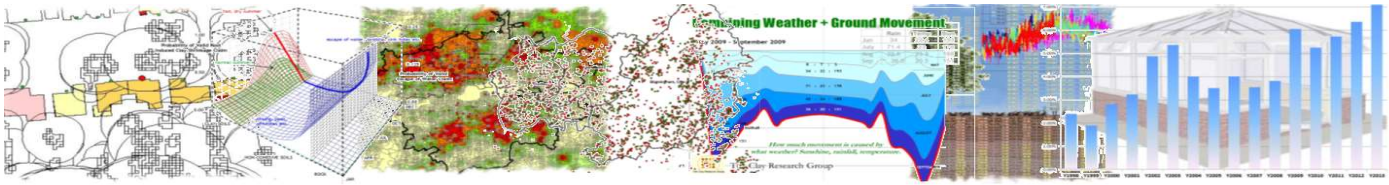
Below, left, mapping the frequency of escape of water claims from the sample reflects the presence of drift deposits (chalk, alluvium, sands and gravels etc) and possibly shallow foundations to older housing stock. The absence of shading often indicates a low frequency rather than the absence of claims.

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.



Higher Risk Escape of Water
(17,852 claim sample)

Claims Involving Council Trees
(2,858 claim sample)



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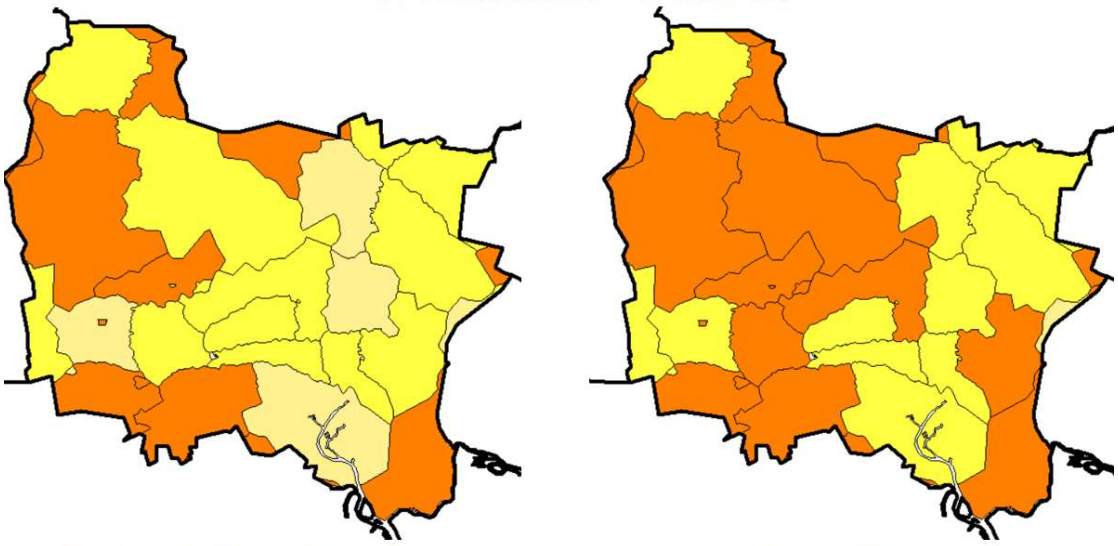
BASILDON - Frequencies & Probabilities

Mapping claims frequency against the total housing stock by ownership, (left council and housing association combined and right, private ownership only), reveals the importance of understanding properties at risk by portfolio. There are several sectors in the 'private only' map with an increased risk.

POSTCODE SECTOR SUBSIDENCE RISK (FREQUENCY)
BY OWNERSHIP – BASILDON



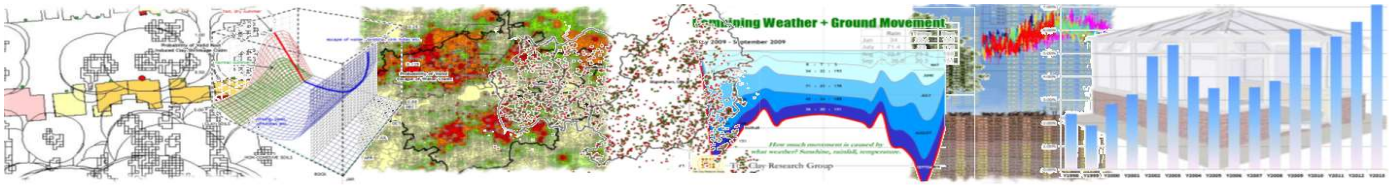
Combined Public and Private Frequency

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.

Liability by Season - BASILDON

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Basildon	0.740	0.045	0.215	0.01	0.16	0.83



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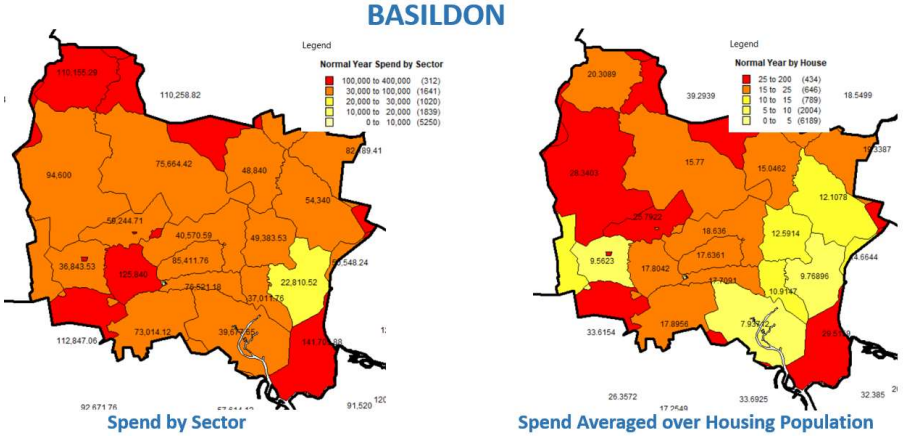
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Surge & Normal Years

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.

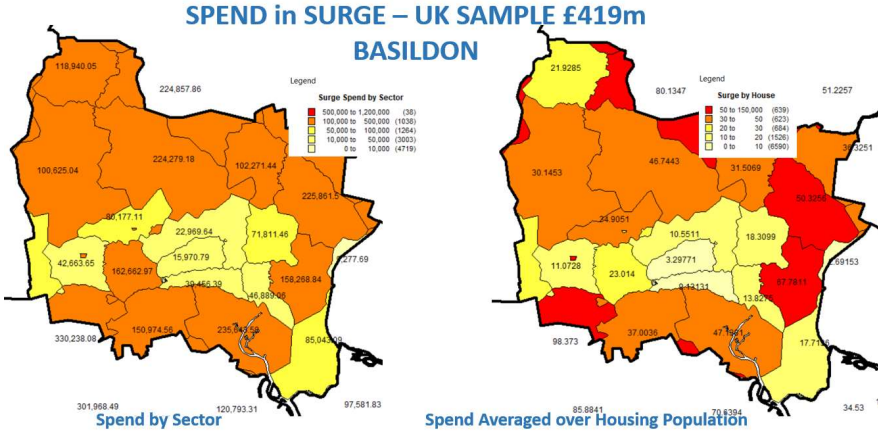
NORMAL YEAR SPEND – UK SAMPLE £200m
BASILDON



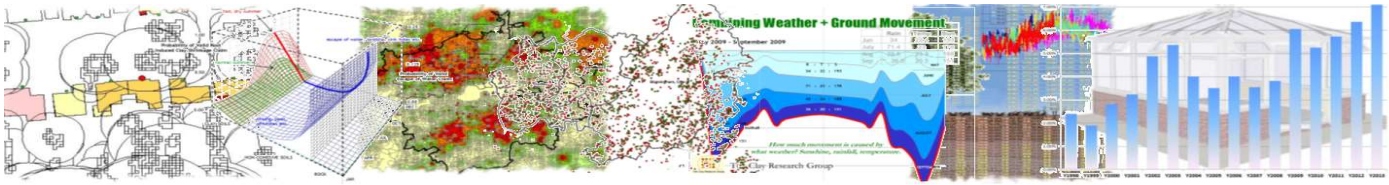
Spend by Sector | Spend Averaged over Housing Population

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 – UK SAMPLE £419m
BASILDON



Spend by Sector | Spend Averaged over Housing Population



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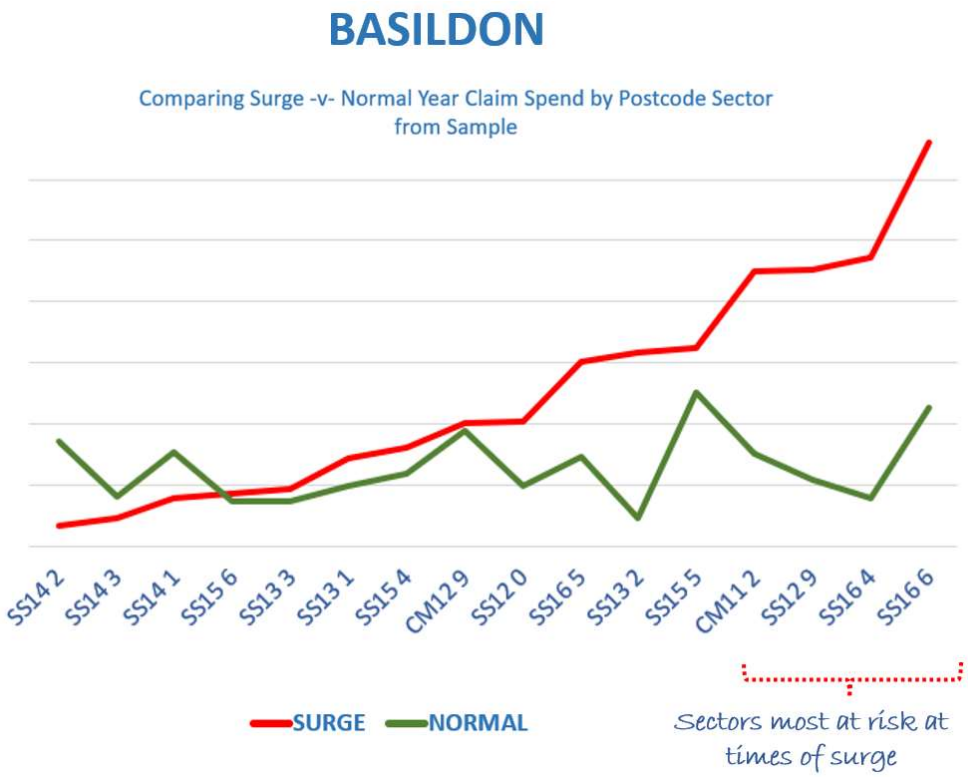

The above graph identifies the variable risk across the district at postcode sector level from the sample, distinguishing between normal and surge years. Divergence between the plots indicates those sectors most at risk at times of surge (red line).

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.