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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 2025
Issue 237

The Clay Research Group

CONTENTS

Issue 237, February 2025

Page 2

ChatGPT – Diagnosing Subsidence

Page 3

UK Met Office Anomaly Maps

January 2025

Page 4

Postcode Sector Analysis. SS5 4 and SS4 3

Pages 5 - 12

Subsidence Risk Analysis by District

Rochford

District and Sector Risk

Rochford is situated in Essex with a population of around 18,500 and is the subject of the ‘Risk by District’ series in this month’s edition. Its geology is predominantly sand, gravel and alluvium deposits overlying London clay – see Page 7.



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

Global Warming

Copernicus Climate Change report that globally, January 2025 was the warmest recorded. Apparently, it was 1.75°C above the 1850 – 1900 average for the month, which is classed as the pre-industrial reference period. January was also recorded as the wettest in Western Europe, including the UK.

The Met Office report “Temperatures in January were below average, with the UK recording a provisional mean temperature of 3.0°C, -0.9°C below the long-term average.”

TDAG Seminars

TDAG are holding an on-line seminar entitled “Trees for Human Resilience and Wellbeing” on Tuesday, 25th February, 2025, commencing at 3pm with an anticipated duration of around 2hrs via Zoom.

Register for the free on-line seminar:

<https://bham-ac-uk.zoom.us/meeting/register/vgwkZAz2SqCcDHA5iY9yOQ#/registration>

To view future the list of planned events, visit their web site at:

<https://www.tdag.org.uk/events.html>

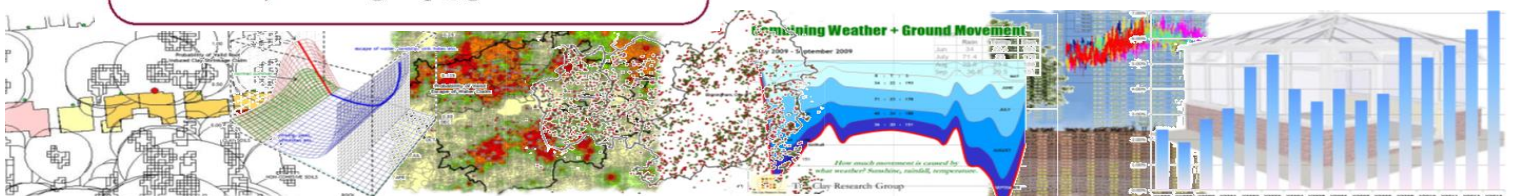
Contributions Welcome

We welcome articles and comments from readers. If you have a contribution, please Email us at: clayresearchgroup@gmail.com

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ChatGPT – Determining Subsidence



Question to ChatGPT

What is the best method to determine if a house is subsiding, precise level monitoring or site investigations and soil testing?

ChatGPT Response

Both **precise level monitoring** and **site investigations with soil testing** are valuable methods for determining if a house is subsiding, and they serve different but complementary purposes. The best approach often depends on the severity of the suspected subsidence and the desired level of accuracy. Here's how they compare:

1. Precise Level Monitoring

Purpose:

- Tracks vertical movements of the building over time.
- Provides accurate data to detect progressive subsidence.

Advantages:

- High precision in detecting movement (millimeter-level accuracy).
- Can track subsidence trends over time, distinguishing between seasonal changes and progressive settlement.
- Non-invasive and relatively cost-effective compared to soil investigations.
- Helps in planning corrective measures if subsidence is confirmed.

Disadvantages:

- Takes time to gather sufficient data for analysis (weeks or months).
- Doesn't identify the root cause of subsidence, such as soil type or water table changes.

Best for:

- Monitoring suspected ongoing movement.
- Evaluating the effectiveness of underpinning or remediation efforts.

2. Site Investigations and Soil Testing

Purpose:

- Identifies the underlying causes of subsidence, such as soil shrinkage, poor compaction, or water-related issues.

Advantages:

- Provides detailed insight into soil composition, bearing capacity, moisture levels, and potential risks (e.g., clay shrinkage or voids).
- Helps engineers design effective solutions to prevent further subsidence.
- Can uncover hidden risks before they manifest visibly.



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Disadvantages:

- More invasive and expensive compared to level monitoring.
- Results are site-specific and may require multiple tests for comprehensive coverage.
- Can be time-consuming depending on testing methods used (e.g., boreholes, laboratory analysis).

Best for:

- Determining the cause of subsidence.
- Assessing foundation stability and suitability for remedial works.
- Early-stage construction assessments to prevent future problems.

Conclusion: The Best Approach

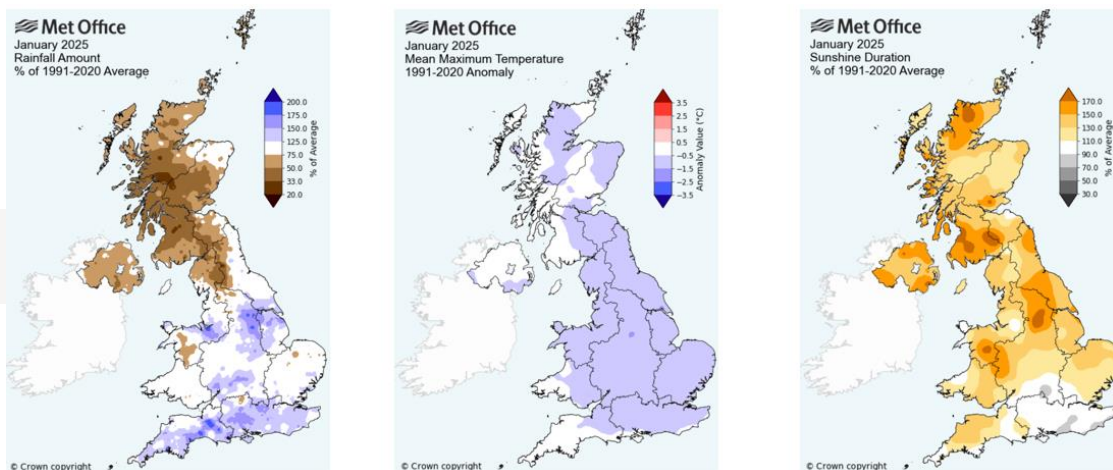
If subsidence is suspected, it's often best to start with precise level monitoring to confirm movement over time. If significant movement is detected, follow up with site investigations and soil testing to understand the root cause and design appropriate mitigation measures.

For critical situations (e.g., visible cracks, foundation distortion), both methods should be used in combination to provide a comprehensive assessment.

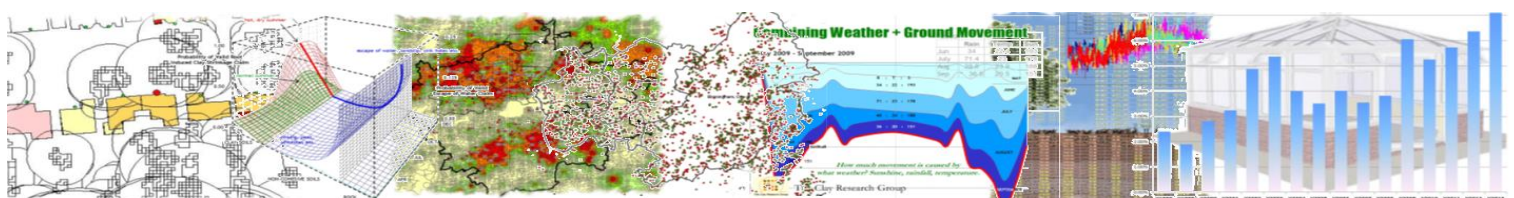
Met Office Anomaly Maps for January 2025

Anomaly maps from the Met Office web site for the month of January 2025 comparing data with average for the period 1991 – 2020 reproduced below.

The month can be summed up as being slightly colder with increased hours of sunshine across the UK. Drier to the north of the UK and slightly wetter to areas to the south.



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



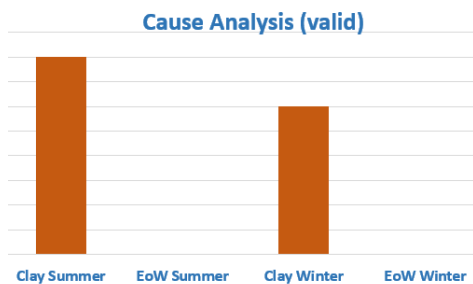
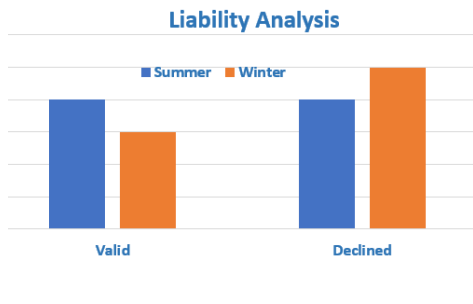
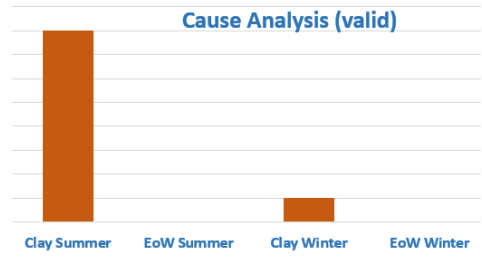
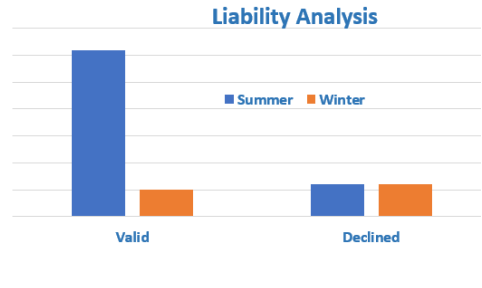
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Rochford - Sector Level Sample Using Past Claims Data to Infer Geology and Derive Probability of Cause and Liability

SS5 4 – Shallow superficial deposits of Till and Alluvium on the western border overlying Lower Lias to the south and Mudstone to the north.

Semi-detached and detached housing in private ownership with higher claim numbers in the summer months and relatively few declinatures throughout the year. Relatively high housing density compared with surrounding sectors.

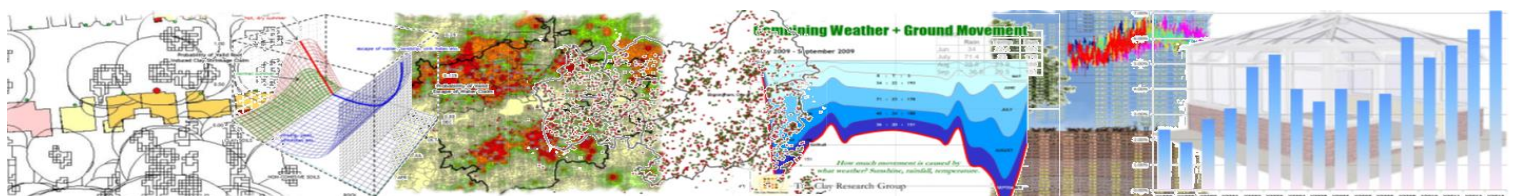
There are a relatively high number of claims due to clay shrinkage in the summer months most likely associated with clay content in the solid geology. Site investigations associated with the investigation of claims reveals a PI of around 45%.



SS4 3 – Outcropping London clay - see page 7 for extract from BGS 625,000 scale maps and page 8 for the results of investigations related to subsidence claims. Shrinkable clay soils with a maximum PI of 57% noted from our records.

Valid claim numbers are similar in the summer and winter, with slightly higher number of declinatures in the winter. Causation predominantly associated with clay shrinkage in the summer and the winter.

The sector has low density housing, predominantly in private ownership.

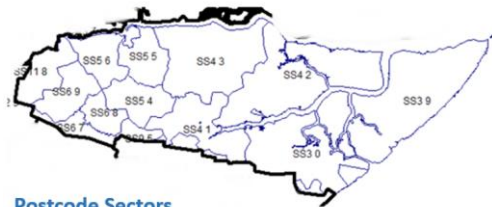


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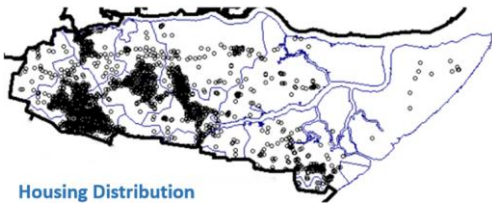
Subsidence Risk Analysis – Rochford

Rochford is located in Essex and occupies an area of around 168km² with a population of around 18,500.

ROCHFORD



Postcode Sectors



Housing Distribution

Distribution of housing stock using full postcode as a proxy. Each sector covers around 3,000 houses on average across the UK and full postcodes include around 15 – 20 houses on average, although there are large variations.

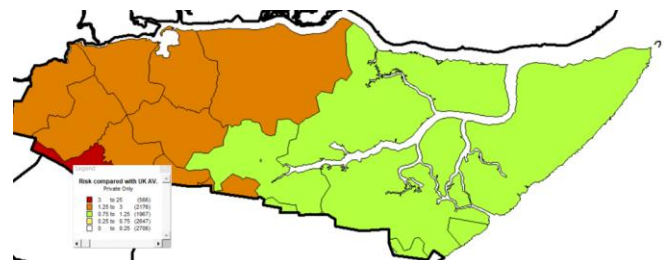
Sector and housing distribution across the district (left, using full postcode as a proxy) helps to clarify the significance of the risk maps on the following pages. Are there simply more claims in a sector because there are more houses?

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.

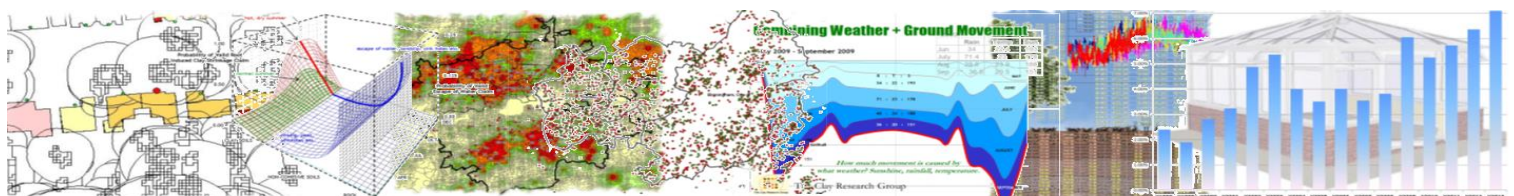
From the sample we hold, sectors are rated for the risk of domestic subsidence compared with the UK average – see map, right.

Rochford is rated 15th out of 413 districts in the UK from the sample analysed and is around 2.33x the risk of the UK average, or 0.605 on a normalised 0 - 1 scale.

There is a greater than average risk to the west of the district associated with outcropping London clay as can be seen from the sector map, right.



Sector risk compared to UK average from the sample analysed. Private ownership only.



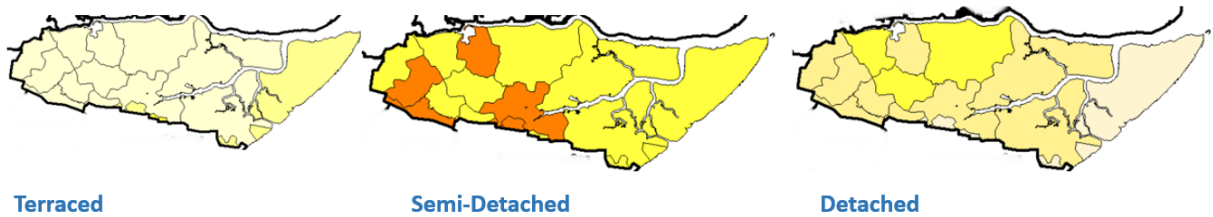
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Rochford - Properties by Style and Ownership

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.

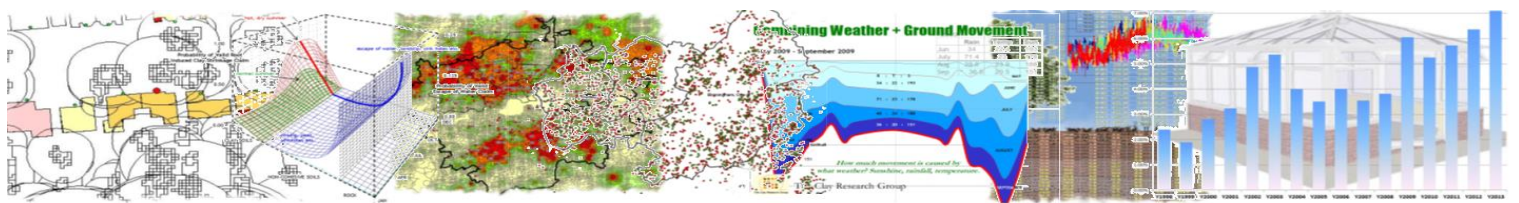
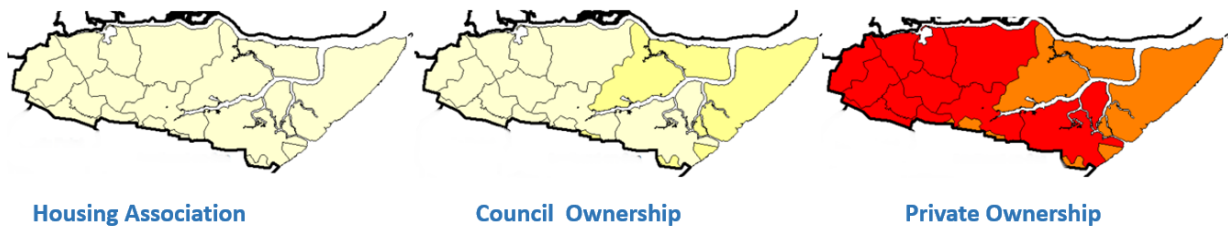
Risk increases with age of property and the model can be further refined if this information is provided by the homeowner at the time of taking out the policy.

ROCHFORD - Distribution by House Type



Distribution by ownership is shown below. Semi-detached, private properties are the dominant class across the district.

ROCHFORD - Distribution by Ownership



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Subsidence Risk Analysis – Rochford

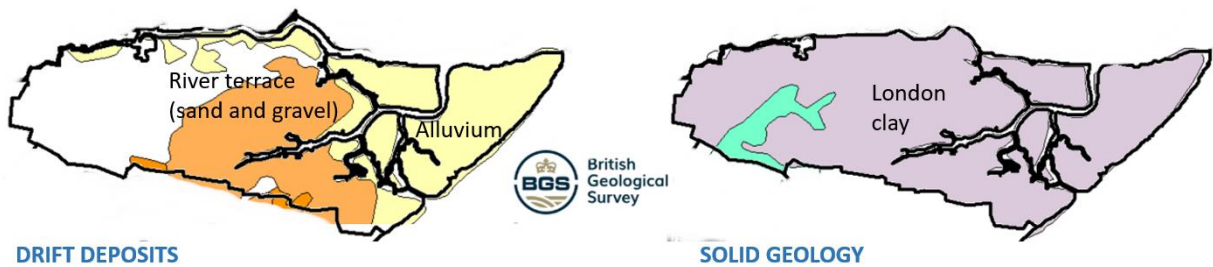
Below, extracts from the British Geological Survey low resolution 1:625,000 scale geological maps showing the solid and drift series. View at: <http://mapapps.bgs.ac.uk/geologyofbritain/home.html> for more detail.

See page 10 for a seasonal analysis of the sample which reveals that, at district level, there is around an 80% probability of a claim being valid in the summer and, of the valid claims, there is a 80% probability that the damage will have been caused by clay shrinkage. This appears high given the distribution of non-shrinkable drift deposits but housing density is greater in the area of outcropping London clay.

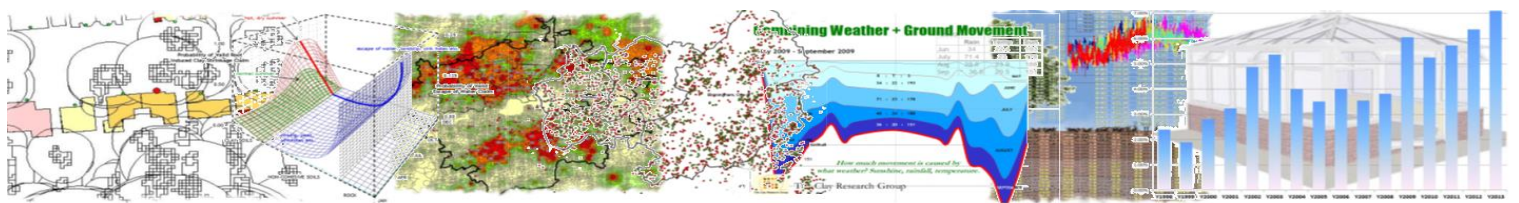
In the winter, the likelihood of a claim being valid drops to around 20% and of the valid claims, escape of water is the most likely cause – 95%.

A postcode sector map on the following page records the PI of soils retrieved following site investigations from actual claims associated with the data held.

ROCHFORD : BGS Geology – 1:625,000 scale



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.

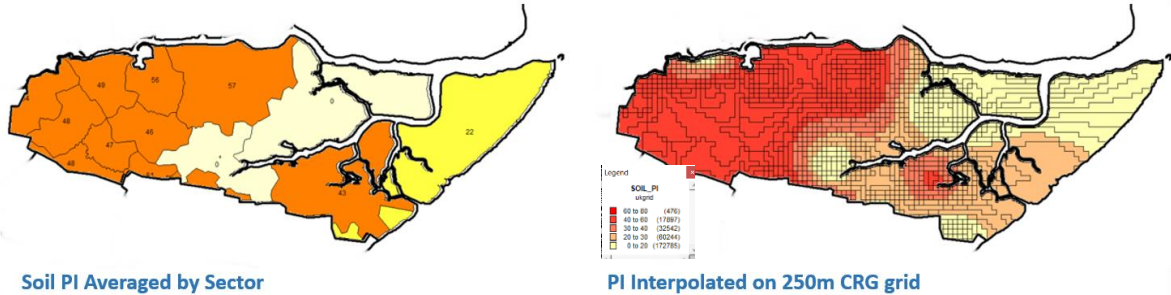


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Liability by Geology and Season

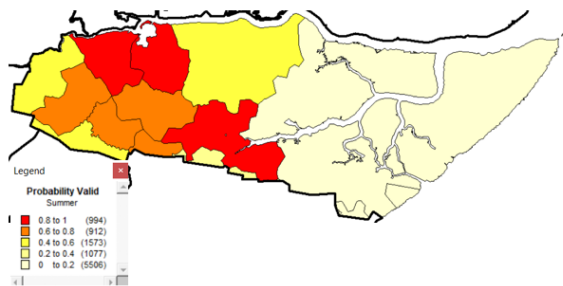
Below, the average PI by postcode sector (left) derived from site investigations and interpolated to develop the CRG 250m grid (right). The higher the PI values, the darker red the CRG grid.

ROCHFORD – Soil Plasticity Index

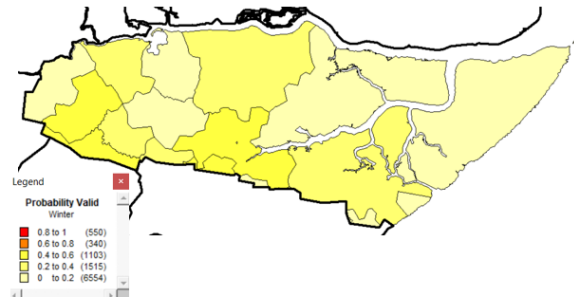


Zero values for PI in some sectors may reflect the absence of site investigation data - not necessarily the absence of shrinkable clay. A single claim in an area with low population can raise the risk as a result of using frequency estimates.

ROCHFORD – by season



Probability Valid, Summer



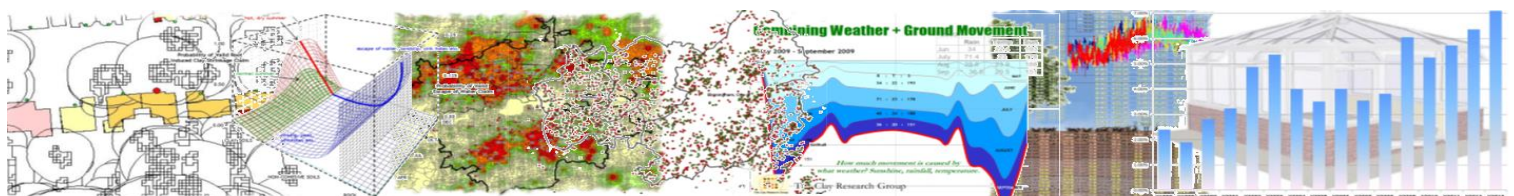
Probability Valid, Winter

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

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

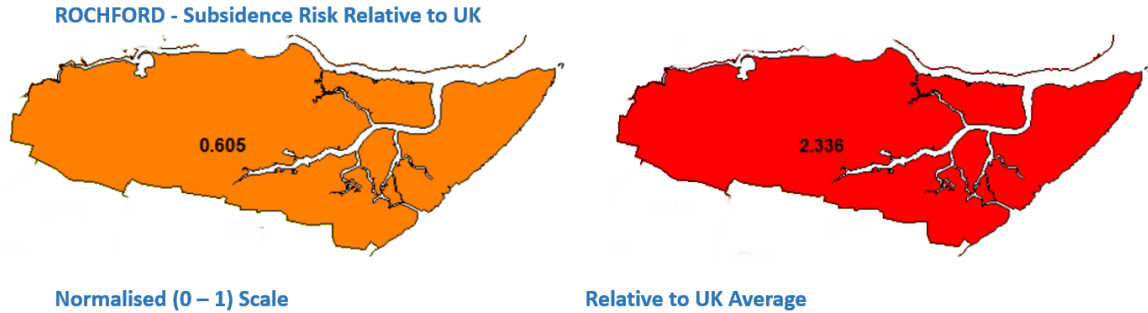
The ‘claim by cause’ distribution and the risk posed by the soil types is illustrated at the foot of the following page.

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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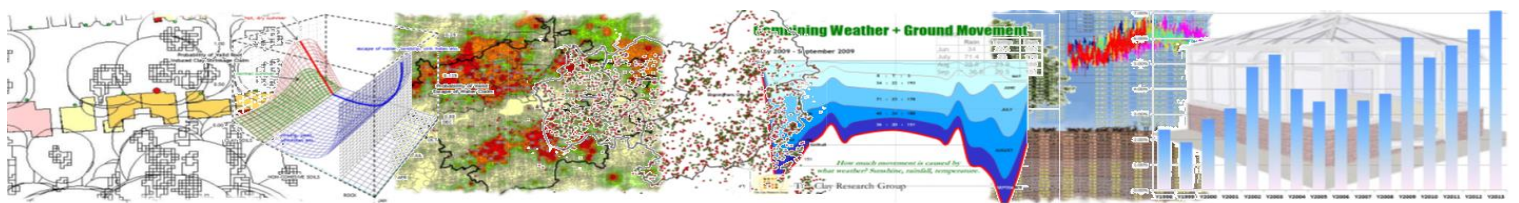
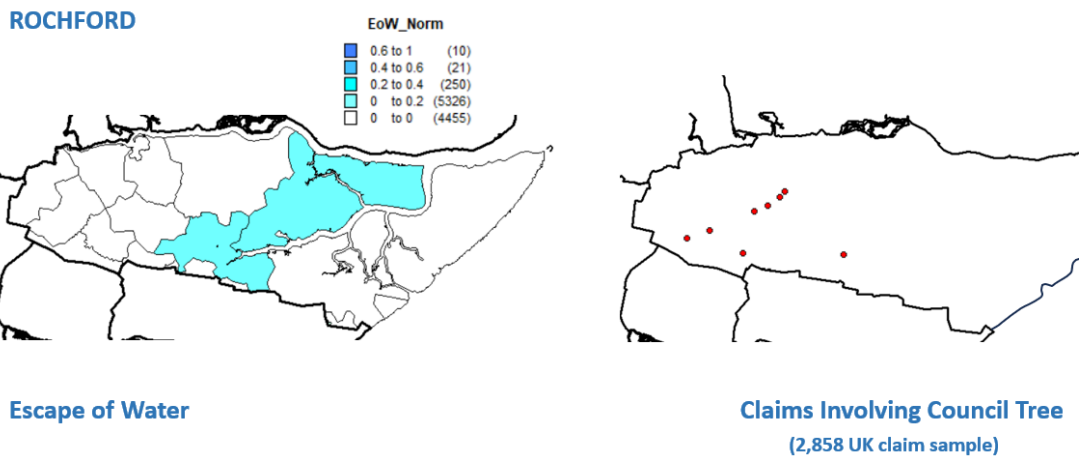
District Risk. EoW and Council Tree Risk.



Below, left, mapping the frequency of escape of water claims confirms the presence of predominantly non-cohesive soils. The distribution on the map reflects the presence of non-cohesive drift deposits.

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 claims coincide with the presence of shrinkable soils shown on the previous page from samples obtained from site investigations associated with claims.

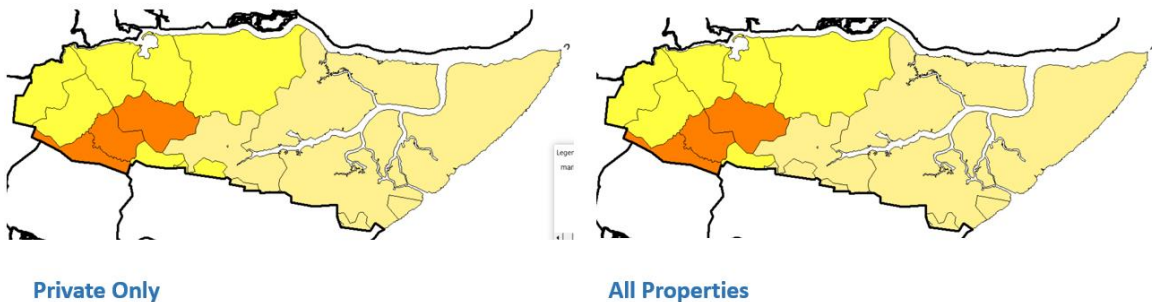


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Rochford - Frequencies & Probabilities

Below, mapping the risk of subsidence by ownership. Claims frequency that includes 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.

ROCHFORD - Sector Risk Compared with UK Average

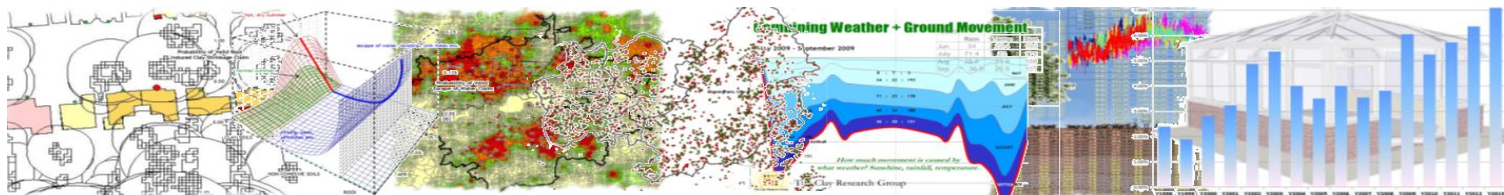


On a general note, a reversal of rates for valid-v-declined by season is a characteristic of the underlying geology. For clay soils, the probability of a claim being declined in the summer is usually low, and in the winter, it is high.

Valid claims in the summer have a higher probability of being 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 - ROCHFORD

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Rochford	0.719	0.065	0.215	0.01	0.16	0.83

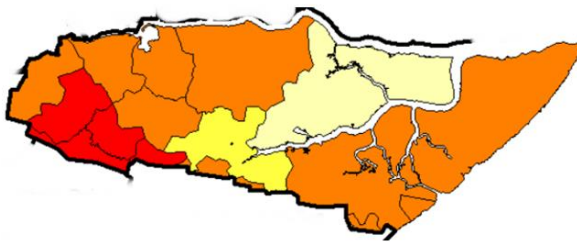


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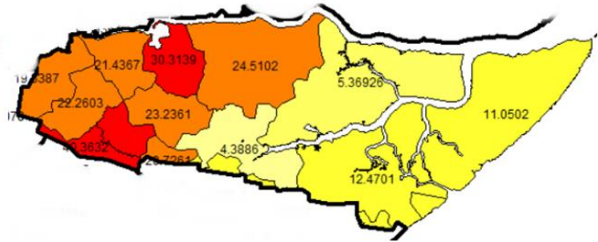
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Normal & Surge Years

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 – ROCHFORD



Spend by Sector

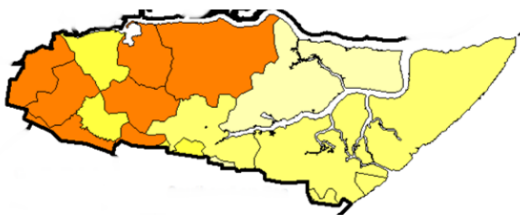


Spend Averaged Over Private Housing Population

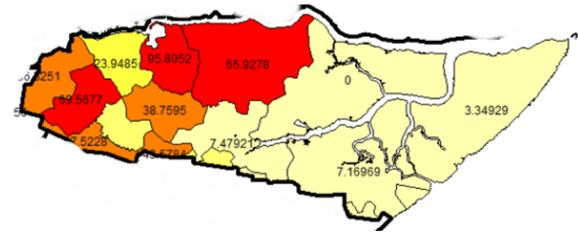
It will also be a function of the distribution of vegetation and age and style of construction of the housing stock. The images to the left in both examples (above and below) represent gross sector spend and those to the right, sector spend averaged across private housing population to derive a notional premium per house for the subsidence peril.

The figures can be distorted by a small number of high value claims. The absence of any distinct difference between surge and normal years reflects the geology.

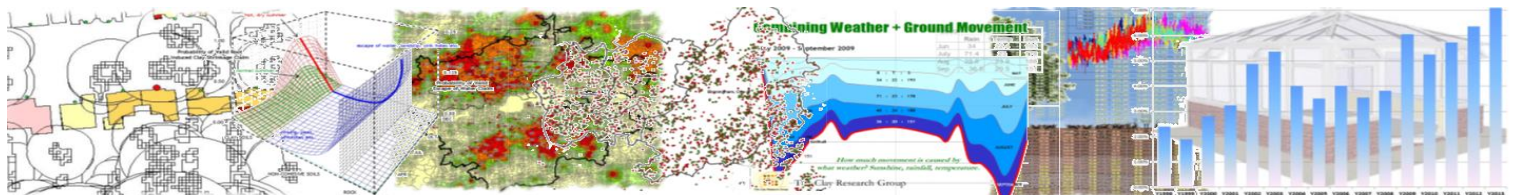
SPEND in SURGE – ROCHFORD



Spend by Sector

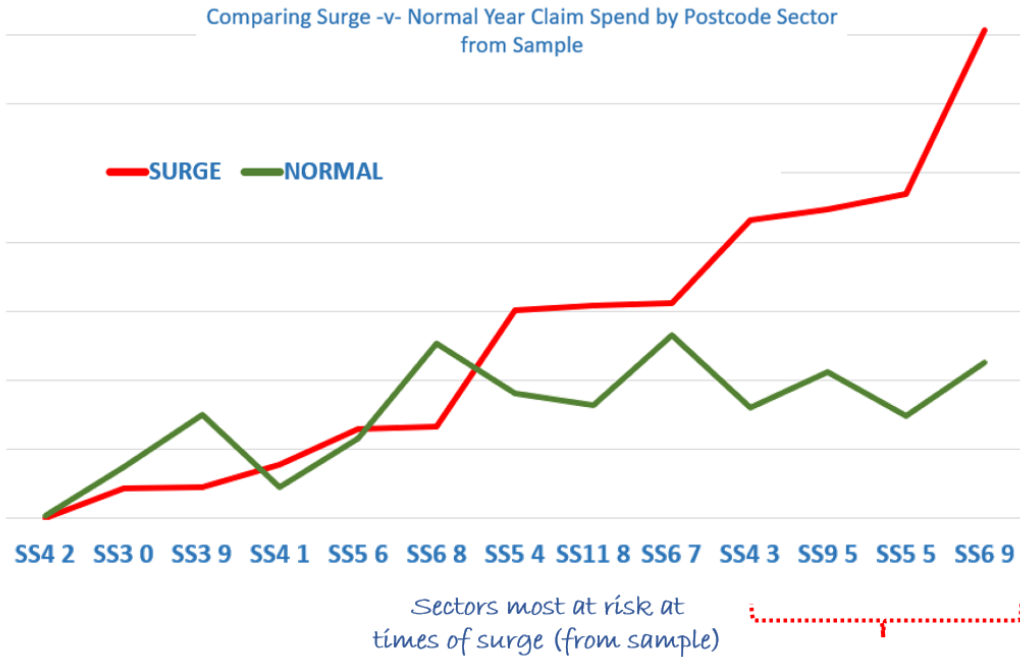


Spend Averaged over Private Housing Population



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ROCHFORD



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.

