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 2024
Issue 235

The Clay Research Group

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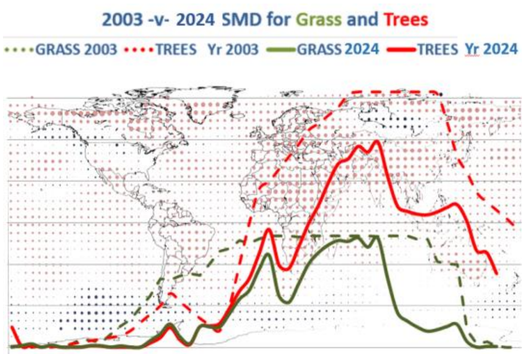
Wealden

SMD

The SMD for both trees and grass remains well below values recorded in a surge year (2003 in this example) which corresponds with ABI claims data showing low claim numbers in the third quarter.



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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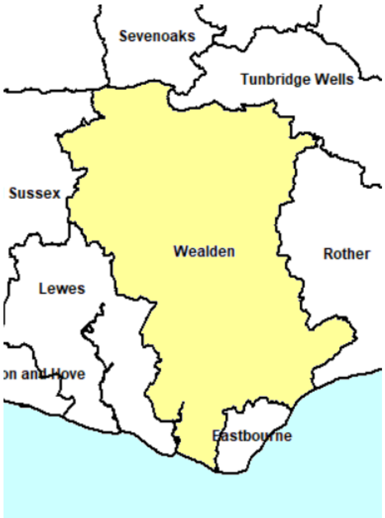
District and Sector Risk

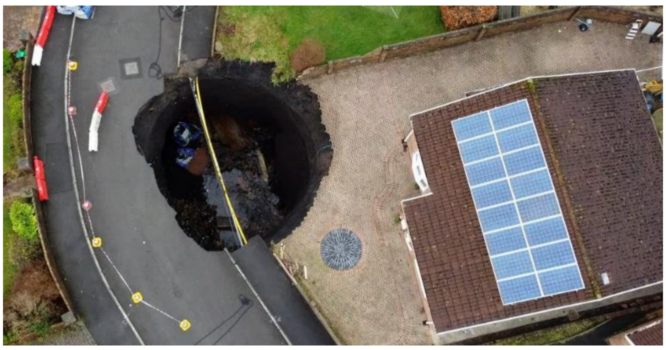
Wealden lies on the south coast of the UK in East Sussex and is the subject of the ‘Risk by District’ series in this month’s edition. Its geology is predominantly outcropping Hastings beds – see Page 7.

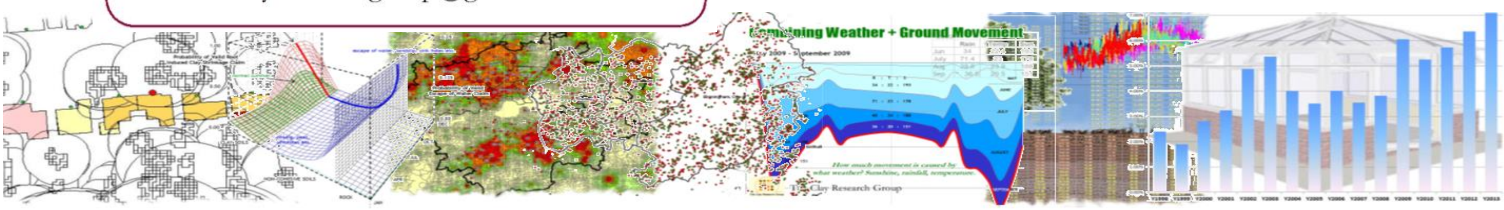


The risk maps are built from a data sample covering four claim years, including one surge and three ‘normal’ years.

Merthyr Sinkhole

A 50ft deep sinkhole has appeared in the Nant Morlais area of Merthyr Tydfil, leading to the evacuation of 30 homes while the Council carry out remedial work. The council suggest the likely cause to be the collapse of a culvert caused by Storm Bert six days earlier with ongoing movement due to storm Darragh. Remedial work is still underway.





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ChatGPT – Diagnosing Subsidence

QUESTION to ChatGPT:

What is the best way to diagnose subsidence?

ChatGPT RESPONSE:

Diagnosing **subsidence** accurately is crucial for addressing the issue effectively and preventing further damage. Here are the best steps and methods for diagnosing subsidence:

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1. Visual Inspection

Look for common signs of subsidence in your building. These include:

- **Cracks in walls**:
    - Wider than 3mm.
    - Diagonal or stair-step pattern.
    - Usually around doors, windows, or weaker structural areas.
- **Doors and windows sticking**: Warping or distortion due to uneven settling.
- **Sloping floors or tilting walls**: Evidence of uneven foundation movement.
- **Gaps between walls and skirting boards** or around doors and windows.
- **External indicators**: Cracks in external brickwork, chimney tilting, or movement of patios.

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2. Monitoring Cracks

Professionals may recommend placing **crack monitors** (such as crack gauges) to track the movement over time. Cracks widening or elongating over several months could confirm subsidence.

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3. Professional Survey

Engaging a **chartered surveyor** is one of the most reliable ways to diagnose subsidence:

- They perform a thorough structural inspection.
- They assess the nature and severity of the damage.
- They might recommend further investigations if necessary.

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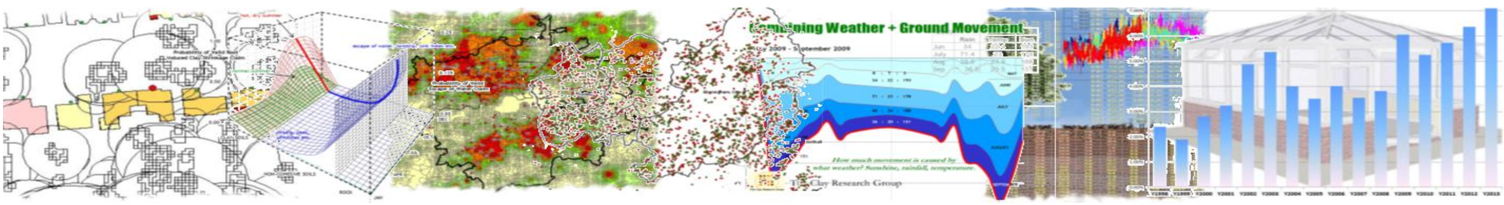
4. Ground Investigation

A more technical diagnosis involves testing the ground conditions:

- **Borehole drilling**: Samples of soil are taken to determine the type and its susceptibility to movement (e.g., shrink-swell behaviour in clay soils).
- **Trial pits**: Dug around the foundation to check its depth, condition, and how the soil interacts with it.



5. Drainage Investigation

Since leaking pipes and drains are common causes of subsidence, a **CCTV drain survey** can identify:

- Cracks or blockages in underground pipes.
- Areas where water is leaking into the soil, potentially destabilizing the foundation.

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6. Tree Survey

A **tree root survey** can identify whether nearby trees are affecting the soil's moisture content, especially in clay-rich soils. Arborists or engineers use this to decide if tree removal or root barriers are necessary.

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7. Movement Monitoring

Structural engineers may use tools like **laser leveling**, **plumb bobs**, or other devices to measure ongoing shifts in the building's structure.

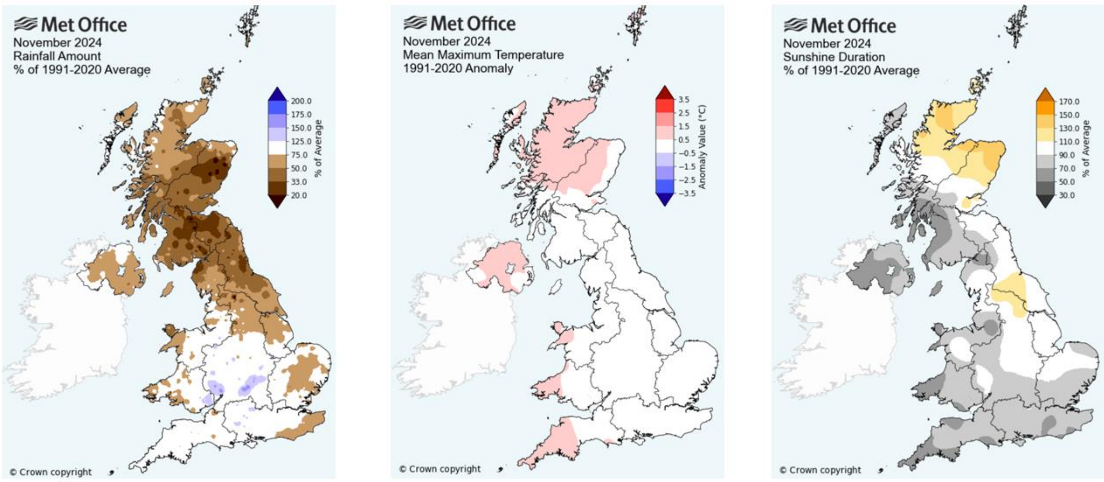
When to Act?

- If cracks widen significantly (beyond 5mm) in a short time.
- If you notice worsening symptoms like sloping floors or sticking doors.
- If external factors like nearby tree growth or poor drainage are visible.

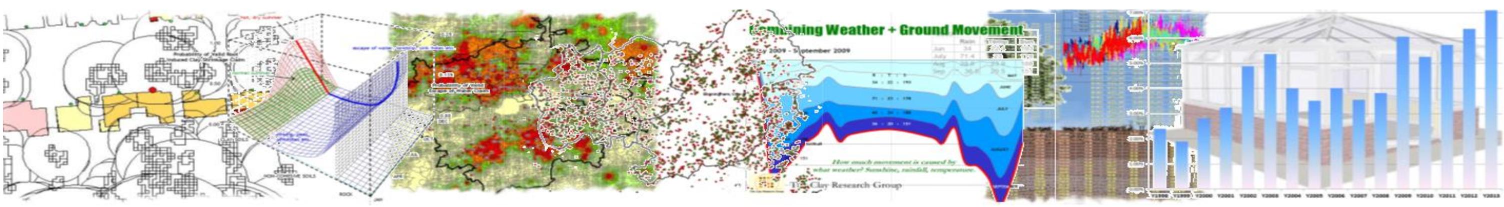
The combination of professional surveys, monitoring, and soil investigations provides the most reliable diagnosis of subsidence. Early intervention can minimize damage and repair costs.

Met Office Anomaly Maps for November 2024

Anomaly maps from the Met Office web site for the month of November 2024 reproduced below. The month can be summed up as being drier and warmer to the north of England and across Scotland, slightly warmer to the north of Scotland combined with an increase in hours of sunshine, but fewer hours across parts of England and Wales.



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



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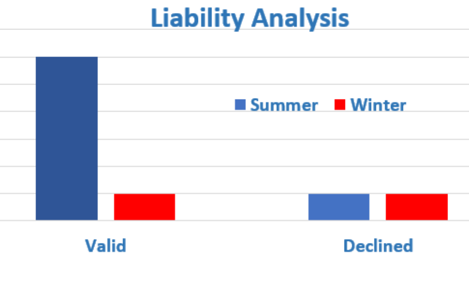
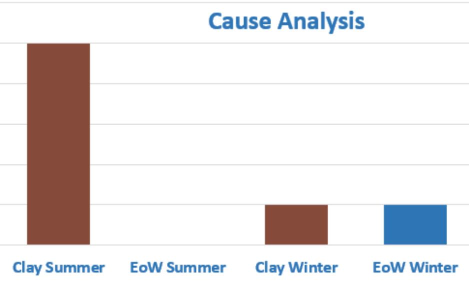
Wealden - Area Sector Level Sample Using Past Claims Data to Infer Geology and Derive Probability of Cause and Liability

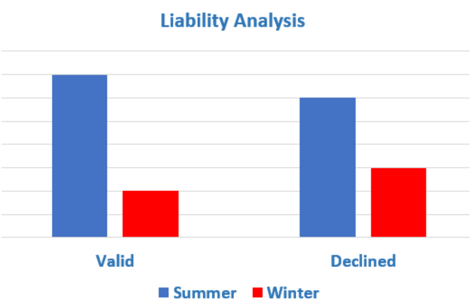
TN20 6 – Outcropping Hastings beds (name obsolete - Ferruginous sandstones, siltstones and shales) predominantly with higher claim numbers in the summer months and relatively few declinatures throughout the year. Low housing density.

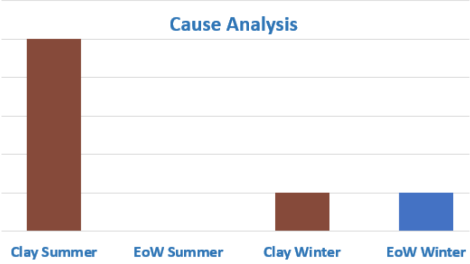
Perhaps perversely given the geology, there are a relatively high number of claims due to clay shrinkage in the summer months but these sometimes relate to older properties with shallow, stepped brick footings bearing onto made ground.

Borehole records listed on the BGS web site describe the presence of 'blue clay and sand' at shallow depth and shrinkable clay is detected from claim related samples – see 250m grid on page 8. Although the sector is rated above average in terms of subsidence risk, this reflects the predominantly lower risk across the UK.









BN27 1 – Mixed geology – see page 7. Page 8 for the results of investigations related to subsidence claims. Shrinkable clay soils and alluvial soils extend into the sector along its southern border with a maximum PI of 48 noted in our records.

Summer and winter profiles are similar with causation predominantly associated with clay shrinkage.

Cause of claims listed on the database all point to the owners/neighbour's vegetation being implicated.

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

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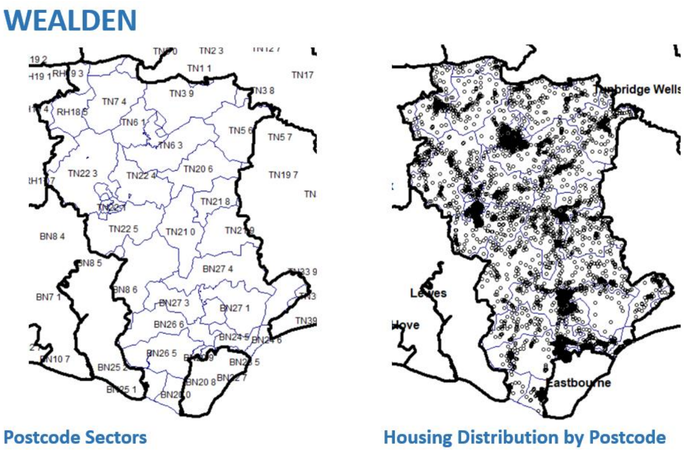
Subsidence Risk Analysis – Wealden

Wealden is located in East Sussex and occupies an area of 835km^2 with a population of around 163,000.



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.

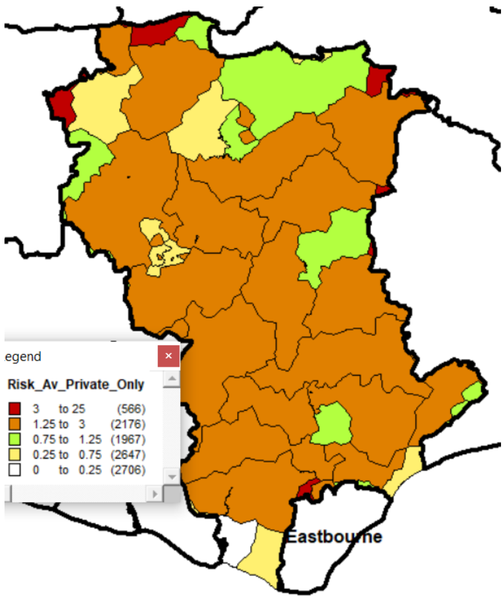
Sector and housing distribution across the district (left, using full postcode as a proxy) helps to clarify the significance of the risk maps on the following pages. Are there simply more claims in a sector because there are more houses?

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.

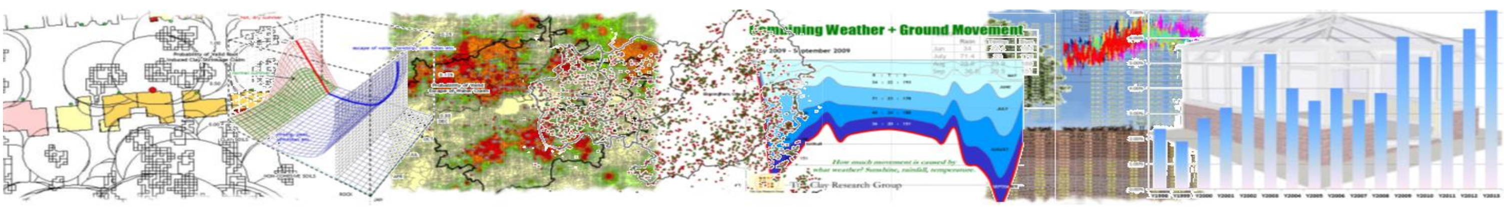
From the sample we hold sectors are rated for the risk of domestic subsidence compared with the UK average – see map, right.

Wealden is rated 78th out of 413 districts in the UK from the sample analysed and is around 1.49x the risk of the UK average, or 0.387 on a normalised 0 - 1 scale.

There is a slightly greater than average risk across the district 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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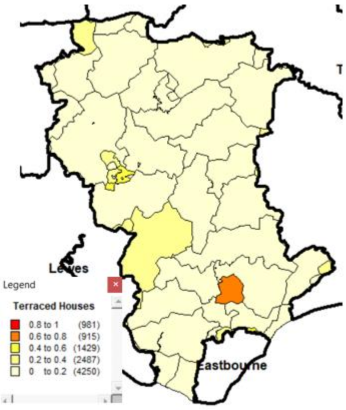
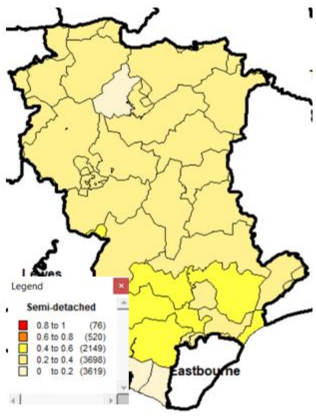
Wealden - Properties by Style and Ownership

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.

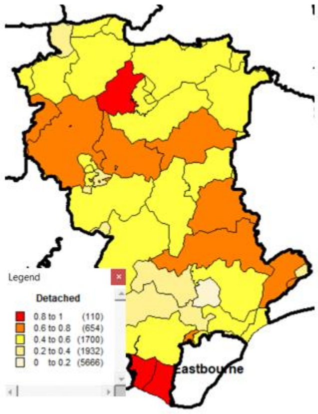
WEALDEN - Distribution by House Type



Terraced



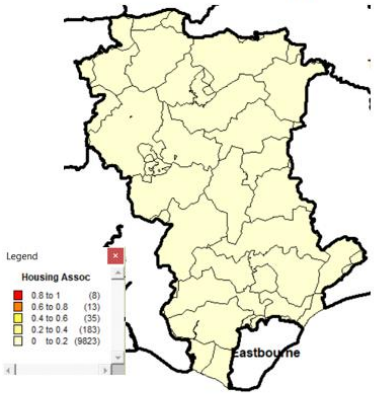
Semi-Detached



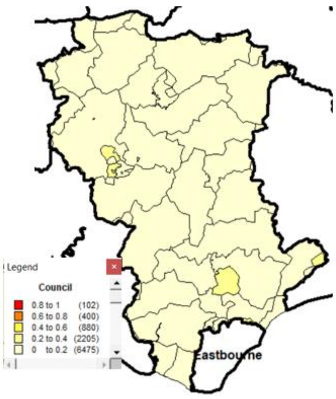
Detached

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

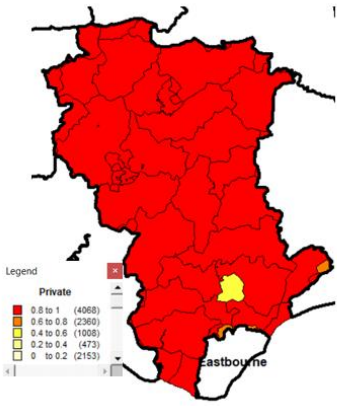
WEALDEN - Distribution by Ownership



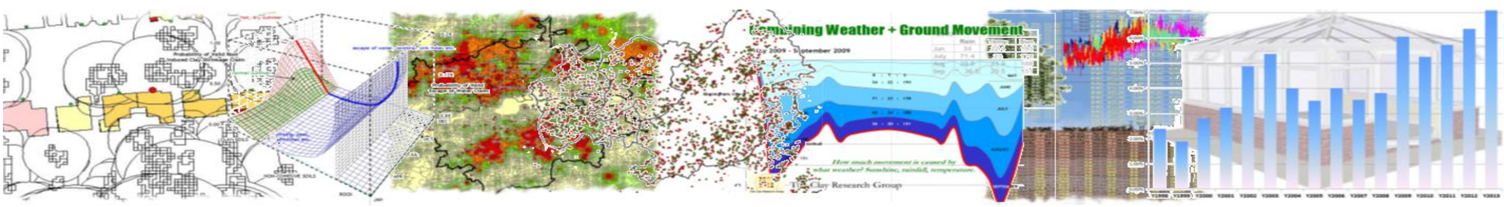
Housing Association



Council Ownership



Private Ownership



Subsidence Risk Analysis – Wealden

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 90% (from the data sample and perhaps perversely given the geology) probability that the damage will have been caused by clay shrinkage. In the winter, the likelihood of a claim being valid drops to less than 20% and of the valid claims, escape of water is the most likely cause.

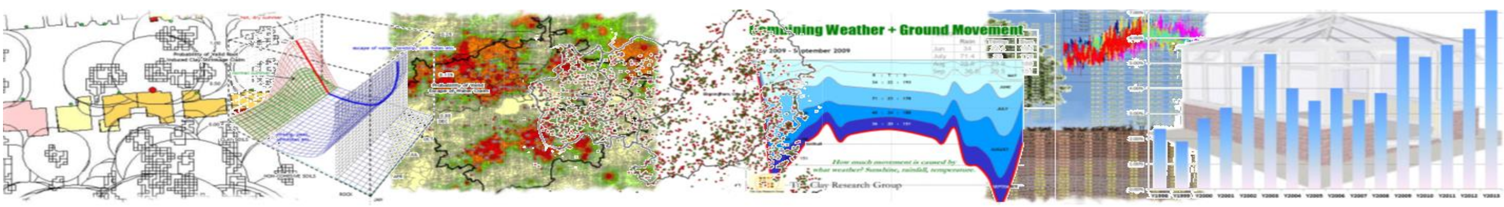
A postcode sector map on the following page records the PI of soils retrieved following site investigations from the claims associated with the data held.

WEALDEN : BGS Geology – 1:625,000 scale

DRIFT DEPOSITS

SOLID GEOLOGY

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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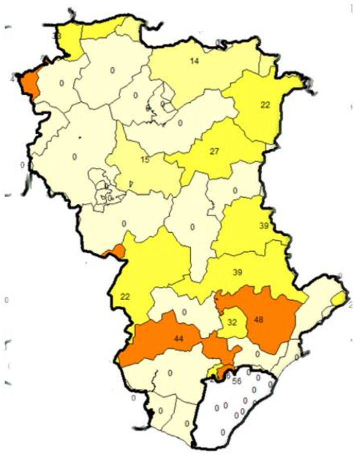
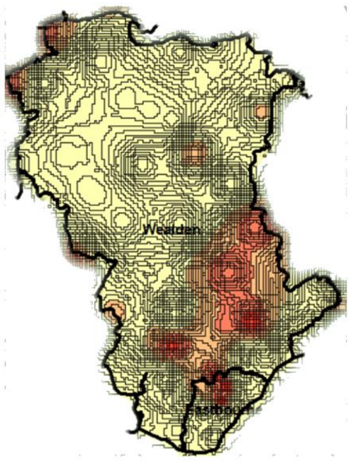
Liability by Geology and Season

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.

WEALDEN – Soil Plasticity Index



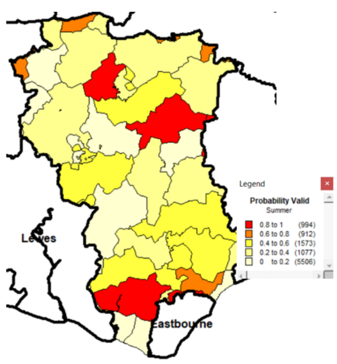
Soil PI Averaged by Sector



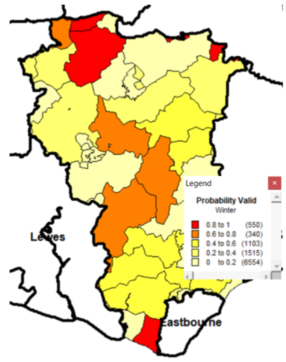
PI Interpolated on 250m CRG grid

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.

WEALDEN – by season



Probability Valid, Summer

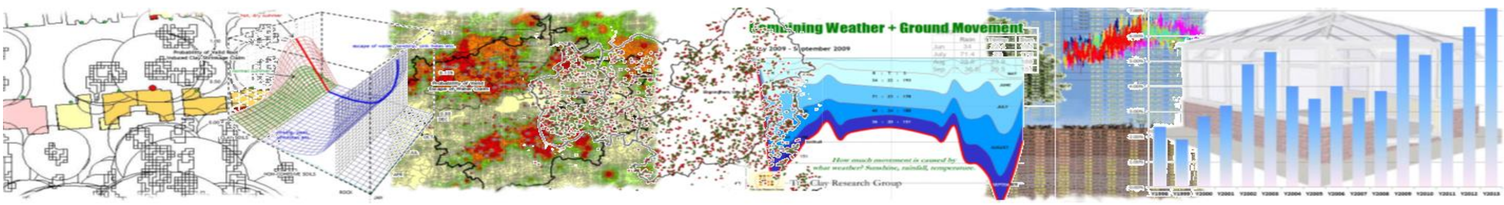


Probability Valid, Winter

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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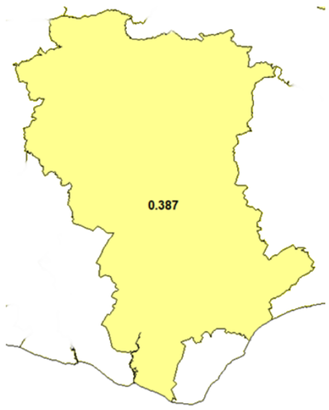
District Risk. EoW and Council Tree Risk.

WEALDEN - Subsidence Risk Relative to UK



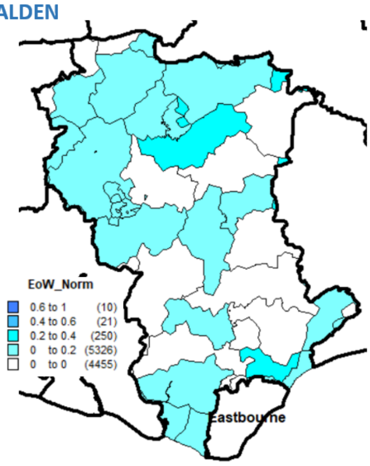
Normalised (0 – 1) Scale

Relative to UK Average

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.

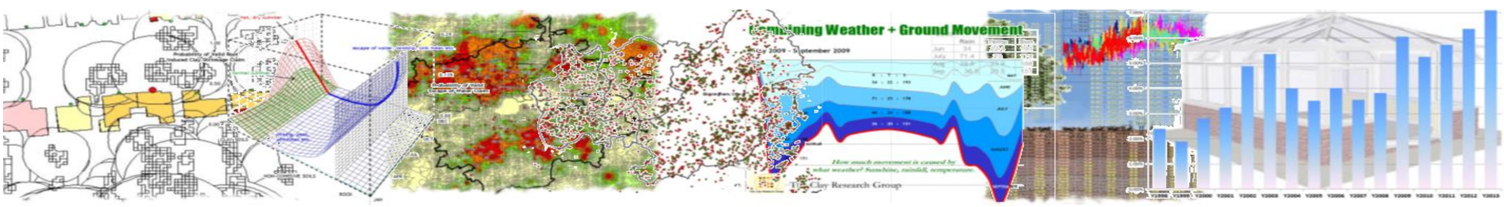
Below right, map plotting claims where damage has been attributable to vegetation in the ownership of the local authority from a sample of around 2,858 UK claims. The claims coincide with the presence of shrinkable soils shown on the previous page from samples obtained from site investigations associated with claims.

WEALDEN



Escape of Water

Claims Involving Council Tree
(2,858 UK claim sample)



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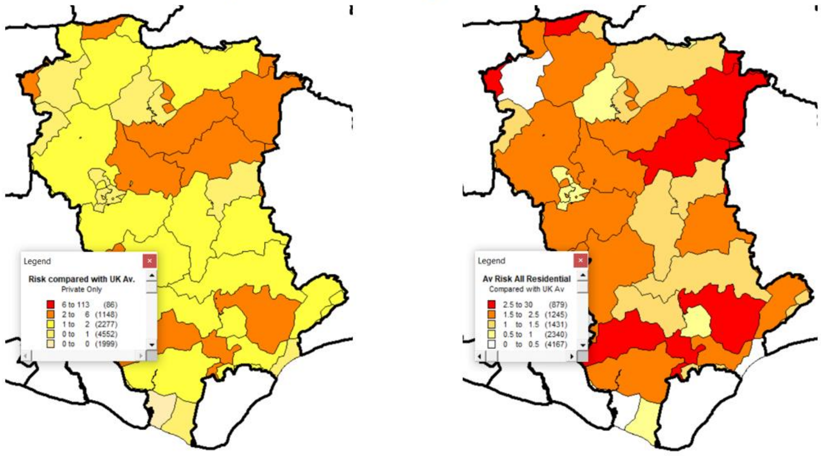
Wealden - Frequencies & Probabilities

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.

WEALDEN - Sector Risk Compared with UK Average



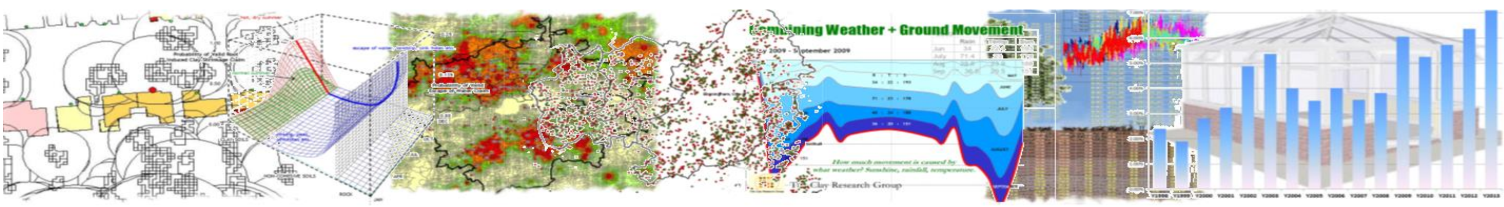
Private Only — All Properties

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 - WEALDEN

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Wealden	0.724	0.061	0.215	0.01	0.16	0.83



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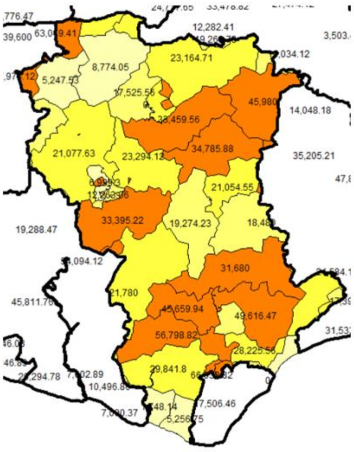
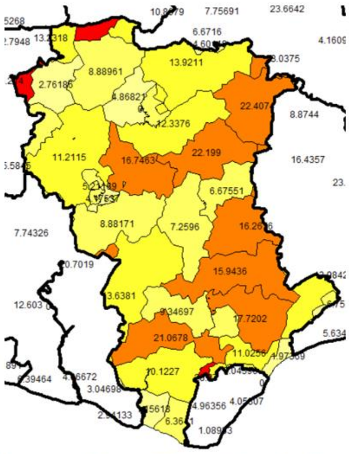
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Normal & Surge Years

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 – WEALDEN



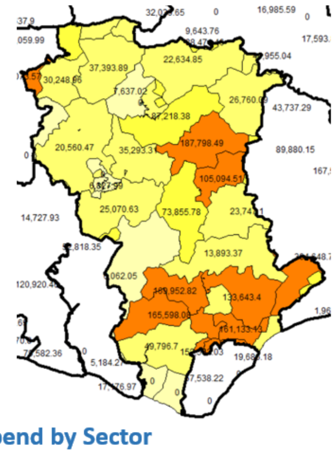
Spend by Sector



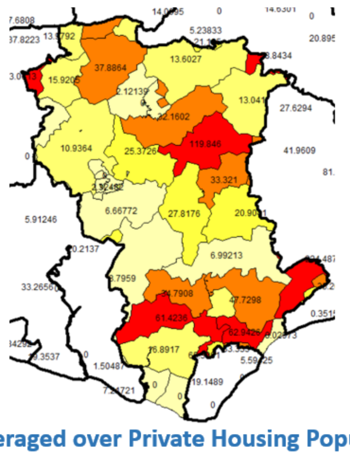
Spend Averaged Over Private Housing Population

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.

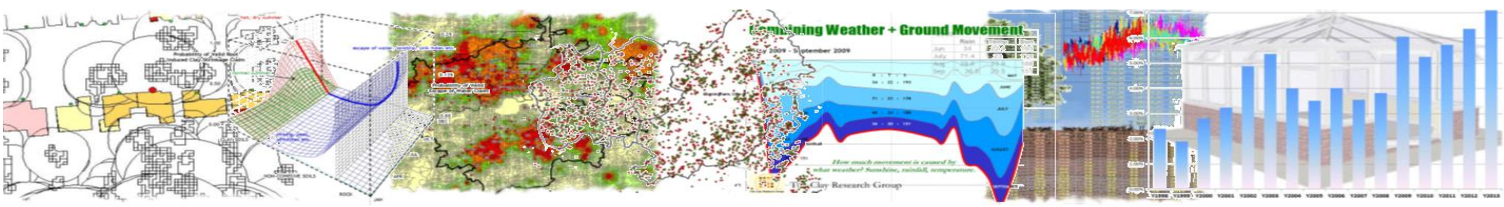
SPEND in SURGE – WEALDEN



Spend by Sector



Spend Averaged over Private Housing Population



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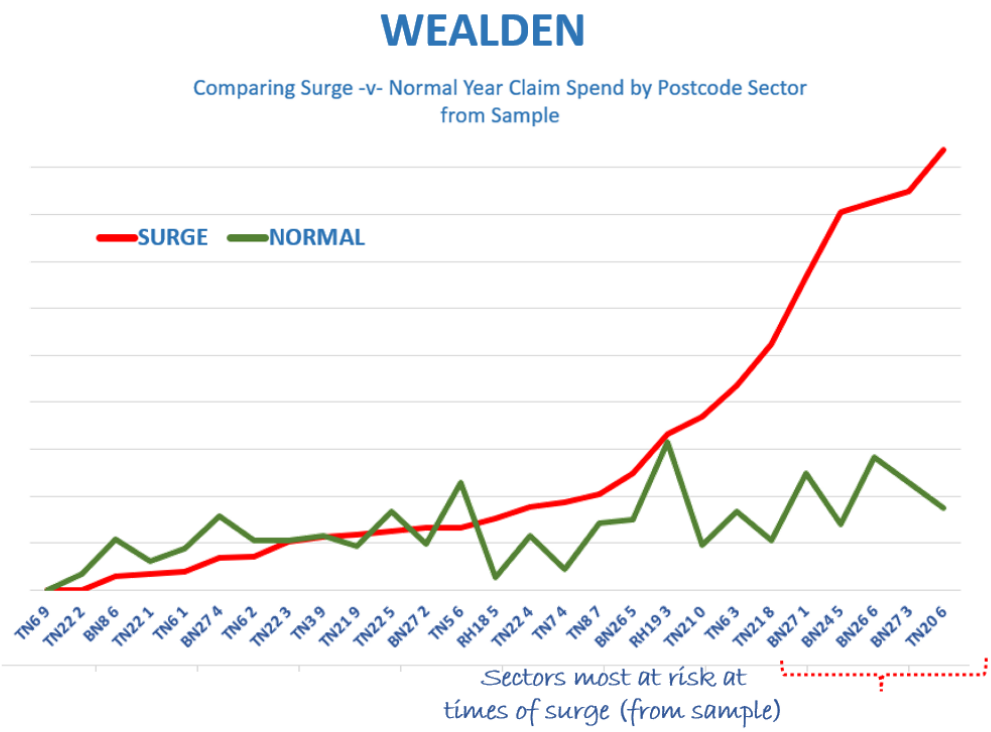

The above graph identifies the variable risk across the district at postcode sector level from the sample, distinguishing between normal and surge years. Divergence between the plots indicates those sectors most at risk at times of surge (red line).

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.