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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



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CONTENTS

Issue 248, January 2026

Page 2

ChatGPT – Best Way to Monitor?

Page 5

Plant News. Temperature, CO₂ absorption and Carbon Sequestration

Page 6

UK Met Office Anomaly Maps

Weather – change by month comparing

2003 with 2025

Pages 7 - 13

Subsidence Risk Analysis by District

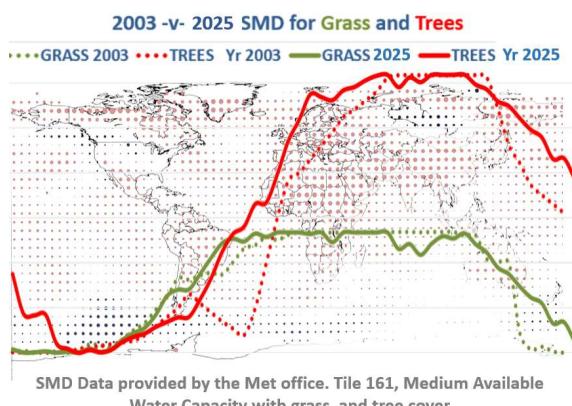
STEVENAGE

District and Sector Risk

Stevenage is situated in Hertfordshire and has an area of around 24.56km² and a population around 92,000. It is the subject of the 'Risk by District' series in this month's edition. Its geology comprises small areas of drift deposits overlying chalk – see Page 9.



SMD Graph



Plotting the correlation between the Soil Moisture Deficit for a surge year (2003) and the current year.

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

Global Average Temperature

Samantha Burgess of the European Union's Copernicus Climate Change Service reports that 2025 looks likely to tie with 2023 as the second-hottest year ever on record.

The three-year average for 2023-2025 is on track to exceed 1.5 °C for the first time,"

An article in **euronews reports** "The global average temperature anomaly for January to November 2025 is 0.60C above the 1991-2020 average, or 1.48C above the 1850-1900 pre-industrial baseline."



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ChatGPT – monitoring



Question to ChatGPT

What is the best way to monitor a building suffering from subsidence to determine cause?

Response

To determine the **cause of subsidence**, the most effective approach is a **structured monitoring and investigation programme**, rather than relying on a single method. Best practice combines **movement monitoring, ground investigation, and environmental data**, so you can distinguish between causes such as shrink–swell clay, leaking drains, tree influence, or structural failure.

1. Monitor the Movement (What is actually moving?)

a) Crack monitoring (baseline + trends)

- **Tell-tales / crack gauges** fixed across representative cracks
- Readings typically taken:
 - Monthly (or more frequently if movement is active)
 - Over **at least 12 months** to capture seasonal effects
- Helps determine:
 - Ongoing vs historic movement
 - Direction and rate of movement
 - Seasonal opening/closing (key indicator of clay shrink–swell)

❖ **Best practice:** Install gauges on multiple elevations and at different heights.

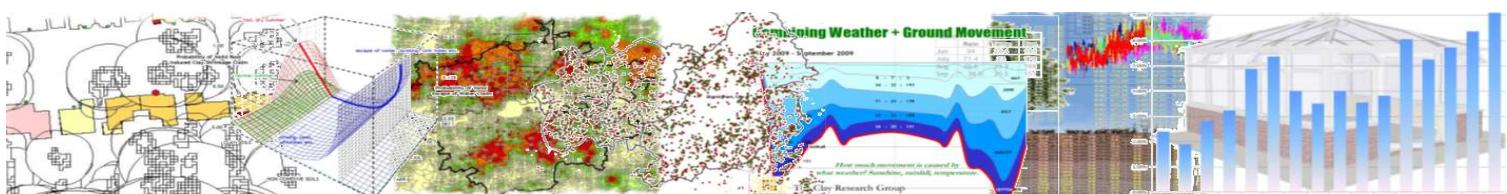
b) Precise level monitoring

- **Datum-based precise levelling** of floors and external ground
- Usually done using:
 - Digital level or total station
- Detects:
 - Vertical movement patterns
 - Differential settlement

❖ This is essential where cracking alone does not tell the full story.

c) Structural deformation monitoring (if severe)

- Targets fixed to walls monitored by **total station**
- Used when:
 - Buildings are large
 - Movements are complex or accelerating



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2. Investigate the Ground (Why is it moving?)

Monitoring alone won't identify cause—ground investigation is critical.

a) Trial pits (often the single most valuable step)

- Excavated adjacent to foundations
- Determines:
 - Foundation depth and type
 - Soil type (clay, sand, made ground)
 - Evidence of desiccation or softening
 - Nearby trees or root activity

↗ Many subsidence cases are misdiagnosed without trial pits.

b) Boreholes and soil testing (if needed)

- Used where:
 - Clay heave/shrinkage is suspected
 - Deeper strata issues exist
- Lab tests:
 - Plasticity Index (PI)
 - Moisture content
 - Sulphate levels (important for remediation design)

3. Rule Out Drainage Failure (Very common cause)

a) CCTV drain survey

- Identifies:
 - Leaks washing out fine soil
 - Collapsed or displaced pipes
- Especially important near:
 - Corners of buildings
 - Bathrooms and kitchens

↗ Drain failure is a leading cause of localised subsidence.

4. Monitor Environmental Influences

a) Trees and vegetation

- Record:
 - Species
 - Distance to foundations
 - Height and canopy spread
- Compare crack movement with:
 - Seasonal moisture changes
 - Periods of drought

↗ Seasonal cyclic movement strongly suggests clay shrink–swell.



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b) Weather correlation

- Compare movement data against:
 - Rainfall records
 - Prolonged dry periods

5. Timeframe: How long is “enough”?

Scenario	Minimum monitoring
Suspected clay shrink–swell	12–24 months
Drain-related subsidence	3–6 months post-repair
Ongoing unexplained movement	Until trends stabilise

6. Interpreting the Results (Key diagnostics)

Observation	Likely cause
Seasonal crack opening/closing	Clay shrink–swell
Progressive downward movement	Foundation settlement
Localised corner movement	Drain leakage or tree
Rapid movement	Structural failure or washout

7. Who should manage this?

- Chartered Structural Engineer (movement interpretation)
- Geotechnical Engineer (ground behaviour)
- Building Surveyor (overall diagnosis + defect mapping)

Bottom line:

The best way to determine the cause of subsidence is to combine long-term movement monitoring (cracks and levels) with targeted ground investigation and drain surveys.

Monitoring alone shows what is moving; investigation reveals why.

If you want, tell me:

- Building age and construction
- Soil type (if known)
- Nature and location of cracks



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Warmer Temperatures = Increased Plant Flowering

Thanks to Keiron Hart, Tamla Trees, for reporting research carried out by the Met Office, with support from citizen scientists across Britain and Ireland over the last ten years, from 2016 to 2025.

The data collected has revealed a significant link between warmer temperatures and increased plant flowering. *“For every 1°C rise in temperature at a given location, an average of 2.5 additional plant species are observed in bloom during the study. This striking trend provides compelling evidence of the influence of climate variability and change on our natural environment.”*

<https://www.metoffice.gov.uk/about-us/news-and-media/media-centre/weather-and-climate-news/2026/new-year-plant-hunt-reveals-influence-of-rising-temperatures-on-british-and-irish-flora>

CO2 Absorption by Plants

In an unrelated paper published in Proceedings of the National Academy of Sciences, by Sian Kou-Giesbrecht *et al*, *“Overestimated natural biological nitrogen fixation translates to an exaggerated CO2 fertilization effect in Earth system models.”* 2025; 122 the researchers arrive at the conclusion that plants can't absorb as much CO2 as climate models predicted. Access at <https://www.pnas.org/doi/10.1073/pnas.2514628122>

Carbon Sequestration

Durability of carbon dioxide removal is critical for Paris climate goals,
 Brunner C. *et al.* [“Durability of carbon dioxide removal is critical for Paris climate goals.”](#)
Communications Earth & Environment 2024.

Research by Brunner *et al* suggest that it takes around a 1,000 years to neutralize carbon sequestered by trees and that felling of trees after a shorter duration simply releases any sequestered CO2 into the atmosphere.

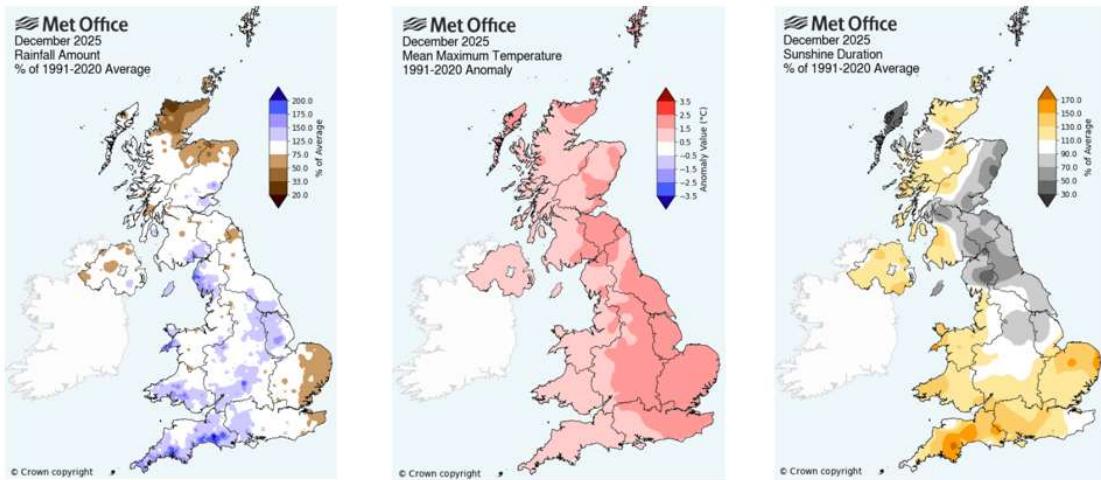
“We found that storage duration substantially affects whether net zero emissions achieve the desired temperature outcomes. With a typical 100-year storage duration, net zero CO2 emissions with 6 GtCO2 per year residual emissions result in an additional warming of 0.8 °C by 2500 compared to permanent storage, thus putting the internationally agreed temperature limits at risk. Our findings suggest that a CO2 storage period of less than 1,000 years is insufficient for neutralizing remaining fossil CO2 emissions under net zero emissions.”



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Met Office Anomaly Maps for December 2025

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



The maps reveal fairly average rainfall, above average temperature across most of the UK and variable sunshine duration compared with 1991 – 2020 averages.

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

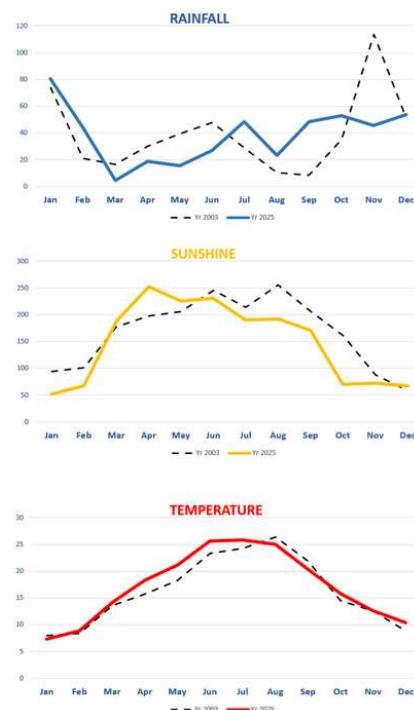
Weather - Change by Month Comparing 2003 – v - 2025

This year saw high claim numbers early in the year and the weather data from the Met Office Heathrow Weather Station explains why.

The graphs, right, plot rainfall, sunshine and temperature for 2025 against the 2003 (blue dotted line) surge year.

It's interesting to see the combination of lower rainfall, higher sunshine and temperature linked to higher claim numbers for 2025 but how does the drop below the 2003 values for all three elements influence the autumn claim number?

We don't have claims data for 2025 yet, but hopefully we can analyse how the two years compare in the March edition.

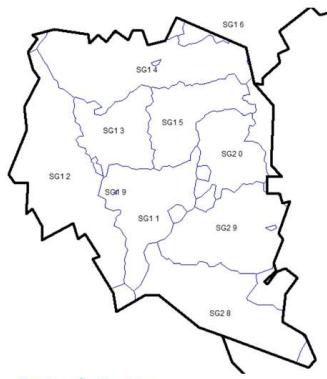


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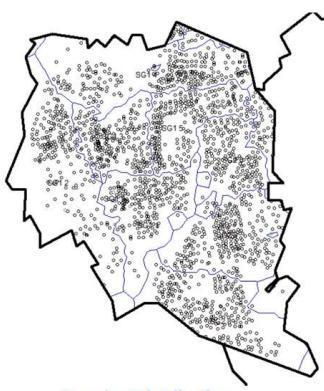
Subsidence Risk Analysis – Stevenage

Stevenage is situated in Hertfordshire and occupies an area of around 24.56km² with a population of around 92,000.

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Postcode Sectors



Housing Distribution

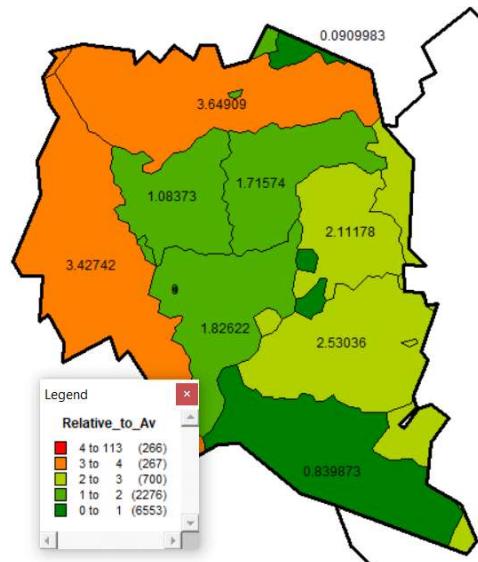
Distribution of postcode sectors and housing stock using full postcode as a proxy. Each sector covers around 3,000 houses on average across the UK and full postcodes include around 15 – 20 houses on average, although there are large variations.

Stevenage is rated 93rd out of 413 districts in the UK from the sample analysed and is around 1.34x the risk of the UK average, or 0.349 on a normalised 0 - 1 scale.

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

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.



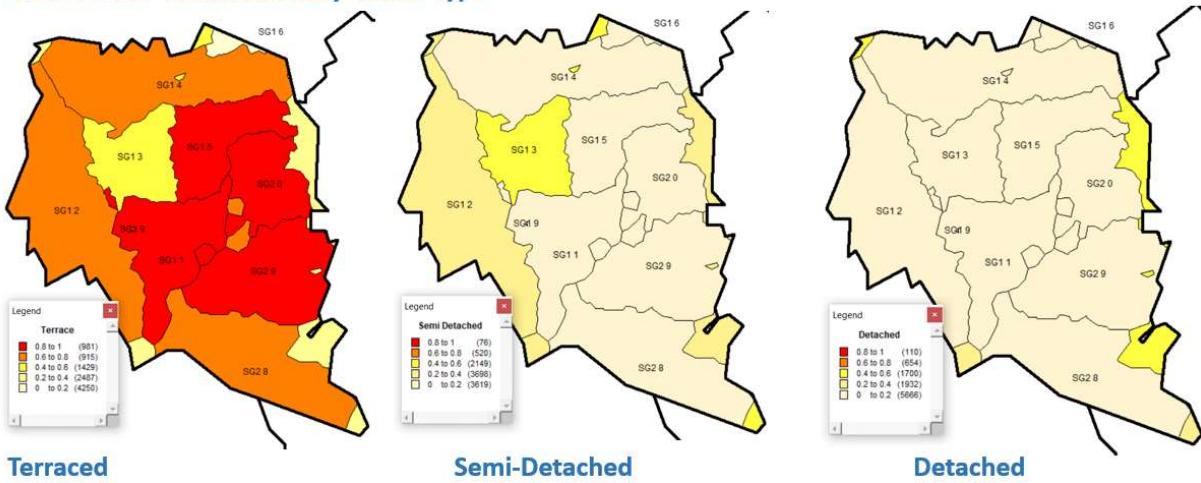
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Stevenage - Properties by Style and Ownership

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.

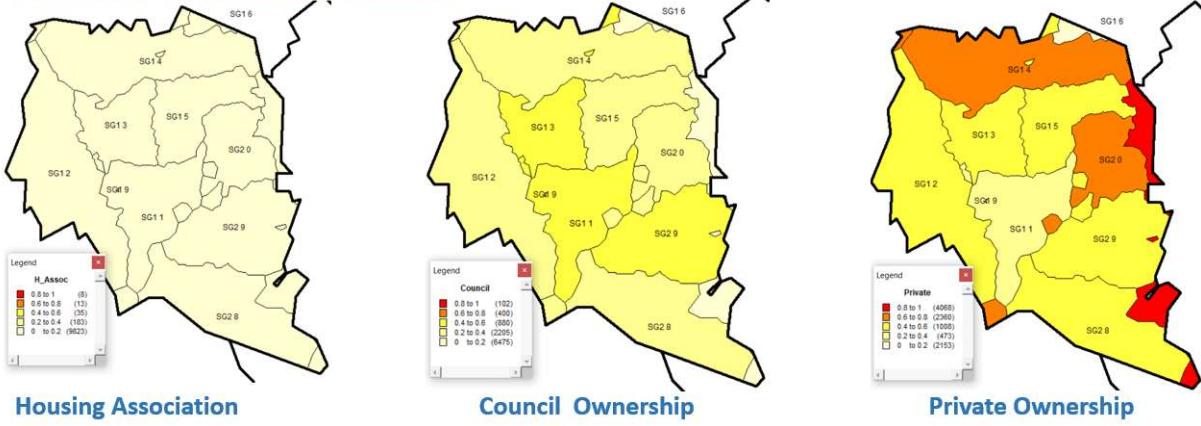
Risk increases with age of property and the model can be further refined if this information is provided by the homeowner at the time of taking out the policy.

STEVENAGE - Distribution by House Type



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

STEVENAGE - Distribution by Ownership



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Subsidence Risk Analysis – Stevenage

Below, extracts from the British Geological Survey low resolution 1:625,000 scale geological maps showing the solid and drift series. View at:

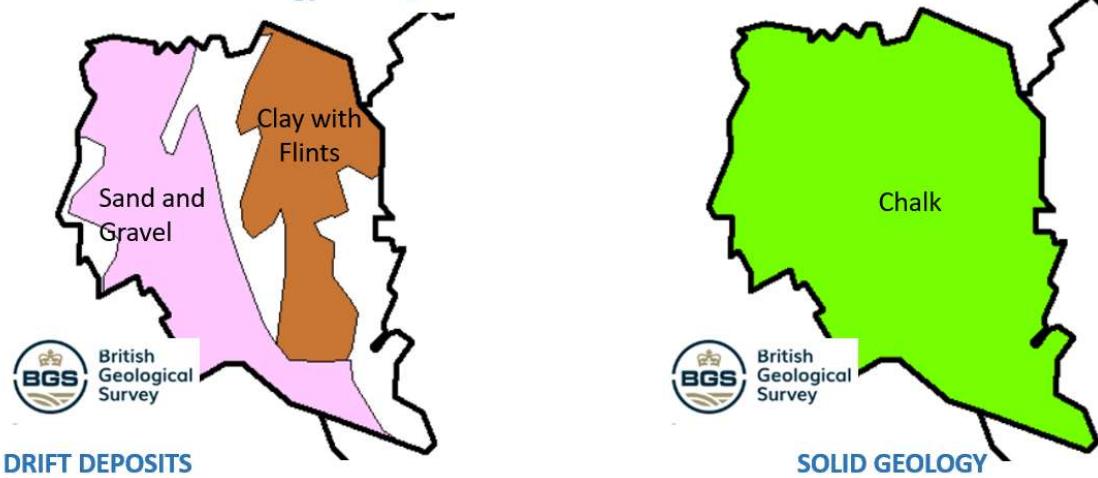
<http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

See page 12 for a seasonal analysis of the sample which reveals that, at district level, there is around a 80% probability of a claim being valid in the summer and, of the valid claims, there is a 100% probability that the damage will have been caused by clay shrinkage. This may appear perverse given the soils but site investigations undertaken relating to claims confirms the presence of clay soils (see following page) with a PI ranging from 30 – 60%.

In the winter, the likelihood of a claim being valid is around 17% 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 actual claims.

STEVENAGE : BGS Geology – 1:625,000 scale



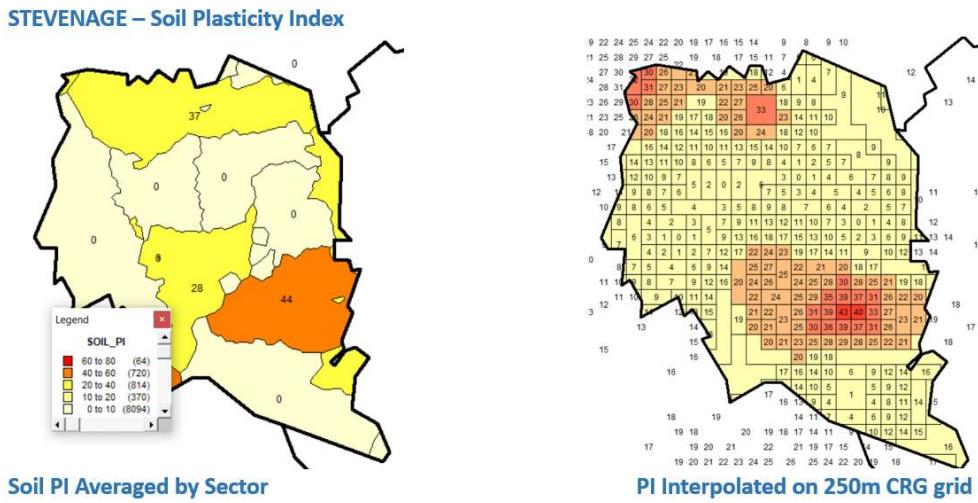
Above, extracts from the 1:625,000 series British Geological Survey maps. Working at postcode sector level and referring to the 1:50,000 series delivers far greater benefit when assessing risk.



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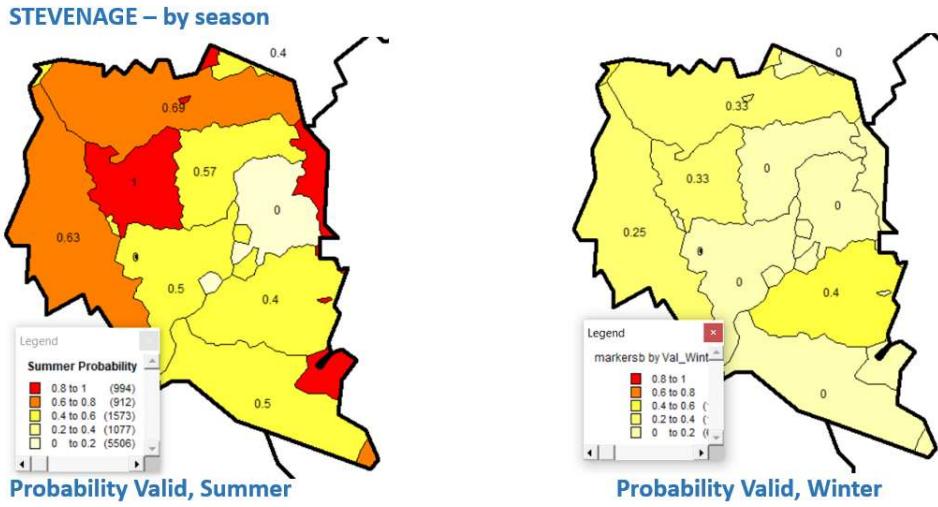
Liability by Geology and Season

Below, the average PI by postcode sector (left) derived from site investigations and interpolated to develop the CRG 250m grid (right), both confirming the varied geology across the district.



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.

The maps below show the seasonal difference from the sample used. Combining the risk maps by season and reviewing the table on page 12 is perhaps the most useful way of assessing the potential liability, likely cause and geology using the values listed.



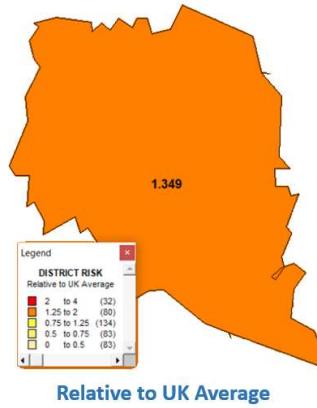
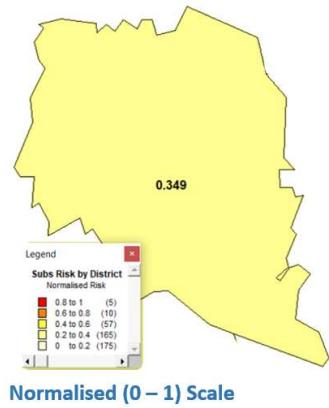
A high frequency risk can be the product of just a few claims in an area with a low housing density of course and claim count should be used to identify such anomalies.



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District Risk. EoW and Council Tree Risk.

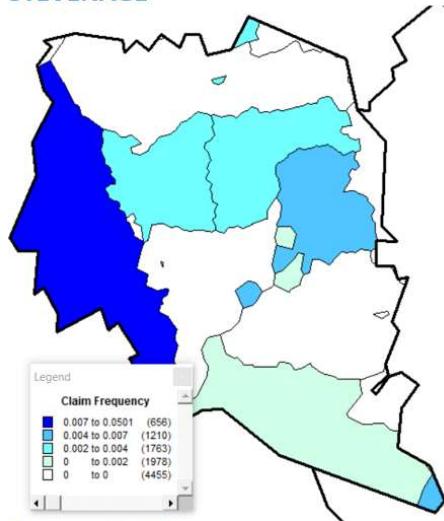
STEVENAGE - Subsidence Risk Relative to UK



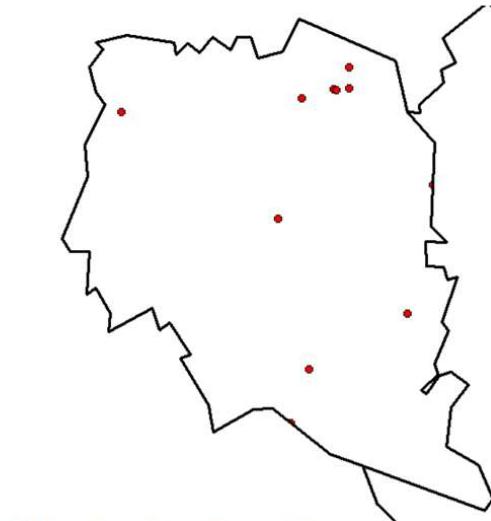
Below, left, mapping the frequency of escape of water claims reflecting the presence of drift deposits of non-cohesive soils including sand and gravel and clay with flints underlain by chalk. As we would expect, the 1:50,000 scale BGS map provides a more detailed picture. The CRG 1:250 grid reflects 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 presence of claims is surprising given the apparent absence of clay soils on the 1:625,000 scale BGS map. Reference to the 1:50,000 map would no doubt explain the apparent anomaly.

STEVENAGE



Escape of Water

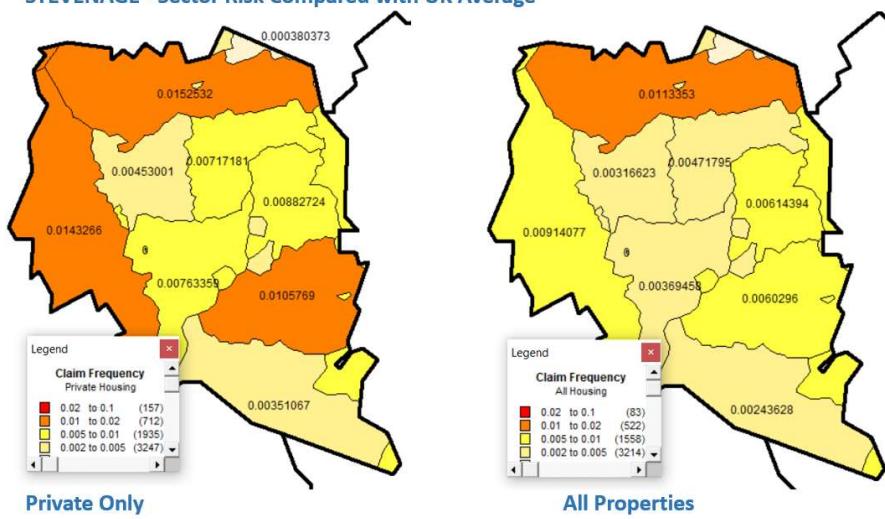


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Stevenage - Frequencies & Probabilities

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 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.

STEVENAGE - Sector Risk Compared with UK Average



To reiterate, 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.

In this case, the numbers reflect the presence and influence of the underlying clay series.

Liability by Season - STEVENAGE

District	valid	valid	Repudiation	valid	valid	Repudiation
	summer	summer	Rate		winter	winter
	clay	EoW	(summer)	clay	EoW	(winter)
Stevenage	0.79	0	0.21	0.00	0.17	0.83

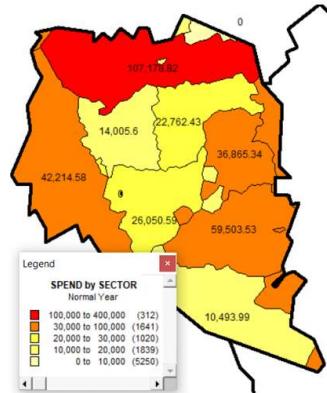


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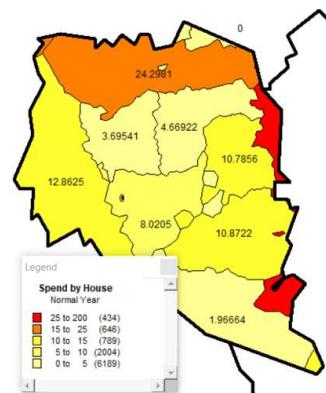
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Normal & Surge Years

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 – STEVENAGE



Spend by Sector

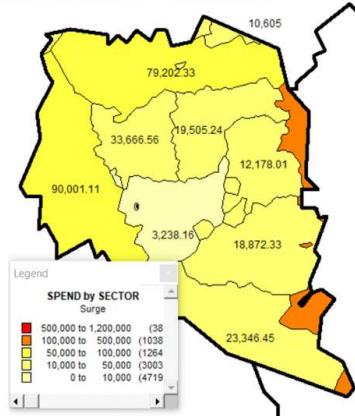


Spend Averaged Over Private Housing Population

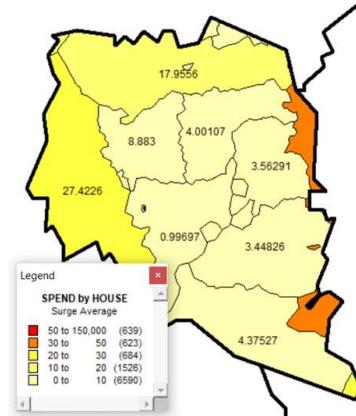
The images to the left in both examples (above and below) represent gross sector spend and those to the right, sector spend averaged across private housing population to derive a notional premium per house for the subsidence peril.

In this case, the absence of any distinct difference between surge and normal years reflects the geology.

SPEND in SURGE – STEVENAGE



Spend by Sector



Spend Averaged over Private Housing Population

