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

September 2019
Edition 172

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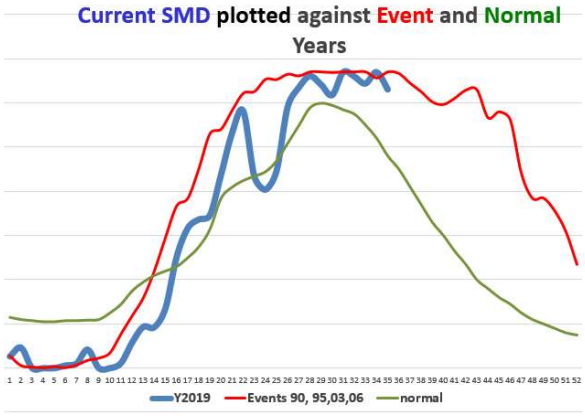
Issue 172, September 2019

2019 Surge?

The SMD continues to fluctuate by month as can be seen in the graph below.



The Met Office confirm the summer of 2019 was the twelfth hottest on record and the seventh wettest since 1910. Hours of sunshine were close to average.

Risk Modelling Upgrade

This edition introduces an extension to the 'risk modelling by district and sector' series by adding (1) a rating comparing the 'claim frequency by district' with the UK average, (2) a value per sector comparing claim spend in surge years with normal years, and (3) a 'spend per household' derived by dividing the gross sector spend by the housing population for both surge and normal years.

The values by sector and household do not include the insurer's overheads or profit, but they do take account of the claim spend, including professional fees, investigations and repairs.

The approach distinguishes between an equal count of claims in two areas with differing geologies. For example, 'x' claims in an area where houses are built on drift deposits, sands and/or gravels are likely to cost far less than the same number of claims on highly shrinkable clay soils. Their frequency and the link to weather and season of notification helps in the development of digital solutions.

This is a significant development in helping practitioners to understand risk and the importance of geology. Claim count is one thing, but understanding the importance of the date of notification and the claim value at sector level and by property adds a refinement to the A*i* model. Costs are a function of the geology and reflect the added technical component involved – site investigations and monitoring etc., as well as alternative accommodation and expert's fees.

The series will continue over the next few months covering 'average' rated districts to allow comparison with the London boroughs before we weave the output together to see the benefits to an A*i* system.

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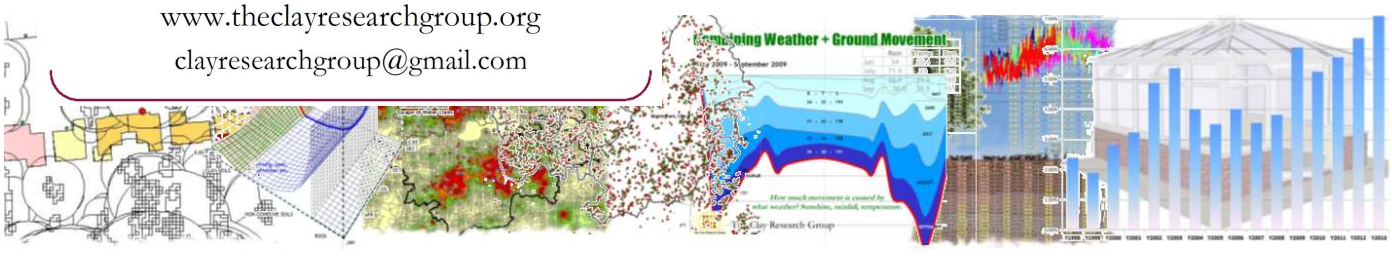

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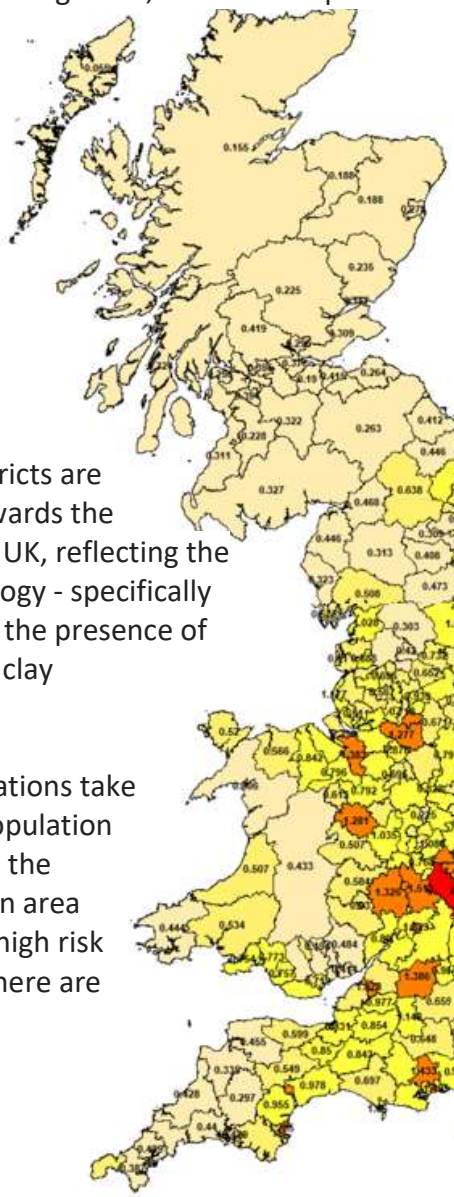
UK Subsidence - Risk Related to Average at District Level

Below, a map showing the risk by district relative to the UK average. The initial risk value has been calculated using a sample size of 103,288 claims. The output has been divided by housing population by district and the output has been normalised on a scale 0 – 1 and then all districts have been ranked relative to the average. For this initial exercise we have used 'all residential' housing stock, rather than 'private only'.



The range extends on a scale from 0 to 4. 'Average' is as a value of 1.

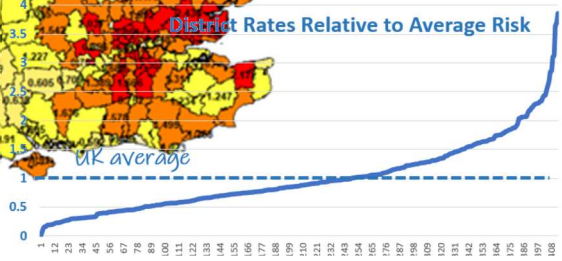
Some districts are up to 4 times riskier than the UK average - the distribution is shown in the map legend.

A similar exercise could be undertaken by month of notification etc., although from an underwriting perspective, this would add little.

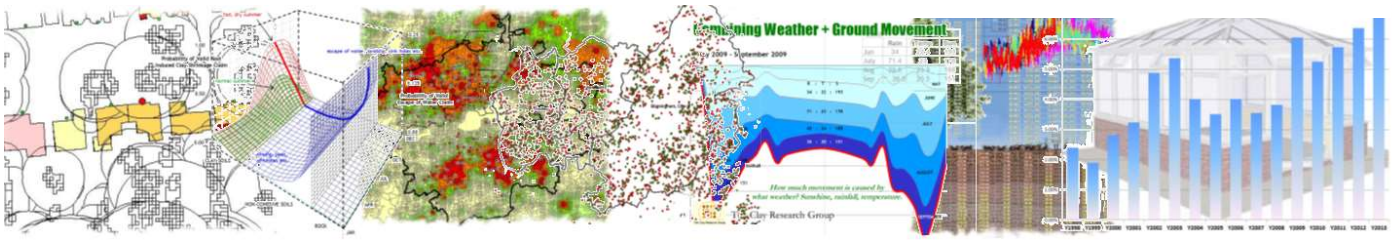
The high-risk districts are concentrated towards the south east of the UK, reflecting the link with the geology - specifically the risk posed by the presence of highly shrinkable clay deposits.

Frequency calculations take account of the population density removing the suggestion that an area is rated as being high risk simply because there are more houses.

Below, a graph showing the risk distribution across the UK. The horizontal dotted line indicates the location of the average.



Charting the risk values over 413 districts to establish the relative risk when compared with the UK average.



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Aggregate Subsidence Claim Spend by Postcode Sector and Household to Derive Risk and Premium in Surge & Normal Years.

Two claim samples have been used for this exercise, one with a gross annual spend of slightly over £410m to replicate a surge year (in the 2003 surge year, 55,400 claims were registered by the ABI with a total cost of £390m) and another with a gross spend of just under £200m to replicate a normal year (in 2002, 32,000 claims were registered by the ABI with a total cost of £183m).

The aggregated average cost by postcode sector across the UK at times of surge for clay soils = £110k, and for escape of water claims= £26k. In normal claim years, the difference is far less – clay shrinkage claims probably cost around 20 – 30% more than subsidence claims resulting from water escaping from drains, water services etc., variable by season and year.

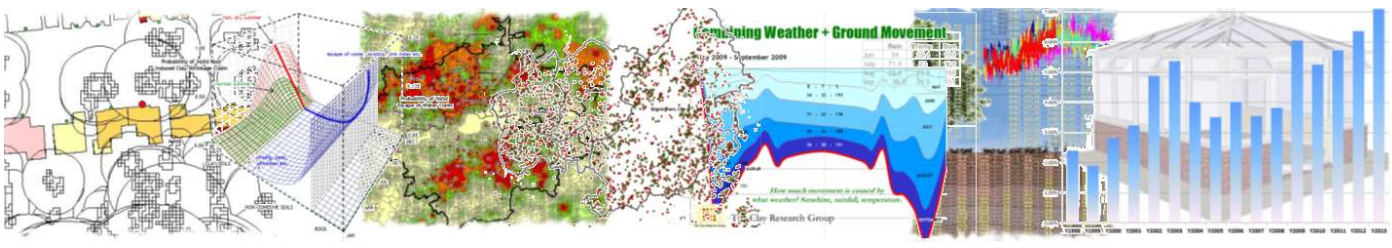
The study calculates a total spend per postcode sector across the UK both at times of surge and in a normal year. It then goes on to divide the sector aggregate by the number of individual households to derive an idea of the premium applicable to the subsidence peril by household. The output takes no account of insurer's profit or overheads.

An example of the difference between surge and normal years is illustrated on the following page.

Future articles on risk modelling will include maps comparing the outcomes and providing a rating of how that district compares with the UK average. In this edition, we look at the risk in Macclesfield.

Recording the value of the claim adds value in terms of an **A*i*** application. The figure reflects the complexity of the claim, including site investigations, soil testing, the appointment of experts and monitoring for example, and alternative accommodation. Duration is another factor, adding to the existing parameters of count of claims and date of notification.

By joining the datasets (count of claim and value) the system can determine if it was a one-off event (landslip, swallow hole etc.) or a recurring peril.



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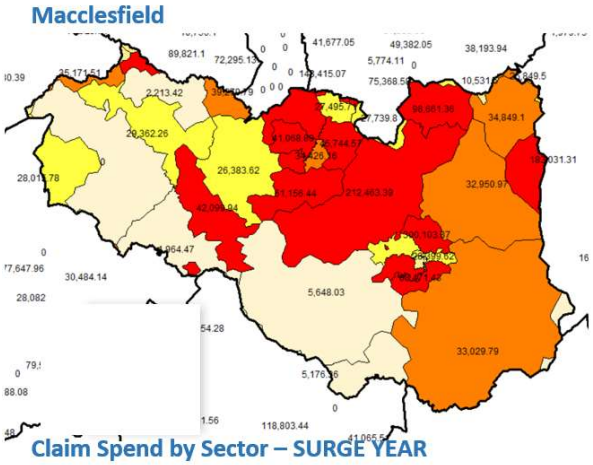
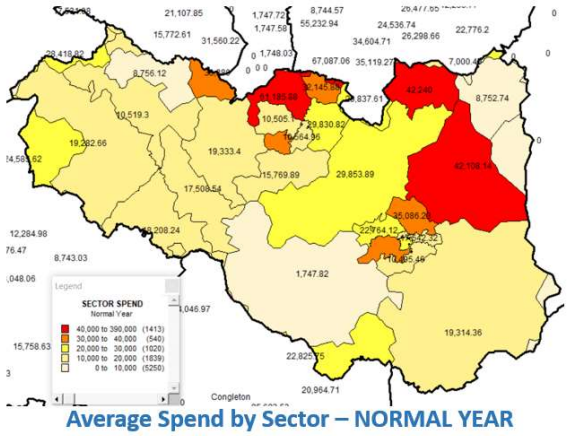
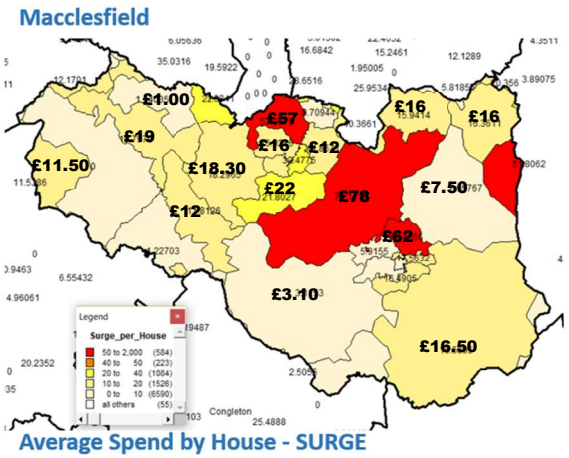
Aggregate Subsidence Claim Spend by Postcode Sector and Household to Derive Risk and Premium in Surge & Normal Years *...continued*

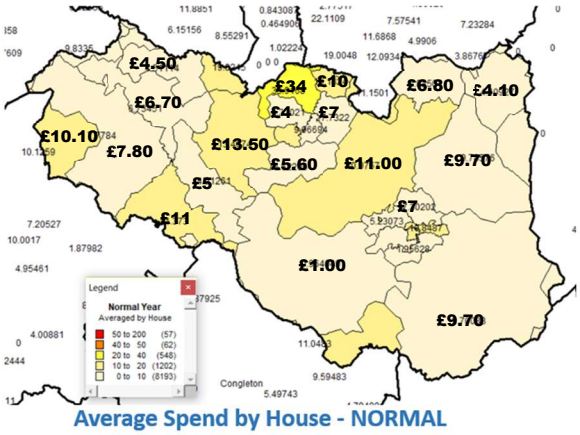
The maps below show the aggregated claim cost from the claim sample per postcode sector for both surge (left) and normal (right) years. The figures reflect the study sample and will vary by the insurer's exposure and distribution.

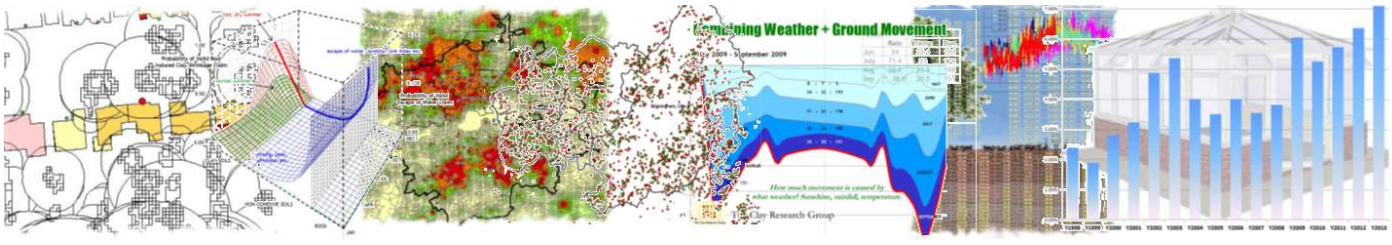




Not all areas see an increase in cost associated with surge, reflecting the variable geology. It will also be a function of the distribution of vegetation and age and style of construction of the housing stock. See page 8. Below, sector spend averaged across housing population to derive a cost per house. Figures published by the ABI suggest that the average sum spent on subsidence in normal years is around 4% of total spend.







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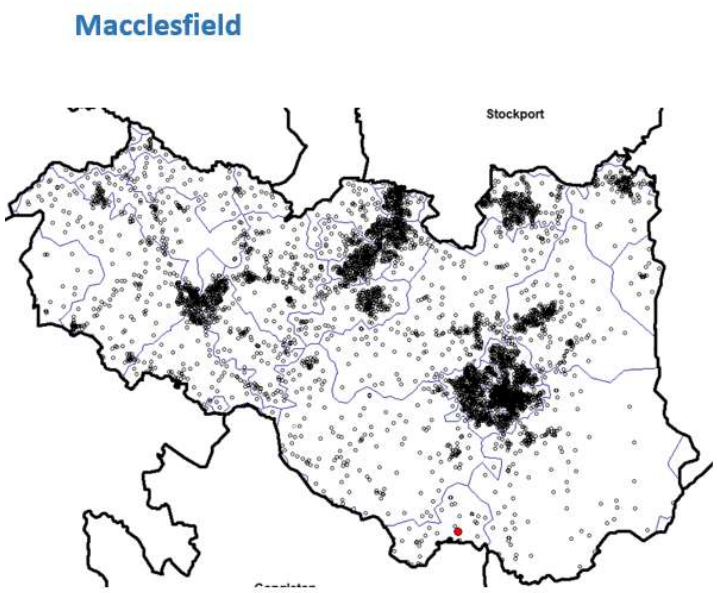
Subsidence Risk Analysis – MACCLESFIELD



Mapping housing distribution across the districts clarifies the risk maps on the following pages.

Some areas are indicated as low risk due to low density housing population, and others a high risk due to housing density. Whilst frequency estimates help to resolve this, large differences of the sort seen here can influence the output.

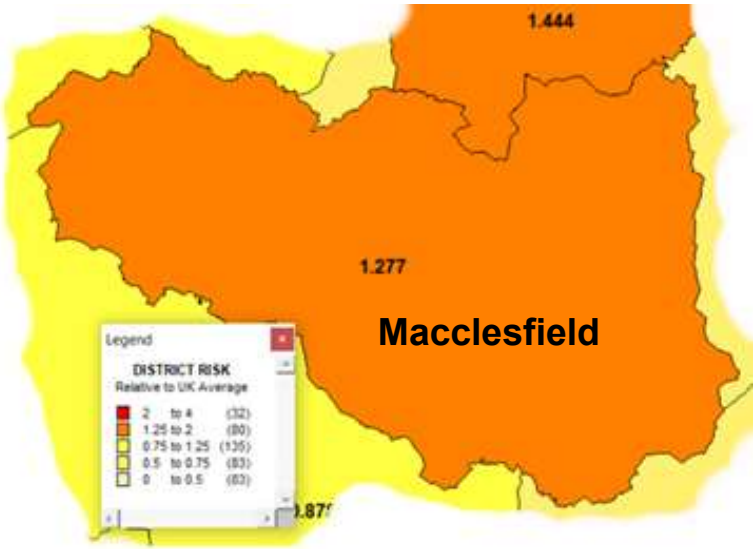
Below, a map ranking district according to their standing in relation to the UK average.

Macclesfield is rated as being 1.277 times the risk of subsidence in terms of claims frequency of the UK average, a value that may initially appear surprising given the heterogenous nature of its geology.

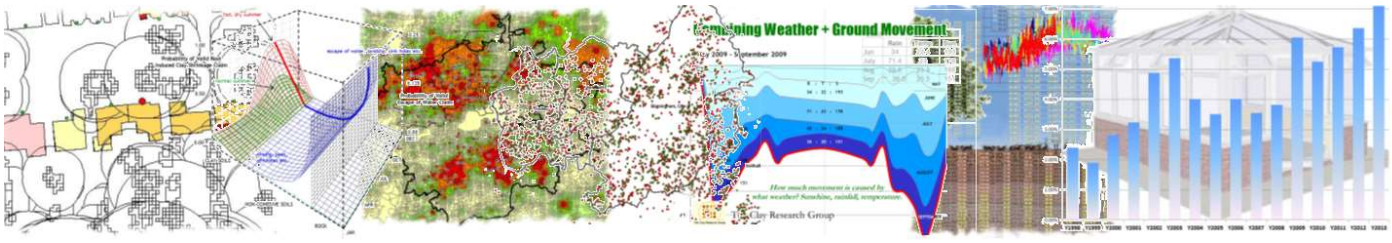
Its standing reflects the large number of districts rated as being low risk.

The highest risk rating is a value of 4 and the map of the UK on page 4 illustrates the distribution.

The map legend lists ratings relative to the UK average and it can be seen there are 80 districts out of a total of 413 with a rating between 1.25 and 2. 32 districts fall into the high-risk category with values between 2 and 4.



Macclesfield is rated 1.277 times the risk of subsidence compared with the UK average at district level. This is a reflection of the low rated risk values of the majority of districts.



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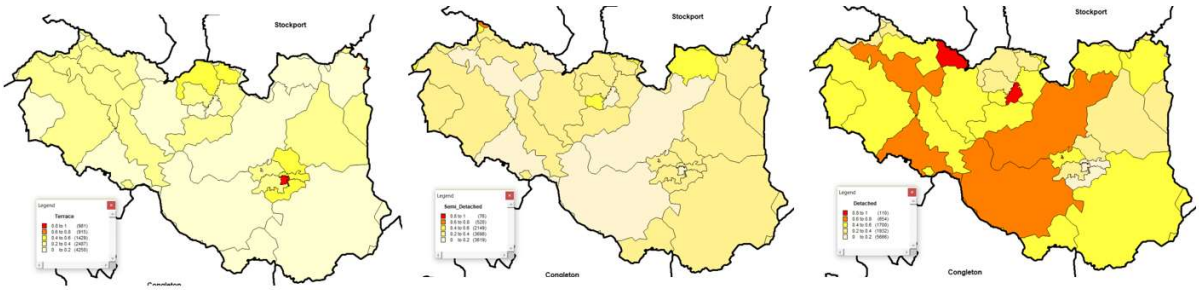
MACCLESFIELD - Properties by Style and Ownership

Below, the general distribution of properties by style of construction, distinguishing between terraced, semi-detached and detached.

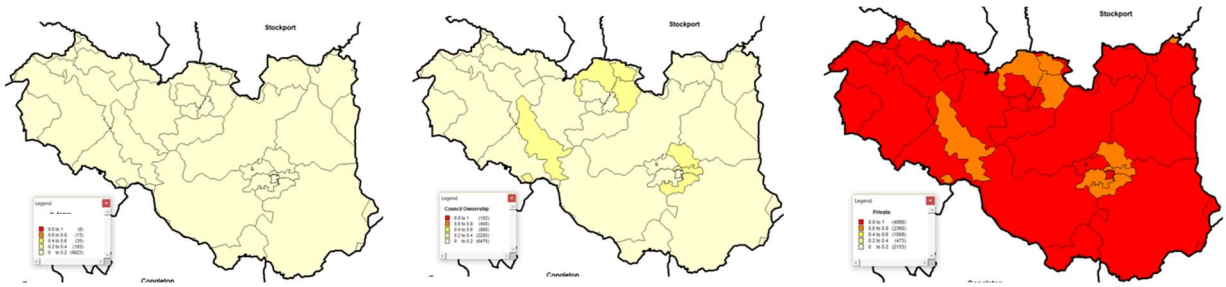
Macclesfield District - Distribution by House Type



Terraced **Semi-Detached** **Detached**

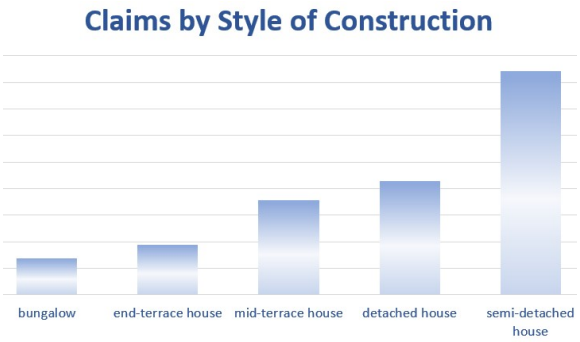
Distribution by ownership is shown below, revealing a high population of privately-owned properties across the borough.

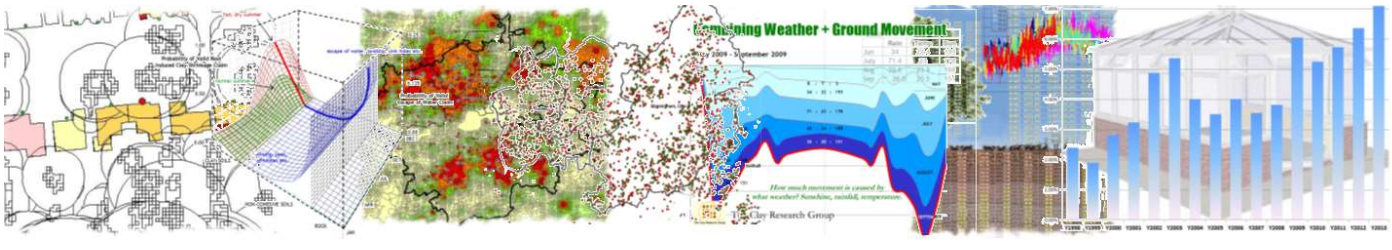
Macclesfield District - Distribution by Ownership



Housing Association **Council Ownership** **Private Ownership**

No link between style of property and risk is evident from a visual assessment – a more detailed analysis is underway to compare claims data with distribution by house type at sector level to refine our understanding. Right, an extract from a claims database covering the UK plotting 'count by style of construction' but without account being taken of house population by area to derive frequency – and risk.





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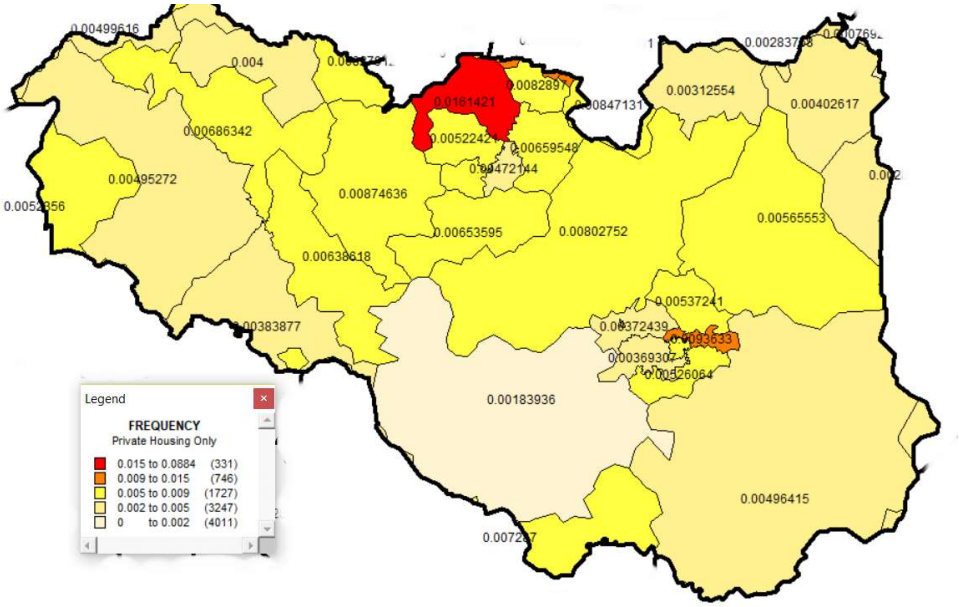
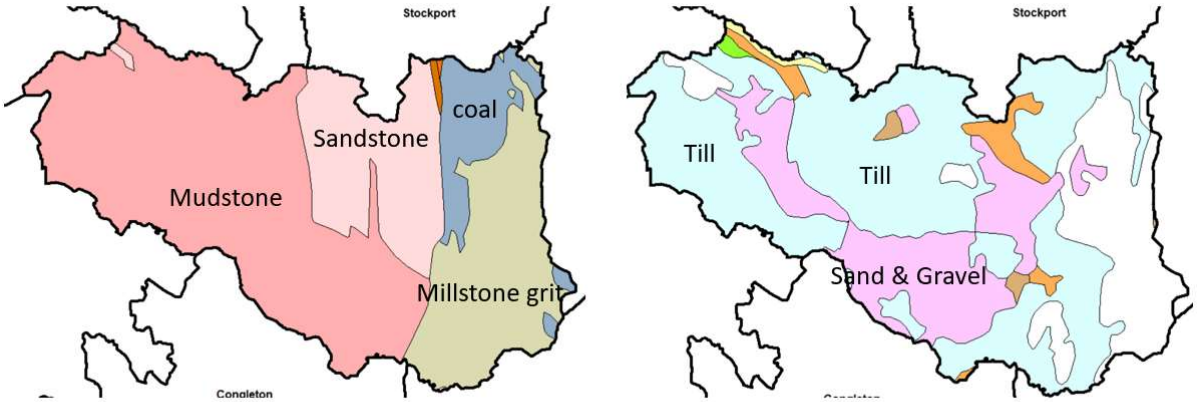
Subsidence Risk Analysis - MACCLESFIELD

Macclesfield comes 118th out of 413 districts in our 'rank order of risk' table for claims frequency, and rated at 1.277 compared with the UK average for spend. The map below shows frequency distribution for private housing from our claim sample – these are not industry annual values.

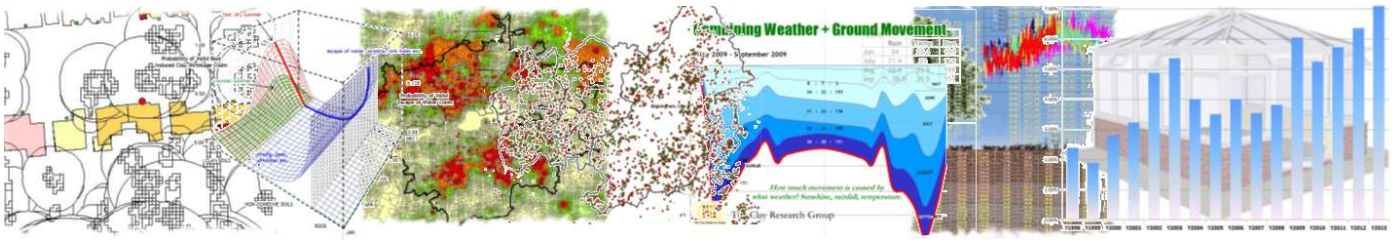


Below, extracts from the British Geological Survey maps showing the solid and drift series. Go to:
http://mapapps.bgs.ac.uk/geologyofbritain/home.html?location=macclesfield&gobBtn=Search
for more information. The drift deposits (sand, gravel and till), peat, alluvial soil and Westphalian measures explain the variable nature of claims in terms of peril and liability and the reduced sensitivity to surge. See page 12 for a seasonal analysis, showing that the probability of a claim being due to either clay shrinkage or escape of water is approximately equal.

Macclesfield District - BGS Geology – 1:625,000 scale low resolution mapping



SOLID **DRIFT**



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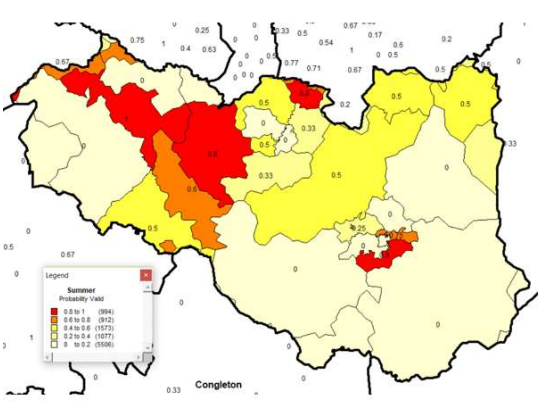
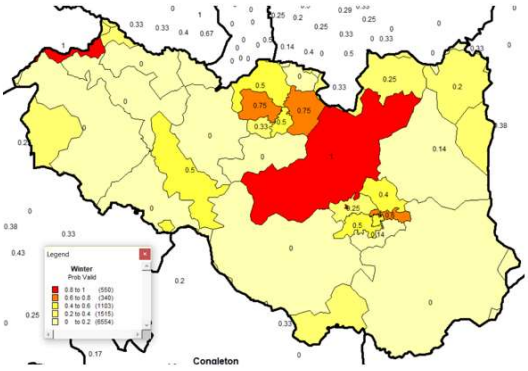
MACCLESFIELD - Liability by Season and Geology

Macclesfield District



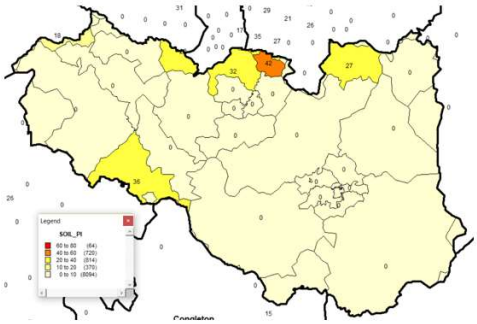
Probability Valid, Summer



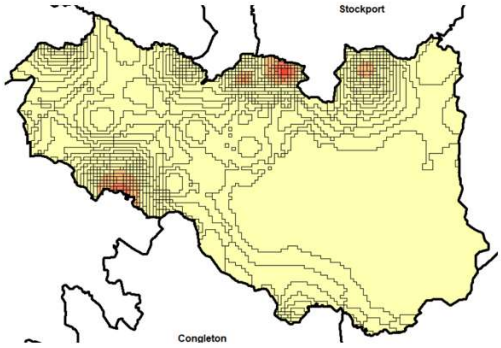
Probability Valid, Winter

Above, the probability of whether a claim is likely to be valid or declined by season, and below, determining if there is a link with the underlying geology by making reference to the CRG 250m grid plotting soil by PI. As we have mentioned in earlier issues clay soils respond to warm, dry summers, but deliver far fewer claims in the winter months. Houses on non-cohesive soils tend to deliver fewer claims overall, but with little change by season. The shrinkable clay content within the till deposits has a variable PI where present, reaching a maximum of 42% in one sector - see CRG map below.

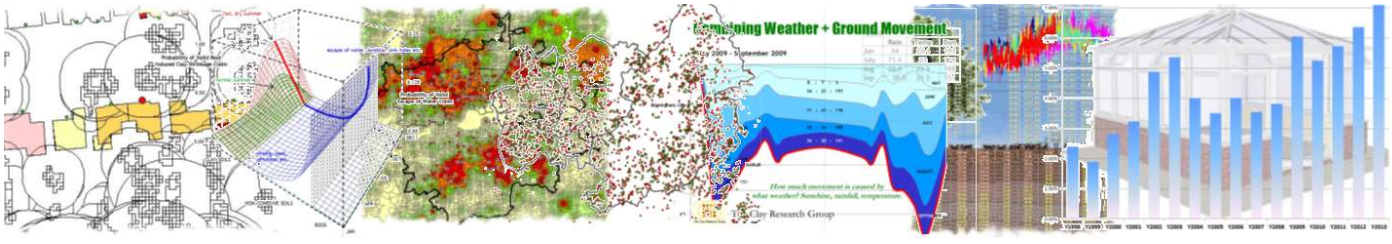
Macclesfield District – Soil Plasticity Index



Soil PI Averaged by Sector



PI Interpolated on 250m CRG grid



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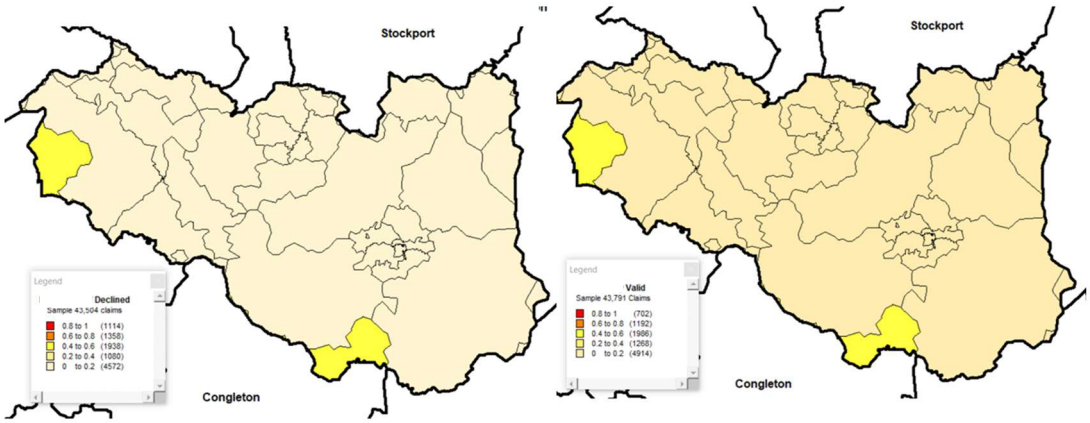
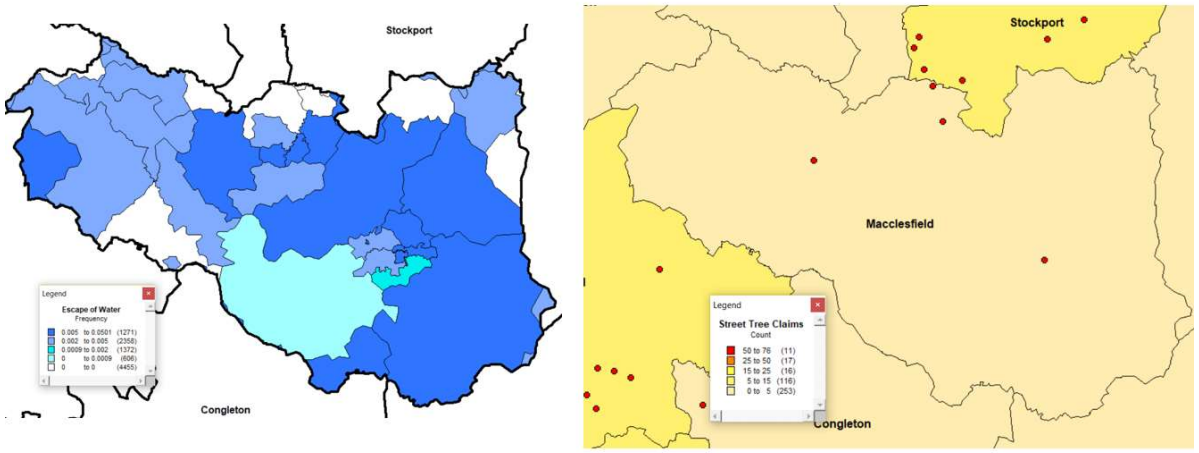
MACCLESFIELD - Liability by Sector. Escape of Water and Council Tree Claims Distribution

Macclesfield District – Liability Distribution

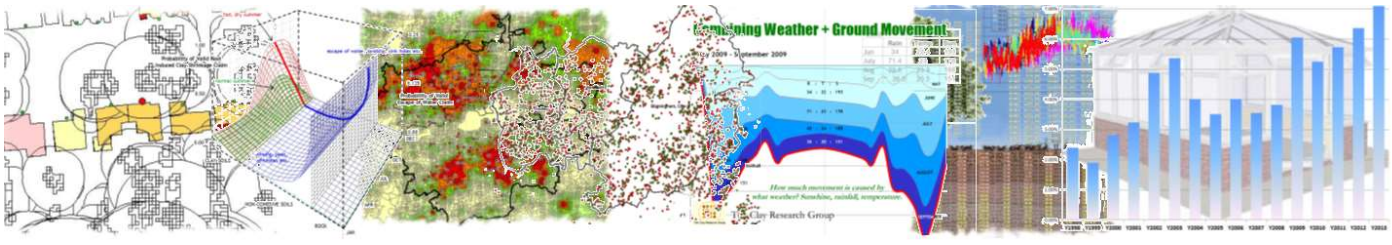


Declinatures | Valid Claims

Above, mapping liability and plotting distribution of valid and declined claims for the sample size shown, not taking into account any seasonal influence. Below left, mapping the frequency of Escape of Water claims from the sample, showing the concentration to the east of the district, corresponding with the presence of the predominantly non-cohesive and alluvial soils. Below right, dots on the 'Council Tree Claims' map, represent properties where damage has been attributable to vegetation in the ownership of the local authority to determine if there is what is known as a 'hot spot'. The low numbers – and consequentially the absence of a hot spot - reflect the absence of outcropping homogenous, highly shrinkable clay soils.



Escape of Water Frequency Distribution | Street Tree Claims



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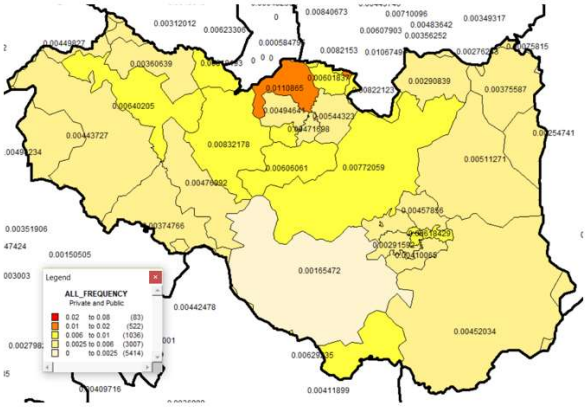
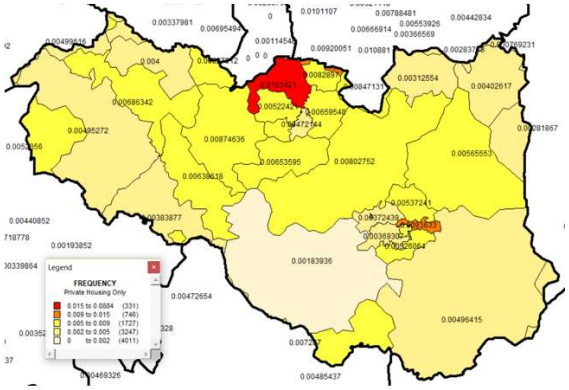
MACCLESFIELD - Frequencies, Count & Probabilities

Macclesfield District



Sector Risk - All Housing



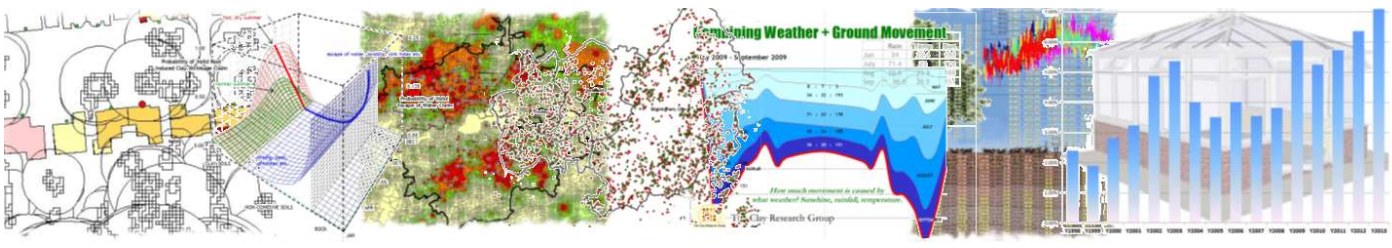
Sector Risk - Private Housing Only

The maps above reflect the relatively high percentage of private housing in the district. Below, the figures reveal a borough with a more variable risk than those to the south east of the UK in terms of subsidence, and by season. The chances of a claim being declined in the summer are around 38%, and if it is valid, there is a 50 – 50 chance of the cause being either clay shrinkage or escape of water. In the winter, the repudiation rate is around 30%, and if it is valid, the chance of a claim being due to an escape of water or clay shrinkage are again 50 – 50.

The figures reflect the variable geology. By contrast, a borough like Harrow with a large coverage of outcropping London clay, has a likelihood of a valid claim being due to clay shrinkage of around 70% in the summer, falling dramatically in the winter months. Data is of course less reliable when there is geological variability across the district, as is the case here, when sector level analysis is preferable.

Liability by Season - Macclesfield District

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Macclesfield	0.319	0.299	0.382	0.36	0.34	0.302



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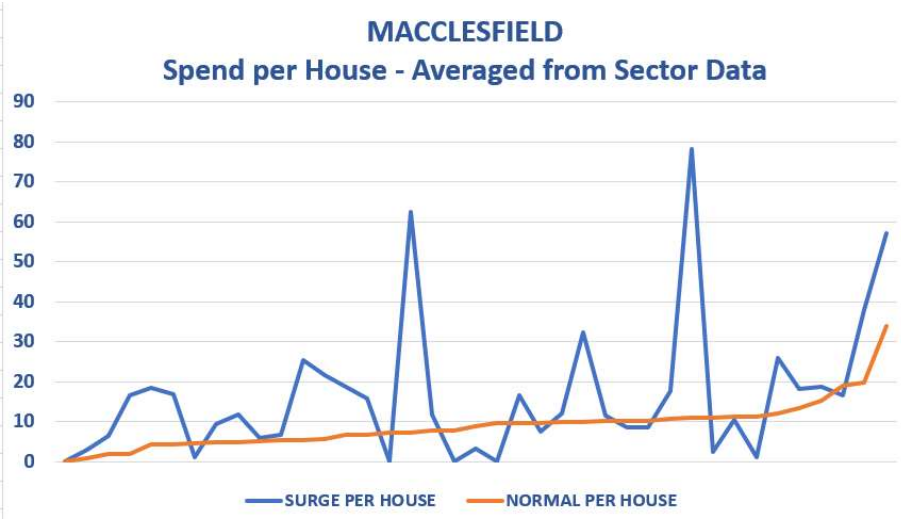
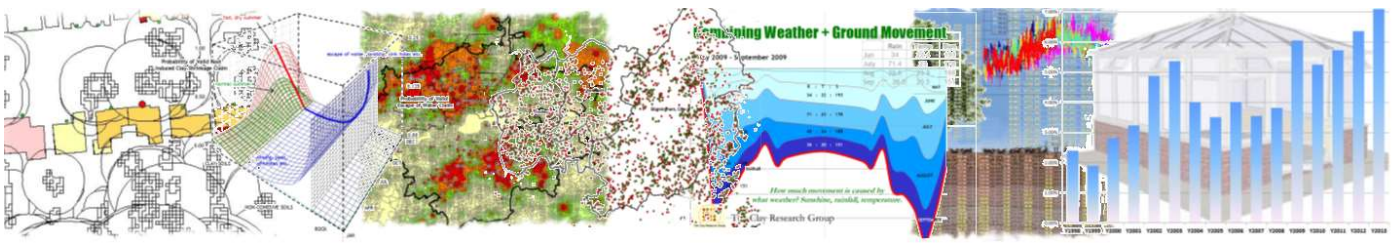
Spend per House Averaged from Sector Data

Taking the spend on subsidence claims for both surge and normal years, and dividing by the housing stock by postcode sector to derive a value per property delivers the following:



The peaks and troughs reflect the variable risk by postcode sector and take into account frequency. The 'y' axis plots the value in pounds, giving an average per property across the district of approximately £9 in normal years and £16 in surge.

The surge response identifies three or four high risk sectors. Elsewhere, differences in the figures are likely to reflect normal variability.



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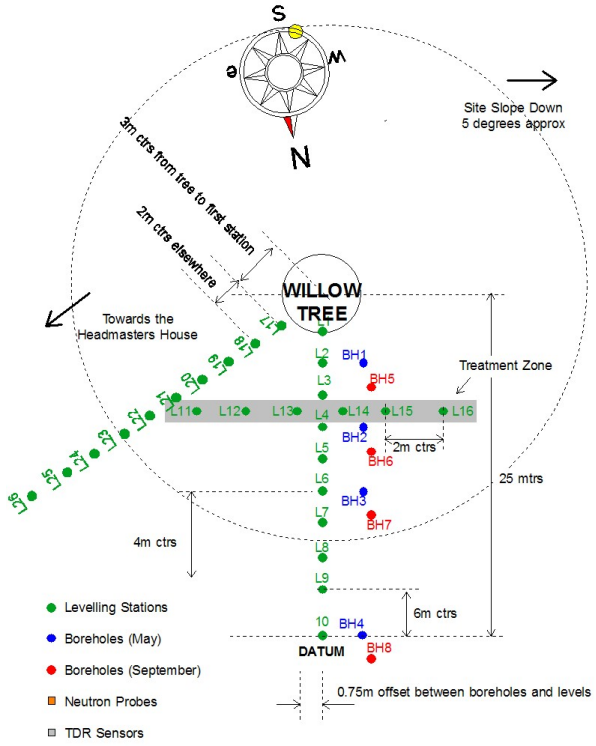
Aldenham Willow – Precise Levels Update

Precise levels have been taken at Aldenham since May 2006. Levels are taken by Geo-Serv Limited and funded by Crawford & Co. Below, a map of the willow tree showing the location of the levelling stations. Array 1 includes stations 1 to 9 inclusive, and array 2, stations 17 to 25. The datum is Station 10.

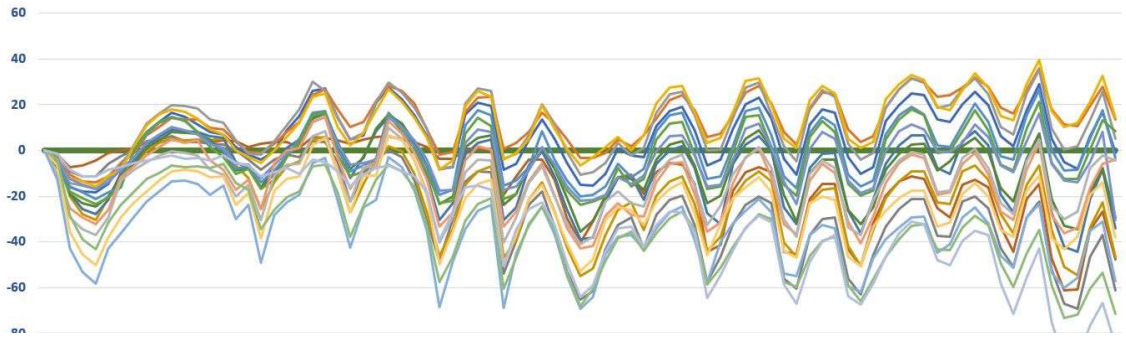


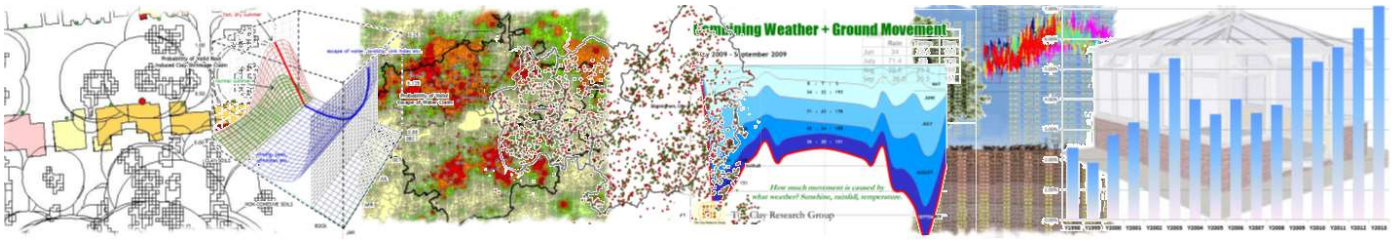
Generally (and there are few exceptions), ground subsidence is greater towards the root periphery, and stations closer to the tree are showing signs of 'normal' seasonal movement with recovery (i.e. rehydration) from the initial position in 2006.

Below, data for all stations plotted showing both the matching seasonal pattern of the stations over time and the variation in terms of subsidence/recovery.

Along array 1, stations 1 – 4 show a regular seasonal rise and fall, with some recovery whereas stations 5 through to 9 exhibit subsidence below the starting point. Along array 2, stations 17 – 19 show a regular seasonal pattern and from station 20 outwards, increasing subsidence.

Ground Movement, Aldenham Willow, from 25th May 2006 to 22nd July 2019





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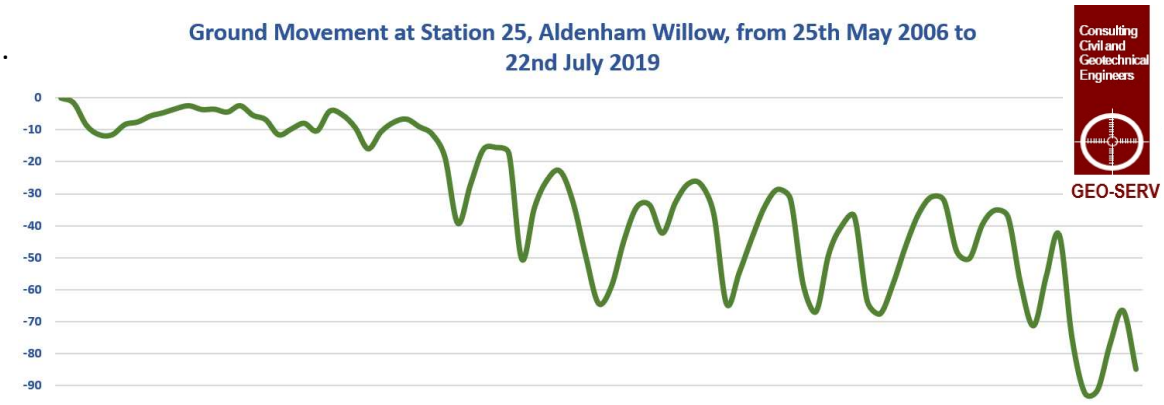
Aldenham Willow – Precise Levels Update *... continued*

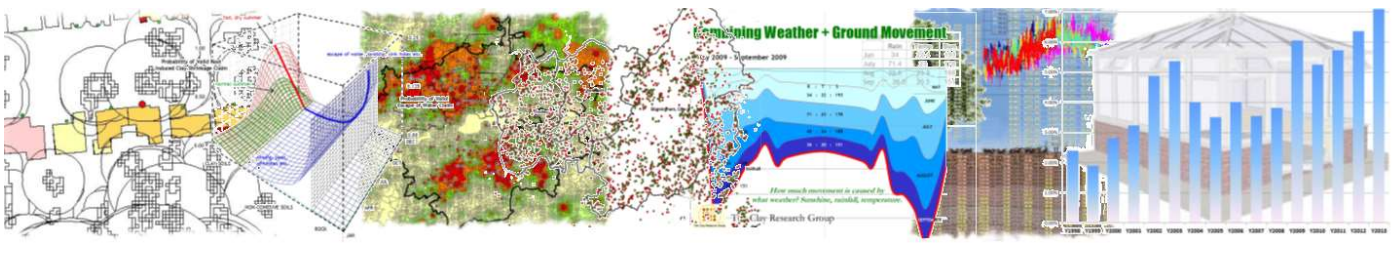
Below, stations 25 (top) and 1 (bottom) plot the trends.



Maximum recorded subsidence of 92.4mm occurred at Station 25 on the reading taken on the 6th September, 2018. This is situated towards the root periphery.

Interestingly given the above, maximum recovery was measured at Station 1, nearest to the willow. See below. Roots at the periphery of the root zone are responsible for maximum water uptake, while those nearer to the tree have become less active, allowing some ground recovery.

The readings reflect the moisture uptake of the willow, with the persistent deficit closer to the tree, gradually rehydrating since monitoring commenced, and the peripheral root system, spread over a much larger area, playing a greater role in moisture uptake and in the process, developing a persistent deficit.



The Clay Research Group