

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 2022

Issue 208

The Clay Research Group

CONTENTS

Issue 208, September 2022

Pages 2 - 3

Precise Level Update for the Aldenham Willow

Page 4

Spiralling Bark

TDAG Online Seminars

Page 5

Subsidence Forum Training Day

July-August Rainfall

ABI Claims Data

Page 6

Sector Level Analysis

Pages 7 - 14

Subsidence Risk Analysis – CANTERBURY

District and Sector Risk

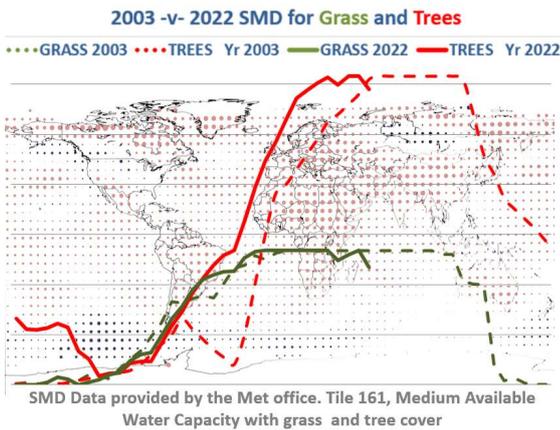
Canterbury is the topic of the District Risk series in this month’s edition and increased resolution is provided with examples at postcode sector level.

The study includes a review of cause and liability by season, providing a useful reference for underwriters, engineers and claim handlers.



Soil Moisture Deficit

Below, SMD values provided by the Met Office from the Heathrow weather station, for both grass and tree cover.



The profiles for both continue to follow the 2003 event year.

THE CLAY RESEARCH GROUP

www.theclayresearchgroup.org

clayresearchgroup@gmail.com

Subsidence Claim Numbers

As expected, given the warm, dry weather experienced throughout July (see last month’s newsletter) and particularly in the south east, claim numbers have increased significantly. See page 5 comparing July and August rainfall with Met Office anomaly maps for the period 1981 – 2010.

Contributions Welcome

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

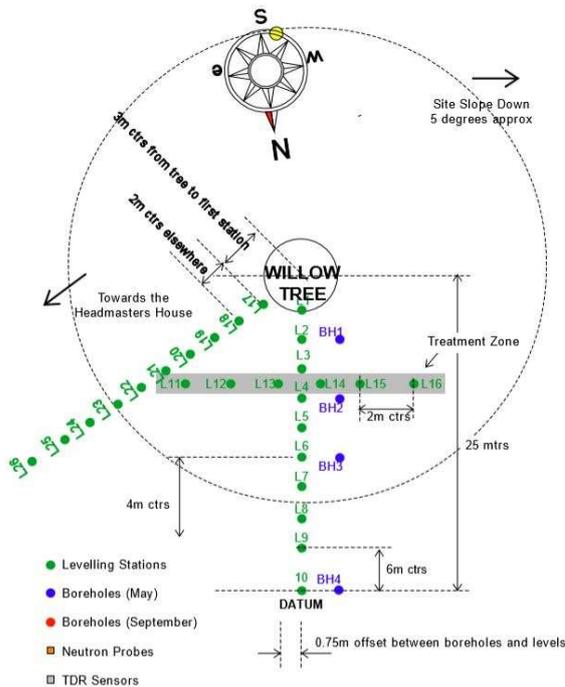
clayresearchgroup@gmail.com



The Clay Research Group

Precise Level Update – Aldenham Willow

Precise levels were first taken at the site of the Aldenham willow in May 2006, over 16 years ago. On the following page are graphs recording ground movement which were updated last month. Below, the site layout showing the location of the level stations.

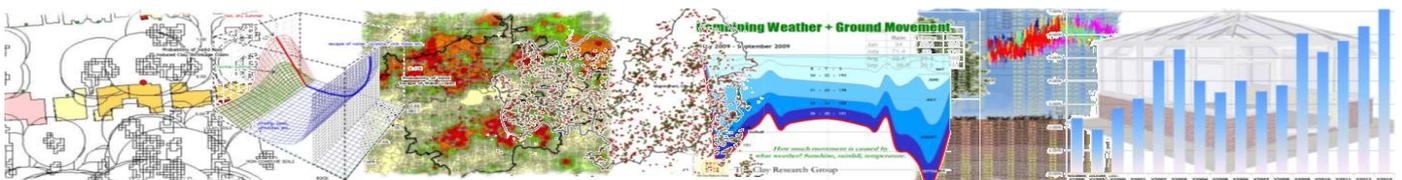
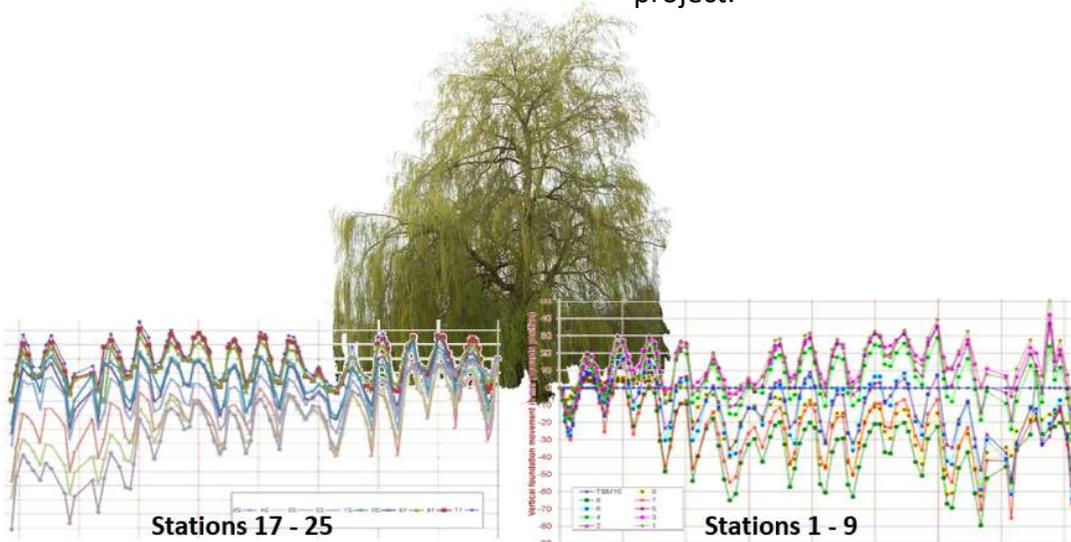


The 10m deep datum is 25m away from the tree which, when measured some 10 years ago, was 14m high.

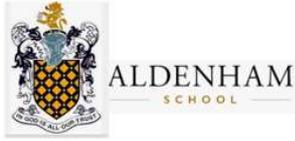
Below, a diagrammatic illustration of ground movement over time in relation to tree height to give some indication of root spread.

Detailed graphs of ground movement for the stations radiating away from the tree (i.e. omitting stations 11 to 16) are shown on the following page.

In next month's edition we look at stations where recovery has taken place and compare recorded movement with estimates of swell from the site investigations and laboratory analysis undertaken at the beginning of the project.



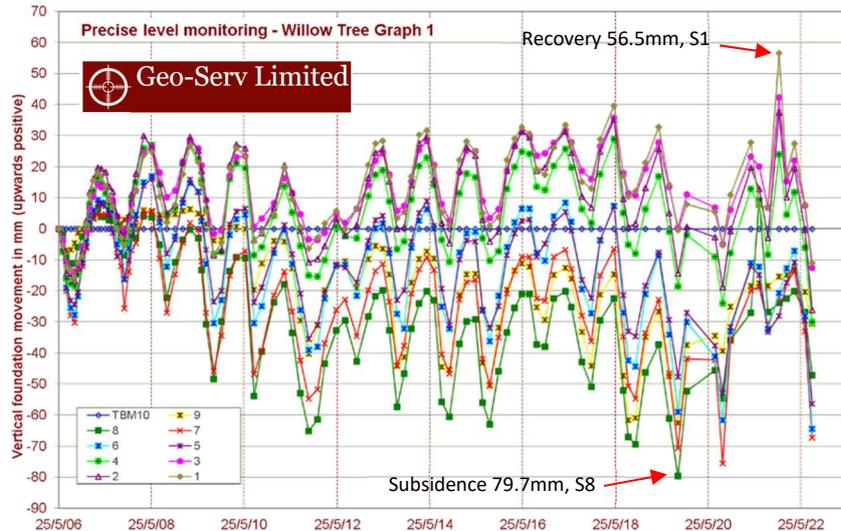
The Clay Research Group



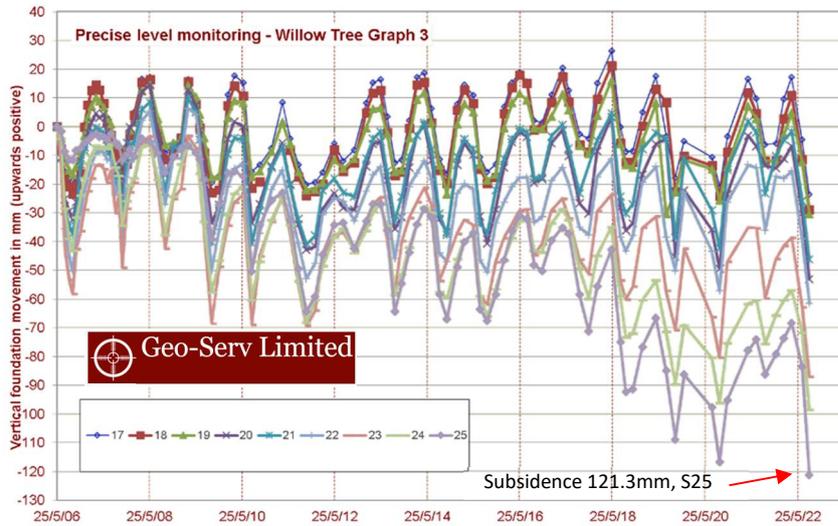
Precise Level Update



The clay soils were already desiccated when the first readings were taken in May 2006, as can be seen from recovery in subsequent years, exceeding 50mm at Station 1, graph 1, taken in December 2021.



Maximum subsidence of 121.3mm has been recorded at Station 25, around 21mtrs from the tree.



Our thanks to Aldenham School for allowing access to the research site over the last 16 years, to GeoServ Ltd., for taking the levels and Crawford for funding the exercise.



The Clay Research Group

A Spiralling Bark



Jon Heuch, Duramen Consulting, was kind enough to identify the tree in the photograph, left, sent in by a reader.

“Sweet chestnut, *Castanea sativa*. Introduced in Roman times for the chestnuts, although some disagree. Potentially a very large tree but often managed in coppice for the wooden poles for fencing etc.

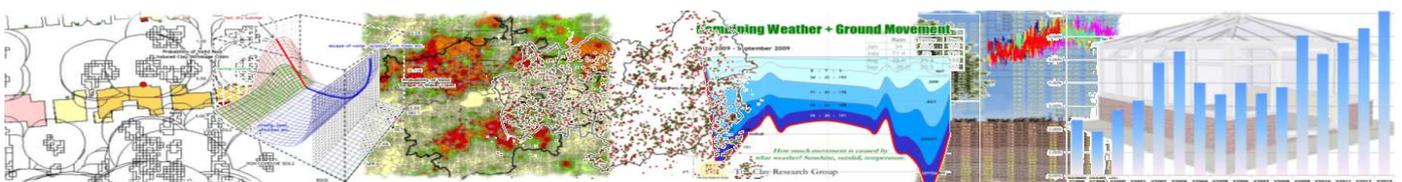
Spiralling bark is a bit of a giveaway although other species can have spiralling bark, this is quite distinctive.”

This specimen was situated at Montacute House, South Somerset, owned by the National Trust.

TDAG Online Seminars

Sue James of the Tree Design and Action Group (TDAG) has notified a meeting on the 14th September, scheduled to run from 2 – 4pm to present and discuss the new short guide entitled First Steps in Trees and New Developments. The link is <https://www.eventbrite.co.uk/e/tdag-meeting-working-with-trees-on-new-developments-tickets-411567006997>

On 4th October, a seminar is scheduled to review the relationship between trees and mental and physical health and wellbeing. TDAG will be joined by the Landscape Institute and the Town and Country Planning Association (TCPA). The link to join the seminar is: 4th October, <https://www.eventbrite.co.uk/e/trees-and-mental-and-physical-wellbeing-tickets-410766251917>



The Clay Research Group

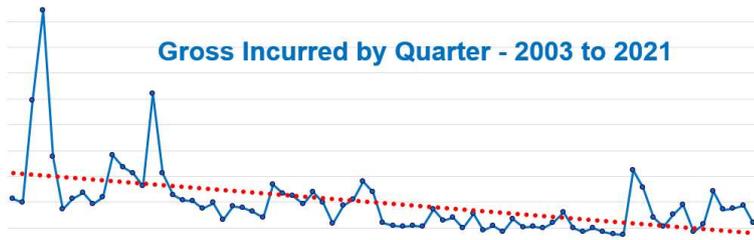
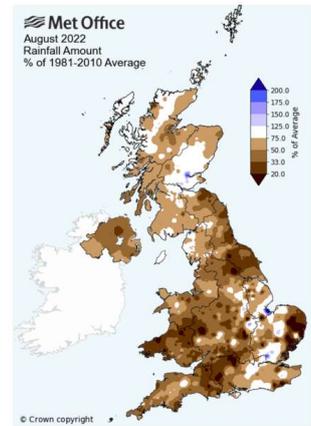
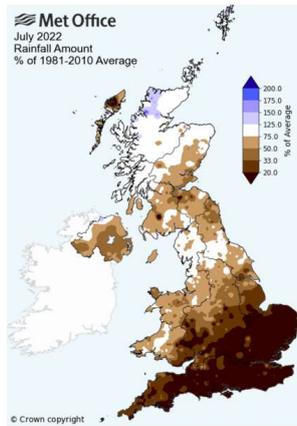
Subsidence Forum Training Day

The Forum have arranged a training day at Tewin Bury Farm, taking place on the 13th October, 2022. Topics covered will include drainage repairs, identification of trees, boreholes, laboratory testing of soils, monitoring and ground strengthening. For details visit their web site at <https://www.subsidenceforum.org.uk/>.

July – August Rainfall

Met Office anomaly maps showing rainfall in July and August of 2022 compared with the 1981 – 2010 average.

July had less than 20% of the rainfall for the 30 year average in the south east, easing in August to match the average in parts.



ABI Claims Data

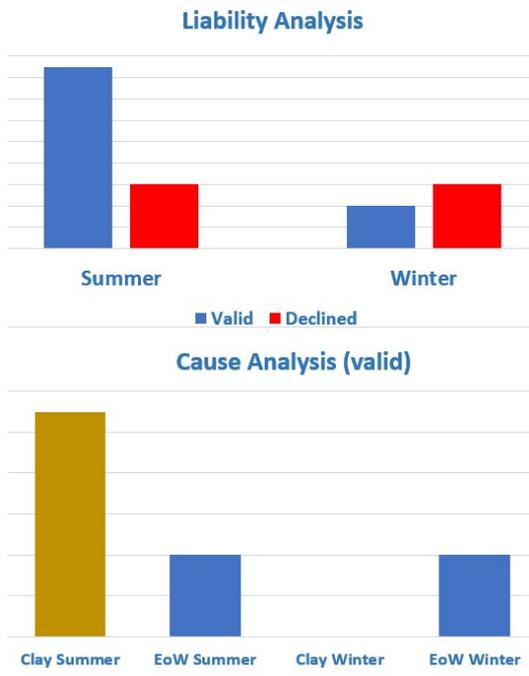
The gradual decrease in claim numbers and associated fall in gross spend by quarter for the period 2003 to 2021 are shown on the graphs, left.

The third quarter of 2018 – a surge – is shown by a red arrow. Recent weather patterns as shown above suggest we may see a similar profile for the current year.



The Clay Research Group

Using Past Claims Data to Infer Geology and Derive Probability of Cause and Liability – Sector Level Analysis



CT6 7 – 74% of claims accepted as valid in the summer and around 40% in the winter. It is rated 3.7 times the UK average risk.

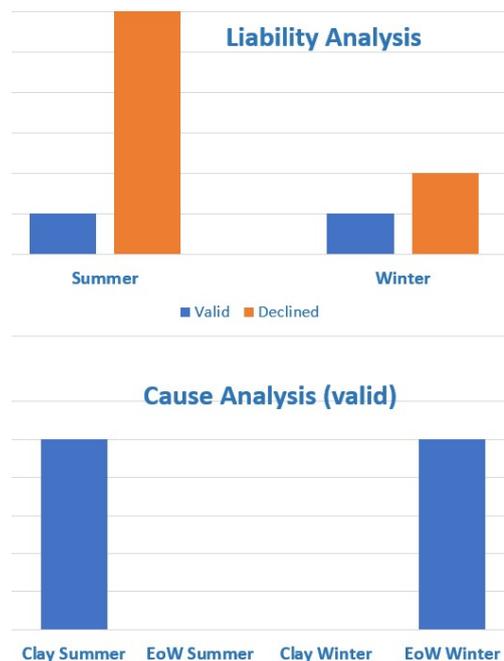
Clay shrinkage is the dominant cause of subsidence in the sector in the summer. No clay shrinkage claims are recorded in the winter from the sample we hold. The count of claims related to an escape of water are the same in the winter and summer.

The BGS maps show a solid geology of outcropping London clay with no drift deposits, which accounts for the summer claim profile.

CT2 9 – Situated to the north west of the district with predominantly clay shrinkage claims in the summer and escape of water claims in the winter.

The sector is rated 4.1 times the risk of the national average. This value seems perverse given the relatively low number of claims notified. This is due to the lower density of private housing and the use of frequency (claims/private housing population) to estimate risk.

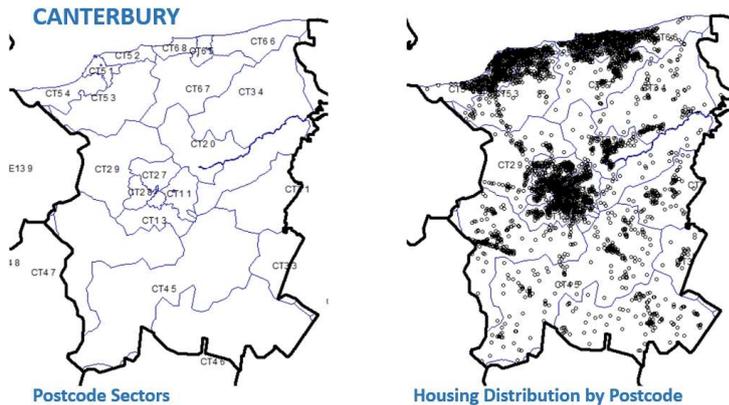
Site investigations revealed outcropping clay soil with a PI in the range 45 – 50%.



The Clay Research Group

Subsidence Risk Analysis – CANTERBURY

Canterbury occupies an area of 24km² and has a population of around 43,500.



Distribution of housing stock using full postcode as a proxy. Each sector covers around 2,000 houses and full postcodes include around 15 – 20 houses on average, although there are large variations.

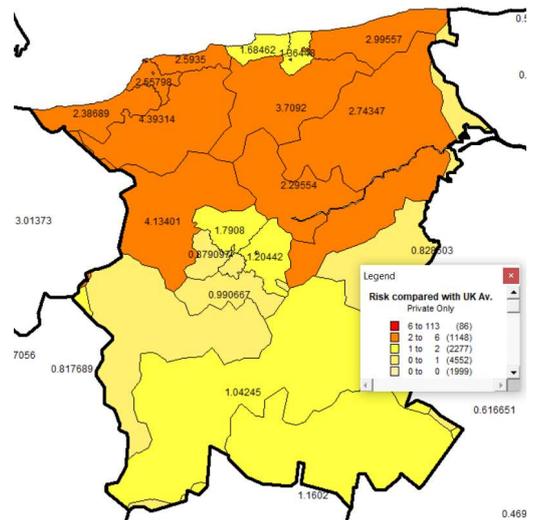
From the sample we have, sectors are rated for the risk of domestic subsidence compared with the UK average – see map, right.

Canterbury is rated 24th out of 413 districts in the UK from the sample analysed and is around 2.1x the risk of the UK average, or 0.56 on a normalised scale.

There is an increased risk to the north of the borough as can be seen from the sector map, right.

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.



Canterbury district is rated around 2.1 times the UK average risk for domestic subsidence claims from the sample analysed. Above, risk by sector.

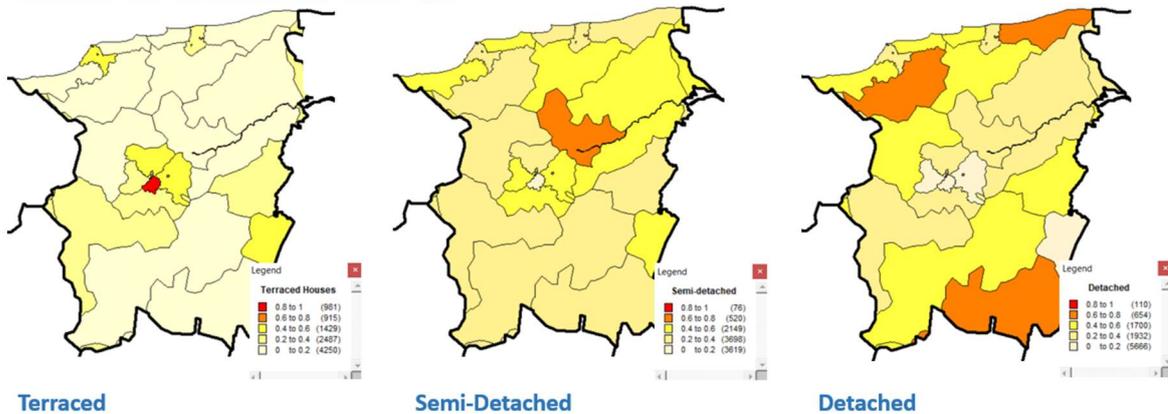


The Clay Research Group

CANTERBURY - Properties by Style and Ownership

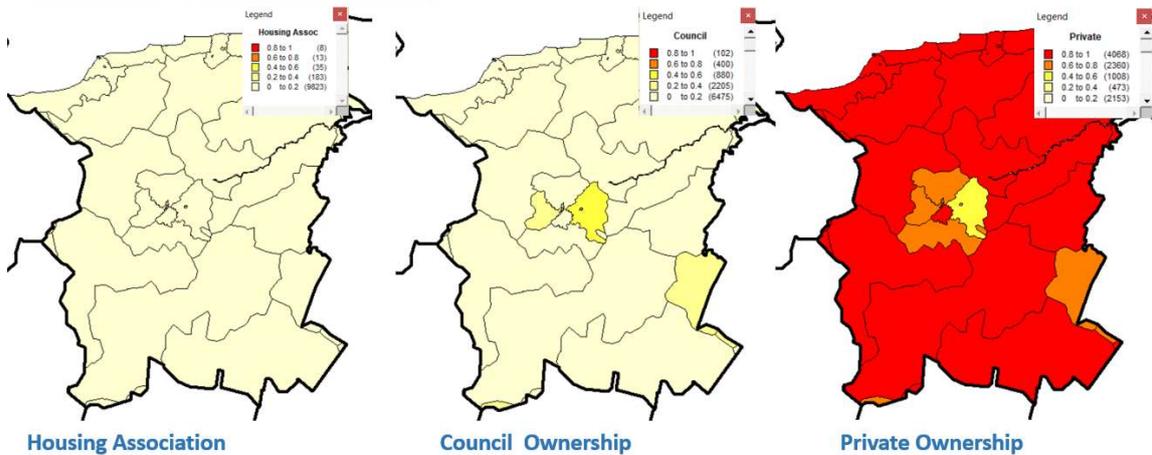
Below, the general distribution of properties by style of construction, distinguishing between terraced, semi-detached and detached. Unfortunately, the more useful data is missing at sector level – property age. Risk increases with age of property and the model can be further refined if this information is provided by the homeowner at the time of application.

CANTERBURY - Distribution by House Type



Distribution by ownership is shown below. Privately owned properties are the dominant class and are spread across the borough. See page 10 for distribution of risk by ownership.

CANTERBURY - Distribution by Ownership



The Clay Research Group

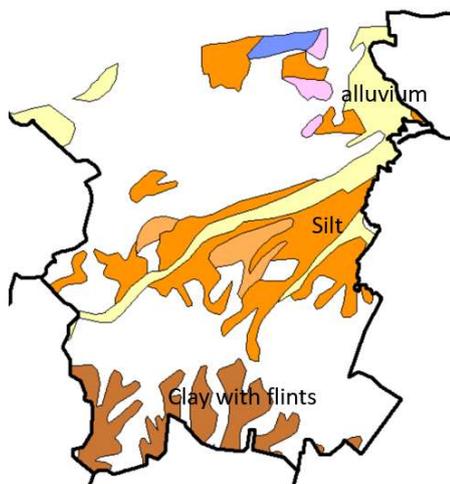
Subsidence Risk Analysis – CANTERBURY

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.

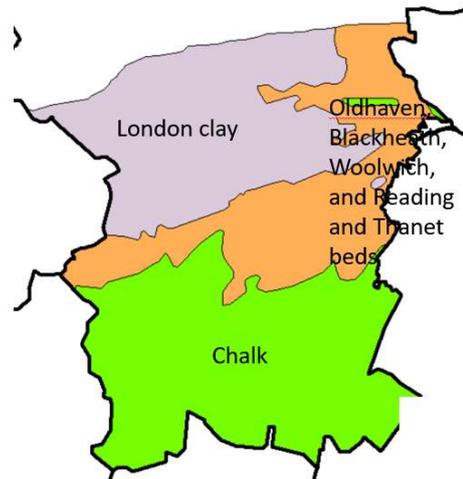
See page 12 for a seasonal analysis of the sample we hold which reveals that in the summer there is slightly less than 76% probability of a claim being valid, and of the valid claims, there is a high probability (around 85% in the sample) that the cause will be clay shrinkage.

In the winter the likelihood of a claim being valid is around 31% - and if valid, there is a slightly less than 90% probability the cause will be due to an escape of water. Maps at the foot of the following page plot the seasonal distribution.

CANTERBURY : BGS Geology – 1:625,000 scale



DRIFT DEPOSITS



SOLID GEOLOGY

1:625,000 series British Geological Survey maps. Working at postcode sector level and referring to the 1:50,000 series maps deliver far greater benefit when assessing risk. Clay shrinkage is the dominant cause of valid claims in the summer, associated with the outcropping clay to the north of the district. Escape of water is the dominant peril in the winter months.

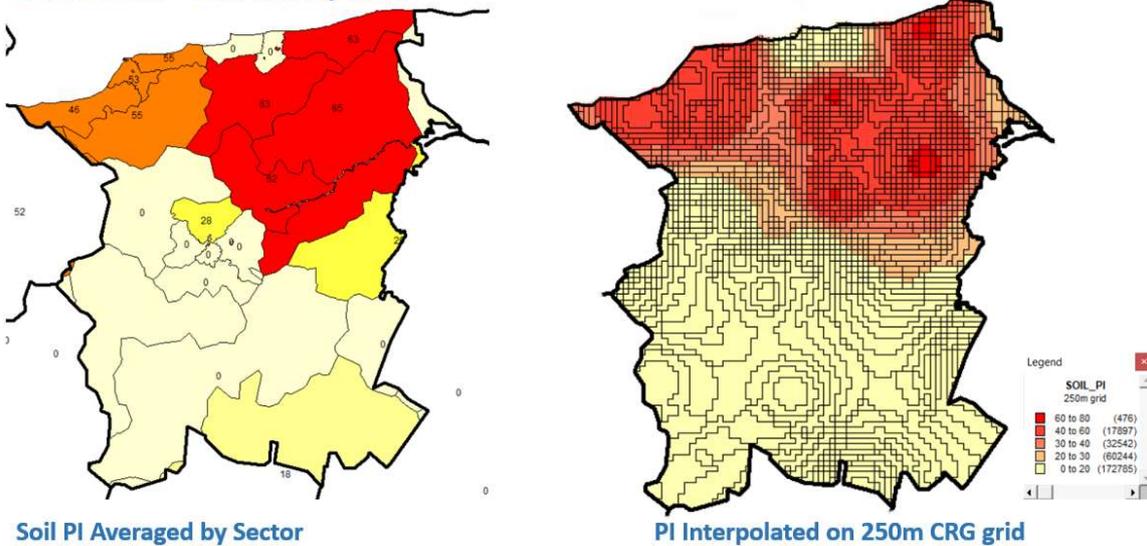


The Clay Research Group

Liability by Geology and Season

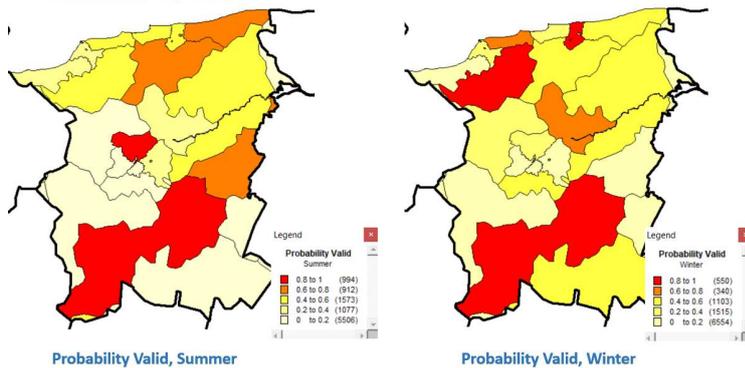
Below, the average PI by postcode sector (left) derived from site investigations and interpolated to develop the CRG 250m grid (right). The higher the PI values, the darker red the CRG grid. The general pattern agrees with the BGS maps on the previous page.

CANTERBURY – 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.

CANTERBURY – by season



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

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

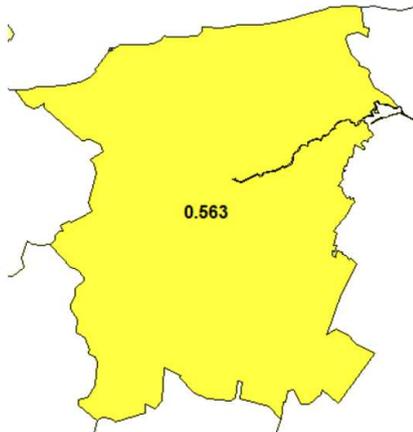
The claim distribution and the risk posed by the soil types is illustrated at the foot of the following page. Escape of water related claims are associated with the superficial deposits or simply shallow foundations on poor ground and the dominant clay shrinkage claim, the outcropping clay. A high frequency 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.



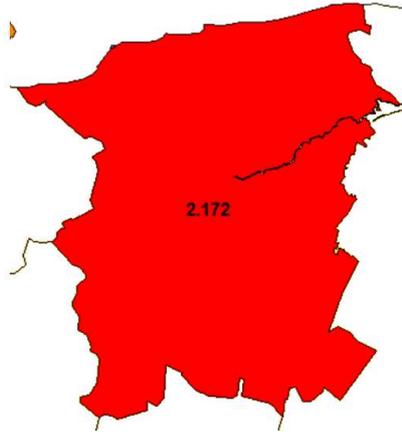
The Clay Research Group

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

CANTERBURY - Subsidence Risk Relative to UK



Normalised (0 – 1) Scale

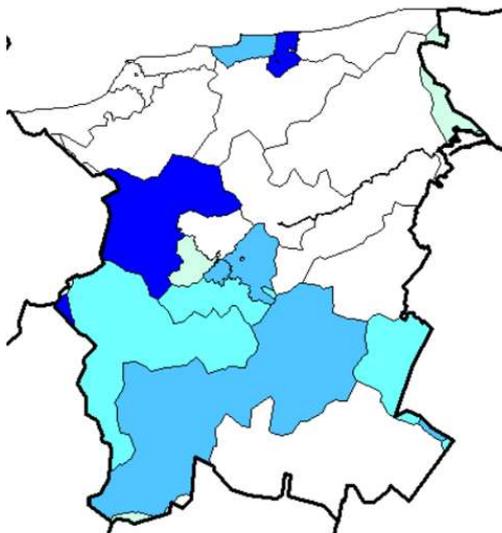


Relative to UK Average

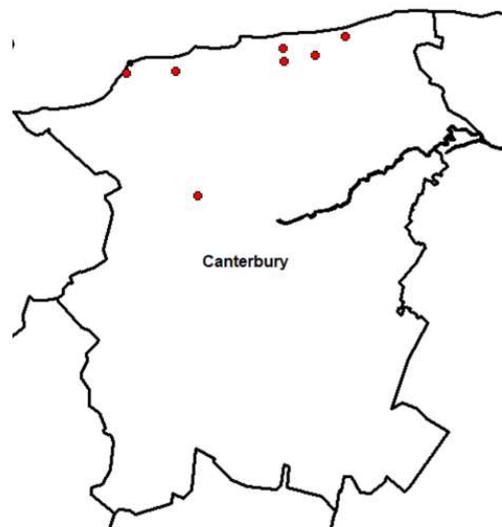
Below, left, mapping the frequency of escape of water claims reflects the presence of, non-cohesive soils – alluvium, sands and gravels etc., with clay to the north of the district. The absence of shading can indicate a low frequency rather than the absence of claims.

Below right, map plotting claims where damage has been attributable to vegetation in the ownership of the local authority from a sample of around 2,858 UK claims. The location coincides the presence of shrinkable clay soils – see both BGS (page 7) and CRG (page 8).

CANTERBURY



Higher Risk Escape of Water



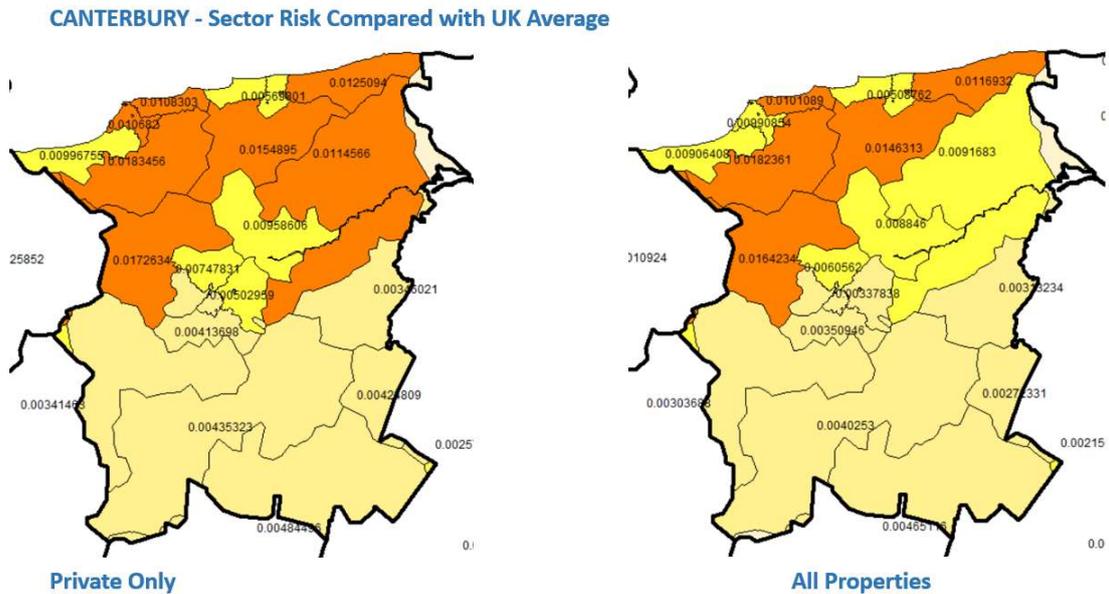
Claims Involving Council Tree
(2,858 UK claim sample)



The Clay Research Group

CANTERBURY - Frequencies & Probabilities

Mapping claims frequency against the total housing stock by ownership (left, private council and housing association combined and right, private ownership only revealing an increased risk), the importance of understanding properties at risk by portfolio.



On a general note, the reversal of rates for valid-v-declined by season is a characteristic of the underlying geology. For clay soils, the probability of a claim being declined in the summer is low, and in the winter, it is high. Valid claims in the summer are likely to be due to clay shrinkage, and in the winter, escape of water. For non-cohesive soils, sands gravels etc., the numbers tend to be steady throughout the year.

Liability by Season - CANTERBURY

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Canterbury	0.659	0.108	0.233	0.04	0.27	0.69

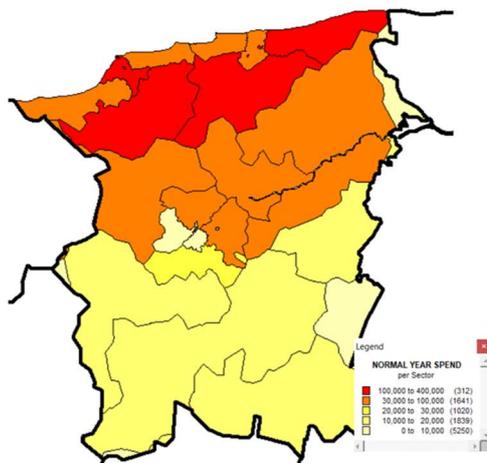


The Clay Research Group

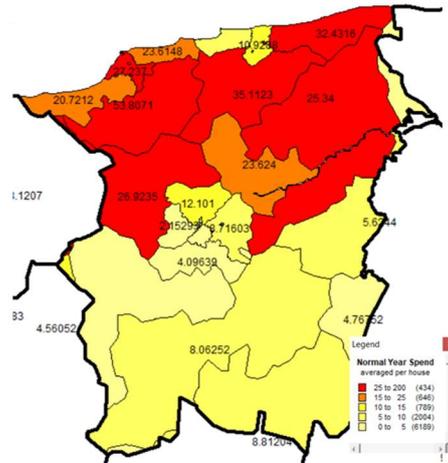
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Surge & Normal Years

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.

NORMAL YEAR SPEND – CANTERBURY



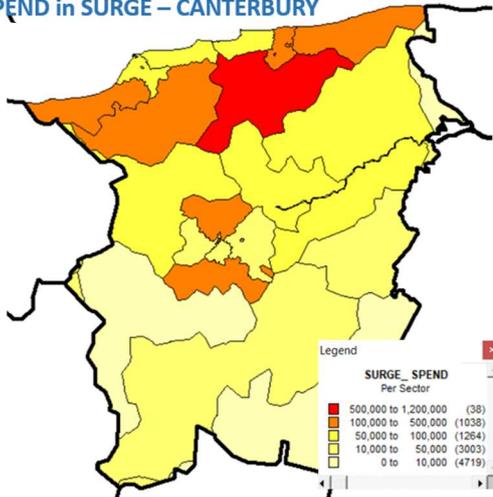
Spend by Sector



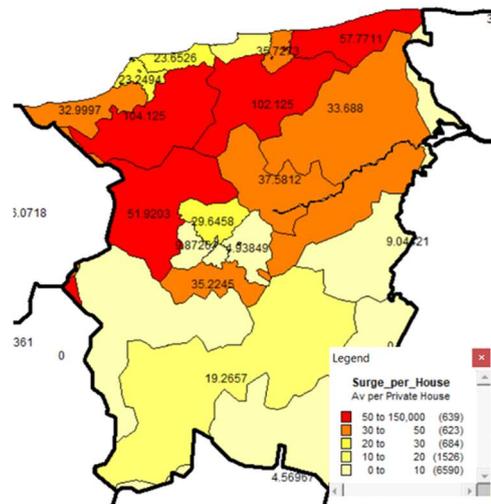
Spend Averaged over Housing Population

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

SPEND in SURGE – CANTERBURY



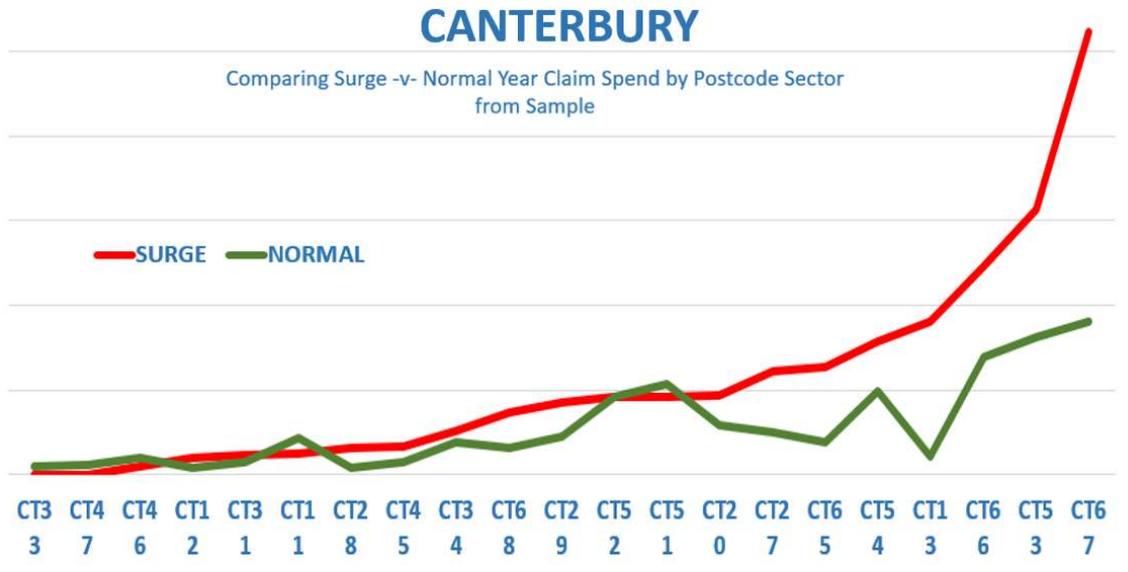
Spend by Sector



Spend Averaged over Housing Population



The Clay Research Group




 Sectors most at risk at times of surge (from sample)

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

It is of course the case that a single expensive claim (a sinkhole for example) can distort the outcome using the above approach. With sufficient data it would be possible to build a street level model.

In making an assessment of risk, housing distribution and count by postcode sector play a significant role. One sector may appear to be a higher risk than another based on frequency, whereas basing the assessment on count may deliver a different outcome. This can also skew the assessment of risk related to the geology, making what appears to be a high-risk series less or more of a threat than it actually is.

The models comparing the cost of surge and normal years is based on losses for surge of just over £400m, and for normal years, £200m.

