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

June 2018
Edition 157

The Clay Research Group

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Issue 157, June, 2018

Sinkhole Alert

Reports of homes being evacuated following the opening of a 6m deep x 2m wide sinkhole on the A26 in Kent.

Subsidence Forum Dissertation Prize

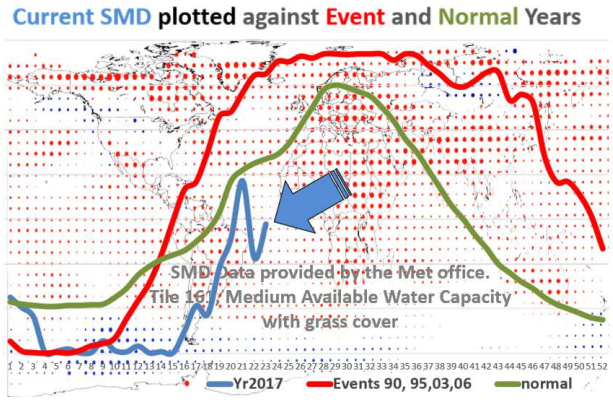
We understand from Lewis Fraser that he is submitting his paper, "*The Relationship between Trees and Rooting Depth on Shrinkable Clay Soils – an Investigation into Vertical Root Depth Below Low-Rise Building Foundations*" for consideration for the Dissertation Award. We hope to persuade Lewis to put together an article outlining his findings for a future newsletter.

Fewer Claims, Wetter Weather?

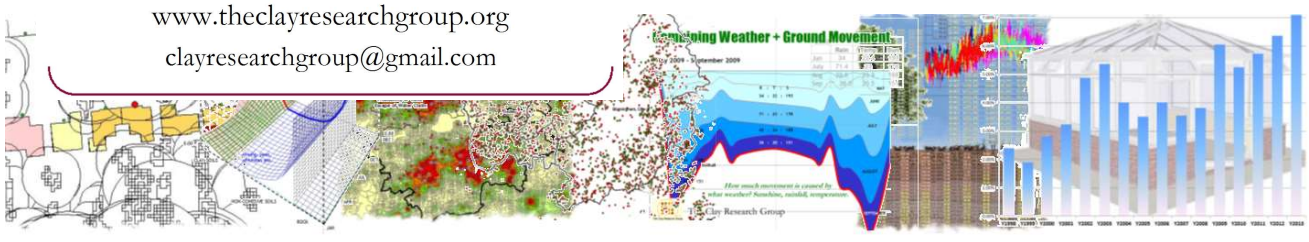
Harry Sturley, last year's winner of the Dissertation Award, contacted us after reading Edition 156, querying the basis of our comment relating to low claim numbers, "*This is in part at least due to heavy bouts of intermittent rainfall reducing the contribution from root induced clay shrinkage claims*". This will be the topic of an article in next month's newsletter.

SMD Update

The profile returns to a more normal pattern following a sudden rise a few weeks ago. No immediate threat of an event year so far.



THE CLAY RESEARCH GROUP
www.theclayresearchgroup.org
clayresearchgroup@gmail.com



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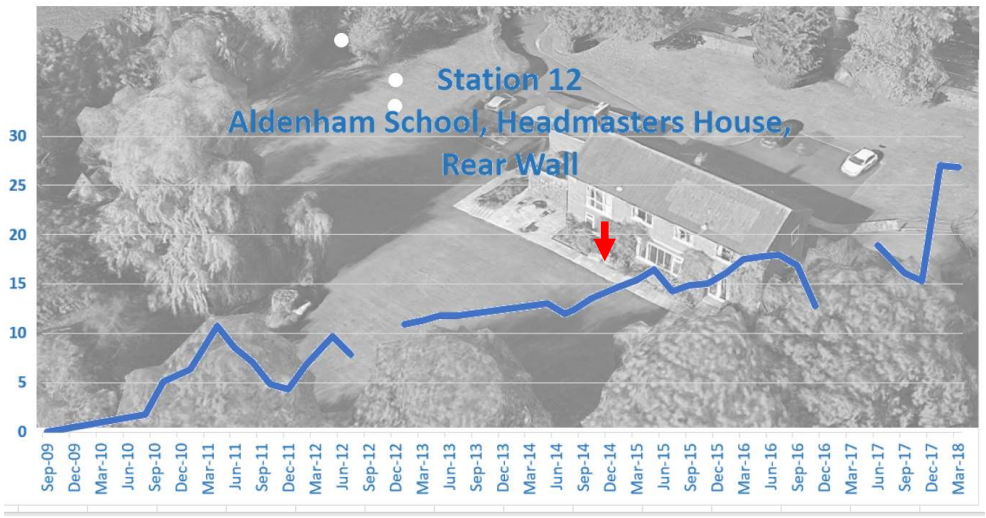
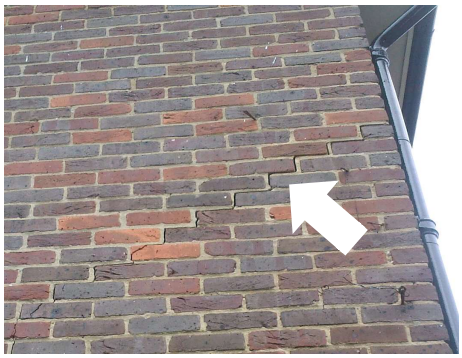
Aldenham School Update – The Headmaster's House

Last month's edition referred to the continued recovery (heave) of the rear wall of the Aldenham School Headmaster's house following the appearance of damage in 2009, and subsequent removal of some shrubs.

Since the shrubs were cut back, precise levels have revealed around 27mm of recovery at Station 12, with minor subsidence in the summer months. This is interesting in the context of understanding the degree of movement required to cause damage. More next month.

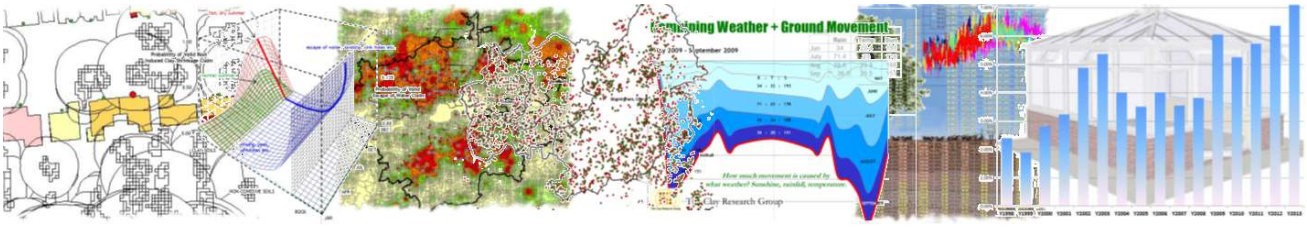


This study is unique as far as we are aware in measuring rehydration over such a long period of time involving damage caused by shrubbery. In most cases, the shrubs would simply have been removed and the property repaired following winter rehydration.



Left, a picture from Edition 154, November 2009, of the newsletter showing the diagonal crack to the side wall.

The initial proposal to use the Intervention Technique was thwarted by the presence of a chalk strata at depth, and the concern that rehydration could trigger the formation of a sink hole.



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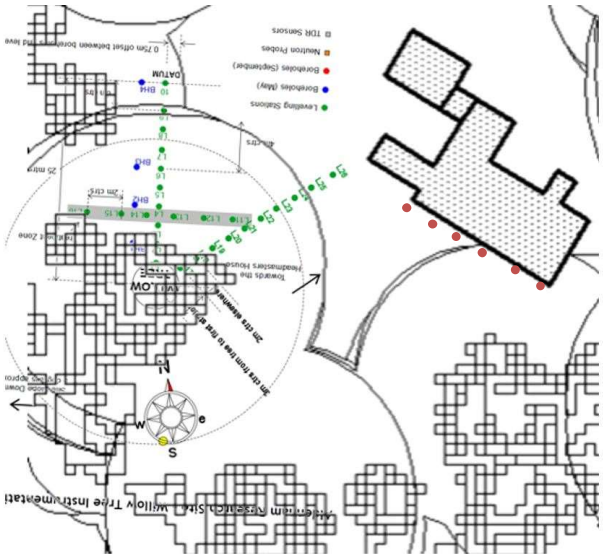
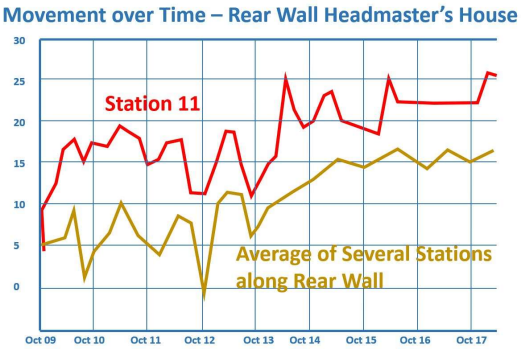
The Headmaster's House *... continued*



Left, the site layout showing the willow in the rear garden of the headmaster's house, the level stations (green) monitoring root induced ground movement and level stations along the rear house wall (red).

Although the house is outside the scope of modelled root activity from the willow, movement has been recorded at station 25 which also lies beyond the zone.

Right, movement at Station 11, and an average for other stations along the rear house wall, showing gradual recovery as the ground rehydrated.

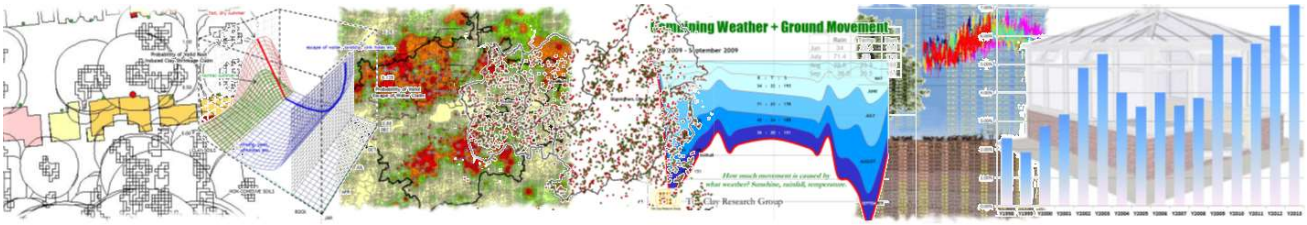


The gradual recovery suggests the shrubs to be the dominant cause of movement in this location as Station 25 at the periphery of the willow root zone exhibits a pronounced periodic signature and continues to subside.

Left, the rear wall showing the shrubbery and recording the distortions in 2009.

Most of the shrubs have been cut back or removed.

Next month, re-visiting the site investigations undertaken at the time damage was notified.



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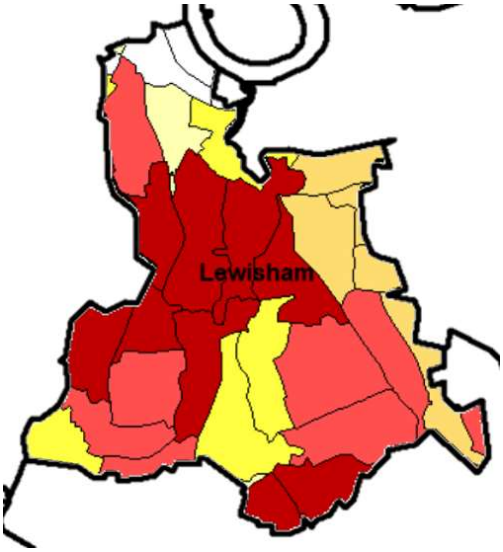
Lewisham Borough – Risk of Subsidence

Population = 301,900
Households = 116,000
Area = 35.15 km^2
UK Risk Frequency Risk (from sample) by district
- 7th (all residential)
- 4th (private housing only)
- 2.84 x average UK risk

3rd in terms of count of claims

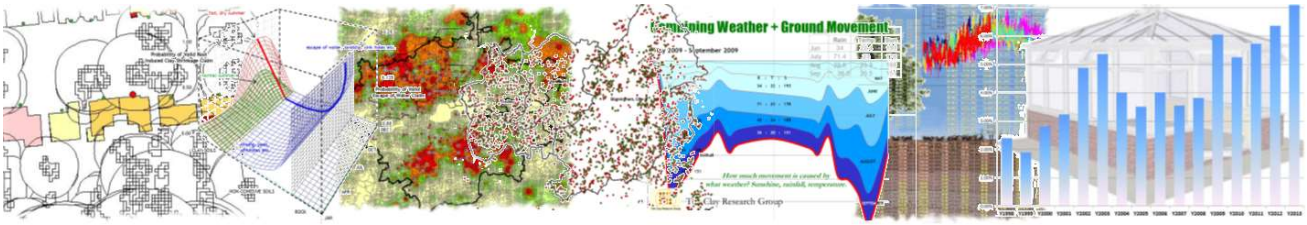
Borough	Edition	Date
Islington	Issue 47	Apr-09
Camden	Issue 69	Feb-11
Brent	Issue 71	Apr-11
Haringey	Issue 72	May-11
Barnet	Issue 77	Oct-11
Waltham Forest	Issue 79	Dec-11
Welwyn and Hatfield	Issue 80	Jan-12
Ealing	Issue 84	May-12
Sutton	Issue 91	Dec-12
Hillingdon	Issue 106	Mar-14
Havering	Issue 149	Oct-17
Harrow	Issue 150	Nov-17
Enfield	Issue 155	Apr-18
Southwark	Issue 156	May-18



Above, a map of the London Boroughs showing the location of Lewisham, bordered by the Thames to the north. Above left, a table of the boroughs covered in earlier newsletters, listing the edition number and date.

Left, a map showing the subsidence spend by postcode sector with high values centralised and to the south, bordering Bromley.

The reason for this variation is described by maps on the following pages. The primary drivers are (a) the geology – outcropping London clay and (b) the distribution of private dwellings.



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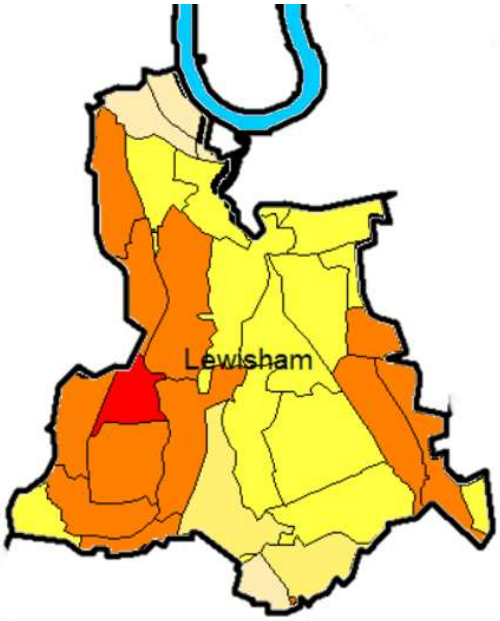
Lewisham Borough – Study Area

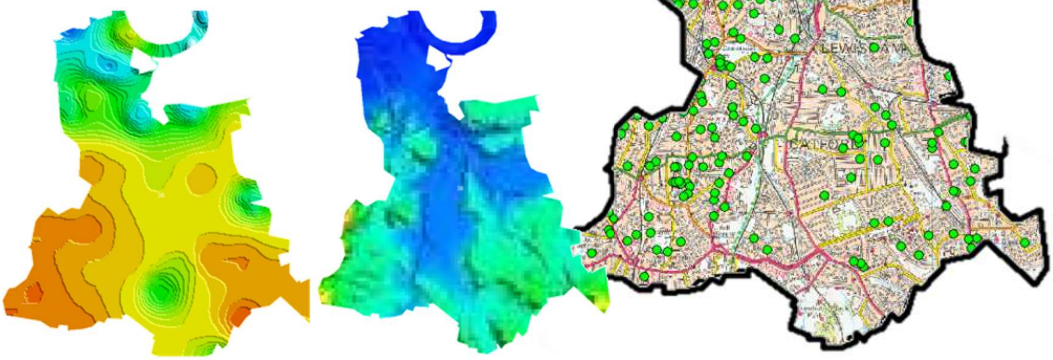


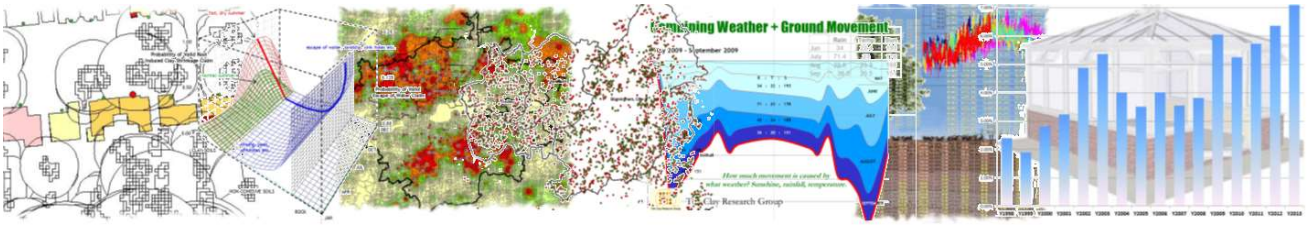
Left, the risk of subsidence by postcode sector, expressed as frequency – that is, claims from sample divided by the housing population.

The distribution reflects the claims spend shown on the previous page and matches the outcropping London clay series.

More information on distributions is provided on the following page.

Right, a map showing claims distribution. As revealed by the sector map above, the main area of risk is to the west. Below, different images of the borough. Left a topographic map visualising the digital output and right, the LiDAR contour map.





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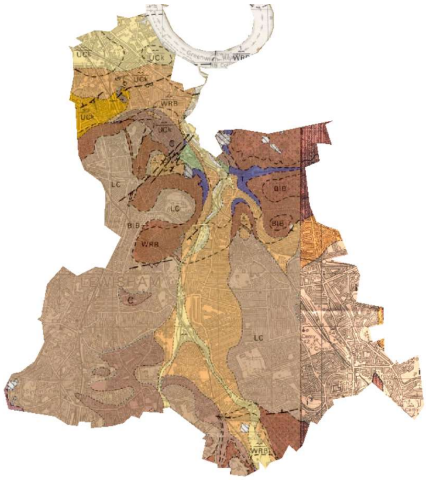
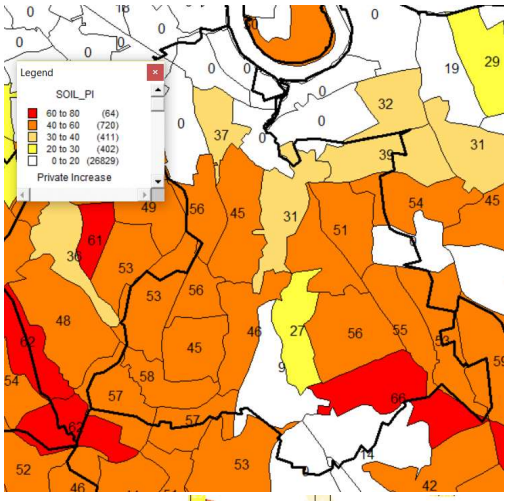
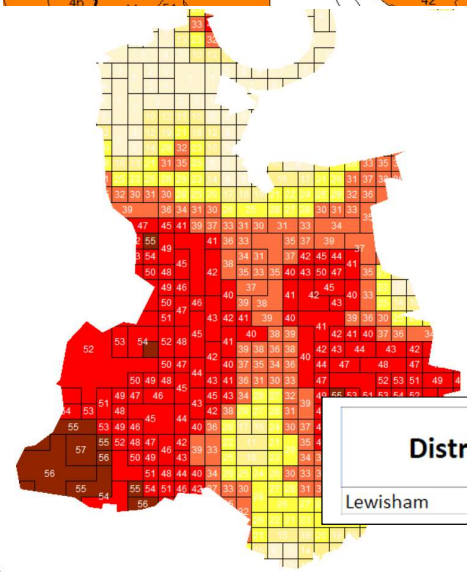






Lewisham Borough
- Geology -

Following the format described in edition 156, top the British Geological Survey 1:50,000 scale map of the area showing the various series which includes River Terrace and Blackheath beds to the north of the district and outcropping London clay to the south.

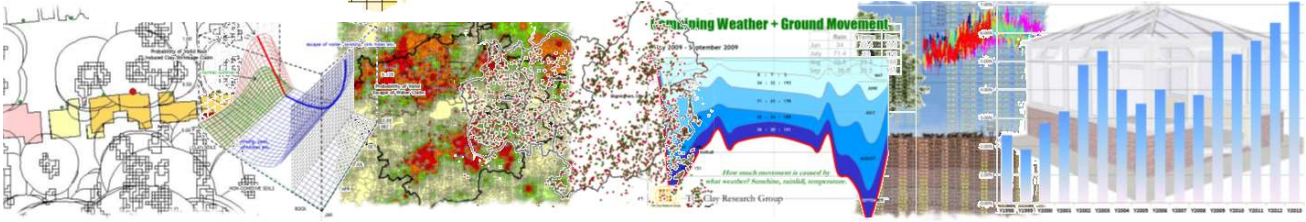
Middle, the sector map which is most useful for database referrals. Again, the distribution is noteworthy when comparing claims frequency and spend.

Bottom, the CRG geological map, built from site investigations and soil data obtained from the investigation of domestic subsidence claims, using interpolated data and plotted on a 250m grid.

The models are useful when handling claims and diagnosing causation. The matching profiles of claims/spend and geology are also useful in Triage and underwriting.

Below, an extract from the Triage application listing probabilities of valid/declined by peril and by season. **NB** the data here has been obtained from a sample of 14,000 claims and may be biased by years of collection. See page 8 for more details.

District	summer clay valid	summer EoW valid	Repudiation Rate (summer)	winter clay valid	winter EoW valid	Repudiation Rate (winter)
Lewisham	0.697	0.082	**0.221**	0.02	0.15	**0.83**



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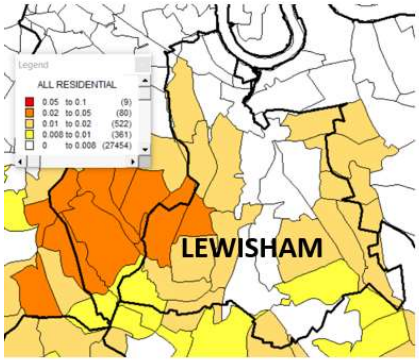
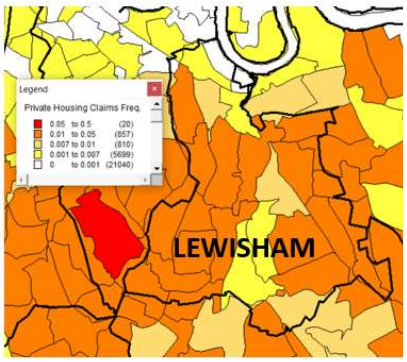
Lewisham Borough – Ownership and Style of Construction

The 'risk by ownership' ranking reveals that the borough is 49th in the 'by district' table taking into account all properties but rises to 10th place if private houses alone are considered.

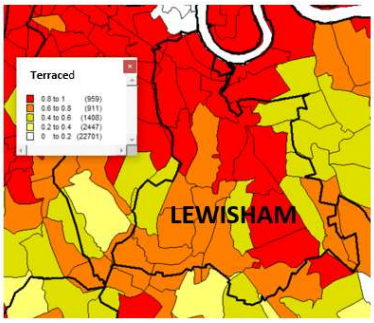


ALL RESIDENTIAL

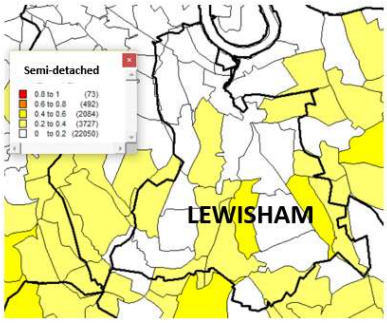


PRIVATE ONLY

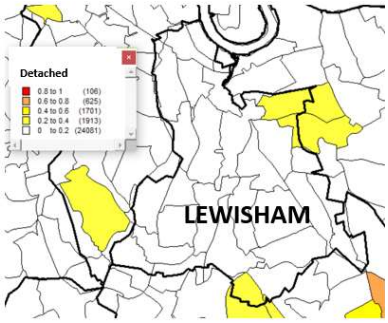
Below, distribution of houses by style of construction showing the concentration of terraced houses to the north of the borough and detached and semi-detached to the south.



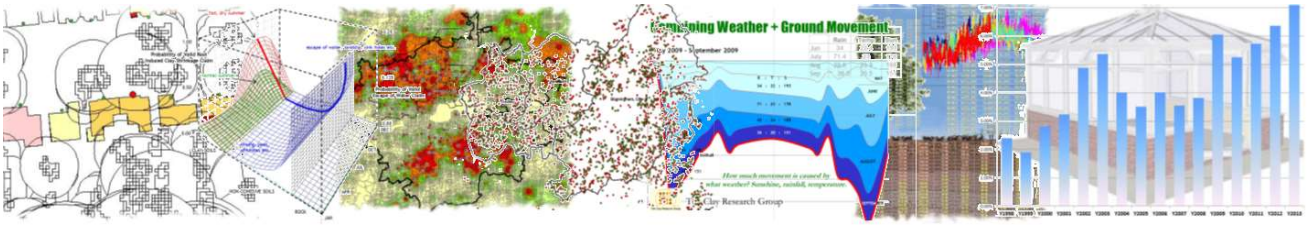
TERRACED



SEMI-DETACHED



DETACHED



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Triage – Building the Probability Table

Reviewing historic claims data can provide a valuable insight into the probabilities of future claims being valid or declined, and the most likely peril. The data can inform us of any variability by season.

The example on this page is at a relatively coarse level, illustrating values by district, towns and cities. The model is easily refined to deliver values at postcode sector level using the same approach as described here.

The chance of a valid EoW claim in the summer is far lower at 0.039.

These are the figures for valid claims. The probability of a repudiation in the summer is 1 – (0.746 + 0.039) = 0.215.

The winter months deliver a very different picture. The chance of a valid clay shrinkage claim drops from 0.746 to 0.1. The chance of a valid EoW claim rises to 0.16. Winter repudiations increase to 0.83.

District	summer clay valid	summer EoW valid	Repudiation Rate (summer)	winter clay valid	winter EoW valid	Repudiation Rate (winter)
Liverpool, City of	0.022	0.288	**0.69**	0.06	0.72	**0.221**
Norwich	0.027	0.283	**0.69**	0.07	0.71	**0.226**
Exeter	0.142	0.308	**0.55**	0.24	0.52	**0.238**
Cambridge	0.561	0.172	**0.267**	0.13	0.43	**0.44**
Harrow	0.728	0.057	**0.215**	0.01	0.16	**0.83**
Barnet	0.746	0.039	**0.215**	0.01	0.16	**0.83**

Above, a small extract from a claims sample illustrating the output.

Taking Barnet as an example, the yellow headings represent the summer values, and the blue heading, the winter values. For our purposes, summer is the middle of July to the middle of November.

Looking at Barnet, there is a 0.78 probability that a claim will be valid if notified in the summer, and the most likely cause (probability of 0.74) will be clay shrinkage.

Values for other locations are shown in the table, illustrating the variability due to their geology. For example, Liverpool and Norwich summer repudiation rates are around 0.6, falling to 0.2 in the winter.

In the summer and the winter, the chance that damage results from an EoW are ten times higher than clay shrinkage, reflecting the mixed drift deposits of primarily non-cohesive soils. The summer values on clay soils fluctuate with the weather and need to be factored to take account of sunshine and rainfall – more in next month's newsletter.