

# The Clay Research Group

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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



May 2015

Edition 120

# The Clay Research Group

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Issue 120, May 2015

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Booking Form

## The Annual Subsidence Conference

16th June, 2015

The Annual Subsidence Conference at Aston takes place in June and there has been early interest in a program that explores the apparently disparate topics of sub-surface investigations and soil stabilisation alongside the evolving business model.

These topics are linked by the need for change, development and improvement. Leading industry speakers will provide details of how they see the future. Some already have their model in place. For example, Tim Freeman and his team have developed a new approach to handling recovery claims that concentrates on fact rather than fiction with the objective of resolving them more efficiently. A thread running through all of the topics.

## Weather Forecasts

The December 2014 prediction by the Met Office was for a global mean temperature for 2015 that would be 0.52 and 0.76 deg. C above the long term (1961 - 1990) average of 14 deg. C.

NOAA data on page 2 confirms that the first three months of 2015 were 0.82 degC above the long-term average with el Nino threatening to persist into the summer.

## 200th Anniversary

The BGS are celebrating the work of William Smith who produced the first geological map of England and Wales in 1815 by publishing the re-mastered original map memoir from their Library.

## Research Programs

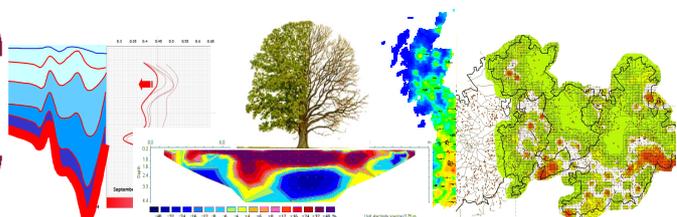
We are supporting two grant applications for research into ground engineering. The first is the UK Collaboratorium for Research in Infrastructure and Cities (UKCRIC) which is a consortium of 13 leading universities.

The second is "Re-Engineering the Ground's Ecosystem Provision to support Future Cities" which aims to address both the intrusiveness and assuredness of ground engineering treatments. We as an industry have a role to play and both projects offer exciting opportunities. See pages 10 and 11.

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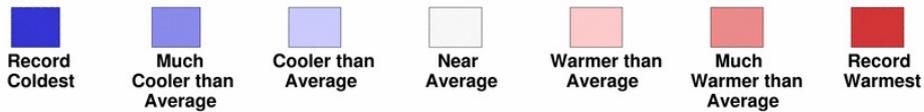
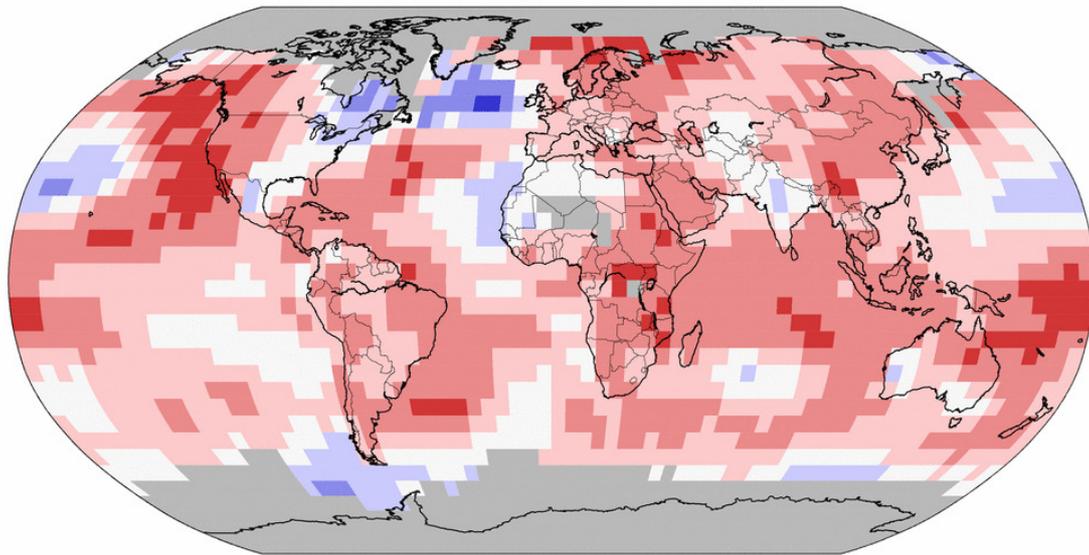
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## NOAA - Global Weather Land & Ocean Temperature Percentiles Mar 2015 NOAA's National Climatic Data Center Data Source: GHCN-M version 3.2.2 & ERSST version 3b



Tue Apr 14 12:31:43 EDT 2015

*Globally, March was 0.85 degC above the average for the 20th century according to NOAA. The first three months of 2015 were 0.82 degC above the long-term average. NOAA climate scientist Jessica Blunden said 2015 probably will break 2014's hottest year mark if conditions persist. Apparently, the rise is mainly due to exceptionally high temperatures in the Pacific Ocean driving a 50% chance that the current weak El Nino will continue throughout the summer.*

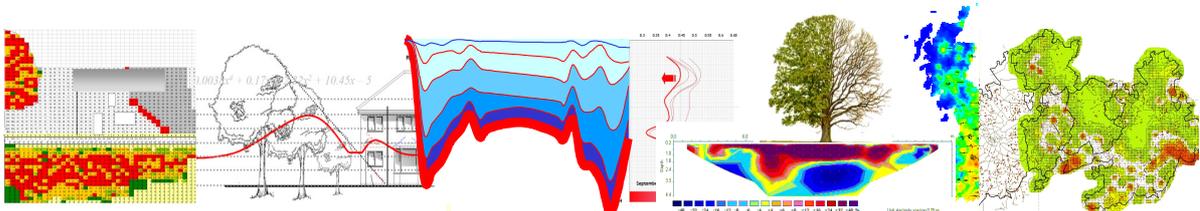
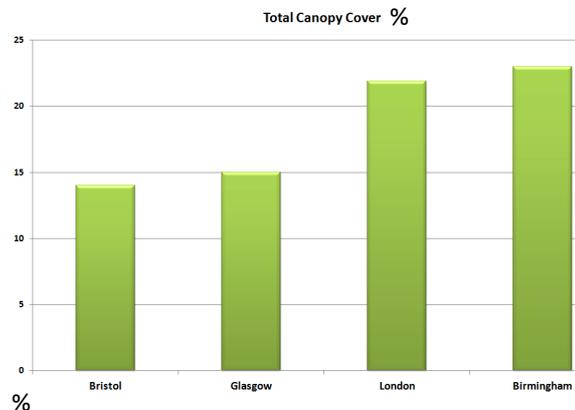
## Tree Data over the Internet

Keiron Hart of Tamla Trees has supplied the following web addresses. To register tree data visit:-

<http://www.treezilla.org/>

To view data - canopy cover, count of trees and population etc., visit:-

<http://www.urbantreecover.org/>



# The Clay Research Group

## It's the Future

Apart from a microchip, 8MB memory and battery, the watch (let's call it the "Apple Watch") features an accelerometer, gyroscope, microphone, speaker and heart rate sensor, all contained in something that can be worn on the wrist measuring 38mm square. It also has bluetooth and wireless connectivity.



Wind forward to the year 2020 - It's October and a homeowner somewhere in Islington is wearing the latest version. When they first wore the watch, (April 2019) it recorded some minor under-measure of the floor plan. After an exchange between the watch and the server at the insurer's office, the premium was adjusted accordingly. No more haggling at the time of claim notification. Rates are set accurately and adjusted over time, taking account of any extensions and alterations.

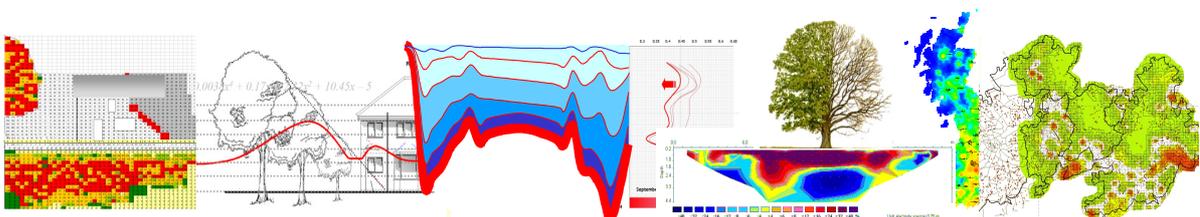
It's 11.15am on 14th and the doorbell rings. It's the builder. They have come to repair the subsidence damage that the homeowner hadn't realised had happened. A small crack above the door leading into the hallway, and the front door was sticking. The homeowner's watch hadn't told him that his home was subsiding. It didn't want to cause him any anxiety following the slight increase in his blood pressure after taking up jogging at the age of 58yrs 3mths, 2 weeks, 1 day and 6.57hrs.

Apparently the laser mounted in the watch had been measuring not only room sizes, but tilts and distortions.

The watch is now checking his owners heart rate for suggestions of fraud. It communicates the data to the insurers server. Everything is fine. No surprising increase in blood pressure or excess sweating. Phew. All non-intrusive of course.

The watch had already sent a text instruction to the building repairer's watch to arrange a start date. More good news. The next message goes to the server at the insurer's office. "Valid claim, £1,000 excess, minor damage. Remove small shrub, fill crack and decorate the living room". The builders are wearing watches with GPS trackers which means they only get paid for the time on site with an allowance for travelling.

The adjusters? They have all re-trained to become watch battery replacers. Apparently, only newsletter editors' positions are safe.



# The Clay Research Group

## A Probabilistic Approach

In last month's edition we reported on the growing interest in statistical modelling. Suzanne Lacasse, the technical director of the Norwegian Geotechnical Institute, gave the 55th Rankine Lecture at Imperial College and spoke about Event Tree Analysis. Prior to this, we reported on a paper entitled "Bayesian Identification of Soils in London Clay", published in Geotechnique in January 2014. Vegetation hasn't been omitted. "Bayesian calibration and Bayesian Model Comparison of a stand level dynamic growth model for Sitka spruce and Scots pine" appeared in the Forestry Journal last June.

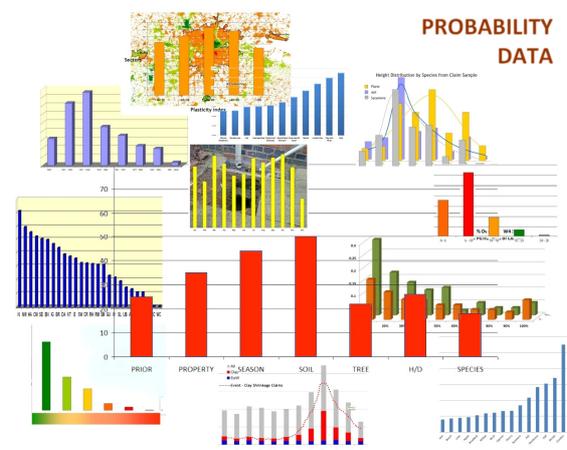
How would we go about building a model to assist in triage, diagnosis and claims handling? What are the factors that determine whether a claim is going to be valid and how might we determine the peril?

The CRG have been developing models over many years and future editions explore some of the issues. With data at our fingertips, just how reliable is a probabilistic approach when measured against claim outcomes?

Could claims handling and diagnosis be enhanced using a statistical approach?

The nuances of conversations we hold with homeowners aren't binary. Nobody wants a check-list interview. On the other hand, we have to ask if we are indeed dealing with engineering facts that can be measured and quantified or is it more to do with intuition and guesswork?

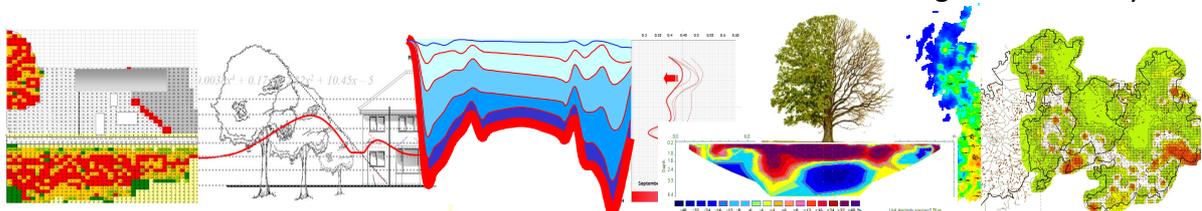
So, returning to the theme, how would our probabilistic model look and what factors do we need - are those elements available? In the main, yes they are and below is a composite of a selection of graphs that we have published over the years.



We know from our data that, by and large, older houses are riskier than younger ones, and by how much. That isn't to say every time we receive a notification of damage to a 1920s house the claim will be valid, but it is an indicator.

We can also distinguish between soils as noted elsewhere in this newsletter. The average escape of water claim will be on non-cohesive soils and there will be a 20% chance of any claim on such soils being valid throughout the year.

In contrast, claims notified on clay soils have a far higher probability of being valid if notified in the summer. It increases still further if the claim is notified in a hot, dry month and there is vegetation nearby.



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## A Probabilistic Approach ... *continued*

The chance of the claim being valid increases if the H/D is say 2, and the tree is an oak or conifer.

The model already has some knowledge of what has gone before in this sector. If clay soils are indeed riskier by a known value, it will have a history. Other postcode sectors will have a low risk score. There may be granite beneath the topsoil, or the demography has influenced the propensity of homeowners in the immediate vicinity to make insurance claims.

The first step will involve three elements. First, the underlying risk based on historic data. If one sector has had four or five times the number of claims than another, there will be a reason - provided we base our estimates on frequency calculations.

We need to understand the underlying risk – not the fact there have been more claims simply because there are more houses.

If that risk sector is on clay, account needs to be taken of the season. If it isn't clay, the season isn't as material. Unless of course it is clay-with-flints over chalk in a particularly wet winter.

Some soils (i.e. peat) are just risky. If we receive a claim on peat it is twice as likely to be valid than if the soil was Keuper marl.

If the soil is shrinkable, then details of vegetation can be added. Most homeowners can name the trees in their garden. The metrics may vary (root distribution etc.) but thousands of records from actual claims help in the analysis.

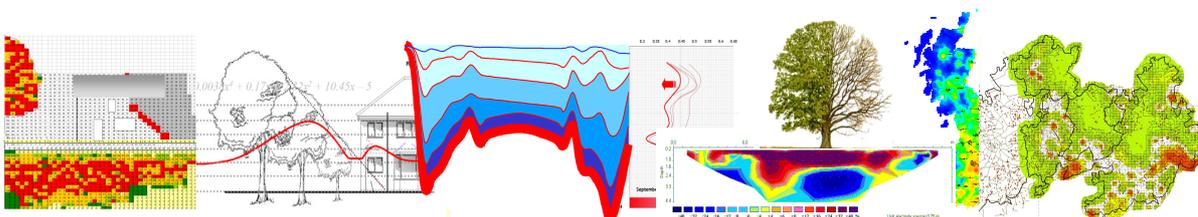
In the alternative, we can use the same approach to weigh the chances of a repudiation. Historic damage is top of the list of causes when repudiating a claim and perhaps questions can be framed to establish dating more accurately.

Other reasons for repudiating claims are shrinkage, poor construction and so forth, but each can be weighted by age of property and date of notification. Historic damage is less likely in more modern houses and there may be a link with the term of occupancy.

We already know that around 80% of claims notified between December and June will be repudiated for one of these reasons.

What are the factors that would enable us to distinguish between valid and repudiated claims in our conversation. Is it the nature of the damage? For example, are cracks that appear both internally and externally more likely to be indicators of a valid claim?

Are certain parts of the building more vulnerable than others? Next month's issue explores some of these factors in more detail.



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## City Profiles by Peril

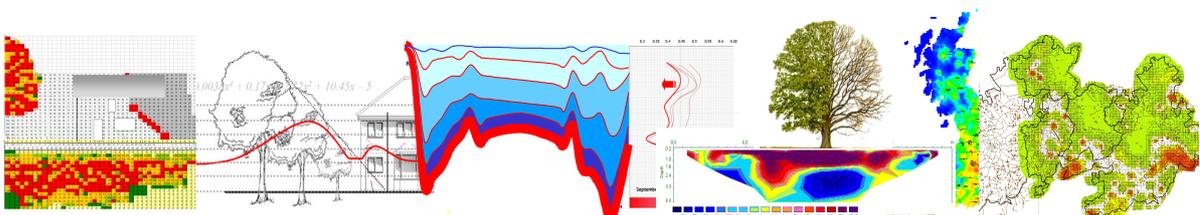
Looking at the UK as a whole, around 70% of valid subsidence claims are related to clay shrinkage (mostly involving vegetation) and the remainder are due to a range of perils - leaking drains, heave, landslip etc.



How do individual cities compare with the UK average? The graph above reveals that in London, around 80% of claims are due to clay shrinkage. The high housing population and shrinkable clays have a considerable influence on the UK average.

Elsewhere, clay plays a much reduced role. In Birmingham, Liverpool and Manchester for example, the majority of valid claims (between 70 - 75%) relate to leaking drains, poor ground etc.

Drilling down still further, at postcode sector level the probability of a valid claim being due to root induced clay shrinkage can reach nearly 100%. In some London Boroughs on London clay, nearly all valid claims are clay related and, conversely, in some postcodes to the north west of the UK, all are related to drains.

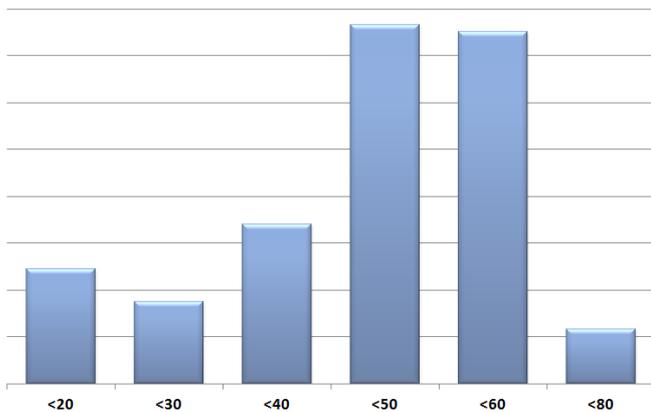


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## London at Sector Level

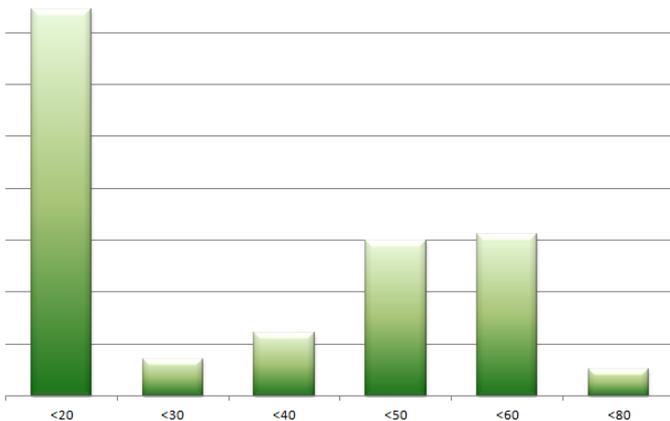
Greater London contains just over 1,100 postcode sectors, of which around 430 or so contain a shrinkable clay soil with a Plasticity Index (PI) greater than 20%.

The top bar graph (blue) plots the number of sectors by soil PI from the 430 total. Around 150 have index properties of between 40 - 50%. The figure is similar for soils with a PI of between 50 - 60%. In contrast, soils between 20 - 30% account for only 35 sectors.



The lower bar graph (green) reflects the count of houses by postcode sector in the PI bands shown.

There are far more houses in postcode sectors with a PI less than 20%, as can be seen by comparing the extreme values to the left of both graphs.

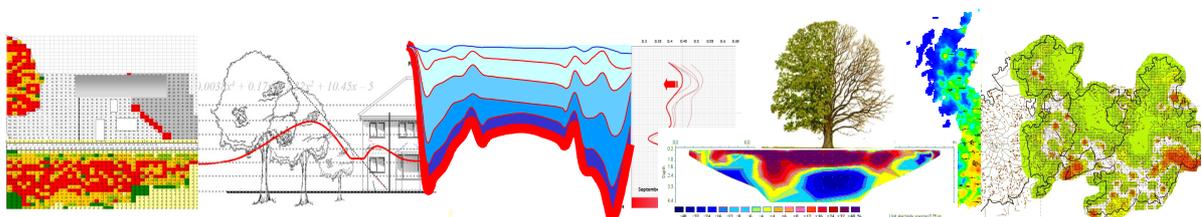


Although there are fewer houses in the 40 - 60% PI bands, there is a higher claims frequency.

In summary, claims frequency is not higher simply where there are more houses but because the underlying geology poses a higher risk.

The fact there are more houses in London than any other city delivers more claims, but on a frequency basis, London is the riskiest city in the UK and this is a product of housing population and geology, as we see on the following page.

*Top, distribution of postcode sectors in London by soil PI. Bottom, housing distribution for each band. The majority of houses are built on soils with non-shrinkable soils or those with a PI less than 20%.*

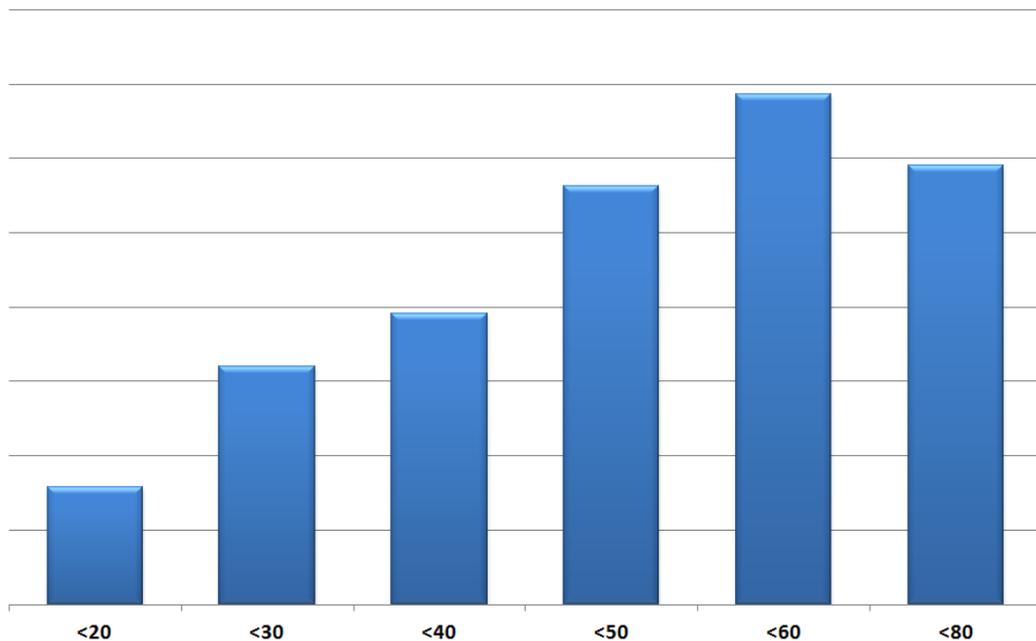


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## Risk across the UK - Claims Frequency by PI

To conclude, on the previous pages we can see there are far more houses on the none, or low shrinkability soils, but fewer claims when expressed as frequency. In contrast, wherever there are shrinkable soils, the claims frequency follows the housing profile.

Average Claims Frequency

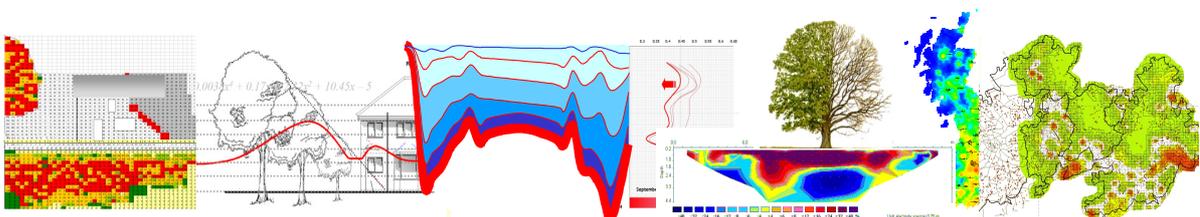


How does that compare with the UK? Just how much riskier are the soils by PI band? Using the 'none shrinkable, soils with a PI less than 20%' as a standard, soils with a shrinkability between 20 - 30% ('<30' in above graph) pose twice the risk, between 30 - 40%, 2.5 times the risk, between 40 - 50%, 3.4 times the risk.

Soils with a PI between 50 - 60% are top of the table at 4.5 times the risk.

On average - taking soils with a PI between 20 and 80% - clay soils are just over 3 times the risk of 'others'.

More accurately, the risk reflects the combination of vegetation and clay. Clay shrinkage in the absence of vegetation is uncommon.

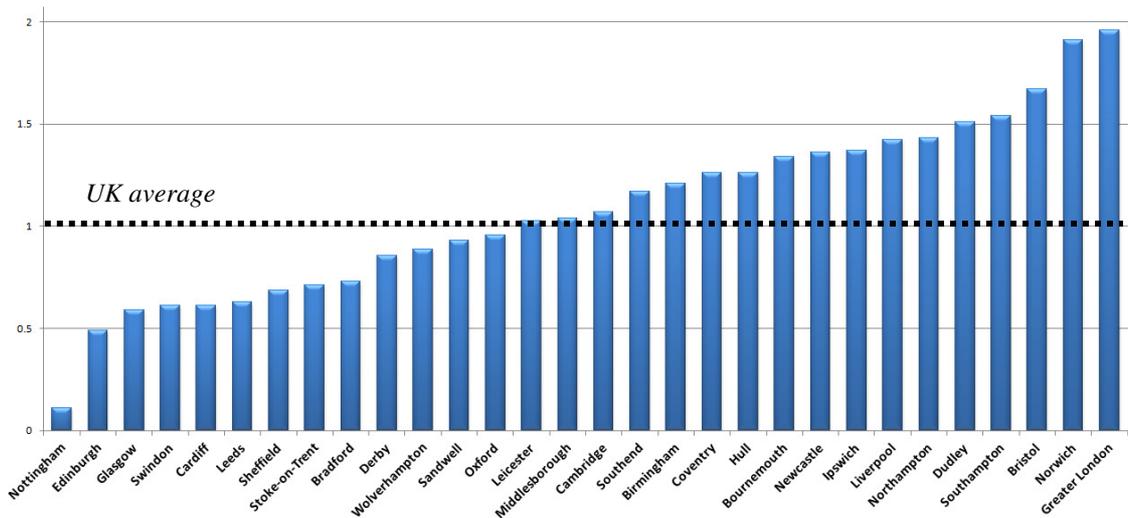


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## Towns and Cities in Rank Order of Subsidence Risk

Just how risky are the major towns and cities when compared with one another? Which is the riskiest, and how do the others compare with the UK average?

Here is the rank order of risk with the average standardised as '1'.



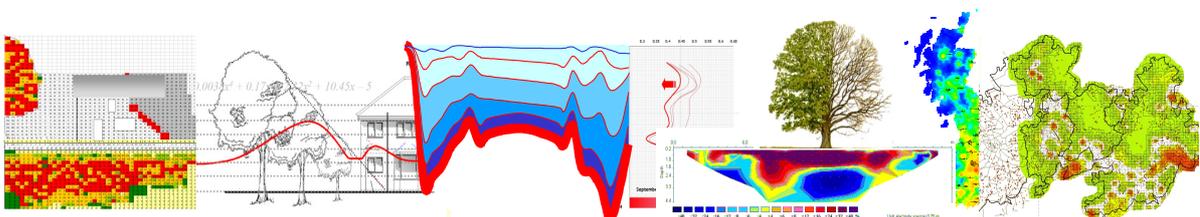
*Cities and towns in rank order of risk, expressed as frequency - that is, claims/private housing. The 'y' axis reflects the risk against the average value = '1'.*

Greater London is top of the table at twice the average risk, followed by Norwich and then Bristol.

Closer to the UK average are Oxford, Leicester, Middlesbrough and Cambridge. Edinburgh and Glasgow at about half the average risk of the UK.

This data is based on claims frequency for private housing stock (i.e. insured property) only. To deliver an improved picture of risk no account is taken of social housing.

It is interesting to see how the cities and towns compare but of more value, we now have a quantifiable difference. For example, we know that Dudley in the West Midlands is 2.22058 times riskier than Sheffield, and 1.198 times riskier than Hull.



# The Clay Research Group



## Research Projects for 2015

We are pleased to confirm our support for two research projects in association with the University of Birmingham's application for funding from the Engineering and Physical Sciences Research Council's (EPSRC) funded projects relating to ground engineering. The first is the UKCRIC project mentioned in edition 117, February 2015, and the second and more recent is a project entitled "Towards Engineering Grand Challenges".

## Towards Engineering Grand Challenges

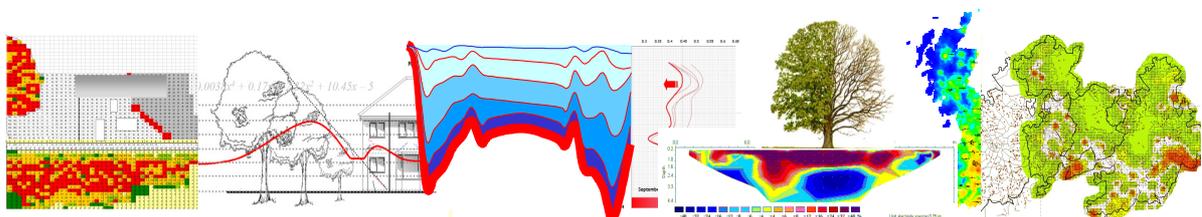
The project application states "Our vision is to understand the multi-functional requirements of the ground beneath our cities, and how to enhance and manage the balance between a city's requirements of the ground and the engineered and natural systems in cities, which collectively provide a wide range of ecosystem services. We aim to achieve this using a suite of minimally-intrusive engineered interventions that are able to restore, and where necessary enhance, the essential functions of the ground such that it can continue to deliver its ecosystem service provision into the far future."

"The project proposes trial and monitoring of several novel ground interventions including thermal, electrokinetic and microbially mediated mineral precipitation. Monitoring will include measuring the effect of these interventions on the electrical and mechanical ground properties using resistivity tomography and surface wave surveys. Ultimately, we hope to develop a decision support system for understanding and utilising physical, chemical and biological conditions to maximise the stability of the engineered ground."

The research team is under the leadership of Dr Helen Reeves from the British Geological Survey, University of Birmingham, University of Strathclyde and the University of Newcastle.

## The UK Collaboration for Research in Infrastructure & Cities (UKCRIC)

Professor Ian Jefferson explains "a buried infrastructure soil-structure interaction test facility would enable assessment of fully-instrumented buried pipes, culverts and other structures at full-scale, and larger, deeper structures (shallow tunnels) at near full-scale. Moreover burying infrastructure brings its own particular engineering challenges – for example, air flow in long tunnels can be a major issue in terms of pollution removal, pressure transients, and most notably, sonic booms at the exit of long railway tunnels – and these will be embraced as part of the new facility. The proposed facility at Birmingham will be approximately 60m by 40-50m including a large pit area in the order of 20m by 15m by 3-5m in addition to smaller laboratory and meeting space."



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## Research - Insurance Industry Benefits

The research initiatives described on the previous page offer significant potential benefits to the domestic subsidence industry and present an exciting opportunity. We propose to hold a meeting for practitioners to suggest topics and areas of research that would benefit insurers and homeowners in the diagnosis and remedy of subsidence claims.

For example, is there a way of measuring foundation depths without excavating trial holes? Can we determine moisture contents without sinking boreholes and testing soils? Is there some way of speeding the whole process up without loss of quality?

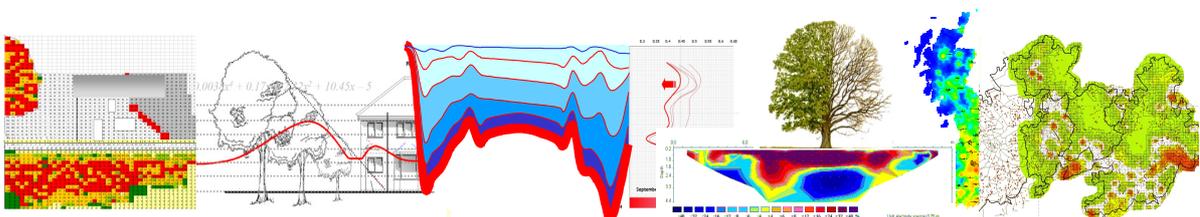
The project team under the leadership of Dr. Helen Reeves from the BGS may be willing to consider suggestions that link into their objectives and our co-operation with a number of Universities over many years has been fruitful in widening our vision of what may be achievable with a co-operative approach.

Of course, there are commercial considerations. No company wants to release the 'next big idea' for their competitors to share. In fact, there is little evidence of this being a problem in the past. Times change and, by and large, the industry moves forward together. It is rare for a company to collapse simply because it didn't use Avonguard tell-tales, adopt suction measurements early enough or subscribe to telemetry. However, companies do collapse because they simply don't keep up with changing needs.

We have published the results from all joint projects undertaken in partnership with academics in the past including the work of Glenda Jones from Keele University on electrical resistivity tomography, the neutron probe data gathered by Southampton University, precise level readings obtained by Geo-Serv and the more recent work by Tom Clinton into electro-kinesis osmosis. We also reported on the deployment of TDR sensors at Aldenham to measure moisture change over time and transmit data over the internet to update the engineer at his desk economically and the use of electrolevels to measure rotation remotely.

This is one of the most exciting opportunities to present itself and we hope that colleagues in our industry with an interest in developing innovative techniques to raise the standards will join with us to present our views to the research team in the hope they may be relevant.

Register your interest by sending an E-mail to [clayresearchgroup@gmail.com](mailto:clayresearchgroup@gmail.com)





# Aston CPD Centre

BIRMINGHAM

presents a one-day Conference on Tuesday 16 June 2015  
at Aston University

## DOMESTIC SUBSIDENCE Challenge and Change

- 09.00 - 10.00 Registration and coffee
- 10.00 - 10.15 Opening by Chairman: **RICHARD ROLLIT**, MD, Subsidence Management Services
- 10.15 - 11.00 *"The Future of Subsidence Claims Handling."*  
**Tony Boobier**, WW Executive for Insurance at IBM
- 11.00 - 11.30 *"Time to let the evidence do the talking"*  
**Tim Freeman**, GeoServ Limited
- 11.30 - 11.45 **Coffee**
- 11.45 - 12.15 *Stabilising Clay Soils – Update on the EKO project*  
**Prof. Ian Jefferson**, University of Birmingham
- 12.15 - 12.45 Discussion
- 12.45 - 14.00 **Lunch**
- 14.00 - 14.30 *"Meeting Customer Expectations"*  
**Mike Mortished**, Claims Team Controller, Ageas Insurance.
- 14.30 - 15.00 *"Clay stabilisation and subsidence : Imaging and monitoring using time-lapse, azimuthal 3D Electrical Resistivity Imaging"*. **Dr. Nigel Cassidy**, Keele University.
- 15.00 - 15.20 **Tea**
- 15.20 - 15.50 *Treating the Customer Fairly. Aligning the Policy and Claim.*  
**Richard Rollit**, MD, Subsidence Management Services
- 15.50 - 16.20 Discussion
- 16.20 - 17.00 Tea & Disperse

*(Directed by Stephen Plante, The Clay Research Group)*

For conference availability: [enquiries@astoncpdcentre.co.uk](mailto:enquiries@astoncpdcentre.co.uk) Telephone Enquiries: 0121 204 3606

Fax: 0121 204 5079 Website & Mailing Subscription: <http://www.astoncpdcentre.co.uk>

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The views expressed at the conference are personal to the speakers and are not necessarily those of Aston CPD.

For terms & Conditions please refer to our Website. By completing this form you accept our terms & conditions.

Conference Organiser: Dr M Sadeghzadeh 07788947658. Please note the programme is subject to change without prior notice

correspondence to: Aston CPD Centre, Aston House, 6 Greville Drive, Birmingham B15 2UU

Please reserve .....Place(s) at the course, (subject to terms & conditions) Domestic Subsidence– 26.6.14

Delegate Name(s): ..... Company: .....

Address:.....

Post Code: ..... Email Address: ..... | ..... Tel: .....

Have you any dietary, access or other requirements? YES/NO if YES please state .....

Do you wish to be invoiced? (VAT exempt) YES/NO Purchase Order No: .....

Invoice address if different from above: .....

Cost £175 per delegate, VAT exempt, covering attendance, papers, lunch and refreshments during the day.  
(Cheques should be made payable to Aston CPD)