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

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June 2013

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ASTON UNIVERSITY
BIRMINGHAM

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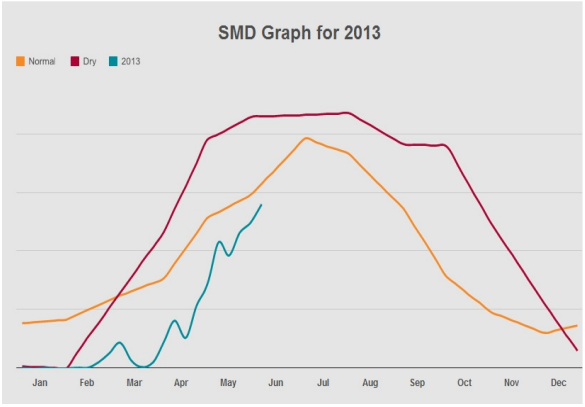
Issue 97, June, 2013

BGS Open Day

The British Geological Survey at Keyworth, Nottingham, are hosting an open day on Saturday, 8th June and well worth a visit. Free entrance, and mostly under cover, with a guest appearance from Prof. Ian Stewart from the BBC series, "How Earth Made US". Book on-line.

Weather Watch – data courtesy of Met Office

SMD at end of November, 2012



The Annual Subsidence Conference

We are looking forward to meeting attendees at the annual subsidence conference at Aston on the 26th June. The conference is wide ranging and covers advances in soil testing, ongoing research in soil stabilisation as well as looking at recent case law and changes to the legislation. The conference is always well received and scores high on the feedback forms. It is also CPD accredited. A booking form is attached to Edition 95 for late subscribers.

Subsidence Forum AGM

An update on the Annual General Meeting on the following page – Iain MacLean has taken over as Chair from Neil Curling and the various interest groups outline their objectives.

Hortlink II

Following release of funding by the ABI, Forestry Commission and Subsidence Forum, Dr. Neil Hipps is currently reviewing data that has been supplied by various parties and updating himself on current research in the field of tree water uptake.

Spring Weather

The Met Office report the coldest Spring (March, April and May) since 1979 and the 6th coldest since records began.

March was exceptional – it was the 2nd coldest on record - colder than the preceding winter months.

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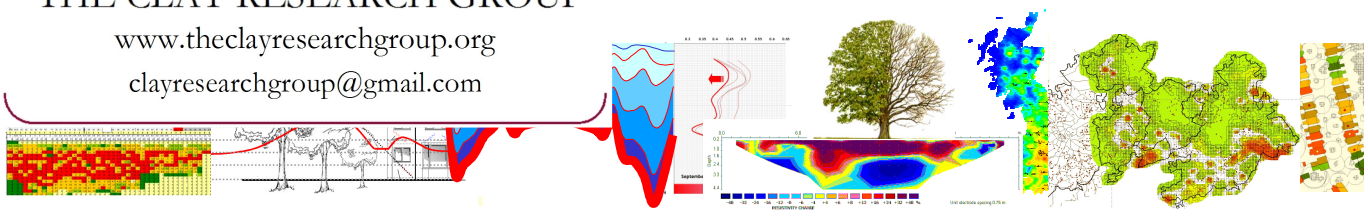

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Annual General Meeting

Iain MacLean (Davies) recently took over as chair of the Subsidence Forum and at the AGM he outlined his vision for the next two years.

Iain is keen to build upon the work of the past chair Neil Curling (LBG) and make the Forum more inclusive by trying to encourage greater participation from the membership and to get the views and feedback from customers who have experienced subsidence claims.

To support this approach Iain will be developing the website so that it becomes the focal point for discussion and posting items of interest, essentially creating a virtual forum. He is also keen to develop and co-ordinate the work of the specialist interest groups and this is an area that his new vice-chair Vic Handley (Van Elle) will focus his efforts.

Updates were given by the Specialist Groups;

Supply and Procurement - John Hogg (DLG) has had to withdraw from leading this group and it will now pass over to Mick Millership (Gelders) who will be looking to develop the earlier work and paper on 'Technical Management of the Subsidence Supply Chain'.

Training and Education - Alan Cripps (RICS) - the Subs Forum Training day is planned for the 23 Oct and should involve a good range of subjects primarily aimed at subsidence claims handlers.

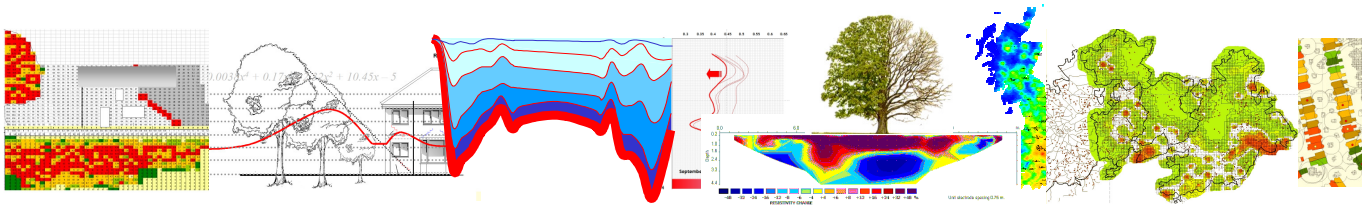
Tree Root Liaison Group - Andrea Plucknett (Welwyn Hatfield Council) has produced the Tree Root Claims Liaison Model - a proposed agreement for handling subsidence caused by Local Authority or Third Party Trees. Andrea would welcome feedback.

Technical and Innovation - Richard Rollit (IFI) - various Technical Papers are being produced aimed at offering pragmatic guidance around some key subsidence issues. The Cay Research Group training day on 26 June in Aston will cover some new innovations in soil testing and electrokinesis (permanently reducing the soils plasticity i.e. its ability to shrink and swell).

Customer Focus - Nigel Barham (GAB) - linked with Iain's view of getting more client feedback Nigel is looking to re-energise the group and is linking into the Institute of Customer Service to get ideas from other service industries that could be used for subsidence.

On a more general note, the Subsidence Handbook is being updated and should be available shortly. It provides an invaluable guide for claims handlers with easy and accessible reference material.

Recently Mike Duckworth (CL) has taken semi-retirement and in recognition of his hard work and support of the Subs Forum he has been given honorary membership



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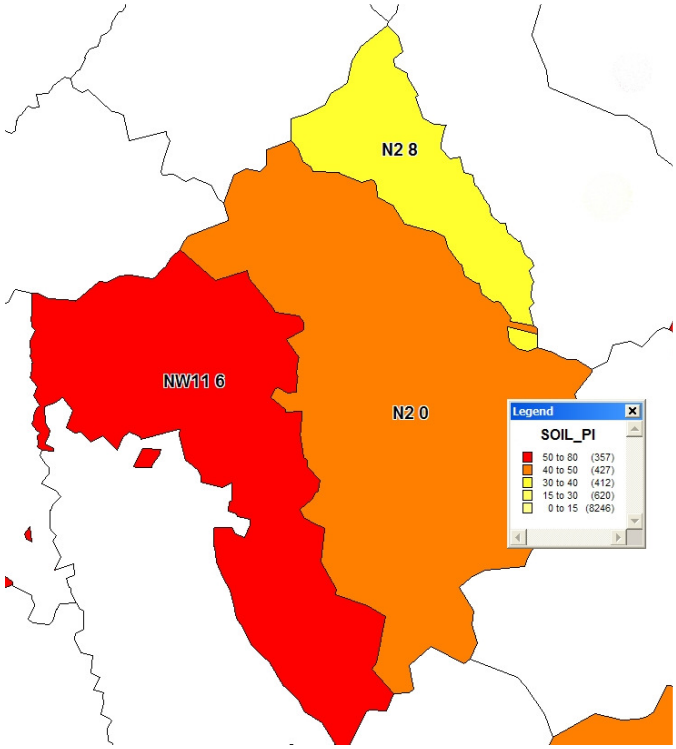
Postcode Sectors - Risk Rating



NW11 6 - Tree Metrics and Soil PI		
Claim Frequency	0.0399	
Av. Tree Height	10.95	mtrs
Av. Root Overlap	53	sq.mtrs
Av. Overlap as %	45	%
Av. Soil PI	38	%
Houses beyond trees	15.4	%
430 houses not in influencing distance of trees out of 2775		

N2 0 - Tree Metrics and Soil PI		
Claim Frequency	0.0176	
Av. Tree Height	11.01	mtrs
Av. Root Overlap	71	sq.mtrs
Av. Overlap as %	38	%
Av. Soil PI	33	%
Houses beyond trees	18.2	%
738 houses not in influencing distance of trees out of 4053		

N2 8 - Tree Metrics and Soil PI		
Claim Frequency	0.0072	
Av. Tree Height	8.27	mtrs
Av. Root Overlap	50	sq.mtrs
Av. Overlap as %	26	%
Av. Soil PI	29.3	%
Houses beyond trees	27	%
772 houses not in influencing distance of trees out of 2856		

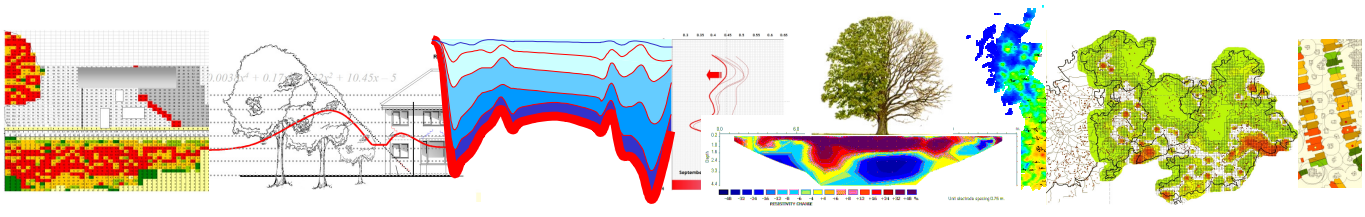
What is immediately obvious is the number of properties outside the tree's zone of influence – the "Houses beyond trees" figure in the table above - when compared with the total housing stock.

NW11 6, a high risk sector, only has 15.4% of the housing stock clear of root activity, whereas the safest, N2 8, has nearly twice as many at 27%.

N2 0, the intermediate risk sector, has 18.2% of the housing stock clear of tree root activity.

Average tree heights have little to distinguish between NW11 2 and N2 0. Both are around 11mtrs. The trees in N2 8 are slightly shorter at 8.27mtrs.

Similarly, there is little to distinguish between the safest and riskiest sectors in terms of root overlap, although when we look at the percentage of the root zone encroaching beneath the building footprint, there is a correlation with risk frequencies as we see on the following page.



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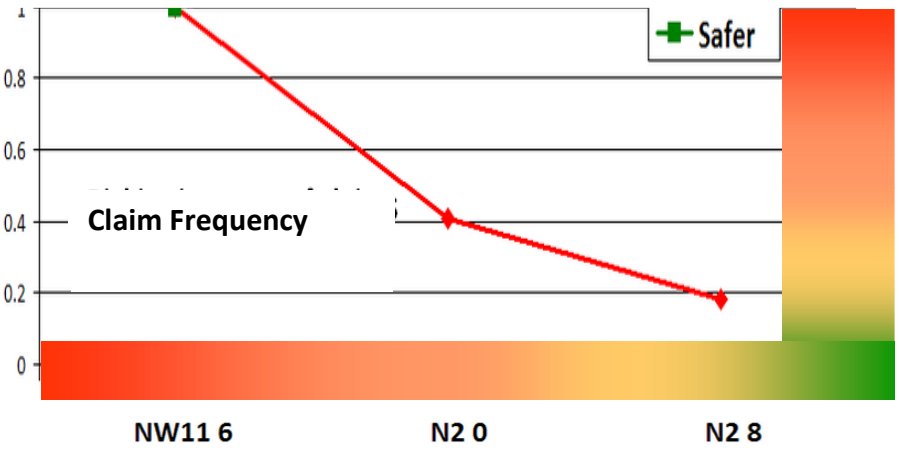

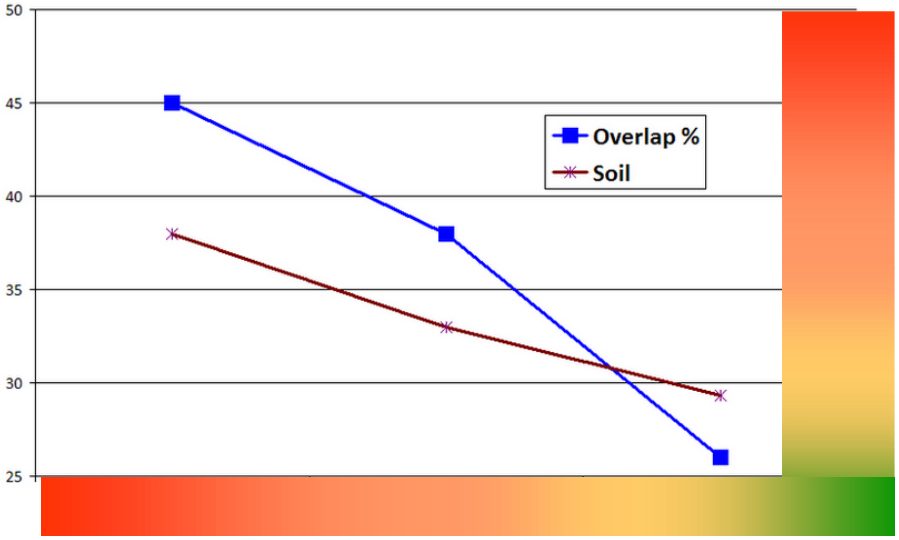

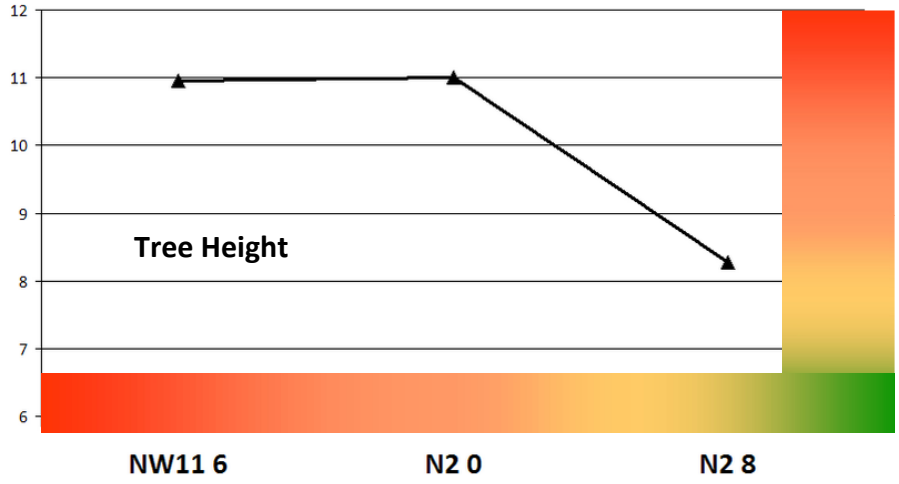

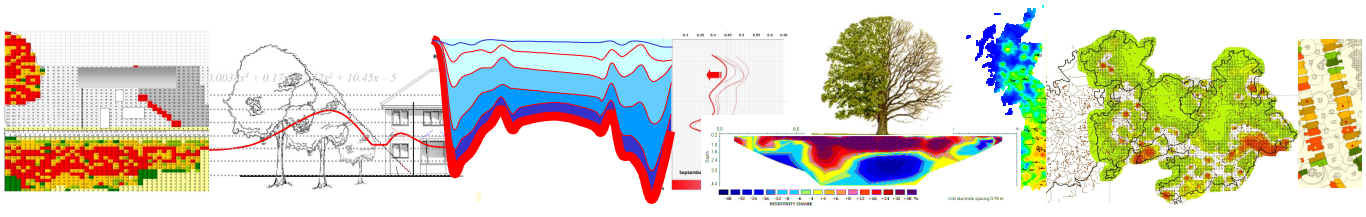

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From our sample of in excess of 110,000 claims, NW11 6 is the riskier of the sectors with 111 claims. This compares with 68 claims in N2 0 and 20 claims in N2 8.

Expressed as claims frequency this means that NW11 6 is nearly 2.3 times riskier than N2 0 and 5.5 times riskier than N2 8.

Looked at another way, our modelled root zones suggest that N2 8 has 1.7 times more 'safe' houses than NW11 6, and 1.48 times more than N2 0. We use the term 'safe' as a house with no roots extending beneath it.

What is the difference between the sectors that would account for this variable risk?

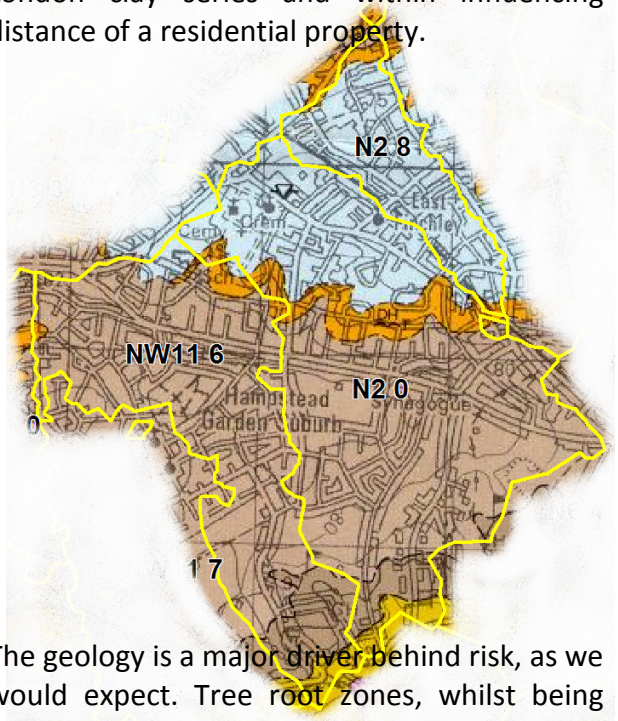
The obvious one is the number of houses with (or without) nearby trees.

The second is the presence of Boulder clay extending across a large area of the safer sectors. Although the clay fraction may have a high PI, the shrink/swell potential is mitigated by the % passing.

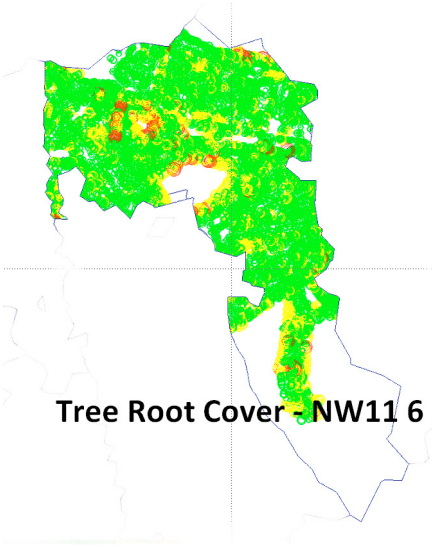
Looking at the extract from the BGS map (next column) it can be seen that nearly all of N2 8 is underlain by Boulder clay, and just under half of N2 0. Further, the densest concentration of properties in N2 0 are concentrated to the north of the sector, on the Boulder clay series.

Incidentally, two of the sectors in the study (NW11 6 and N2 0) span Hampstead Garden Suburb.

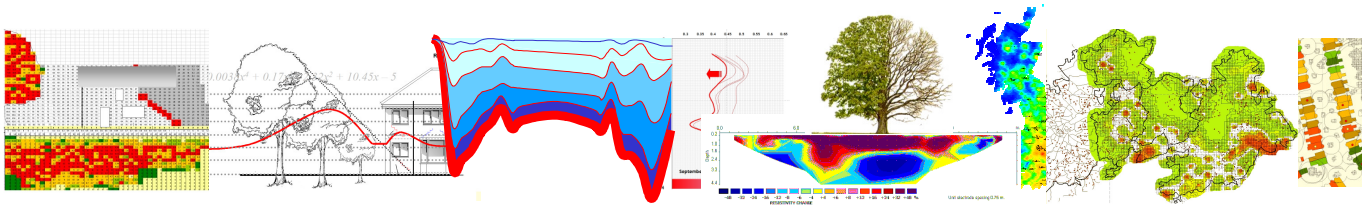
We estimate that there are 923 public trees in NW11 6 and 824 in N2 0, on the outcropping London clay series and within influencing distance of a residential property.



The geology is a major driver behind risk, as we would expect. Tree root zones, whilst being implicated in 70% or more of subsidence claims in periods of dry weather play a major, but less predictable role. As we see below, modelled tree root zones cover almost the entire populated areas in sector NW11 6.



Using a notional '1.2 x tree height' to describe the possible root zones of trees within influencing distance of buildings, on outcropping London clay, reveals a large area of cover in populated London.



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Classification of Urban Tree Species using Hyperspectral Imagery

Jensen *et al*
Geocarto International
Volume 27, Issue 5, 2012

Whilst Google Earth helps us to identify the layout of trees etc., and the LiDAR survey allowed measurement of height and distance etc., we still do not have a mean of identifying species.

This study takes us a step towards our goal by using "spectral features derived from airborne hyperspectral data".

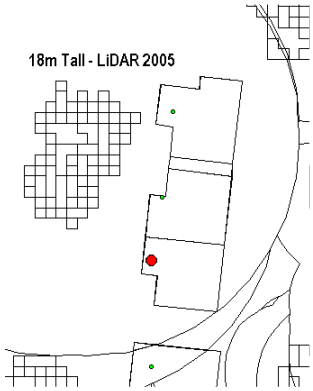
The abstract describes that "500 urban trees were identified through fieldwork. Visible and near infrared airborne hyperspectral imagery was collected over the same area.

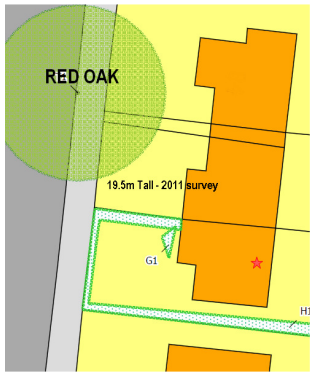
The 500 trees were identified on the images, and spectral features of each tree were extracted. Principal components, vegetation indices, band means, and band ratios were all used as features to discriminate between different tree species.

The tree classification was 82% accurate when just the six principal components were used. Classification accuracy increased to 91.4% after combining vegetation indices, band mean values and band ratios."

A step towards the objective of refining and improving our understanding of risk.

Google Earth & Street View

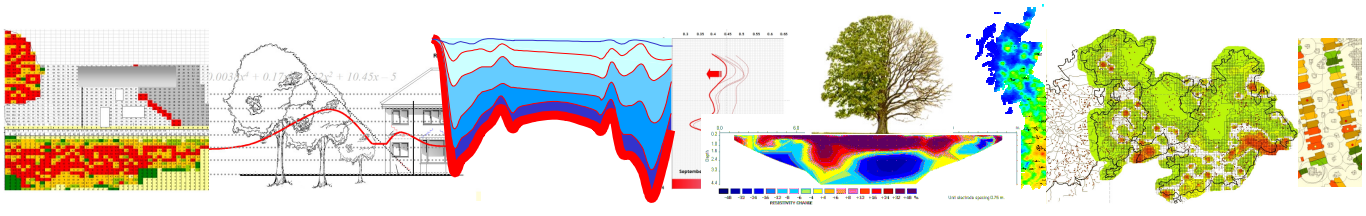




How far are we away form remote assessment of species using Google screens? Probably nowhere near from the vertical aerial imagery, but what about Street View?

The above screenshots have been taken from a valid claim and we can see that LiDAR imagery has identified the risk. The tree was 18m tall in 2005, and 19.5 mtrs tall in 2011. A growth rate of just under 300mm per year. Canopy spread was similar.

By May 2012, a visit to Street View confirms that work had been done to the canopy, but how difficult is it to identify species in trees that haven't been pruned?



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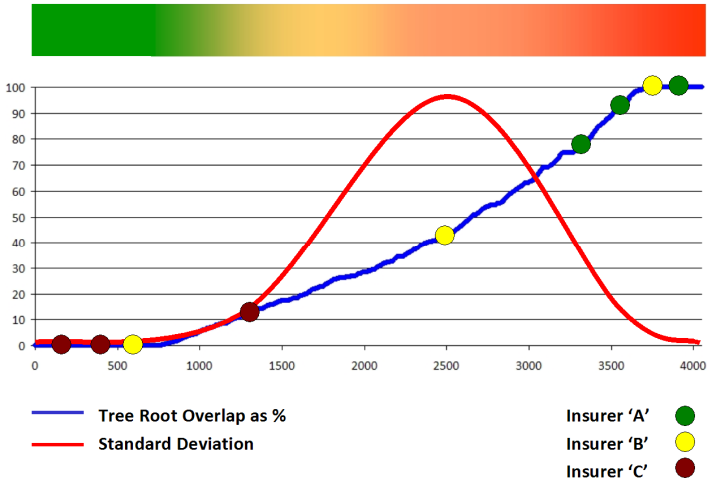
Implementing the Risk Model

The question arises, how is the prudent underwriter to make best use of the model? Clearly 'red lining' any property with a tree nearby would be commercial suicide – apart from being incorrect technically.

Nonetheless, it has to be recognised from evidence on the previous pages that there are circumstances that increase the risk significantly. The recommendation is that the portfolio is rated in the aggregate, taking account of the need to balance risk on the basis of probabilities.



Insurer 'A' has a high risk portfolio, with mature trees with roots overlapping the entire building footprint. As we say in the last edition, this is around 40% riskier than the counterparts, with smaller overlaps producing high claim numbers, but with average to below average claim costs.

The initial sifting selects those houses on clay, and attributes a 'risk of clay' with an average increase in repair costs of around 20% over 'other' soil types.

Properties to the right of the graph will have taller trees, closer to the building

They will not only produce higher repair costs, but will be more difficult and costly to manage.

Properties to the left are clear of trees. If they do cause damage, the tree should be easier to manage. The Standard Deviation confirms that the bulk of the risk falls towards the middle.

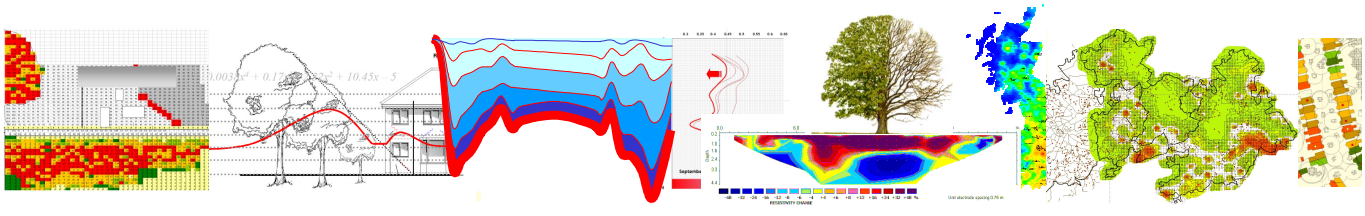
The benefit of the risk model is easy to see. Insurer 'C' carries a lower frequency of 'at risk' properties.

This isn't in support of 'red lining', whereby high risk properties can't obtain insurance, but balancing the portfolio.

If the insurer knows the risk – if the claim spend divided by the number of policies in force delivers a sensible return – then it may be regarded as prudent underwriting.

Risk by Numbers

By taking the average claims frequency of all sectors, and then averaging the risk of those with a clay soil with a PI above 15%, and the remainder, we estimate that clay soils are around 3 times riskier than non-shrinkable soils. More details next month.



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Genotypic Recognition and Spatial Responses by Rice Roots

Proceedings of the National Academy of Sciences of the United States of America. 2013 110(7):2670-5

Root system growth and development is highly plastic and is influenced by the surrounding environment. Roots frequently grow in heterogeneous environments that include interactions from neighboring plants and physical impediments in the rhizosphere.

To investigate how planting density and physical objects affect root system growth, we grew rice in a transparent gel system in close proximity with another plant or a physical object. Root systems were imaged and reconstructed in three dimensions. Root-root interaction strength was calculated using quantitative metrics that characterize the extent to which the reconstructed root systems overlap each other.

Surprisingly, we found the overlap of root systems of the same genotype was significantly higher than that of root systems of different genotypes.

Root systems of the same genotype tended to grow toward each other but those of different genotypes appeared to avoid each other.

Shoot separation experiments excluded the possibility of aerial interactions, suggesting root communication. Staggered plantings indicated that interactions likely occur at root tips in close proximity. Recognition of obstacles also occurred through root tips, but through physical contact in a size-dependent manner.

These results indicate that root systems use two different forms of communication to recognize objects and alter root architecture: root-root recognition, possibly mediated through root exudates, and root-object recognition mediated by physical contact at the root tips. This finding suggests that root tips act as local sensors that integrate rhizosphere information into global root architectural changes.

Elevated Carbon Dioxide Making Arid Regions Greener

Donohue *et al.* Accepted for publication in Geophysical Research Letters,

Satellite data suggests that elevated levels of CO2 have actually encouraged greening around the globe. Looking at southwestern corner of North America, Australia's outback, the Middle East, and some parts of Africa, the research team have recorded an increase in what they term the 'fertilisation effect' from 1982 through to 2010. Donohue and his team from the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Canberra, Australia said, "it is the warm, dry environments that the CO2 effect is expected to most influence leaf cover." Leaf cover is the clue, he added, because "a leaf can extract more carbon from the air during photosynthesis, or lose less water to the air during photosynthesis, or both, due to elevated CO2." That is the CO2 fertilization effect.

Cleaning the London Air

We have just come across a paper from 2011 (Tallis *et al.,* **Estimating the removal of atmospheric particulate pollution by the urban tree canopy of London, under current and future environments**. *Landscape and Urban Planning*, 2011) explaining that London trees clean between 850 and 2000 tonnes of particulate pollution from the air every year. The study recommends planting a larger mix, comprising both conifers and deciduous to take advantage of the year round benefit provided by evergreens such as pines and the evergreen oak. Professor Gail Taylor explains: "Trees have evolved to remove CO2 from the atmosphere, so it's not surprising that they are also good at removing pollutants. Trees which have leaves the whole year are exposed to more pollution and so they take up more. Using a number of different tree species and modelling approaches, the effectiveness of the tree canopy for clean air can be optimised."