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

November 2014
Edition 114

The Clay Research Group

CONTENTS

Issue 114, November, 2014

What do hayfever and medicine have to do with Subsidence?

This month we take a look at articles in the press that – at first sight at least – appear unrelated to subsidence.

Hayfever in Australia and the "Your doctor will Skype you now" article that appeared in the May 2014, edition 108 of the Newsletter – may have closer links than we might have thought.

Hormones and business processes come together to show us the way.

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

Last Month's News

Our thanks to The Subsidence Forum for agreeing to fund the renovation of the weather station. Normal service will hopefully be resumed shortly.

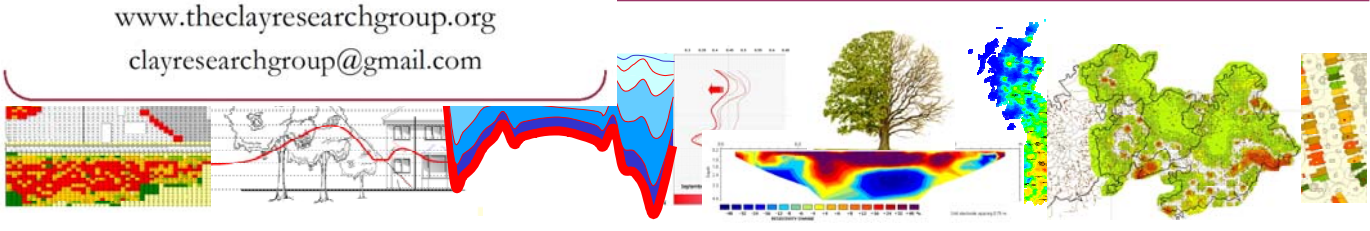
Tom Clinton's project is underway, and Dr. Nigel Cassidy from Keele University joins the team at Aldenham School to take further readings from the arrays set up by Glenda Jones a few years ago. Hopefully we will be able to share the findings with you shortly.

We delivered a talk to a group of subsidence engineers last week, outlining the challenges we face, and guessing where the future might lie. Will we be doing more from our desk using remote imaging and sensing, or will the industry revert to a more personal service? Are the two approaches mutually exclusive – or is there a middle way that combines both? What does the customer really want?

Climate modelling continues to occupy us all. Hotter, colder but certainly wetter. What are the associated risks and how do they translate to claim numbers? Recent research suggests current models miss a major contributory factor – infrared light emissivity. The Arctic is shrinking as the Antarctic expands. Northern latitudes are experiencing greater temperature increases than southern latitudes. And the UK is coloured blue in an ocean of yellow – see page 11.

The Government have announced support for a £97m super-computer for the Met Office that will be "13 times more powerful than the current system … and will have 120,000 times more memory than a top-end smartphone".

This could be a significant step forward in modelling all of the variables and hopefully make sense of the chaos.



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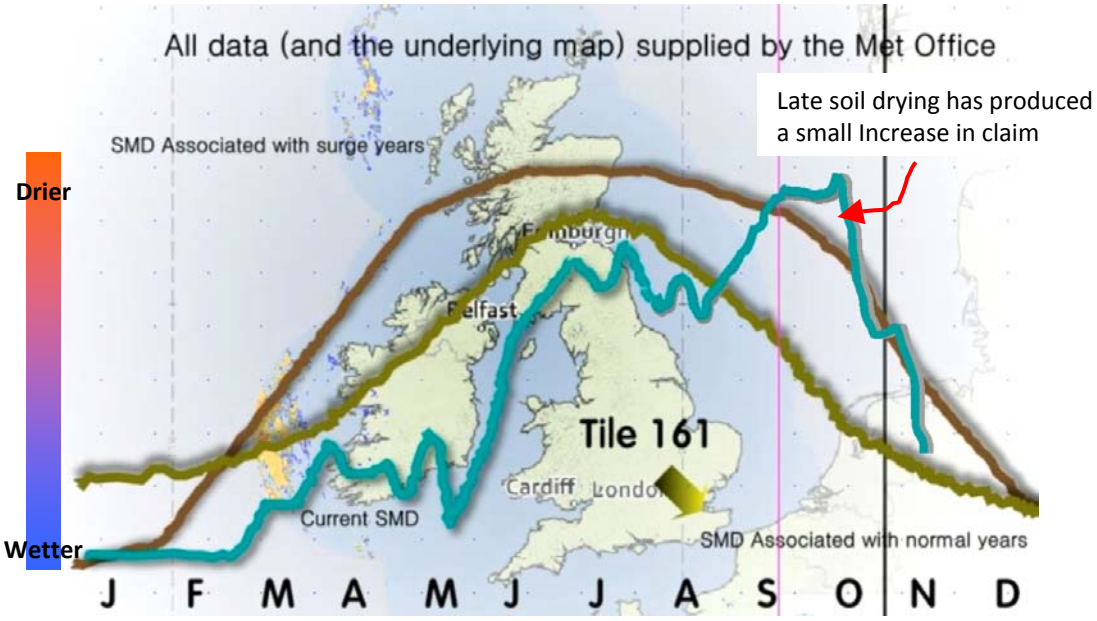
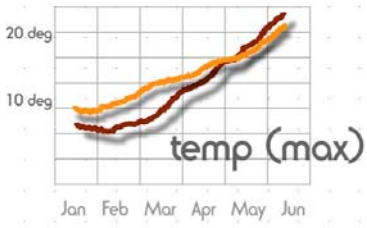
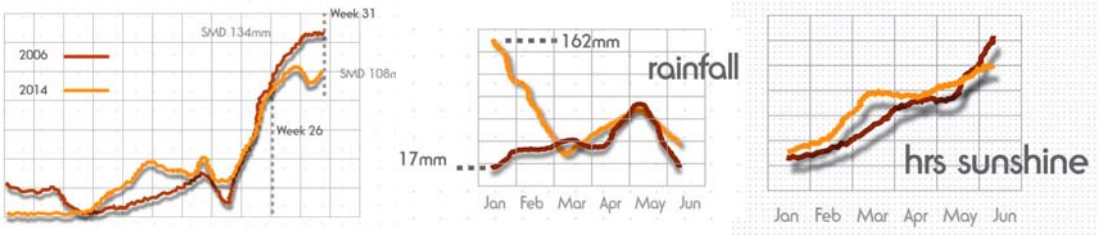
Soil Moisture Deficit Update

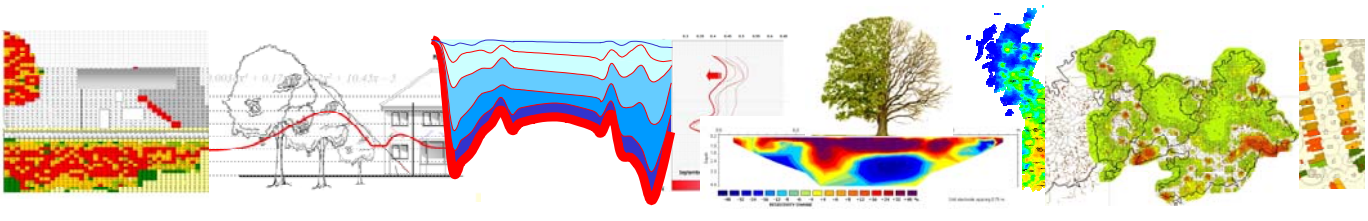
The Soil Moisture Deficit rose sharply in June and again in August, peaking in October to deliver a late increase in claim numbers. An unusual profile and the sharp incline in June was comparable with 2006 which delivered around 48,000 claims. This year has been quieter, with a small increase in claims associated with the October drying.



Below and right comparison profiles for 2006 and 2014, plotting SMD, maximum temperature, rainfall and hours of sunshine. Very little to choose between them, other than higher rainfall early in 2014 which may have saturated the ground at depth. SMD values are taken from shallow depth and reflect saturation.







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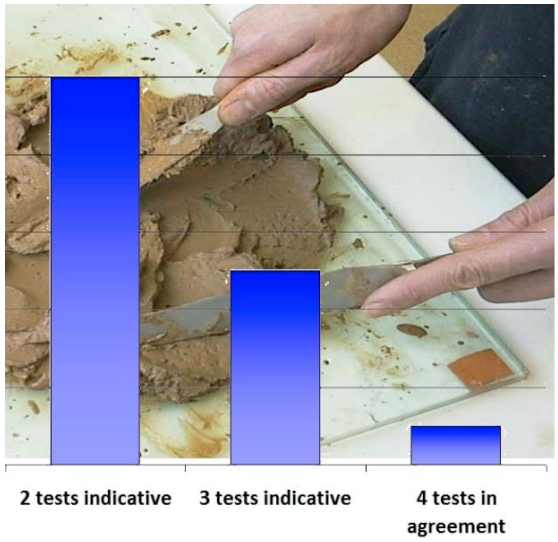
Soil Testing to Determine Desiccation

Is it the case that 'more' = 'better'?

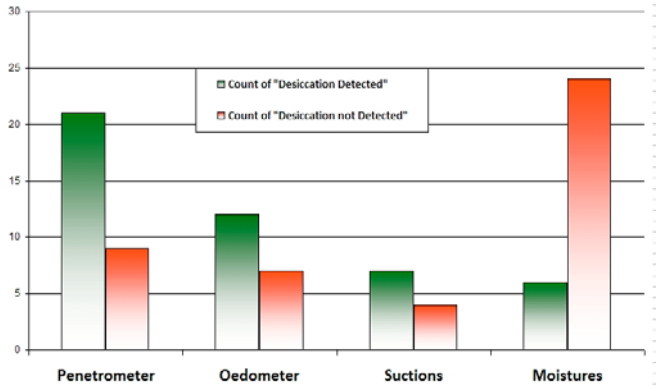
Detecting desiccation isn't always easy, and sometimes it will depend on the test selected and the method of sample retrieval.

Unfortunately, it doesn't appear that increasing the number of tests delivers more evidence. Quite the contrary.

From a small sample of claims where investigations had been undertaken, the results were surprising. See graph, right. In the sample reviewed the greater the number of methods used, the less positive the outcome.



Where two tests were used, the chances of them agreeing was quite good. More testing appeared to confuse the outcome. The tests in our study included penetrometer, moisture comparisons with index properties, suctions using filter papers and swell using the oedometer test.

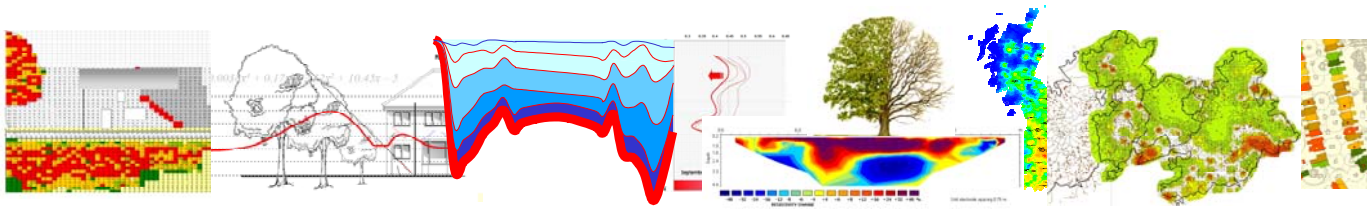


The graph, left, plots the success or otherwise of the various tests.

The penetrometer produced positive results more often than any other (as a percentage of the claims where it was used) and the moisture test (used more often than the others) was the least reliable.

CAVEAT

This limited study assumed that when a particular test proved desiccation that it (the test) was correct, and when it didn't, it is flawed. We have no absolute evidence that the test that detected desiccation was in fact correct. The study is no more than a brief view of around 80 laboratory reports from a range of claims when desiccation was detected using at least one of the tests and confirmed lack of agreement between test methods.



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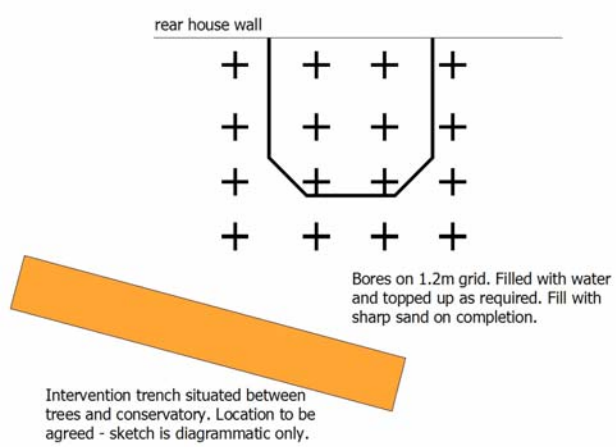
Simple Rehydration

Wetting the ground to resolve problems caused by desiccation of a clay soil isn't new. The problems are (a) ensuring that rehydration doesn't result in heave damage and (b) dealing with desiccation of the surrounding ground to ensure the clay soil beneath the structure remains at equilibrium levels.

Problems with heave are reasonably well understood. Site investigations will hopefully provide some estimate of the swell potential. The loss of water to surrounding ground that remains desiccated – and therefore has suctions that will draw water away from the treated zone – is less researched.



We are currently rehydrating the ground beneath a conservatory damaged by root induced clay shrinkage. The trees that have caused the damage are to be retained. The soil has a PI of 34%.

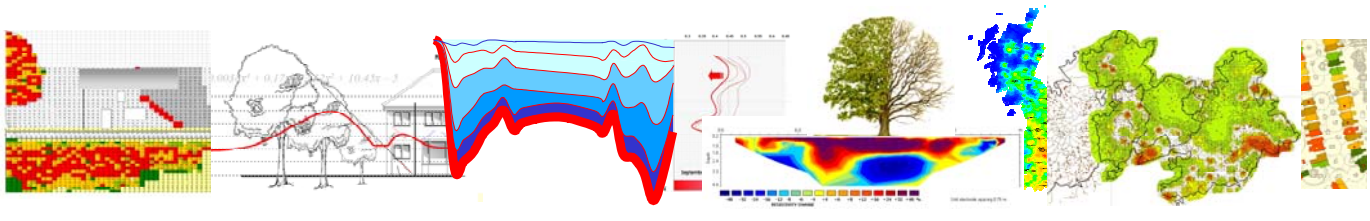
Shallow (1.5 – 2mtr deep) hand augered bores will be sunk on a 1.2m grid as shown left. The bores will be filled with sand before being watered in.

Precise level readings are to be taken every week or so to establish when swelling ceases. Without accounting for suctions in the surrounding ground, we anticipate (as recorded by Blight) that a further episode of subsidence would occur as negative porewater pressures equilibrate across the garden. To counter this an intervention trench is to be installed.

Briefly, soil mineralogy, density and the degree of desiccation determine the amount of swell and the rate of recovery. The higher the soil density, the greater the potential suctions and amount of swell that will take place. The lower the permeability, the longer it will take.

Oedometer tests suggest that the amount of swell in this study will be between 30 – 40mm. In South Africa[(1)], a site was flooded for 96 days after which 90% of surface heave was completed.

Blight et al (1992) "Preheaving of Expansive Soils by Flooding – Failures and Successes" Proceedings, International Conference on Expansive Soils.



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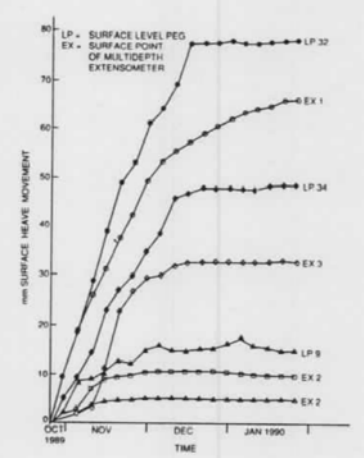
Simple Rehydration … continued

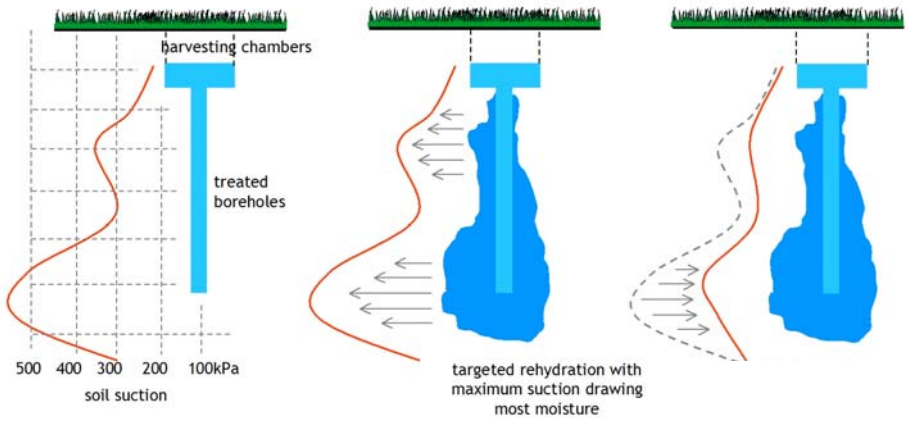


Loosely based on the graph produced by Blight et al (1992), left, we anticipate recovery of the conservatory will take around one month to complete bearing in mind the relatively shallow depth of the moisture deficit and lower plasticity of the soil. In the case reported by Blight the soil was desiccated to a depth of around 5mtrs.

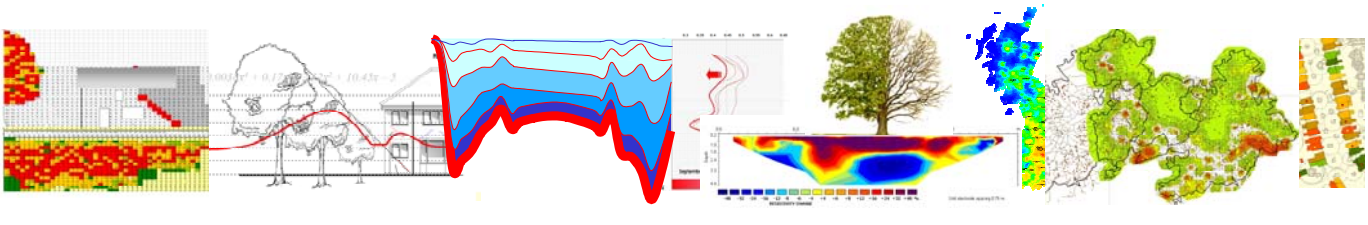
Other authors have used small diameter wells to rehydrate desiccated clay soils with success.

Once the ground has rehydrated, repairs will be undertaken and monitoring will continue to ensure a satisfactory conclusion to the claim.

The intervention trench is being installed to counter the suctions in the surrounding ground induced by root activity. Rehydrating the ground beneath the conservatory is of limited use if water is lost to adjoining zones where deficits remain.



Diagrammatic illustration of how the intervention trench will work. To the left of the trench – the area closest to the trees – root induced negative porewater pressures will draw moisture from the treated zone beneath the conservatory. The trench is designed to satisfy the water demand and ensure the ground beneath the conservatory remains stable.



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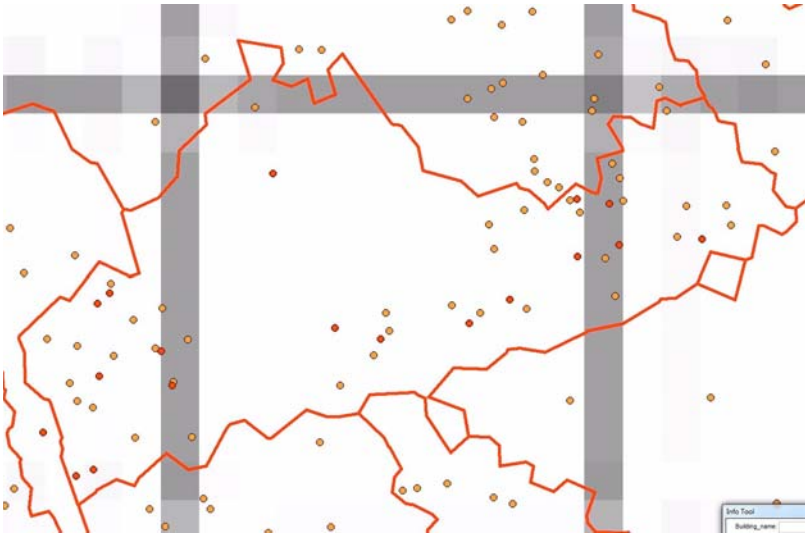
Risk Variability within a Postcode Sector

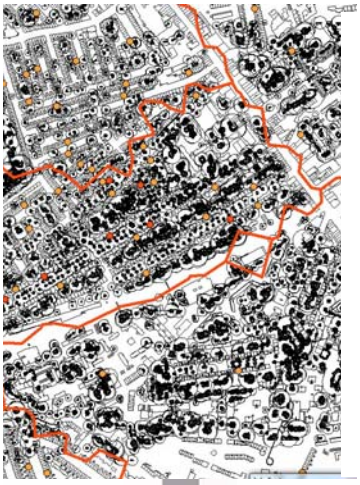
Example - NW6 6

The top image, right, shows the outline of postcode sector NW6 6. Claims from our sample have been plotted to determine the variation of risk within the postcode sector.



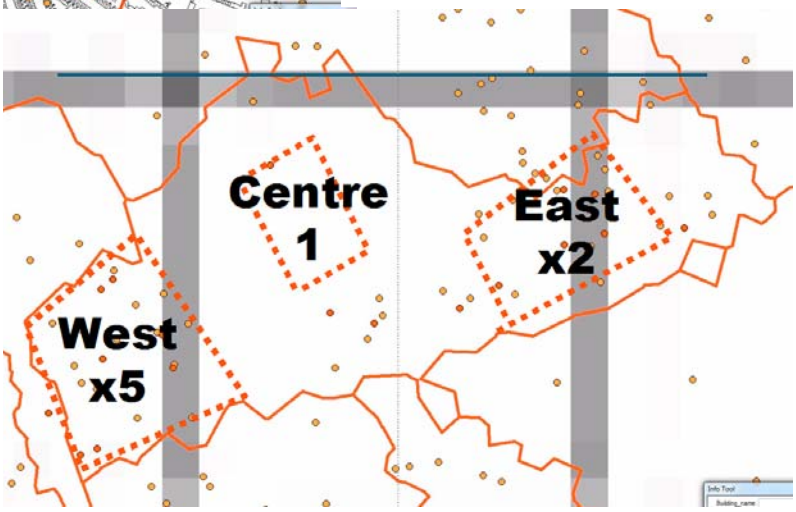
Writing risk at sector level is a blunt tool but what are the drivers that determine risk?

Right, a "times more risky" frequency map showing the relative risk in terms of number of claims/count of houses.



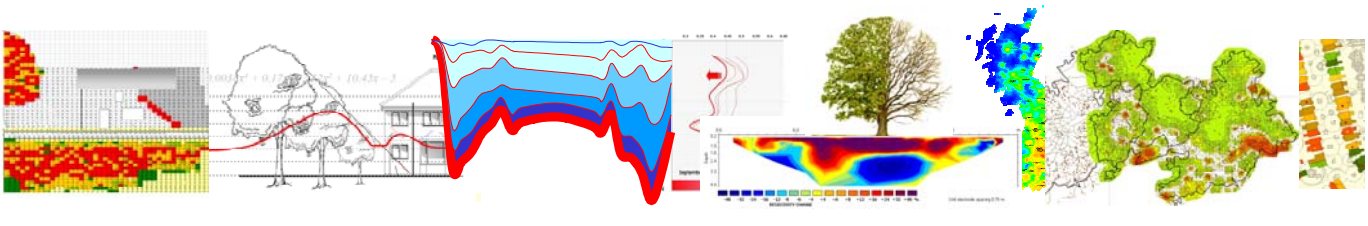
Our current model takes account of soil shrink/swell potential, tree metrics (height and distance from property) and to a limited extent, building vulnerability estimated using a root zone algorithm.

Left, a map of the postcode sector showing the layout of housing and open amenity land with claims superimposed.



The centre area has been standardised with a value of 1, and others rated accordingly.

The block labelled 'east' was twice as risky and the block labelled 'west' five times riskier than 'centre'.



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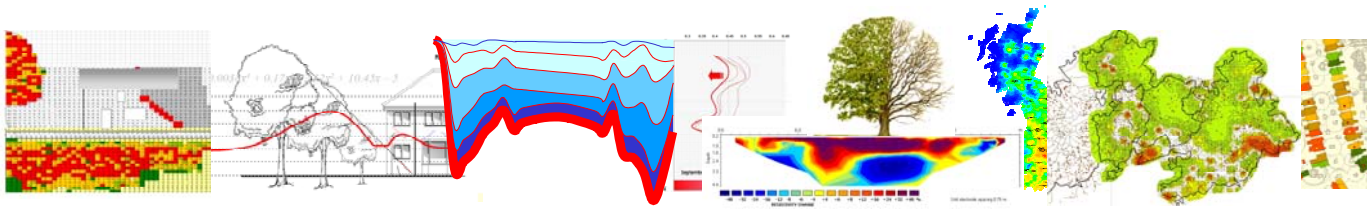
Lowest Risk

This is the street scene of the lowest risk area at the centre of NW6 6. The street trees are saplings in the main, and some of the more mature specimens have had their crowns raised.

Intermediate Risk

The zone to the east (above) presents twice the risk. There are a selection of saplings (above, right) and crown thinned trees (above, left) with some larger, un-thinned trees at intervals (above, right). There are also slightly larger front gardens in the street scene above, with private vegetation nearer to the houses.



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Higher Risk

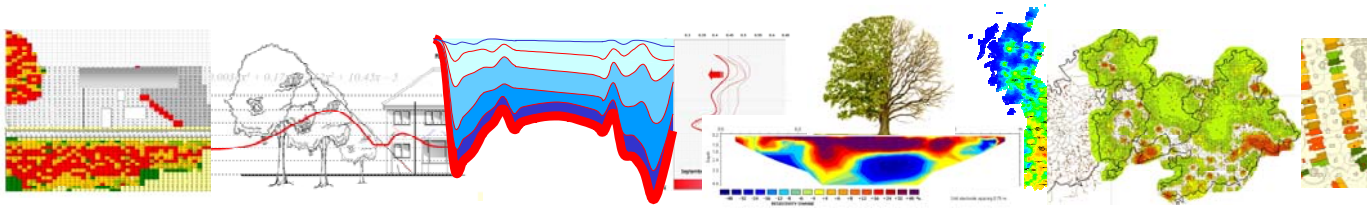
Below is the street scene in the highest risk zone of NW6 6. Perhaps the trees have been pruned back in recognition of claim numbers.

The risk driver 'by tree' is almost certainly the trunk diameter and tree species. Trunks in the lower risk areas generally have a much smaller diameter.

This study is a refinement of the underlying risks. Namely the presence of a clay soil, tree height, proximity and building vulnerability (bay windows and porches for example).

Perhaps the way forward is to use the existing model based on these factors initially (soil, tree metrics and building vulnerability) and provide this additional layer. The existing house-by-house risk model works well, but could be refined.

The method would involve listing all of the properties identified as being at risk using the current model, and then visit each using Street View or carry out a physical survey to assess the up-to-date position.



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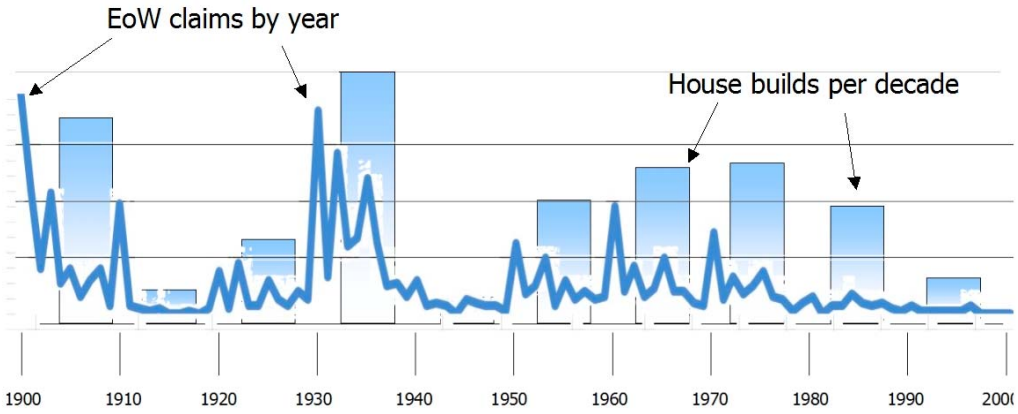
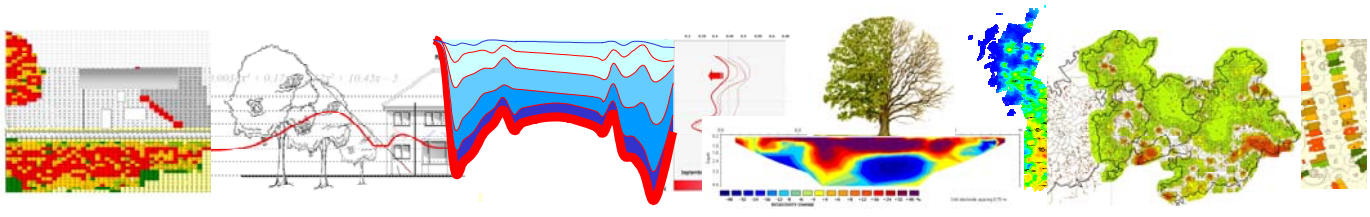
Escape of Water - Damage by Age of Property



The bar chart above plots the house-builds per decade and the line graph reveals the number of claims under the 'escape of water' peril from a sample of around 30,000 valid EoW claims. Peaks at the beginning of each decade (line graph) are most likely the result of engineers and homeowners making a "1950's" assessment when they aren't sure of the date of construction, rather than any particular risk associated with the beginning of a decade. It can be seen that there are far more claims in the 1930-40 interval, which is a result of the number of houses built, as is the 'blip' between 1960 – 1980. The risk diminishes as a percentage of housebuilds from 1980 onwards.

Escape of Water - Damage by Location

EoW claims by location – external locations only. The rear and side walls appear most often as one might expect given the location of drainage connections from bathrooms and kitchens. Side walls are under-rated when expressed as frequency due to the population of terraced houses without exposed side walls.



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Is there a link between Subsidence and Hayfever?

What does hayfever have to do with subsidence? More than we may think apparently, and the phytohormone abscisic acid is the link. Perhaps. Maybe.

Café society in Melbourne, Australia, struggle with runny noses and sneezing around this time of year and – according to some – the cause may be the seed pods of London plane trees, which make up 75 percent of Melbourne's trees.

Initially, the Council tried injecting a hormone directly into the tree trunk – see above. This delivered little benefit.

The idea now is to drench the soil surrounding the tree with a substance containing the hormone to see if they can reduce its influence. 'Close it down', without causing harm to the tree.

It is hoped the treatment will stop the tree from producing seed pods which are thought to be the cause of the problem.

Very much what we are trying to achieve with the Intervention Technique - reducing the moisture uptake of the tree whilst retaining cell turgor.

Talking about Hayfever

In edition 108 we reported on the emerging use of remote assessment in medicine following an article in The Times, April 29th, 2014. "The Doctor will Skype you now" approach to diagnosis as seen on Embarrassing Bodies.

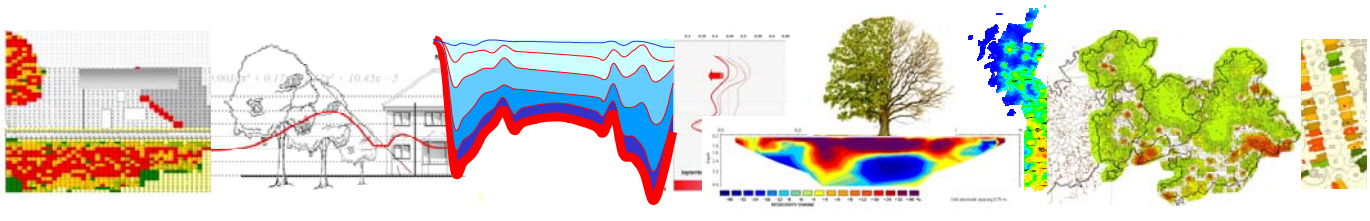
The idea that patients could be diagnosed using the Skype application has hit a hurdle. It seems that more people feel disposed to send their GP an Email reporting the most modest of symptoms and doctors are overwhelmed with enquiries.

The barrier of phoning the receptionist to make an appointment, taking a few hours off work and sitting face to face with the GP used to put some patients off. In contrast, sending an Email takes a few minutes and requires minimal input.

This could easily confound what would seem to be a good way of resolving routine medical problems.

It is unlikely to be a problem in the world of insurance. Homeowners aren't keen to have a claim notification logged without good cause, and particularly in the field of subsidence.

It does however illustrate the difficulty of anticipating all eventualities when developing new ideas. It might be quicker and cheaper but does it take account of the human condition?



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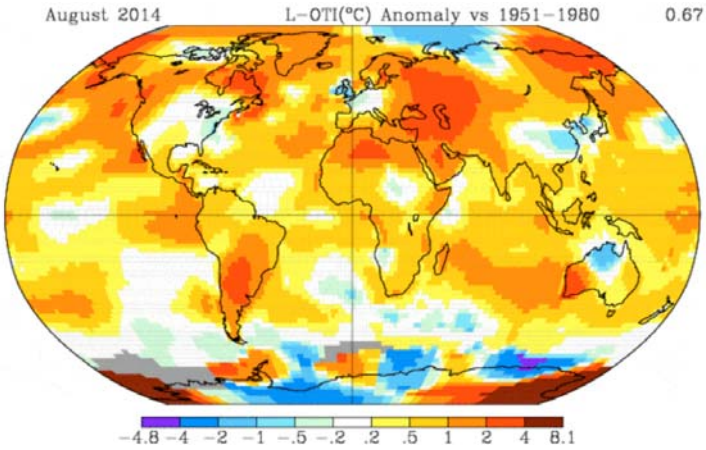
Climate Change and a Warming Globe

A blue smudge covers the UK, but apparently the global situation is a little different. According to NASA, April to September was the hottest middle period of a year on record. April, May, June and August were hotter than they have ever been. July was the fourth warmest it has been since 1880.



It is the hottest middle six months of a year since record began. The temperatures were based on global averages across land and sea and 2014 may rank as the hottest year on record.

Scientists from Lawrence Livermore National Laboratory have recommended increasing estimates of the rate of ocean warming by between 48 per cent and 152 per cent following their analysis of satellite observations. They suggest that old data was inaccurate and found 'this underestimation is a result of poor sampling prior to the last decade and limitations of the analysis methods that conservatively estimated temperature changes in data-sparse regions,' said oceanographer Paul Durack, lead author of the study.

Scientists from the US Department of Energy's Lawrence Berkeley National Laboratory have studied a long-wavelength region of the electromagnetic spectrum called far infrared which accounts for about half the energy emitted by Earth's surface. This process balances out incoming solar energy. Apparently this is a little recorded element in the climate equation although it could be significant.

Researchers at MIT and the University of Washington have forecast a rapid increase in the rate of global warming following the recent pause.