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

The Clay Research Group
www.theclayresearchgroup.org

September 2008

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~ Extracts from Nature - September 2008 ~

"Old Forests Capture Plenty of Carbon"

Emma Marris

Emma Marris reports that "planting a new tree may be a less effective way to sequester carbon than saving an old tree from the axe.

Old forests continue to accumulate carbon at a much greater rate than researchers had previously thought, making them more important as carbon sinks that must be factored into global climate models, researchers say.

Until recently, it was assumed that very old forests no longer absorbed carbon."

"Tiny Synthetic Tree Pumps Water"

Heidi Ledford - Nature

"A 'microtree' created from a synthetic gel used to make contact lenses has replicated water transport in plants. The design could be tweaked to improve extraction of water from dry soils, or to create more efficient cooling systems, researchers say."

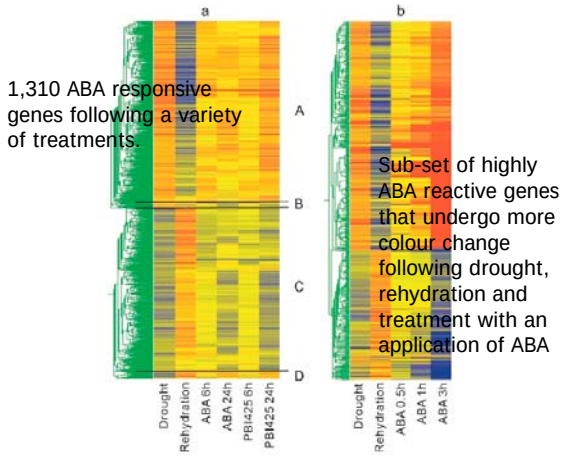
The CRG were interviewed by the BBC to provide an update on the latest developments in the clay soil/tree interaction for their program, 'The Politics Show'.

We outlined our work on the intervention technique and spoke about how, in the future and using telemetry, we might reach a time when subsidence isn't the problem that it is today.

The 'claim and repair' phase we are entering might be superseded in the next ten years by 'stop the claim from happening' using black box technology and 'movement by exception' algorithms.

ABA & Drought Stress

Huang et al report in The Journal of Experimental Biology (Vol 59) the link between ABA and drought stress in an article entitled "The Relationship of Drought-Expression in Arabidopsis to Hormonal and Environmental Factors"



1,310 ABA responsive genes following a variety of treatments.

Sub-set of highly ABA reactive genes that undergo more colour change following drought, rehydration and treatment with an application of ABA

The authors explain that many drought regulated genes are ABA-responsive and the map above illustrates this clearly. We can get some understanding of the complexity of the mechanism when we learn that there are 1,969 drought regulated genes, and ABA plays a part in 1,310 of them. The 1,310 are illustrated above.

The authors have shown how gene expression changes in varying conditions (Picture A). Looking along the bottom row we see the response to drought, rehydration and various ABA treatments, including the analogue. Image B shows a sub-set that react more (and therefore have a closer link to) to the same conditions as revealed by the deeper spectrum of colour change.

The authors tell us that around 30% of the genes were **not** influenced by ABA, suggesting other stress mediation pathways exist and typically, the mechanism is complex.

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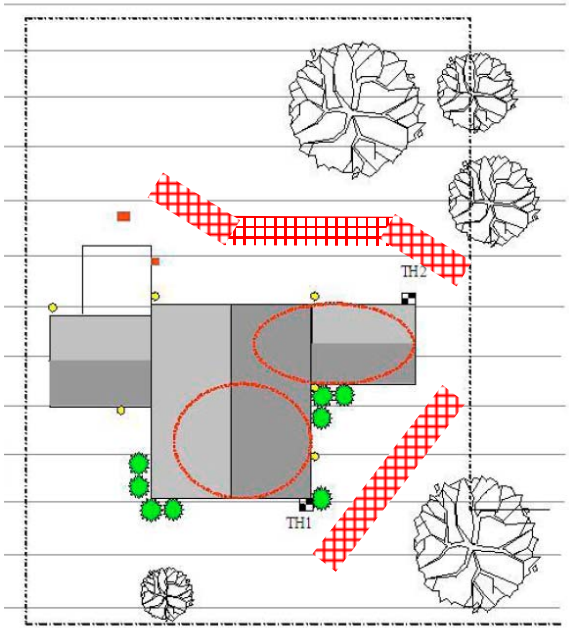
Intervention Project No. 3

Innovation have provided a further case to test the intervention technique – see site plan below.

Several mature Oaks surrounding a detached property on a soil with a fairly low Plasticity Index (24%) have caused minor but recurrent damage. Dr Allan Tew has produced a scheme that we hope will allow the homeowner to live in peace and the trees to be retained.



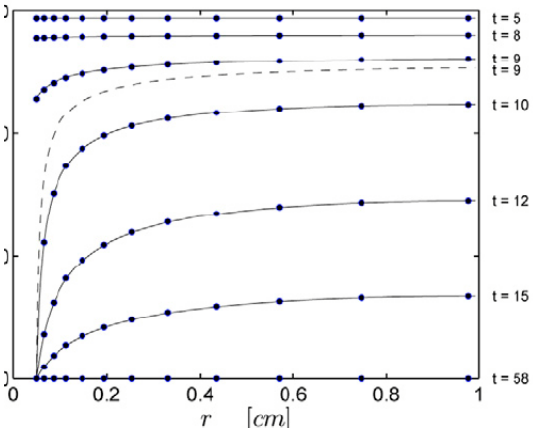
The Oak trees are around 14m high and between 6 – 14mtrs away from the building and matters are complicated by the fact that extensions have been added to three elevations, all with differing foundation depths.

The work is scheduled to commence shortly and will take about two days to complete. The cost is around £4,000 compared with £50,000 for foundation stabilisation.

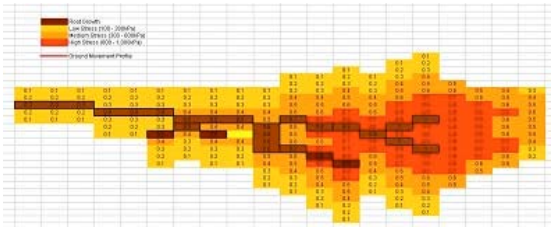
Tree removal would be an option, but the work would cost as much and we would lose a valuable amenity. Precise levels will be taken from time to time to determine the efficacy of the treatment.

Numerical Model of Water Potential in Vicinity of Roots

In last months edition 39 we saw Clive Bennett's suggestion for modelling suctions surrounding the root, with negative pressures diminishing with distance.



Account has to be taken of the variable hydraulic conductivity of the soil with distance and above we reproduce a graph from the paper entitled "Effect of Local Soil Hydraulic Conductivity Drop using a Three Dimensional Root Water Uptake Model", Schroder et al. Vadose Zone Journal. Our own suggestion from an earlier edition is reproduced below.



MatLab have been examining samples to compare the relationship between strains and the presence/absence of roots. Their preliminary view is that variations in root densities may account for variable strains and the sometimes odd looking results that we see, which echoes the findings of recent ERT papers both from Glenda and others.

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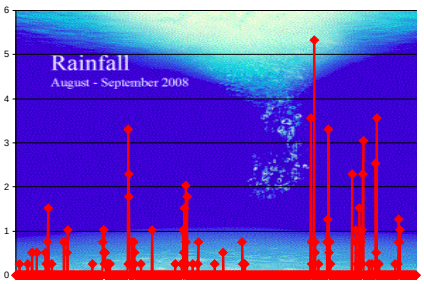
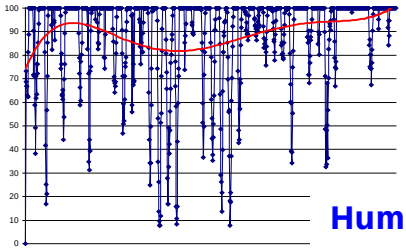
Summer 2008

The weather station at Aldenham records the rainfall in August and September, confirming what we already know. 2008 is another wet year with low numbers of valid claims.



The Relative Humidity chart (below) tells a similar story. Low humidities drive transpiration and will assume greater significance going forward in our predictive model.

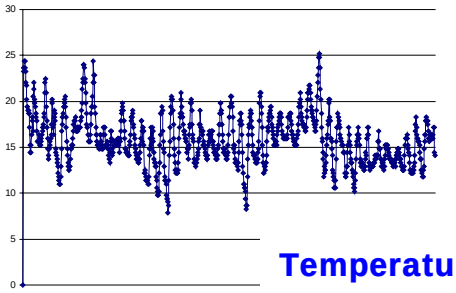


Humidity

The Meteorological Office confirms that rainfall has been above average this summer, and the hours of sunshine, below average.

They blame this on the jet stream: fast moving, high-atmosphere winds which were further south than usual, preventing the Azores high from bringing hot weather from southern Europe.

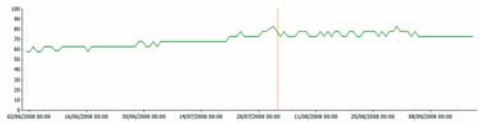
Temperature data below.



Temperature

Telemetry

The new sensors are recording fairly minor movements as we would anticipate given the wet weather over the last few months but the output will be useful in building a library of characteristic signatures that we can pattern-match against in the future.



Electrolevel Calibration

Jonathan Grey from Crawford & Co., is calibrating the new range of electrolevels, using a 1m long arm and dropping it every day by 1mm.

The rig has been set up in his workshop and has provided the following results via the web portal. We hope to deliver the results by the end of November if all goes well.

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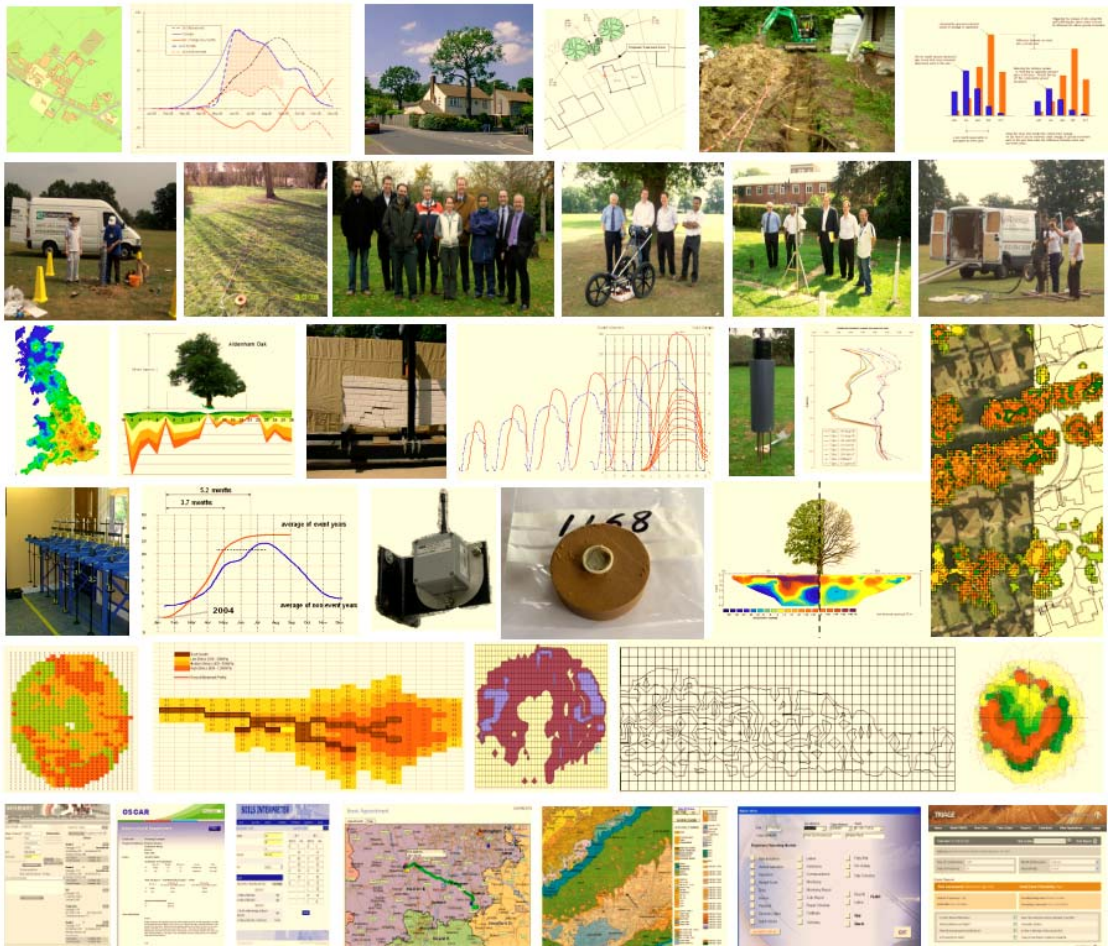
The Last Few Years

The work of many individuals and groups has improved our understanding about moisture change over time due to root activity in fine grained soils related to climate. Below is a compilation of our efforts. We have encouraged people to share in both the research and the output wherever possible.



The CRG have delivered many practical solutions to the subsidence industry and the images above are a compilation of our work. The outputs for insurers and adjusters include (a) a soils interpretation application, (b) improved understanding of ground movement beneath mature trees, (c) a range of risk models (d) event prediction modelling (e) telemetry – measuring moisture change using Time Domain Reflectometry and building movement – electrolevels - from our desk, (f) researching soil retrieval, sampling and existing test procedures, (g) developing new methods of testing soils, (h) understanding how masonry flexes prior to bending, (i) stochastic modelling soil stress around the root tip and across the root zone, (j) using non-invasive techniques – ERT - to detect moisture change across the root zone, (k) triage application, (l) a soils interpreter capable of pattern matching a range of outputs using either the oedometer or filter paper results, (m) mapping tools, (n) understanding the depth at which roots exert most stress in mature trees, (o) sophisticated interpretation tools for the telemetry sensors and finally (p), development of an intervention technique based on various threads of research both at Aldenham and undertaken elsewhere and by others, mainly in the field of BioSciences. The CRG have lectured at most domestic subsidence venues and their work has been published in our specialist press. We have been given support by a wide range of individuals, universities and commercial practices, many of whom are listed below.

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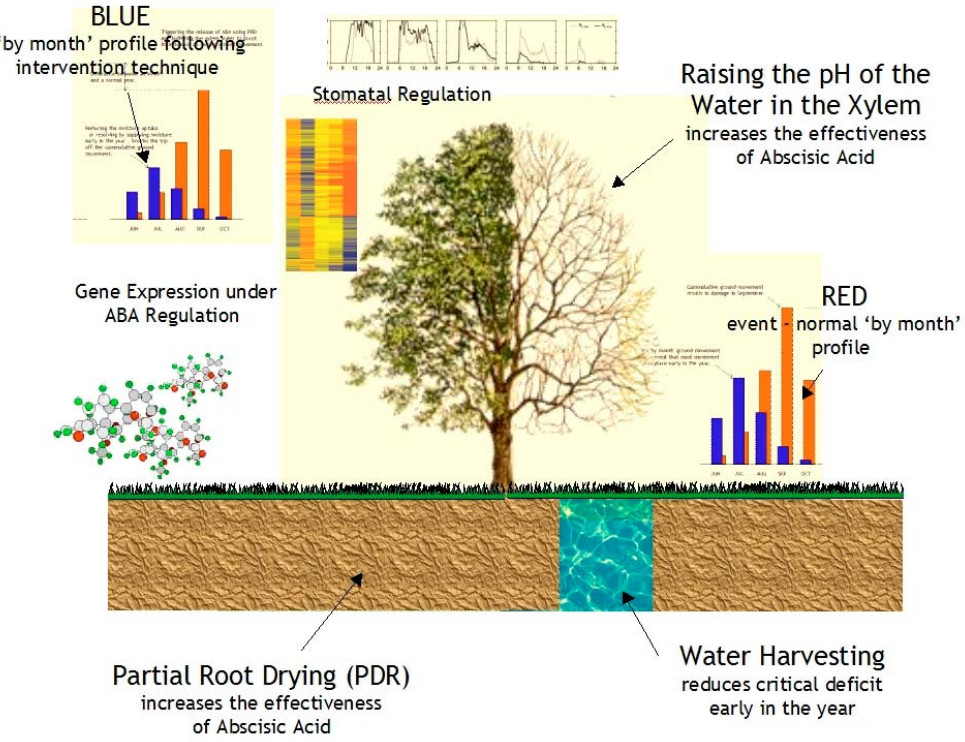
Moisture Uptake by Month and Intervention

Below is a composite of the three combined methods that form the intervention technique. First, we provide water to the root system using a unique method that drip feeds a controlled supply to the roots early in the year, without the need for any mains supply. We regulate the moisture uptake by building in a resistance sufficient to be triggered by root suctions. Water isn't allowed to simply drain under gravity.

Second, the ground is treated using a naturally occurring and abundant mineral to raise the soil pH. The benefit of this is to raise the pH of the water in the tree xylem, increasing the effectiveness of Abscisic Acid significantly. The mineral has a slow release phase, and can be topped up at any time although we anticipate it lasting for many years.



To further increase the effectiveness of Abscisic Acid we take advantage of Partial Root Drying. The treatment is only applied over part of the root footprint, and this, combined with the provision of water, enhances the influence of this important hormone.

The approach uses several available, well researched, methods to ensure we have a fail-safe should any individually prove to be ineffective. The objective is to reduce the SMD locally by 20% in June and July. The water our scheme provides is unlikely to satisfy this requirement in full for the year but will meet the needs in the so-called 'danger months'. By reducing transpiration at the same time we build in a factor of safety.

The health of the tree remains unaffected. Because we are helping it self-medicate, it will consume less water naturally, and the tree can be retained if we are successful.

We have five projects on site at the moment and anyone interested in adding claims should contact us.