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

March 2010

The Clay Research Group

CONTENTS

Contacts

~ tree root identification ~

EPSL research have developed a unique ability to differentiate Willow from Poplar roots. They are of the view that no other laboratory in the UK can currently provide this service. Contact Mark Mitchell on 01248 672 652.

~ 'same day' reporting ~

MatLab are offering on-site penetrometer readings and a 'same day' reporting service. Contact Lisa on 0121.704 3339.

~ original research~

OCA have a selection of excellent publications on their web site, and in particular a paper by Giles Mercer, dated 2005, exploring the relationship between trees, climate and soils.

The Subsidence Forumcan be found at (http://www.subsidenceforum.org.uk/) and the LTOA (http://www.ltoa.org.uk/) for background information on the JMP, and look out for updates from Plexus Law (http://www.plexuslaw.co.uk/services/).

Anyone with developments that they are willing to share with the industry, please contact us on the E-mail address below.

www.theclayresearchgroup.org
splante@hotmail.co.uk

2010 Update

It is traditionally quiet at the beginning of the year, but not so in 2010. We are re-visiting our proposals around electro-kinesis, possibly working alongside industry partners and a University.

The initial proposals were to move water through the soil whilst changing the soil structure to effect permanent change that would reduce future ground movement, and perhaps induce stress into the soil by flocculation. The treatment would increase soil stress locally, inducing an increase in the production of ABA.

The synthetic tree has attracted interest, again joining suppliers with academics.

Others have shown interest from a slightly different perspective. One industry expert has pointed out the need to bring together the various elements – software applications, triage, investigation techniques, mapping and so forth – into a commercial package. Hopefully a brief article will follow shortly, outlining the proposals.

Another has suggested broadening the remit of the group taking environmental considerations into account.

Then we have the conference at Aston on 19th May. Do come along if you can. It's a chance to catch up with friends and colleagues, and see what is happening across the industry.

John Parvin will provide the insurer's perspective, and Gary Strong outlines his plans to take the RICS forward, developing the skills of their members with regard to subsidence.

In addition, we have talks on the work of the CRG from Dr. Allan Tew and a review of non-invasive methods of geotechnical investigation by Dr. Nigel Cassidy.

2010 looks like being a busy year. Do join in.

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Equilibrium Line

What is becoming clearer is the qualitative value of soil testing in many instances, rather than the idea of any absolute value, shared by all (or several) tests.

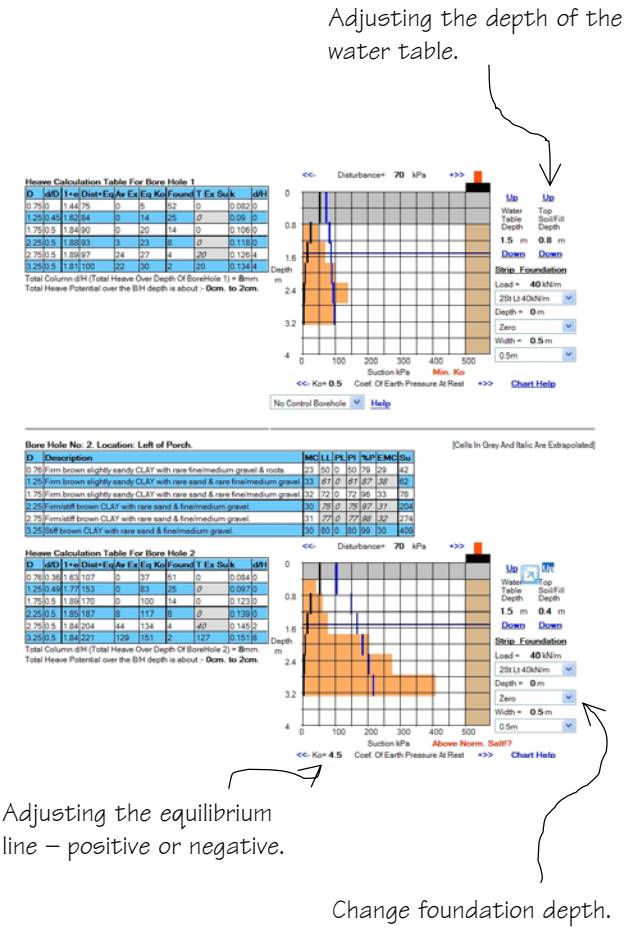
Much relies on interpretation and as we see when experts meet, views aren't always consistent. Matters are made more difficult with low level desiccation, when determination rests on the smallest of bulges.

This is sometimes the result of testing too late in the year. We are sometimes forced to take samples when the ground is hydrating, in the recovery phase.

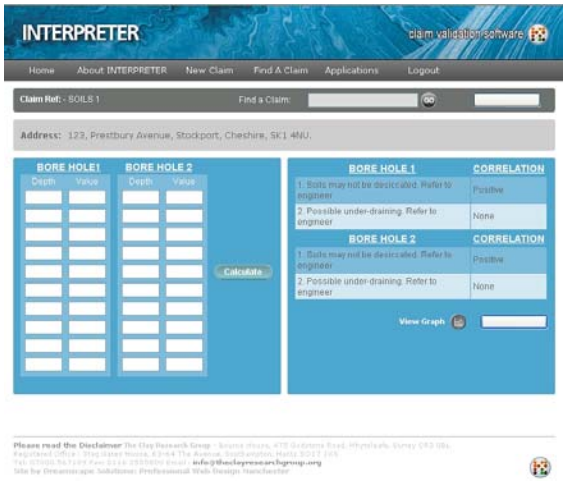
Other times, the results will over-record desiccation, and we need to amend the 'at rest' plot. From our studies at Aldenham and elsewhere, we know that the filter paper test can sometimes yield anomalous results and the engineer needs to increase the Ko line, shifting it to the right.

With the penetrometer, we sometimes see the reverse, and the equilibrium line might need to be lowered.

MatLab have developed a web based system – Beta release at the moment – that helps to estimate the amount of recovery when we encounter these situations. The skilled user can adjust the equilibrium line to match the data, aligning the shallow readings with those at depth, to deliver a more meaningful result.



SOILS INTERPRETER



The CRG have developed a web based application to interpret soils data, using suctions, strains or penetrometer readings. The system automatically takes account of the units of measurement, and pattern matches against a library of profiles.

The system provides help to determine if the results are indicative of (a) root induced desiccation, (b) anomalous testing, (c) under-draining or simply (c) a soil that isn't desiccated.

The application then produces a graph comparing the actual results with the closest match from the library.

It also has a 'consult an engineer' option when it doesn't find a match, together with explanatory help screens.

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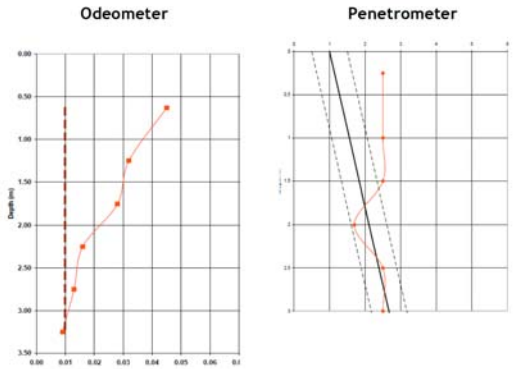
Penetrometer -*v*- Oedometer

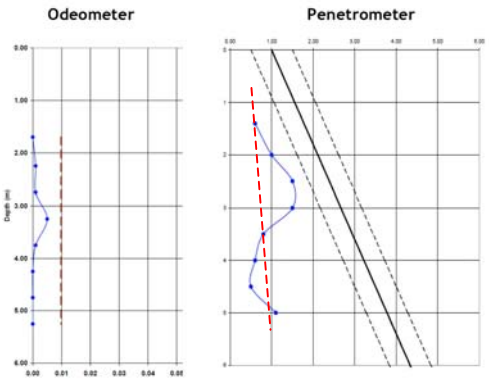
Here are a selection of results from site investigations taken towards the end of 2009, from samples extracted using a top driven, window sampler in London Clay.

Perhaps the remarkable thing – apart from the level of agreement between these tests - is the detection of fairly small amplitudes of desiccation using the penetrometer.

See following page on developments to allow the experienced engineer to amend the equilibrium line using a web based service.



Desiccation down to 2mtrs, detected by both the oedometer (left) and penetrometer (right).



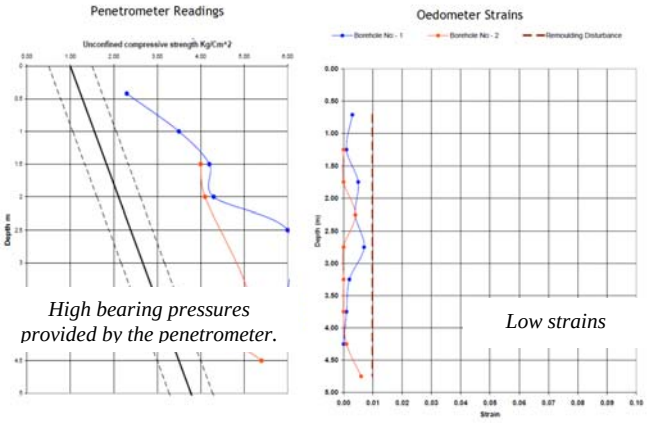
Similar profiles. Note the apparent need to adjust the equilibrium line (suggested by the red dotted line) in the penetrometer graph. The penetrometer appears to detect the low strains recorded by the oedometer.

Low Strains – High Bearing Pressure

~ Issues with the Penetrometer ~

The penetrometer works efficiently in London Clay, but isn't suited to all soils, and care is needed.

The following penetrometer results are clearly anomalous. High penetrometer readings accompanied by negligible strains.



Penetrometer (left) and oedometer results from the same site in Kent, showing very different results. The high penetrometer values are associated with the overconsolidated clay and are not indicative of root induced desiccation, as confirmed by the oedometer, there is negligible swell potential, and no evidence of desiccation.

The soils from the example above have a LL of 49% with a relatively low PI.

The laboratory explain … *"the results are typical of an overconsolidated clay of low to medium plasticity exhibiting a high stiffness in its natural state. The overconsolidation could have been caused by removal of overburden pressures (for example, glaciation) or desiccation."*

The results were taken from soils with a cementiteous matrix which explains the high bearing pressures - and the low strains. Problems also exist when testing homogenous soils – high values can be due to the granular nature of the matrix.

None of the tests provide 100% reliable results all of the time, reflecting the nature of the soils we are examining.

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UNDISTURBED SAMPLES

MatLab, working with Dick Scarf of GeoDrive have developed and tested a sampling device to extract undisturbed samples down to 6 – 7mtrs in London clay to deliver Class A samples.

The method allows simple and economic retrieval of samples that can be tested traditionally in the oedometer, or used for suction testing to provide accurate results.

Picture of the tubes and core using a top driven hydraulic jack hammer.

Crews are being equipped and full deployment is envisaged around June 2010, two months earlier than originally planned.

This is a significant development in the world of domestic subsidence. Previously, obtaining undisturbed samples, tested using the oedometer, was too expensive to use routinely.

This development puts the test in easy reach, and within existing budgets.

A superior method of sampling and testing, for less.

ASTON UNIVERSITY
BIRMINGHAM

19th May, 2010

Do come along to this year's conference. We have several industry figures delivering updates on a range of topics, and news of the most recent developments in the field of technology, industry and law.

Topics include …

"New Technologies. Intervention Technique, Rehydration, Modelling. Project Update."
Dr Allan Tew – Clay Research Group

"Assessing Tree-Induced Subsidence with Geophysics: What can it tell us?"
Dr. Nigel Cassidy, Keele University

"The Insurer View of Subsidence"
John Parvin, Zurich

"Is Monitoring always Golden?"
Richard Rollit, Crawford & Co

"The Surveyors View of Subsidence. RICS Subsidence Strategy Review"
Gary Strong, RICS

"Subsidence - Legal and Evidential Requirements"
Jonathan Bingham, Beachcroft LLP

Who should attend? Insurers, claims handlers, arborists, surveyors, engineers. There is something of interest for everyone, plus a chance to catch up with your colleagues.

Fee £165 per Delegate. Contact:-

Helen Mallinson 0121 204 3593
or
Claire Wallis 0121 204 3624

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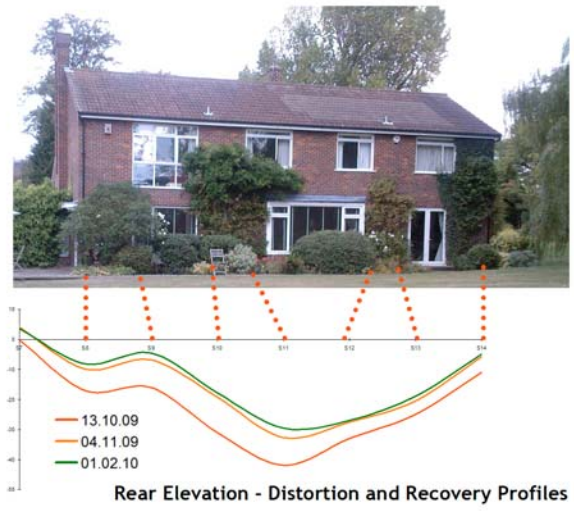
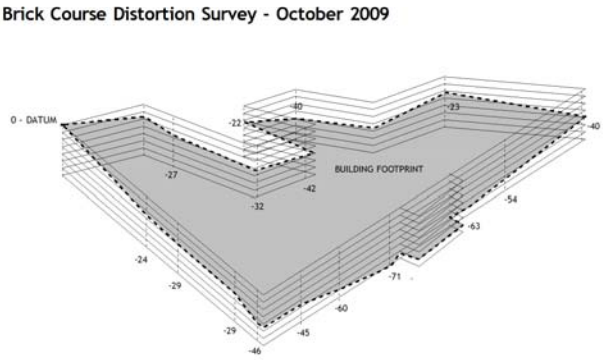
Aldenham Headmaster's House

The latest set of readings taken on 1st February 2010 reveal continued movement (recovery) to the rear elevation, in the vicinity of the Wisteria either side of the centrally placed bay window.

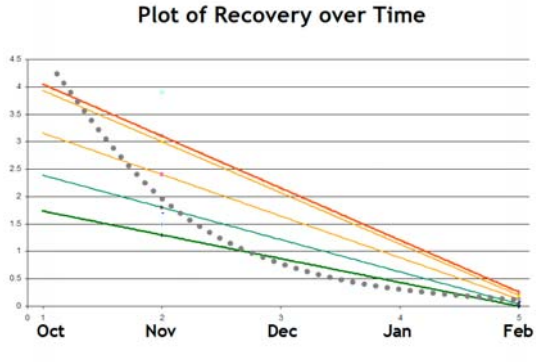


The readings show that recovery in the three weeks or so between 13th October and 4th November was fairly rapid. Relatively small movement has been recorded over the 12 week period from November to February.

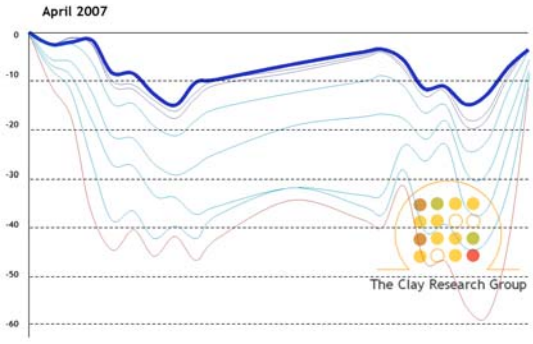
Maximum recovery has taken place at Station 10 - 4mm of movement/week recorded.



Above is a 3D distortion profile relating to readings taken in October, 2009. Below is the plot of the speed of recovery over time using linear trendlines.



By adding ground movement profiles over time using the level data from the site of the Aldenham Willow we see how much movement takes place over time, and from this tree, on this site at this time, plotting month by month movement with the lowest profile recording the September profile.



Depending on rainfall, more recovery can be expected and it might follow the general form of the grey dotted line on the "plot of Recovery over Time" graph above.

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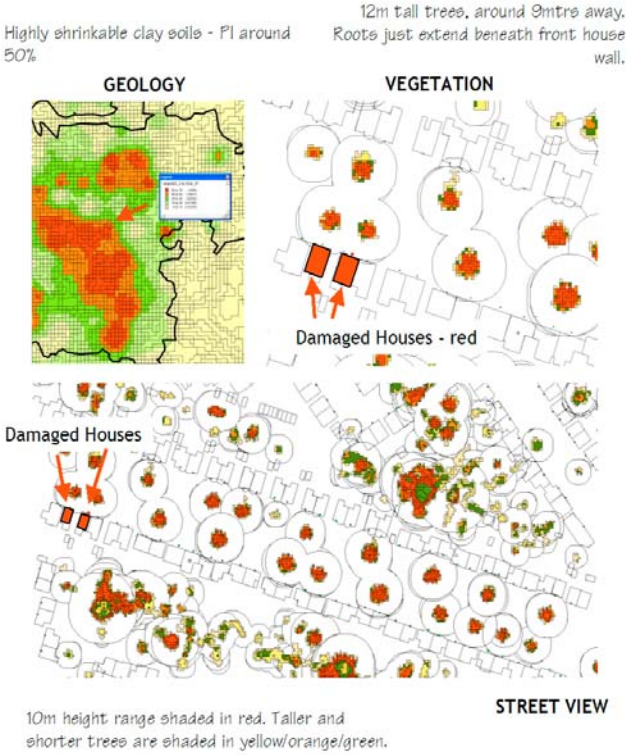
TRIAGE

Cyril Nazareth called to two adjoining properties in South London last summer, and applied the Triage system, making use of the Risk and Disorder models. Exactly how much can we do from the desk, and how reliable is the output?

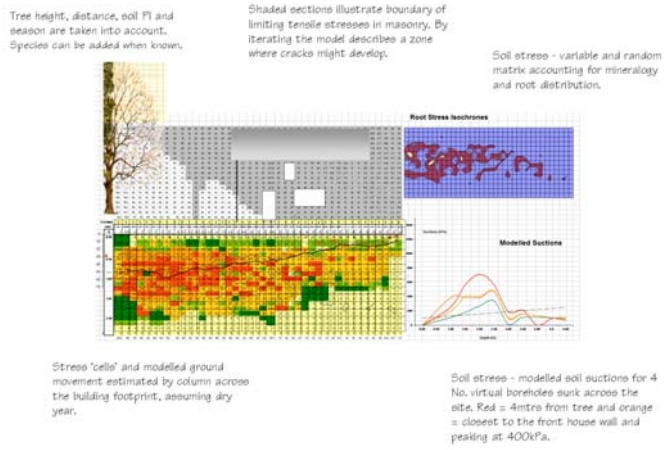
The street-scene doesn't appear particularly threatening at first sight. The tree has a relatively sparse canopy with a sensible distance between the tree and building, and a lawn – room for rehydration in the winter. The front gardens haven't been concreted over to make a car parking space.



What do the various models tell us? First, the geology map correctly identifies a highly shrinkable clay with a P.I. of around 50%. See below. The actual site investigations confirmed this to be the case.

The trees are between 10 – 12mtrs tall, putting them in the high risk category. The model suggests the root periphery extends beneath the front house wall.

The Disorder Model assesses a potential for ground movement sufficient to exceed the limiting tensile stresses in the masonry. It 'suggests' where damage might be found, and the width of cracks. See shaded area below.



The system works very well on outcropping London clay. The model has an empirical base, using claims data gathered from this location so a degree of success would be expected.

More interestingly, we see several identical situations on the same road. Trees of similar height, identical species, the same distance away from the houses. How many of the houses have been damaged? How many are at risk?

We assume the taller trees (to the right of the lower image, and at the end of the road) are taller, but may present less of a risk.

This is an ideal road for a research project. What can we do to keep the trees? Can we change the perception of subsidence? Is it possible to send a crew to site to apply a cheap treatment that avoids the money insurers pay to professionals to gather information that – as we see from this example – is already available? If you have claims data in this area (E-mail for location) that you are willing to share, or have an interest as a LA, contact us.

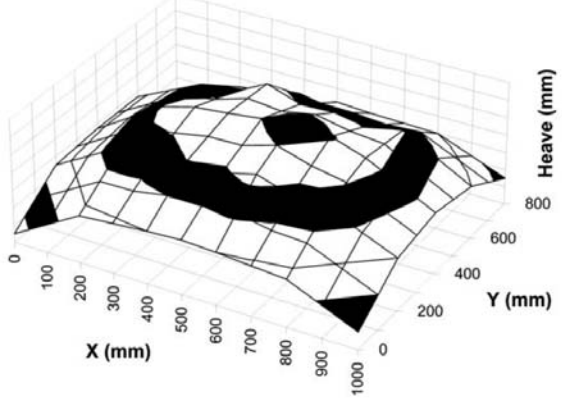
The Clay Research Group

Infiltration Tank

Geotechnical Testing Journal carried an interesting paper relating to our work on building a Synthetic Tree. Entitled "***Development of a Large-Scale Infiltration Tank for Determination of the Hydraulic Properties of Expansive Clays***", Tang *et al* compare moisture change over a 12 month period using a variety of sensors.

They instrumented a tank with RH and Echo sensors, tensiometers and psychrometers to compare results, and found *"the response of the TP sensor has been found to be in agreement with that of suction measurement, while the response of the ECH2O-TE showed some anomalies"*.

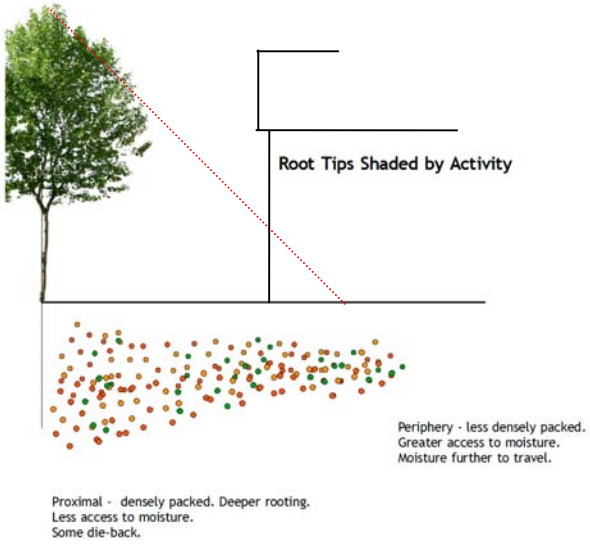
Perhaps more importantly was the recording of frictional resistance at the interface of the soil and the container, which resulted in the following pattern of heave at the tank surface.



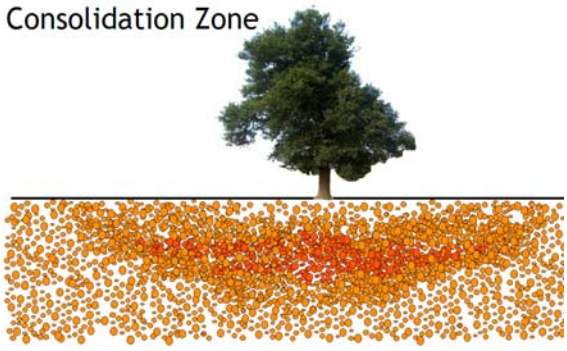
Synthetic Trees

Work has commenced on the design of the synthetic tree. An appreciation that we have discrete moisture abstraction 'units' concentrated at the root tip means that any treatment has to target these zones.

The tip itself will probably be formed from a ceramic. This will have absorption properties overcome the issues around blocking the root itself – the micro-bore connecting them to the environment chamber.



The upper water chamber will simulate rainfall. Sliding plates will allow simulation of run-off from paving. The lower chamber will measure under-draining. The model has to replicate the consolidation process, but in a limited space.



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Polyols

The first test when we have the design for the Synthetic Tree agreed will be a treatment using Polymeric Polyols.

An unlikely name but something we have had some experience with around 15 years ago when we injected them into the ground, close to subsiding buildings.

As far as we are aware, none of the damage has returned, but this is purely anecdotal. Properly constructed tests are required to understand why they might have been effective – if indeed they were.

Partial Root Drying – the basis of our treatment using the Intervention Technique - didn't provide sufficient water across a large enough section of the root footprint, although results were encouraging – movement certainly reduced.

The objective remains to treat the soil and discourage root growth in the vicinity of damage whilst rehydrating using harvested water. Combined with a slightly amended Intervention, we hope to 'turn the tree off' by triggering the production of Abscisic Acid whilst reducing the volume change potential of the soil at the root tip. See previous page.

Weather and Ground Movement

'Standing back' from the data we understand the link between long dry summers and subsidence claims intuitively.

Right, we have plotted the 'by month' data, using ground movement as a proxy for moisture uptake by the tree.

The correlation between rainfall and ground movement is high at -0.95. The correlation between ground movement and temperature is much weaker at -0.5.

As rainfall decreases, so the tree is forced to work harder, abstracting 'bound' moisture from the soil matrix.

We have set climate data against each layer of ground movement (by month) to try and improve our understanding of this relationship.