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 2010

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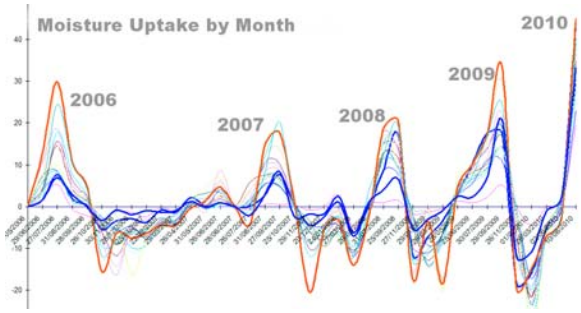
Moisture Uptake - Willow



Above are the latest (8th August 2010) ground moisture uptake profiles for the Aldenham Willow, supplied by GeoServ. The latest readings are the highest since monitoring commenced in 2006.

On Page 7 we see which elements best correlate with claim notifications and the output suggests (unsurprisingly) that ground movement delivers the most accurate measure.

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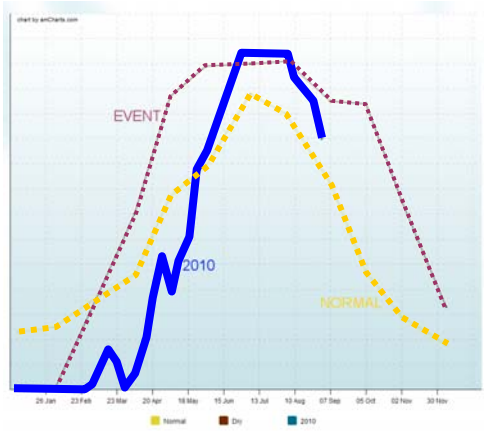
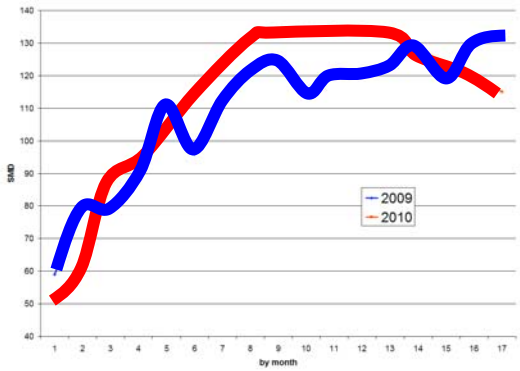
CLIMATE

For live weather data, including satellite imagery, visit http://www.wunderground.com/wundermap/?sat=1. By clicking on one of the balloons that appear, temperature, relative humidity and dew point are revealed.



SMD readings have peaked and now returning to the profile for average years and as we see left, claim numbers will probably be slightly higher than normal, but not in the event category.



Above are the Soil Moisture Deficit values for 2009 and 2010 for the period to the end of August, which show a remarkable similarity.

The combination of SMD data, current weather trends and ground movement profiles (left) from Aldenham suggest that this year could be busy, but as far as we can see, not an event and numbers may start to decline shortly.

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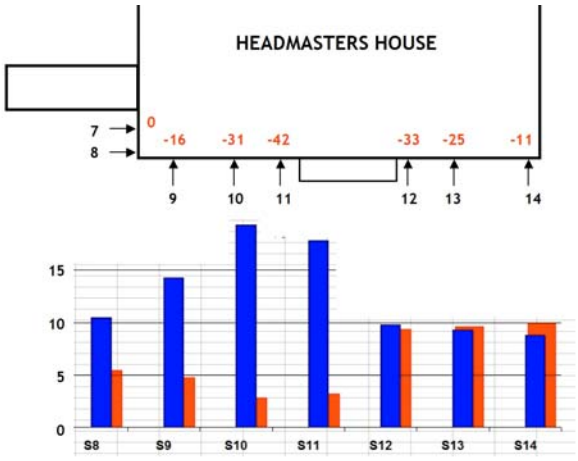
HEADMASTERS HOUSE

Below is an update on movement at the Headmasters House. The red figures inside the building outline indicate the distortion survey – movement that had already taken place. The focal point of movement was the Wisteria to the left of the bay window. Station 11 recorded subsidence of 42mm.

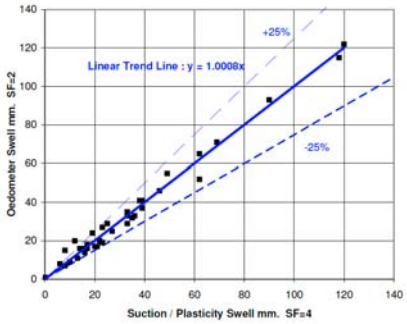


The blue columns above show the amount of recovery over the winter period and following reduction of the Wisteria combined with some watering-in – see earlier editions for details.

The red columns indicate downward movement this summer. Reducing the Wisteria has helped and there has been little further subsidence at Stations 10 & 11. In contrast, Station 12 – 13 all show ongoing movement either due to nearby shrubbery or the peripheral roots of the Willow.

SUCTIONS v STRAINS

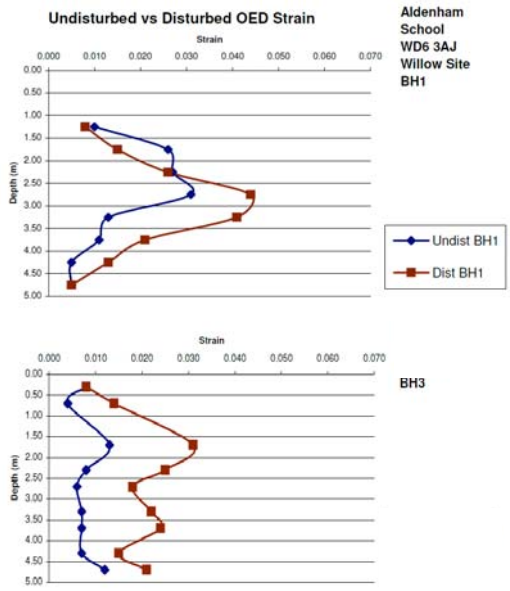
The relationship between strains and suctions (using carefully calibrated filter papers) is shown below, taking boundary lines of +/- 25% as described for the filter paper test. Provided a careful regime of testing is adopted, the results of the two tests have a reasonable correlation.



Comparing strains ('y' axis) with suctions ('x' axis) reveals a good correlation, improving as the soil becomes increasingly desiccated. A shrinkage factor of 2 has been used for the oedometer, and 4 for suctions.

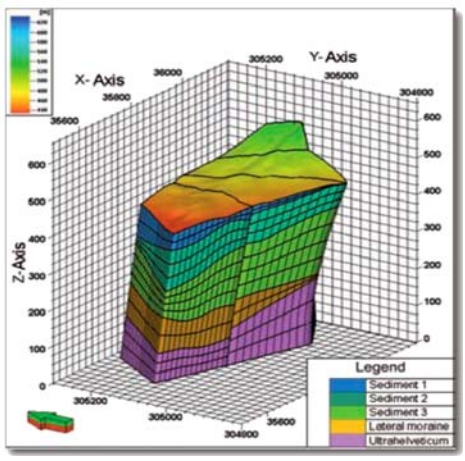
DISTURBANCE

Sample disturbance on retrieval can increase measured strains as we see below, and on Page 7. The same applies to suctions. All examples come from samples from the Aldenham Willow site.



GEOINFORMATICS

This three-dimensional model has been built from seismic reflectometry and when plotted using spatial co-ordinates can deliver useful, site specific information



The image has been taken from an article in the GeoInfomatics Journal which is available for download from http://fluidbook.microdesign.nl/geoinformatics/06-2009/#0

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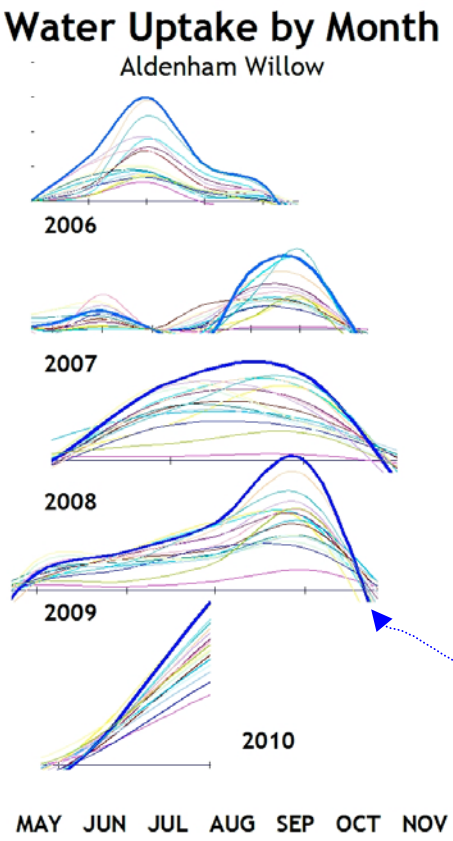
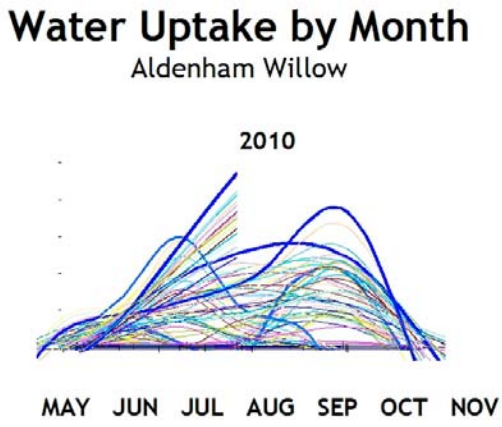


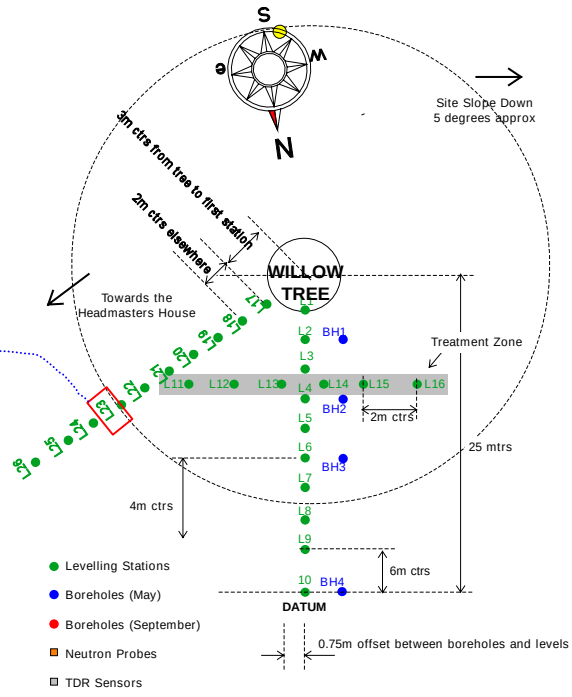
Levelling Station 23 of the Aldenham Willow exhibits more movement than any other. Roots in this location are aggressive pumps, withdrawing moisture resulting in ground movement greater than elsewhere along the two arrays. 2010 reveals that most stations are extracting more water – this graph is based on data gathered on the 8th August 2010. Below the plots have been superimposed onto one another to show the increases abstraction in 2010.



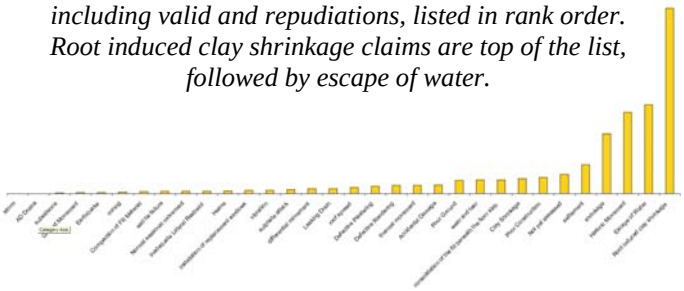
Roots

Researchers have suggested that a 100 year old Scots pine could have around 5 million root tips, and a mature red oak, 500 million.

Impossible to count of course, and largely meaningless, other than to tell us that relatively little is known about roots, beyond the fact they are amazing, and the more we look, the less we seem to know.



A typical sample of claims notified to insurers, including valid and repudiations, listed in rank order. Root induced clay shrinkage claims are top of the list, followed by escape of water.



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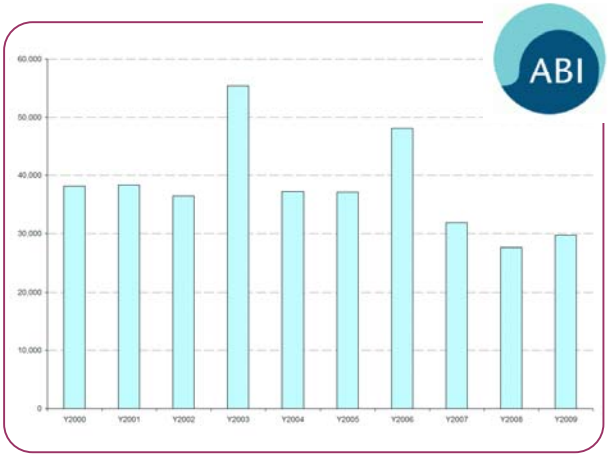
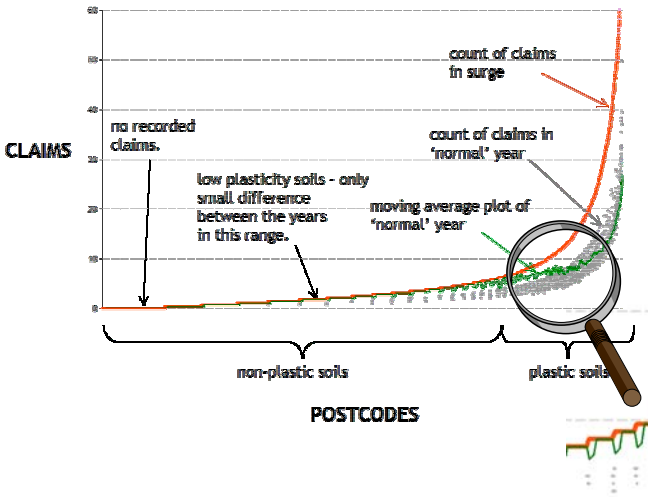
SURGE

ABI figures (see right) reveal the increase in claim numbers at times of surge. In 2003, 55,000 claims were notified. This compares with around 35,000 in 'normal' years, although numbers have been falling recently due to the recent wetter weather in 2007 and 2008.





Above are subsidence claim notification figures from the ABI showing the difference between surge and normal years. Left we plot postcodes that are effected most by surge (red line). The postcodes to the right of the graph on the 'x' axis are on plastic soils and vulnerable to clay shrinkage. This is where increased claim notifications are to be found in surge. In the same location as normal years, just more of them.

What does the data look like? As surge involves a combination of dry weather and clay shrinkage, it will have a geographic location. Which postcodes pose the greatest risk in terms of frequency? If we are handling claims, does this matter particularly? Isn't it count – how many engineers handling how many claims – that is more important?

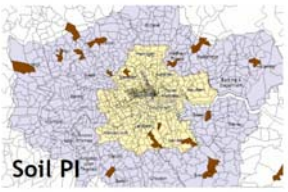
As we all know there is a relationship between increasing claim numbers in busy years and clay soils, but how closely does one follow the other? Are clay soils with a high PI linked to high claims numbers? Or is it just clay?

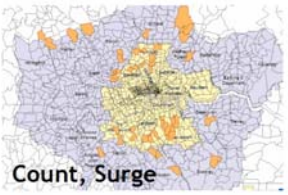
What do 'normal' years look like when compared with 'surge' years? Does the location of the risk change, or is it simply "more of the same"?

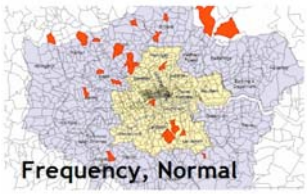
The problem for the industry is that increases in claim numbers takes place over a very short period of time. 3 months or so. The annualised figures don't reflect the problem adequately. An annual jump of 20,000 claims represents an increase of 57%. Over 3 months, the figure can be closer to 200% or more.

The maps, right, show that the underlying risk is fairly static, moving slightly within areas, but the result of the analysis is that "a risk, is a risk, is a …" in the sense that busy sectors in normal years suffer the largest increases at times of surge, and – no surprises – yes, there is a relationship with the highly shrinkable soils.

A "top 50" of postcode sectors mapped using different criteria. Although there is a small amount of change, the risk areas remain fairly static whether mapped by PI, frequency or count.







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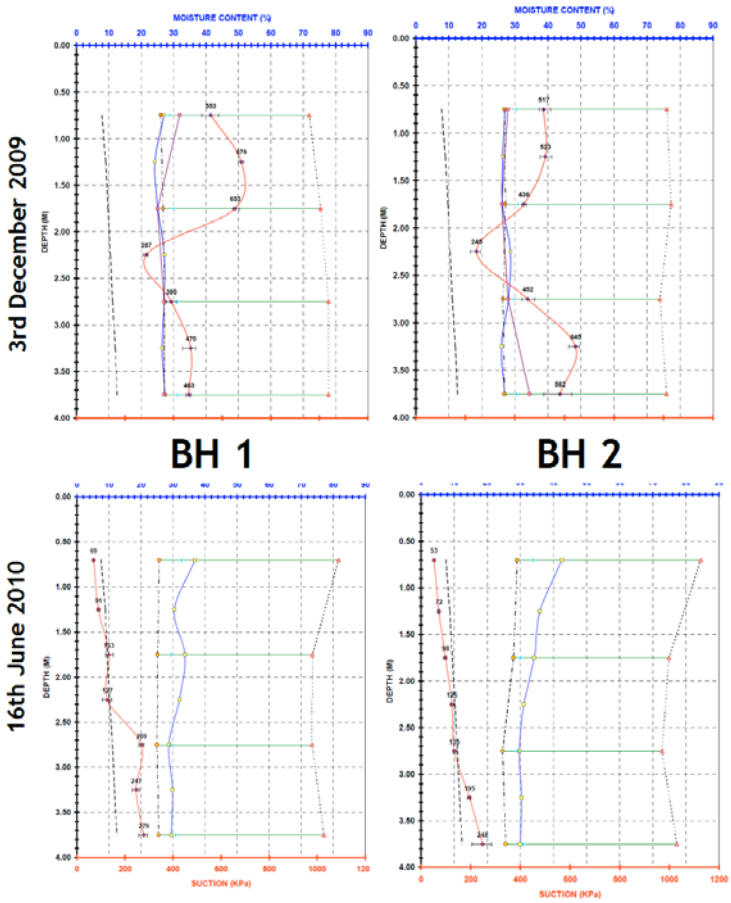
InterTeq … update

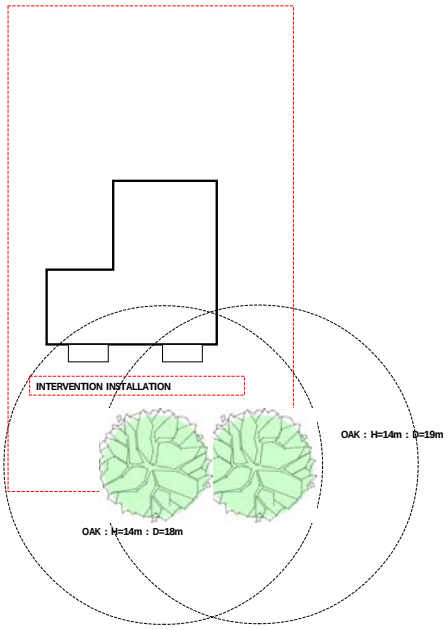
Encouraging results from the site in Harlow, on London clay, where the Intervention Technique has been applied with some apparent success as we see from the investigation results shown below.

The initial SI's were undertaken in December 2009, and revealed what appears to have been a moisture deficit. Damage was quite significant with cracks 25mm wide – see Edition 60 of the Newsletter 60 for details.

In the middle of July 2010, following a period of very dry weather, investigations reveal that the soils have been restored to field capacity even though the trees have been retained.



Boreholes sunk in front of the two damaged bay windows. The first investigations were undertaken in December 2009 and the second (bottom) in the middle of July, 2010.



A plan of the site showing the 2 No. Oak trees, which remain. The damaged structure is at the periphery of the root zone.

The suctions have dissipated completely, and the moistures appear to have reached their equilibrium level.

In December 2009 the moisture values were at, or even below, the PL. In July 2010 they are several percentage points above the PL.

Suction values now align with the estimated Ko line. The cracks have closed and some repairs have already been undertaken.

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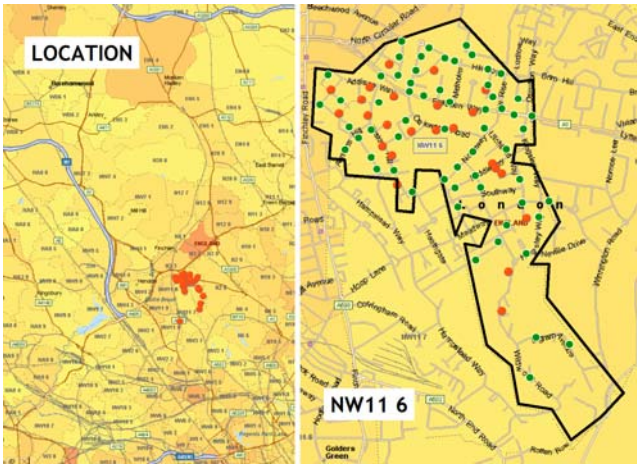
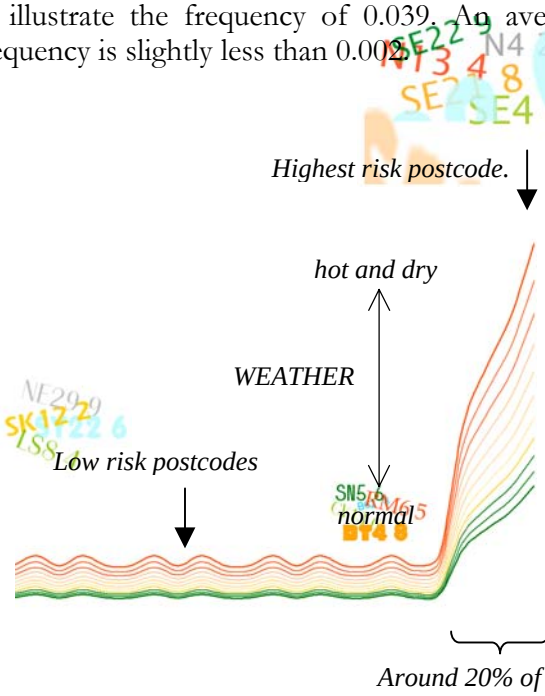
NW11 6 – Study Area



NW11 6 is a high risk postcode sector. It contains around 2,800 properties, and we hold records of 111 claims in the sector over time. The red dots (above right) show claims where we have full postcodes, and the remainder are shown as green dots which have been randomly scattered around to illustrate the frequency of 0.039. An average frequency is slightly less than 0.002.

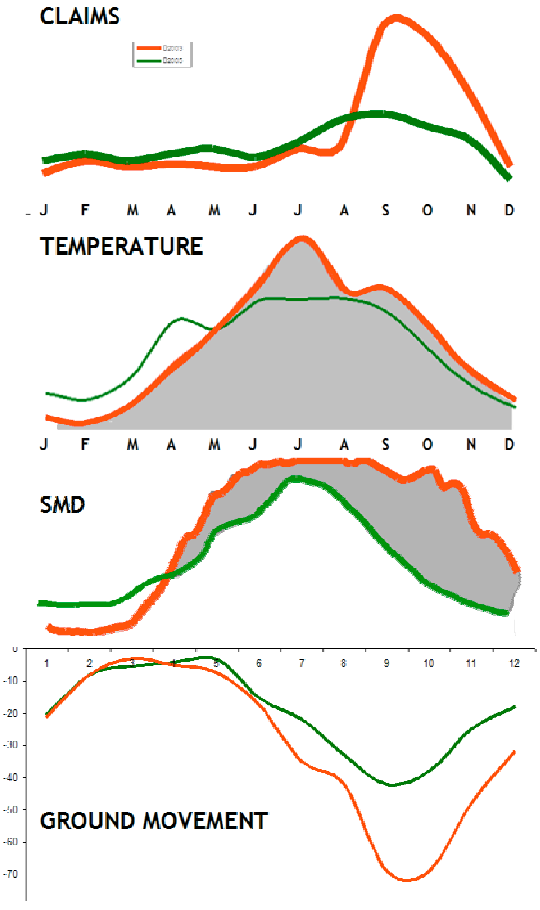


The high risk postcodes will have more claims in terms of both count and frequency in most years, whatever the weather as we see from this diagram. Claims in the high risk sectors can increase significantly in surge.

Soil suctions can reach 1,500kPa – this is the point at which suctions exerted by the tree cannot overcome the suctions in the ground. In contrast, atmospheric water potentials can reach very high values depending on the Relative Humidity and temperature, as we saw last month. We have a figure of 3,000kPa but this can easily exceeded, reaching much higher values. Negative pressures within the tree xylem will be at some intermediate value depending on the above.

RELATIONSHIPS

A brief look at correlation's between claim notifications by month, and other data including temperature, ground movement and SMD values.



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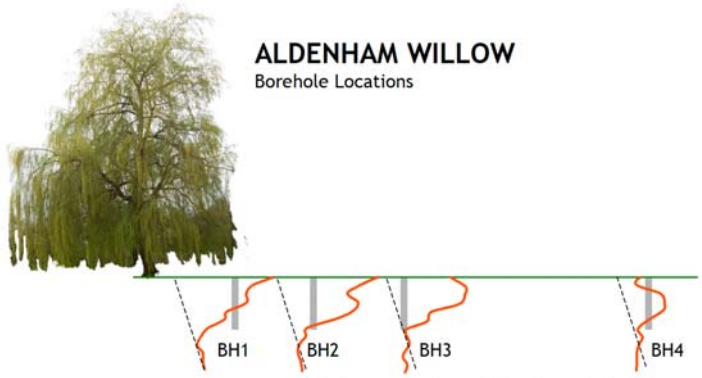
DESICCATION OVER TIME

Here we reproduce the results of investigations and soil tests that have been undertaken at the site of the Aldenham Willow, at different times, using different methods to measure the change in desiccation and the influence of sample disturbance.



Oedometers : May 2006 : Disturbed

Above are the borehole locations in relation to the tree and one another. Below are the results of investigations undertaken in May 2006 and June 2007. The samples extracted in May 2006 were disturbed. Both disturbed and undisturbed samples were retrieved in June 2007, for comparison purposes.

A gradual reduction in both amplitude and depth of desiccation is illustrated in the results, by whatever test used.

The results in May – taken prior to the tree coming into leaf – suggests a persistent deficit. Close to the tree there is a substantial deficit, extending up to ground level. At the root periphery (BH4, 25mtrs from the tree), the deficit persists, but is less as we would expect.

Recovery – rehydration – takes place between May 2006 and June 2007 at all bores. That recovery 'removes' the shallow layer of desiccation, leaving a more typical 'bulge' at around 2 – 3mtrs bGL.

The disturbed samples from June 2007 (blue line) tend to over-estimate strains slightly, but not excessively.

This 'time lapse' record of desiccation at the beginning of a dry year, and again in the summer of a wet year, catalogue the dynamic nature of the interaction between climate, trees and soil.