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

August 2010

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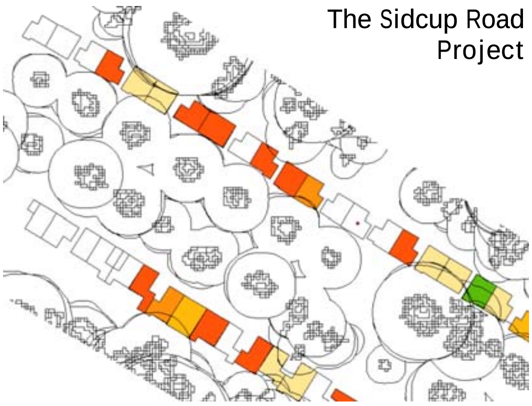
Sidcup Road Project

Below is an extract of the map relating to the Sidcup Road project – the background to this study has appeared in recent newsletters.



If industry colleagues continue to report claims in this road, we can share the outcome to help Councils to identify which trees pose the highest risk. They can put their efforts into trimming fewer trees instead of crown reducing all of the trees, all of the time.

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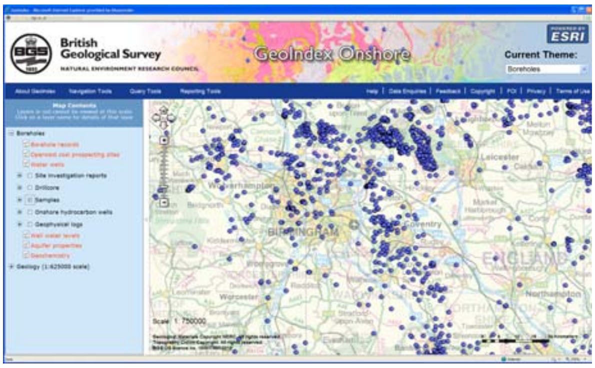
BGS – New Mapping Index

The British Geological Survey has developed an excellent application to locate detailed information about specific sites across the UK from their extensive database. GeoIndex can be located at http://www.bgs.ac.uk/geoindex/.



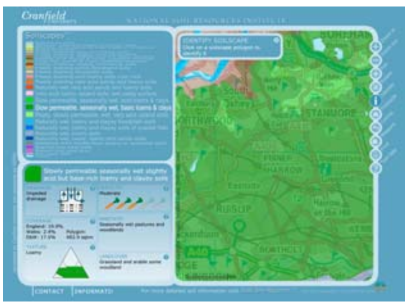
Access is relatively easy and once opened, the application allows the user to locate SI reports, aquifer properties, earthquakes, geochemistry and boreholes (as is the case here), as well as a range of other geological data. Apparently they hold 850,000 borehole records going back 200 years, and well worth a visit. The reports are very reasonably priced.

Soils at Cranfield

Cranfield have a similar (but less extensive) offering. To view their web site go to http://www.landis.org.uk/soilscapes/

Their application is called Landis, and it allows the user to enter a postcode and identify the soil characteristics. It's a sophisticated package in terms of delivery, with lots of useful information including the soil type, drainage, agricultural use and so forth.

It is slightly different to the BGS offering. For example, Harrow is described as "basic loams and clays". A soil type that they estimate covers around 20% of the UK.



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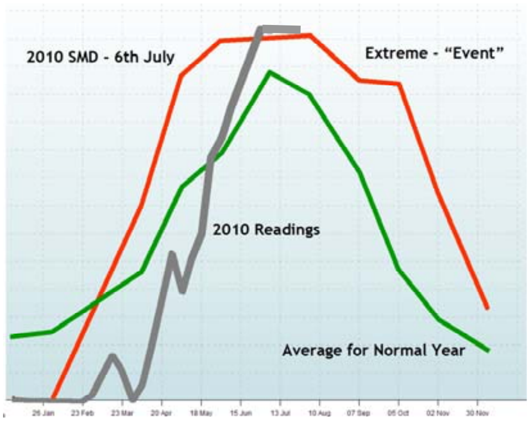
WEATHER WATCH 2010

The recent spell of hot weather has produced SMD values that match the 2003 values.

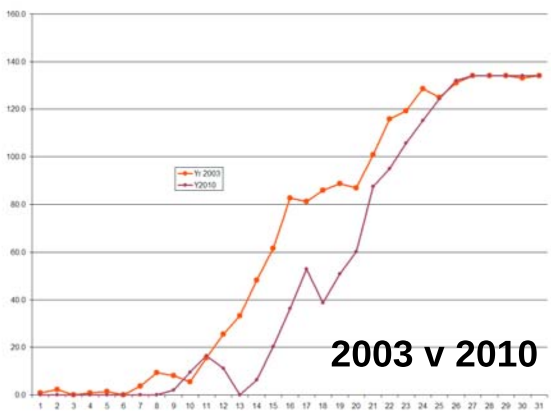


This is interesting territory. Our model has always relied on values at the end of May to predict the September claim numbers whilst recognising that two others factors could be involved.

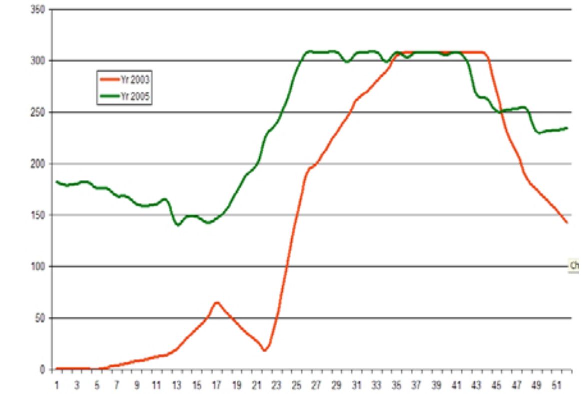
The first is the 'steepness of the line', which would be linked to an energy requirement sufficient to cause ground to subside.

The second was whether events were driven by more immediate weather patterns. Can one hot, dry month deliver an Event year?

2010 might provide the answer.

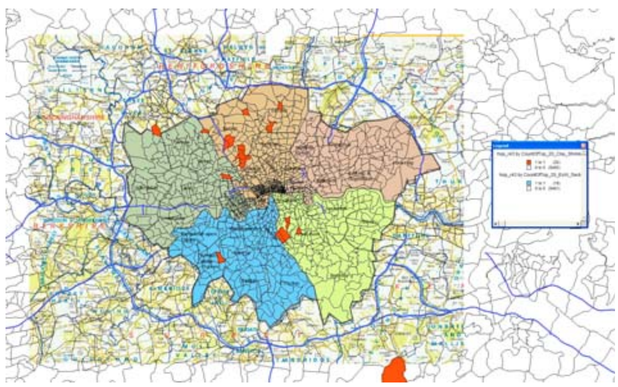


An event year doesn't have to follow a dry winter. In the example below, soils started the year at field capacity in 2003. In contrast, 2005 followed a dry year and reaches the same level of dryness as 2003, but it didn't deliver high claim numbers. This is the data behind the idea that active drying in May, as the tree is coming into leaf, might trigger an increase in moisture uptake under hormonal control.



TOP 20 – Clay Shrinkage

Expressed as frequency (count of claims –v- number of houses), the top 20 postcode sectors in terms of valid root induced clay shrinkage claims notified is shown below. Nearly all fall within the M25.



The map discounts sectors with few properties, to avoid distortion when there is one claim in a small village for example.

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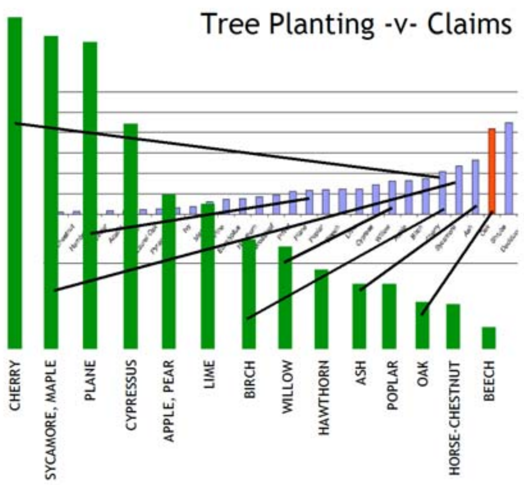
Planting –v- Claims

There can be no claim to any great accuracy given the topic under review, but below we compare tree planting frequency using a chart from a BRE paper, and compare it with tree count from our database of trees involved with damage.

The Cherry and Sycamore/Maple appear towards the top of the list in both categories. There are lots of them and they frequently cause damage to houses.

More interesting is the other end of the scale, where we have comparatively few of a particular species, and they feature often in reported cases of subsidence damage. For some, the list is almost 'in reverse', allowing us to identify the more 'aggressive' species.



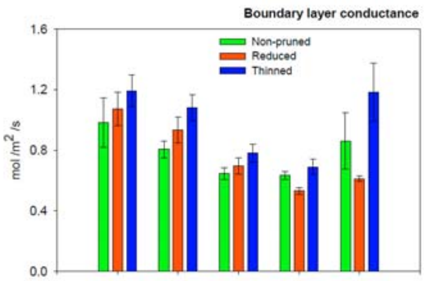
For example, the Oak is top of our list in terms of 'associated with claims', and yet towards the bottom of the list in terms of numbers planted.

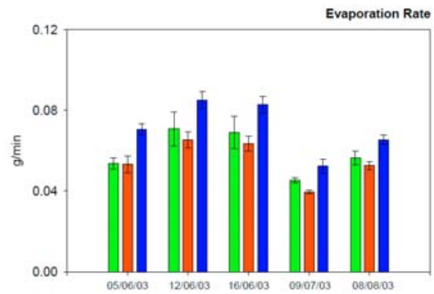
Others in this high frequency category include the Ash, Polar and Willow. No real surprises amongst these.

HORTINK re-visited

The Horticultural Link project published its report entitled "Controlling Water Use of Trees", in May 2004 following a series of controlled experiments over several years on saplings. The report explored the moisture uptake of a control tree compared with others where crowns had been either thinned or reduced.

The results showed that crown thinning appeared to increase moisture uptake. Air passing through an open canopy combined with larger leaf areas on re-growth may have been the explanation.





In contrast, "*crown-reduction reduced soil drying by trees in the year of pruning, but the effects were generally small and disappeared within the following season, unless the reduction was severe, in which case the effects were larger and persisted for up to two years*", which supports the Queens Park findings.

In summary, the report says, "*Total tree water use (transpiration) was reduced by crown-reduction and unaffected by crown-thinning in the year of pruning.*"

The question is, does the reduction in water uptake remove the risk of subsidence when we are dealing with mature trees, and for how long?

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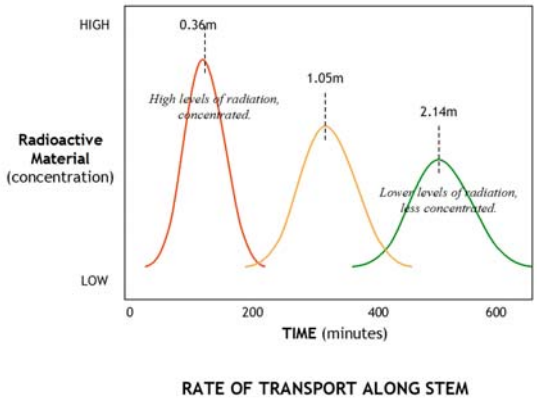
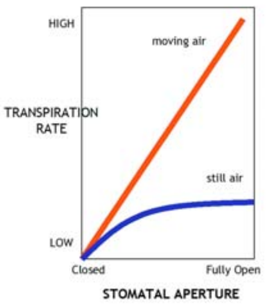
Transpiration Control

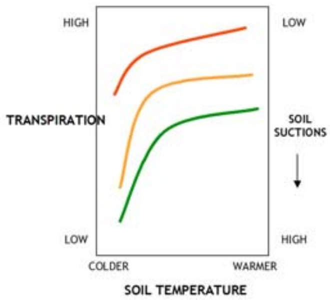
A brief – and by necessity sketchy – look at relationships that drive moisture change and transport between soil, vegetation and atmosphere. We say sketchy because no two species are identical and variations within species, on a wide range of soils and growing in differing climatic conditions make anything more definite impossible but here is some qualitative idea of the importance of atmospheric moisture.



Above, researchers have demonstrated the rate of flow by injecting radioactive material into a stem, and measured flow towards the leaf recording a reduced amplitude in the signal as the radioactive material becomes more dilute on its journey.

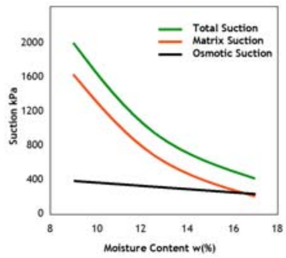


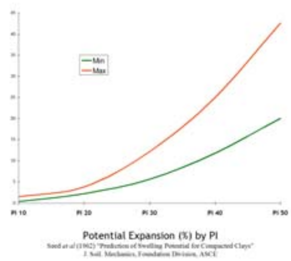
The "Boundary Layer" Effect

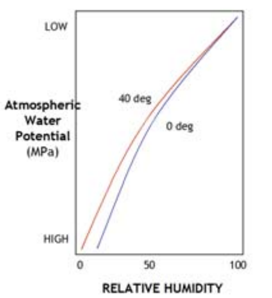


TRANSPIRATION & TEMPERATURE

Transpiration increases and stoma open wider in moving air, compared with still. The rate of flow is also linked to temperature – increasing in warmer months – and as we would anticipate, when soil suctions are low. High suctions, cold weather and still air reduce transpiration.

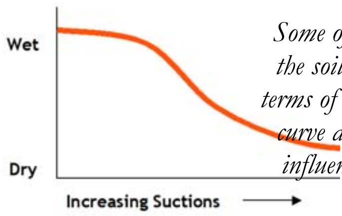






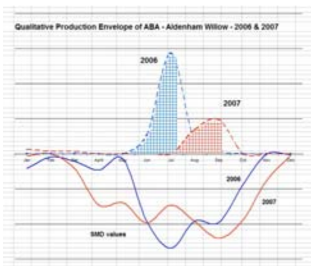
Relationship between Atmospheric Water Potential and RH

Left, atmospheric water potential increases with a decrease in Relative Humidity, and is a significant factor behind transpiration.



Some of the influences exerted by the soil including the response in terms of shrink/swell, the retention curve and associated suctions all influence the tree/soil response.

Right, tension in the xylem water column, root dryness, water pH all influence the production of ABA and its influence on stomata.



The link between the elements is dynamic and influences tree physiology every hour of the day. Stoma can open and close very quickly in response to a change in climate, soil dryness and hormone concentrations. All of the elements are linked and it is the combined influence that determines moisture uptake.

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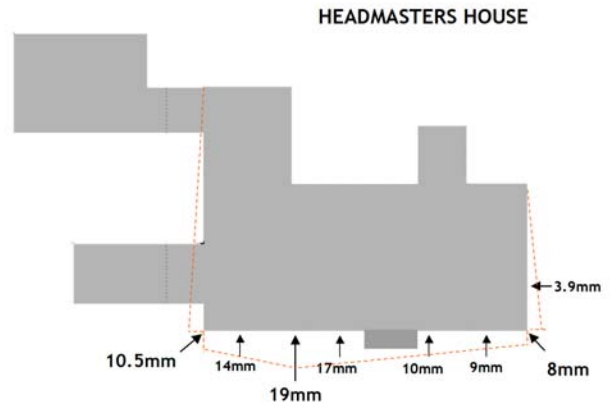
Headmaster's House

The background to this study is described in "Aldenham Investigations – Special Edition" available for download from the CRG web site.

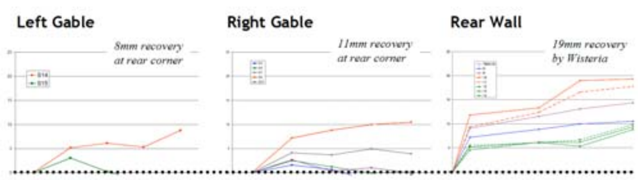
The latest level readings reveal nearly 20mm of recovery half way along the rear wall, in the vicinity of the large Wisteria (now cut back), with other stations showing reducing movement with distance from this focal point, diminishing towards the corners.

It remains to be seen whether movement at the corners is the result of the shrubbery or the willow trees.

We have revisited the SI results to see if they add anything in the light of the recent levels.



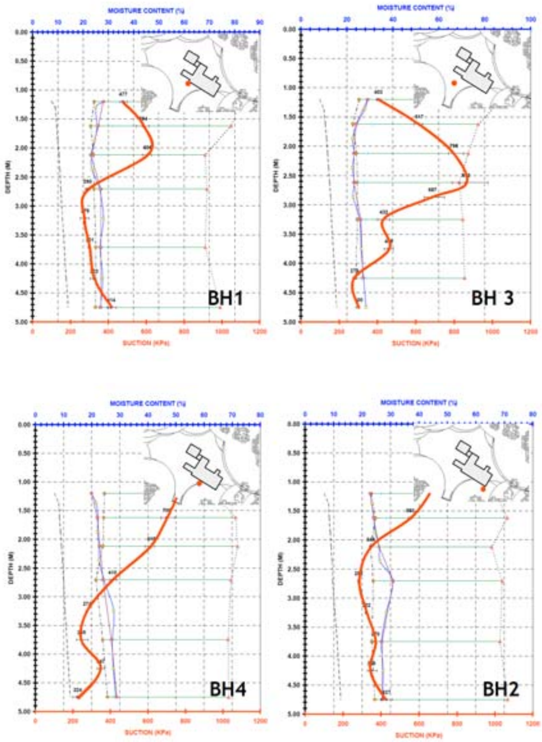
Plan of the Headmasters House showing recovery at various locations to try to determine the influence – if any – of the Willow trees.



Plots of individual stations showing maximum recovery by elevation. The side walls of the house have recovered by between 8 – 10mm. Maximum recovery has taken place approx. half way along the rear wall, in the vicinity of the Wisteria, and amounts to 19mm.

Investigations

The depth and amplitude of desiccation in BH3 is indicative of root activity from the Willow. BH1 has a shallower profile which could be due to shrubs in the vicinity, or the periphery of the willow root system, or a combination of both, but the profile, increasing at 1.75mtrs bGL, suggests the tree is making a contribution.



BH4 reveals the suction profile of the Wisteria – shrub rooting often produce 'top down' drying, whereas the root activity of mature trees can produce peak suctions at somewhere around 2mtrs. BH2 has a similar profile, again indicating the involvement of nearby shrubs, but perhaps with a contribution from the peripheral roots of the Willow.

If this is so, then BH 3 is clearly related to the root activity of the Willow (see next edition for further information), BH1 perhaps the periphery of the Willow root system (the tree is 15m tall and 28mtrs away) and BH2 and BH 4 relate primarily to the action of nearby shrubs.

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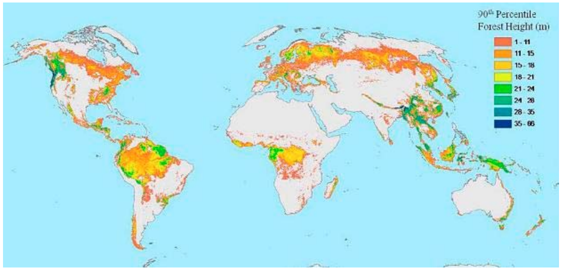
What on earth …

World Tree Heights

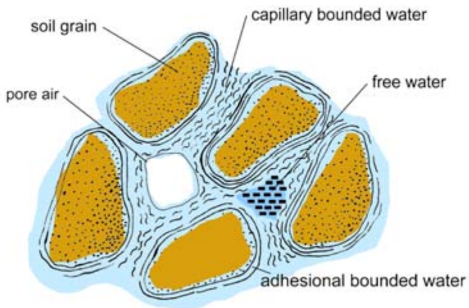


The above map, appearing in *Geophysical Research Letters*, could help estimate the total biomass in the Earth's forests according to Michael Lefsky of Colorado State University.

Lefsky used LiDAR data from three NASA satellites – ICESat, Terra, and Aqua.

Water, water, everywhere …

Moisture change is central to much of our work, but where is it, and in what states does it exist?



Water is held by the soil in several forms. At a molecular level, within the layered structure, but also bound tightly to the surface of the clay particles, where it is known as the "adhesion layer". Then we have water a little further away from the particle, but held in place by capillary forces before finally encountering what we term "free water".

Tree Moisture Uptake in Spain

"Effects on rainfall gradient on tree water consumption and soil fertility on Quercus pyrenaica forests in the Sierra de Gata (Spain)", by Moreno *et al* (1993) describes the authors investigations into water uptake in a dry climate.

Their work reinforces (and pre-dates) our findings at Aldenham in terms of maximum water uptake early in the year, and they say *"The maximum values of actual evapotranspiration in absolute terms were generally reached in June (sometimes May or July). Consumption begins to decrease generally in July, reaching very low values as early as August"*.

This may be a response to dry weather conditions, although interestingly they go on to say *"It can be concluded that the greater abundance of rain in the Wet season did not tend to increase water consumption by the vegetation"*.

As ever, it is not possible to extrapolate findings across differing climatic conditions, and this could be a response to the local environment. The correlation with Aldenham in terms of moisture uptake early in the year might reflect the persistent deficit at the Aldenham site.

The relevance to us is anticipating climate change and building a profile of how mature, high water demand trees are likely to respond. Spain provides an ideal model.

Quote for the month …

"Both on economic and environmental grounds, in most situations it is better to accept that damage will be caused by a small percentage of trees, and to deal with these by prompt and appropriate remedial action."

Biddle, (1998) *"Tree Root Damage to Buildings"*, Willowmead Publishing