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

Ground Movement
by month beneath the
Aldenham Willow

June 2006 – September 2009

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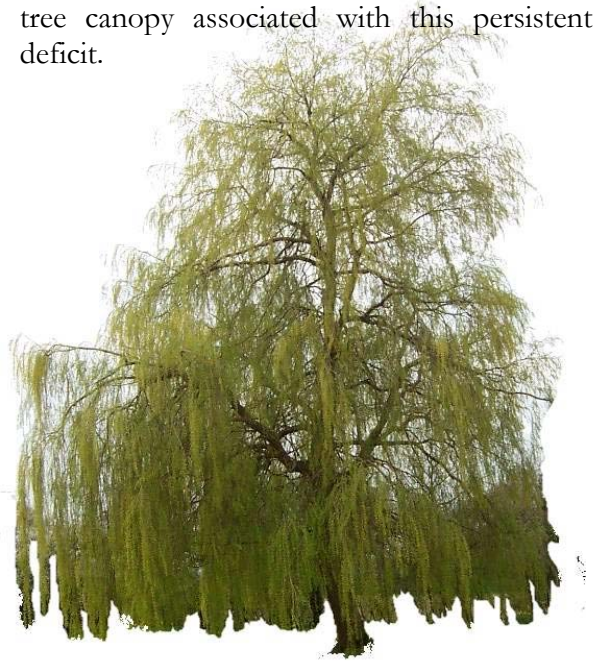
SPECIAL EDITION

'Ground movement by month' profiles across the root zone of the Willow tree at Aldenham are recorded in this edition. See Page 2 for the Site Layout.

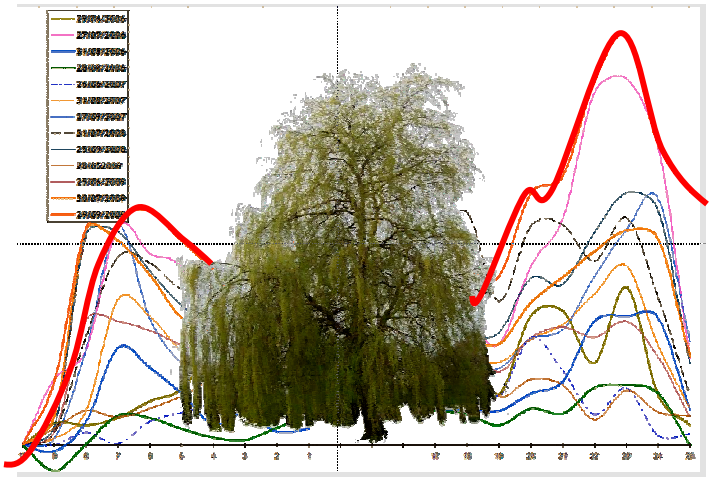
The circumstances are unique to the site. It is likely that there was a persistent deficit carried over to 2006, but that some rehydration has been taking place over the wetter years of 2007 and 2008.

Throughout the levelling period, movement has been more pronounced at the root periphery, which we assume is associated with the lack of available water directly beneath the tree canopy associated with this persistent deficit.



The soils are highly shrinkable, with a P.I of 45 – 50%. The tree is estimated to be about 35 years old, around 15m high, with a trunk diameter of around 570mm and a 10m diameter canopy.

Ground Movement by Season



10 ---------- 1 17 ---------- 25

Station 10 is the datum and, considering Station 25, movement almost certainly extends beyond the monitoring array. The Headmasters House at Aldenham is situated at the end of array 17 – 25, about 30mtrs from the Willow.

The profiles on the following pages plot month by month movement, recording the drying and wetting phases. They illustrate the regular form but changing amplitude of movement.

Why do some trees cause damage and others don't? Will the tree that has caused damage one year, present a risk in the future if left unattended? Or is it a 'one-off' and random event? Claims experience suggests that once a tree has caused damage, it poses an ongoing threat and work by the BRE referred to in earlier editions, supports this view. Most arboricultural practices tell us that tree removal (rather than pruning, thinning or pollarding) is the most reliable remedy in alleviating subsidence, once a tree has caused damage.

Why? The following pages provide a possible answer. Ground movement may appear chaotic, but we see the regular form and varying amplitude would most likely cause recurrent damage if the tree is retained.

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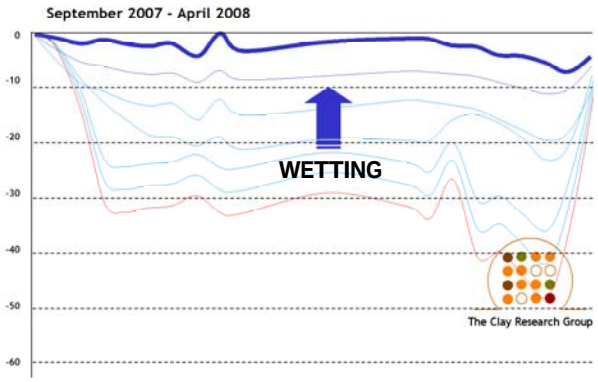
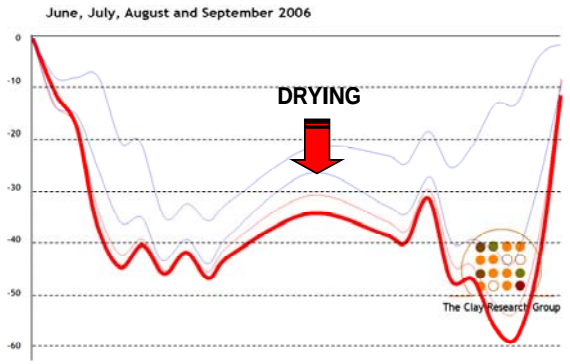
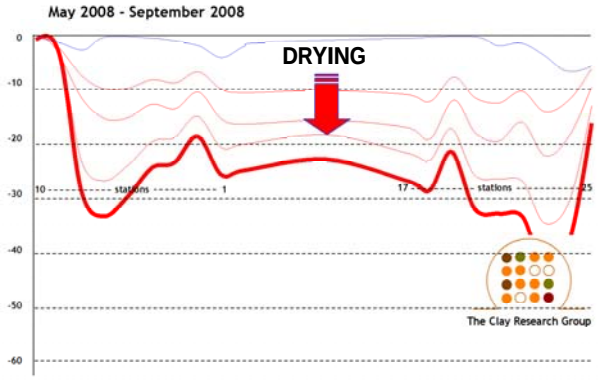
Wetting & Drying Profiles

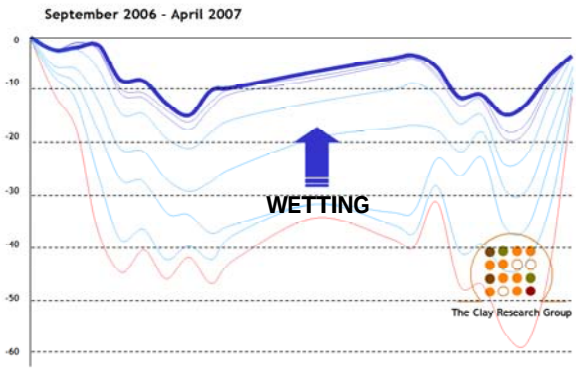
~ June2006 to September 2009 ~

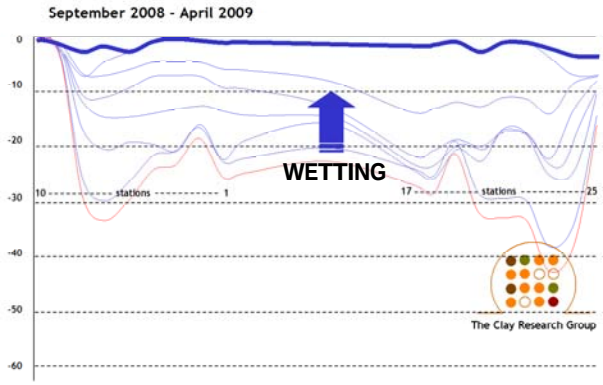
Ground movement development profiles by month for seasonal wetting and drying. The first image (below) shows how movement early in the year can 'set the scene' for claim numbers. In excess of 50% of the ground movement had already taken place by then end of June in 2006, compared with say 25% in 2009.

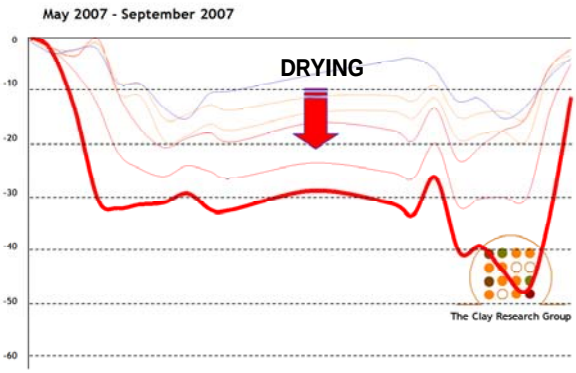


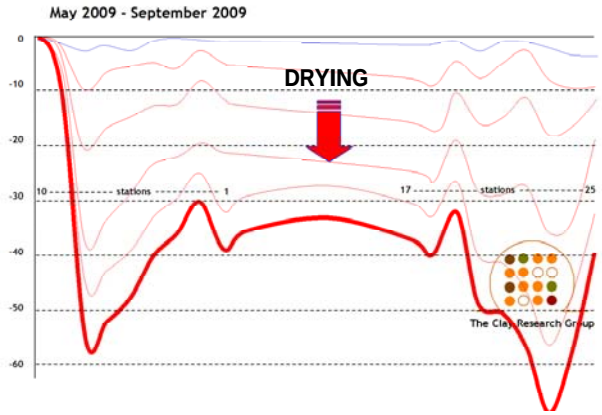












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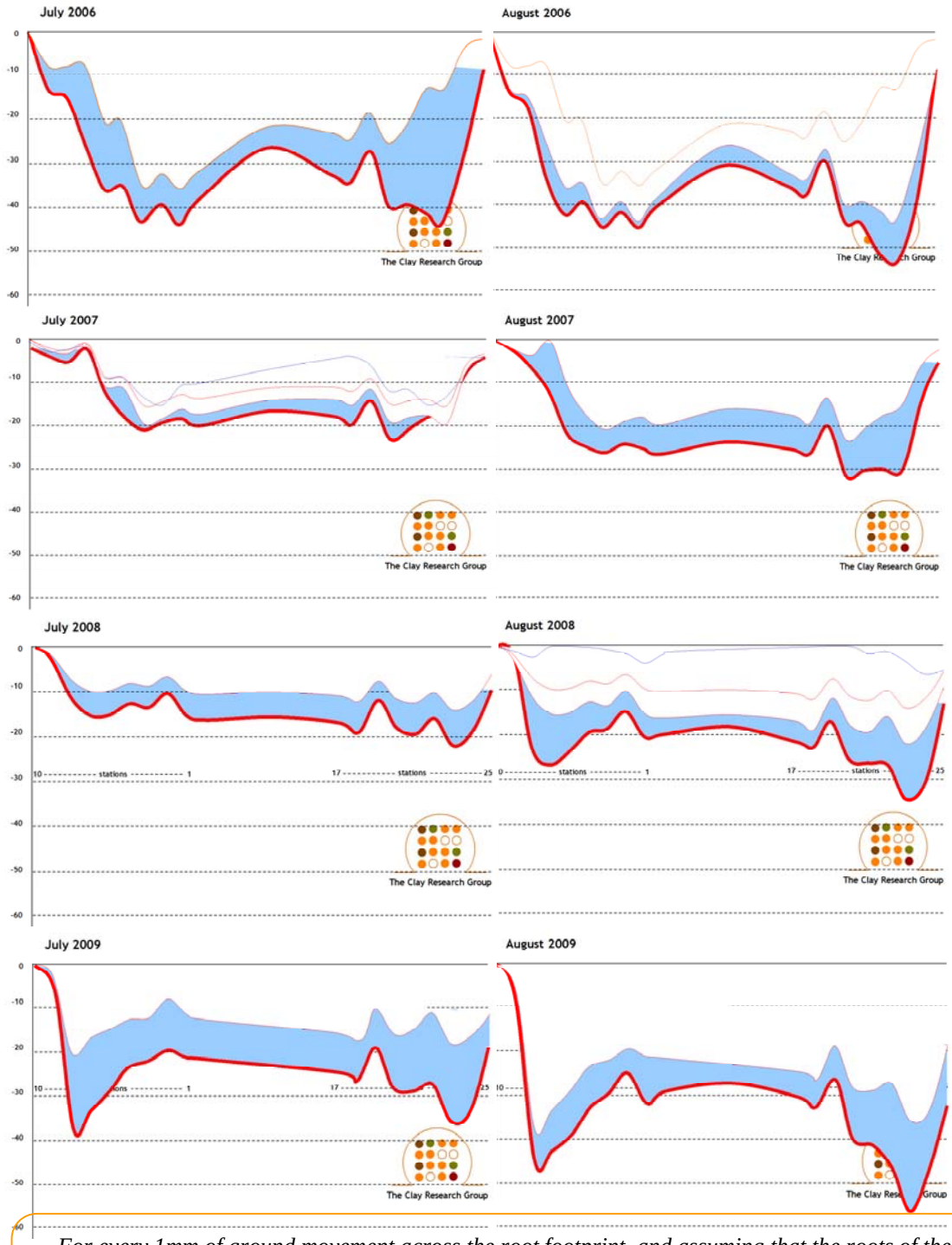
Water Uptake by Month

Comparing July with August



For every 1mm of ground movement across the root footprint, and assuming that the roots of the Willow extend 25mtrs from the trunk, the volume change would be Πr^2 x 0.001 = $2m^3$ of water loss for every 1mm of subsidence. In 2009, an average drop in the ground level of 40mm equated to a moisture loss of $80m^3$. Around 17,500 gallons of water.

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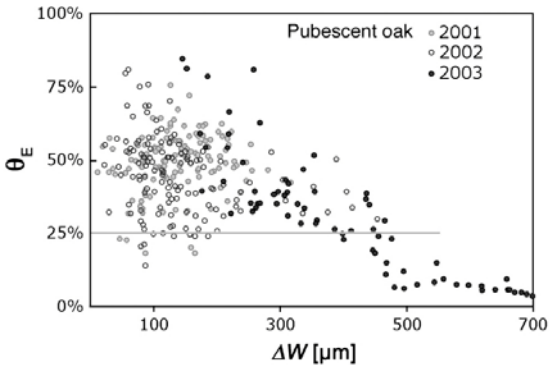
ROOT ZONES

The root zone is dynamic and can change over time, responding to moisture availability. Roots here have extended further afield to seek out water as the ground beneath the tree canopy has become drier. Roots that have a water supply modify their uptake by month, according to the climate.

As the ground dries, so moisture uptake is reduced - no doubt part of this is the water retention properties of the clay soil making access more difficult. Soil suctions increase.

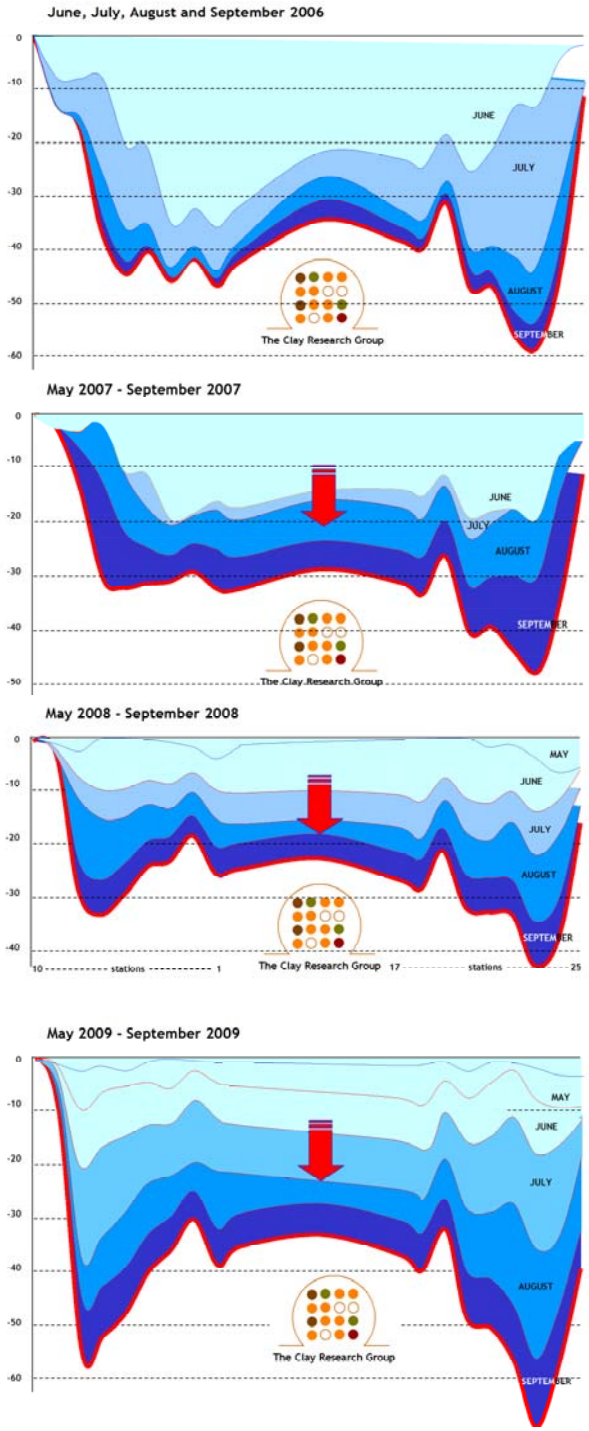
The tree can also 'close down', surviving on less. Stomatal aperture adjusts very quickly in response to long, hot summer days, opening less, and for shorter periods, according to Zweifel et al, Journal of Exp. Biology, 2007.

Mean Daily Stomatal Aperture Values ({theta}E)
Corresponding to Tree
Water Deficits ({Delta}W) over Three Years



Zweifel, R. et al. Journal of Experimental. Botany, 2007

July appears to play an important part in distinguishing between 'normal' and 'event' years. Much of the work – the greater part of ground movement – is complete at the end of this period. In 2006, September saw very little change.



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