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

December 2012

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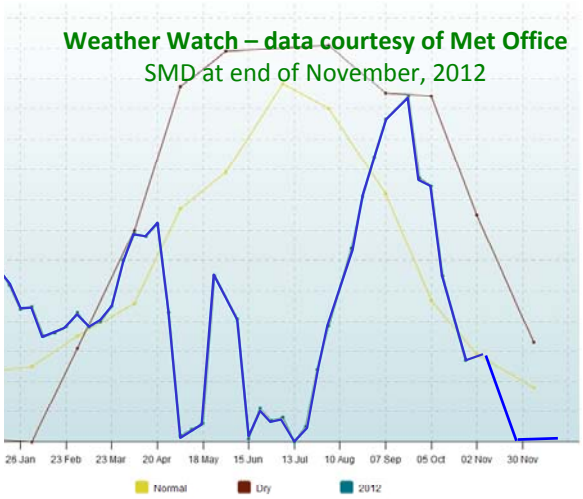
Issue 91, December, 2012

It's all about Sutton

NEXT MONTH

Evidence of the adage "Time is Money". Policy life and risk. Do the odds stack up? How many valid/repudiated claims by season, and then by peril.



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Climate Update

The Met Office (as reported in The Times by Jonathan Leake, their Environment Editor) have recorded that the worlds climate has cooled over the last two years. Peter Stott of the Met Office says "it is a short period that is scientifically meaningless. Climate Change can only be recorded over decades – and records show that the world has warmed by 0.75 degrees over the past century."

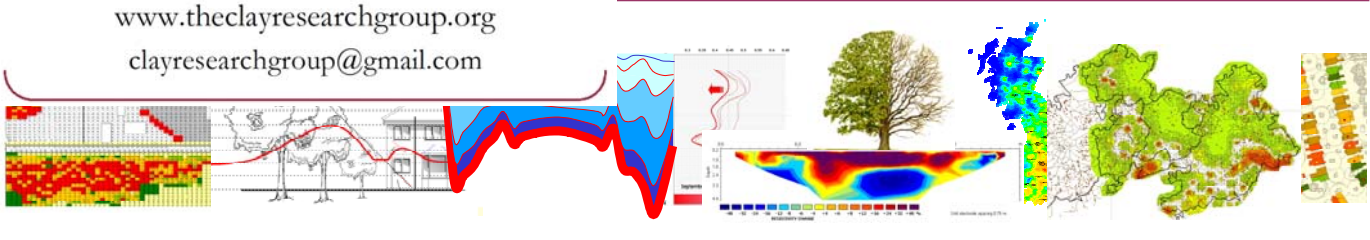
The first 10 months of 2010 were 0.11^{0}C warmer than the same period in 2012, which was attributable to natural variations associated with El Nino – not Climate Change, said Stott.

Apparently, global temperatures have hardly risen for the past 15 years.

London Borough of Sutton

Study Area

The London Borough of Sutton is situated to the south of London (see map below). Our study includes plots of claims, the risk at sector level, topography, geology and tree metrics. All are combined to demonstrate how our risk model is constructed.



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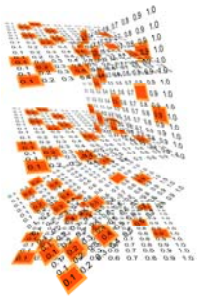
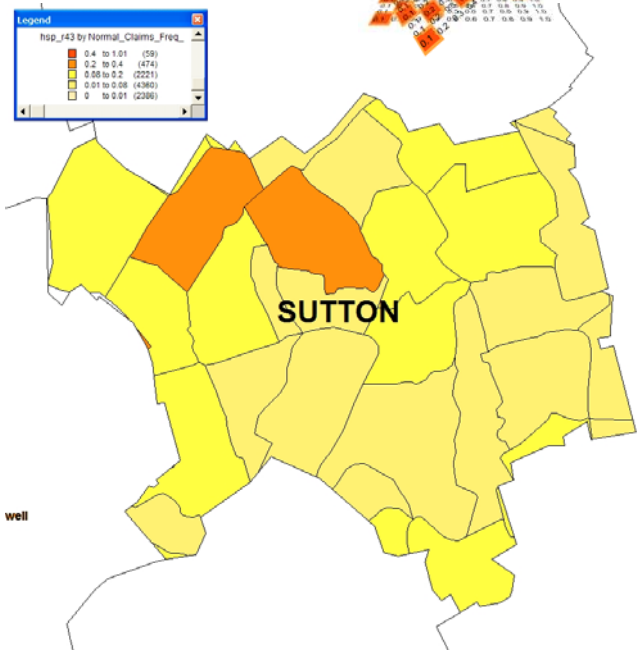
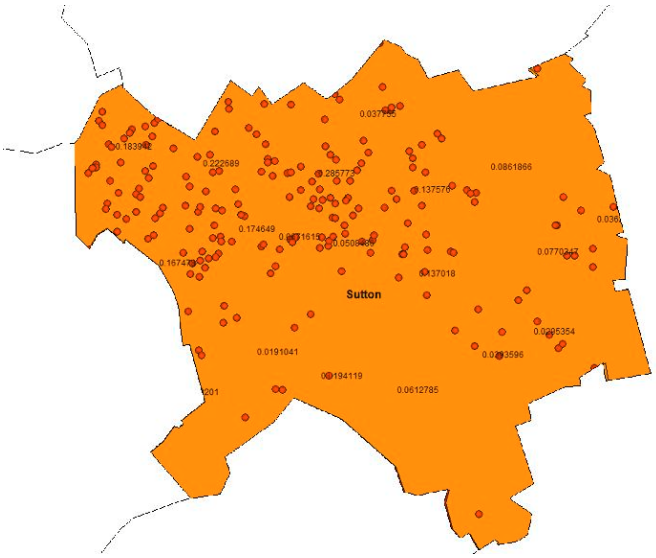


The London Borough of Sutton

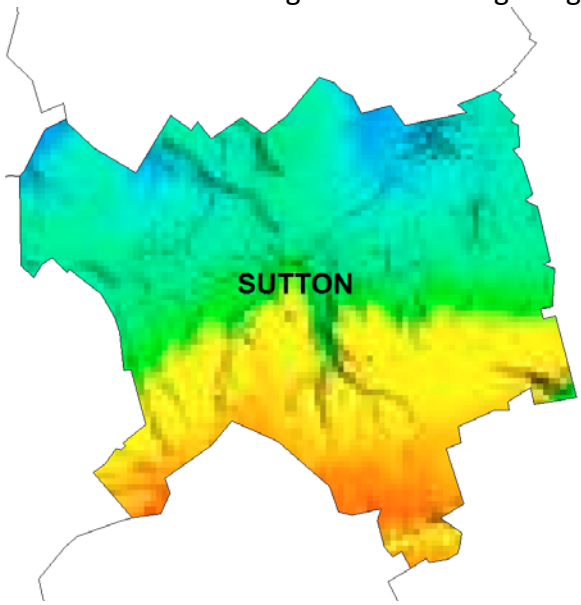
The South London Borough of Sutton has an area of 43 sq.km and a population of around 190,000.

The publication, 'Chainsaw Massacre' lists the total number of street trees removed over a five year term = 1,205, of which 33 were removed due to subsidence. This loss amounts to 2.74% compared with the London Borough average of 5%.



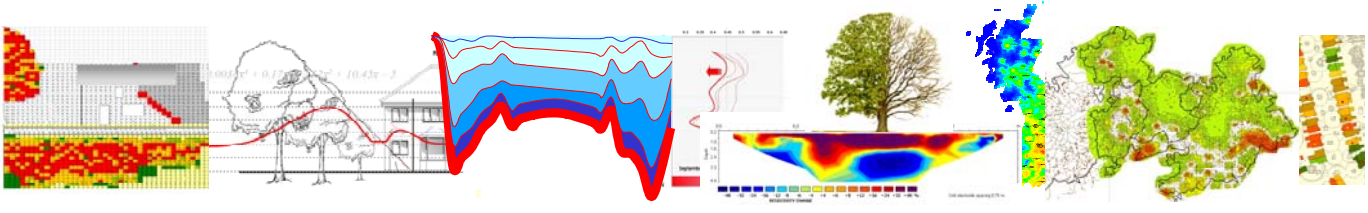


The terrain map (below) reveals the gradual slope down towards the Thames (to the north of the map), with the chalk outcropping to the south and south east and clay deposits in the basin to the north. It is interesting to note the correlation between height and surface geology.



Claims (red dots) occur predominantly to the NW of the Borough on the clay series – see following page.

Next is a map showing claim distribution by sector, and expressed as frequency. The model suggests that postcode sectors SM1 3 and SM3 9 have the highest claims frequency.



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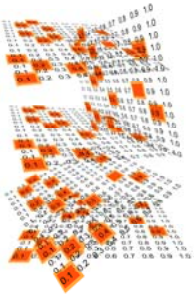
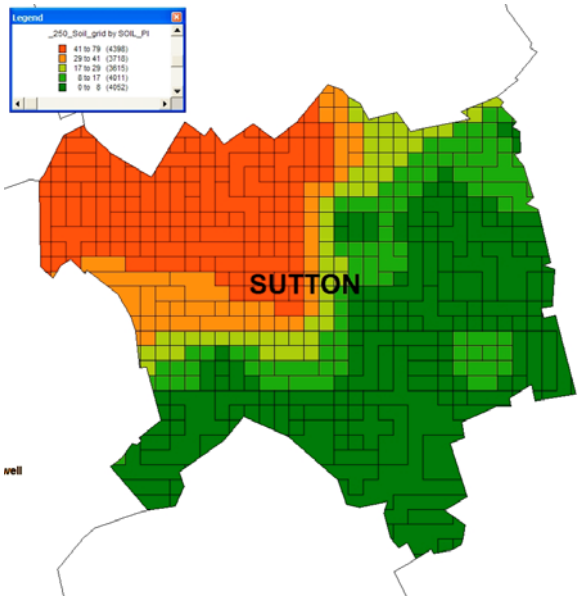


THE GEOLOGY of SUTTON

The geology of Sutton as revealed using our unique tiled grid, (top) and an extract from the 1:625,000 scale extract from the BGS map, below. The BGS do of course have much larger scale maps.



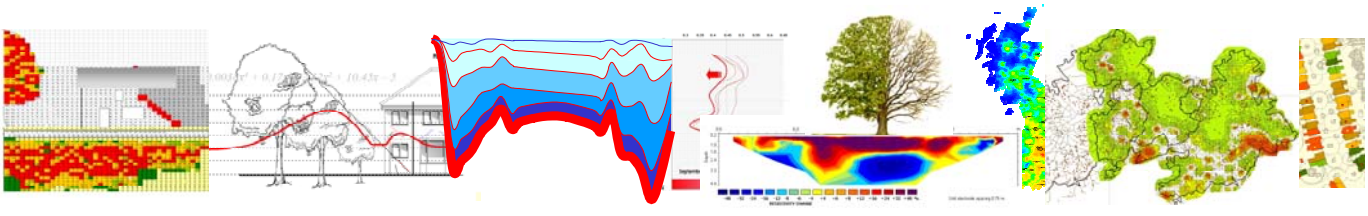
The CRG map is useful because in each 250m cell there is a value reflecting the index property (in the case of clay soils) of the soil at a depth relevant to tree root activity.

The values have been derived from actual investigations over a twenty year period, and the shrink/swell potential has been extracted from a depth of around 2mtrs.

The settled cost of claims has a relationship to the geology, both in terms of the presence or absence of shrinkable soil, but also their plasticity index. Setting the cost at 1 for a claim on a non-cohesive soil and then using a multiplier based on the index properties provides indemnity values representing industry averages.

The BGS map reveals the presence of London clay to the North of the Borough, and chalk to the south.

In this instance, both deliver a similar picture and explain the distribution of claims on the previous page.



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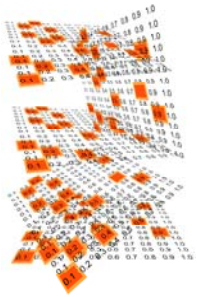


SUTTON - TREES by HEIGHT

Public trees, top, and private trees below, thematically plotted by height.

Public trees are predominantly in the height range 7–10mtrs with the taller running north south just to the left of the Borough.

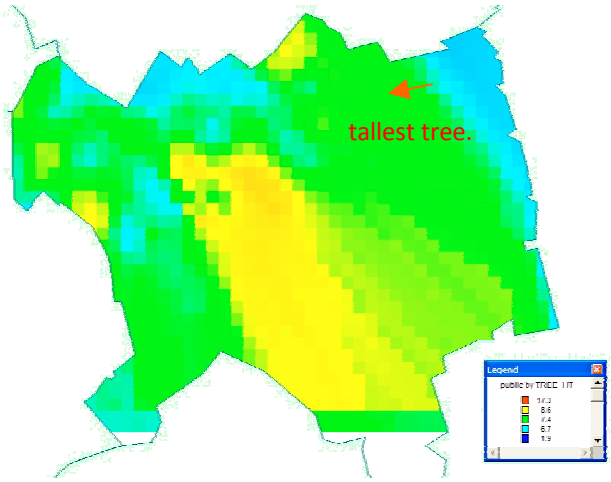
Private trees tend are slightly smaller, averaging 7-8mtrs in height.

If we restrict our analysis to trees situated on clay soils, and within influencing distance of houses, and exclude trees on chalk, well away from buildings, we find the following.

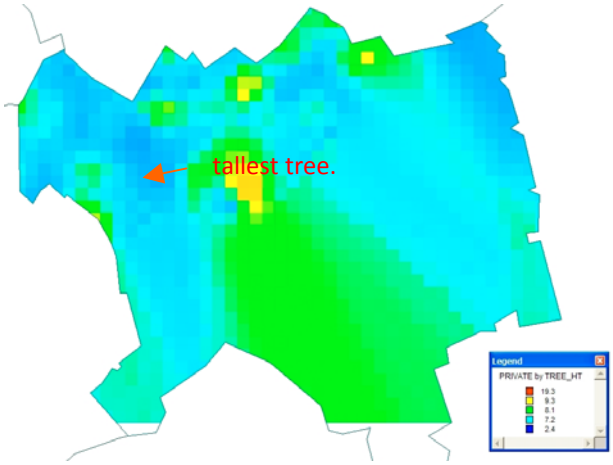
There are around 27,000 trees in private ownership on clay soil, within influencing distance of buildings. The average height is 7mtrs, and the tallest private tree in the Borough is 30mtrs.

Public trees on clay soils, and within influencing distance of buildings total in excess of 5,000. They have an average height of 7.5mtrs – maximum height, around 24mtrs. This compares with the total number of street trees estimated by the Borough to amount to 22,000.

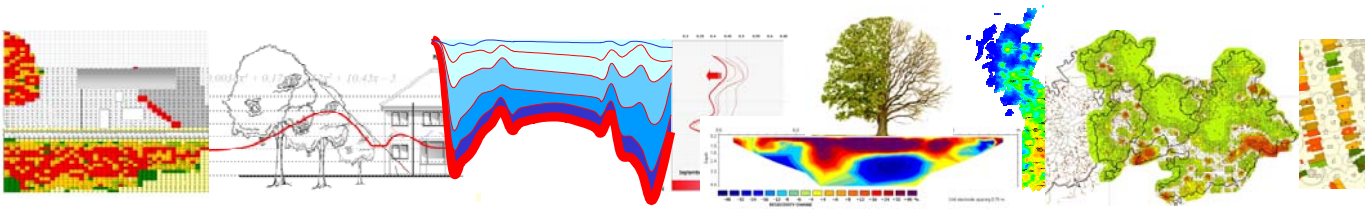
The location of the tallest trees, both public and private, are shown very approximately by the arrows on the maps.



Public Trees by Height



Private Trees by Height



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SM1 3 - Metrics

SM1 3 is one of the higher risk postcode sectors in Sutton. In the adjoining column we graph the number of properties with roots within influencing distance, and their estimated overlap.

The 5,106 properties form the 'x' axis of the graphs in the adjoining column.

All are situated on clay – PI in range max 68%, average 52%, and some very low values – less than 10%.

The maximum tree height is 25mtrs, and the average = 6.7mtrs.

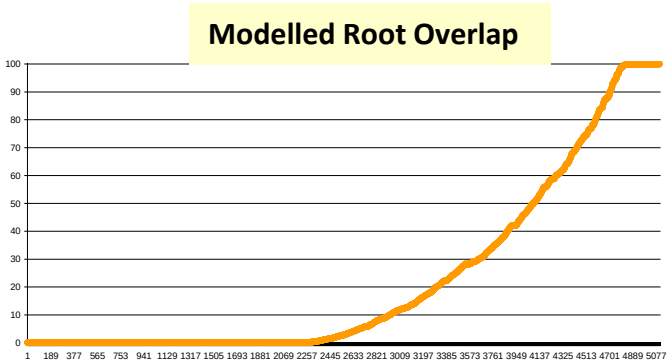
The maximum root overlap beneath buildings is 1,535 sq mtrs and the average = 26 sq mtrs.

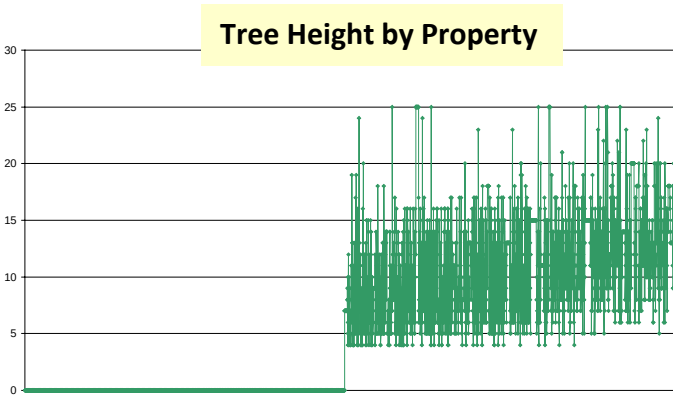
The estimated % overlap is maximum 100%: the average is 22%.

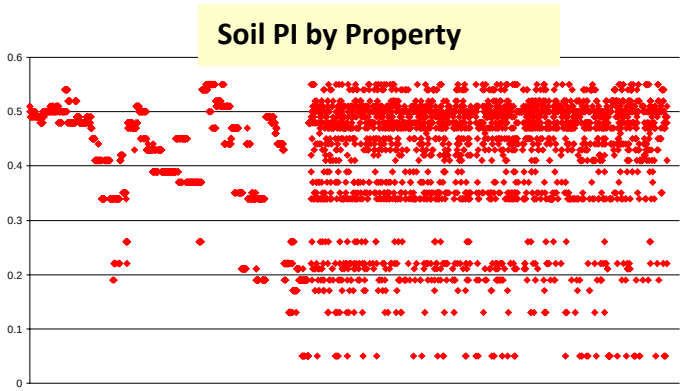
There are 2,232 properties with no tree influence out of a total of 5,106 buildings.

To improve our understanding of risk, the various parameters have been plotted in the same rank order to combine the risk of root overlap, tree height and soil shrink/swell potential.

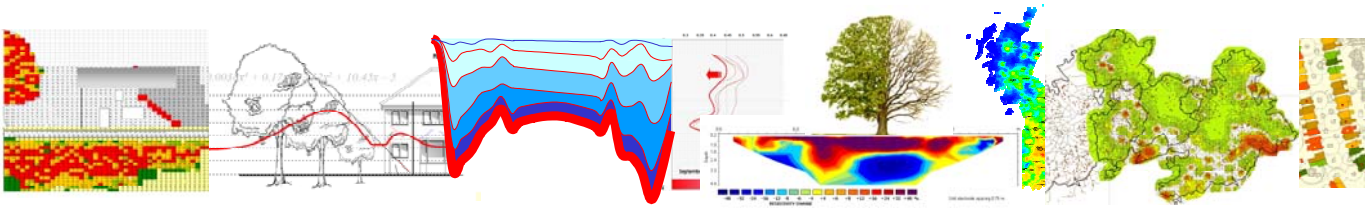
On the following page the spatial distribution of the above elements are mapped to visualise these relationship. Where are the 'hot spots'? When do they combine and does this reflect claims experience?







Top (orange), the count of properties in modelled influencing distance of trees, by estimated root overlap. The model suggests that 43% of the buildings in Sutton postcode SM1 3 are outside the influencing distance of trees. The green line plots the trees by height, in the rank order of the graph above, and the red dots are the soil PI – again, plotted in the same rank order.



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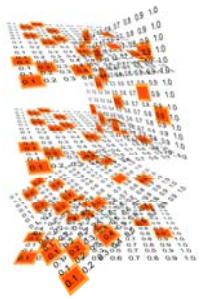
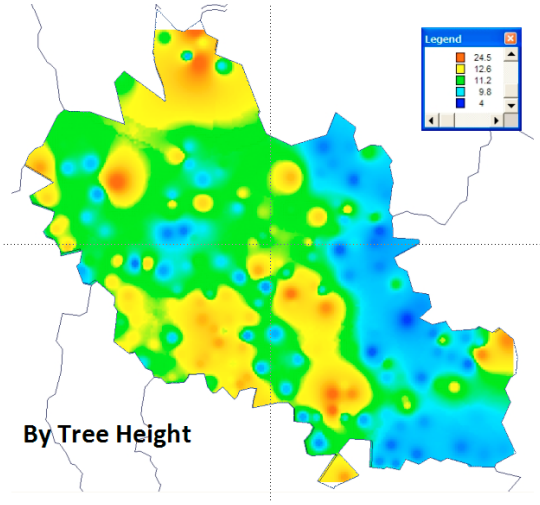
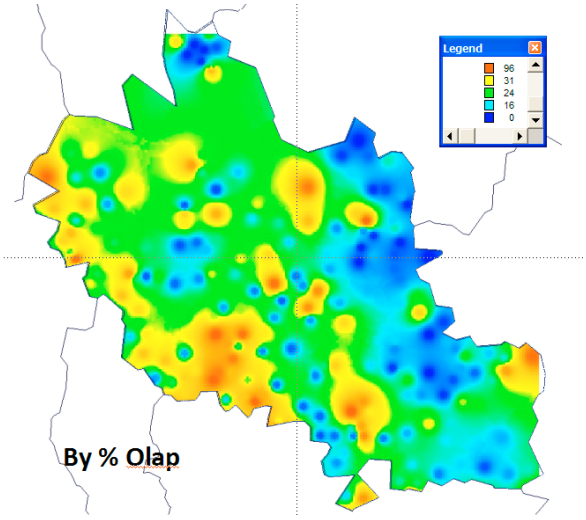
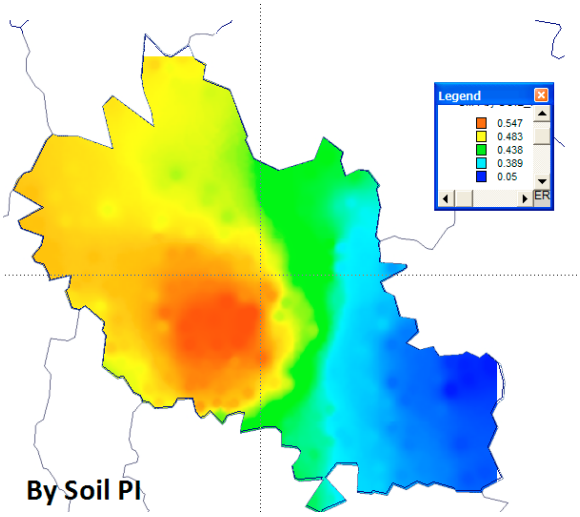








SECTOR RISK - SM1 3

By combining the risk posed by the height of the tree in terms of D/H with the soil shrink/swell potential the spatial models allow us to visualise the interaction between trees, possible root zones and geology (following page).

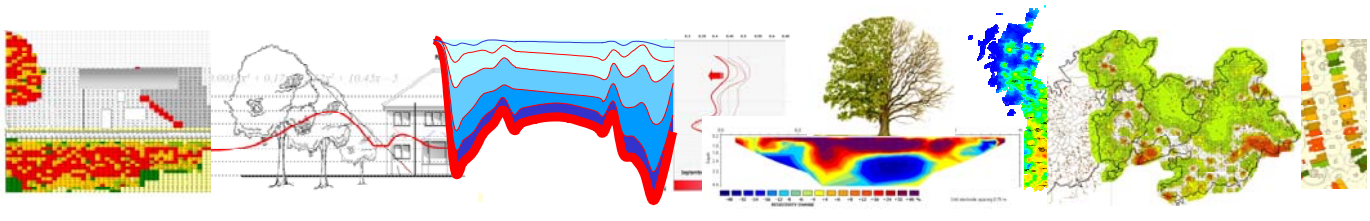
Top left, a map plotting trees by height. Centre, possible root zones and bottom left, the distribution of clay soil in terms of their plasticity index.

By laying one on top of the other the contribution from each can deliver a sum that defines the risk.

Red zones are the riskiest, green intermediate and blue, relatively low risk.

Where red zones from each element coincide, then the risk is greater. Tall trees, near to buildings on highly shrinkable clay soils are easily identified.

The fact that each layer is built from a data grid (see following page) makes the calculation much easier.



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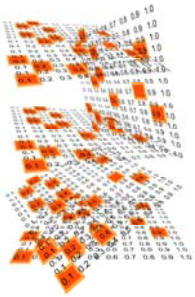
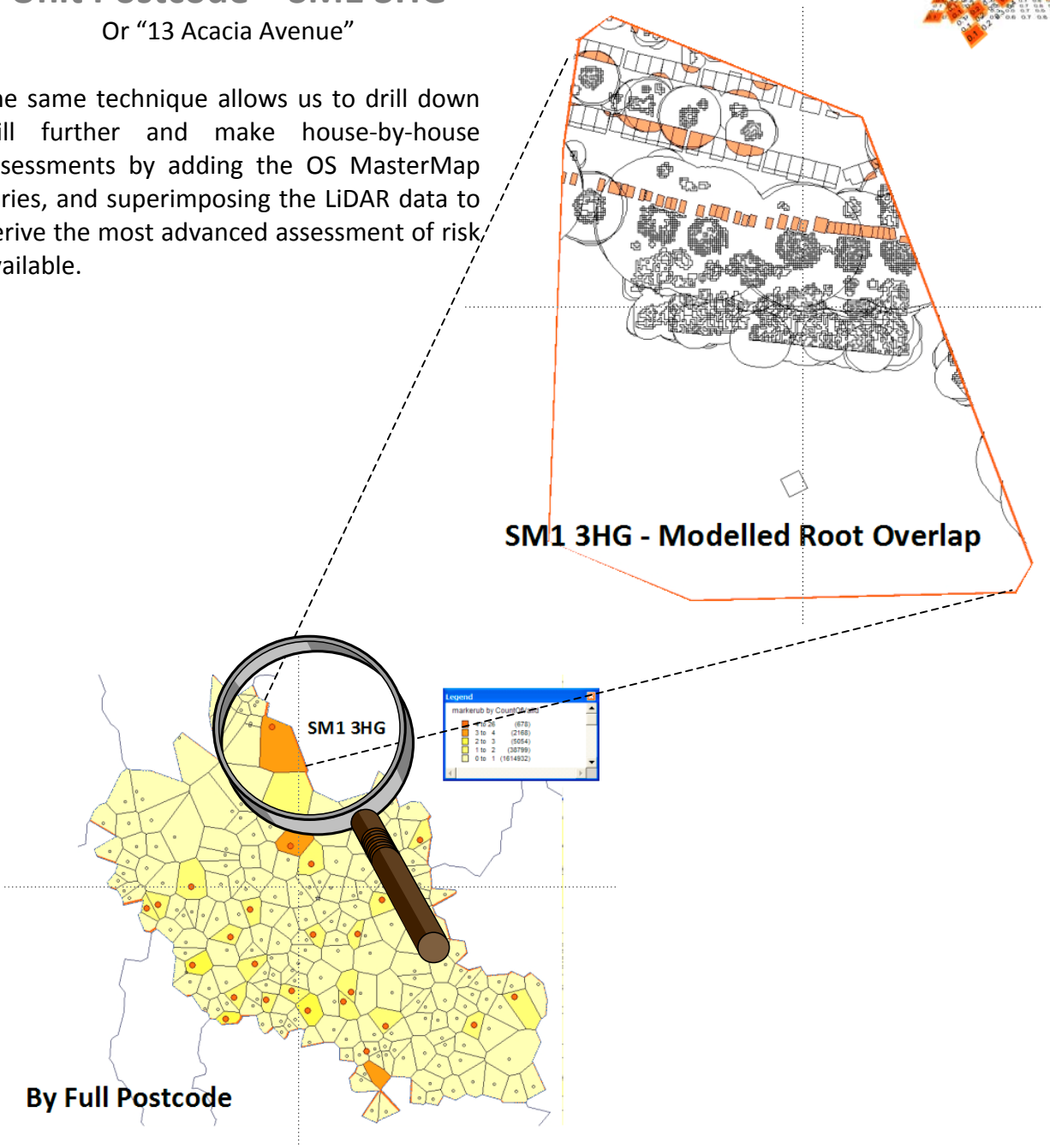
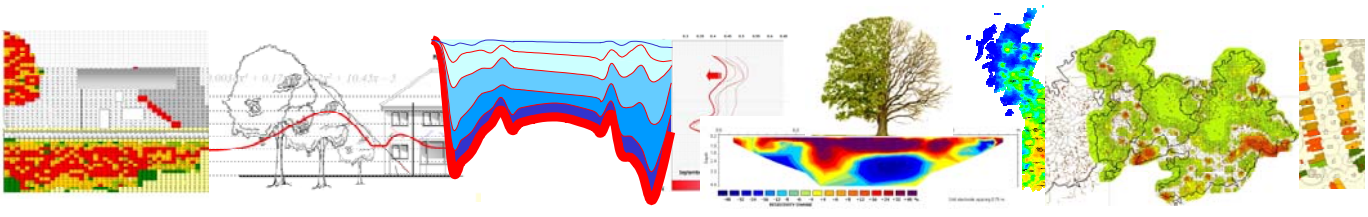


Unit Postcode – SM1 3HG

Or "13 Acacia Avenue"

The same technique allows us to drill down still further and make house-by-house assessments by adding the OS MasterMap series, and superimposing the LiDAR data to derive the most advanced assessment of risk available.





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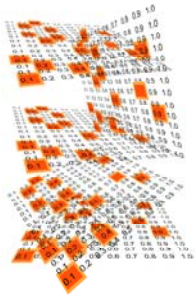
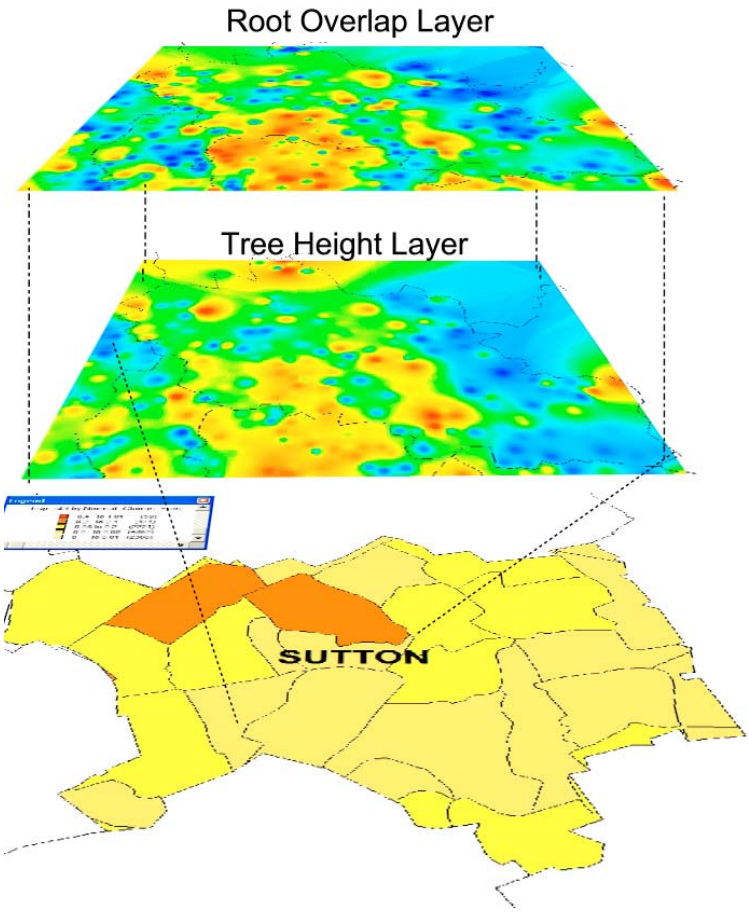




Deriving Risk

By layering datasets, each with a value on the pre-defined grid, the risk can be derived.

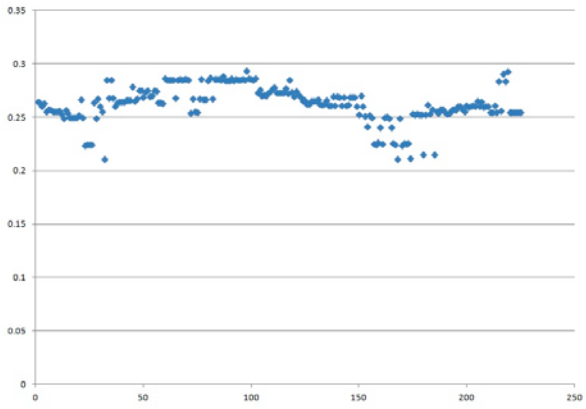
If at one location each of the maps has a red coding and a high risk value – that is, a highly shrinkable clay, high claims experience and within influencing distance of a tree – then the cumulative score will be high.

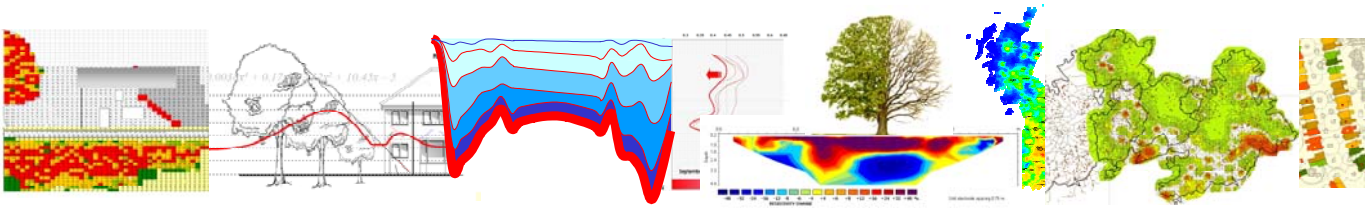
Each of the layers is weighted. A clay soil is far riskier if there is a tree nearby than it would be without. The weighting has to be reduced if the dataset is incomplete to avoid blighting areas.

Add in age of property, style etc., to refine the model even further.

To Conclude

So, where does Sutton stand in the scheme of things, in relation to the risk of subsidence? What is its position in the UK, and compared with other London Boroughs? It's individual sectors are rated in the graph, right. Scores of between 0.22 and 0.28, across the Borough suggest it ranks 66th out of 413 Districts across the UK in terms of subsidence risk, and 15th out of the 33 London Boroughs.





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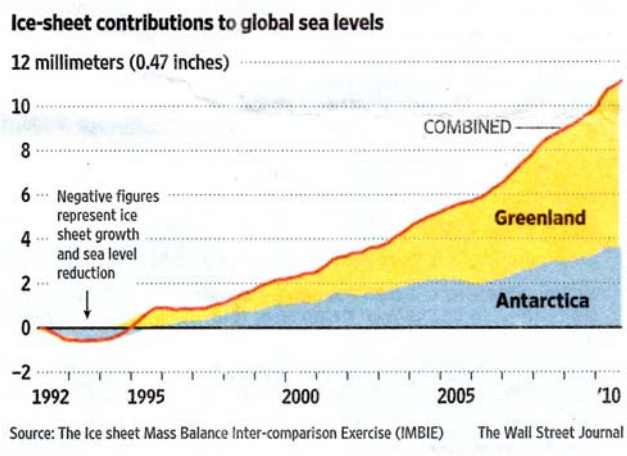
Melting Ice Raises Sea Levels

"The Ice Sheet Mass Balance Inter-Comparison Exercise"
Prof A Sheppard *et al*
Journal Science

In a paper published in the Science journal last week, scientists suggest that melting ice from the Antarctica and Greenland have caused the oceans to rise by 11.1mm over the last two decades.

The lead author, Prof Sheppard from Leeds University says that past satellite measurements either were limited in scope or suffered from methodological inconsistencies. Current readings have been compared with those taken in 1992.



The study suggests that melting of the ice accounted for 10% of the rise in sea level in the 1990's, but now accounts for around 30%.

Other contributory causes include warming resulting in an increase in volume and run-off from glaciers.

Prof. Sheppard concludes "there is no immediate threat from rising sea levels" but goes on to suggest that there are instabilities that need to be investigated.

The graph, left, is reproduced from an article in The Wall Street Journal.

Measuring 11mm rise in sea levels is quite remarkable using satellite data from oceans and we imagine the estimates are based on algorithms that derive averages.

Global Drought

Estimates use a Flawed Index

In an unrelated article, Justin Sheffield from Princeton University suggests that the weather is likely to get wetter, and that prediction of more droughts could be wrong.

He bases this on what he considers to be the incorrect use of what is known as Palmer Drought Severity Index (PDSI) used in climate models.

The index looks at the difference between precipitation and evaporation to deliver a 'drought index'. Because evaporation is difficult to measure, temperature is used as a proxy, which is where the method falls down.

Instead, the Penman-Monteith method should be used which takes account of wind speed, hours of sunshine and humidity etc., to deliver a more accurate estimate.

Based on this revised estimate, Sheffield found "little change in global drought over the past 60 years".

We are a little embarrassed to mention our article in Newsletter 70, March 2011 when we came up with the same flawed method. Our model used precipitation and temperature to model tension in the xylem.