ADDENDUM ARBORICULTURAL REPORT

SUBSIDENCE CLAIM

Crawford Reference: SU1903345

Uplands Residents Management Company

Flats 1 & 3

Uplands Court

19 Frithwood Avenue

Northwood

HA6 3LY

Prepared for

Allianz Commercial

Claim Reference BH/2/337828

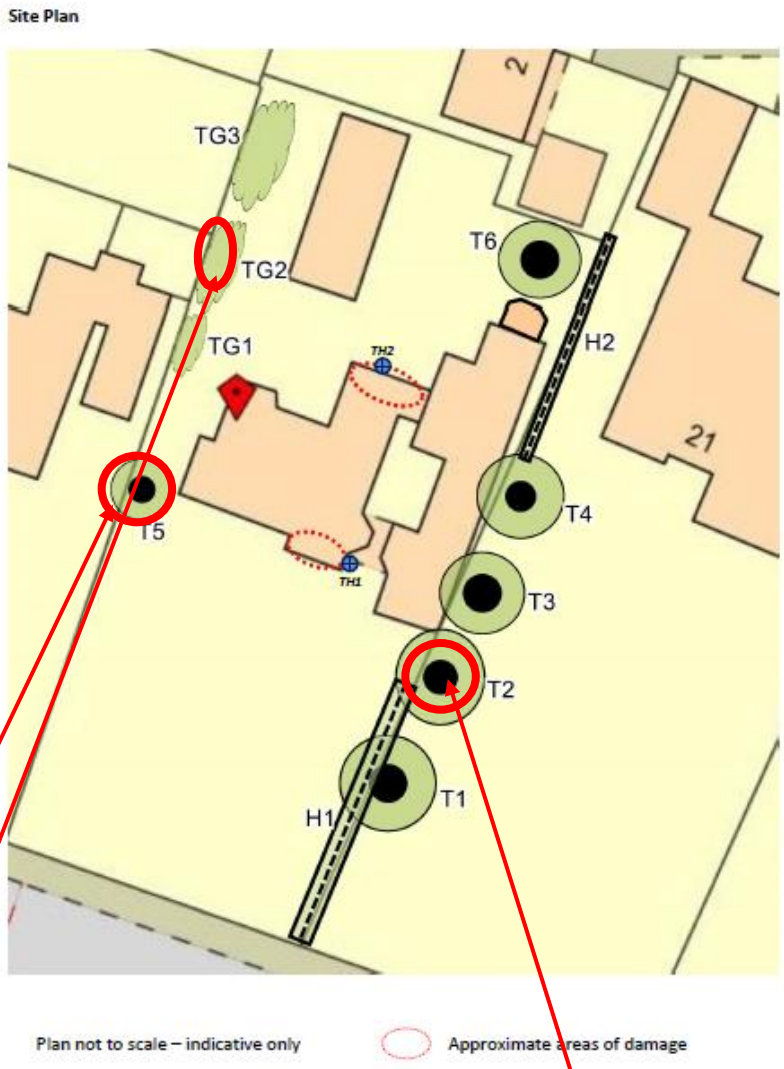
18 July 2023

Crawford Claims Solutions – Subsidence

Cartwright House,

Tottle Road,

Riverside Business Park, Nottingham, NG2 1RT



T5 & TG2 Removed 2020

T2 Removed 22/06/22

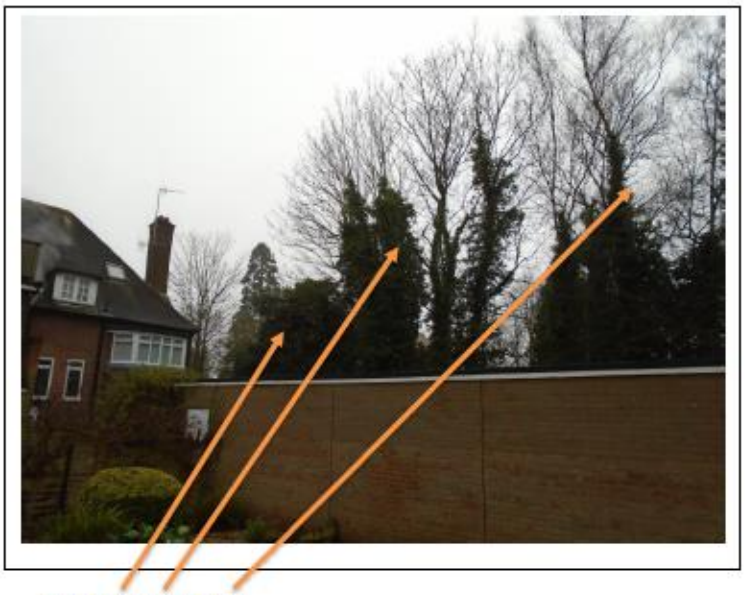
Recommendations to remedy Current Damage:

T1 Oak – Fell to ground level
T3 Horse Chestnut – Fell to ground level
T6 Lime – Fell to ground level
TG1 Prunus – Fell to ground level

Images

View of T2, T1 and H1

View of T2, T3 and T4



View of TG1, TG2 and TG3

View of T5 and TG1

INTRODUCTION

We have been asked by insurers to comment on movement that has taken place to the above property. This report outlines the arboricultural issues and should be read in conjunction with our initial Technical Report and the subsequent Addendum Technical Report dated 27/05/21, the MWA Arboricultural Report (second Addendum) dated 16/02/23 and the site investigations including soil and root testing and level monitoring, which are summarised within this report.

TECHNICAL CIRCUMSTANCES

The owner of Flat 1 is recently deceased and we are dealing with the Executor who advised that damage was pointed out by a Surveyor engaged for probate purposes. The Surveyor highlighted a number of cracks which were considered to be due to subsidence. We also inspected Flat 3 above

who advised that damage first occurred in Summer 2018 but they have only become concerned having heard that subsidence is affecting the flat below. Given the likely cause of subsidence, we suspect it occurred in both flats around Summer 2018.

PROPERTY

Two and three storey large detached house converted into flats. Construction is cavity brick wall, rendered at 1st floor level with Mock Tudor decoration. The roof is hipped and ridged tiled. To the right side is a newer extension of two and three storey to provide additional flats, with a link block at ground floor between. There is a conservatory on the rear of this extension. Flat 1 is on the ground floor right side of the original house with Flat 3 directly above it. The property is in a Conservation Area and there is an Area Tree Protection Order. We understand there are 10 flats in total.

HISTORY & TIMESCALE

- Temporary repairs to Flat 1 to enable it to be let.
- Site investigations, arboricultural report & level monitoring in order to submit TPO application for tree mitigation works.

Date of Construction c.1930s

Damage First Noticed ..... July 2019

TOPOGRAPHY

The property occupies a level site with no unusual or adverse topographic features.

OBSERVATIONS

The areas of damage are the front right elevation and the rear elevations of Flats 1 and 3.

The following is an abbreviated description. Photographs accompanying this report illustrate the nature and extent of the problem.

INTERNAL

Flat 1 - Entrance Hall

Diagonal crack above front door.

Diagonal crack adjacent to rear bedroom wall and associated crack to coving and across ceiling.

Flat 1 - Lounge

Diagonal cracks below right side of front window.

Separation of coving with wall at front right corner and along right wall.

Vertical crack below left side of front window.

Vertical crack at external splay junction in alcove area and cracks at wall/ceiling junction

Flat 1 - Side Bedroom

Cracks at plasterboard joints in ceiling

Flat 1 - Rear Bedroom

Plasterboard joint crack across ceiling.

Diagonal crack above door to hall.

Flat 1 - En-Suite to Rear Bedroom

Diagonal crack above door to bedroom

Diagonal and stepped cracking above and below rear window including through wall tiles.

Flat 3 - Front Bedroom

Diagonal stress cracks above either side of front window.

Vertical and stepped cracks below window into skirting.

Slight crack to ceiling.

Flat 3 - Rear Lounge

Diagonal and horizontal crack above rear patio doors.

Slight crack above door to hall.

Flat 2

Inspected but cracking is not subsidence related.

EXTERNAL

Front Elevation

Stepped vertical crack below left and stepped crack below right of Lounge window (Flat 1). Cracks above both sides of window extending up to Flat 3 bedroom window above.

Vertical crack in porch of right internal splay which is reflected internally in the alcove (Lounge of Flat 1)

Rear Elevation

Vertical crack below Flat 1 rear bedroom bow window - not reflected internally.

Stepped crack below En-Suite window, open 2-3mm.

Laser level survey shows rear elevation is dropping towards the rear left corner. The left elevation is relatively level.

CATEGORY

In structural terms the damage falls into Category 2 of Table 1, Building Research Establishment[1] Digest 251, which describes it as “slight”.

[1] Building Research Establishment, Garston, Watford. Tel: 01923.674040

Category 0	"negligible"	< 0.1mm
Category 1	"very slight"	0.1 - 1mm
Category 2	"slight"	>1 but < 5mm
Category 3	"moderate"	>5 but < 15mm
Category 4	"severe"	>15 but < 25mm
Category 5	"very severe"	>25 mm

Extract from Table 1, B.R.E. Digest 251

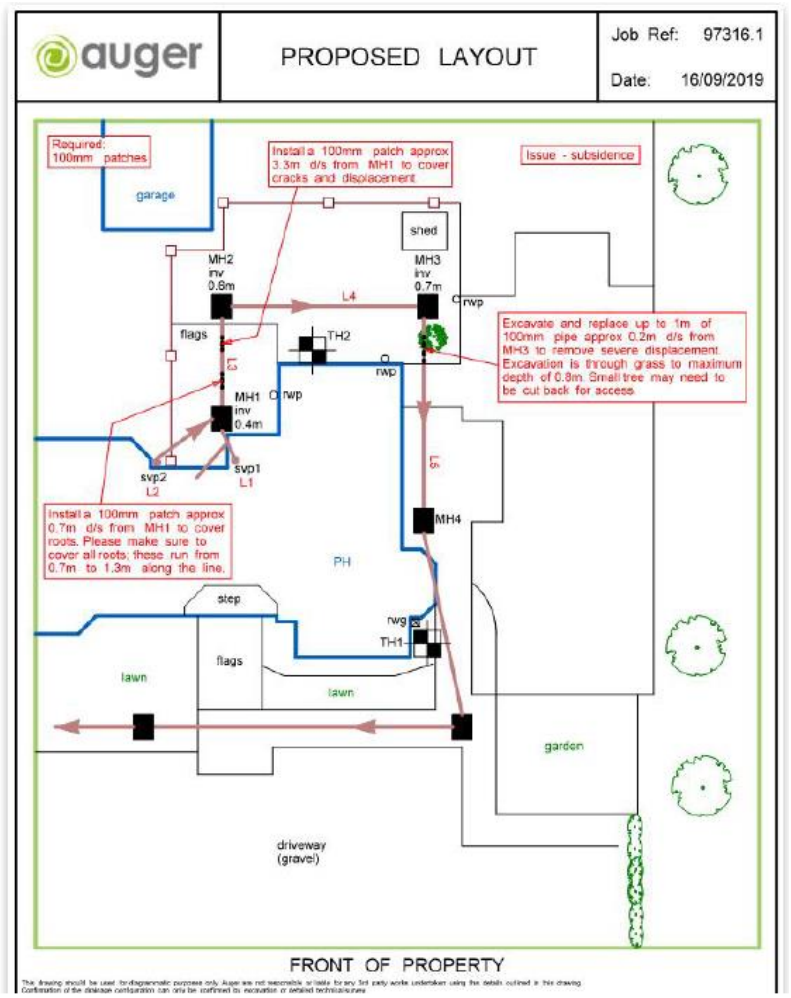
Classification of damage based on crack widths.

GEOLOGY & SOIL

Reference to the 1:625,000 scale British Geological Survey Map (solid edition) OS Tile number TQNW suggests the underlying geology to be London Clay.

Site investigations confirm clay that has high plasticity, meaning it can significantly change in volume due to seasonal variations in moisture content, particularly if influenced by tree roots extracting moisture.

Site Investigations 16/09/2019



A trial hole was excavated to expose the foundations - see site plan for location and the diagram below for details.

No.	Borehole Depth	Footing (a)	Underside (b)	Thickness (c)
TH1	3.00 m.	200 mm.	1,000 mm.	700 mm.

AUGERED BOREHOLES

A 50mm diameter hand auger was sunk - see site plan for location(s).

Borehole 01 was sunk from the base of trial hole 01 and to a depth of 3000mm below ground level. This confirmed very stiff clay to the full depth of the borehole.

SOIL SAMPLES

Soil samples were retrieved from the bore, wrapped in clingfilm before being bagged and deposited with a testing laboratory the same day. The laboratory have instructions to test the samples to determine if there is evidence of root induced desiccation.

DRAINS

A drain survey was completed which confirmed defects to the installation away from the area of damage. These were repaired in October 2020.

2019 Laboratory Tests:

TH Trial Hole	Sample Type	Depth (m)	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity index %	Passing .425mm %	NHBC Chapter 4.2	Remarks
TH1	D	1.00	21	53	20	33	86	MEDIUM VCP	CH High Plasticity
TH1	D	1.50	23						
TH1	D	2.00	24	59	24	35	100	MEDIUM VCP	CH High Plasticity
TH1	D	2.50	27						
TH1	D	3.00	27	54	26	28	88	MEDIUM VCP	CH High Plasticity
TH2	D	1.00	24	65	21	44	84	HIGH VCP	CH High Plasticity
TH2	D	1.50	23						
TH2	D	2.00	28	77	24	53	89	HIGH VCP	CV Very High Plasticity
TH2	D	2.50	29						
TH2	D	3.00	29	74	23	51	100	HIGH VCP	CV Very High Plasticity

Flats 1-3

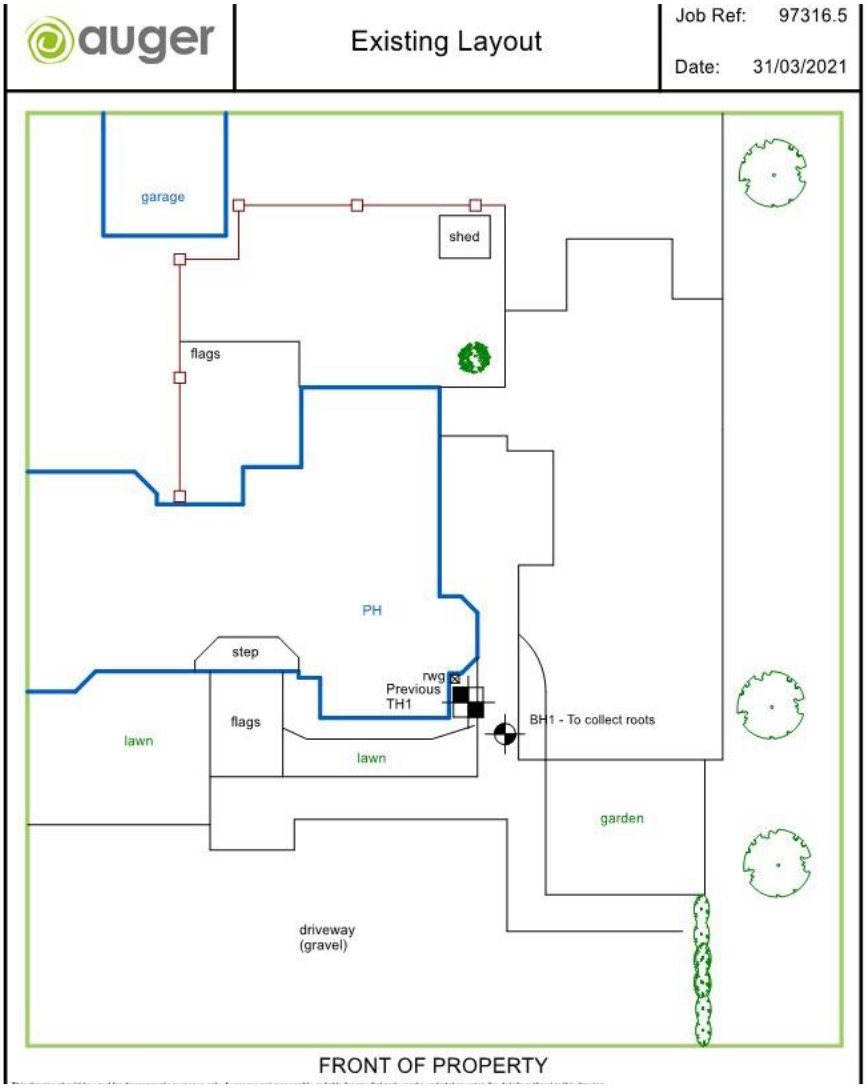
The samples you sent in relation to the above have been examined. Their structures were referable as follows:

TH1, 1.0m		
1 no.	Examined sample: essentially too immature for identification; definitely NOT a conifer. Note that this was unusual in structure - it could well be a TWIG or SUCKER, rather than a root.	Dead*.
1 no.	A piece of BARK only, insufficient material for identification.	
3 no.	Unfortunately all with insufficient cells for identification.	
TH2, 1.0m		
3 no.	Examined root: most referable to ACER (Maples, Sycamores). This was a very IMMATURE sample.	Alive, recently*.

Click here for more information: ACER

As a result of the above, T5 and TG2 were removed during 2020.

Due to continuing foundation movement and damage, further investigations were undertaken during March 2021 and the results are as follows:



RBH, 1.0m		
2 no.	Examined root: similar in many ways to AESCULUS (Horse Chestnut and related Buckeyes). This was a very IMMATURE sample.	Alive, recently*.
RBH, 1.2m		
3 no.	Examined root: essentially too immature for identification; definitely NOT a conifer.	Dead*.
RBH, 1.5m		
1 no.	Examined root: also very THIN. We cannot rule out AESCULUS (Horse Chestnut and related Buckeyes).	Alive, recently*.
2 no.	Both pieces of BARK only - insufficient material for recognition.	
RBH, 1.8m		
2 no.	Examined sample: very unusual in structure. Could, tentatively be either GINKGO (Maidenhair Tree) - or - a fairly insignificant herbaceous (non-woody) plant. Note that this could well be a TWIG or SUCKER, rather than a root.	Dead*.
RBH, 2.1m		
1 no.	Examined root: as previously, could be AESCULUS (Horse Chestnut and related Buckeyes).	Alive, recently*.
1 no.	Examined root: QUERCUS (Oak) or the related CASTANEA (Sweet Chestnut).	Alive, recently*.
1 no.	A piece of BARK only, insufficient material for identification.	

Click here for more information: AESCULUS CASTANEA QUERCUS

As a result of the above T2 was removed during June 2022 and T1 was reduced in size at the same time.

DISCUSSION

The results of the site investigations confirm that the cause of subsidence is root-induced clay shrinkage. The clay is plastic and thus will shrink and swell with changes in moisture content. Roots have extracted moisture below the depth of the footings, thus causing differential foundation movement to occur. This is supported by the following investigation results:-

- The foundations are at a depth of 1,000mm which is below the level that normal seasonal movement would occur.
- The moisture content profile indicates a reduction in moisture content at 1,000mm below ground level and using Driscoll's rule (0.4xLL) the moisture content reading of 21% does indicate desiccation at this level. This is also co-incident with the depth of root activity.
- Atterberg limit testing indicates that the soil has medium shrinkage potential with reference to NHBC 4.2 and hence will shrink and swell with changes in moisture content.
- Suction tests indicate desiccation in borehole 01 coincident with the depth of root activity.
- Roots retrieved, taken from an additional borehole completed in April 2021 (immediately adjacent to the original trial / borehole) , were found to a depth of 2100mm below ground level. The roots stemmed from *Aesculus* (Horse Chestnut) and *Quercus* (Oak) species.
- Level monitoring indicates seasonal cyclical movement with downward movement in the summer months (as the clay shrinks) and upward movement in the winter months (as the clay swells).

VEGETATION

There are trees and shrubs nearby, some with roots that may extend beneath the foundations. The following are of particular interest and recommendations have been made to provide a remedy to the current damage:-

Table 1 **Current Claim** - Tree Details & Recommendations

Tree No.	Species	Ht (m)	Dia (mm)	Crown Spread (m)	Dist. to building (m)	Age Classification	Ownership
T1	Oak	15.5 *	1000 *	11 *	15 *	Older than Property	Third Party 21 Frithwood Ave HA6 3LY
Management history		Reduced to previous pruning points 22/06/2022.					
Recommendation		Remove (fell) to near ground level. Owner to physically remove any regrowth (no chemical treatment due to translocation risk).					
T2	Horse Chestnut	15	750	12 *	5	Older than extension	Third Party 21 Frithwood Ave HA6 3LY
Management history		Removed 22/06/2022.					
Recommendation		N/A.					
T3	Horse Chestnut	12 *	650 *	11 *	2.75 *	Older than extension	Third Party 21 Frithwood Ave HA6 3LY
Management history		No recent management noted.					
Recommendation		Remove (fell) to near ground level. Any regrowth from stump to be removed as it appears.					
T5	Sycamore	11 *	Ms 250 *	7 *	3	Younger than Property	Policy Holder
Management history		Removed 2020.					
Recommendation		N/A					
T6	Lime	17 *	800 *	14	4 *	Older than extension	Policy Holder
Management history		Previously subject to significant reduction. 12m to area of damage.					
Recommendation		Remove (fell) to near ground level. Any regrowth from stump to be removed as it appears.					

Ms: multi-stemmed * Estimated value

Table 1 **Current Claim** - Tree Details & Recommendations cont'd

Tree No.	Species	Ht (m)	Dia (mm)	Crown Spread (m)	Dist. to building (m)	Age Classification	Ownership
TG1	Prunus	8	Ms 250 *	5	6.5 *	Younger than Property	Policy Holder
Management history		No recent management noted. Infested with ivy.					
Recommendation		Remove (fell) to near ground level and treat stump to inhibit regrowth.					
TG2	Sycamore	12.5 *	Ms 300 *	12	10 *	Younger than Property	Policy Holder
Management history		Removed 2020.					
Recommendation		N/A.					

Ms: multi-stemmed * Estimated value

Tree roots can be troublesome in cohesive (clay) soils because they can induce volumetric change. They are rarely troublesome in non-cohesive soils (sands and gravels etc.) other than when they enter drains, in which case blockages can ensue.

VEGETATION INFLUENCE

According to the standard published work on the subject (Cutler, D.F. and I.B.K. Richardson, (1989) further confirmed by Mercer, Reeves & O'Callaghan (2011) in shrinkable clay soils, Oak species are capable of causing subsidence damage at distances up to 30m, with 75% of cases occurring where the tree was within 18m. The Oak T1, at only 15m, is therefore well within its species' potential rooting and influencing distance of the building and would be capable of causing seasonal soil drying beneath foundations. The site investigations confirm significant rooting beneath foundations in any event.

According to the same published works, Horse Chestnut T3 at only 2.5m distance is well within its species normal influencing distance and would be capable of causing soil drying beneath foundations as is Lime T6 at only 4m distance as well as Prunus group TG1 at only 6.5m distance.

The published works confirm these species influencing distances as follows:

- Horse Chestnut (Aesculus) species are capable of causing subsidence damage at distances up to 23m, with 75% of cases occurring where the tree was within 10m and 90% of cases occurring where the tree was within 15m.
- Lime (Tilia) species are capable of causing subsidence damage at distances up to 20m, with 75% of cases occurring where the tree was within 8m and 90% of cases occurring where the tree was within 11m.
- Prunus species are capable of causing subsidence damage at distances up to 11m, with 75% of cases occurring where the tree was within 6m and 90% of cases occurring where the tree was within 7.5m.

PATTERN OF MOVEMENT

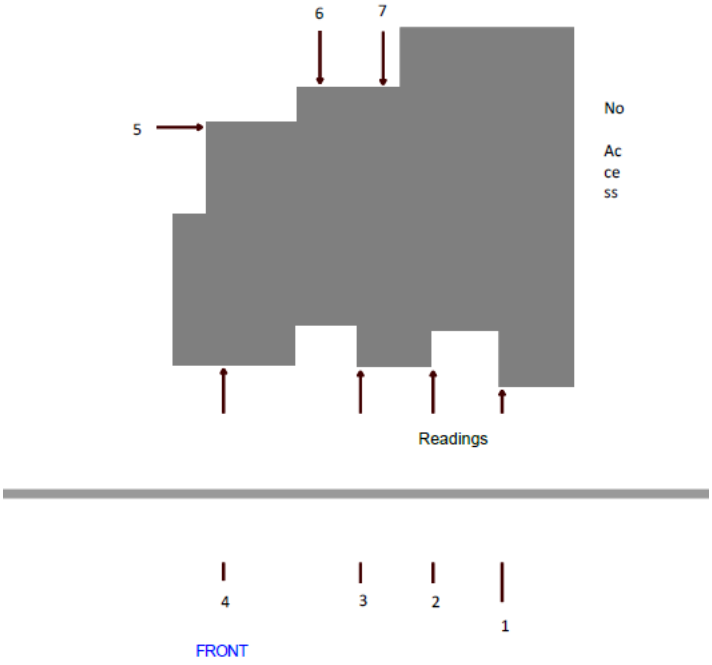
Damage was observed to worsen during summer 2022 during a time of year when soil moisture deficits due to tree root activity would be reaching their peak and following the removal of trees in 2020 and further removals and reduction works during June 2022.

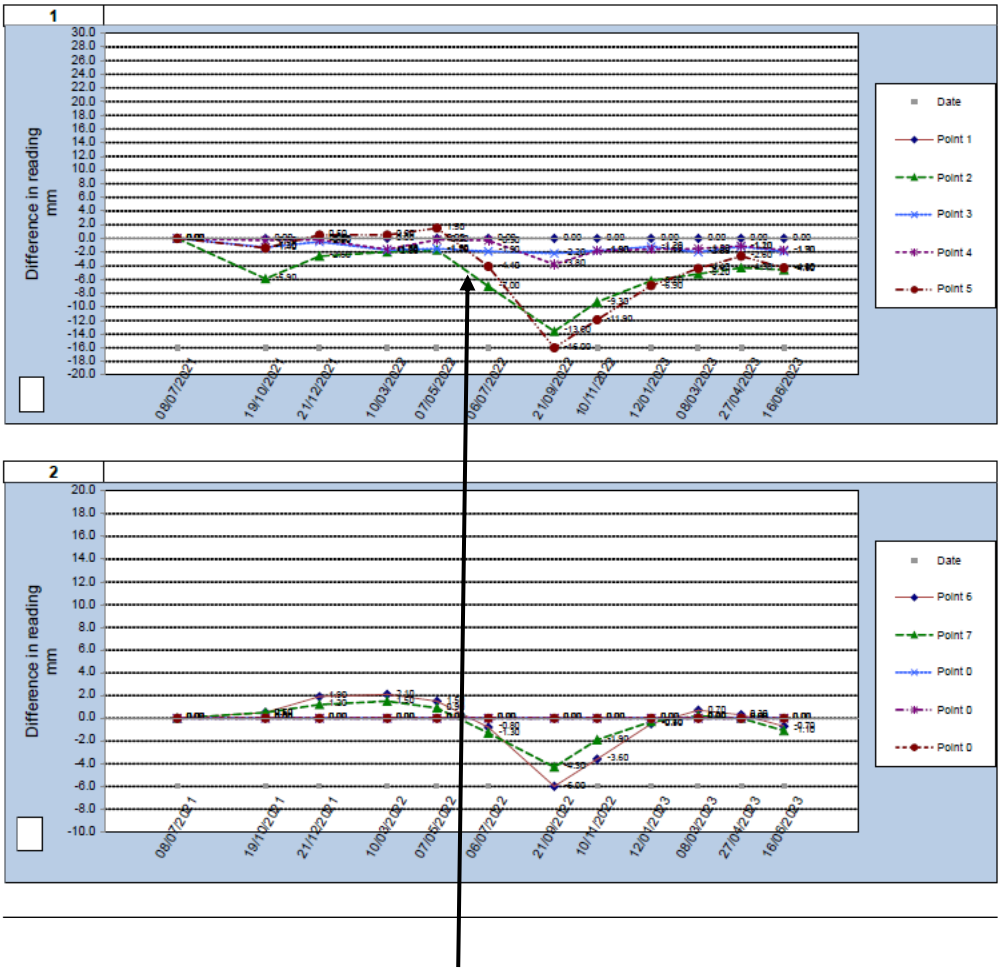
The area of movement and damage is consistent with the locations of the subject trees T1, T3, T6 and TG1.

The pattern of movement is entirely consistent with the seasonal, cyclical influence of tree roots on soil moisture, foundations moving down during summer months when roots are active and extracting soil moisture, then returning to recovery and uplift as soil moisture increases during winter when tree roots are inactive.

Precise Level Monitoring

The results are as follows:





T1 reduced and T2 removed June 2022

The level monitoring indicates a clear seasonal and cyclical pattern of movement consistent with root induced clay shrinkage with the greatest amplitude of movement being consistent with the locations of the subject trees and after the works to T1 & T2 were completed, this confirms the ongoing influence of T1, T3, T6 and TG1.

DISCUSSION

The pattern and nature of the cracks is indicative of an episode of subsidence. The cause of movement is clearly attributable clay shrinkage exacerbated by tree root activity.

The timing of the event, at a time of year when soil moisture deficits due to tree root activity would be reaching their peak.

The presence of shrinkable clay beneath the foundations and the proximity of vegetation where there is damage indicates the shrinkage to be root induced. This is a commonly encountered problem and probably accounts for around 70% of subsidence claims notified to insurers.
Root identification implicates Oak & Horse Chestnut as the main cause of the damage with the almost certain significant influence of roots from the nearby Lime and Prunus species..

MITIGATION OPTIONS

Tree reduction option - Pruning is generally unreliable as a means of controlling water uptake. Whilst the tree remains, even if heavily pruned, damage is likely to continue or worsen, as the roots will continue to extract moisture from beneath foundations of the damaged building. In any event, the tree is sufficiently close to the structure that even heavy pruning is very unlikely to reduce root moisture uptake. There is no linear relationship between foliage volume and the amount of water lost. Being dynamic organisms, trees react to pruning by trying to restore the root to shoot ratio by producing as many leaves as they can. These new leaves are usually juvenile leaves with a larger surface area and generally more pores on the underside, these pores stay open for longer compared to an unpruned tree and increase the degree of water uptake by the roots. Research has shown that even a heavily pruned tree will quickly return to absorbing soil moisture and the seasonal movement and damage will continue.

Previous crown reduction to T1 has also failed to provide a remedy.

The publication "CONTROLLING WATER USE OF TREES TO ALLEVIATE SUBSIDENCE RISK" © 2004 BRE on behalf of the Link Consortium for Horticulture Link Project No. 212 concluded that:

• For practical soil moisture conservation, severe crown-reduction 70-90% of crown volume would have to be applied. Reduction of up to 50% crown volume is not consistently effective for decreasing soil drying.

• To ensure a continued decrease in canopy leaf area and maximise the period of soil moisture conservation, crown reductions should be repeated on a regular managed cycle with an interval based on monitoring re-growth.

For trees of the age and proximity of the subject trees, a severe crown reduction would diminish their amenity value and would cause decays in the large pruning cuts that would be required. Also, repeated regular pruning (bi-annually) would be an expensive but not necessarily effective means of controlling above ground growth of the tree that would not be guaranteed to negate root activity beneath foundations.

Therefore, if the trees remain (even in a heavily pruned state) roots beneath foundations will remain active and seasonal subsidence damage is likely to continue to the damaged part of the property (and possibly more extensively in future).

Once subsidence damage has occurred pruning is not a consistently reliable means of mitigation.

On page 98 of the BRE publication "Has your house got cracks?" Second Edition Freeman, Driscoll & Littlejohn 2002 it states "Removing the tree altogether will have the greatest and most immediate effect on the levels of desiccation in the soil."

Also, from page 98 "In most cases there is no advantage in a staged reduction in the size of the tree and the tree should be completely removed at the earliest opportunity.

If the subject trees are not removed, then damage will almost certainly continue and worsen. Tree roots from these trees have almost certainly encroached beneath foundations and caused seasonal soil drying that has led to the damage.

Root barrier option - Root pruning as a form of mitigation is inherently unreliable as the level of excavation required could include many cubic meters of soil to be guaranteed to have removed all roots causing a nuisance, to effect such a remedy might materially make the tree unsafe or so biologically damaged as to destroy the amenity being the subject of the attempted remedy. Also, new roots will immediately seek to colonise the soil subject to the root cutting and the nuisance will recur. Due to the juxtaposition of the subject trees in relation to the damage, a root barrier would be possible to instal but it would need to be extensive and would have significant costs associated with its installation.

Underpinning – if the tree remains then the only appropriate solution would be underpinning to stabilise foundations, the cost of which is currently estimated at £120,000

Tree removal – The removal of any trees that are causal or contributory will allow the soil beneath foundations to rehydrate and to recover its original moisture content. Once trees are removed the activity of roots is negated and foundations will stabilize and repairs can be undertaken. If appropriate tree removal is not undertaken then the damage is likely to continue and worsen. Drains - There are apparent issues in relation to drains, but soil softening/washing by an escape of water is not considered to be a factor in the damage.

Heave Potential – The subject trees do not significantly pre-date the construction of the house or conservatory (they appear to post-date the house but not the conservatory) and we consider that there would be no risk of adverse soil heave occurring after the trees are removed.

RECOMMENDATIONS

T1 Oak – Fell to ground level
T3 Horse Chestnut – Fell to ground level
T6 Lime – Fell to ground level
TG1 Prunus – Fell to ground level
(Subject to consent being granted under the TPO)

Statutory Controls – The trees T1, T3 & T6 are covered by a Tree Preservation Order administered by the London Borough of Hillingdon, therefore an application is required and consent needs to be granted prior to any tree works occurring.

The trees T6 & TG1 are located within the risk address and trees , T1 & T3 are located within 21 Frithwood Avenue HA6 3LY.

RESERVES

2019 Reserves–
Superstructure repairs and decorations - £15,000

Underpinning & Repairs - £75,000

2023 Reserves

Superstructure repairs and decorations - £25,000

Underpinning & Repairs - £120,000

Yours faithfully

Chris Davies **Dip.Arb.(RFS), F.Arbor.A**

Arboricultural Consultant - Subsidence Team
Crawford & Company

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