Arboricultural Consultancy for Aviva

Note(1): This report is intended for use between the client, Environmental Services and any parties detailed within the report. It is based on the understanding at the time of visiting the property that Engineers are satisfied that damage is attributable to clay shrinkage subsidence exacerbated by vegetation.

1. Case Details

Insured	Haverstock Hill Limited	**Address**	96 Haverstock Hill, London, NW3 2BD		
Client	Subsidence Management Services	**Contact**	Emily Bogie	**Claim No.**	IFS-AVI-SUB-14-0052426
ES Ref	NL/0110140922/TP-REV2	**Consultant**	Andrew Cayley Bsc (Hons) Arb, M.Arbor.A	**Contact No.**	0330 380 1036
Report Date	02/10/2015 **Revised:** 16/10/2015 & 08/06/2016				

Scope of Report: To survey the property and determine significant vegetation contributing to subsidence damage, make recommendation for remedial action and assess initial mitigation and recovery prospects. The survey does not make an assessment for decay or hazard evaluation.

Please note: *REV2 is a revision of our previously revised report following a site meeting between all parties involved in the ongoing subsidence claim; it was agreed that the following report will attempt to address all the concerns raised by the Local Authority at the time of our meeting.*

2. Property and Damage Description

The insured structure is a 4 storey semi-detached house. The property occupies a level site with no adverse topographical features.

Damage relates to the right-hand flank of the insured dwelling (internally). Please refer to the engineers report(s) for a full description of the claim history and damage.

3. Technical Reports (Revised)

In preparing our revised report we have had the benefit of the following technical investigations:

Foundation Detail / Borehole Log	☒	Soil Analysis	☒	Root Analysis	☒
Drain Report	☒	Level Monitoring	☒	Engineers initial / addendum report	☒

4. Action Plan

Mitigation	
Insured Involved?	Yes
Local Authority involved?	No
Other third party Mitigation involved?	Yes
Recovery	
Is there a potential recovery action?	Yes

Tree Works	
Local Authority	Camden London Borough
TPO / Conservation Area / Planning Protection Searches	Insured: TPO Adjacent & Adjoining properties: TPO

Additional Comments

Awaiting Further Instructions.

A potential recovery action has been identified.

5. Technical Synopsis (Revised)

This report is based upon our understanding at the time of visiting the property that Subsidence Management Services' engineers are satisfied that damage is due to clay shrinkage subsidence exacerbated by vegetation.

We are aware that the insured property has been subject to previous episodes of movement/damaged investigated by independent engineers and each time confirmed to be the result of clay shrinkage subsidence exacerbated by the influence of vegetation.

An application to fell the Elm (T1 of this report) and a Sycamore (at No. 94) was submitted to London Borough of Camden by OCA (UK) Ltd on the 11th July 2007 (OCA REF: 36550/2452270/Hill).

The conclusion reached, following independent investigations undertaken by Cunningham Lindsay / OCA (UK) LTD to support the above TPO application were as follows:

'*It is the view of Chartered Engineers appointed to investigate damage that the insured property has suffered differential movement and subsequent damage consistent with vegetation related clay shrinkage subsidence'*.

The above claim was resolved by Shire Stabiliser Installation (certificate of structural adequacy being issued 24th July 2009), however tree removal works were not progressed and subsequently damage returned in 2011.

The 2011 application concerned two Sycamores at 94 Haverstock Hill (reference: 2011/1491/T); permission was given for the removal of one tree only (this work being undertaken).

Movement / damage returned in 2014 and we were instructed to advise on the causal vegetation and to deliver management proposals which will provide on-going and long term stability, thereby allowing repairs to be undertaken.

Site investigations were undertaken in both 2014 (Drain survey and the excavation of x2 TP/BH's) and a further limited investigation in 2015 (x1 BH and further drain survey).

The results of the above site investigations confirm the following.

Site Investigations (undertaken in 2014) indicate that the foundations to the front of the property extend to a depth of 500mm below ground level in TP/BH1 and 1200mm in TP/BH2.

Foundations bear onto subsoil described within the borehole log as containing clay, thereby indicating the potential for the observed damage to be the result of clay shrinkage subsidence exacerbated by the influence of vegetation.

The above view is echoed by previous investigations.

NHBC 4.2 (2010) classifies these soils as being of medium - high plasticity i.e. capable of significant volumetric change potential in response to moisture content.

Site investigations have been undertaken by accredited independent soil testing laboratories in accordance with BS5930:1999 "Code of Practice for Site Investigations".

Desiccation of the underlying clay strata (in November 2014) is demonstrated by an abnormal soil moisture content profile (BRE 412).

Atterberg testing for soils recovered in both TP/BH1 and TP/BH2 (SubsNet ref: C18151G7214) show the soil moisture content to be below to plastic limit for the full depth of testing 500mm – 1800mm) below ground level.

Moisture content comparison with plastic limit is a reliable indicator of desiccation, whilst moisture depletion at the depths identified are beyond that to which ambient soil drying can be influential and thereby indicate a vegetative influence in the movement / damage.

Soil suction testing (within TP/BH1 and TP/BH2) 2014 indicates the presence of Very Severe, desiccation in accordance with BRE digest 412 from 500mm to 1800mm below ground level.

BRE Digest 412; Desiccation in Clay Soils states that '*soil sample suctions, since they will reflect any changes in in-situ pore water pressures due to desiccation, provide the most fundamental indicator of desiccation of all of the techniques'*.

Further site investigations (BH3) undertaken in March 2015 (SubsNet Ref: C18151G9987) confirmed similar soil conditions as found in TP/BH1 and TP/BH2 i.e a medium – high shrinkable clay substrate.

Desiccation / on-set desiccation of the underlying clay strata (in March 2015 is demonstrated by an abnormal soil moisture content profile (BRE 412).

Atterberg testing for soils recovered in BH3 show the soil moisture content to be at/close (within 3% max) of plastic limit for the full depth of testing 1200mm – 3200mm) below ground level.

Soil suction testing (within BH3) indicates the presence of Moderate - Severe, desiccation in accordance with BRE digest 412 from 1200mm to 3700mm below ground level.

The time of testing (winter 2015) is likely to explain the reduced soil desiccation noted when compared to TP/BH1 & TP/BH2; April being the point in the season where soil rehydration reaches its peak; winter rainfall has likely masked any previous evidence of severe desiccation.

A survey of the drainage system at the property has been undertaken (in both 2014 and 2016) and some minor defects noted; however, Engineers have confirmed that they do not consider damaged or leaking drains to be a material cause of the current subsidence damage and soils analysis confirms this position.

Atterberg / Suction tests (2014 and 2015) demonstrate that the load bearing capacity of the soil has not been compromised by excessive water content due to leaking drains and is therefore capable of bearing the imposed load.

It should be noted that runs G and H (which lie under the main property (bathroom/lounge/kitchen) are free from defects; as such, the evidence available does not support the possibility that damage is a result of damaged or leaking drains.

In addition, level monitoring has confirmed soil recovery over the winter period; soil recovery serves to confirm that defective drainage is not a material cause of the subsidence.

In the opinion of expert engineers, defective drainage can be eliminated as a material factor in this instance; vegetation is therefore deemed to retain the capacity to be causal to the current movement / damage.

Site Investigations (2014) revealed the presence of functionally active *Ulmus* roots in TP/BH1 to a depth of 1500mm and 1900mm in TP/BH2; this depth is in excess of foundations which extend to a depth of 500mm in TP/BH1 and 1200mm in TP/BH2.

Functionally active *Acer spp* and *Ulmus spp* roots were also recovered in BH3 (2015) down to a depth of 3000mm below ground level.

Our survey of the site identified T2 (Acer) and T3 (Elm), which, given their position relative to the damage it is our opinion that the roots identified emanate from these trees.

Sample trial pits are generally small in size and the recovery of roots from such a small excavation leads us to conclude that these will not be isolated examples; there is significant potential for further root proliferation below the insured structure.

Whilst there is no positive root identification to implicate T5 (Pear), based on our assessment on site we consider that the footings of the subject property will also fall within the anticipated rooting zone of this tree.

Please note that T5 was removed at the time of our site visit and therefore no longer forms part of the ongoing claim.

The role of vegetation is further supported by the results of level monitoring which has been undertaken since October 2014 with readings available through to February 2016.

Where vegetation is involved it produces a characteristic 'seasonal' pattern of foundation movement (subsidence through the summer, recovery through the winter); no other cause produces a similar pattern.

If it is occurring soil drying by vegetation must be involved, unless the foundations are less than 300mm in depth, which in this case they are not.

The results of this monitoring have confirmed soil recovery over the winter period; soil recovery serves to confirm that defective drainage is not a material cause of the subsidence.

The pattern of movement exhibited in this instance is clear and consistent with the known influence of vegetation; the peak amplitude of movement would appear to relate to stations 3, 4 and 9.

The above pattern of movement is not associated with any other cause of movement and serves to discount both defective drains and the assertions made by the Local Authority regarding underground streams softening the supporting subsoil.

If defective drains and excessive water content due to underground streams can be discounted (as the above site investigation confirm) then that only leaves one other likely cause of the movement, vegetation (and in particular trees).

Given the above, vegetation is clearly judged to retain the capacity to be causal to the current movement/damage.

In assessing the extent of damage and the potential drying influence of the vegetation on site, T3 (Elm) is judged to be the dominant feature and accordingly we have identified it as the principal cause of the subsidence.

T2 (Acer) and cannot be discounted as contributing to the overall level of soil drying proximate to the area of damage and is therefore also considered to retain a contributory influence, albeit in a limited / secondary capacity when compared to and T3 (Elm).

The relative roles of the two trees is based on number of roots found and the extent of desiccation noted.

Is vegetation likely to be a contributory factor in the current damage?	Yes
Is vegetation management likely to contribute to the future stability of the property?	Yes
Is replacement planting considered appropriate?	See Above
Would DNA profiling be of assistance in this case?	No

6.0 Recommendations (Revised)

6.1 Table 1 - Current Claim Requirements

These recommendations may be subject to review following additional site investigations

Tree No.	Species	Age Cat	Approx. Height (m)	Distance to Building (m)	Ownership	Action	Requirement
T2	Acer	1	17	8	F - Commercial Third Party	Remove	Remove and treat stump to inhibit regrowth.
T3	Elm	1	15	10.5 (to front elevation; 5.5m to front steps)	C - Insured	Remove	Remove and treat stump to inhibit regrowth.
T5	Pear	1	9	1	F - Commercial Third Party	Remove	Removed by time of site visit (03/06/2016)
Age Cat: 1 = Younger than property; 2 = Similar age to the property; 3 = Significantly older than property							

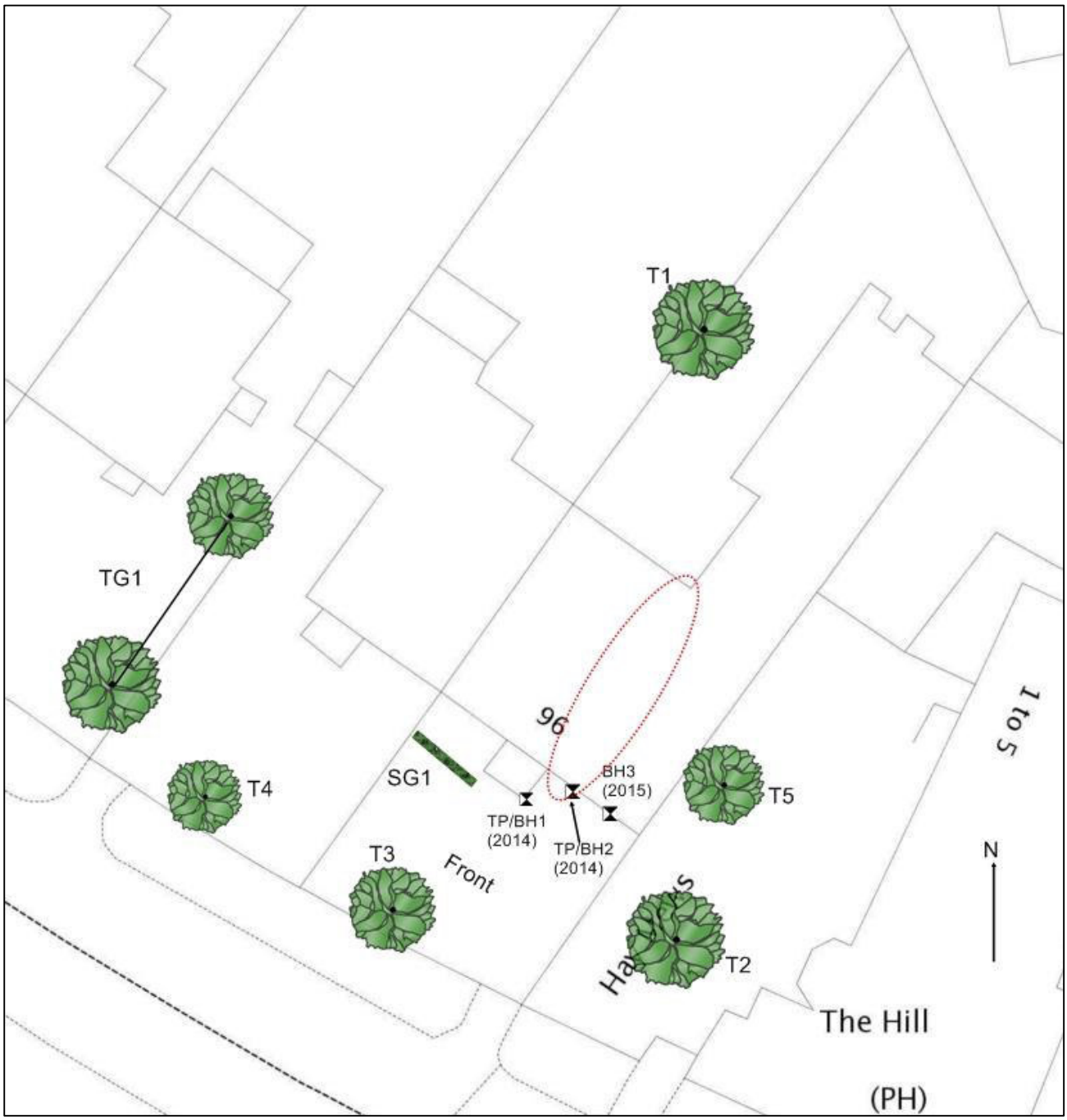
6.2 Table 2 - Future Risk Recommendations

Tree No.	Species	Age Cat	Approx. Height (m)	Distance to Building (m)	Ownership	Action	Requirement
SG1	Mixed species group including Cordyline and Fern.	1	1	1	C - Insured	Action to avoid future risk	Do not allow to exceed current dimensions by way of regular pruning.
T1	Lime	1	16	10	A - Third Party 98 Haverstock Hill London NW3 2BD	Action to avoid future risk	Crown reduce by 3m - 4m all abound and maintain at reduced dimensions by way of regular re-pruning (3-years max).
T4	Lime	1	11.5	16	A - Third Party 98 Haverstock Hill London NW3 2BD	Action to avoid future risk	Do not allow to exceed current dimensions by way of regular pruning.
TG1	Mixed species group	1	17	15	A - Third Party 100 Haverstock Hill London NW3 2BD	Action to avoid future risk	Reduce Beech to 14m in height and maintain at reduced dimensions. Do not allow Lime to exceed 12m max height current dimensions by way of regular pruning.
Age Cat: 1 = Younger than property; 2 = Similar age to the property; 3 = Significantly older than property							

* Estimated

Third party property addresses should be treated as indicative only, should precise detail be required then Environmental Services can undertake Land Registry Searches

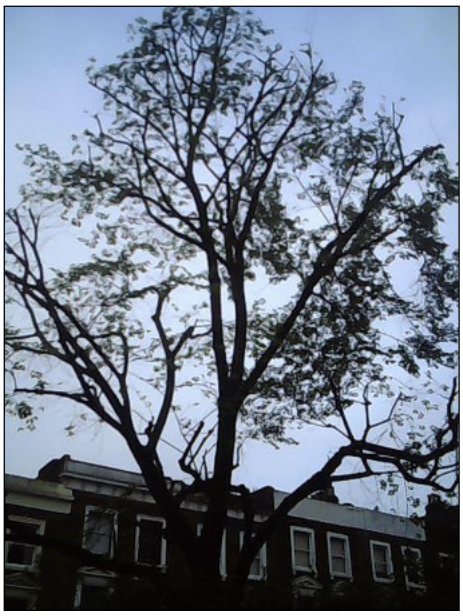
7. Site Plan (Revised)



Please note that this plan is not to scale. OS Licence No. 100043218

8. Photographs

T2 - Acer



T3 - Elm

T4 - Lime

SG1 - Mixed species group

T5 - Pear

9. Tree Works Reserve - Does not include recommendations for future risk.

Insured Property Tree Works	£1130
Third Party Tree Works	£2250
Provisional Sum	£0

- The above prices are based on works being performed as separate operations.
- The above is a reserve estimate only.
- Ownerships are assumed to be correct and as per Section 6.
- A fixed charge is made for Tree Preservation Order/Conservation Area searches unless charged by the Local Authority in which case it is cost plus 25%.
- Should treeworks be prevented due to statutory protection then we will automatically proceed to seek consent for the works and Appeal to the Secretary of State if appropriate.
- All prices will be subject to V.A.T., which will be charged at the rate applying when the invoice is raised.
- Trees are removed as near as possible to ground level, stump and associated roots are not removed or included in the price.
- Where chemical application is made to stumps it cannot always be guaranteed that this will prevent future re-growth. Should this occur we would be pleased to provide advice to the insured on the best course of action available to them at that time. Where there is a risk to other trees of the same species due to root fusion, chemical control may not be appropriate.

10. Limitations

This report is an appraisal of vegetation influence on the property and is made on the understanding that that engineers suspect or have confirmed that vegetation is contributing to clay shrinkage subsidence, which is impacting upon the building. Recommendations for remedial tree works and future management are made to meet the primary objective of assisting in the restoration of stability to the property. In achieving this, it should be appreciated that recommendations may in some cases be contrary to best Arboricultural practice for tree pruning/management and is a necessary compromise between competing objectives.

Following tree surgery we recommended that the building be monitored to establish the effectiveness of the works in restoring stability.

The influence of trees on soils and building is dynamic and vegetation in close proximity to vulnerable structure should be inspected annually.

The statutory tree protection status as notified by the Local Authority was correct at the time of reporting. It should be noted however that this may be subject to change and we therefore advise that further checks with the Local Authority MUST be carried out prior to implementation of any tree works. Failure to do so can result in fines in excess of £20,000.

Our flagging of a possible recovery action is based on a broad approach that assume all third parties with vegetation contributing to the current claim have the potential for a recovery action (including domestic third parties). This way opportunities do not “fall through the net”; it is understood that domestic third parties with no prior knowledge may be difficult to recover against but that decision will be fully determined by the client.

A legal Duty of Care requires that all works specified in this report should be performed by qualified, arboricultural contractors who have been competency tested to determine their suitability for such works in line with Health & Safety Executive Guidelines. Additionally all works should be carried out according to British Standard 3998:2010 *"Tree Work. Recommendations".*

Considering engineers conclusions, results of site investigations and our observations on site, vegetation management is considered appropriate with a view to restoring stability.

Please refer to Section 6 for management prescriptions.

In order to mitigate the current damage and allow soils beneath the property to recover to a position such that an effective engineering repair solution can be implemented we recommend a program of removals as listed by this report.

Whilst we have given consideration to pruning as a means of mitigating the vegetative influence of the above, this has been discounted.

Pruning is generally ineffective as the severity required to impact on the tree's water use often results in trees which no longer fulfil their visual amenity function.

Research (Hortlink 212 Project) has shown that any pruning must be extensive (well in excess of that advised within BS3998: Tree Works) and repeated every 2 years to have a sustained impact.

Whilst Certain species, can tolerate this approach (as is the case here) guarantees that the 2-year repeat pruning cycle will be adhered to cannot be provided, thereby rendering the long-term efficacy of this approach in doubt.

Given the above and in line with FSA Case study 59/10, and the terms of the insurance policy a long lasting remedy is required to stabilise the building and manage the influence of the trees are to remains, pruning is unlikely to offer the long-term solution required.

Removal of the above vegetation will therefore offer the most certain and reliable arboricultural solution likely to restore long-term stability.

The Local Authority consider the Elm (in particular) to have a high level of visual amenity within the streetscape and to make a positive contribution to the character of this part of the conservation area; this is not disputed.

However, in our opinion, the above tree is the principal cause of subsidence damage to 96 Haverstock Hill and this is affecting the residents ability to enjoy the full use of their property free from damage/distress.

This view is supported by the recovery of moisture deficient clay subsoil from below confirmed foundations depths (even after winter soil rehydration) and functionally active *Ulmus spp* roots being recovered from within TP/BH1, TP/BH2 and BH3.

T3 being the only likely source whilst Level Monitoring has demonstrated a clear 'seasonal' pattern of movement to the damage.

Given that foundations extend to a depth where the effects of seasonal climatic variations due to the weather cease to be of influence, it is our opinion that the movement demonstrated clearly confirm the role of vegetation, in this instance.

In our application form submitted on the 16th December 2015 it was clearly stated that 'Estimated costs of repair to the building are £11,205 if the proposed tree works are allowed to proceed and an additional £50,000 (not including relocation costs and professional fees to bring the case to the lands tribunal) if an engineered solution is required.

Granting permission will limit these costs; for the avoidance of doubt, in the event of a refusal our client will seek to secure compensation for the additional costs incurred through a section 202(E) claim.

It is the expert opinion of both the case engineer and arboriculturalist that on the balance of probabilities the supporting information clearly demonstrates the influence of the trees identified below.

The level of works required to impact of the trees water demands are such that the Local Authority are unlikely to sanction these works. With these predisposing factors, the retention of the above trees is considered unsuitable.

We consider the impact on the wider public amenity from the proposed tree works is mitigated by the presence of further trees within the immediate area and the scope for replacement planting.

Replacement planting of appropriate species could be carried out, the following trees being deemed suitable for this site / location: *Acer ginnala, Acer griseum, Catalpa bignonioides* 'Aurea' or *Gleditsia triacanthos* 'Ruby Lace'.

It is our view that, in this case, the benefits of removing T2 and T3 outweigh any harm to the amenity of the area. Other than felling the trees, underpinning does offer a solution to the damage, but at a significant additional financial cost; a root barrier is not feasible.

We respectfully request that the Local Authority grants consent for the works detailed below.