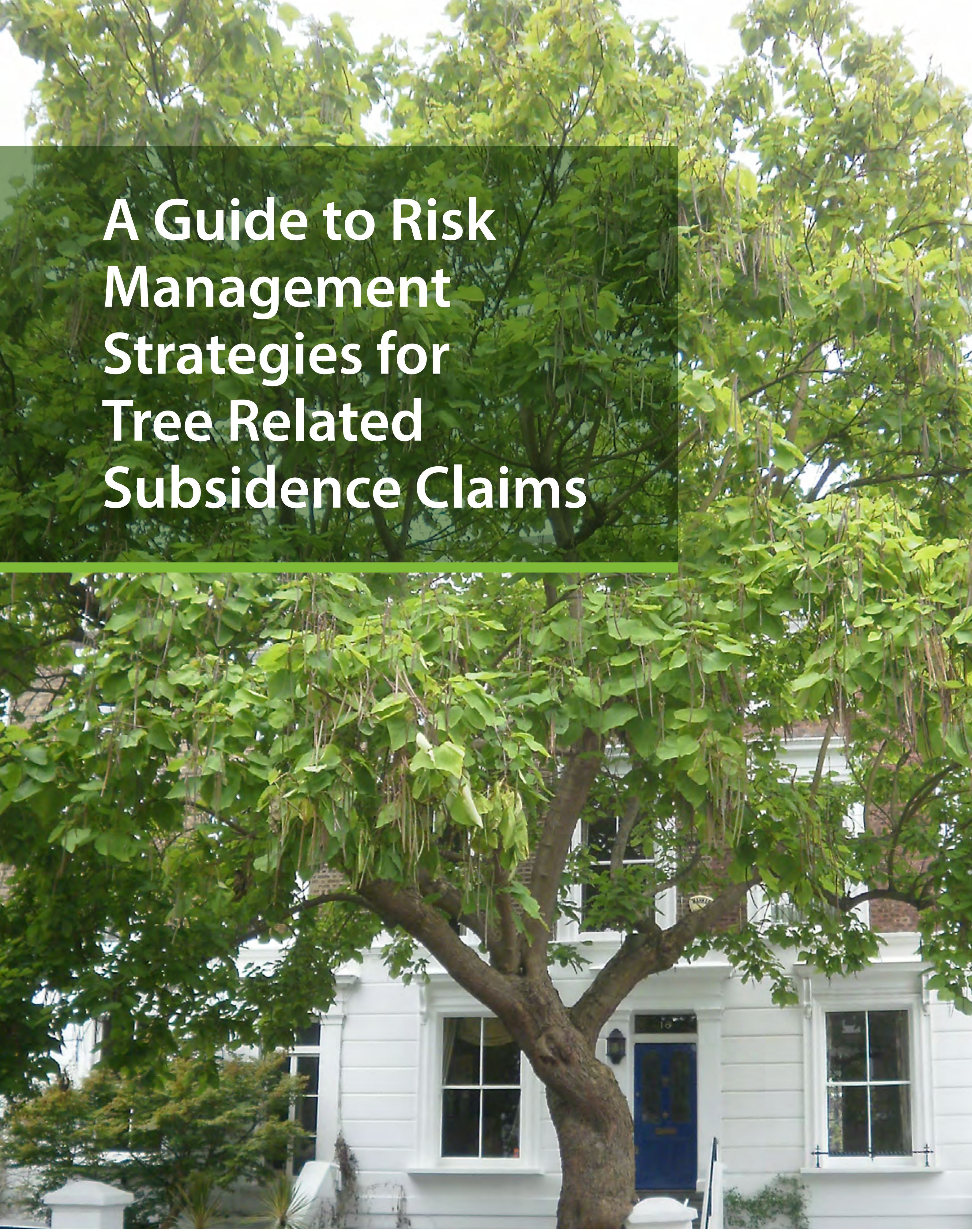
A Guide to Risk Management Strategies for Tree Related Subsidence Claims



4th edition, Revised November 2024

London Tree Officers Association

Risk Management Strategy

1 Introduction

Purpose and Background

The main purpose of this document is to provide up-to-date guidance to reduce incidences of tree related subsidence to properties and reduce the financial risk to local authorities whilst retaining trees where their removal is not justified.

This document is based on the premise that trees have an intrinsic value and they play an essential role providing numerous benefits to society in our towns and cities. The London Tree Officers Association (LTOA) recognises that trees can cause subsidence damage to properties and that this can affect householder's quality of life. A balance needs to be struck between the many benefits that trees provide and the risk of trees causing damage to buildings.

The LTOA produced its first Risk Management Strategy for Tree Root Claims in 1992. The first edition was a collaborative effort between a broad partnership of the affected sectors. Tree Officers from various London boroughs involved in its drafting received advice and guidance from the insurance and loss adjusting sectors. It was produced in response to the demand from Tree Officers and Insurers alike to have some frame of reference to deal with an increasingly contentious issue.

Over time our understanding of the issue and judgements in court cases have clarified legal positions. In response to these changes a second edition was produced in 1995 and a third in 2008.

Since the third edition was published there have been several relevant court cases, as set out in *Appendix B – Case Law*. This edition is informed by the experience of local authorities already following the principles detailed in former versions of this Strategy and responds to the outcomes of particular cases, notably Berent v Family Mosaic Housing & London Borough of Islington, Robbins v London Borough of Bexley and Pattichis v London Borough of Enfield.

These cases and their judgments have led the LTOA to conclude there was a need for local authorities to improve their management policies and processes in the context of dealing with tree related subsidence claims.

Focus and Aim

The focus of the latest edition is advice and guidance on:

- **Changes in the legal position due to cases that have come before the courts since the last revision.**
- **Assessment of historical claims to establish the risk of tree related subsidence occurring within geographical areas.**
- **Devising targeted maintenance regimes to make the best use of resources and create a logical and defensible approach to limiting the risk of tree related subsidence damage.**

Trees can cause subsidence damage, but there are many other causes of building damage and it is therefore important for the insured, insurer and tree owner that the cause of damage is correctly identified in order to limit claims, reduce inconvenience to insured parties, carry out correct building repairs and prevent unnecessary tree pruning or removal.

It is not uncommon for trees to be wrongly implicated in building damage when the cause of damage is due to other factors. Improvements have been made in recent years and the Joint Mitigation Protocol (JMP) has led to improved standards of evidence, clarity in the range of investigations and a more efficient claims handling process. The LTOA further asserts that the issue is also one of dedicating sufficient resources to maintain and manage trees so that they may continue to be an essential part of everyday life in the future.

The principal aim of this Strategy is to lessen the number of tree root claims to local authorities and reduce the numbers of trees removed unnecessarily. This document deals primarily with London, however the benefits to be derived from the strategy can be applied across the country where shrinkable clay soils are present. The cost reductions from applying this strategy are of value to both local authorities and insurers but must not be at the expense of losing trees which are essential infrastructure and are critical for future resilience to climate change. From the point of view of the homeowner and property insurer, there are major advantages to acknowledging this strategy such as correctly identifying the reason why a property is damaged and specifying appropriate repair.

The Risk Management Strategy's effectiveness in assisting local authorities in dealing with claims has been proven by its wide dissemination and acceptance as authoritative advice, including by the judiciary. It is hoped that this 4th edition will in the future continue to be a key reference document for local authorities in how they manage their tree resource.

This should especially be the case if this document is referenced in Tree and Woodland Strategies and Policies. Referencing the document in this way will inform and justify the local authority's arguments in any subsequent defence of claims.

History of Tree-Related Subsidence Claims

Building movement due to the shrinkage of clay soils is not a new phenomenon. London has experienced the movement of its building stock for many years. It has continued since the construction of the first brick buildings that characterised the wholesale expansion of London as a capital city during the Victorian and Edwardian eras.

Prior to the early 1970's subsidence was not an insured risk on many policies, and the presence of minor cracking in a property in the London area did not usually affect the value of the property or the ability of the owner to sell it.

Those situations that did require more extensive works were dealt with but represented only a very small proportion of the entire building stock in the London area.

A significant driver to changing this situation was mortgage lenders requiring that subsidence become an insured risk on the policies of the increasing number of new homeowners in the 1970s. Subsequently, during the drought of 1976, a large number of claims were made and insurers found themselves dealing with increased numbers of claims that were essentially without precedent and related to mainly minor cosmetic defects that did not affect the structural integrity of the building.

Many of these claims were made on properties that were recently built using modern, but brittle, building materials that did not have the same level of flexibility associated with older buildings constructed using lime mortar. This led to a dramatic increase in the numbers of insurance claims that previously would not have been made and would not have disadvantaged the property owner by affecting the value of the property or their ability to sell it.

Other reasons for an increase in tree related subsidence claims include:

- The age of a significant proportion of urban dwellings – much of inner/middle London's housing stock date from 1900 or even earlier and much suburban stock from the 1920s and 1930s.
- Increased loading on soils from building alterations and extensions often associated with change of use primarily from single family homes to multi-residential.
- Extensions/additions to properties with different foundation depths to the existing structure.
- Permitted Development carried out without the need for Building Control approval.
- Periods of below average rainfall.
- Trees growing in close proximity to buildings.
- Lack of flexibility in the modern cement mortar post 1930s.
- The significant increase in the value of property in recent years.
- Inaccurate media articles resulting in a disproportionate concern of subsidence occurring.
- Covering gardens with impermeable surfaces, effectively capping previously permeable areas.
- Poor previous underpinning.
- Underpinning parts of a building or an adjacent property creating differential movement within a single structure or between two connected structures.

The Property Owner's Perspective

For a homeowner, experiencing subsidence to their property can be an extremely worrying situation. Both the insurer and the local authority should consider the financial and emotional impact that subsidence damage can have on a property owner if is not resolved.

Home ownership has for some time represented not just a building in which to live but also as possibly the single most significant financial investment most people make in their lives. Understandably, there is an expectation from homeowners that their properties remain in good order.

Subsidence claims can take many months and sometimes years to resolve. There may be long periods of uncertainty for residents while necessary investigations are undertaken. Concerns arise that property will be devalued, insurance premiums will increase and disruption will occur during repair, resulting in a difficult process for the homeowner.

In 2007 the LTOA working with the insurance and loss adjusting sectors produced a standard procedure, the Joint Mitigation Protocol (JMP) that sought to address these issues. It set a framework of timescales and evidence that both sides could agree to as the basis for more efficient and quicker claims resolution. The second edition of JMP has recently been revised to take account of current advice and recent technical advances so that it remains compatible with the advice in this Risk Management Strategy using the same evidential criteria as prescribed on the Planning Portal for trees covered by Tree Preservation Orders.

2 Producing a Risk Management Strategy

In order to produce a strategy to manage the risk of tree root related subsidence, the following steps should be considered:

- Consider Available Resources
- Identify Subsidence Risk Areas (SRAs)
- Controlling the Risk
- Maintain Records

It should be noted, an authority may decide not to create a Risk Management Strategy due to factors such as:

- Little or no history of subsidence claims.
- Absence or limited areas of shrinkable clay soils.
- Insufficient resources to work on a low-level internal agreement as suggested in Appendix A.

Consider Available Resources

- Development of a risk management strategy is dependent on the resources available, in particular allocation of adequate time to follow the recommendations fully. Resource levels within local authorities (LA's) vary considerably and in some cases have been reduced or removed altogether. This guidance attempts to be sufficiently flexible to encompass various resource levels.
- For LA's with low levels of resources, a document should be developed outlining an internally agreed approach, formally adopted at an appropriate level.
- For LA's with adequate resources, a document should detail the approach that will be taken to manage trees in identified areas of risk, and for all future tree root claims the LA receives for alleged subsidence.
- The document should be able to demonstrate to a court that a local authority has:
    - Considered the risk of tree root claims to the authority.
    - Considered the risk to residents' properties.
    - Considered the current approach to risk management.
    - Detailed the approach the authority will adopt to reduce the risk of subsidence.
    - Considered the resource level (financial, officer and contractors) available to the authority.

Identify Subsidence Risk Areas

Definition of Subsidence Risk Area (SRA)

A Subsidence Risk Area (SRA) is a geographical area which has been identified with shrinkable soil and a history of proven subsidence cases implicating trees. This data can be taken from the British Geological Society's survey Geology viewer. The boundaries of the SRA can be refined by reviewing insurance claims history for subsidence damage and identifying the locations where there is a history of proven tree root subsidence claims.

Guidance on Identifying SRAs

- How SRAs are identified will vary from council to council with individual local authorities approaching this in different ways due to the amount and quality of information available. It is important that local authorities document the method used to identify a SRA.
- The basic information required to identify an SRA is the location of shrinkable soil types within the local authority via the British Geological Society's website.
- Plotting the location of previous tree related subsidence claims will further refine the SRA. This information should be available from the local authority's insurers. Data should be gathered on claims going back as far as possible.
- It is for each local authority to determine what is considered to be a proven claim, but this is usually a claim settled where a payment is made to the claimant for subsidence damage.
- It is important to differentiate between building damage claims caused by clay shrinkage and direct damage claims to lightweight structures such as garden walls and driveways. Failure to differentiate between these types of claims will lead to inaccurate mapping of SRAs.
- SRAs should clearly identify the locations of proven insurance claims and further information should be added such as value of claims, tree details and management programmes.

Review Claims Based on Past Records

To provide local authorities with a defensible position, a method of considering the risk within an area should be adopted and documented. Management approaches can then be detailed for each SRA identified within a local authority's geographical area. This approach is based on reviewing historic claims and identifying SRAs.

The following is guidance. It is understood that not all LA's have the data available to undertake a full review as detailed below and that approaches will need to be considered depending on the data and resources available.

Prioritising Tree Management in Subsidence Risk Areas

It will be necessary to prioritise management approaches in SRAs for example:

- Value of claims within an SRA.
- Number of claims in an SRA.
- Available budget.
- Repeat claims for an individual property or a number of properties in the immediate proximity.
- Size of trees.
- Species of trees.
- Proximity to buildings.
- Existing management regimes such as pollarding.

Controlling the Risk

The number and value of claims paid within an SRA will focus resources to carry out appropriate tree management in these areas.

- The LTOA considers crown reduction programmes on a cyclical basis as the most effective method of controlling the numbers of claims in SRAs. This reinforces the advice given in the Institution of Structural Engineer's Subsidence (2023) publication (8.1.3) and the previous editions of the LTOA's Risk Management Strategy.
- The adoption of a cycle of crown reduction has led directly to a reduction in subsidence claims and provided local authorities with a defensible position, saving many thousands of trees from unwarranted removal and securing the benefits they provide for future generations.
- Where a cyclical pruning programme of either pollarding or crown reduction has been implemented it must be carried out at regular intervals.
- Where root action has been proven to have caused damage, tree removal may be the most appropriate action.
- Where a tree is in poor condition, removal on a 'without prejudice' basis may be appropriate. The reason for this removal should be recorded by the local authority and communicated to the claimant.
- If tree removal takes place and replacement in the same location is desirable, the selection of appropriate trees species in relation to buildings must be considered.

Engineering options as an alternative to cyclical crown reduction or tree removal may be appropriate in some circumstances but will need careful assessment on a case by case basis. More research into engineering options, such as root barriers and ground injections, are required to explore these possibilities without the need for tree removal.

Considerations

The outcome of this work is to identify which trees need strict control and to differentiate these from the rest of the tree stock.

- It would be a reasonable approach to subject a road containing trees of a similar age, size, species and building type to a uniformed management regime.
- Conversely a road of mixed species that may be of a mixed age range with different types of buildings at different distances from trees may have a mixed management approach.

Reviewing SRAs

- SRAs should be reviewed periodically, taking into account local changes including any cyclical pruning regimes, tree removal, changes in planting programmes, changes in climate, new claims or new development with sufficient building foundations.

Maintaining Records

Data Recording

Using a database to record tree management and claims history in SRA's is vital. The database should allow records to be categorised by management regime to allow these to be extracted from the database and analysed when necessary.

Environmental Information Regulations Requests

Information relating to subsidence is likely to fall under the definition of 'environmental information' in the Environmental Information Regulations (EIR) and requests for the public disclosure of this information will accordingly be considered under the EIR rather than the Freedom of Information Act. Under the EIR, the release of an internal communication which would harm the public interest would generally be considered an exception to the requirement to release information and form the basis upon which an EIR request can be refused. For example, claims companies seeking to generate new business may ask for information about Subsidence Risk Areas (SRAs) identified by local authorities and potentially increase the number of claims brought against local authorities. It is recommended that if such a database is created then it should have clearly stated (written confirmation) that this is for internal business use only and that the local authority concerned should protect data which it would not be in the public interest to release.

Appendix A

Managing Claims Internally and Preparing to Adopt This Strategy

1 What to do When a Claim is Received

Local authorities require claims to be supported by adequate technical information. Formal adoption of the JMP will assist these considerations.

- A practical approach to assessing a claim and acting in a timely and professional manner demonstrates a responsibility toward the property owner and should mean any damage suffered can be rectified with a minimum of cost and delay to the resident.
- By assessing the evidence carefully and questioning any inconsistencies, the local authority is demonstrating a professional responsibility to the wider community.
- It is important for local authorities to have clearly defined procedures for dealing with all types of claims, such as those recommended in the JMP, which give officers a framework to operate.
- If the local authority has not adopted the processes as laid out in the JMP, a point of contact in the Insurance Team needs to be established to handle claims and to keep track of resulting actions.
- The Tree Officer should be informed that a claim has been opened and that they need to assess the case relating to the tree(s) under their control. Any inconsistencies or omissions in the information submitted need to be noted and clarified. Engineering advice, if available, should be sought where appropriate.
- If the tree is in poor condition, such that it does not warrant retention regardless of the claim, the tree can be removed on a 'without prejudice' basis. This does not indicate the authority admits any liability to the claim but is acting in the interests of all concerned. If the claim ever reaches court, it is likely that timely action will be viewed favourably by the court and the reasonableness of the approach will be assessed.
- If tree pruning is the preferred course of action, consideration needs to be given whether this is one-off works or needs to take place on a regular basis to control water demand and crown growth of the tree. If it is to be cyclical in nature, the work needs to be scheduled, undertaken and recorded.

2 Timing of Tree Works

Any tree work identified as necessary in response to the claim, whether removal or pruning, needs to be arranged and carried out in a timely manner. There are issues that need to be considered when arranging works:

- If trees are transpiring then work should be carried out as soon as practicable.
- If trees are dormant then it may be reasonable to delay the works to later in the dormant period if the local authority is awaiting further information which may influence the extent of the works.
- Relevant legislation including Planning, Wildlife and Duty to Consult and the time that consultation will take before tree works can take place.
- Local authorities' internal practices and procedures such as consultation with local councillors and other interested parties.
- Where a decision is escalated up through the authority for sign off by senior management or Councillors.
- Make sure works are completed within agreed timescales.

3 Duty to Consult – Environment Act 2021

- The decision to retain or remove a tree involved with a subsidence case is difficult and involves financial, reputational and environmental risks to local authorities. The decision also impacts on the property owner whose asset may be being damaged.
- Under statutory Duty to Consult obligations, local authorities have to consult the public when they propose to remove a healthy tree regardless of reasons for this decision.
- When this involves a tree that has been implicated in a subsidence claim and when pruning is considered unlikely to be appropriate, reasoning will need to be publicised and systems developed to be able to communicate effectively.
- The duty to consult reinforces the need for claims to be supported by quality evidence to accompany requests for tree removal. Where evidence and strength of argument is lacking, it will be necessary to communicate this within the consultation.

4 Tree Valuation Systems

Increasingly tree valuation systems are being used to attribute value to trees that might otherwise be considered a cost incurring liability. This process of tree valuation has developed and continues to be refined and improved so trees are considered assets and not liabilities.

Valuation may be used as a very simple method of quantifying the importance of an individual tree or groups of trees in a claim. I-Tree Eco values tree populations for the ecosystem services they provide (e.g. carbon capture, flood alleviation, air quality). Capital Asset Value for Amenity Trees (CAVAT) can be used to value the amenity of individual trees and tree populations.

5 Making a Case for Budgets

Tree maintenance and staffing budgets need to be maintained at levels to ensure that trees are appropriately inspected and managed, as well as there being sufficient staff resources to investigate and process claims.

The cost of claims to many local authorities is far greater than the cost of the annual tree maintenance budget.

There is a strong argument for appropriate budgets to maintain trees to reduce the risk of future subsidence claims. Local authorities have demonstrated the total cost of claims can be reduced by the implementation of cyclical maintenance programmes, in some locations by up to 90%.

From a purely financial perspective, for many local authorities there is no stronger argument for providing sufficient budgets than adequately handling tree related subsidence claims and managing personal injury risk.

It is accepted that the recommendations as laid out in this document may not be able to be fully implemented due to budgetary restrictions.

It is recognised that even within the same authority there are likely to be variations in budget provision for different department's trees. For example, Highway trees may be well funded, but Housing tree budget may be limited. Differences in management approach should be documented.

It is recommended that once SRAs have been identified, the available budget is used to work on trees requiring regular crown reduction works identified in these SRAs. It is reasonable to consider the available budget as a constraint when defining maintenance programmes.

6 Financial Arrangements

It is important for tree managers to understand the internal financial agreements to make a clear business case for sufficient budgets. Often, different Council departments (Housing, Property Services, Parks, etc) pay tree maintenance costs out of existing maintenance budgets but may not be able to follow the recommendations in this strategy due to budgetary restrictions. Local authorities who adopt the principals of this strategy may only be able to partially implement the recommendations in different departments.

The cost for claims is often paid from a central budget controlled by insurance colleagues. It is not unusual for different directorates to not know what the financial impact on the council is from subsidence claims from the trees on land in their portfolio.

It may require investigation to establish the annual cost of subsidence for the council, and what proportion of that cost is applicable to each directorate to support any business case for sufficient budgets for tree management for different Council departments.

7 Political Support

Councils are political organisations and, at times of financial pressure, it is difficult to argue for increased budgets. An invest-to-save business case for financing tree maintenance to reduce the cost of claims from subsidence will have a longer return period than the life of the political cycle. Therefore, it is difficult to gain political support unless the politicians have a truly long-term view.

For the above reasons, a clear argument needs to be presented and the following approach can be considered:

- Clarify the cost of subsidence claims to the council and to the individual client departments.
- Identify the annual cost of claims and the projected tree maintenance and staff costs to adopt this strategy.
- Identify what investment is needed to ensure that trees are sufficiently maintained.
- Produce an Options Appraisal (e.g. less, same or more investment and effects on maintenance regimes).
- Develop projected effect on the cost of claims for the different options over a number of years.
- Use examples from other councils who have adopted the previous versions of this strategy to support and evidence the financial benefits of working in this manner.
- Develop the approach/report with the aid of finance, claims, risk and client officers.
- Present the report at director level with the intention of adopting this as policy and engage with other directorates to inform them of this and seek buy-in.

8 Understanding the Insurance Context Within the Authority

The approach to insurance and claims handling differs across local authorities. Tree managers should be aware of:

- Is the council self-insured or not?
- How are the cost of claims funded e.g. central fund that is paid into by departments who own trees?
- How this differs for TPO and public trees?
- Who handles the claims?
- Who is responsible for corporate risk management?
- Points of contact for other areas of expertise e.g. engineering, soils etc?
- What is the approach to tree management in other departments of authority, if applicable?

Appendix B
Law

1 Duties and Powers of Local Authorities

The duties and powers of local authorities in relation to trees and their provision are continuously changing. The most pertinent Acts of Parliament in relation to tree management in urban areas are:

- The Highways Act (1980)
- The Miscellaneous Provision's Act (1976)
- The Occupiers' Liabilities Act (1984)
- The Forestry Act (1967)
- The Wildlife and Countryside Act (1981)
- The Town and Country Planning Act (1990)
- The Compensation Act (2006)
- The Health and Safety at Work Act (1974)
- Freedom of Information Act (2000)
- The Environment Act (2021)

The Town and Country Planning Act (1990) places a duty upon local authorities to use their powers to ensure the protection and planting of trees in relation to development. The Natural Choice – Securing the Value of Nature was produced by the Government in 2012. This guidance is specifically aimed at Local Authorities to encourage them to value green infrastructure in the context of the ecosystem services provided.

The most recent duty imposed on local authorities with respect to trees is Section 115 of The Environment Act (2021). This places a duty on local authorities in England to consult local residents and interest groups before felling healthy street trees. This has implications for dealing with street trees implicated in building damage claims and how the evidence proving such claims is presented and used by local authorities as part of these consultations.

2 Case law

The following is a list of court cases that are pertinent to subsidence.

The issues to be addressed in considering liability were set down in Solloway v Hampshire County Council (1981). The area on which the Claimant's property was founded was nearly entirely plateau gravel but there were small pockets of clay. The question was whether the highway authority should reasonably have foreseen that there might be pockets of clay under the house. Ultimately, the Court concluded that the damage was not foreseeable.

At the Court of Appeal, the following necessary requirements to be proven by a claimant to establish his case:

(1) Causation, i.e. roots from the defendant's tree caused the damage;

(2) Foreseeability – the defendant should have foreseen that the roots were likely to cause damage if nothing was done to prevent it;

(3) Failure to exercise reasonable care – the defendant could have reasonably taken steps to limit the growth of the tree and incursion of the tree roots and did not.

Causation

Eiles v London Borough of Southwark (2006)

The argument on causation was whether the damage had been caused by the local authority tree or by settlement of the extension to the rear. The Court found for the Claimant on causation for the following reasons:

- the position of the tree (zone of influence);
- the evidence of desiccation at the front of the claimant's property (soil analysis);
- the location and direction of the movement in the property (monitoring) and
- the fact that there was evidence that the amount of movement reduced when the council's tree had been reduced in size.

The decision was in a large part reliant on the fact that the crack width monitoring demonstrated a significant reduction in movement of the property when the implicated tree was reduced in size.

Loftus-Brigham v London Borough of Ealing (2003)

The local authority argued that the damage was either solely caused or partly caused by a Virginia creeper growing on the claimant's property. The Defendant's argument was rejected with the Court holding that the question to be answered is: "whether desiccation from the tree roots materially contributed to the damage". Accordingly, it is not a defence to a claim to point to other contributing causes if it is found by the court that the tree(s) under the control of a local authority is/are partially causative of the damage.

Hilda's Montessori Nursery Ltd v Tesco Stores Ltd (2006)

The evidence on causation was not conclusive. There were anomalies with the timing of damage, slight desiccation, and movement of the building. Nonetheless, in light of the position of the tree, the limited evidence of desiccation and the building being founded on shrinkable clay enabled the Court to conclude causation had been established. The case demonstrates that although the evidence on causation may not be conclusive, when considered in its entirety, the court may still conclude that causation to be established.

Foreseeability and Duty

In Kirk v London Borough of Brent (2005) the issue before the Court of Appeal was whether the order for Summary Judgment in favour of the Defendant should be set aside. Although the Court found that it should, Lloyd LJ gave interesting guidance on the approach to be taken to foreseeability issues.

> *'… you cannot say that simply because here is a mature plane tree, in London, or on London clay, whose height is greater than its distance from a neighbouring property, therefore you are on notice that there is a risk that the roots may have encroached upon the foundations of the neighbouring property and you are therefore liable in nuisance. That would be an argument that is far too wide and would, as the judge said, amount almost to strict liability.'*

The above decision makes clear that a tree within **influencing distance of a property founded on shrinkable clay does not necessarily result in damage being foreseeable. Each case will be decided on its own particular facts**. Simply by proving causation will not necessarily result in liability being established against a local authority.

Berent v London Borough of Islington and Family Mosaic Housing (2012)

It was alleged that damage to the risk address had been caused by trees. Some of the trees were on the neighbours land but also trees for which the council was responsible were implicated. At the first instance trial, the judge held that removal of the trees would have been the only reliable way of eliminating the risk that they might cause damage, but that removal of the trees based on general knowledge of risk would not be reasonable and did not amount to a breach of duty. On Appeal Tomlinson LJ held that:

> *'There are at least two points to make … first, Lord Reid uses the expression 'a real risk', which was the expression used by the judge in this case. Secondly, one cannot in this context separate the enquiry as to reasonable foreseeability of damage from the related enquiry what it is reasonable to do in the light of the reasonably foreseeable risk. It may be reasonable to take no steps to eliminate a risk which is unlikely to eventuate and which will be of small consequence if it does.'*

Further

> *'…a responsible local authority mindful of its obligation under Town and Country Planning Acts and the preservation of such amenities as an established treed environment **could not reasonably contemplate the desertification of such a neighbourhood by wholesale tree felling to avoid a possible risk of damage.** Such an approach it seems commended by the Claimant almost gives rise to strict liability.'*

As to what the council should or could have done to prevent the damage prior to notice being given, the court at first instance found that it was reasonable for those responsible for the trees to await a reasonable level of information before they could be expected to remove the trees. Although the local authority would have known of the possible risk of damage from its street trees, nevertheless, being mindful of the preservation of amenities, it could not reasonably contemplate removing trees so as to avoid a possible risk of damage to the claimant's property. It was not until the council had been presented with evidence that its trees had caused damage that the trees should have been removed or action taken.

In **Robbins v London Borough of Bexley (2012)** the trial judge held that the council's failure to adopt a 25% crown reduction every 3-4 years was a breach of duty. The council appealed on the grounds that such a regime would not have prevented the damage. The Court of Appeal found that what the trial judge meant was that there was a duty to take reasonable steps to avoid damage from occurring and doing nothing was a breach of duty. This was especially true given that **historically the trees had been implicated in damage to other properties and the local authority had not followed its own tree management policy**, therefore the damage was foreseeable.

Patiches v London Borough of Enfield (2016)

The local authority had its Norway Maple street trees on a 4 year pruning regime. The claimant argued that the trees should have been subject to biennial reductions of 70% - 90% of crown volume.

> ***"There is nothing in the evidence before me that leads me to conclude that the decision taken by the Defendant not to include Norway Maples within its 2-year programme or alternatively not to manage their Norway Maple stock by using aggressive biannual Hortlink style pruning techniques showed a failure to take reasonable care of the Claimants' property"***

This is a first instance decision which was not appealed. The case demonstrates that the Courts will not necessarily accept that there will be a breach of duty if trees within influencing distance from properties should be subject to biennial punting of 70% to 90% of crown volume.

Delaware Mansions Ltd v Westminster City Council (2001)

The question before the House of Lords was whether a subsequent owner of a property was entitled to claim for damage, which occurred prior to the transfer in title. The House of Lords held that:

- Desiccation of the subsoil by way of moisture extraction by tree roots is in and of itself damage.
- By virtue of the above, a claim is not extinguished by virtue of a change of ownership of the risk address.
- A local authority must be given adequate notice of the damage and the opportunity to avoid further damage.
- Once adequate notification and evidence on causation has been received by the local authority it is incumbent for it to abate the nuisance or alternatively become liable for the costs of stabilising the risk address.

Within his speech Lord Cooke said the following:

> *'If reasonableness between neighbours is the key to the solution of problems in this field,* ***it cannot be right to visit the authority or owner responsible for a tree with a large bill for underpinning without giving them notice of the damage and the opportunity of avoiding further damage*** *by removal of the tree. Should they elect to preserve the tree for environmental reasons, they may fairly be expected to bear the cost of underpinning or other reasonably necessary remedial works; and the party on whom the cost has fallen may recover it…'*

Appendix C

Engineering Evidence

1 Levels of Evidence

One of the most contentious issues in the submission and processing of alleged tree related subsidence cases is the level of evidence required for a reliable conclusion to be reached on whether a tree is implicated in building damage and, if so, to what extent. The time taken can also be an issue, particularly following dry summers when claim numbers and workloads are high. Monitoring, by its nature, also takes time, although conclusive results can be obtained rapidly if started early enough to show recovery during the first winter [and better still if a baseline horizontal distortion survey showing actual distortion at the time of claim or shortly afterwards is provided]. Notwithstanding this, it is important in the interests of fairness, particularly to the affected householders, that Councils respond promptly to any claims, especially where further information or clarifications are needed.

It is important to note that legally it is the claimant's duty to prove, on the balance of probabilities, that the implicated tree(s) is (are) the cause of the damage.

It is well-established, and made clear in The Joint Mitigation Protocol (JMP), that claims for subsidence damage relating to Council owned trees are to be accompanied by the same supporting evidence as that prescribed on the Planning Portal to accompany applications for work to protected trees. This has the benefit of all parties having a clear understanding of the investigations to be undertaken and those submitted.
Work To Trees (planningportal.co.uk)

Costs of compensation for building damage can be high, but the local authority has a duty to balance that against the possible loss of trees, which might be public assets of considerable value. Therefore, it is essential that the information submitted in support of tree related subsidence damage is accurate and complete.

For the reasons above, tree officers and their authorities should require appropriate evidence to support any claim that a tree is the material cause of building damage, and that other possible factors have been considered and eliminated. This follows the guidance set out in the Institution of Structural Engineers' document Subsidence (2023) and the BRE Good Repair Guide 2, which recommend other possible causes of movement are eliminated before any assumptions are made about a tree's involvement and what course of action to take.

The notes contained in this appendix are intended to be a guide to the available tests, not a comprehensive manual. Buildings can move for numerous reasons and the investigative tests can cover a range of specialised areas, so tree officers are encouraged to seek advice from other specialists if necessary or appropriate.

2 Gathering Technical Evidence

The various steps required to identify a tree as being the cause or not, of subsidence damage are illustrated in the flowchart below. As can be seen from this chart, the technical evidence required to arrive at a confident conclusion can be broken down into eleven key questions. Arguably, it is not essential for the investigators to answer all eleven, and some are more important than others, in particular, without monitoring showing seasonal movement of a scale capable of causing damage Q10, the evidence implicating the tree will be largely circumstantial and inconclusive.

The technical evidence will generally come in a series of reports which are identified on the left hand side of the flowchart. Most of these will be available at the time of notification, except for the monitoring reports, which will only become available as the investigation progresses. The following sections have been written to provide the tree officer with guidance on extracting the critical information from the technical reports and have been structured to follow the normal sequence in which the information is presented:

Engineering Appraisal (Damage Assessment)

Site Investigation

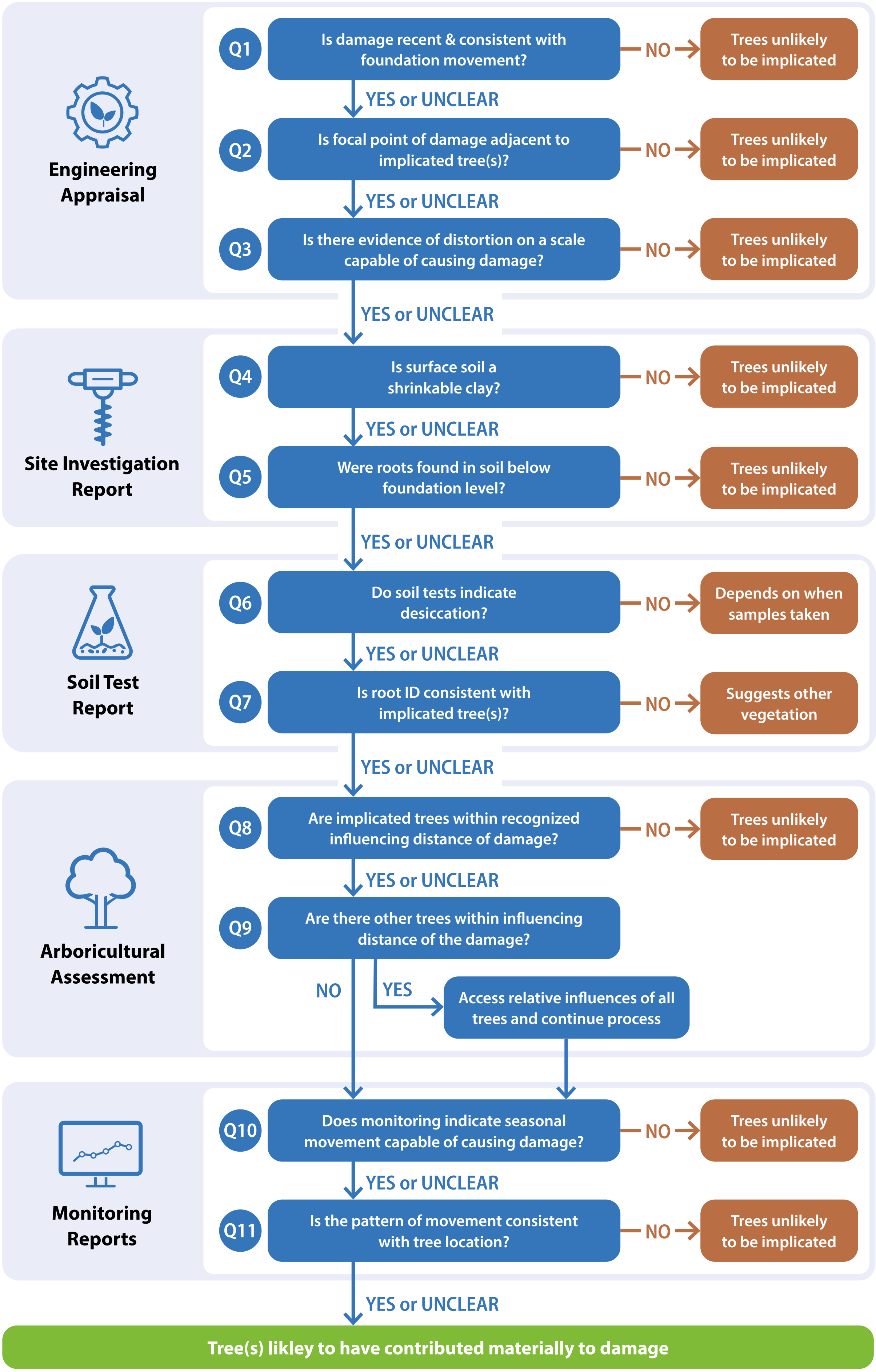
Soil Testing (Including Root Identification)

Arboricultural Assessment

Monitoring

There is plenty of information in the literature on how investigations of this kind should be conducted, for example: Has Your House Got Cracks?, Skinner & Driscoll, ISE Subsidence Guide. However, the focus here is on how the investigations are commonly undertaken, what to expect and what to look out for. The individual questions in the flowchart are marked in the text using numbers with blue highlighting – e.g. Q1, Q2, Q3

Flowchart for investigation of tree-related subsidence



3 Engineering Appraisal

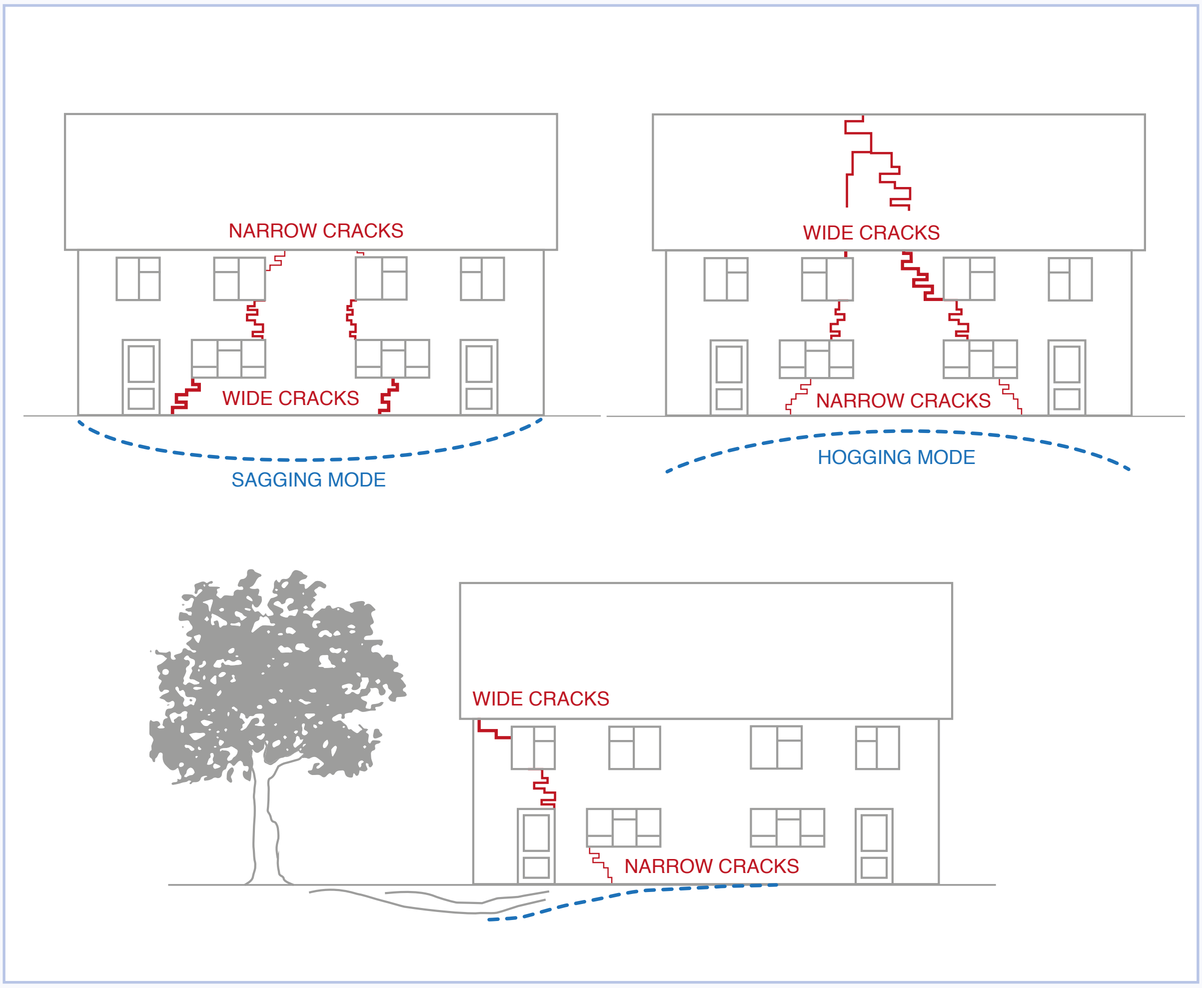
Most investigations start with an inspection and report by an engineer appointed by the insurer. While the report will include an appraisal of the damage, some reports will simply state the areas affected, while others will include a room-by-room description of the cracking with photographs and estimated crack widths.

The severity of the damage is often described on a scale of 0–5 using the classification reproduced below (BRE Digest 251, Assessment of damage to low rise buildings first published in 1990), however, this classification is commonly misused. The crack widths referred to in the table are intended to be a measure of the distortion in the walls and, as such, should be appearing within a load-bearing wall; they do not apply, for example, to a gap between an extension and the house or between two panels of plasterboard.

Category	Definition	Crack width
0	Negligible	<0.1mm
1	Very slight	<1mm
2	Slight	<5mm
3	Moderate	5–15mm
4	Severe	15–25mm
5	Very severe	>25mm

Damage classification table – taken from BRE Digest 251

In addressing Q1, it should be appreciated that the cause of cracking is not always obvious, especially where the damage is Category 2 or less. Nevertheless, subsidence damage has certain characteristics: the cracks tend to be diagonal rather than vertical, visible on both sides of the wall, and originate at window or door openings. Most importantly the cracks are consistent with a pattern of distortion. The two forms of distortion that can result from foundation movement are illustrated in the sketch below (BRE Digest 251): 'sagging' where the middle of the wall is lower than one or both ends, and 'hogging' where the middle of the wall is higher. Trees usually affect the corners of buildings rather than the mid-points, and therefore the distortion often results in hogging, which causes cracks that are wider at the top than the bottom.



Patterns of distortion – taken from BRE Digest 251

The engineering report should contain enough information to identify the focal point of the damage and hence to conclude whether or not there is a correlation between the cracking and the location of the trees Q2. It is important to check for signs of damage in areas well removed from the implicated trees, in particular, minor cracks throughout the property might indicate general wear & tear issues rather than an episode of subsidence.

All houses have a certain amount of flexibility and will be able to withstand some distortion without cracking; in fact, under normal circumstances, several centimetres of foundation movement are required to cause a crack to appear. Although movements on this scale are readily detectable with a long spirit level, it is rare for measurements to be included in the initial appraisal and, as a result, Q3 often remains unanswered. Occasionally, however, the investigator will specify a 'distortion survey' to be carried out as part of the monitoring exercise (see Section 7).

4 Site Investigation

The depth of the foundations and the nature and properties of the soil supporting them are key pieces of information and practically every investigation of suspected subsidence will include some form of excavation. This work is normally carried out by a specialist contractor either during or shortly after the initial assessment by the engineer, but before any monitoring results become available. The siting of the excavations will therefore be governed by the engineer's initial appraisal as to the cause.

Trial pits (small hand dug excavations) are used to expose the foundations and small diameter boreholes are used to obtain samples from greater depths. These boreholes are often excavated through the base of the trial pit and, using hand-held equipment, it is possible to recover samples from depths of 3 to 6 m in a clay soil.

A typical investigation might consist of two or three trial pits or boreholes, which allows the properties of the soil sampled at the different locations to be compared. However, to reduce cost, it is not uncommon to see an investigation based on a single trial pit and borehole; sometimes with the trial pit failing to expose the base of the foundations or the borehole failing to penetrate below the zone of root activity.

Properly sited trial pits can provide important information on how the foundation depth varies between different parts of the building. For example, extensions may have been built on deeper or shallower foundations than the original house, or parts of the property may have been underpinned. In newer properties, relatively shallow, smooth concrete footings may in fact be 'ground beams' spanning between much deeper piles or bases. A good site investigation report will include commentary on clues of this kind, but this may not always be the case.

One of the key pieces of information to be extracted from the site investigation report is the nature of the supporting soil and in particular whether or not it is a 'clay'. To be shrinkable, a soil requires a significant clay content. Coarser soils such as sands and gravels are largely unaffected by changes in moisture content. Pouring water into a bucket of sand is much the same as pouring water into a bucket of marbles; the marbles don't expand and jump out of the bucket, nor does the sand. Conversely, clays are different because the particles are so small (less than 2 microns) and are electrically charged, the water filling the pores is bound to the surface of the particles and behaves like a jelly. To compress the clay the water must be forced out under pressure, which can be achieved by applying loads or by applying suctions.

Trees extract moisture from clay soils by generating suctions in their root systems. When a tree goes into dormancy for the winter, suction dissipates and water is drawn back in, albeit slowly. This is the basic explanation for seasonal movement; summer drought causing shrinkage and winter rainfall induced swelling.

The site investigation report will include logs for each trial pit and borehole, showing the type of soil encountered at various depths with a brief description (e.g. clay, silt, sand, gravel), and an indication of where the soil and root samples were taken. The definition of soil type is based predominantly on particle size, clays having the smallest particles and gravels the largest; most soils are, in fact, a mixture and often the description will be something like "a silty, sandy, gravelly CLAY", the uppercase letters indicating the predominate soil type. If the contractor sees bricks or other man-made detritus in the samples, they will describe the soil as 'Made Ground'.

Any soil that is not described as a CLAY is unlikely to be shrinkable, which provides at least a preliminary answer to Q4 however, in practice, the difference between a 'very sandy CLAY' and a 'clayey SAND' may be marginal. Moreover, where the borehole has failed to penetrate more than one or two metres, it is possible that there may be a layer of shrinkable soil at a greater depth. In such cases, it is worth consulting the British Geological Survey (BGS) online geology viewer, which shows both the 'superficial deposits' and the 'bedrock geology'. These terms can cause confusion because they have nothing to do with the distinction between rock and soil. To the geologist, because they were laid down many millions of years ago when the United Kingdom was covered by an ocean, soils such as London Clay are classed as 'bedrock'; more recent soils laid down during, and since, the ice age are classed as 'superficial deposits'. This is relevant because some investigators rely on large-scale geological maps that do not show the superficial deposits, which can lead to a property founded on, say 'River Terrace gravels', being described as 'underlain by London Clay'.

It is not possible to place total reliance on the BGS database: thin surface layers may not be shown and the boundaries between outcropping soils may not be exact. Nevertheless, knowing what soils are likely to be present can help in the interpretation of the borehole logs. Often the nature of the soil is obvious from its name; for example, where the word 'clay' appears in the name. Other names, such as 'Lambeth Beds', may not be so helpful. In such cases, it can be helpful to consult the BGS lexicon https://webapps.bgs.ac.uk/lexicon for details. The lexicon is also useful in highlighting potential anomalies in the soil names, for example where a soil described as a 'gravel' may contain pockets of clay or a soil described as a 'clay' may contain sand layers.

The logs for each trial pit or borehole should include the presence or absence of roots, although occasionally this information may be recorded separately in a small box at the bottom of the log or in the accompanying text. It is important to bear in mind that

moisture is extracted through very fine roots and these may not be immediately obvious in the recovered samples; however, it is usually possible to find the fine roots by breaking open the lumps of soil that are recovered and looking for the fibrous material in the newly exposed surface. The care taken in this operation will vary from contractor to contractor.

To cause subsidence, a tree needs to extract moisture from a substantial layer of soil, approximately one or two metres thick. It follows that roots should be present to a depth of at least 1 m, and probably 2 m, below foundation level. If this is not the case, then it is unlikely that trees have caused damaging movement in the area where the samples were taken Q5.

5. Soil Testing

A key part of the soil investigation is to (a) assess the characteristics of the soil supporting the foundations, and (b) look for evidence of 'desiccation' – i.e. the removal of moisture from the supporting soil by the roots of nearby vegetation. The first of these is relatively straightforward, the second is more complex and poorly understood, even by engineers experienced in subsidence investigations. We will look at some of the common mistakes and misconceptions later in this section but will first deal with characterising the soil.

Soil Index Properties

When we describe a soil as being clay or clay-like, what we usually mean is that it is mouldable and, once moulded, it retains its shape and form. Engineers refer to this property as 'plasticity' and for each clay soil there will be a range of moisture contents over which it retains its plasticity. If the soil is too dry it will start to fall apart and is described as being below the 'plastic limit' (PL), if it's too wet it will start to lose its shape and is described as being above the 'liquid limit' (LL). The difference in moisture content between the liquid limit and the plastic limit is known as the 'plasticity index' (PI). Moisture contents are normally expressed as a percentage, so if a clay soil has a moisture content of 20% at its plastic limit and 65% at its liquid limit, it has a plasticity index of 45%.

It follows that plasticity index is a measure, albeit a rough and ready one of the amount of volume change that can take place in a particular soil. As such, it allows the concept of shrinkability, which is touched on in Section 4, to be taken one step further, so clay soils can be classified in terms of their potential to shrink and swell. In particular, when the NHBC produced their advice for building near trees, they proposed the following three categories of shrinkage potential:

Shrinkage potential category	Plasticity index
LOW	< 20%
MEDIUM	> 20% and < 40%
HIGH	> 40%

Because the soil samples are sieved prior to measuring the liquid and plastic limits, the NHBC also recommended the use of a 'modified plasticity index' which has a pro-rata adjustment to account for the retained coarse material. For sandy or gravelly soils, this adjustment can have a significant effect on the representative PI and any reports that do not show this correction should be regarded with caution.

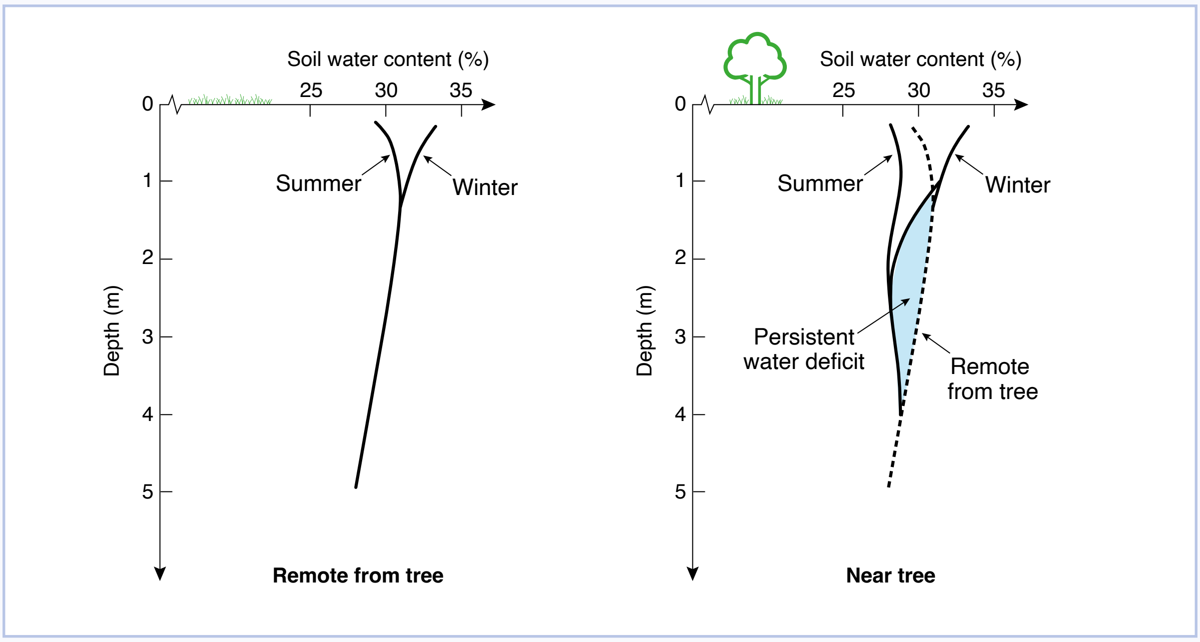
In terms of answering Q4, tree-related damage is unlikely to occur unless the subsoil has a medium or high shrinkage potential. It is not possible to record a meaningful plasticity index in soils with high silt, sand or gravel contents and soil test reports tend to label these soils as 'essentially non-plastic' (ENP).

Evidence of Desiccation

Having established that the surface soil is a shrinkable clay, the next step attempted in most investigations is to look for signs of desiccation – i.e. evidence that the moisture content of the soil is lower than it would be if there were no nearby trees.

Levels of desiccation vary throughout the year, and a typical moisture content profile, near a large tree, might look something like that shown in the figure below (BRE Digest 298). The sketch shows how a 'persistent moisture deficit' (PMD) can develop slowly over the lifetime of the tree, because winter rainfall fails to replenish all the moisture extracted the previous summer. However, if the soil is relatively permeable, or the tree has a lower moisture demand, there will be no PMD and, hence, no desiccation present in late winter or spring.

It follows from the figure below that the most straightforward way of assessing desiccation is to compare the moisture content profile in a borehole near the area of damage with that in a control borehole well removed from trees. Unfortunately, control boreholes are relatively rare, either because of cost constraints or because there are no available locations that are remote from vegetation. This approach also relies on the soil in the two boreholes having similar index properties, which is not always the case.



Moisture content profiles near to and remote from a large tree – taken from BRE Digest 298.

Where there is no 'control borehole' it is far more difficult to assess desiccation reliably. There are essentially four methods: (i) comparisons of soil moisture profiles with index properties (ii) comparisons of strength profiles with typical values, (iii) measurement of pore water suction and (iv) measurement of swelling potential. An excellent overview of the use of these methods can be found in BRE Digest 412 'Desiccation' first published in 1996 and there is little merit in repeating this information here. However, there are a few things to look out for, which are detailed in the following paragraphs.

Comparing Moisture Contents With Index Properties

The commonest method assumes the soil to be desiccated if its moisture content is less than 40% of the LL. A less common method uses the PL plus 2% as the desiccation threshold. Because of their simplicity, these criteria have been embraced by the subsidence-investigation industry. Unfortunately, they are at best, indicators, and applicable only to highly plastic clays such as London clay. BRE Digest 412 warns against their use without corroborating test results, despite this, it is not uncommon to see site investigation reports assess desiccation using only comparisons with index properties.

Using Soil Strength Profiles

Desiccation increases soil strength, which can be assessed during the sampling operation using either a pocket penetrometer or a shear vane device. Although soil strength can be measured in kPa (or kN/m2), it is more common to rely on the strength classification which ranges from 'soft' to 'hard'. Many of the commonly encountered shrinkable clays in their natural state are 'firm' or 'firm-to-stiff', but where moisture has been extracted by tree roots, these soils tend to become 'stiff' or 'very stiff'. Conversely, the presence of a 'soft' or 'soft-to-firm' clay suggests either a recent deposit, such as alluvium, or that the soil is, in fact, Made Ground even if it contains nothing artificial.

Filter Paper Suction Tests

The suctions generated by a tree's root system to extract moisture from a clay soil are very large – commonly several times atmospheric pressure - and in extreme cases can approach the 'wilting point', which is around 14 bars (1,400 kPa). The usual method of measurement is to sandwich a sample of soil between sheets of filter paper and allow it to come to equilibrium over a seven day period. The greater the suction in the soil, the less water that the filter paper is able to extract and by using a standard filter paper that has been calibrated it is possible to calculate the suction from the final moisture content of the paper. Unfortunately, this approach has a number of drawbacks, the main one being that some suctions will be present in the sample even if there is no desiccation, due to stress relief and sampling disturbance. In addition, filter paper suction results can be affected by poor sample storage & preparation, and soils containing gypsum & other salts have been known to cause false high readings.

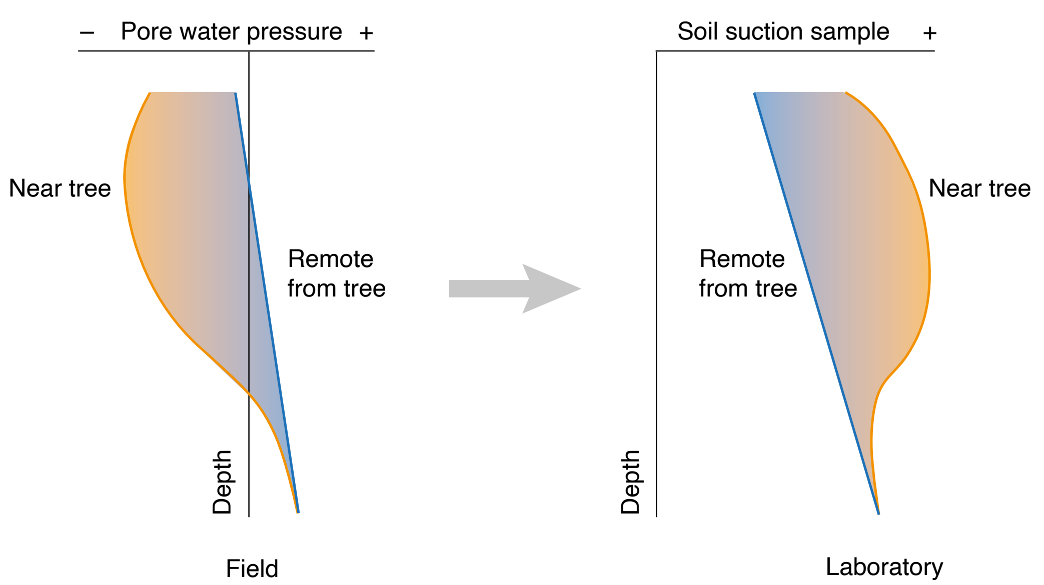
Oedometer Swell Test

Arguably the most direct method of assessing desiccation is to measure how much a sample of soil expands when it comes into contact with excess water. This measurement can be made in a device known as an oedometer. In practice, it is found that a small amount of swelling (~1 %) occurs in all clay samples whether they are desiccated or not. However, as desiccation can produce swelling in the vertical direction of 5 % or more, it is often possible to distinguish the effects of desiccation from these background variations.

Overview

It follows that total reliance cannot be placed on any single method of determining desiccation and, in addressing Q6, a holistic approach should be adopted that considers all the evidence including the presence or absence of roots in the soil samples. Trees normally form a 'bulb' of suction, and hence desiccation, as shown in the sketch below. This bulb should broadly correspond to the zone of root activity and it is important therefore that samples taken from below this zone are tested to confirm the properties of the undesiccated soil. Results that do not show a bulb of pressure or show the apparent desiccation extending below the recorded depth of root activity should be regarded with caution.

It is also important to remember that soil conditions vary seasonally; the absence of desiccation in samples taken during the winter or spring does not rule out the possibility of the soil having been desiccated in the previous summer. This would be particularly true in a winter following an exceptionally dry summer such as 2018 or 2022.



Bulb of desiccation taken from Digest 412

Heave Potential

When it comes to deciding on appropriate tree management or remediation scheme, it is more meaningful to think of desiccation in terms of how much vertical movement will occur as the soil suctions dissipate. This movement, normally referred to as 'heave potential', is expressed in mm. BRE Digest 412 provides a detailed explanation of how heave potential can be estimated, using the various soil tests described in section 5. All the methods rely on approximations and empirical corrections which, combined with the fundamental problems in measuring desiccation, means that the resulting 'heave potential' predictions need to be viewed with a degree of circumspection.

In assessing the significance of estimated heave potential, it is worth bearing in mind that the movements associated with soil swelling will be spread out over the area influenced by the tree(s) in question. Accordingly, as it is differential movement that causes distortion, the potential for heave of this kind to cause damage may be less than it might seem at first sight. Taking all these factors into consideration, an estimated heave potential of less than 10 mm is generally inconsequential and, in many cases, heave potentials of 50 mm or more may be considered acceptable.

For completeness' sake, it is necessary to mention 'heave', as opposed to 'subsidence', which is sometimes identified as a cause of foundation problems. It occurs where a large 'persistent moisture deficit' has developed in the underlying soil. A typical scenario might be where mature trees have been removed from a clay soil site prior to construction. The ensuing swelling can take place over many years resulting in damage to the newbuild properties, especially if the foundations have not complied with the guidance in Chapter 4.2 of the NHBC Standards. However, apart from newbuilds, heave is likely to occur only when large trees have been removed or substantially cut back. In such cases, it is simply reversing previous subsidence, even though some of the subsidence may have occurred during the early life of the tree and/or property.

Root Identification

Identifying the roots recovered from the trial pits and boreholes excavated as part of the soil investigation is commonly carried out to help identify which vegetation may have affected the building. The usual form of identification is based on optical microscopy, although DNA testing is available and its use is becoming more widespread, especially where multiple trees of the same genus are adjacent to the effected property, an oak woodland for example.

Normally for the trees to be implicated in the damage, it will be necessary to identify compatible roots taken from below foundation level Q7. Although only roots growing below the foundations can affect the building, it can also be useful to identify shallower ones, particularly if the deeper ones are small. It is also worth remembering the presence of roots alone does not necessarily mean that the parent tree has caused enough soil shrinkage to damage the building, the other evidence needs to be considered as well.

Microscopic identification is still the most commonly used method. Samples need to be about 0.5mm diameter or larger and should ideally have bark. It is usually possible to identify roots to genus level, but that can be limiting if there are several related trees or shrubs that might be sources of the roots. Some can only be identified to family level, the commonest example being the numerous genera, species and cultivars in the Pomoideae family, which are virtually indistinguishable microscopically. However, the root stocks and scions (aerial parts) of grafted trees will match.

DNA identification matches DNA extracted from the root samples with that taken from aerial tissue samples, ideally twigs, from all the potential parent trees. This can distinguish roots from closely related species that cannot be distinguished microscopically, which can be helpful if there are several trees near the affected area, particularly if they belong to different parties. Where the recommendation received from the investigator is to remove all trees within a theoretical rooting area, DNA test can clarify which trees' roots have been discovered in the borehole and this can lead to the correct tree being identified and appropriate works being carried out. However, DNA testing cannot distinguish between individuals of the same clone (e.g. cultivated varieties). London Planes are propagated vegetatively, so individuals in the same street or planted group might well be clones. Root stock from grafted individuals will be different from the scions and close growing individuals of the same species can form natural root grafts, creating what amounts to a shared combined root system.

Starch testing. Roots are tested with iodine which stains blue/black if starch is present. This is widely considered to show whether the roots are alive or not, but it is not that simple. Starch contents vary naturally through the year and reserves can drop rapidly once growth starts during the spring and early summer. Also, the fine feeder roots die and are replaced each season, so the root systems of healthy plants will always contain a proportion of dead roots. In dry clay it can take a long time for the starch of dead roots to be broken down by soil organisms, therefore long dead roots can test positive. For example, root samples have tested positive for starch after being stored in dry conditions in a laboratory for eight years. Therefore, this is another test that needs to be treated with caution and the results should be considered with all the other available evidence, particularly the health of the parent tree. Roots might test as 'dead', but they must have been alive when they grew into the places they were found and as boreholes sample only a small area, the health and vitality of the parent tree will be far more important than the condition of the selective sample of roots that can be recovered.

6 Arboricultural Assessment

Most investigations will include a formal assessment of the nearby trees, undertaken by an arboriculturist, although some may rely on the engineer's initial appraisal. The arboricultural report is sometimes delayed until the results of the initial investigations are available, in which case it may contain an overview of the foundation depths, the soil test results and root identification. In other cases, the arboriculturist is asked to attend site before the site investigation has been carried out, in which case it is common to see a caveat to the effect that the report relies on the engineer's assessment of the damage being tree related.

Where present, the arboricultural report should identify all vegetation within potential influencing distance of the property and include appropriate details such as height, location, species, health and evidence of previous management. Obviously, it is worth checking this information for accuracy. It is also worth checking that all the relevant vegetation has been included; for example, some reports will include only the vegetation at the front of the property, if the engineer has stated that to be the area of concern.

Reviewing online street imagery (e.g. Google Street View), particularly historic imagery, for signs of any recently removed trees or shrubs may assist in the assessment.

The arboricultural report will make recommendations for the management (i.e. removal or canopy reduction) of any trees thought to be implicated in the damage. This should only include trees that are within potential influencing distance of the property Q8 and there are essentially two methods of determining this: (a) by reference to the Cutler & Richardson data in their publication 'Tree roots & buildings' (1981) or (b) by reference to Chapter 4.2 of the NHBC Standards. The latter has the advantage of taking some consideration of the size of the tree.

The use of the Cutler & Richardson data is self-explanatory and does not merit further detail here. Tree officers will be familiar with the table in Chapter 4.2 of NHBC Standards, which groups trees into two categories according to their perceived moisture demands and lists their mature heights (H). For high moisture demand trees, such as oak, willow, elm and poplar, deeper foundations are required within a distance of 1.25 x height. For moderate moisture demand trees, the figure is 0.75 x height. These ratios are the same for low, medium & high volume change potential soils, although the depths of root influence do vary with shrinkability.

NHBC Standards makes it clear that the zone of influence is based on the mature height of the tree and not its current height. There is, however, a caveat to this, which is that the current height can be used if the tree has yet to attain half its mature height. It is also important to realise that the NHBC guidance is based on the depth to which roots can influence foundations and not the depth of root activity, which can be expected to be greater – i.e. roots will need to extend to about 0.5 m below the foundations before they have a discernible effect and about 1 m before they have an adverse effect.

In practice, it is better to err on the side of caution and accept that a tree is within potential influencing distance if it is within the maximum distance-to-damage specified in the Cutler & Richardson database, or HHBC Standards. Nevertheless, due consideration has to be given to any other first, or third, party trees that also fall within potential influencing distance. If any of these are larger, or closer, to the area of damage they, rather than the local authority trees, may be the dominant vegetative influence Q9.

7 Monitoring

Monitoring is an essential part of the investigation and in most cases will be the key to confirming the cause of the subsidence and identifying appropriate remedial measures. Unfortunately, it is likely to be the last evidence that is presented because the measurements have to be made over at least six months but ideally 12 months. Two types of monitoring are commonly undertaken: crack measurements that show whether the cracks are opening or closing, and precise levelling that records the vertical movement of the foundations. Although it is generally accepted that level monitoring is the more powerful diagnostic tool and the cost has reduced significantly in recent years, many investigators still rely on crack measurements because they are cheaper and simpler.

Crack Monitoring

Crack measurements can be made using a variety of devices including using sensors which take continuous measurements and send the results via the internet. The most common method is to glue small, dimpled stainless steel discs either side of the crack and to measure the separation using a digital vernier. Other methods are described in publications such as BRE Digest 343.

Although the measurements can be made using only one disc on each side of the crack, it is more common to use a third disc and to use the measurement between the two discs on the same side of the crack as a reference. This is particularly important where comparative measurements are being made by different technicians because variations can occur as a result of the design of the caliper as well as measuring technique. In particular, digital calipers have two sets of jaws that are referred to as 'inner' and 'outer'; most technicians use the smaller, inner, jaws and using the larger, outer, jaws can result in a reading that is about 2 mm less, which will often swamp any genuine changes. Installed and read correctly, the digital caliper readings should be accurate to about +/- 0.2 mm.

The hallmark of tree-related subsidence are cracks that open in summer and close in winter, which indicates that the soil under the foundations is shrinking and swelling. However, to answer Q10 it is necessary to consider how much variation is needed to demonstrate that the changes are being caused by a tree, because once a crack has formed there will always be a tendency for it to open and close slightly over the course of the year. The ISE Subsidence Guide suggests that changes of no more than 1 mm are 'inconsequential' but this is by no means a universally accepted criterion.

Although they have their limitations, crack measurements can be helpful. In particular, cracks that remain stable indicate either that the cause of the subsidence has been eliminated or a cause unrelated to foundation movement, while cracks that open progressively with no sign of closure over the winter period suggest the cause to be defective drains or landslip or other uni-directional form of subsidence. In addition, measurements over periods of more than one year, can indicate whether the distortion, and hence movement, is decreasing or increasing. In the example below, the net closure in the summer following tree management, suggests that the trees were at least a contributory cause; had there been no change, this would suggest the opposite.

Level Monitoring

Levelling is carried out using optical surveying techniques. Small points are fixed to the walls and surveyed to measure their vertical offset relative to a reference point (or datum), which can be a rod installed in a borehole, a deep drain, or a point on the house that is remote from any damage. The monitoring points are normally fitted externally near ground level, but in principle they can be at any height and can also be fitted internally. Ideally the monitoring points should be fixed to all accessible elevations; however, some investigators prefer to restrict them to the area of damage which can bias the interpretation of the results.

The surveys are repeated periodically, typically every 4 to 8 weeks, to measure the changes in the levels (i.e. heights) of the monitoring points. Using experienced personnel and the most accurate equipment on the market these changes can be read to +/- 0.01 mm, but inherent measurement errors limit the true accuracy to about 0.2 mm. Unfortunately, some monitoring contractors cut corners and use equipment that measures only to the nearest 1 mm which, coupled with poor technique, can result in spurious or ambiguous results.

The commonest 'error' is to choose a reference point that is itself moving seasonally. This is usually obvious, because parts of the property will appear to move upwards during summer and downwards during winter. When this happens, the results can be corrected to relate the changes to another point, but it is not uncommon to receive uncorrected results that have been misinterpreted.

Good quality level monitoring that shows parts of the property moving down in summer and up in winter is direct confirmation of seasonal movement. As with crack monitoring, there is an issue regarding how much movement is needed to confirm that a tree is causing damage Q10. There is a tendency amongst insurance-funded investigators to imply that any movement is unacceptable, which is clearly not the case as all properties founded on clay soils will move to a degree.

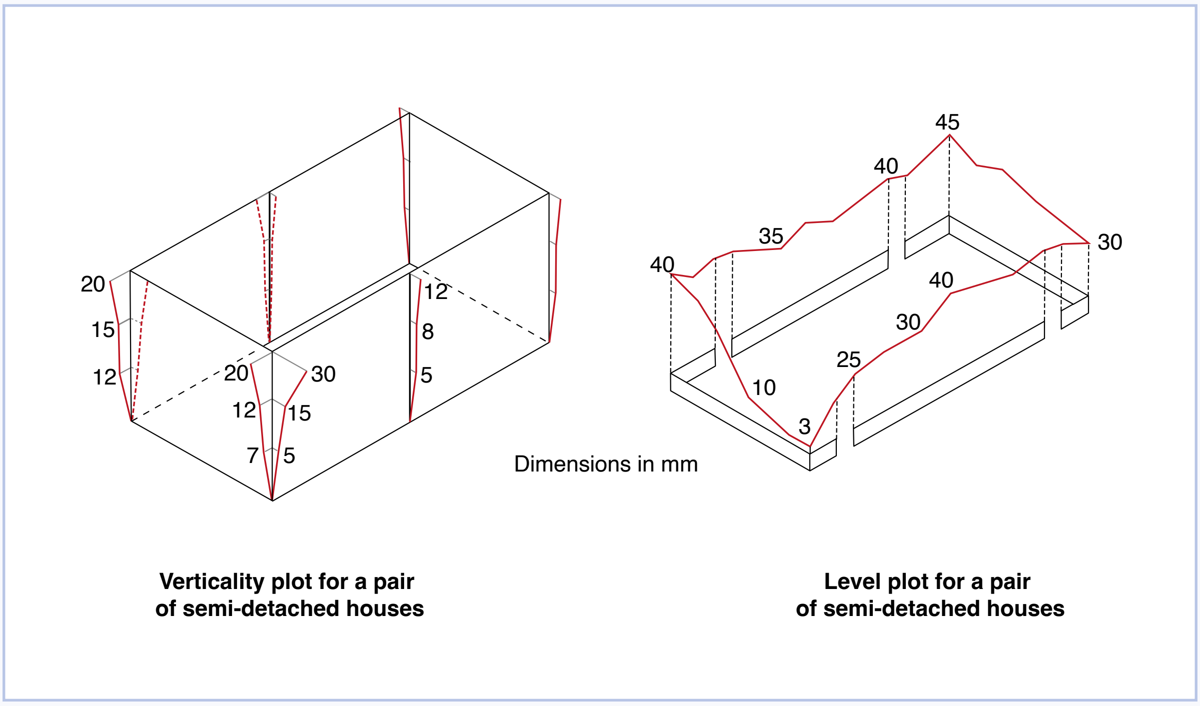
One of the major advantages of level monitoring is that it gives a clear indication of which parts of the property are moving. If the largest movements are taking place within the zone of influence of the implicated tree(s), this would be strong evidence that the tree(s) are the principal vegetative influence Q11. Crack monitoring can also provide some indication of the area of movement in some cases, but it could be open to misinterpretation; for example, changes to a crack between a porch and the house may be interpreted as movement to the porch, when in fact it is the house that is moving.

There are no well-defined limits to acceptable movement in the literature, likely due to the difficulty of relating the distortion in the walls which causes cracks to the vertical movements taking place in the soil. That said, there is an argument that foundation movements of a few millimetres will cause no more distortion that normal temperature and humidity changes in the building materials and, at the other end of the scale, there is some limited research to suggest that movements in excess of 20 mm are required to cause cracking. In practice, seasonal movements that exceed 5 mm can be considered 'undesirable' and movements that exceed 15 mm constitute 'genuine subsidence' and require remedial action.

Because the shrinkage caused by trees during summer months is generally reversed in the following winter period, level monitoring over a single summer or winter can provide a clear indication of the scale and extent of the movement affecting the property. In the longer term, level monitoring offers a fair and objective means of testing the efficacy of tree removal or other remedial measures. In the example below, the seasonal changes were substantially reduced in the year following tree management and eliminated in the year following tree removal. Often there will be some net swelling (heave) in the soil following major tree works and, where this occurs, level monitoring has the added benefit of confirming when the foundations have stabilised sufficiently for the repairs to be carried out.

Distortion Surveys

Level monitoring points are often installed in the same brick course which means that the initial readings can be used to quantify the vertical movements that have occurred since the time of construction. Alternatively, an entirely separate survey can be made on the brick course and supplemented by measuring how far out of plumb the walls are. Measurements of this kind are commonly referred to as a 'distortion survey', which can be a powerful diagnostic tool especially when the results are presented isometrically as shown in the sketch below. Unfortunately, it is not common for a distortion survey to be undertaken as part of a routine subsidence investigation.



Sample of a distortion survey – taken from BRE Digest 251

Where available, distortion surveys can be used to provide a meaningful answer to Q3 in terms of floors dipping and walls leaning towards the location of the implicated tree, particularly if the survey was done during the growing season. Walls on the far side of the building can also lean towards the tree, depending on the amount of lateral restraint within the building. However, care is needed in the interpretation of surveys to older buildings, particularly those from the 19th century and earlier, that might have undergone movement during construction or at any time since.

8 Material That Should be Submitted With a Claim

The number and type of test results needed to draw firm conclusions about the cause of damage will depend on the circumstances of the particular claim but should follow the prescribed list on the Planning Portal as advised by JMP (8.4. below)

In order to assess any claim alleging tree related damage properly, the local authority will need a combination of results from relevant tests set out in Section 6, depending on the circumstances. These should normally be submitted with one or more appropriate professional reports, interpreting the test results and giving their opinion on the cause of the damage and the remedial work that they consider necessary. These can be:

- Engineer's report including an assessment of the building, particularly the location, nature and severity of the damage and any seasonal effect. Comment on other reasonably likely causes of the problem, such as drains, and whether or not they are a factor.
- Structural/geotechnical engineering report setting out and interpreting soil test results and monitoring readings as appropriate.
- Site plan showing the building in relation to the trees, both on the site and on neighbouring properties.
- Arboricultural report, where appropriate.

It is essential that tree officers are scrupulous in ensuring that their decisions or recommendations to members are based on adequate and appropriate evidence and also to inform Duty to Consult notices. It is in the interests of all concerned that this is provided to the authority at the earliest possible stage in the claim.

A list of tests has been agreed under JMP and, if adopted by both the local authority, insurers and/or their representatives, this then becomes a straightforward exercise.

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