Town & Country Planning Act 1990

Planning (Listed Building and Conservation Areas) Act 1990

Appeal by *Karawana Holdings Ltd*

Re: New End Nurses Home, 29 New End, London NW3 1JD

REFERENCES:

Planning Inspectorate's Ref: APP/X5210/A/14/2218243

LPA (London Borough of Camden) Ref: 2012/3089/P

Public Inquiry

Appendices of Adam Hollis

On behalf of *Karawana Holdings Ltd*

31st October 2014

Adam Hollis MSc ARB MICFor FArbor A MRICS C Env,

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Appendices

Appendix 1 - Curriculum Vitae – Adam Hollis MSc ARB MICFor FArbor A MRICS C Env

Appendix 2 - KWA/29NE/AIA/01Lttr dated 27th November 2013

Appendix 3 - Trial Pit Results

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Appendix 6 - Landscape proposals (The Bowles and Wyre Landscape Plan 1375-11-02)

Appendix 7 - A Critical Analysis of the Role of Trees in Damage to Low Rise Buildings by Michael Lawson and Dealga O'Callaghan (Source: Journal of Arboriculture 21(2): March 1995 Pages 90 - 97)

APPENDIX 1

Curriculum Vitae – Adam Hollis MSc ARB MICFor FArbor A MRICS C Env

INTRODUCTION

My qualifications as consultant can be summarized as follows:

The author of 3 recent, scientific papers, published in the Arboricultural Journal / International Journal of Urban Forestry on tree appraisal methodology within the planning framework (see CV).

Registered Consultant of the Arboricultural Association, which is the highest professional qualification in arboriculture. My surveys and reports have been vetted by a panel of fellow experts. I am also a Fellow of the Association.

Masters Degree in Arboriculture, which is the highest academic qualification in arboriculture.

Chartered Forester and Chartered Environmentalist, which means I can draw upon a wider knowledge base of natural resource management than simple preservation in my professional services.

Chartered Surveyor and advisor to the RICS committee, drafting the recent Valuation Information Paper on amenity trees.

Registered Expert Witness trained and experienced in presenting evidence in court and at public enquiries.

Chairman of the UK Regional Plant Appraisal Committee, inaugurated to promote international standards of valuation and appraisal in arboriculture and have published national guidance on international valuation methods in arboriculture.

UK delegate to the International Society of Arboriculture's Plant Appraisal and Valuation Committee, which meets at the Moreton Arboretum in Chicago, America to discuss standards.

25 years experience of the landscape industry in consultancy, contracting and research.

CURRICULUM VITAE
FOR ADAM HOLLIS

SURNAME: Hollis
FIRST NAMES: Adam
TITLE: Mr
DATE OF BIRTH: 19.1.64
NATIONALITY: British
PRESENT POSITION: Registered Consultant

KEY CAPABILITIES AND EXPERTISE:

- Arboricultural planning consultancy (BS5837 / TPO surveys & reports);
- Expert witness duties *(including public inquiries)*;
- Inventory, valuation and management of trees and woodlands;
- Health & safety risk assessments of trees and woodlands;
- Design, planting and restoration of arboreta and historic parkland;
- Soil subsidence investigation & insurance reports.

WORK/PROJECT EXPERIENCE WITHIN THE LAST 5 YEARS:

Secretary of State for Culture, Media and Sport:

Arboricultural Consultancy 2009 framework agreement:

Date: Current
Details: Consultancy advice to Royal Parks on arboriculture.

Atkins, Barratt Homes, Capita Symmonds, City of Westminster, Cluttons, Colliers CRE, Fitzroy Group, GVA Grimley, Hanson Aggregates, Harrison Varma, Halcrow Yolles, Kier Property, Knight Frank, Jones Lang LaSalle, KSR, Linden Homes, London Boroughs of Barking & Dagenham, Barnet, Brent, Hammersmith & Fulham, Hillingdon and Islington, London Business School, Norman Rourke Pryme, Persimmon Homes, PKS, Royal Borough of Kensington & Chelsea, Royal London Mutual Insurance Society, Savills, SHH, Sultan of Oman, Sunley Estates, Taylor Wimpey, Weston Homes plc:

Arboricultural Planning Consultancy across the capital:

Date: Current

Details: Planning consultancy for property & infrastrucutre development in Central & NW London, including Avenue Road, The Bishops Avenue, Hampstead Lane & Smith Square, providing arboricultural consultancy and project managing environmental assessments, landscape design and Japanese Knotweed control.

Strategic Land Partnership, Foot Anstey, Highgrove Homes, MBaker Properties:

Arboricultural Strategies for Property Development across the South West:

Date: January 2003 - Present
Details: Reporting on value and constraints of both forests and trees on public and private properties across the southwest, including the Bristol South West Extension.

Environment Agency, Eton College, Wycombe Abbey & John Lyons School:

Health & Safety Tree Risk Assessments:

Date: January 2006 - Present
Details: Risk assessment and appraisal of large and mature tree resources on public and private estates, balancing environmental costs and benefits with infrastructure demands / land usage to rationalise resource management decisions.

Korean Airways: **Principal Expert Witness in c. £1 million damage claim:**

Date: November 2005 – 2007
Details: Leading expert witness team of arboriculturalists, ecologists, soil scientists, chartered surveyors and valuation experts in plane crash damage claim to ancient woodland.

DTI: Training Courses & Risk Assessment for Vegetation Management.

Date: June 2005 - 2006
Details: Training liability managers how to balance the conflicting demands of national electricity supply and tree clearance with considerations of visual amenity, ecological benefits and longer-term management.

EDUCATION AND QUALIFICATIONS:

- ICF Edinburgh (January 1998) Chartered Forester
- University of Aberdeen (September 1994) MSc Arboriculture
- Askham Bryan College (June 1990) HND Amenity Horticulture

MEMBERSHIP OF PROFESSIONAL BODIES:

- Fellow & Trustee of Arboricultural Association
- Member of Institute of Chartered Environmentalists
- Member of Institute of Chartered Foresters
- Member of Institute of Chartered Surveyors
- Member of International Society of Arboriculture
- Member of UK Register of Expert Witnesses

LANGUAGES:

- French, Spanish, Italian

PUBLICATIONS

Hollis, A. (2007), UKI-RPAC Supplement No. 1 (Provisional): a depreciated replacement cost approach to amenity tree valuation. United Kingdom and Ireland-Regional Plant Appraisal Committee.

Hollis, A. (2009), Can a more disciplined approach to tree appraisal inform development site surveys and *vice versa*? Arboricultural Journal. AB Academic Publishers **32** (1) March pp 19-33.

Hollis, A. (2009), Can trees be depreciated like (mechanical) plant – a depreciated replacement cost solution to the adjusted trunk formula anomaly in CTLA's Trunk Formula Method, Arboricultural Journal. AB Academic Publishers **32** (2) June pp 97-110

Hollis, A. (2009), A critical analysis of CTLA's depreciation factors – do inherent inconsistencies of method complicate the simplicity of process?" Arboricultural Journal. AB Academic Publishers (in review/**32** (3) September pp 157-166)

APPENDIX 2

KWA/29NE/AIA/01LTTR DATED 27TH NOVEMBER 2013

Landmark Trees

Your ref: N/a
Our ref: KWA/29NE/AIA/01Lttr

Karawana Ltd
c/o Intrust Advisory Ltd
Charles House
108 Finchley Road
London
NW3 5JJ

27th November 2013

Dear Charles,

29 New End, Hampstead, London NW3 1JD

I have reviewed the report of Margaret MacQueen of Landscape Planning (Ref. 53375) on the above property and current planning application(s) (LBC Ref. 2012/3092/C & 2012/3089/P). The report is essentially, a critique of the Tree Projects report (2012) submitted in support of the proposals.

Ms Macqueen makes some valid points about the submitted tree survey being out of date (undertaken in 2008) and their being inevitable inconsistencies with the intervening revision of the British Standard (BS583&: 2012). She has also had the benefit of access to the base of the beech tree to measure the stem more accurately than as estimated by Mr Bentley of Tree Projects. However, I am not convinced that these facts amount to more than a corrigendum to Mr Bentley's report. They do not affect the conclusions of his report and their relevance to planning. For the record, I also visted the site in May 2013 and recorded slightly different dimensions to those stated by her.

I am a Registered Consultant and Fellow of the Arboricultural Association and a Chartered Forester, with a Masters Degree in Arboriculture and 25 years experience of the landscape industry - including the Forestry Commission and Agricultural Development and Advisory Service. I am a UK Registered Expert Witness, trained in single joint expert witness duties. I am also Chairman of the UK & I Regional Plant Appraisal Committee, inaugurated to promote international standards of valuation in arboriculture.

There are no substantive errors as such: the elm (T2) remains an indifferent semi / early mature specimen of very limited public visibility that is susceptible to a common and fatal disease and that is growing in a confined space of less than 5m to surrounding buildings. In the unlikely event that the tree reached maturity it would require onerous pruning to keep it shoehorned into place: the tree has a mature spread of up to 30m diameter and an equivalent height. In my view, the tree is rightly categorized as unsuitable for retention (Category U) and its removal within the proposals classed as a non-impact / very low one. The fact of the marginal increase on the stem diameter makes no difference when the tree is to be removed. Nor does incorporation of the subsidiary stem into the calculation of the RPA render the tree any older / larger than the intervening 4-5 years growth. For the record, I dispute Ms MacQueen's measurement: I found the combined stem diameter to be 310mm not 365mm.

The birch tree (T3) again, to be removed is a reasonable specimen of limited public visibility, internal to the site with some minor dieback at the tips and in sporadic clusters, with a somewhat erratic habit (long low laterals branches challenging the dominance of the lead stem) growing a little close to the existing building for comfort: at 6m distance, the canopy is touching down on the roof and guttering of the house. The species does not readily lend itself to the routine, if not onerous pruning, that would be required, to maintain the tree in the current setting. The tree is growing in compacted ground on the edge of a disused tennis court, which may explain its loss of apical dominance and sporadic dieback. I see the sacrifice of this less than optimal and relatively short-lived tree to be sustainable, subject to suitable replacement planting. For the record, I dispute Ms MacQueen's measurement: I found the stem diameter to be 480mm, not 500mm.

Ms MacQueen references the council's duty to protect such trees, but in fact the council is encouraged to exercise its discretion in these matters: as stated in BS5837, paragraph 5.1.1:

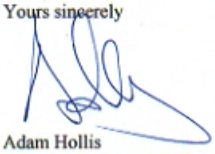
5.1.1 The constraints imposed by trees, both above and below ground (see Note to **5.2.1**) should inform the site layout design, although it is recognized that the competing needs of development mean that trees are only one factor requiring consideration. Certain trees are of such importance and sensitivity as to be major constraints on development or to justify its substantial modification. However, care should be taken to avoid misplaced tree retention; attempts to retain too many or unsuitable trees on a site can result in excessive pressure on the trees during demolition or construction work, or post-completion demands for their removal.

There is no disputing the requirement to protect a tree of the calibre of T4 beech – a substantial mature tree of individual specimen value and subject to a Tree Preservation Order. However, the difference between the actual and estimated stem diameters is again academic: the applicant has undertaken substantial site investigations to demonstrate a lack of root penetration into the site. Whilst I do not doubt that roots can confound our expectations (as suggested in the research note appended to MS MacQueen's report), I submit that in this instance there has been no great departure from the norm and the rooting pattern of this shallow rooting species has been restricted by the substantive change in levels between properties. My experience of development sites is that this species does tend to be restricted by underground obstructions and changes in levels. These are the natural inhabitants of the shallow chalkland soils, not the robust elms, oaks, poplars and willows of the flood plains that luxuriate in deep fertile soils and are typically associated with the undermining of foundations. Thus, the correction of the theoretical RPA radius remains academic, when the actual rooting within the site is *de minimus.*

To conclude, there are some minor inconsistencies and redundancies in the Tree Projects' report, but these are essentially academic. They do not alter the key considerations that the proposals seek to remove two low to poor quality trees in T2 & 3 and to excavate a proven area of no impact within the theoretical RPA of T4. I see no reasonable objections on policy or practical grounds to such proposals. I recommend the proposals to planning.

Please let me know, if I can be of further assistance.

Yours sincerely



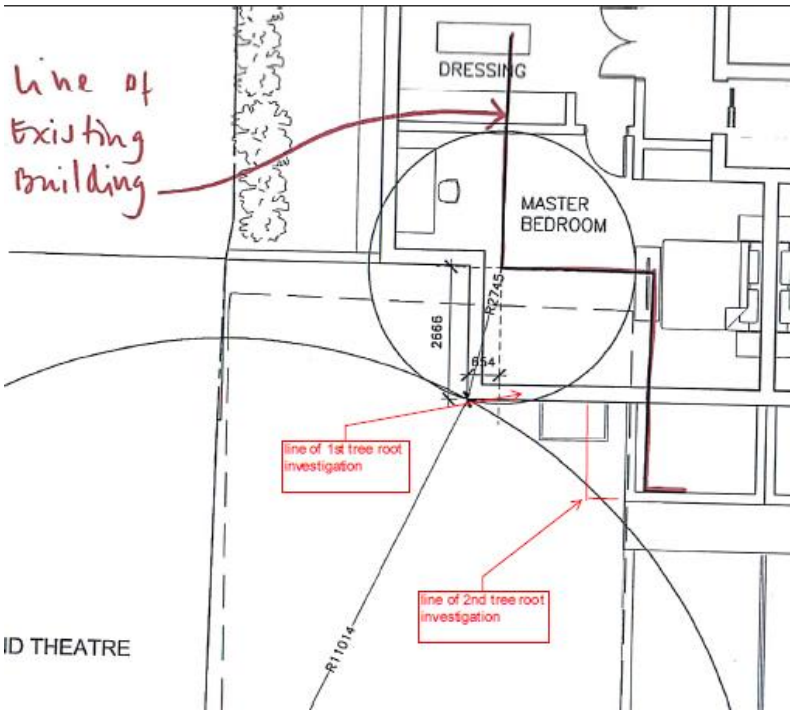
Adam Hollis
MSc Arb FAborA MICFor HND Hort
Chatered Forester
Fellow & Registered Consultant of Arboricultural Association

APPENDIX 3

TRIAL PIT RESULTS

A3.0 TREE ROOT INVESTIGATIONS FOR T1 HORSE CHESTNUT AND T4 COPPER BEECH

A3.1 Plan of Trial Pits for T1:



A3.2 Photographs from T1 Trial Pit

Tree Root Investigation to T1 opened for 3/3/2009

Trench 1, T1 Behind to left | Trench 1, T1 Forward to right

Trench 2, T1 to right, behind | Trench 2, to right, behind

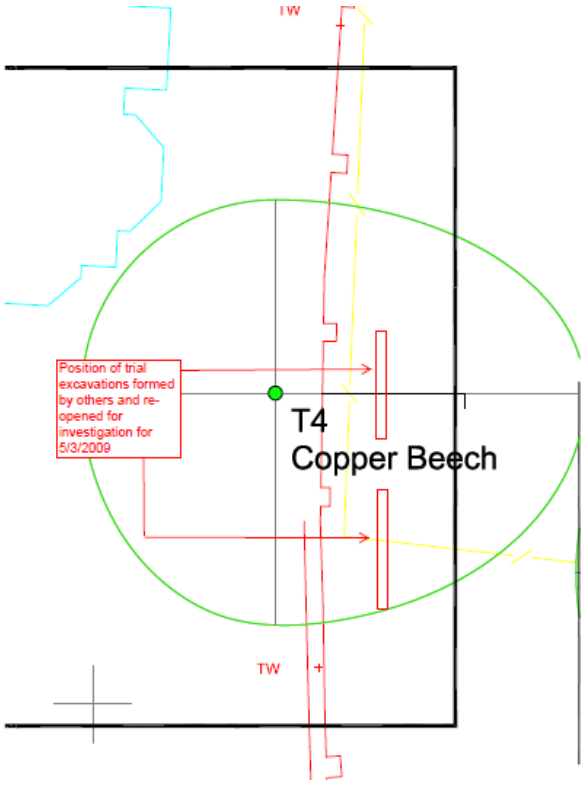
Tree root investigation based on early scheme design however the line of proposed constru
subsequently been altered to the approximate lines shown red.

Tree Root Investigation to T1 opened 25/3/2011

Revised line of construction shown red overlaid to first line of excavation/ investigation	Overview, T1 to right of picture
Trench parallel to side elevation, T1 behind to left	Trench in line with front elevation, T1 behind to right.

Tree root investigation to 700mm based on revised scheme design. Excavation mainly through crushed brick and fill with few and fibrous roots.

A3.3 Plan of Trial Pits for T4:



A3.4 Photographs from T4 Trial Pits

APPENDIX 4

THE LOCAL DEVELOPMENT FRAMEWORK (LDF) POLICIES OF RELEVANCE TO TREES

A4.0 Extracts from the Local Development Framework (LDF) – Adopted 8th November 2010.

A4.1 Core Strategy CS15 - Protecting and improving our parks and open spaces and encouraging biodiversity

The Council will protect and improve Camden's parks and open spaces….

The Council will protect and improve sites of nature conservation and biodiversity, in particular habitats and biodiversity identified in the Camden and London Biodiversity Plans in the borough by:

j) protecting trees and promoting the provision of new trees and vegetation, including additional street trees.

Trees

15.21 Trees are important for their aesthetic value, as habitat, in shading, cooling and filtering the air and in removing carbon dioxide and providing oxygen. They will play an increasingly important role in providing shade and refuge in the hotter summers predicted due to climate change. More guidance on trees and groups of trees can be found in Camden Development Policies and our Camden Planning Guidance supplementary document. There is often pressure for the removal of trees and groups of trees in the borough due to subsidence fears, perceived dangers, locations close to existing underground infrastructure and to facilitate development.

15.22 The Council has a Tree Strategy which deals with tree management on its land. This aims to retain trees and provide new trees on Council land. We have a tree planting programme which is increasing the number of trees in the borough, in streets, parks housing estates and schools. We will resist the loss of trees and groups of trees wherever possible and, where this is not possible, require their replacement on development sites or nearby streets and open spaces. The choice of species should consider historic context, availability of space, soil conditions, potential improvements to air and soil quality and reducing the effects of and adapting to climate change.

Further information on protected trees and groups of trees, the procedures for seeking their removal and their replacement is set out in the Council's Camden Planning Guidance supplementary document.

A4.2 Policy DP24 - Securing high quality design

The Council will require all developments, including alterations and extensions to existing buildings, to be of the highest standard of design and will expect developments to consider:

a) character, setting, context and the form and scale of neighbouring buildings;
b) the character and proportions of the existing building, where alterations and extensions are proposed;
c) the quality of materials to be used;
d) the provision of visually interesting frontages at street level;

e) the appropriate location for building services equipment;
f) existing natural features, such as topography and trees;
g) the provision of appropriate hard and soft landscaping including boundary treatments;
h) the provision of appropriate amenity space; and
i) accessibility.

Responding to natural features

24.19 New developments should respond to the natural assets of a site and its surroundings, such as slopes and height differences, trees, groups of trees and other vegetation. Extensions and new developments should not cause the loss of any existing natural habitats, including in private gardens. Core Strategy policy CS15 - Protecting and improving our parks and open spaces and encouraging biodiversity provides further guidance on nature conservation in Camden and the Council's strategy for trees.

24.21: Development will not be permitted which fails to preserve or is likely to damage trees on a site which make a significant contribution to the character and amenity of an area. Where appropriate the Council will seek to ensure that developments make adequate provision for the planting and growth to maturity of large trees.

Incorporating Landscaping

24.22 As with buildings, consideration of context is essential in the design of new hard and soft landscaping. Hard landscape elements (surfaces, boundary treatments etc), and the materials from which they are made, play a significant role in defining the character and attractiveness of a site or area and reinforcing local distinctiveness. New planting can contribute to the attractiveness of a development, soften and balance the impact of buildings and contribute to the biodiversity value of a site. Effective maintenance is often essential to the success of soft landscaping (shrubs, grass etc) and, where appropriate, the Council will expect planting plans to be accompanied by a maintenance schedule. New hard and soft landscaping should be of high quality and should positively responsive to its local character.

A4.3 Policy DP25 - Conserving Camden's heritage

Conservation areas

In order to maintain the character of Camden's conservation areas, the Council will:

a) take account of conservation area statements, appraisals and management plans when assessing applications within conservation areas;
b) only permit development within conservation areas that preserves and enhances the character and appearance of the area;
c) prevent the total or substantial demolition of an unlisted building that makes a positive contribution to the character or appearance of a conservation area where this harms the character or appearance of the conservation area, unless exceptional circumstances are shown that outweigh the case for retention;
d) not permit development outside of a conservation area that causes harm to the character and appearance of that conservation area; and
e) preserve trees and garden spaces which contribute to the character of a

conservation area and which provide a setting for Camden's architectural heritage.

25.5 The value of existing gardens, trees and landscaping to the character of the borough is described in DP24 - Securing High Quality Design, and they make a particular contribution to conservation areas. Development will not be permitted which causes the loss of trees and/or garden space where this is important to the character and appearance of a conservation area. DP27 - Basements and lightwells provides further guidance on this issue where landscaping may be affected by basements and other underground structures.

A4.4 Policy DP27 - Basements and lightwells

In determining proposals for basement and other underground development, the Council will require an assessment of the scheme's impact on drainage, flooding, groundwater conditions and structural stability, where appropriate. The Council will only permit basement and other underground development that does not cause harm to the built and natural environment and local amenity, and does not result in flooding or ground instability. We will require developers to demonstrate by methodologies appropriate to the site that schemes…….. and will consider whether schemes

e) lead to the loss of open space or trees of townscape or amenity value;

27.9 A basement development that does not extend beyond the footprint of the original building and is no deeper than one full storey below ground level (approximately 3 metres in depth) is often the most appropriate way to extend a building below ground. Proposals for basements that take up the whole rear and / or front garden of a property are unlikely to be acceptable. Sufficient margins should be left between the site boundaries and any basement construction to sustain growth of vegetation and trees. Developments should provide an appropriate proportion of planted material above the structure to mitigate the reduction in the natural storm water infiltration capacity of the site and / or the loss of biodiversity caused by the development. This will usually take the form of a soft landscaping or detention pond on the top of the underground structure, which is designed to temporarily hold a set amount of water while slowly draining to another location. It will be expected that a minimum of 0.5 metres of soil be provided above the basement development, where this extends beyond the footprint of the building, to enable garden planting.

27.10 Consideration should also be given to the existence of trees on or adjacent to the site, including street trees, and the root protection zones need by these trees. Where there are trees on or adjacent to the site, the Council will require an arboricultural report to be submitted as part of a planning application.

Camden Planning Guidance and the Hampstead Conservation area Statement Policies CGP1 and CGP4 are listed below:

6 Landscape design and trees

KEY MESSAGES

- Camden's trees and green spaces are integral to its character.
- Landscape design and green infrastructure should be fully integrated into the design of schemes from the outset.
- We require a survey of existing trees and vegetation to be carried out prior to the design of a scheme.

6.1 This guidance sets out how to protect trees and vegetation and design high quality landscapes in conjunction with development proposals to ensure an attractive, safe, accessible, sustainable and ecologically diverse environment.

6.2 This chapter sets out:

- how existing trees and landscape should be protected;
- what specific protection is given to some trees;
- how new landscaping should be incorporated into developments; and
- considerations for specific landscaped areas and types of landscaping.

6.3 The green landscape of the Borough is formed by parks and open spaces, railway and canal corridors, trees, gardens, green walls and roofs. These landscape components provide Camden's green infrastructure and play a key role in maintaining the local climate, reducing storm water run off, increasing biodiversity, providing space for urban food production and providing public enjoyment.

6.4 We expect landscape design and the provision of green infrastructure to be fully integrated into the design of development proposals from the beginning of the design process.

6.5 This section sets out further guidance on how we will apply Core Strategy Policy CS14 Promoting high quality places and conserving our heritage and Development Policy DP24 Securing high quality design.

Where does this guidance apply?

6.6 This guidance applies to all proposals affecting or including landscape design on and around buildings and proposals relating to on and off site trees.

How should existing Trees and Landscape be protected?

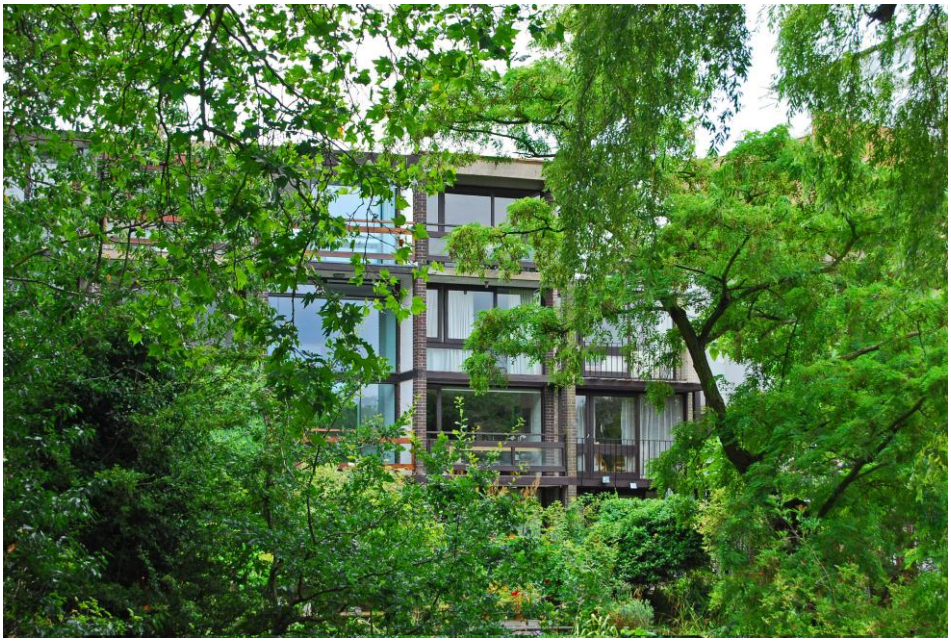
Benefits of retaining vegetation and trees

6.7 Vegetation of all types is at a premium in Camden given the Borough's dense urban environment. Camden's tree canopy and other existing vegetation are integral to its character. If you maintain existing trees and

vegetation on a development site it will help provide a sense of maturity to a development and integrate a development into its setting. Existing trees and vegetation are a key component in adapting to climate change and conserving biodiversity. See CPG3 Sustainability chapters on Climate change adaptation and Biodiversity. Existing species can serve as an indicator of what might be successfully grown on the site when selecting additional plants. The retention of existing mature trees and vegetation also make an important contribution to the sustainability of a project. For example by reducing the impacts and energy demand associated with the provision of new plants such as in their transportation and the irrigation required.

How should existing trees and vegetation be protected?

6.8 We will require a survey of existing trees and vegetation to be carried out prior to the design of a scheme in order to identify what trees and vegetation should be retained and protected on site. We will expect developers to follow the principles and practices set out in BS 5837: 2005 Trees in relation to construction to integrate existing trees into new developments.



6.9 BS5837: 2005 Trees in relation to construction outlines the survey method for identifying which trees should be retained and protected. Once the survey has identified the important trees and vegetation a Tree Constraints Plan (TCP) needs to be prepared for the site. The TCP is essential to site planning as it provides the limitations for development including:

- site layout and building lines;
- changes in levels;
- foundation design; and

- service provision where the root zones and crown spread of trees are to be protected.

NEW UTILITIES

Useful guidance for the installation of new utilities in the vicinity of trees is also provided in National Joint Utilities Group (NJUG) Vol 4 - Guidelines for the Planning, Installation and Maintenance of Utility Apparatus in Proximity to Trees

6.10 The TCP should also identify the provision of sufficient space, above and below ground for new planting to develop and mature and existing trees to continue to grow (see paragraph 6.42 below regarding soft landscape design).

6.11 Where trees are identified to be retained it is imperative that contracting and site supervision procedures are in place to ensure that there is no damage during and after construction. We will normally seek a Method Statement which sets out how trees that are to be retained, both on and adjacent to the site will be protected. The Method Statement should identify how the provision of site accommodation, storage areas, site access and the positioning, heights and arcs of cranes will not affect the trees and vegetation that are to be protected.

Root zone

The area and volume of soil around the tree in which roots are found. May extend to three or more times the branch spread of the tree, or several times the height of the tree.

Crown spread

The extent of the branches, twigs and leaves that form the top of the tree

Specific protection for trees

6.12 Where a planning application involves works that affect trees either within the application site or on adjacent land (including street trees) we will require the following information to determine the application:

1. A Tree Survey
   (see section 4.2 of BS5837:2005)
2. A Tree Constraints Plan
   (see sections 5.2 and 5.3 of BS5837:2005)
3. An Arboricultural Implications Assessment
   (see section 6 of BS5837:2005)
4. An Arboricultural Method Statement for the protection of trees to be retained including a Tree Protection Plan
   (see section 7 of BS5837:2005)

6.13 Failure to supply the documents outlined above may lead to a planning application not being validated.

6.14 To obtain a copy of BS5837:2005 please visit www.StandardsUK.com and for a list of arboricultural consultants visit www.trees.org.uk, www.charteredforesters.org and www.consultingarboristssociety.co.uk.

Tree preservation orders

6.15 Many trees in Camden are covered by a Tree Preservation Order (TPO). Please contact the Council to find out if a tree is protected by a TPO.

TREE PRESERVATION ORDER

A tree preservation order is made by the Council to legally protect specific trees or groups of trees that provide public amenity.

Unauthorised works to a tree with a TPO is a criminal offence and may result in prosecution and, upon conviction, a fine.

6.16 Works (above or below ground) to trees with a TPO require our permission. Application forms for these works are available at www.camden.gov.uk.

6.17 Works to a tree with a TPO required to enable the implementation of a planning permission are dealt with as part of a planning application. A further TPO application is not required.

Trees in Conservation Areas

SECTION 211

Under Section 211 of the Town & Country Planning Act 1990, anyone proposing to cut down or carry out work on a tree in a Conservation Area must provide the Council 6 weeks notice of their intention to do so.

6.18 All trees in Conservation Areas with a trunk diameter of 75mm or greater measured at 1.5m above ground level are protected under section 211 of the Town and Country Planning Act 1990 (as amended). If you are proposing works to a tree in a Conservation Area, above or below ground, you are required to give Camden Planning Services six weeks notice of your proposals (See above link for forms). Works to a tree in a Conservation Area required to facilitate the implementation of a planning permission are dealt with as part of a planning application. A further section 211 Notification is not required. If you carry out unauthorised works to a tree in a Conservation Area is a criminal offence and may result in prosecution and, upon conviction, a fine.

How should new landscaping be included into a development?

General principles

6.19 Urban landscape design encompasses the following types of spaces:

- streets and associated public spaces,
- parks, public and private squares, gardens,
- amenity and servicing space around buildings; and

- buildings themselves.

6.20 The principle components of landscape design are soft landscape details (planting) and hard landscape details (the constructed aspects of design) for example surfaces, lighting, seating, water features and boundary treatments.

6.21 Urban spaces have particular character which results from a combination of factors including geology, ecology, topography and the history of their development and use. We will expect new landscape design to respond to, preserve and enhance local character, including through the:

- preservation of existing trees and hedges;
- planting of new trees and hedges; and
- detailed design of boundary treatments and spaces within the site particularly where they are visible to the public domain.

6.22 Planning applications will be assessed against

- the successful resolution of the above elements into the design of the site
- whether the site design has optimised opportunities to increase a site's sustainability and function in adapting to climate change (see CPG3 Sustainability for further details on Biodiversity and Climate change adaptation)
- the need to reduce opportunities for criminal behaviour (see the chapter in this guidance on Designing safer environments)
- the need to provide inclusive environments (see CPG6)

Specific areas that are landscaped and contain trees

6.23 Areas within a development site that are generally landscaped include:

- gardens;
- access and servicing routes;
- parking spaces and cycle stores;
- boundary walls, fences and railings; and

- building roofs and walls.

Gardens

6.24 Front, side and rear gardens make an important contribution to the townscape of the Borough and contribute to the distinctive character and appearance of individual buildings and their surroundings. Gardens are particularly prone to development pressure in the Borough with their loss resulting in the erosion of local character and amenity, biodiversity and their function in reducing local storm water run off.

Front Gardens

6.25 The design of front gardens and forecourt parking areas make a large impact on the character and attractiveness of and area and in particular the streetscene. The design of front gardens and other similar forecourt spaces should:

- consider a balance between hard and soft landscaping. Where changes take place no more than 50% of the frontage area should become hard landscape. Where parking areas form part of the forecourt enough of the front boundary enclosure should be retained to retain the spatial definition of the forecourt to the street and provide screening;
- retain trees and vegetation which contribute to the character of the site and surrounding area;
- retain or re-introduce original surface materials and boundary features, especially in Conservation Areas such as walls, railings and hedges where they have been removed. If new materials are too be introduced they should be complementary to the setting; and
- prevent the excavation of lightwells as a means of providing access to basements where this does not form past of the historical means of access to these areas.

Paving of front gardens

CHANGES TO PERMITTED DEVELOPMENT

The General Permitted Development Order no longer allows the creation of more than 5 square meters of impermeable surfaces at the front of dwelling houses that would allow uncontrolled runoff of rainwater from front gardens onto roads without first obtaining planning permission.

Changes to frontages incorporating hard standings may also be affected by Article 4 Directions. Article 4 Directions are issued by the Council in circumstances where specific control over development is required, primarily where the character of an area of acknowledged importance would be threatened, such as conservation areas

6.26 Planning Permission will not be granted for hard standings greater than five square metres that do not incorporate sustainable urban drainage systems (SUDS) into the design. SUDS incorporate permeable surfaces to allow water to soak into the subsoil, rather than being diverted into the stormwater system. SUDS are particularly appropriate in the parts of the borough north of Euston Road as this area has predominantly clay soils. Methods for choosing the appropriate design of a SUDS are provided in "Responsible rainwater management around the home" available from www.paving.org.uk. Planning applications which incorporate car parking areas into developments will be required to demonstrate that the chosen solution is appropriate to the underlying soil type.

Creating a cross over

6.27 For single family dwellings planning permission is not required for the creation of a cross over unless the property is affected by an Article 4 Direction or the cross over is to a classified road. However permission is required for the formation of a cross over from the Highways Authority. The Highways Authority will generally refuse permission where it would result in the loss of on street car parking spaces.

6.28 Planning permission is required for forecourt parking at the fronted of buildings divided into flats. Listed Building Consent is required to alterations to structures affecting listed buildings including structures within their curtilage.

Listed building consent

Legally required in order to carry out any works to a Listed Building which will affect its special value. This is necessary for any major works, but may also be necessary for minor alterations and even repairs and maintenance. Listed Building Consent may also be necessary for a change of use of the property.

Rear Gardens

6.29 Rear gardens are important as they:

- form part of the semi public domain where they are over looked by large numbers of properties and the occupants of surrounding buildings benefit from the outlook.

- form the character of an area in terms of the relationship between buildings and spaces and the resulting openness or sense of enclosure
- provide a sense of the greenery where they can be viewed through gaps between buildings
- provide a sense of visual separation and privacy
- soften the impact of buildings and integrate them into their setting
- play a significant role in maintaining the biodiversity of the borough (see CPG3 Sustainability for further details on Biodiversity). In particular groups of trees and vegetation along the rear boundaries of garden provide important wild life corridors within existing development patterns.

6.30 The potential detrimental affects of new structures in gardens can be reduced by:

- carefully siting structures away from vegetation and trees,
- designing foundation to minimises damage to the root protection zones of adjacent trees,
- including green roofs, green walls on new development and vegetation screens.

Root protection zone

The area around the base or roots of the tree that needs to be protected from development and compaction during construction to ensure the survival of the tree.

6.31 Planning permission is unlikely to be granted for development whether in the form of extensions, conservatories, garden studios, basements or new development which significantly erode the character of existing garden spaces and their function in providing wildlife habitat (See the chapters on Extensions, Alterations and Conservatories in this guidance document, and CPG4 on Basements).

Access and servicing areas

6.32 Where underground parking and/or servicing forms part of a larger development, access should be integral to the design of the development. Entrances and ramps should be discrete.

6.33 Entrances and adjoining areas of buildings are often spaces which require the integration of a number of competing needs such as the provision of bins, cycle storage, meters and inspection boxes and external lighting. These elements should be constructed with materials sympathetic to the site and surroundings. You can minimise the visual impact of storage areas by careful siting and incorporating planters to screen developments and incorporating green roofs as part of their structure.

6.34 Space and location requirements for the storage of waste and recycling can be found in this guidance in chapter on Waste and recycling

storage. Further guidance on how access to site and parking areas should be designed can be found in CPG6 Transport.

Boundary Walls, Fences and Railings

6.35 Boundary walls, fences and railings form the built elements of boundary treatments. They should be considered together with the potential for elements of soft landscaping. For example, we encourage the combination of low brick boundary walls and hedges as a boundary treatment. Boundary treatments should:

- delineate public and private areas;
- contribute to qualities of continuity and enclosure within the street scene; and
- provide site security and privacy.

6.36 Due to the prominence of the boundary treatments in the streetscene we will expect the design, detailing and materials used to provide a strong positive contribution to the character and distinctiveness of the area and integrate the site into the streetscene.

6.37 With regards to boundary walls, fences and railings, we will expect that:

- you consider repairing boundary walls, fences and railings before they are replaced;
- they make a positive contribution to the appearance and character of the development site and to the streetscene;
- you consider designs to be effective for their function.
- the design and construction does not damage any on site or off site trees that are identified for retention (See paragraphs 6.15 to 6.18 above).

6.38 For boundary treatments around listed buildings or in a conservation area we will expect:

- the elements are repaired or replaced to replicate the original design and detailing and comprise the same materials as the original features
- the works preserve and enhance the existing qualities and context of the site and surrounding area

6.39 Planning Permission is not required for the erection of a boundary treatment no higher than 1m where it abuts the highway or 2m on any other boundary. These heights are measured from ground level and include any structure that may be attached for example a trellis attached to the top of boundary wall.

6.40 Listed Building consent may be required for any works to boundary treatments within the curtilage of a listed building.

Types of landscaping

6.41 Landscaping are divided into the following broad types:

- soft landscaping (planting);
- hard landscaping; and
- landscaping on building.

Soft Landscape Details (Planting)

6.42 Soft Landscape is a term to describe the organic, vegetative or natural elements of Landscape Design. There are three main objectives in planting design (1) Functional (2) Ecological and (3) Aesthetic. Each of these objectives is likely to be inter related however one may be prioritised over another for the purpose of a particular project.

6.43 Functional objectives include:

- integrating a site with its surroundings;
- providing spatial definition and enclosure;
- directing pedestrian and vehicular movement;
- providing shelter,
- providing micro climatic amelioration and
- providing SUDS.

Ecological Objectives include:

- maintaining and enhancing natural processes; and
- increasing the biodiversity value of a site.

Aesthetic Objectives include:

- creating or contributing to the character of a place; and
- adding to people's sensory enjoyment in the use of a space.

Crown canopy

The uppermost layer in a forest or group of trees.

6.44 Landscaping schemes need to maintain and plant large canopy trees as a means of countering the negative effects of increasing urban temperatures due to climate change. Existing large canopy trees are part of the character of several areas in the Borough. In these areas in particular and other areas where the opportunity arises space should be made for the growth and development of large canopy trees. Large canopy trees are usually considered to be trees which reach a mature height of 15-20m+. Site design should make provision for the expansion of the crown canopy of these trees and sufficient soil volume to support a trees growth to maturity. As a general rule the soil volume required to support a healthy large canopy tree is 6m x 6m x 1m depth. The detailed requirements for the growth and development of large canopy urban trees can be found in “Up by the Roots” by James Urban (International Society for Arboriculture, 2008).

6.45 The long term success of planting schemes will determine species selection suitable for local growing conditions (soil conditions, temperature ranges, rainfall, sun light and shade) and provision for on

going maintenance. Generally native species are considered to be most adapted to local conditions however there are a range of exotic plants which are at least equally adaptable to the unique ecology of urban areas and which provide an important contribution to a site's biodiversity.

6.46 Maintenance requirements should be considered at the design stage in terms of ensuring there is access for maintenance, whether maintenance materials need to be stored on site and that there are available sources of water. Water conservation should be intrinsic to the design of a planting scheme whether it is by selecting drought tolerant plants, maintaining soil conditions conducive to water retention with, for example, mulching or providing for on site water harvesting and grey water recycling.

6.47 Planning applications will be assessed against the degree to which planting schemes meet their objectives and that the chosen objectives are appropriate for the site. Planning applications should be accompanied by:

1. a statement of the design objectives of planting plans;
2. planting plans indicating species, planting patterns, planting size and density; and
3. where appropriate managements plans.

Hard Landscape Details

6.48 Hard landscape is a term used to describe the hard materials used in landscape design such as paving, seating, water features, lighting, fences, walls and railings (see paragraphs 6.35 to 6.38 above for guidance on boundary walls, fences and railings and the chapter on Design excellence regarding the design of public space).

6.49 Hard landscape makes a significant contribution to the character of the Borough. The scale, type, pattern and mix of materials help define different uses and effects the perception of the surrounding buildings and soft landscape and overall quality of an area. To help integrate the development with its surroundings and contribute to the sustainability of the project we will expect:

- the selection of materials, patterning and methods of workmanship to consider those already at use in the area;
- traditional and natural materials to be used, especially in Conservation Areas (Guidance can be found in Conservation Area Statements, Appraisals and Management Plans); and
- the use of salvaged and re used materials, where appropriate.

6.50 The Council will discourage the replacement of soft landscaping with hard landscaping in order to preserve the environmental benefits of vegetation identified above. However where hard landscape is unavoidable we will seek sustainable drainage solution to any drainage (see CPG3 Sustainability chapter on Flooding).

Trees, landscape and biodiversity

2.65 Proposals for basement development that take up the whole front and / or rear garden of a property are very unlikely to be acceptable. Sufficient margins should be left between the site boundaries and any basement construction to enable natural processes to occur and for vegetation to grow naturally. These margins should be wide enough to sustain the growth and mature development of the characteristic tree species and vegetation of the area. The Council will seek to ensure that gardens maintain their biodiversity function for flora and fauna and that they are capable of continuing to contribute to the landscape character of an area so that this can be preserved and enhanced. Applicants should contact the Council for further advice.

GREEN ROOF
A roof that has vegetation growing on it, which can help improve visual appeal, reduce the environmental impact of the building and create habitat for native flora and fauna.

DETENTION POND
A stormwater management facility that is designed to protect against flooding by storing water for a limited period of a time.

2.66 The basement development should provide an appropriate proportion of planted material to allow for rain water to be absorbed and/or to compensate for the loss of biodiversity caused by the development. This will usually consist of a green roof or detention pond on the top of the underground structure. It will be expected that a minimum of 0.5 metres of soil be provided above basement development that extends beyond the footprint of the building, to enable garden planting, although we will encourage applicants to provide 1 metre of soil to mitigate the effect on infiltration capacity. The use of SUDS is sought in all basement developments that extend beyond the profile of the original building. For further guidance on SUDS, see CPG3 Sustainability (water efficiency chapter).

2.67 Consideration should be given to the existence of trees on or adjacent to the site, including street trees and the required root protection zone of these trees (further information on the protection of existing trees in included in CPG in this document on Landscaping and trees).

ROOT PROTECTION ZONE
The area around the base or roots of the tree that needs to be protected from development and compaction during construction to ensure the survival of the tree.

Lightwells

2.68 The building stock in Camden is varied. Some areas contain basements developments that include front lightwells taking up part, or all, of the front garden. Other areas do not have basements or lightwells that are visible from the street. The presence or absence of lightwells helps define and reinforce the prevailing character of a neighbourhood.

A4.7 Hampstead Conservation Area Statement (2001)

Trees and Landscape Design

H45 All trees which contribute to the character or appearance of the Conservation Area should be retained and protected. Developers will be expected to incorporate any new trees sensitively into the design of any development and demonstrate that no trees will be lost or damaged before, during or after development.

H46 All new development should have a high standard of external space (landscape) design, which should respect the character and appearance of the Conservation Area.

H47 Applications for development should take into account the possible impact on trees and other vegetation, and state clearly whether any damage/removal is likely and what protective measures are to be taken to ensure against damage during and after work. BS 5837: 1991 shall be taken as the minimum required standard for protection of trees. All trees within 10 metres of a development proposal should be clearly identified. This also applies to underground development.

A4.8 The London Plan 2011, Paragraph 7.21, Trees and Woodland:

A) Trees and woodlands should be protected, maintained, and enhanced, following the guidance of the London Tree and Woodland Framework (or any successor strategy).

B) Existing trees of value should be retained and any loss as the result of development should be replaced following the principle of 'right place, right tree'. Wherever appropriate, the planting of additional trees should be included in new developments, particularly large-canopied species.

C) Boroughs should follow the advice of PPS9 to protect 'veteran' trees and ancient woodland where these are not already part of a protected site.

D) Boroughs should develop appropriate policies to implement their borough tree strategy.

A4.9 The London Tree and Woodland Framework (4. P 21) (Key aims):

A. To ensure trees and woodlands contribute to a high quality natural environment.
B. To help shape the built environment and new development in a way that strengthens the positive character and diversity of London.
C. Through people's contact with trees and woodlands to help foster community and individual people's well-being and social inclusion.
D. To support the capital's economy.

APPENDIX 5

LANDMARK TREES REPORT (REF: KWA/29NE/AIA/01)

Landmark Trees

ARBORICULTURAL IMPACT ASSESSMENT REPORT:

29 New End

Hampstead

London

NW3 1JD

REPORT PREPARED FOR:

Karawana Ltd

c/o Intrust Advisory Ltd

Charles House

108 Finchley Road

London

NW3 5JJ

REPORT PREPARED BY

Adam Hollis

MSc ARB MICFor FArbor A MRICS C Env

Ref: KWA/29NE/AIA/01a

Date: 14th October 2014

APPENDICES

Caveats

This report is primarily an arboricultural report. Whilst comments relating to matters involving built structures or soil data may appear, any opinion thus expressed should be viewed as qualified, and confirmation from an appropriately qualified professional sought. Such points are usually clearly identified within the body of the report. It is not a full safety survey or subsidence risk assessment survey. These services can be provided but a further fee would be payable. Where matters of tree condition with a safety implication are noted during a survey they will of course appear in the report.

A tree survey is generally considered invalid in planning terms after 2 years, but changes in tree condition may occur at any time, particularly after acute (e.g. storm events) or prolonged (e.g. drought) environmental stresses or injuries (e.g. root severance). Routine surveys at different times of the year and within two - three years of each other (subject to the incidence of the above stresses) are recommended for the health and safety management of trees remote from highways or busy access routes. Annual surveys are recommended for the latter.

Tree works recommendations are found in the Appendices to this report. It is assumed, unless otherwise stated ("ASAP" or "Option to") that all husbandry recommendations will be carried out within 6 months of the report's first issue. Clearly, works required to facilitate development will not be required if the application is shelved or refused. However, necessary husbandry work should not be shelved with the application and should be brought to the attention of the person responsible, by the applicant, if different. Under the Occupiers Liability Act of 1957, the owner (or his agent) of a tree is charged with the due care of protecting persons and property from foreseeable damage and injury.' He is responsible for damage and/or nuisance arising from all parts of the tree, including roots and branches, regardless of the property on which they occur. He also has a duty under The Health and Safety at Work Act 1974 to provide a safe place of work, during construction. Tree works should only be carried out with local authority consent, where applicable.

Inherent in a tree survey is assessment of the risk associated with trees close to people and their property. Most human activities involve a degree of risk, such risks being commonly accepted if the associated benefits are perceived to be commensurate.

Risks associated with trees tend to increase with the age of the trees concerned, but so do many of the benefits. It will be appreciated, and deemed to be accepted by the client, that the formulation of recommendations for all management of trees will be guided by the cost-benefit analysis (in terms of amenity), of tree work that would remove all risk of tree related damage.

Prior to the commencement of any tree works, an ecological assessment of specific trees may be required to ascertain whether protected species (e.g. bats, badgers and invertebrates etc.) may be affected.

Tree Constraints & Protection Overview

Client:	Karawana Ltd c/o Intrust Advisory Ltd	**Case Ref:**	KWA/29NE/AIA/01a
Local Authority:	LB Camden	**Date:**	14th October 2014
Site Address: 29 New End, Hampstead, London NW3 1JD			
Proposal: Demolition of the existing building and replacement with residential flats with a basement (LGF) and associated landscaping.			

Report Checklist	**Y/N**		**Y/N**
Arboricultural constraints on site	Y	Trees removal proposed	Y
Tree Survey	Y	Topographical Survey	Y
BS5837 Report	Y	Conservation Area	Y
Tree Preservation Orders	Y	(T4 and T14)	
Tree Protection Plan:	N/a	(Include in future method statement)	
Tree Constraints Plan:	Y		
Arboricultural Impact Assessment:	Y		

Site Layout				
Site Visit	Y	Date: 22/05/13 – reviewed 08/10/14	Access Full/Partial/None	F
Trees on Site	Y		Off-site Trees	Y
Trees affected by development	Y		O/s trees affected by development	Y
Tree replacement proposed:	Y		On or off-site trees indirectly affected by development	N

Trees with the potential to be affected

Felling of 5 category 'C' trees: T3, T5, T10, T11 and T14 (TPO'd tree, but felling previously agreed with Council). Category U trees T2, T8, T9 and T12 impacted by development or landscape enhancement to be felled on grounds of good husbandry (see comments below).

Low/very low RPA impacts to T1 & T4 (TPO'd) from LGF (confirmed by trial pits)

Potential landscaping impacts to T4, T6 & T7 – low subject to mitigation

Comments

Recommended works to 8 trees, including felling the 4 'U' category trees (T2, T8, T9 and T12), regardless of development but also pertinent to maintaining a safe work site.

Recommendations

1	Proposal will mean the loss of important trees (TPO/CA)	N
2	Proposal has sufficient amelioration for tree loss	Y
3	Proposals provide adequate tree protection measures	Y
4	Proposal will mean retained trees are too close to buildings	N
5	Specialist demolition / construction techniques required	Y
6	The Proposal will result in significant root damage to retained trees	N
7	Further investigation of tree condition recommended	Y

RPA= Root Protection Area
TPP= Tree Protection Plan
AMS= Arboricultural Method Statement
AIA = Arboricultural Implication Assessment
BS5837: 2012 'Trees in relation to design, demolition and construction – Recommendations'

1. SUMMARY

1.1 This report comprises an arboricultural impact assessment of the proposals for 29 New End, Hampstead, London NW3 1JD, reviewing any conflicts between the proposals and material tree constraints identified in our survey. The report incorporates information identified in the previous Arboricultural Impact Assessment of the proposals by Tree Projects, in the report dated March 2012.

1.2 There are 13 trees surveyed on or around the site, of which 1 is category 'A' (High Quality), 3 are 'B' category *(Moderate Quality), 5 are 'C' category *(Low Quality) and 4 are 'U' category *(Unsuitable for Retention). In theory, only moderate quality trees and above are significant material constraints on development. However, the low quality trees will comprise a constraint in aggregate, in terms of at least, replacement planting.

1.3 The principal primary impacts of the proposals are the felling of 5 category 'C' trees T3, T5, T10, T11 and T14 (with 4 further category 'U' trees T2, T8, T9 and T12 to be felled on husbandry grounds/ to facilitate landscaping). The felling of the TPO tree, T14 has been previously discussed and agreed with the Council's Tree Officer (Source: Tree Projects Report dated March 2012). The loss of these trees is rated as low impact, without significant effect on the visual character of the local conservation area.

1.4 Other primary impacts include the minor Lower Ground Floor (LGF) Level encroachment of T1 and T4's theoretical RPA. Both impacts to T1 and T4 (also subject to a TPO) have been investigated by trial pits and are (very) low. Of potentially greater significance, is the construction of the LGF beneath the canopies of both trees (subject to method of working). T1 already requires arboricultural work to be undertaken on husbandry grounds (see Appendix 2), which should provide the necessary clearance for construction. A crown-lift to T4 would also provide the necessary clearance, provided low-access equipment is used (e.g. mini-piling rigs).

1.5 The demolition of the existing property should be undertaken with due care, proceeding inwards in a "pull-back" fashion. Adequate supervision and protection of the retained trees will be required.

1.6 The removal of the existing tennis court and proposed landscaping to the rear of the property also has the potential to cause significant impacts. However, with the manual excavation of the tennis court and no-dig/porous paving replacement treatment, the impact to the retained trees would be minimal, if not beneficial.

1.7 Secondary impacts comprise minor shading and leaf deposition, particularly from T1. However, these impacts are similar to those which exist today, with mitigation rendering them negligible.

1.8 The site has potential for development without impacting significantly on the wider tree population or local landscape. Thus, with suitable mitigation and supervision the scheme is viable.

* British Standards Institute: Trees in relation to design, demolition and construction BS 5837: 2012 HMSO, London

2. INTRODUCTION

2.1 Terms of reference

2.1.1 LANDMARK TREES were asked by Karawana Ltd c/o Intrust Advisory Ltd to provide a survey and an arboricultural impact assessment of proposals for the site: 29 New End, Hampstead, London NW3 1JD. The report is to accompany a planning application.

2.1.2 The proposals are for the demolition of the existing building and replacement with residential flats with a basement and associated landscaping. The proposal has undergone several revisions, with the latest comprising a minor realignment of the basement wall to the west of the proposed building. This report will assess the impact on the trees and their constraints, identified in our survey. Although the proposals were known at the time of the survey, Landmark Trees endeavour to survey each site blind, working from a topographical survey, wherever possible, with the constraints plan informing their evolution.

2.1.3 I am a Registered Consultant and Fellow of the Arboricultural Association and a Chartered Forester, with a Masters Degree in Arboriculture and 25 years experience of the landscape industry - including the Forestry Commission and Agricultural Development and Advisory Service. I am a UK Registered Expert Witness, trained in single joint expert witness duties. I am also Chairman of the UK & I Regional Plant Appraisal Committee, inaugurated to promote international standards of valuation in arboriculture.

2.2 Drawings supplied

2.2.1 The drawings supplied by the client and relied upon by Landmark Trees in the formulation of our survey plans are:

Existing site survey: JKK4657_1A-TOPO

Proposals: NEN - PL - 120 rev L

2.3 Scope of survey

2.3.1 As Landmark Trees' (LT) arboricultural consultant, I surveyed the trees on site on 22nd May 2013, recording relevant qualitative data in order to assess both their suitability for retention and their constraints upon the site, in accordance with British Standard 5837:2012 Trees in relation to design, demolition and construction – Recommendations [BS5837:2012]. I returned to the site to review the survey on the 8th October 2014.

2.3.2 Our survey of the trees, the soils and any other factors, is of a preliminary nature. The trees were SURVEYED on the basis of the Visual Tree Assessment method expounded by Mattheck and Breloer (The Body Language of Trees, DoE booklet Research for Amenity Trees No. 4, 1994). LT have not taken any samples for analysis and the trees were not climbed, but inspected from ground level.

2.3.3 A tree survey is generally considered invalid in planning terms after 2 years, but changes in tree condition may occur at any time, particularly after acute (e.g. storm events) or prolonged (e.g. drought) environmental stresses or injuries (e.g. root severance). Routine surveys at different times of the year and within two - three years of each other (subject to the incidence of the above stresses) are recommended for the health and safety management of trees remote from highways or busy access routes. Annual surveys are recommended for the latter.

2.3.4 The survey does not cover the arrangements that may be required in connection with the laying or removal of underground services.

2.4 Survey data & report layout

2.4.1 Detailed records of individual trees are given in the survey schedule in Appendix 1 to this report.

2.4.2 A site plan identifying the surveyed trees, based on the client's drawings / topographical survey is provided in Appendix 5.

2.4.3 This plan also serves as the Tree Constraints Plan with the theoretical Recommended Protection Areas (RPA's), tree canopies and shade constraints, (from BS5837: 2012) overlain onto it. These constraints are then overlain in turn onto the client's proposals to create an Arboricultural Impact Assessment Plan in Appendix 6. General observations and discussion follow, below.

3.0 OBSERVATIONS

3.1 Site description

Photograph 1: Site at 29 New End, Hampstead, London NW3 1JD (Source: Google Maps)

3.1.1 New End runs broadly east to west within a largely residential area north of Hampstead Village. Christ Church stands adjacent to the northern boundary of the site. The existing property No. 29 New End comprises former nurses' accommodation standing within its plot on higher ground on the north side of New End.

3.1.2 The plot slopes gently from north to south, with retaining walls to the south containing landscape beds forward of the existing southern elevation.

3.1.3 In terms of the British Geological Survey, the site overlies the Bagshot Formation (see indicated location on Fig.1 plan extract below). The associated soils are generally fine, white, buff and sometimes crimson sands, grey when unweathered, with sporadic seams of pale pipe-clay and local beds of flint-pebble gravel. The actual distribution of the soil series are not as clearly defined on the ground as on plan and there may be anomalies in the actual composition of sand, clay and gravel content. Further advice from the relevant experts on the specific soil properties can be sought as necessary.

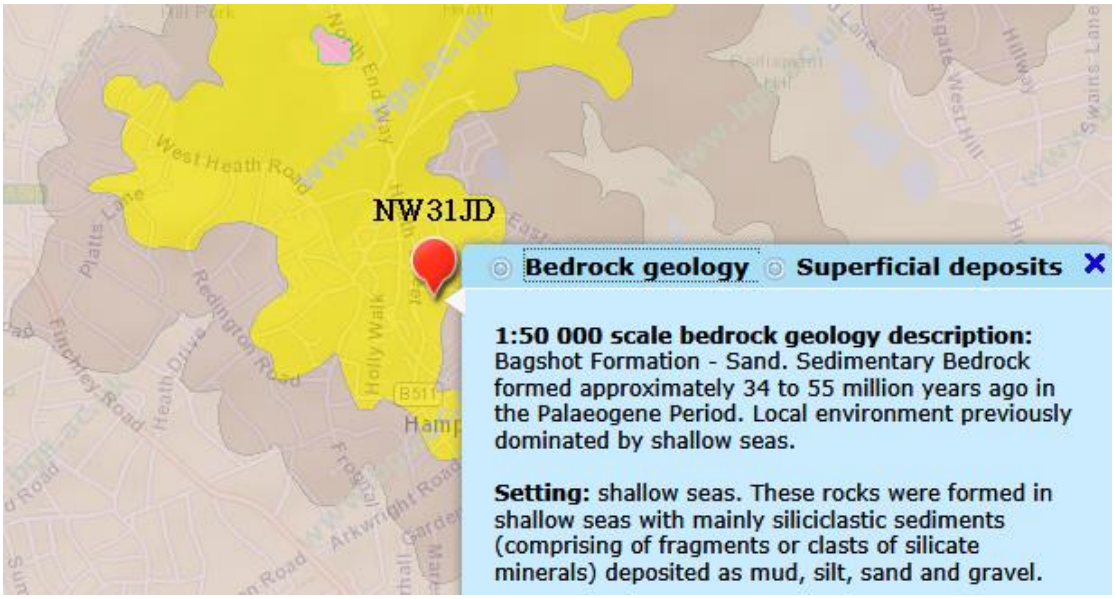


Figure 1: Extract from the BGS Geology of Britain Viewer

3.2 Subject trees

3.2.1	Of the 13 surveyed trees T4 is category 'A' (High Quality), T1, 6 & 7 are 'B' category (Moderate Quality), T3, 5, 10, 11 & 14 are 'C' category (Low Quality) trees and T2, 8, 9 and 12 are 'U' category trees (Unsuitable for Retention).
3.2.2	T1 is a category 'B' mature tree in fair condition given its age, pruning history, confined location and onset of Horse Chestnut Leaf minor and bleeding canker etc. The crown overhangs the street and adjacent New End Theatre and contains one 'Cobra' non-invasive support system. It is located in hard paved area with walls surrounding, which has limited root development and specifically, the root colonisation within the site (see trial pit evidence in Appendix 5).
3.2.3	T2 is a category 'U' elm sucker, which will most likely soon succumb to Dutch Elm Disease (DED). It is a relatively young tree (semi-mature), already exhibiting dead patches of brown, wilted leaves, each arising from a single branch – all symptoms of DED. It is also of poor form with an inherently flawed structure of weak primary unions (instead of a single stem, supporting well-spaced and subordinate branches the tree has developed a shrub-like, crowded habit of multiple-stems with compromised unions. The tree can be picked out from the street, if one is looking for it, but it is more or less eclipsed by the dominant horse chestnut, which stands in front of it and the building to its side.

3.2.4 T3 is a reasonable specimen of birch (category 'C'), that is now showing significant signs of stress with much smaller leaves on the upper branches, minor dieback at the tips and an overall sparse canopy. This may relate in part to the exceptionally dry September this year, but the trees condition is more marked than others of its species, and already exhibited the symptoms (to a lesser extent) in 2013 (our survey), if not in 2009 (Tree Projects' survey). This would suggest a fairly rapid decline. I am particularly aware of the condition of birch trees in the area, as we have been asked to provide an opinion on a birch tree's condition, in the area in a boundary dispute. The tree is located towards the rear of the plot, away from public view, conferring limited visual amenity.

3.2.5 T4 is a category 'A,' fully mature copper beech tree protected by TPO. It is located in an adjacent garden, but with its crown substantially overhanging the site with a low crown ground clearance. The tree was remotely surveyed only, but it appears to be in good condition. There is a large retaining wall between the site and ground in which the tree is rooted, with the tree perched on higher ground, approximately 1200mm above the site. The interposing wall acts as significant impediment to radial rooting, with the trial trench revealing only minor rooting (see Appendix 5). The canopy hangs down to c. 2m above ground to the east, but this lowest tier is composed of small tertiary branches of less than 50mm diameter. Larger branches of 75mm and above are found from c. 4m above ground and upwards. The outer limits of the canopy are also found in these lower tiers, such that any reduction in plotted dimensions could be concentrated herein (upon these smaller branches).

3.2.6 T5 is a category 'C', relatively small, self-seeded Sycamore to the north boundary of the site adjacent to Christ Church. This tree has limited amenity value, relative to T6 and T7, these being two well-established and mature category 'B' sycamores to the north of the site, adjacent to Christ Church, with T7 the more prominent from Christ Church Passage.

3.2.7 T8 & 9 are two category 'U' trees of somewhat limited stature, in fair condition (T9 low leaf/ bud density at the time of survey) and of low amenity value and foreshortened life expectancy. T10 is a category 'C,' self-seeded tree in good condition, but inappropriately located and damaging one adjacent wall. T11 (category 'C') and T12 (category 'U') are located to the front of the property; although in a prominent location, they are of limited service life and amenity. T14 is off-site, located adjacent to them at the back of the footpath, close to the south west corner of the site. This category 'C' tree is protected by a TPO, but previous informal discussions with the Borough Arboriculturist, Alex Hutson confirmed that its replacement should be acceptable (Source: Tree Projects Report dated March 2012).

3.2.3	In terms of age demographics there is a preponderance of mature trees on the site with few younger, replacement trees in the population.

3.2.4	Full details of the surveyed trees can be found in Appendix 1 of this report.
3.2.5	There are some arboricultural works required within the existing tree population. These are listed in Appendix 2. It is important to note that 3 trees require arboricultural works within the next 6 months (T1, T7 & T12).

3.3 Planning Status

3.3.1	The trees on and adjacent to the site are all provided with statutory protection by designation of the Hampstead Conservation Area. Camden Council has noted the existence of Tree Preservation Orders (TPO) to a Sorbus aucuparia (assumed to be T14) and a Copper Beech rooted in 10/11 Hampstead Square (assumed to be T4).

4.0 DEVELOPMENT CONSTRAINTS

4.1 Primary constraints

4.1.1 BS5837: 2012 gives Recommended Protection Areas (RPA's) for any given tree size. The individual RPA's are calculated in the Tree Schedule in Appendix 1 to this report, or rather the notional radius of that RPA, based on a circular protection zone. The prescribed radius is 12-x stem diameter at 1.5m above ground level, except where composite formulae are used in the case of multi-stemmed trees.

4.1.2 Circular RPA's are appropriate for individual specimen trees grown freely, but where there is ground disturbance, the morphology of the RPA can be modified to an alternative polygon, as shown in the diagram below (Figure 2). Alternatively, one need principally remember that RPA's are area-based and not linear – notional rather than fixed entities. **No modifications have been made in this instance (please see overleaf) on plan, but the findings of the trial pits and other structural features have been considered within our assessment.**

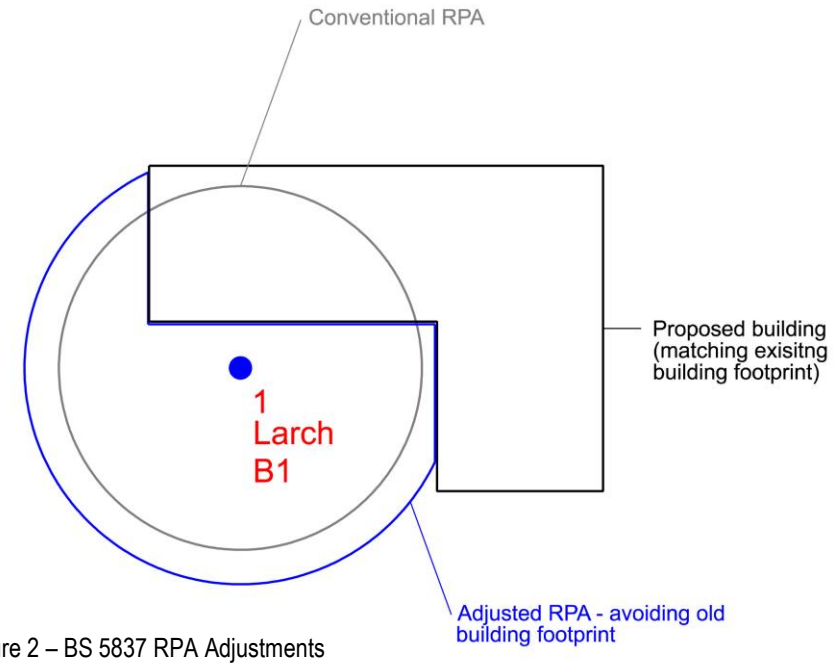


Figure 2 – BS 5837 RPA Adjustments

4.1.3 In BS5837, paragraph 4.6.2 states that RPA's should reflect the morphology and disposition of the roots; where pre-existing site conditions or other factors indicate that rooting has occurred asymmetrically, a polygon of equivalent area should be produced. Modifications to the shape of the RPA should reflect a soundly based arboricultural assessment of likely root distribution. Not infrequently, LT are requested by LPA Tree Officers to modify the RPA's to reflect their assumptions that e.g. a road will have drastically limited root growth.

4.1.4 Such assumptions cannot be proved without prior site investigations / trial pits. Where it is not always possible to conduct site investigations (e.g. below busy roads), we can always look to the published science. There seems little support for the popular myth that roads and services will curb root growth: research for the International Society of Arboriculture by Kopinga J (ISA 1994), found that "a constant high moisture content of the soil directly underneath the pavement surface can be considered as a major soil factor in attracting the trees' roots to develop there." By contrast, grass in lawns may actively antagonise tree roots with natural pathogens. Similarly, Professor F Miller (ISA 1994) found that service trenches at > 3m distances from trees had minimal impact on growth or crown shape.

4.1.5 A key misunderstanding, even among professionals, is that we conflate the RPA with the actual root system: RPA's are *prima facie* a notion / convention / treaty and almost entirely theoretical, but readily calculable. Conversely roots are a "known unknown," spatial entity that we predict at our folly. Yet, many are quick to do so.

4.1.6 LT favour the neutrality of a circular RPA, because in a difference of opinion, the tree officer will always have the prerogative to dictate the final modification of shape. With the best will in the world, the free allowance of modifications will tend to lead to inequitable outcomes, prejudicing the applicant and the practice is in our view, best avoided. The neutral circle dispenses with this inequity.

4.1.7 Ultimately, the point of the circular RPA is to illustrate areas of concern. The purpose of this report is to consider areas of concern (not to modify them to suit our argument or findings). Therefore, no modifications are made here to the RPA's, regardless of roads etc.

4.1.8 The quality of trees will also be a consideration: U Category trees are discounted from the planning process in view of their limited service life. Again, Category-C trees would not normally constrain development individually, unless they provide some external screening function.

4.1.9 At paragraph 5.1.1. BS5837: 2012 notes that "Care should be exercised over misplaced tree preservation; attempts to retain too many or unsuitable trees on a site are liable to result in excessive pressure on the trees during demolition or construction work, or post-completion demands on their removal."

4.1.10 In theory, only moderate quality trees and above are significant material constraints on development. However, the low quality trees will comprise a constraint in aggregate, in terms of at least, replacement planting.

4.1.11 In this instance, there are high and moderate quality trees on an around the site which could potentially constrain development. However, the existing building, hard surfacing and levels have evidently constrained the root colonisation of trees such as T1 and T4. The site also has 2 TPO trees (T4 and T14), which could potentially constrain future development. Both these trees are off-site, with T14 owned and managed by the Borough Council. It is understood that previous discussions with the Borough's Tree Officer confirmed that the removal and replacement of this tree would be acceptable (Source: Tree Projects Report dated March 2012).

4.2 Secondary Constraints

4.2.1 The second type of constraint produced by trees that are to be retained is that the proximity of the proposed development to the trees should not threaten their future with ever increasing demands for tree surgery or felling to remove nuisance shading (Figure 3), honeydew deposition or perceived risk of harm.

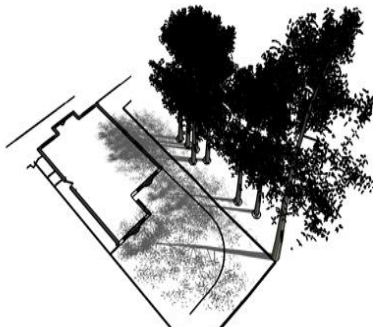


Figure 3 – Shading Constraints

4.2.2 The shading constraints are crudely determined from BS5837 by drawing an arc from northwest to east of the stem base at a distance equal to the height of the tree, as shown in the diagram opposite. Shade is less of a constraint on non-residential developments, particularly where rooms are only ever temporarily occupied.

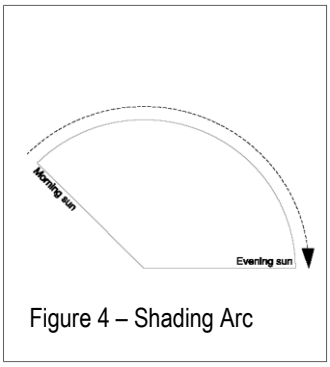


Figure 4 – Shading Arc

4.2.3 This arc (see Figure 4) represents the effects that a tree will have on layout through shade, based on shadow patterns of 1x tree height for a period May to Sept inclusive 10.00-18.00 hrs daily.

4.2.4	The orientation and proximity of T1 is likely to provide a variety of secondary constraints, including shading and organic deposition and the potential need to maintain crown clearance in the future. Minor leaf deposition is also likely to result from the retained trees on and off-site. The significance of these constraints will vary depending on the location and proximity to the proposed re-development.

Note: Sections 5 & 6 will now assess the impacts upon constraints identified in Section 4. Table 1 in Section 5 presents the impacts in tabular form (drawing upon survey data presented in Appendices 1 & 2). Impacts are presented in terms of whole tree removal and the effect on the landscape or partial encroachment (% of RPA) and its effect on individual tree health. Section 6 discusses the table data, elaborating upon the impacts' significance and mitigation.

5.0 Table 1: Arboricultural Impact Assessment

Hide irrelevant | Show All Trees

(Impacts assessed prior to mitigation and rated with reference to From Matheny & Clark (1998))

Ref: KWA/29NE/AIA

B.S. Cat.	Tree No.	Species	Impact	Tree / RPA Affected	Age	Growth Vitality	Species Tolerance	Impact on Tree Rating	Impact on Site Rating	Mitigation
B	1	Chestnut, Horse	Removal of existing hard landscaping Basement Demolition within Canopy (trial pit evidence suggests no RPA impact)	m^2 N/A %	Mature	Moderate	Moderate	Low	N/A	Airspade / manual excavation Remedial tree surgery (see Rec. Works)
U	2	Elm, English	Felled to Facilitate Development (NB: To be felled for general husbandry)	m^2 N/A %	Semi-mature	Normal	N/A	N/A	Very Low	New planting / landscaping
C	3	Birch, Silver	Felled to Facilitate Development	m^2 N/A %	Mature	Moderate	N/A	N/A	Low	New planting / landscaping
A	4	Beech, Copper (TPO)	Landscaping within RPA Building construction within RPA/Canopy (trial pit evidence suggests no roots)	m^2 N/A %	Mature	Normal	Moderate	Low	N/A	No-dig construction with porous surfaces. Remedial tree surgery/ supervised working
C	5	Sycamore	Felled to Facilitate Development/landscaping	m^2 N/A %	Semi-mature	Normal	N/A	N/A	Low	New planting / landscaping
B	6	Sycamore	Landscaping within RPA	m^2 N/A %	Mature	Normal	Moderate	Low	N/A	No-dig construction with porous surfaces

5.0 Table 1: Arboricultural Impact Assessment

Hide irrelevant | Show All Trees

(Impacts assessed prior to mitigation and rated with reference to From Matheny & Clark (1998))

Ref: KWA/29NE/AIA

B.S. Cat.	Tree No.	Species	Impact	Tree / RPA Affected	Age	Growth Vitality	Species Tolerance	Impact on Tree Rating	Impact on Site Rating	Mitigation
B	7	Sycamore	Landscaping within RPA	m^2 N/A %	Mature	Normal	Moderate	Low	N/A	No-dig construction with porous surfaces
U	8	Laburnum	Fell for general husbandry prior to development	m^2 N/A %	Mature	Poor	Moderate	N/A	Very Low	New planting / landscaping
U	9	Laburnum	Fell for general husbandry prior to development	m^2 N/A %	Early Mature	Poor	N/A	N/A	Very Low	New planting / landscaping
C	10	Sycamore	Felled to Facilitate Development	m^2 N/A %	Semi-mature	Normal	N/A	N/A	Low	New planting / landscaping
C	11	Plum, Myrobalan	Fell to facilitate new landscaping	m^2 N/A %	Mature	Moderate	N/A	N/A	Very Low	New planting / landscaping
U	12	Cherry, Kanzan	Fell to facilitate new landscaping	m^2 N/A %	Mature	Moderate	N/A	N/A	Very Low	New planting / landscaping

5.0 Table 1: Arboricultural Impact Assessment

Hide irrelevant | Show All Trees

(Impacts assessed prior to mitigation and rated with reference to From Matheny & Clark (1998))

Ref: KWA/29NE/AIA

B.S. Cat.	Tree No.	Species	Impact	Tree / RPA Affected	Age	Growth Vitality	Species Tolerance	Impact on Tree Rating	Impact on Site Rating	Mitigation
C	14	Rowan (TPO)	Fell to facilitate new landscaping	m^2 N/A %	Young	Normal	N/A	N/A	Low	New planting / landscaping

6.0 DISCUSSION

6.1 Rating of Primary Impacts

6.1.1 The principal primary impacts of the proposals are the felling of 5 category 'C' trees T3, T5, T10, T11 and T14 (with 4 further category 'U' trees T2, T8, T9 and T12 to be felled on husbandry grounds/ to facilitate landscaping). The felling of the TPO tree, T14 has been previously discussed and agreed with the Council's Tree Officer. The loss of these trees is rated as low impact, without significant effect on the visual character of the local conservation area.

6.1.2 Other primary impacts include the minor Lower Ground Floor (LGF) Level encroachment of T1 and T4's theoretical RPA. Both impacts to T1 and T4 (also subject to a TPO) have been investigated by trial pits and are (very) low. Of potentially greater significance, is the construction of the LGF beneath the canopies of both trees (subject to method of working). T1 already requires arboricultural work to be undertaken on husbandry grounds (see Appendix 2), which should provide the necessary clearance for construction. A crown-lift to T4 would also provide the necessary clearance, provided low-access equipment is used (e.g. mini-piling rigs).

6.1.3 The demolition of the existing property could also affect the retained tree population. Techniques are available to mitigate potential impacts. Adequate supervision and protection of the retained trees will be required.

6.1.4 The removal of the existing tennis court and proposed landscaping to the rear of the property also has the potential to cause significant impacts. However, with the manual excavation of the tennis court and no-dig/porous paving replacement treatment, the impact to the retained trees would be minimal, if not beneficial.

6.1.5 The principal of RPA encroachment is established within BS5837:2012 and supported by the source document, National Joint Utilities Guidelines 10 / Vol. 4 1995 / 2010. NJUG introduced the x12 diameter *Precautionary Zone* for supervised working and *Prohibited Zone* at a universal 1m from the base of the tree. RPA's are frequently confused with the NJUG Prohibited Zone, when they clearly correlate with the NJUG Precautionary Zone.

6.1.6 An RPA encroachment of <20% of RPA may be considered as low impact, given the permissive references to 20% RPA relocation and impermeable paving within BS5837:2012 and other published references to healthy trees tolerating up to 30-50% root severance (Coder, Helliwell and Watson in CEH 2006). The trees in question are healthy specimens of species with a good resistance to development impacts, and quite capable of tolerating these low impacts.

6.1.7 "**In practice 50% of roots can sometimes be removed with little problem**, provided there are vigorous roots elsewhere. Inevitably, this degree of root loss will temporarily slow canopy growth and even lead to some dieback" (Thomas 2000). LT do not recommend annexing such high proportions of the root system; rather that within the context of the published science, planning should not be unduly concerned by impacts that are well below the subcritical threshold – *tree health is not at stake.*

6.2 Rating of Secondary impacts

6.2.1 Secondary impacts comprise minor shading and leaf deposition, particularly from T1. However, these impacts are similar to those which exist today, i.e. development has no significant effect on the status quo, which has not lead to excessive pruning pressures.

6.3 Mitigation of Impacts

6.3.1 All plant and vehicles engaged in demolition works should either operate outside the RPA, or should run on a temporary surface designed to protect the underlying soil structure. The demolition of the building should proceed inwards in a "pull down" fashion. Hard surfacing can be lifted with caution by a skilled machine operator again working away from the tree.

6.3.2 RPA piling encroachments will be pre-emptively excavated by hand or with an Airspade under arboricultural supervision. Roots smaller then 25mm diameter may be cut cleanly with a sharp pruning saw or secateurs back to a junction. Roots larger than 25mm diameter may only be cut in consultation with an arboriculturalist

6.3.3 The replacement paving/hard landscaping will require a no-dig construction technique, either using a cellular confinement system with no fines aggregate for the sub-base or simply building upon the existing sub-base without disturbing the ground below. Choice of construction method will initially depend upon root penetration within the existing sub-grade. The key principle is not to excavate in the presence of roots and to provide a porous surface to promote healthy soil water relations for future root growth.

6.3.4	The immediate canopy encroachment can be avoided with a crown lift of lower limbs to T1 and T4, undertaken in accordance with British Standard 3998:2010 Tree work [BS3998].
6.3.5	Nuisance deposition can be mitigated with regular crown cleaning and filtration traps on the guttering (see Figure 5 below).
6.3.6	The shading impacts can be mitigated by building design, with the provision of dual aspect windows and choice of room layout. Some minor crown reduction may be necessary, but not such as to impose a burden of frequent, repetitive management.
6.3.7	The landscape impact of tree losses can be offset by the landscape proposals, ideally involving new planting of ornamental varieties of native species, and where appropriate with columnar or compact form. A selection of columnar tree species cultivars for constricted sites is provided in Appendix 4.

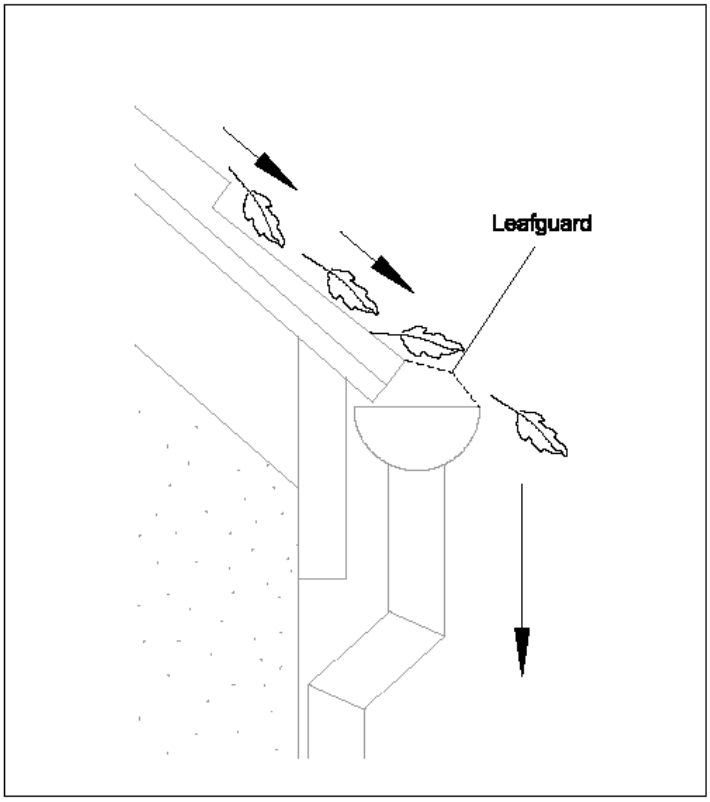


Figure 5: Filtration traps, as shown above, could be fitted on the gutters which can easily be maintained at 2-3m above ground.

7.0 CONCLUSION

7.1 The potential impacts of development are all relatively low in terms of both quality of trees removed and also RPA encroachments of trees retained.

7.2 The full potential of the impacts can be largely mitigated through design and precautionary measures. These measures can be elaborated in Method Statements in the discharge of planning conditions.

7.3 The species affected are generally tolerant of root disturbance / crown reduction and the retained trees are generally in good health and capable of sustaining these reduced impacts (subject to the further investigation of T1).

7.4 The trees that are recommended for felling are of little individual significance, such that their loss will not affect the visual character of the Conservation Area.

7.5 Therefore, the proposals will not have any significant impact on either the retained trees or wider landscape.

8.0 RECOMMENDATIONS

8.1 Specific Recommendations

8.1.1 Current tree works recommendations are found in Appendix 2 to this report, with works to facilitate development in Appendix 3 and a selection of columnar tree species cultivars for constricted sites provided in Appendix 4. Any tree removals recommended within this report should only be carried out with local authority consent.

8.1.2 Excavation and construction impacts within the RPA's of trees identified in Table 1 above, will need to be controlled by method statements specifying mitigation methods suggested in para 6.3 above and by consultant supervision as necessary. These method statements can be provided as part of the discharge of conditions.

8.1.3 Replace felled trees with native ornamental nursery stock under current best practice; i.e. conforming to and planted in accordance with the following:

- BS 3936:1980 Nursery Stock;
- BS 4043:1966 Transplanting Semi-Mature Trees; and
- BS 5236:1975 Cultivation and Planting of Trees in the Advanced Nursery Stock Category.
- All replacement stock should be planted and maintained as detailed in BS 4428:1989 (Section 7): Recommendations for General Landscape Operations.

8.2 General Recommendations

8.2.1 Any trees which are in close proximity to buildings proposed for demolition should be protected with a Tree Protection Barrier (TPB). This TPB should comprise steel, mesh panels 2.4m in height ('Heras') and should be mounted on a scaffolding frame (shown in Fig 2 of BS5837:2012). The position of the TPB can be shown on plan as part of the discharge of conditions, once the lay out is agreed with the planning authority. The TPB should be erected prior to commencement of works, remain in its original form on-site for the duration of works and removed only upon full completion of works.

8.2.2 A TPB may no longer be required during soft landscaping work but a full arboricultural assessment must be performed prior to the undertaking of any excavations within the RPA of a tree. This will inform a decision about the requirement of protection measures. It is important that all TPBs have permanent, weatherproof notices denying access to the RPA.

8.2.3 The use of heavy plant machinery for building demolition, removal of imported materials and grading of surfaces should take place in one operation. The necessary machinery should be located above the existing grade level and work away from any retained trees. This will ensure that any spoil is removed from the RPAs. It is vital that the original soil level is not lowered as this is likely to cause damage to the shallow root systems.

8.2.4 Any pruning works must be in accordance with British Standard 3998:2010 Tree work [BS3998].

8.2.5 Where sections of hard surfacing are proposed in close proximity to trees, it is recommended that "No-Dig" surfacing be employed in accordance with BS5837:2012 and 'The Principles of Arboricultural Practice: Note 1, Driveways Close to Trees, AAIS 1996 [APN1]'.

8.2.6 If the RPA of a tree is encroached by underground service routes then BS5837:2012 and NJUG VOLUME 4 provisions should be employed. If it is deemed necessary, further arboricultural advice must be sought.

8.2.7 Numerous site activities are potentially damaging to trees e.g. parking, material storage, the use of plant machinery and all other sources of soil compaction. In operating plant, particular care is required to ensure that the operational arcs of excavation and lifting machinery, including their loads, do not physically damage trees when in use. Accordingly, low access machinery, such as mini-piling rigs, are recommended work construction work below T1 and T4.

8.2.8 To enable the successful integration of the proposal with the retained trees, the following points will need to be taken into account:

1) Plan of underground services.
2) Schedule of tree protection measures, including the management of harmful substances.
3) Method statements for constructional variations regarding tree proximity (e.g. foundations, surfacing and scaffolding).
4) Site logistics plan to include storage, plant parking/stationing and materials handling.
5) Tree works: felling, required pruning and new planting. All works must be carried out by a competent arborist in accordance with BS3998.
6) Site supervision: the Site Agent must be nominated to be responsible for all arboricultural matters on site. This person must:
   - be present on site for the majority of the time;
   - be aware of the arboricultural responsibilities;

- have the authority to stop work that is causing, or may cause harm to any tree;
- ensure all site operatives are aware of their responsibilities to the trees on site and the consequences of a failure to observe these responsibilities;
- make immediate contact with the local authority and/or a retained arboriculturalist in the event of any tree related problems occurring.

8.2.9 These points can be resolved and approved through consultation with the planning authority via their Arboricultural Officer.

8.2.10 The sequence of works should be as follows:

i) initial tree works: felling, stump grinding and pruning for working clearances;
ii) installation of TPB for demolition & construction;
iii) installation of underground services;
iv) installation of ground protection;
v) main construction;
vi) removal of TPB;
vii) soft landscaping.

9.0 REFERENCES

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APPENDIX 1

TREE SCHEDULE

Notes for Guidance:

1. Height describes the approximate height of the tree measured in metres from ground level.
2. The Crown Spread refers to the crown radius in meters from the stem centre and is expressed as an average of NSEW aspect if symmetrical.
3. Ground Clearance is the height in metres of crown clearance above adjacent ground level.
4. Stem Diameter (Dm) is the diameter of the stem measured in millimetres at 1.5m from ground level for single stemmed trees. BS 5837:2012 formula (Section 4.6) used to calculate diameter of multi-stemmed trees. Stem Diameter may be estimated where access is restricted and denoted by '#'.
5. Protection Multiplier is 12 and is the number used to calculate the tree's protection radius and area
6. Protection Radius is a radial distance measured from the trunk centre.
7. Growth Vitality - Normal growth, Moderate (below normal), Poor (sparse/weak), Dead (dead or dying tree).
8. Structural Condition - Good (no or only minor defects), Fair (remediable defects), Poor - Major defects present.
9. Landscape Contribution - High (prominent landscape feature), Medium (visible in landscape), Low (secluded/among other trees).
10. B.S. Cat refers to (British Standard 5837:2012 section 4.5) and refers to tree/group quality and value; 'A' – High, 'B' - Moderate, 'C' - Low, 'U' - Unsuitable for retention. The following colouring has been used on the site plans:
    - High Quality (A) (Green),
    - Moderate Quality (B) (Blue),
    - Low Quality (C) (Grey),
    - Unsuitable for Retention (U) (Red)
11. Sub Cat refers to the retention criteria values where 1 is Arboricultural, 2 is Landscape and 3 is Cultural including Conservational, Historic and Commemorative.
12. Useful Life is the tree's estimated remaining contribution in years.

Landmark Trees

Site: 29 New End, Hampstead, London NW3 1JD

Date: 22nd May 2013 & 8th October 2014

BS5837 Tree Constraints Survey Schedule

Landmark Trees Ltd
Tel: 020 7851 4544
Surveyor(s): Adam Hollis

Ref: KWA/29NE/AIA

Tree No.	English Name	Height	Crown Spread	Ground Clearance	Clear Stem Height	Stem Diameter	Age Class	Protection Radius	Growth Vitality	Structural Condition	B.S. Cat	Sub Cat	Useful Life	Comments
1	Chestnut, Horse	17	8,7,11,7	2.0	3.0	920.0	Mature	11.0	Moderate	Fair	B	1	20-40	Bleeding canker (early) Constricted rooting N-S Cobra brace over theatre W Long laterals E fr'm decay'd h'd's
2	Elm, English	12	5543	2.0	2.0	349.0	Semi-mature	4.2	Normal	Fair	U		<10	Early signs of DED; poor form: Included bark in main stem unions
3	Birch, Silver	18	7766	1.0	3.0	480.0	Mature	5.8	Moderate	Fair	C	2	20-40	Sparse w. small upper leaves Long low lateral branches Die-back branch tips / clusters Canopy on roof and walls
4	Beech, Copper (TPO)	19	6996	2.0	3.5	860.0	Mature	10.3	Normal	Good	A	1	>40	Remote survey only Branches below 3.5m are <50mm dm.
5	Sycamore	13	3	5.0	7.0	230.0	Semi-mature	2.8	Normal	Good	C	2	>40	A tree with insignificant defects
6	Sycamore	19	5975	1.0	4.0	849.0	Mature	10.2	Normal	Good	B	1	20-40	Co-dominant stems Included bark in main stem unions Constricted rooting to N cracking boundary wall
7	Sycamore	16	6759	0.5	4.0	500.0	Mature	6.0	Normal	Good	B	2	20-40	Asymmetry (minor) Deadwood throughout crown Constricted rooting to N & E

Landmark Trees

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Date: 22nd May 2013 & 8th October 2014

BS5837 Tree Constraints Survey Schedule

Landmark Trees Ltd
Tel: 020 7851 4544

Surveyor(s): Adam Hollis

Ref: KWA/29NE/AIA

Tree No.	English Name	Height	Crown Spread	Ground Clearance	Clear Stem Height	Stem Diameter	Age Class	Protection Radius	Growth Vitality	Structural Condition	B.S. Cat	Sub Cat	Useful Life	Comments
8	Laburnum	6	2.5	2.0	2.0	400.0	Mature	4.8	Poor	Fair	U		<10	Ivy smothered Dm estimated
9	Laburnum	7	2	2.0	3.0	290.0	Early Mature	3.5	Poor	Fair	U		<10	Ivy clad A sparser than normal canopy
10	Sycamore	16	2442	2.0	3.0	496.8	Semi-mature	6.0	Normal	Fair	C	2	20-40	Multi stem weakness Included bark in main stem unions Constricted rooting to S & E
11	Plum, Myrobalan	6	1411	1.0	1.0	240.0	Mature	2.9	Moderate	Fair	C	2	10-20	A sparser than normal canopy limited SULE@
12	Cherry, Kanzan	6	4534	1.0	1.0	360.0	Mature	4.3	Moderate	Fair	U		<10	A sparser than normal canopy V. limited SULE
14	Rowan (TPO)	5	2	2.0	2.0	80.0	Young	1.0	Normal	Fair	C	2	>40	Remote survey only

APPENDIX 2

RECOMMENDED TREE WORKS

Notes for Guidance:

1, 2, 3 - Urgent (ASAP), Standard (within 6 months), Non-urgent (2-3 years)
RP - Pre-emptive root pruning of foundation encroachments under arboricultural supervision.
CB - Cut Back to boundary/clear from structure.
CL# - Crown Lift to given height in meters.
CT#% - Crown Thinning by identified %.
CCL - Crown Clean (remove deadwood/crossing and hazardous branches and stubs).
CR#% - Crown Reduce by given maximum % (of outermost branch & twig length)
DWD - Remove deadwood.
Fell - Fell to ground level.
FInv - Further Investigation (generally with decay detection equipment).
Pol - Pollard or re-pollard.
Mon - Monitor ongoing condition (annually by staff / owners & every 2-3 yrs by consultant).
Svr Ivy / Clr Bs - Sever ivy / clear base and re-inspect base / stem for concealed defects.

Landmark Trees

Site: 29 New End, Hampstead, London NW3 1JD
Date: 22nd May 2013 & 8th October 2014

Surveyor(s): Adam Hollis
Ref: KWA/29NE/AIA

Recommended Tree Works

Show All Trees
Hide irrelevant

Tree No.	English Name	Height	Stem Diameter	Crown Spread	Recommended Works	Comments/ Reasons
1	Chestnut, Horse	17	920.0	8,7,11 ,7	FInv CL3.5 CR15 Finv= climbing inspection of rot & brace 2	Bleeding canker (early) Constricted rooting N-S Cobra brace over theatre W Long laterals E fr'm decay'd h'd's Advisable for good arboricultural practice
2	Elm, English	12	349.0	5543	Fell 3	Early signs of DED; poor form: Included bark in main stem unions For general husbandry
7	Sycamore	16	500.0	6759	CR 15% DWD 2	Asymmetry (minor) Deadwood throughout crown Constricted rooting to N & E Advisable for good arboricultural practice
8	Laburnum	6	400.0	2.5	Fell 3	Ivy smothered Dm estimated For general husbandry
9	Laburnum	7	290.0	2	Fell 3	Ivy clad A sparser than normal canopy For general husbandry
12	Cherry, Kanzan	6	360.0	4534	Fell If tree not felled within 6 months CB S limb 25% 2	A sparser than normal canopy V. limited SULE For general husbandry

APPENDIX 3

RECOMMENDED TREE WORKS TO FACILITATE DEVELOPMENT (See Table 1)

Notes for Guidance:

CB - Cut Back to boundary/clear from structure.
CL# - Crown Lift to given height in meters.
CT#% - Crown Thinning by identified %.
CCL - Crown Clean (remove deadwood/crossing and hazardous branches and stubs).
CR#% - Crown Reduce by given maximum % (of outermost branch & twig length)
DWD - Remove deadwood.
Fell - Fell to ground level.
FInv - Further Investigation (generally with decay detection equipment).
Pol - Pollard or re-pollard.
Mon - Monitor ongoing condition (annually by staff / owners & every 2-3 yrs by consultant).
Svr Ivy / Clr Bs - Sever ivy / clear base and re-inspect base / stem for concealed defects.

Landmark Trees

Site: 29 New End, Hampstead, London NW3 1JD

Surveyor(s): Adam Hollis

Date: 22nd May 2013 & 8th October 2014

Ref: KWA/29NE/AIA

Recommended Tree Works To Facilitate Development

Show All Trees
Hide irrelevant

Tree No.	English Name	Height	Stem Diameter	Crown Spread	Recommended Works	Comments/ Reasons
3	Birch, Silver	18	480.0	7766	Fell	Sparse w. small upper leaves Long low lateral branches Die-back branch tips / clusters Canopy on roof and walls To facilitate development
4	Beech, Copper (TPO)	19	860.0	6996	CL3.5m CB2.5m Cut back only as necessary to clear footprint; i.e. lower SE crown	Remote survey only Branches below 3.5m are <50mm dm. To facilitate development
5	Sycamore	13	230.0	3	Fell	A tree with insignificant defects To facilitate development
8	Laburnum	6	400.0	2.5	Fell 3	Ivy smothered Dm estimated For general husbandry/to facilitate development
9	Laburnum	7	290.0	2	Fell 3	Ivy clad A sparser than normal canopy For general husbandry/to facilitate development
10	Sycamore	16	496.8	2442	Fell	Multi stem weakness Included bark in main stem unions Constricted rooting to S & E To facilitate development

Landmark Trees

Site: 29 New End, Hampstead, London NW3 1JD

Surveyor(s): Adam Hollis

Date: 22nd May 2013 & 8th October 2014

Ref: KWA/29NE/AIA

Recommended Tree Works To Facilitate Development

Show All Trees
Hide irrelevant

Tree No.	English Name	Height	Stem Diameter	Crown Spread	Recommended Works	Comments/ Reasons
11	Plum, Myrobalan	6	240.0	1411	Fell 3	A sparser than normal canopy limited SULE@ To facilitate new landscaping
12	Cherry, Kanzan	6	360.0	4534	Fell If not felling within 6months, CB S limb 25% 2	A sparser than normal canopy V. limited SULE For general husbandry/To facilitate new
14	Rowan (TPO)	5	80.0	2	Fell Felling and replacement previously agreed with Tree Officer	Remote survey only To facilitate development

APPENDIX 4

TREE SELECTION FOR CONSTRICTED SITES

Table 4: Rosaceous Tree Species for Constricted Planting Sites

Common Name	Species	Selected Form
Hawthorn	Crataegus monogyna	Stricta
Cockspur	Crataegus prunifolia	Splendens
Cherry	Prunus x hillieri	Spire
Bird cherry	Prunus padus	Albertii
Rowan / Mountain ash	Sorbus aucuparia	Cardinal Royal
Rowan / Mountain ash	Sorbus aucuparia	Rossica Major
Rowan / Mountain ash	Sorbus aucuparia	Sheerwater Seedling
Swedish whitebeam	Sorbus intermedia	Brouwers
B. whitebeam	Sorbus x thuringiaca	Fastigiata

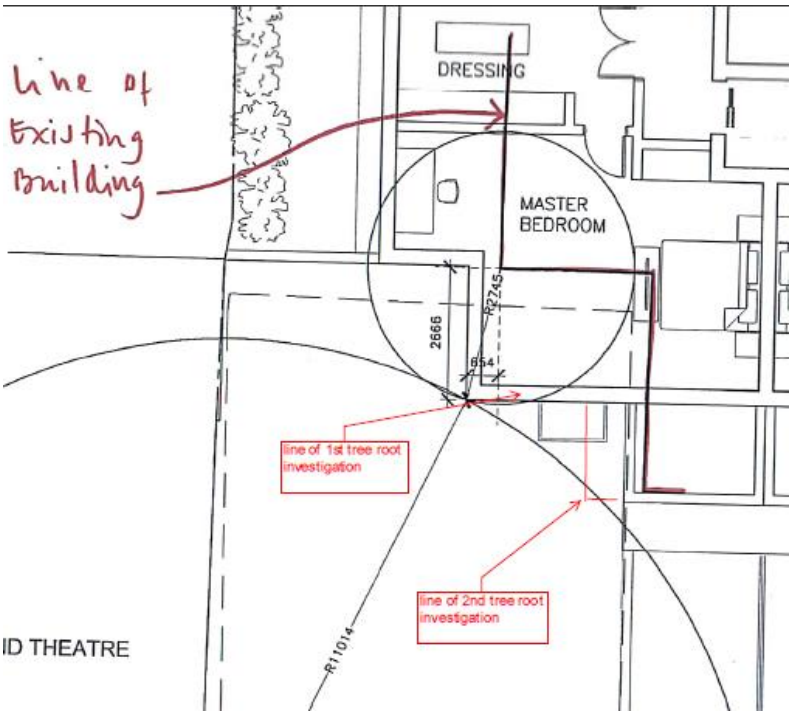
Table 5: Specimen Tree Species for Constricted Planting Sites

Common Name	Species	Selected Form
Chinese red bark birch	Betula albosinensis	Fascination
Swedish birch	Betula pendula	Dalecarlica
Hornbeam	Carpinus betulus	Fastigiata Frans Fountaine
Turkish Hazel	Corylus colurna	
Maidenhair tree	Gingko biloba	
Pride of India	Koelreuteria paniculata	Fastigiata
European larch	Larix decidua	Sheerwater Seedling
Tulip tree	Liriodendron tulipfera	Fastigiata

APPENDIX 5

TREE ROOT INVESTIGATIONS FOR T1 HORSE CHESTNUT AND T4 COPPER BEECH

Plan of Trial Pits for T1:



Photographs from T1 Trial Pits

Tree Root Investigation to T1 opened for 5/3/2009

Trench 1, T1 Behind to left | Trench 1, T1 Forward to right

Trench 2, T1 to right, behind | Trench 2, to right, behind

Tree root investigation based on early scheme design however the line of proposed constru
subsequently been altered to the approximate lines shown red.

Tree Root Investigation to T1 opened 25/3/2011

Revised line of construction shown red overlaid to first line of excavation/ investigation

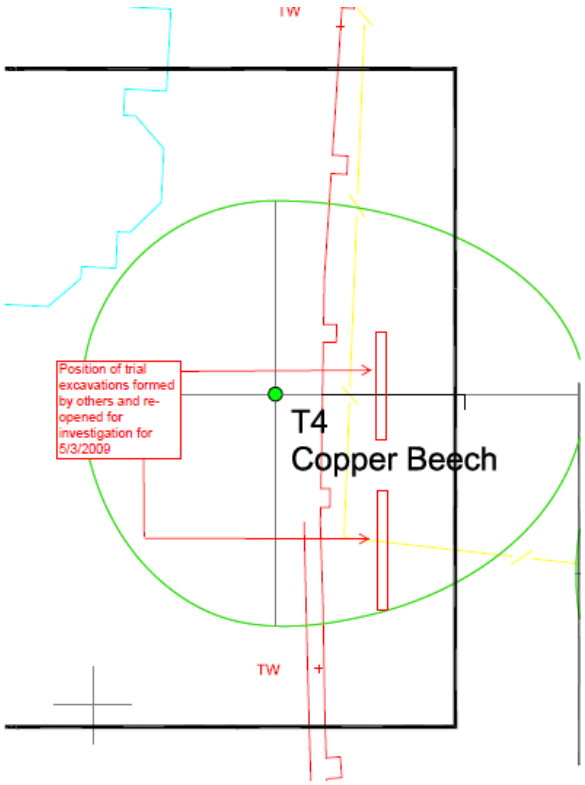
Overview, T1 to right of picture

Trench parallel to side elevation, T1 behind to left

Trench in line with front elevation, T1 behind to right.

Tree root investigation to 700mm based on revised scheme design. Excavation mainly through crushed brick and fill with few and fibrous roots.

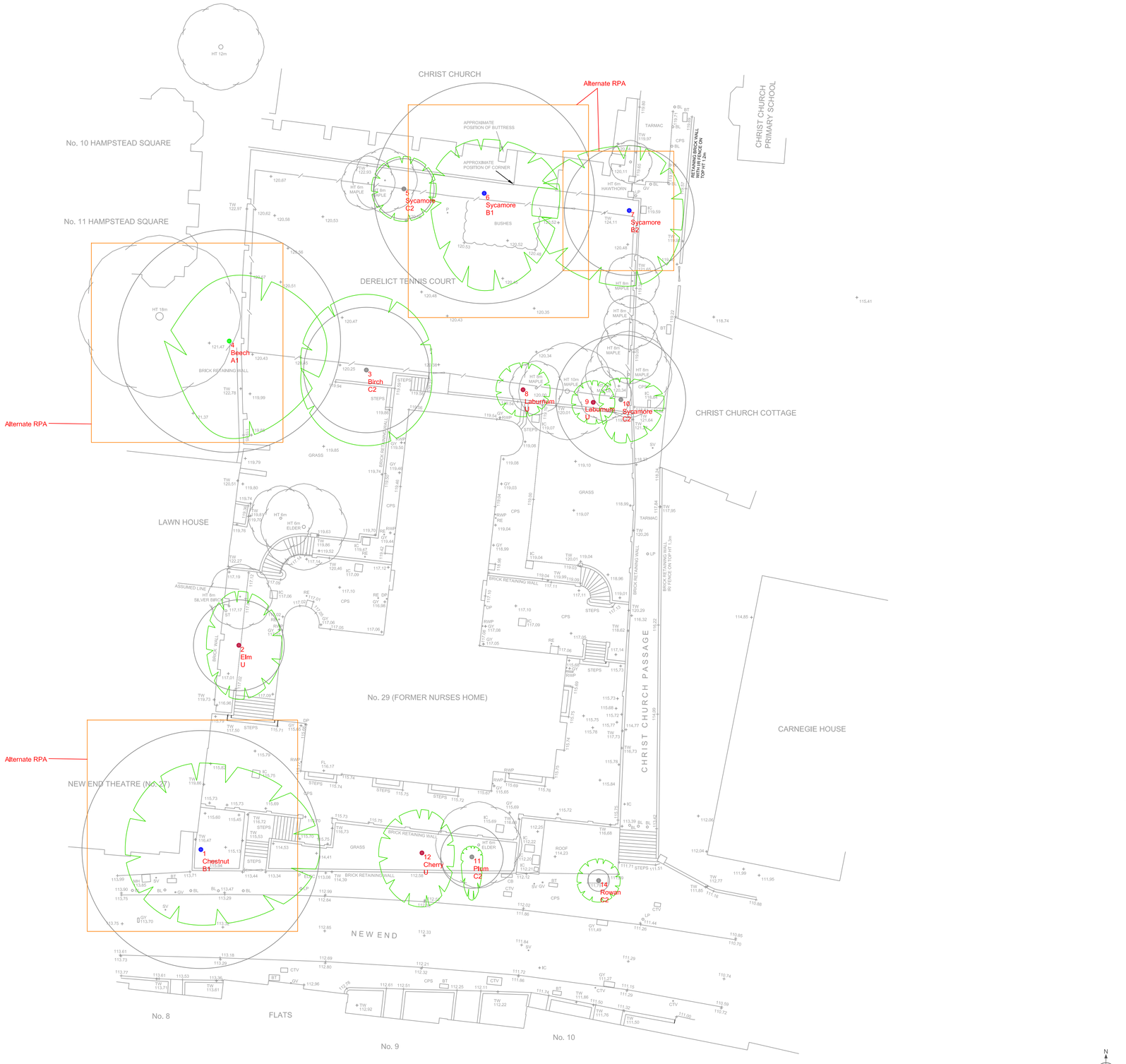
Plan of Trial Pits for T4:



Photographs from T4 Trial Pits

APPENDIX 6

TREE CONSTRAINTS PLAN



NOTE:

This survey is of a preliminary nature. The trees were inspected from the ground only on the basis of the Visual Tree Assessment method. No samples were taken for analysis. No decay detection equipment was employed. The survey does not cover the arrangements that may be required in connection with the laying or removal of underground services.

Branch spread in metres is taken at the four cardinal points to derive an accurate representation of the crown.

Root Protection Areas (RPA) are derived from stem diameter measured at 1.5 m above adjacent ground level (taken on sloping ground on the upslope side of the tree base).

Landmark Trees

20 Broadwick Street, London, W1F 8HT
Tel: 0207 851 4544 Mobile: 07812 989928
e-mail: info@landmarktrees.co.uk Web: www.landmarktrees.co.uk

Site: 29 New End, Hampstead, London	1-200@A1
Drawing Title: Tree Constraints Plan	Oct 2014

Key:

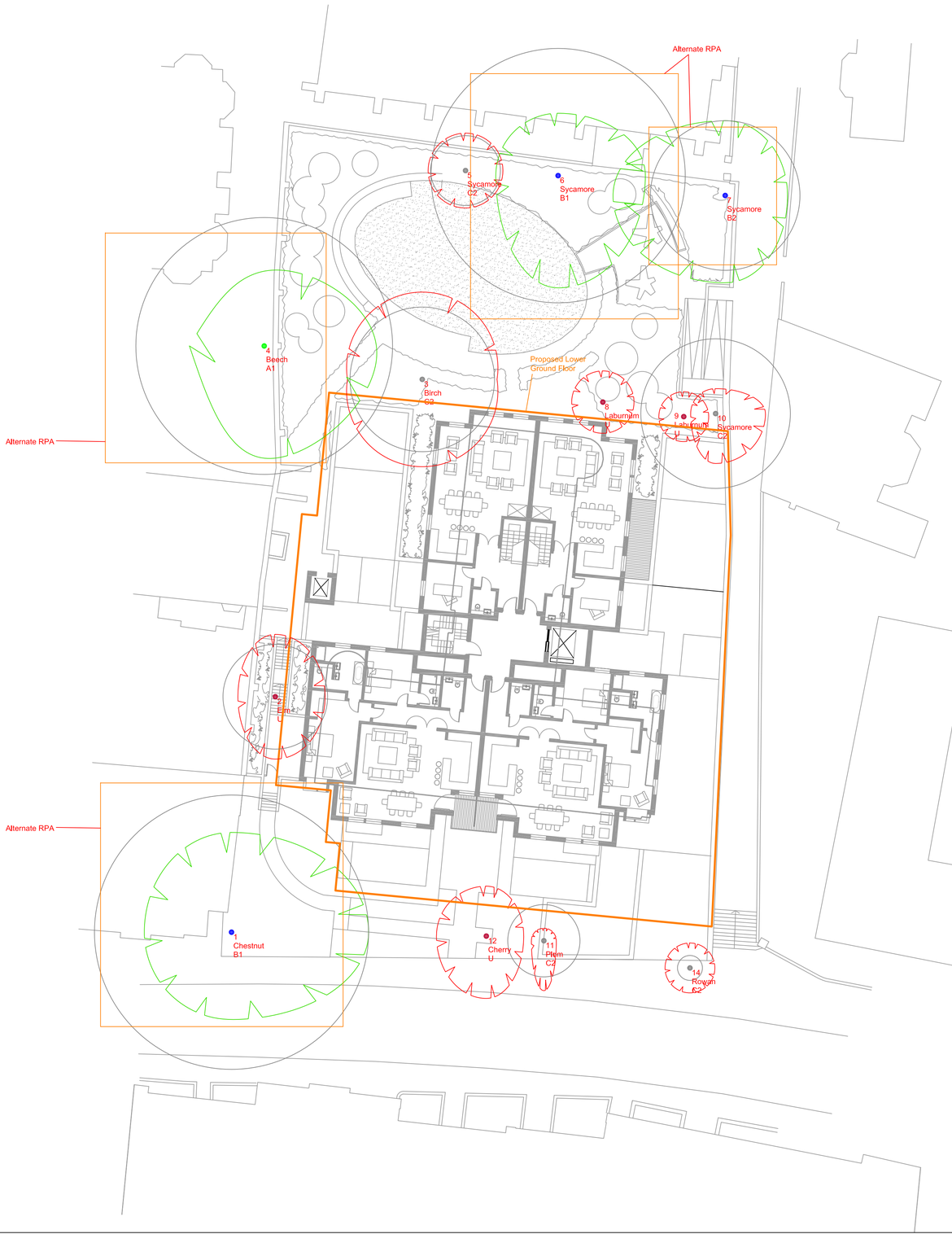
- Category A High Quality
- Category B Moderate Quality
- Category C Low Quality
- Category U Trees Unsuitable for Retention

Category — Crown Spread — Tree Number — Species — Category — Root Protection Area

13 Birch B2

APPENDIX 7

ARBORICULTURAL IMPACT ASSESSMENT PLAN



NOTE:

This survey is of a preliminary nature. The trees were inspected from the ground only on the basis of the Visual Tree Assessment method. No samples were taken for analysis. No decay detection equipment was employed. The survey does not cover the arrangements that may be required in connection with the laying or removal of underground services.

Branch spread in metres is taken at the four cardinal points to derive an accurate representation of the crown.

Root Protection Areas (RPA) are derived from stem diameter measured at 1.5 m above adjacent ground level (taken on sloping ground on the upslope side of the tree base).

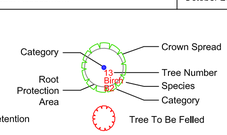
Landmark Trees

20 Broadwick Street, London, W1F 8HT
Tel: 0207 851 4544 Mobile: 07812 989928
e-mail: info@landmarktrees.co.uk Web: www.landmarktrees.co.uk

Site: 29 New End, Hampstead, London	1-200@A1
Drawing Title: Arboricultural Impact Assessment	October 2014

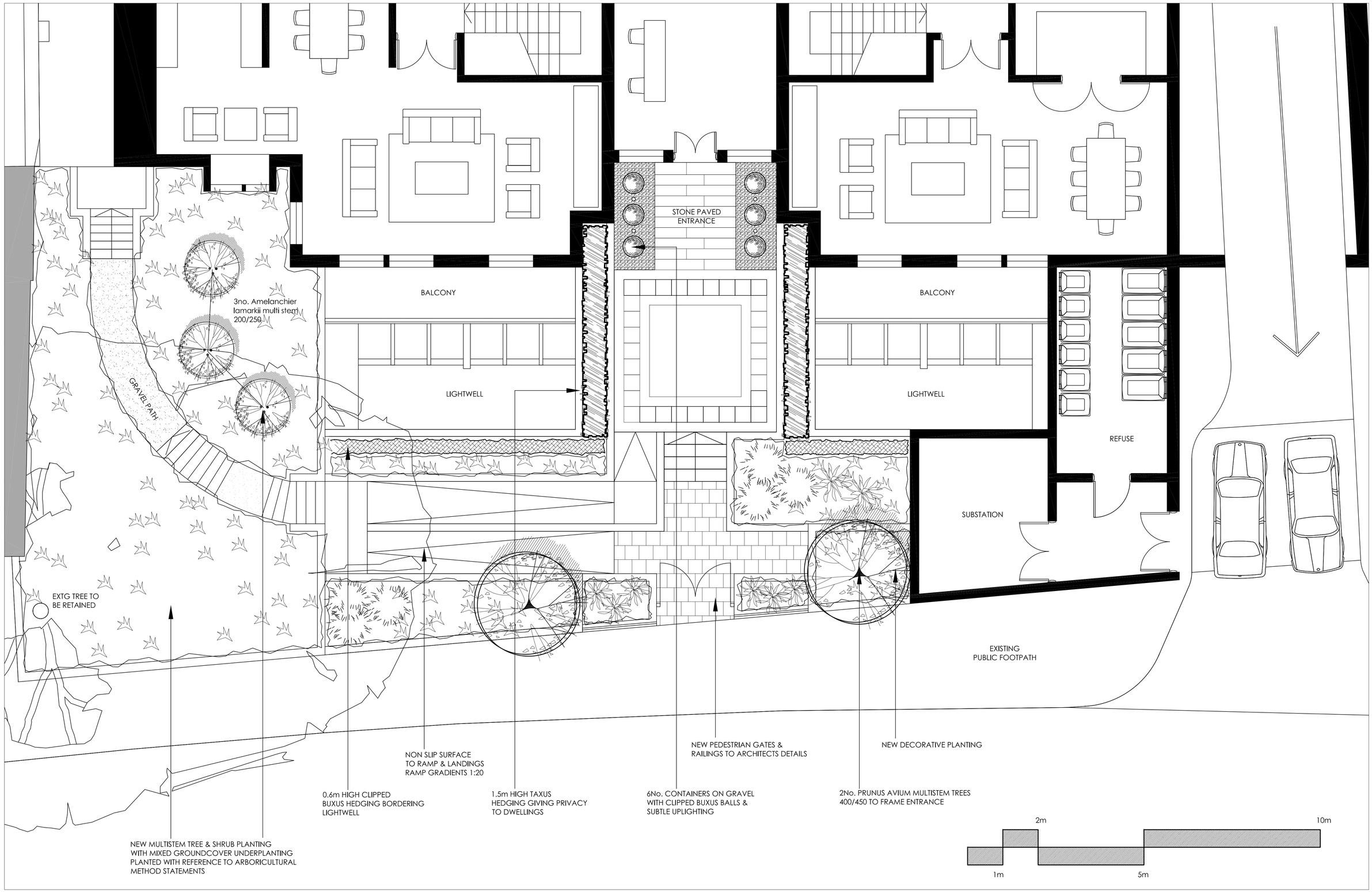
Key:

- Category A High Quality
- Category B Moderate Quality
- Category C Low Quality
- Category U Trees Unsuitable for Retention



APPENDIX 6

LANDSCAPE PROPOSALS
The Bowles and Wyre Landscape Plan 1375-11-02



REV A 16.10.14 - TREE SIZES AMENDED

NOTE:
1. This drawing to be read in conjunction with all relevant architect's and engineer's drawings and the specification.
2. Any discrepancies or details on or between these drawings must be drawn to the attention of the landscape architect (and to the architect or engineer as appropriate) in writing for clarification.
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5 Williams Court, Tunnel Way, Pitstone, Nr. Leighton Buzzard, LU7 9GJ
Tel: 01296 662439 Fax: 01296 663959 Email: admin@bowleswyer.co.uk

Description: NEW END HAMPSTEAD, LONDON
Drawing Name: FRONT LANDSCAPE MASTERPLAN
Dwg number: 1375-11-01
Rev: J
Drawn: JS
Checked: JW
Scale: 1:50@A1
Date: 16.10.14

CURVED HARDWOOD TIMBER BENCH

SCULPTURE OR FEATURE POT

1No. Sorbus aucuparia 20/25cm girth

3No. Prunus subhirtella 'Autumnalis Rosea' 250/300 m/stem

2no. Acer campestre 300/350 m/stem

EXTENT OF ROOT PROTECTION AREA

EXTG HT 18m Beech

HT 18m Sycamore EXTG

REPLACE FENCE WITH NEW WALL TO MATCH EXISTING

HT 14m Sycamore EXTG

3No. Amelanchier lamarkii 250/300 m/stem

EXTENT OF ROOT PROTECTION AREA

LAWN

3No. Prunus serrula 300/350 m/stem

1No. Magnolia kobus 200/250 m/stem

RAMPED ACCESS TO ARCHITECTS DETAILS WITH NEW GATE ENTRANCE LOCATED IN EXISTING BOUNDARY WALL

SEMI DEFENSIBLE PAVED TERRACE & ACCESS TO REAR GARDEN FROM PROPERTIES

3no. Betula nigra 300/350 m/stem

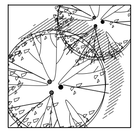
Planting bed to prevent overlooking to neighboring property 500mm maintenance strip against building

Planting bed to prevent overlooking to neighboring property 500mm maintenance strip against building

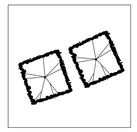
Decked terrace with space for containers

LIFT

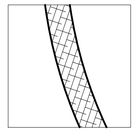
LEGEND



PROPOSED MULTISTEM TREES & SHURBS



BOX TOP HORNBEAMS 20/25 1.8/2m CLEAR STEM, 1m3 HEAD

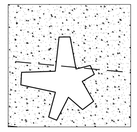


CLIPPED EVERGREEN HEDGING - VARYING HEIGHTS

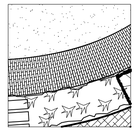
MIXED EVERGREEN 70% & DECIDUOUS PLANTING 30%

NEW CLIMBERS TO EXTG BOUNDARY WALLS SUPORTED ON S/STEEL WIRING SYSTEM

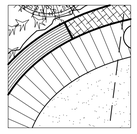
STONE PAVING (NO DIG THROUGH RPA)



CONTEMPORARY FURNITURE OVER PERMEABLE RESIN BOUND GRAVEL



BRICK ON EDGE FOOTPATH



STONE PAVED FOOTPATH RADIAL CUT NO-DIG THROUGH RPA

REV G 07.11.11 - NEW TREE SPECIES LABELLED
REV H 08.02.12 - BUILDING PLAN UPDATED
REV I 07.03.12 - UPDATED TO SUIT KSR DWGS
REV J 16.10.14 - TREE SIZES UPDATED

NOTE:
1 This drawing to be read in conjunction with all relevant architect's and engineer's drawings and the specification.
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BOWLES & WYER
5 Williams Court, Tunnel Way, Pitstone, Nr. Leighton Buzzard, LU7 9GJ
Tel: 01296 662439 Fax: 01296 663959 Email: admin@bowleswyer.co.uk

Description: NEW END HAMPSTEAD, LONDON

Drawing Name: REAR LANDSCAPE MASTERPLAN

Dwg number 1375-11-02 | Rev J

Drawn JS | Checked JW

Scale 1:75@A1 | Date 16.10.14

APPENDIX 7

A Critical Analysis of the Role of Trees in Damage to Low Rise Buildings
By Michael Lawson and Dealga O'Callaghan
(Source: Journal of Arboriculture 21(2): March 1995 Pages 90 - 97)

A CRITICAL ANALYSIS OF THE ROLE OF TREES IN DAMAGE TO LOW RISE BUILDINGS

by Michael Lawson and Dealga O'Callaghan

Abstract. Trees have been blamed for damage to building foundations in the United Kingdom. This has resulted in large numbers of high value insurance claims. Trees exert their influence through removal of moisture from clay soils. The existing data do not adequately explain the problem. A review of the situation as related to trees, biology, soil, water relations, and the effects of climate is presented. The published data are shown to be inadequate. A working model of how trees affect clay soils is proposed which explains the observed patterns. The need for greater interaction between the consulting arborist and the structural and building professionals is emphasized.

In Britain, there has been an increasing concern for the level of damage caused to built structures, mostly private dwelling houses, as a result of alleged tree-induced subsidence. Damage has resulted in a large volume of insurance claims. Within the London metropolitan area, claims against the Borough Councils alone have exceeded £23 million during the period 1988-1992 [20]. Nationally during the same period claims exceeded £1.6 billion [12].

Insurance policies for buildings have for many years carried a 'ground movement' element of coverage. In the early 1970's this was offered as a policy "sweetener," i.e., free cover as insurance carriers competed for business. Following the dry period of 1975/76 there was a large increase in the volume of claims, subsequently free subsidence coverage was removed. Attention has focused upon trees as the causal agents for many claims.

History of the problem. Following the drought of 1975/76 and the increase in insurance claims, the interaction between man-made structures and the clay soils upon which they are built, and the trees growing in that same soil received much attention. The common conclusion was that where a tree is growing close to a building, moisture is extracted from soil by the tree, which causes clay soils to shrink, leading to subsidence and failure of foundations. When the soils rewet, they swell, causing heave and associated damage. That this happens everywhere clay soils occur has assumed the status of *scientific fact* which is often cited by surveyors and engineers and from which it is proving difficult to shift opinion.

The need for research to investigate the relationship between trees, soil and buildings became clear. This research was undertaken by various organizations and has resulted in a number of well known and often cited publications, two of which are the National House Building Council's (NHBC) Practice Note 3 *Precautions when Building Near Trees* [26] and the Kew Root Survey [8].

The Building Research Establishment (BRE) has produced a number of publications on the subject [5,6]. Likewise the NHBC has revised the Practice Note 3 [26] and included it in their Building Standards, Chapter 4.2, *Building Near Trees* [27]. (The NHBC offers a 10-year guarantee for new properties but these must be built and certified in accordance with the NHBC Standards).

Claims. Claims continued to rise and by 1990/1991 were in excess of £500 million per year [12] (Fig. 1). Despite all the information which went to produce the BRE Digests, the NHBC Chapter 4.2 and other publications, the claims problem is still occurring. Since the first escalation following the 1975/76 drought and subsequent court actions, notably *Greenwood-v-Portwood CLY 1985*, which held that trees had been responsible for subsidence leading to building damage, the building professionals, i.e., surveyors and engineers, seem to have assumed that if a tree is growing close to a building that is exhibiting signs of subsidence damage, the tree is responsible for that damage. These assumptions are usually based on limited data.

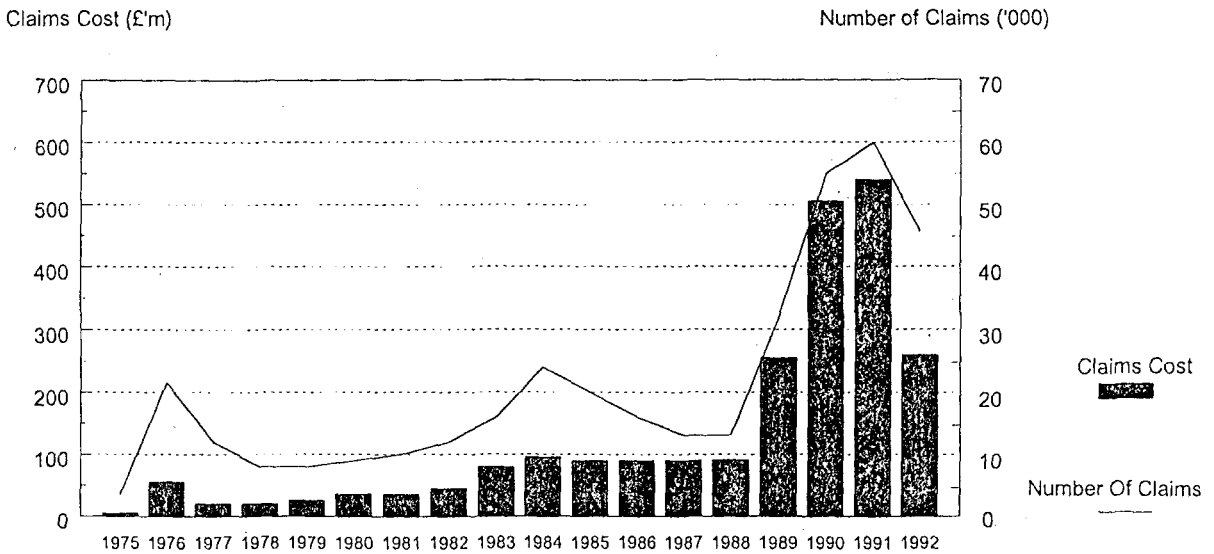

Fig. 1. Annual value of insurance claims for subsidence and heave damage to housing. From *ISE, March 1994 (12).*

The Basis for Current Practices

The soils. Clay soils have been classified as being shrinkable when the volume can be shown to change with the addition or abstraction of water. The usual measure of a soil's potential to shrink (subsidence) and to swell (heave), is the Plasticity Index (PI). This is a measurement of the moisture content of clay soils between the plastic and liquid limit (Atterburg limits) [4]. The NHBC [26,27] have, for the purposes of their *Standards of Building Near Trees,* classified clay soils as high, medium or low shrinkage potential based on the PI of the soil (Table 1).

Trees do extract moisture from the soil in which they grow and the main way in which moisture gets into the soil is by precipitation. Analysis of the British climate suggests that evaporation almost always exceeds precipitation in the period of greatest tree activity, May through October, in the English lowlands [19,24,25]. This results in the production of a seasonal soil moisture deficit (SMD). In an urban environment, trees need to obtain water as not all the precipitation reaches the soil. Some is intercepted by canopy foliage, some runs off, some is taken by other vegetation, thus compounding the deficit. Therefore, during dry weather, trees must extract more and more moisture from greater and greater soil volumes to keep their physiological processes functioning. This can contribute to the drying and cracking of clay soil and thus to subsidence with resultant foundation damage. It should be noted that much of the UK housing stock is built on shallow concrete strip foundations and that basements are relatively rare; timber framed houses are also rare.

Water demand of trees. For insurers the main reason for implicating trees in claims is a result of their requirements for water and this has been called their *water demand.* However, the water demand of individual trees is not known and is

Table1. Soil classification in relation to plasticity index. From *NHBC Chapter 4.2 (27)*

Plasticity index**	Shrinkage* potential
>40%	High
20 - 40%	Medium
10 - 20%	Low

* Shrinkable soils are those containing more than 35% fine particles (silt and clay) and have a plasticity index of more than 10%.

**Plasticity index is related to shrinkage potential as shown. If the shrinkage potential is unknown, high shrinkage potential should be assumed.

difficult to measure. Attempts to do this using a combination of leaf area index and pan evaporation rates has yielded some success [18], although the methods need to be refined. However, the term *water demand* has not been defined by any of the publications which refer to it continually. For the present purposes the following definition is proposed:

The amount of water required by a tree in order to keep its metabolism functioning at optimum levels to meet its physiological requirements.

Such a definition of water demand has not been attempted before in the arboricultural literature and certainly not in NHBC Chapter 4.2 [27] and the Table of Relative Water Demands and Mature Height of Trees in that Chapter, i.e., Table 4.2B, which is reproduced here as Figure 2. Note that trees are ranked as high, moderate or low in their demand for water in this table. Yet there are no published scientific data on water demand of mature trees to support such a classification. Data published by Biddle [1,2] on the patterns of soil drying and moisture deficits as measured by a neutron probe in the vicinity of trees, has been taken as meaning *Water Demand.* Indeed, Biddle confirms that the term *water demand* in this context is not accurate in biological terms, but the concept in this instance refers to the *lateral extent, depth and intensity of soil drying which is achieved by different tree species* (Biddle, 1993, Pers Comm.)

Experimental data published by Biddle [2] and supported to some extent by the work of Messenger & Ware [23] was produced by neutron probe analysis of soil moisture levels and deficits. While the probe does measure soil moisture levels, there is no allowance in either set of data for the influence of other vegetation in the area where the measurements were made, nor was any attempt made to locate the roots of the trees whose "demand" was being measured. In addition no controls were reported in either experiment. There is also some doubt as to the reliability of the neutron probe to accurately measure soil moisture contents in aerated and fissured upper soil horizons [13].

The term *water demand* continues to be interpreted biologically by arborists. The target audience for the Building Standards is builders [26,27]. The term was not designed for use by arborists but it has been used by them throughout its publication history. Advice provided to builders by arborists often relies heavily upon this publication, Table 4.2B and the data contained therein.

It must be remembered however, that the amount of water taken up by the tree can and will vary through the seasons and with changes in physiological activity. It is important that the amount of moisture extracted from soil by trees is examined and quantified separately from the other mechanisms by which moisture is lost to the soils, i.e., interception of precipitation by tree canopy and man-made structures, evaporation, albedo, surface run off, etc. Only canopy interception is the result of the biological activity of trees and other vegetation. If the contribution of trees to the soil moisture loss equation, and thus, their contribution to deficits, subsidence and possibly structural damage, is to be a factor in claims, then it must be separated and quantified accurately.

Trees & damage. A correlation between trees and damage to buildings was attempted by the Royal Botanic Gardens at Kew [8]. The survey database comprised root samples and record cards compiled by professionals working in the field (loss adjusters, surveyors, structural engineers, arboriculturists, etc.) and sent to Kew for identification and compilation. The record cards were completed when a tree was suspected of causing damage. Various common species were then classified with regard to the following: 1) maximum tree-to-damage distance recorded, 2) normal maximum tree height on shrinkable clay in urban areas, and 3) proportion of cases of damage occurring within a certain distance from the tree on shrinkable clay soils. It should be remembered that the majority of these records were taken from trees within a 60 km radius of central London. However, these data have, and continue to be, erroneously cited by building and arboricultural consultants as representative of the whole country, regardless of varying climate and clay type.

The concept that trees extract water from the soil and thus cause foundation damage, wherever clay soils exist, persists among most building

Broad leaved trees			Conifers			Orchard trees (take as broad leaved)		
Water Demand	Species	Mature height (m)	Water Demand	Species	Mature height (m)	Water Demand	Species	Mature height (m)
High	Elm		High	Cypress				
	English	24		Lawson's	18			
	Wheatley	22		Leyland	20			
	Wych	18		Monterey	20			
	Eucalyptus	18						
	Oak							
	English	20						
	Holm	16						
	Red	24						
	Turkey	24						
	Poplar							
	Hybrid black	28						
	Lombardy	25						
	Willow							
	Crack	24						
	Weeping	16						
	White	24						
Moderate	Acacia False	18	Moderate	Cedar	20	Moderate	Apple	9
	Alder	18		Douglas fir	20		Cherry	15
	Ash	23		Pine	20		Pear	12
	Bay Laurel	10		Spruce	18		Plum	10
	Blackthorn	8		Wellingtonia	30			
	Cherry			Yew	12			
	Japanese	9						
	Laurel	8						
	Wild	17	Notes:					
	Hawthorn	10						
	Honey locust	14						
	Hornbeam	17	1					
	Horse chestnut	20	Where hedgerows contain trees, their effects should be assessed separately. In hedgerows, the height of species likely to have the greatest effect should be used.					
	Laburnum	12						
	Lime	22						
	Maple							
	Japanese	8	2					
	Norway	18	Within the classes of water demand, species are listed alphabetically; the order does not signify any gradation in water demand					
	Mountain ash	11						
	Plane	26						
	Sycamore	22	3					
	Tree of heaven	20	When the precise species is unknown the greatest height and highest water demand should be assumed					
	Walnut	18						
	Whitebeam	12						
Low	Beech	20	4					
	Birch	14	Further information regarding trees may be obtained from the Arboricultural Association of the Arboricultural Advisory and Information Service (see Appendix 4.2-G).					
	Holly	12						
	Magnolia	9						
	Mulberry	9						

Fig. 2. The relative "water demand" and mature heights of trees. From *NHBC, Chapter 4.2 (27)*.

professionals and some arboriculturists. The Kew Root Survey [8] and the NHBC Chapter 4.2 [27] are invariably being cited in support of this concept. The relevance of both of these publications to the problem has been questioned [15,16,17,21,22].

In addressing the problems at a practical level,

it is becoming obvious that the published data are not always consistent with the field results. Increasing claims costs and a need to solve the problems in the most cost effective way without major tree losses, is forcing a re-assessment of the situation. The problem consists of a number of parts: 1) Geographic Location (Geology, Weather, Climate), 2) Tree Biology and Actual Water Demand, and 3) Interaction of the Structural Professionals.

Shortcomings and the Need for Improvement and Research

To allow a thorough review of the present situation requires an assessment of the conditions prevailing in the urban or built environment. Such data are generally lacking and the only reliable data available on water loss from trees are from closed forest stands or potted specimens where control is possible [29]. In the forest situation it can be seen that oak and beech transpire approximately the same amount of water per day (Table 2) [29], which is at variance with the NHBC Classification of oak as high and beech as low in water demand [26,27].

How relevant these data are to the urban situation is difficult to determine. A single large tree in the urban environment is subject to varying conditions and pressures from that of the forest location. Research has shown that the availability of soil moisture to trees under these conditions is variable in the extreme [18], and attempts to calculate the soil volume necessary to provide enough water and nutrients to support a tree of given canopy size suggest that most urban trees are growing in poor situations without adequate volumes of suitable soil [30]. We must therefore expect many urban trees to be in a stressed condition and not performing to their full biological potential.

Table 2. Daily transpiration (mm) of four species in closed stands in Denmark. Data from Rutter 1968 (29)

	Cloudless summer day (no morning dew)	Mean June - August
Fagus sylvatica	4.1	2.9
Quercus spp	4.3	2.7
Fraxinus excelsior	3.3	1.7
Picea abies	3.6	2.4

Towards a model. The production of fine, non-woody roots, root hairs, etc., are dictated by soil conditions. These are susceptible to decreases in soil moisture and are quickly shed when soil conditions become unfavourable. Energy is required to maintain the non-woody roots and biological energy is generally not wasted.

Roots tend to be most active in spring and autumn when soil moisture is most likely to be available and temperature is favourable. At these times, roots are involved in supply of water and mineral nutrients for the generation of new tissues. In summer, root activity feeds the transpiration needs of the tree. However, as the usual summer soil moisture deficits begin and build up, trees need to conserve water. They will do so effectively by either seeking out water deeper in the soil, by a recycling of metabolic water and or readjusting their mass, or by transporting subsoil water reserves through the deep root system and then "dumping" this water in the upper soil horizons, via the primary root network, a phenomenon known as "hydraulic lift" [7].

However, as the deficits occur and build up in periods of drought, clay soils dry out and cracks / fissures appear in the clay. Clays, particularly those that can swell, show typical cracking patterns of large vertical cracks and a fall in soil surface with the remainder as fine cracks within the soil [28]. Cracking affects thermal conductivity of the soil which is an important parameter in the analysis of water flow, evaporation and soil temperature [28].

With the fissures comes new sources of water and air as porosity increases [28] to allow root extension down the fractured horizon. This allows the active and vigorous species to exploit deeper reserves of water and to survive the periods of drought more effectively than other species.

Some species have the ability to take advantage of this new rooting environment and thus it is suggested that trees can best be classified according to their *rooting habit,* rather than any hypothetical *water demand* as follows:

Deep rooting trees. Oak (*Quercus* spp.) for example, will quickly take advantage of the increasing oxygen availability at depth and a second ephemeral absorbing root system will be produced. This will occupy the subsoil until precipitation causes re-hydration and the fissures close.

Intermediate rooting trees. Linden / Lime (*Tilia* spp.) will respond more slowly to the availability of the fissures, especially if they are in competition with the deep rooting species. They can produce the second root system but seem to require a higher degree of drought stress to initiate growth, possibly a second consecutive year of drought.

Shallow (non-deep) rooting trees. European Beech (*Fagus sylvatica*) seem to have limited genetic capabilities to pursue moisture at depth. These are also the first trees to show external signs of drought stress.

The basis for this suggestion lies in the fact that the best place for absorbing roots to be is close to the surface. In a closed forest stand, the precipitation that reaches the floor will be absorbed first by the most superficial roots. If anaerobic clay soils exist, then roots are unlikely to be present. If they are present they may be under a great amount of biological stress.

Discussion

Trees can survive in lower volumes of soil than current research suggests that they need [18,30]. They survive in hostile urban environments where water availability is very unpredictable. But they survive because they seem to have a differential requirement for water over time and have developed effective management strategies in periods of extreme drought. The existing UK models are oversimplified and unconfirmed. Much more fundamental research is required. However, there is published work that has not been previously referenced in the context of the problems being discussed.

The data from 43 scientific papers on water use by trees in forests have been collated [29]. Essentially, all of these data suggest that trees generally use similar volumes of water, i.e., have a similar "demand." The data cover species such as eucalyptus, pine, spruce, oak, poplar etc. and there seems to be no significant difference between these species on the basis of amounts of water used [10,11,14,31,32].

As trees are using/demanding broadly similar amounts of water from the soil, other explanations for the observed differences between trees are required. One explanation has already been proposed in this paper, i.e., the differential genetic capability of trees to root into clay subsoils in response to environmental changes. Another could be in the different capability of trees to intercept water. Eidmann [9] shows that over a 12 month period, European beech intercepts 93 mm of precipitation, while Norway spruce will intercept 314 mm in the same period.

Tree species seem to have adapted differently to the urban environment as opposed to the forest situation. Species such as poplar were selected for urban plantings because they coped well with poor soils, limited water availability and less than perfect atmospheres. While other 'forest' species struggled to grow and generate tissue (probably limited by water availability), poplar grew equivalent to its forest stand norm. Consequently, a difference in water demand might be attributable to a species *fitness* to survive poor soils, low water availability and poor air and still perform to optimum levels. An appropriate phrase may be termed *urban fitness.* Much more data are needed.

That vegetation extracts water from clay soils is not in dispute. Indeed a large specimen tree can contribute to substantial ground movements, which, if linked with foundation failure, can produce significant effects. However, the currently available practice and guidance notes and the legal precedents and attitudes mitigates against rational decisions based on sound arboricultural advice being made. Given that the published and accepted norms for mature tree heights, root spread indices and distance to height ratios have been set with a maximum level, then tree removals are inevitable in most situations.

An attempt to rationalise the approach to subsidence claims has been made recently by a working party of the London Tree Officers Association (LTOA) [20]. The London Boroughs have claims averaging £850,000 per borough (1988-92) against their policies for alleged damage by street and other publicly-owned trees. The LTOA Risk Limitation Strategy [20] for insurance claims produced the following recommendations:

(i) Identify those trees that are most likely to

cause subsidence damage and subject them to a regular and systematic pruning regime.

(ii) Make the identification of the trees at *(i)* an on-going programme.

(iii) Avoid planting trees that are likely to cause subsidence.

(iv) When appropriate carry out prompt remedial pruning to implicated trees.

If public and private sector arborists are to implement the above proposals sensibly, then fundamental research is required. Which trees are most likely to cause damage? Which species of tree should we avoid planting? What are the real effects of extended remedial pruning programmes? Do the current data provide answers to these questions? What "new" species or developing trees might cause the future claims?

Conclusions and Recommendations

Trees growing on clay soils contribute to building failures. This has been attributed to a differential "water demand" between species [26,27]. The published Tables of water demand are clearly in error and misleading and are based on limited scientific data. However, the differences between the effects caused by trees highlighted in these data can be explained by factors other than "water demand", i.e., differential genetic rooting capability, species interception indices, species urban fitness and individual species biology and physiology. Also to be considered would be hard surface interception and evaporation, total run-off, albedo, etc.

The current pressure from insurance companies, engineers and the courts for permanent, "one off" solutions and answers is not helpful. The education of both arboriculturists and the building professionals is obviously lacking. In England, colleges that teach arboriculture on a full-time basis contain little within Course Syllabi that prepare students to deal with this problem on even a rudimentary basis.

The need for trained experts in this area is obvious and the interdisciplinary aspects make this all the more important. It is becoming increasingly clear that this is the most complex problem / challenge that faces the arboricultural professional working in the UK today [12]. We need help to address the issue and we need research monies to develop the knowledge. The main beneficiaries will be the insurance and building industries.

Ultimately, given the tens of millions of pounds that have been expended to date in efforts to secure solutions to vegetation related structural damage, no attempt has been made to finance the management of the problem. The costs of remedial building works increase dramatically with each new dry-phase. The effects of climate change and selection of "new" tree species upon the housing stock in the future, cannot be predicted with any degree of accuracy at this time. This is particularly so if houses are built on inadequate foundations or if no attempt is made by the building profession to take arboricultural advice.

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Résumé. Les nombreux blâmes adressés aux arbres pour les dommages aux fondations des bâtiments au Royaume-Uni a résulté en un grand nombre de réclamations élevées d'assurance. Les arbres exercent leur influence en captant l'humidité contenue dans les sols argileux. Les données existantes n'expliquent pas de façon adéquate le problème. Une revue de la situation est présentée en regard des arbres, de la biologie, des relations de l'eau dans le sol et des effets du climat. Les données qui sont publiées se sont montrées être inadéquates. Un modèle de travail est proposé sur le comment un arbre affecte les sols argileux.

Zusammenfassung. Bäume werden in Großbrittanien für Schäden an Grundmauern verantwortlich gemacht, was zu einer großen Anzahl von hohen Versicherungsansprüchen führt. Bäume machen ihren Einfluß durch den Entzug von Feuchtigkeit in Tonböden geltend. Das vorhandene Datenmaterial reicht nicht aus, um das Problem zu klären. Hier ist ien Situationsüberblick gegeben, der Bäume, ihre Biologie, die Boden-Wasser-Beziehung und den Einfluß des Klimas miteinbezieht. Die veröffentlichten Daten erwiesen sich als unzureichend. Es wurde ein Model erarbeitet, um zu zeigen, wie Bäume Tonböden beeinflussen.