August 2011
CBA7715 v1

Mr John Pearce

ARBORICULTURAL REPORT

Site:
5A Wallis Road
Waterlooville

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THE ACADEMY OF EXPERTS

CBA7715

ARBORICULTURAL REPORT

ALLEGED SUBSIDENCE DAMAGE

Client: Mr John Pearce

Site: 5A Wallis Road, Waterlooville, PO7 7RX

Arboricultural Consultant: Dominic Gane *BSc(Hons)Arb, BSc(Hons)Env.Biol, Cert.Arb(RFS), MIEEM, M.Arbor A*

Date: August 2011

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1.0 CLIENT'S BRIEF

1.1 CBA Trees has been instructed by John Pearce of 5A Wallis Road, Waterlooville.

The primary focus of the investigation is to assess the likely heave potential of soils below the property of 5A Wallis Road, Waterlooville, in the event of the removal of one Oak tree growing on that land. This Oak tree has been implicated in subsidence damage to the properties of 3B Wallis Road and 11 Wallis Gardens.

The assessment is to:

- Visit site to visually check information provided by the claimant's insurers and their agents.
- Record dimensions, condition and defects of identified trees.
- Consider the evidence provided by other experts.
- Provide a written report of the findings of the assessment with specific focus on the risk of heave to the property of 5A Wallis Road should the Oak be removed or severely pruned. The report to include a sketch plan showing the approximate position of the trees in relation to the property.

2.0 LIMITATIONS

2.1 The opinions expressed are those of a qualified and experienced arboriculturist, and although an assessment of the hydrological, engineering and geotechnical information is considered for a more complete understanding of the problem, these areas are beyond my field of expertise. Where further clarification is required, it is suggested that advice is sought from a suitably qualified expert.

2.2 No excavations were carried out, or samples taken for analysis. Information regarding soil and root analysis was provided by the claimant's experts.

2.3 Trees were inspected from ground level using binoculars where necessary, tree condition was assessed using Visual Tree Assessment and no invasive methods were used to confirm the internal condition of individual trees.

2.4 Trees are living, dynamic organisms that can be affected by external conditions. It is therefore not possible to state with certainty that any tree is completely safe. The condition of a tree or a group of trees can change rapidly as a result of external factors and this survey is therefore valid for a period of 12 months.

2.5 <u>Document Disclosure</u>

A set of bound documents was provided and included the following:

Date	Author	Reference
11/01/1993	Havant Borough Council	TPO 1529 Plan. Dwg. No. PC 26/51
09/03/2000	Havant Borough Council	Letter outlining foundation type and depth.
01/09/2000	Havant Borough Council	Consent for works to one oak and two Horse Chestnut trees at the property of 5A Wallis Road

Date	Author	Reference
15/09/2004	Havant Borough Council	Consent for works to one oak and two Horse Chestnut trees at the property of 5A Wallis Road
28/08/2009	Havant Borough Council	Consent for works to one Oak and two Horse Chestnut trees at the property of 5A Wallis Road
23/02/2011	Marishall Thompson Group	Preliminary Arboricultural Appraisal Report. 3B Wallis Road.
14/7/2011	OCA UK Ltd	Arboricultural Assessment Report 11 Wallis Gardens.
20/07/2011	OCA UK Ltd	Application to fell the Oak at 5A Wallis Road and treat the stump to prevent regrowth.
28/07/2011	Cunningham Lindsey	Engineering Appraisal Report (incomplete) 11 Wallis Gardens.

A copy of the British Geological Survey's Geomap for the postcode of 5A Wallis Road, Waterlooville was obtained on the client's behalf to assist with the assessment.

3.0 LEGAL PROTECTION

Two Horse Chestnuts and one Oak are protected by Havant Borough Council Tree Preservation Order 1529. It has not been ascertained whether any other vegetation discussed in this report is situated within a Conservation Area or protected by a Tree Preservation Order.

4.0 SITE DESCRIPTION AND CLAIM HISTORY

4.1 The property is a detached, single storey dwelling, with a later addition of a conservatory to the rear, at an unknown date, but previous to 2000, and a flat roofed extension linking the previously detached garage to the main structure at its front and right elevations, circa 1995. It has a large rear garden to the South and smaller front garden and surfaced car parking area to the North. All boundaries are formed by hedges, on the southern and western boundaries; these have grown to trees.

4.2 Both pedestrian and vehicular access is gained from Wallis Road to the North. The topography of the site is generally level with the properties of 3B Wallis Road and 11 Wallis Gardens situated to the East, and 5 Wallis Road to the West.

4.3 The claim history is as described in the Marishall Thompson report dated 23rd February 2011 and the OCA report dated 14th July 2011.

4.4 The Cunningham Lindsay engineering appraisal dated 28th July 2011 provides a summary of the factual investigation conducted by CET Safehouse Ltd on 7th September 2011 of the damage to the property of 11 Wallis Gardens, although level monitoring data referred to in this report was not available. The CET factual report was not available.

4.5 Structural damage has been classified category 3 moderate, as described in Building Research Establishment Digest 251.

4.6 One borehole and one trial pit were excavated adjacent to the rear right hand corner of 11 Wallis Gardens. Root samples were taken from below the foundation in the trial pit and at a depth of up to 2.2m in the boreholes; subsequent analysis determined that they were from an Oak tree.

The soil beneath the foundations has been identified as silty clay with partings of silt and sand, having high to very high plasticity (liquid limit 63-86%) and medium to high swelling/shrinkage potential (plasticity index 38-54%)

In-situ shear vane tests were conducted and apparently these indicate that the clay becomes stiff below 2m.

The site investigation apparently confirmed desiccation of the soil underlying the foundation to between 1 and 2m depth.

Level and crack monitoring has been underway since November 2010. Cunningham Lindsey reports that results are indicating a rise of 9.7 to the right hand corner of the house, nearest the Oak tree, between November 2010 and April 2011, followed by a drop of 5.2mm to June 2011. The crack to the right hand wall of the property is reported to have closed 0.7mm November 2010 – February 2011 and opened 0.2mm to May 2011.

OCA reports that the Oak and one of the Horse Chestnuts growing at 5A Wallis Road were topped 2 years ago and another Horse Chestnut 3 years ago, and also states that there is no vegetation other than the Oak at the property of 5A Wallis Road within normal rooting influence of the property of 11 Wallis Gardens.

Furthermore, OCA states that due to the proximity of the Oak to the insured property, they do not consider pruning to be an effective means of controlling its water uptake.

The recommendation of OCA and Cunningham Lindsay with respect to the damage to 11 Wallis Gardens is the removal of the Oak tree and treatment of the stump.

During the course of my onsite investigation I met with the owner of 3B Wallis Road and was given to understand that cracks had previously appeared some 7- 8 years ago. These cracks were filled during the course of household redecoration and subsequently closed, forcing the filler out into a ridge which is apparently still evident. I am also given to understand that crack monitoring is currently being undertaken in respect of the recent damage at 3B Wallis Road.

The Marishall Thompson's preliminary arboricultural appraisal reports that the Oak at 5A Wallis Road has been subject to an annual pruning regime and recommends the removal of the Oak, subject to an engineering heave assessment.

No engineering appraisal or investigation has been supplied with respect to 3B Wallis Road.

A visual inspection of the property of 5A Wallis Road and discussion with the owner, revealed cracks on interior walls that have been increasing in number and severity since 2009, cracks in the exterior walls where the 1995 flat roof extension adjoined the existing structure, and what appears to be outward lateral displacement of the eastern and western foundations (Photographs 1-10).



Photograph 1



Photograph 2



Photograph 3



Photograph 4



Photograph 5



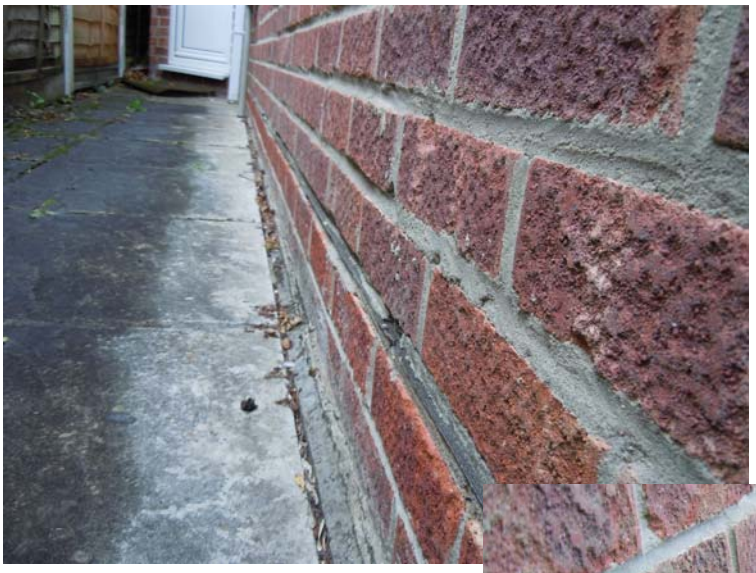
Photograph 6



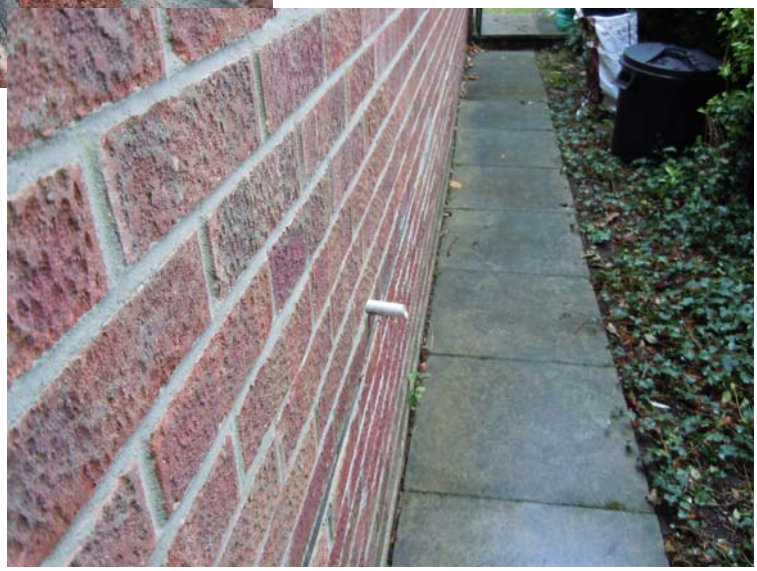
Photograph 7



Photograph 8



Photograph 9



Photograph 10

5.0 DISCUSSION

5.1 The British Geological Survey report indicates that the bedrock underlying the three affected properties is the Bognor Sand Member bordered by the London Clay Formation.

5.2 It is clear that a shrinkable clay soil underlies the rear right hand corner 11 Wallis Gardens; however, the distribution of the non-shrinkable sand across the foundations of the three properties is uncertain.

5.3 It is not with in my area of specific expertise, and further advice should be sought from an appropriately qualified expert, however, it appears plausible that a structure with shallow foundations bearing partly onto a substrate which does not undergo volumetric changes in response to moisture content and partly on to a substrate which does, may exhibit seasonal structural distortion independent of the effects of vegetation, as a consequence low Summer rainfall and higher Summer evaporation of soil moisture.

5.4 No attempt has been made to establish the type and distribution of strata onto which the foundations bear.

5.5 Furthermore, grasses and low herbaceous cover may cause drying to a depth of 1.2m. It appears from the Cunningham Lindsey report that the foundations of 11 Wallis Gardens are <1m deep. This potential cause of damage has not been considered.

5.6 It is worth considering the chronology of onset of damage with reference to tree management history.

5.7 Review of Havant Borough Council tree work consents relating to 5A Wallis Road reveal that the Oak has been pruned 3 times in the last 11 years, coinciding with pruning work to two Horse Chestnuts.

Letter of consent dated 1st September 2000
- 20% crown reduction
- 15% crown thin
- reduce to achieve 2m clearance over neighbour's garage.

Letter of consent dated 15th September 2004
- 20% crown reduction
- 15% crown thin
- shorten limb over driveway of no. 5 Wallis Road.

Letter of consent dated 28th August 2009
- 20% crown reduction
- 10% crown thin.

5.8 Both OCA and Marishall Thompson give differing views on management history neither of which appears to be representative of the available evidence; therefore, their respective assessments and management recommendations may be based on incorrect assumptions.

5.9 The onset of recent damage at 11 Wallis Gardens is reported as being noticed in the Summer of 2009. Later that year, drain repairs were carried out, a small conifer to the front right hand side removed, and structural repairs carried out.

5.10 In late 2009 the implicated Oak tree and two Horse Chestnuts growing on land at 5A Wallis Road were pruned.

5.11 More extensive damage at 11 Wallis Gardens occurred in the Summer of 2010, giving rise to the current claim and investigations.

5.12 Tree pruning has short-term limiting effects on water uptake by trees. The fact that the worst damage occurred in the Summer following the pruning operation indicates a contributing and significant mechanism of damage other than the implicated Oak, or that the pruning work undertaken was insufficient to limit the water uptake of the tree.

5.13 Unfortunately, there does not appear to have been any attempt to establish whether the roots recovered from the trial pit and borehole at 11 Wallis Gardens were recently alive. Dead roots may persist for a number of years in clay soils, and it is possible that following the 2009 pruning, the Oak reduced its root volume; thus the root recovered may have been exerting no effect on soil moisture. Clarity on this point would be invaluable when performing assessment.

5.14 I understand from the owner of 3B Wallis Road that there exists a long history of building cracks and symptoms of structural distortion that at times appear to worsen and at others subside.

5.15 As a general point, the owner made particular reference to the garden door jamming in dry weather, and quickly easing in wet weather. Tree induced shrinkage and recovery generally occur over periods measured in months. This observation indicates a significant contributory factor other than the Oak.

5.16 The owner also advised that cracks opened in the interior walls *"7 or 8 years ago"*; that these cracks were filled during household redecoration and subsequently closed of their own accord, forcing the filler out into ridges that may still be seen.

5.17 No information is supplied regarding the onset time of the recent damage, however given the preliminary nature of Marishall Thompson's report, it is likely to be circa 2009.

5.18 If this information is considered against the pruning history of the Oak, it is apparent that the earlier period of damage circa 2003/2004 preceded the pruning works of that time. This damage self-corrected following that pruning operation.

5.19 That the current damage is continuing following the late 2009 pruning, indicates a contributing and significant mechanism of damage other than the implicated Oak, or that the pruning work undertaken was insufficient to limit the water uptake of the tree.

5.20 OCA state that the Oak is the only tree within influencing distance of 11 Wallis Gardens; this is incorrect.

5.21 National House Building Council (NHBC) chapter 4.2 provides an indication as to the water demand of various species of tree commonly found in the United Kingdom, along with guidance on mature height of each species. The document also provides a multiplier from which a crude potential zone of influence can be calculated. Moderate water demanding trees are estimated to have a zone of influence approximately 0.75 times the height of the tree, high water demanding trees a multiplier of 1.25. It is recognised that this information is provided to guide the construction of new foundations, and is not directly applicable to existing properties. It does, however, provide a useful guide when considering a potential zone of influence.

5.22 The Garage at 3B Wallis Road has been underpinned in the past and there are no recent allegations of vegetation related movement with respect to this structure, therefore it has not been considered in this exercise.

5.23 In Tables 1 and 2 below, the figures in red indicate those trees with a potential zone of influence affecting the respective properties.

5.24 The figures in green are suggested maximum management heights, for those trees currently within influencing distance of the dwellings at 3B Wallis Road and 11 Wallis Gardens (Table 1 and 2).

5.25 I also consider that the shrubs adjacent to the front right hand corner of 3B Wallis Road may be contributing to the alleged differential seasonal moisture deficit and should be removed (Table 1 and 2).

Table 1: Potential Zone of Influence 3B Wallis Road

Tree No.	Species	Water Demand NHBC	Mature Height (m)	Actual Height (m)	Mature Height Zone of Influence (m)	Distance from Building (m)	Current Height Zone of Influence (m)	Proposed Maximum Height (m)	Zone of Influence at Maximum Proposed Height (m)
T.1	Corkscrew Willow	High	16	6.5	20	18	8.125		
T.2	Horse Chestnut	Moderate	20	16	15	21	12		
T.3	English Oak	High	20	16	25	18	20	14	17.5
T.4	Apple	Moderate	10	6	7.5	7	4.5		
T.5	Horse Chestnut	Moderate	20	10	15	12	7.5		
T.6	Lilac	Moderate	8	4	6	7	3		
G1	Mixed	Moderate	8	2	6	0	1.5	Remove	
G2	mixed	Moderate	8	2	6	0	1.5	Remove	
H1	Mixed conifer and deciduous	Moderate to high	18	2	22.5	11	2.5		
H2	Deciduous hedge	Moderate	8	2	6	2	1.5		

Table 2: Potential Zone of Influence 11 Wallis Gardens

Tree No.	Species	Water Demand NHBC	Mature Height (m)	Actual Height (m)	Mature Height Zone of Influence (m)	Distance from Building (m)	Current Height Zone of Influence (m)	Proposed Maximum Height (m)	Zone of Influence at Maximum Proposed Height (m)
T.1	Corkscrew Willow	High	16	6.5	20	7	8.125	5	6.25
T.2	Horse Chestnut	Moderate	20	16	15	11	12	14	10.5
T.3	English Oak	High	20	16	25	18	20	14	17.5
T.4	Apple	Moderate	10	6	7.5	5.5	4.5		
T.5	Horse Chestnut	Moderate	20	10	15	16	7.5		
T.6	Lilac	Moderate	8	3	6	11	2.25		
G1	Mixed	Moderate	8	2	6	6	1.5		
G2	Mixed	Moderate	8	2	6	10	1.5		
H1	Mixed conifer and deciduous	Moderate to high	18	2	22.5	10	2.5		
H2	Deciduous hedge	Moderate	8	2	6	2	1.5		

5.25 When considering a tree management regime intended to limit a tree's water requirement, it is important to understand, in basic terms, tree biology. Transpiration is the process through which trees lose water, primarily through their leaves. Trees take up water through their roots and along with it, a range of essential nutrients. Via a network of vessels these nutrients and water are transported to the primary sites of organic synthesis, the leaves. In the leaves, in the presence of sunlight and using carbon dioxide from the air and using a very small percentage of the transported water the primary building block of the tree,

glucose, and indeed the energy it requires to sustain its parts, is produced. This process is termed photosynthesis. The majority of the water is no longer required, (approximately 90%) and is lost to the air. The products so produced in the leaves are then transported to sites of use, to build new and maintain existing tissues, such as roots, for example, and to sites of storage.

5.26 If the tree is pruned, the leaf area and photosynthetic capacity is initially reduced thus the transpirational capacity, and consequently water demand of the tree are also reduced. However, trees will respond to pruning, using stored reserves, by attempting to redevelop the lost leaf function or photosynthetic capacity and will increase transpirational requirements and water demand accordingly. Depending on the severity of pruning this may take between 1 and 2 years. Thus, on a recently reduced tree, it would be expected for water demand to be reduced.

5.27 If the loss of the leaf bearing area of the crown is repeated on a regular basis, stored energy, reserves within the tree would become depleted, and distal parts of the root system are starved of energy resulting in their decline and death. (Modern Arboriculture. Alex Shigo 1991. A New Tree Biology. Alex Shigo 1989 – Appendix 5).

5.28 In 1999, the Building Research Establishment together with East Malling Research, Cambridge University and other partners, instigated a number of experiments relating to controlling water uptake by trees. The final report of this research was published in May 2004 referred to as *Horticultural LINK project 212*. The information was disseminated by Building Research Establishment within Document *IP7/06* (Appendix 4). Crown reduction works were carried out on 28 year old London Planes, which were well spaced, having branches to within 2 metres of ground level. Heavy reductions were carried out, reducing the height of the trees by 60% and 90% of crown volume, indicating that between 10% of the leaf area remained. This pruning was found to effectively decrease soil moisture deficits for up to 2 years. Re-growth following reduction *"produced trees with a greater leaf area density of the canopy, because they had larger leaves more closely packed together, with a smaller crown volume compared with non-pruned trees. This was associated with lower water use by the crown*". The document further goes on to state that *"..more information is needed on the effect of repeated pruning, to determine the impact on the root system and moisture conservation at the periphery of the root system".*

5.29 Repeated pruning back to the point of reduction would result in the formation of *callus* knuckles. This knuckle will become a point where energy, which is produced by the new shoots, is stored and from where new shoots will form following regular pruning. This type of heavy pruning is effectively topping the tree, and is contrary to arboricultural best practice. However, such drastic pruning has been carried out for many decades on urban trees as a form of crown control. It should be noted that even after a period of prolonged and repeated works, if the management ceases, the trees will continue to develop to their full size, given their genetic characteristics and growing conditions. Such extended growth would have an increased risk of failure as a result of poor quality branch attachment to the parent stem, and decay which inevitably forms in the pollard head and old pruning wound.

5.30 I suggest that on the balance of probabilities a biennial pruning regime which does not allow the indicated trees to exceed the stated heights would be adequate to mitigate the possibility of the indicated trees contributing to moisture deficits in soils underlying the foundations of 11 Wallis Gardens and 3B Wallis Road.

5.31 Management of this nature will have long-term cost implications for the respective trees owners and on the amenity value of the respective trees. The benefits of such management must be weighed carefully in consideration with other management options such as underpinning the affected properties.

5.32 If a pruning regime is implemented ongoing level monitoring should be carried out at both properties to assess the effectiveness of the management and any modifications that may be required to it.

5.33 It also falls to me to consider the potential for heave to the property of 5A Wallis Road should the Oak be removed or severely pruned.

5.34 The age of the oak is estimated at approximately 150 years old. Given the tree's recent management history and the progressive development of its surroundings which has occurred during the tree's life, an accurate assessment of age is not possible without employing invasive techniques.

5.35 Notwithstanding, it is apparent that the Oak tree predates the affected properties by approximately 100 years. It is therefore probable that this tree had created a persistent moisture deficit in the surrounding shrinkable clay soils at the time the adjacent properties were constructed.

5.36 Biddle (1998) provides a simplified approach for assessing risk and duration of heave where a persistent moisture deficit may have arisen and a tree is removed or heavily pruned, and advises where there is variability in plasticity index, the highest figure should be applied.

5.37 Applying this method to the Oak tree in question with regard to 5A Wallis Road and using the higher plasticity index value in the Cunningham Lindsey report (54%) gives a score of 59.4.

5.38 This score relates to a near certainty of heave of a prolonged duration (exceeding 10 years) affecting the property of 5A Wallis Road.

5.39 Although it lies outside of the scope of my specific instructions, it is my view that I must note that this assessment of risk and duration of heave also broadly applies to the property of 5 Wallis Road.

5.40 As stated, this is a simple method and is considered appropriate approach given the available information, however, this method takes no account of foundation design or depth.

5.41 Furthermore, as previously indicated, it is not entirely clear whether the underlying geology is homogenous in this area.

6.0 CONCLUSIONS

6.1 Several trees and shrubs are within influencing distance of the affected properties.

6.2 It is not clear on the basis of the information available that the trees and shrubs are the sole significant cause of damage to the affected properties.

6.3 There exist indications that factors, other than subsidence induced by the oak tree, may be involved which have not yet been identified or considered.

6.4 There are remedial options other than the removal of the Oak, such as a short interval pruning regime or underpinning, which have not been afforded due consideration.

6.5 On the basis of information provided it appears that the properties of 5A & 5 Wallis Road have a near certainty of prolonged duration heave should the Oak be removed.

7.0 RECOMMENDATIONS

7.1 A structural engineer and soil scientist should be appointed to thoroughly investigate the various contributory causes of damage to the properties of 5A and 3B Wallis Road and 11 Wallis Gardens.

7.2 Advice should also be sought from a structural engineer and soil scientist regarding heave potential at the above properties and 5 Wallis Road should the Oak be removed.

8.0 BIBLIOGRAPHY

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- Institute of Structural Engineers – *Subsidence of Low Rise Buildings 2nd Edition* August 2000
- Charles Mynors – *The Law of Trees Forests and Hedgerows* 2002
- Arboricultural Journal 1995. Volume 19. Dead or Alive?
- NHBC (2006) chapter 4.2 Building near trees.

---------CBA----------


CB1

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Drawing Title	Job No	Client	
Tree Location Plan Indicative North	CBA7715	Mr John Pearce	
	Drawing No CBA7715.01HD	**Date** August 2011	**Scale** Not to Scale




CB2

The Professional Arboricultural Consultancy

QUALIFICATIONS OF DOMINIC GANE

SENIOR CONSULTANT

CBA TREES

Dominic Gane *BSc (Hons) Arb, BSc (Hons) Env Biol, Cert.Arb (RFS), M Arbor A, MIEEM*, joined CBA Trees in February 2011 as has recently been confirmed as Senior Consultant.

Dominic gained experience in many fields of our work; whilst employed as a Tree & Landscape Officer with North Dorset District Council, managing Tree Preservation Orders, Conservation Areas and development control caseloads, and as an Arboricultural Officer with Dorset County Council managing public space, school and highway tree stocks.

Dominic also has substantial practical experience of arboricultural management gained as an arboricultural contractor and has conducted fundamental arboricultural research in collaboration with the Chinese Research Institute of Tropical Forestry.

Dominic has been trained by the respective authors to conduct Helliwell Visual Amenity Tree Valuation and Capital Asset Value for Amenity Trees (CAVAT) tree valuations, holds the LANTRA Professional Tree Inspection Certificate and is a qualified tree climber.

Dominic will continue to handle development projects on behalf of his own portfolio of clients, as well as assisting the other consultants within the Practice. He will undertake Tree Surveys, provide Condition Reports, Constraints Advice, Implications Assessments and Development Statements and associated methodologies, together with Tree Protection Order, landscape and woodland advice, Expert Witness reports and tree valuations.

Dominic recently gained the BSc (Hons) Arboriculture at Myerscough College to reinforce his Senior Consultant status with CBA Trees, and we are confident he will soon become an eminently respected member of the professional CBA team.