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**CALL-IN OF THE PLANNING APPLICATION FOR THE PROPOSED  
CONSTRUCTION OF THE UNITED KINGDOM HOLOCAUST  
MEMORIAL AND LEARNING CENTRE, AT VICTORIA TOWER  
GARDENS, MILLBANK, WESTMINSTER, LONDON, SW1 3JA.**

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**ARBORICULTURAL PROOF OF EVIDENCE  
ON BEHALF OF THE SECRETARY OF STATE FOR HOUSING  
COMMUNITIES AND LOCAL GOVERNMENT**

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*Prepared by Dr Frank Hope*

LOCAL PLANNING AUTHORITY REFERENCE: 19/00114/FULL

PLANNING INSPECTORATE REFERENCE: APP/XF990/V/19/3240661

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## **1.0 FORMAL DETAILS**

- 1.1 My name is Dr Frank Hope, and I am an independent arboricultural Consultant based at Chestnut House, Northside, Thorney, Peterborough. The practice specialises in arboriculture, urban forestry, biological sciences and project management. I have advised many major clients during the past thirty years, for example, Sainsburys, Midland Bank, Alfred McAlpine, P&O, the BBC, Church of England, Ministry of Defence, Environment Agency, The Health and Safety Executive, Metropolitan Police, Local Authorities, Insurance Companies and Loss Adjusters.
- 1.2 For five years (April 1998 to April 2003), I acted for the Office of the Deputy Prime Minister (ODPM) as an Inspecting Officer on Tree Preservation Order Appeals. This provided me with a detailed insight into this topic.
- 1.3 In addition to having a doctorate and master's degree in Biological Sciences (research on woody plants), I hold the National Diploma in arboriculture (RFS) which is the foremost practical British qualification in trees and their management. I also hold numerous general horticultural qualifications, the most notable of which is the National Diploma of Horticulture (now the Master of Horticulture (RHS)).
- 1.4 I am a retired Fellow of the Arboricultural Association, and a retired Fellow of the Institute of Groundsmanship. I am a past member of the education committee of the Arboricultural Association, past vice Chairman of the East Anglian Branch, and am a past member of the governing council. I am also a past member of the governing body of the East of England Show.
- 1.5 During 1997 I was one of three people commissioned by the Arboricultural Association to develop a computerised model capable of assessing the future risk of subsidence damage to buildings when trees are growing close by.
- 1.6 For further detail on my qualifications and experience see Appendix -A-.

## **2.0 INTRODUCTION**

### **2.1 THE WESTMINSTER CITY COUNCIL RESOLUTION**

2.1.1 Item (ii) of The City of Westminster Planning Applications Sub-Committee (Ref: CD 5.11) cites the following in relation to arboricultural issues as part of the Council’s objections to the proposed development:

*“Inadequate and conflicting information has been submitted which is not sufficient to permit a proper assessment of the impact of the proposed development on trees within Victoria Tower Gardens, together with the effectiveness of suggested mitigation. As such it has not been satisfactorily demonstrated that unacceptable harm to, and/or loss of, trees would not arise as a result of the proposed development. Damage to or loss of trees would be contrary to policies S25 and S38 of Westminster’s City Plan (November 2016), ENV 16 and DES 9 of our Unitary Development Plan that we adopted in January 2007, 7.12 of the London Plan (2016) and G7 of the Intend to Publish London Plan 2019. Moreover, damage and/or loss to trees would be detrimental to the visual amenities of the area, and would have a further adverse effect on the significance of heritage assets (as referred to within reason (i) above).”*

### **2.2 THE SCOPE OF THIS PROOF OF EVIDENCE**

2.2.1 The scope of this Proof of Evidence addresses the two main arboricultural issues raised by Westminster City Council, i.e.

- i. is the information adequate to enable an assessment of whether the proposed development would be likely to lead to the loss of some of the London plane trees, and if so -
- ii. whether the proposed development would be likely to lead to the loss of some of the London planes.

2.2.2 This Proof of Evidence includes the following assessments:

- the arboricultural issues of the proposed construction of the United Kingdom Holocaust Memorial and Learning Centre (UKHMLC) located within Victoria Tower Gardens, London, SW1P 3YB;
- the Westminster City Council reasons for refusal;

- assessment of the arboricultural reasons of objection to the project as identified in the report produced for Westminster City Council, by David Archer Associates, dated March 2020;
- review of the arboricultural reports dated the 4<sup>th</sup> of February 2019, and the 18<sup>th</sup> of May 2019 produced by Mr Jeremy Barrell, acting as an independent consultant, in support of the refusal for consent of the proposed development.

2.2.3 This Proof of Evidence has been produced on instructions from Gustafson, Porter and Bowman, on behalf of the Secretary of State for Housing Communities and Local Government, in relation to the Public Inquiry instigated following the call-in of the planning application (ref: 19/00114/FUL) for the proposed development at Victoria Tower Gardens.

## **2.3 MY INVOLVEMENT IN THE PROPOSED DEVELOPMENT**

2.3.1 I initially became involved with the proposed development in May 2019, when commissioned by Gustafson, Porter and Bowman on behalf of the UK Holocaust Memorial Foundation, to:

- visit Victoria Tower Gardens, and inspect the mature London plane trees located around its perimeter;
- review the tree-related literature relevant to the proposed construction of the United Kingdom Holocaust Memorial and Learning Centre;
- carry out a peer review of the arboricultural aspects of the proposed development, to assess if Bartlett Consultancy had followed good arboricultural practice.

2.3.2 I attended a site meeting with Mr Donncha O’Shea of Gustafson, Porter and Bowman on the 10<sup>th</sup> of May 2019, and inspected the trees growing along the perimeter of the Gardens. As the Head of Arboricultural Services had not questioned the dimensions of the trees, and they were not considered contentious, I did not attempt to verify all of the dimensions produced by Bartlett Consultancy.

2.3.3 Following the meeting, I subsequently produced a Peer Review (CD 6.36), dated the 16<sup>th</sup> of August 2019, which included a discussion of points arising from my site visit, analysis of the concerns voiced by the Westminster City Council Head of Arboricultural Services, and an analysis of a report produced

by Mr Jeremy Barrell, who was acting as an independent arboricultural consultant.

2.3.4 I re-visited the site on the 6<sup>th</sup> of August 2020.

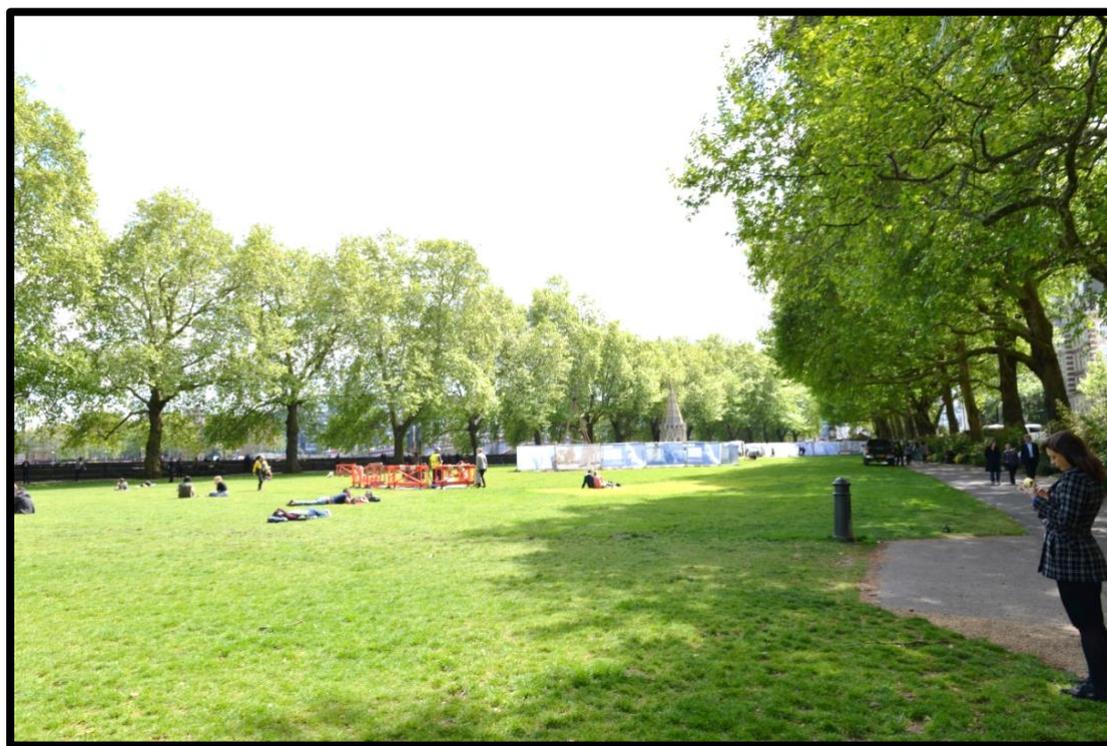
## **2.4 THE SITE AND SURROUNDINGS**

2.4.1 Victoria Tower Gardens is a large, Grade II registered park and garden. It is an approximately triangular-shaped piece of land located adjacent to the southern end of the Palace of Westminster on Millbank, London.

2.4.2 Victoria Tower Gardens is a generally level, grassed-covered area containing hard-surfaced pathways running along the eastern and western sides. Some important memorials and monuments are present. There is also a playground area for children, and a food kiosk.

2.4.3 Two rows of mature London plane trees are located along the eastern and western sides of the gardens. There are twenty-five trees located along the eastern side, parallel with the river Thames, with twenty-six trees running parallel with Millbank. Other smaller trees of various species are present close to the northern end.

**Picture taken on the 10<sup>th</sup> of May 2019 showing the trees along the Eastern side of Victoria Tower Gardens.**



**Picture taken on the 10<sup>th</sup> of May 2019 showing the planes along the western boundary of Victoria Tower Gardens.**



### **3.0 WAS ADEQUATE INFORMATION PROVIDED TO ENABLE THE ASSESSMENT OF WHETHER THE PROPOSED DEVELOPMENT WOULD BE LIKELY TO LEAD TO THE LOSS OF SOME OF THE LONDON PLANE TREES?**

3.1.1 At the commencement of the project, Bartlett Consulting (Bartlett) were engaged for Arboricultural services to survey the existing trees, plot their Root Protection Areas (RPAs) and produce Tree Constraints Plans (TCP) as part of the project to guide and inform the proposed development. The initial constraint plans were produced in February 2018, and resulted in significant modification of the design, including relocation of the development 40 metres to the north, as well as amending the shape and layout of the memorial.

3.1.2 Submitted with the revised application on the 26<sup>th</sup> of April 2019 was a suite of Tree Constraints Plans showing:

- i. the existing site layout;
- ii. overall proposed development in relation to retained trees;
- iii. trees identified for root pruning;
- iv. trees identified for crown raising;
- v. amount of ingress into the notional RPAs by the proposed development;
- vi. tree mitigation measures;
- vii. vehicle security measures in relation to retained trees;
- viii. existing and proposed services in relation to retained trees.

Additional plans and documentation consisted of:

- ix. Environmental Statement (Volume 5) Appendix C Revised Construction Management Plan dated April 2019;
- x. Arboricultural Impact Assessment Addendum dated April 2019 (including Appendices A - C)
  - Root Survey Report - Security Measures by Canopy Consultancy dated April 2019 (ref. 18-660 Root Survey report -02) (Appendix B to Arboricultural Impact Assessment dated April 2019);
  - Root investigation by Tree Radar by Sharon Hosegood Associates dated 23 March 2018 ref SHA 621) (Appendix C to Arboricultural Impact Assessment dated April 2019);
- xi. Root Investigation by Tree Radar - further information by Sharon

- Hosegood Associates dated 19 April 2019 (ref. ref SHA 621) (Appendix C to Arboricultural Impact Assessment);
- xii. Root Investigation Report by Sharon Hosegood Associates dated 07 June 2019 (ref. SHA 621);
  - xiii. Bartlett Consulting letter dated 16 August 2019 “Formal arboricultural comments and further recommendations following ground investigations” (ref JH\_JPL/190181/R1);
  - xiv. Bartlett Consulting letter dated 16 August 2019 “Interpretation and Further Recommendations Following Soil Sampling and Analysis (ref. JH/190181/R2);
  - xv. Dr Frank Hope Peer Review August 2019.
  - xvi. Ground investigation report by Ground Engineering dated August 2019 (ref. C14757).

3.1.3 In my opinion, comprehensive arboricultural documentation was provided with the planning application. The documentation and reports were professional and bespoke. They were disclosed in full; and provided technical detail on their relevant subject areas.

3.1.4 Page 66 of the City of Westminster Planning Application sub-committee states the following:

*“Whilst the Arboricultural Impact Assessment Addendum dated April 2019 and the Environmental Statement (Volume 5) Appendix C Revised Construction Management Plan April 2019 (CMP Apr 19) **include more information, only a partial assessment of the impact of the development on the trees has been provided** - many potential impacts are not considered or are not properly considered.”* (Emphasis added).

3.1.5 The above highlighted text acknowledges that more information had been provided. The committee did not state the available information remained inadequate, or that it was misleading; their objection was that they considered only a partial assessment of the impact of the development on the trees had been carried out using the information.

3.1.6 On the 13<sup>th</sup> of February 2020, Mr Mark Mackworth-Praed, of David Archer Associates, visited the site and carried out an inspection of the trees. He subsequently produced a detailed report, dated March 2020, which was disclosed on the 30<sup>th</sup> of March 2020.

3.1.7 Appendix 7 of Mr Mackworth-Praed’s report identifies the extensive documentation considered in his assessment of the proposed development.

He does not claim the extent of the disclosed documentation to be inadequate, although he does question the analysis of the assessment of the impact of the development on the trees.

3.1.8 I disagree with the assertion that inadequate information has been provided. I consider it adequate; enabling a full, accurate assessment as to whether the proposed development would be likely to lead to the loss of some of the London planes.

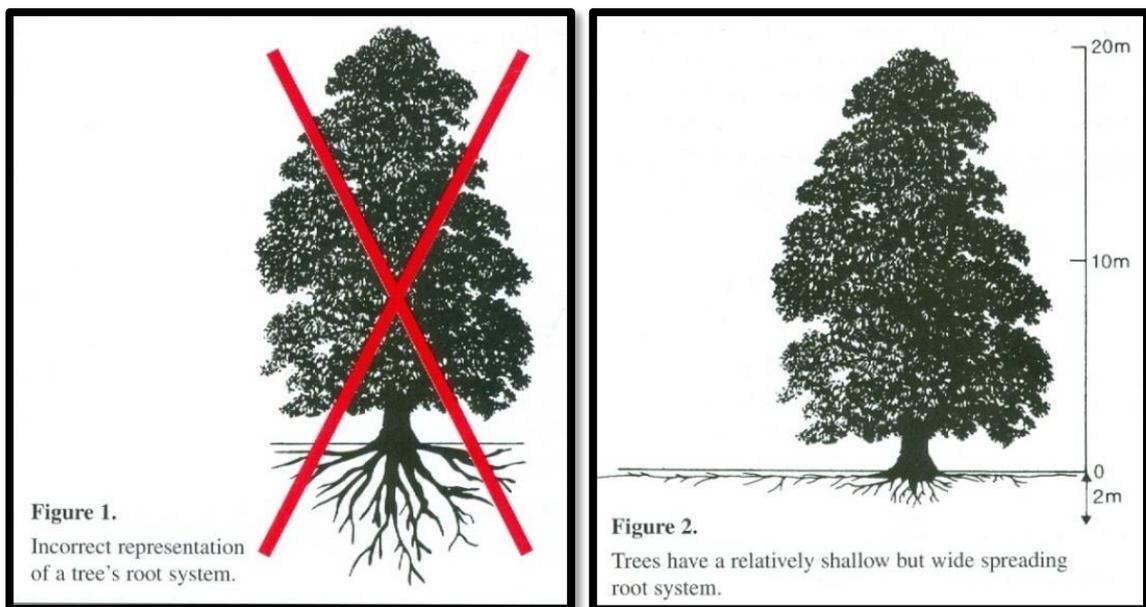
3.1.9 I consider the claim of inadequacy and misleading information, has arisen by the misinterpretation of the data by WCC's Head of Arboricultural Services.

## 4.0 KEY BASIC PRINCIPLES

### 4.1 THE DEVELOPMENT OF TREE ROOT SYSTEMS

4.1.1 There is a general misconception that tree roots grow to great depths within a soil, and often have large “Tap-Root” systems (See Figure 1 below). However, the root systems of trees are typically shallow, and spread out for considerable distances (See Figure 2 below).

#### Scanned copies of Figures 1 & 2 of AAIS – APN12.



4.1.2 Tree roots typically grow parallel with the soil surface, rather than vertically. On level sites, the greater part of a tree's root system is within a depth of between 600mm and 1.0 metre below ground level (See Appendix “B”). However, it is possible for some roots to develop below these depths in certain soil conditions, i.e. where adequate available oxygen, moisture and nutrients are available, and where low compaction and free drainage, are conducive to healthy growth.

4.1.3 The soil conditions within Victoria Tower Gardens would be suitable for roots to develop below a depth of 1.0 metre.

4.1.4 Roots can be up to 30cm or more in diameter at the base of the trunk of a tree, but they sub-divide and taper rapidly as they extend away from the trunk. In most cases the roots are only 2-3cm in diameter, or much less than that, at a distance of between 5.0 metres to 10.0 metres away from the trunk.

4.1.5 Further, the greatest density of feeding and moisture absorbing roots are produced closest to the trunks of trees. The large, structural roots extending towards the limits of overall root spread act as conduits increasing the overall area of moisture and nutrient extraction, but at less density.

4.1.6 The standard recognised text in relation to tree root development is entitled “Tree Root Systems”, written by Dr Martin Dobson for the Arboricultural Advisory and Information Service (AAIS) in 1995. The Summary section of the publication states the following:

*“The development and structure of tree root systems are described. They are wide spreading, extending radially in any direction for distances often in excess of the tree’s height. **Roots grow predominantly near the surface – over 90% of all roots, and virtually all the large structural supporting roots, are in the upper 600mm of soil.** Soil disturbance within the rooting area should be avoided, as this can significantly affect tree stability and moisture uptake.”* (Emphasis added).

## **4.2 CAN TREE ROOTS BE SEVERED WITHOUT CAUSING HARM TO TREES?**

4.2.1 The National Joint Utility Group publication entitled “NJUG Guidelines for the Planning, Installation and Maintenance of Utility Apparatus in Proximity to Trees – volume 4, Issue 2, 2007” (CD 4.15), accepts that roots of up to 25mm in diameter can be severed without specialist arboricultural input, and that roots with greater than 25mm diameter may also be severed in certain circumstances following advice from a qualified arboriculturist. It is important to note that although roots of less than 25mm may be severed, special care must be taken where clumps of roots of this diameter are present.

4.2.2 The importance of the last sentence above is that clumps of minor diameter roots may have a disproportionate influence on moisture uptake (See item 7.2.3 of BS:5837).

4.2.3 Item 2 of BS 5837 accepts the NJUG recommendations.

4.2.4 The picture below provides an example of a sycamore located in the London Borough of Kensington and Chelsea, where highly professional tree specialists acknowledged that significant root severance could take place without harming trees.

**Picture showing exposed roots of a Sycamore (Not in VTG). A senior Arboricultural Association Registered Consultant, and a senior Local Government Tree Officer considered that the tree would not be harmed if all the exposed roots were severed.**



4.2.5 The tables on pages 38 and 39 of this Proof of Evidence, extracted from the Bartlett report, provide data on the known roots found during the investigations. The right-hand column of the tables indicates the implications relating to the identified roots.

4.2.6 If the severance of roots follows good arboricultural practice as identified in the Bartlett report, there should be no reason they would not regenerate quickly, especially when remedial mitigation is provided.

#### **4.3 British Standard 5837 (2012) - Trees in Relation to Design, Demolition and Construction – Recommendations (CD 4.16)**

4.3.1 British Standard 5837 (BS 5837) is the industry standard, and nationally accepted, document for providing guidance and recommendations in relation to the juxtaposition of trees and buildings. Although not a statutory document, or specification, BS 5837 now forms the basis for almost all arboricultural impact assessments relating to development sites. It was revised and updated in April 2012.

4.3.2 Westminster City Council typically recognises the use of BS 5837 in planning issues concerning trees, and has relied on it in their assessment of

the proposed development at Victoria Tower Gardens.

- 4.3.3 There appears to be no disagreement between the various parties that BS 5837 is the relevant, and recognised publication to use when considering developments near trees. However, there does appear to be significant disagreement as to how rigidly it should be applied.

#### **4.4 THE USE OF BRITISH STANDARD 5837 ROOT PROTECTION AREA CALCULATIONS**

- 4.4.1 BS 5837 provides a theoretical calculation for estimating the likely extent of root spreads of individual trees. The figures are used as a design aid only. The calculations are based on the concept of a circular Root Protection Area (RPA) described as follows:

*“... layout design tool indicating the minimum area around a tree deemed to contain sufficient roots and rooting volume to maintain the tree’s viability, and where the protection of the roots and soil structure is treated as a priority.”*

- 4.4.2 The RPA figures of single-stemmed trees are calculated utilising their trunk diameters measured at a height of 1.5 metres above ground level. They are capped at 707m<sup>2</sup>, and are calculated as follows:

Radius of RPA = (trunk diameter at 1.5 metres above ground level) x 12.

- 4.4.3 Simplistic RPAs, i.e. without incorporation of site investigation data, are not precise, and should only be used as guidance during the early design phase of a project.

- 4.4.4 Item 4.3.1 “Soil Assessment” of BS 5837, states the following:

**“A soil assessment should be undertaken** by a competent person to inform any decisions relating to: (Emphasis added)

- **the root protection area (RPA);** (Emphasis added)
- tree protection;
- new planting design; and
- foundation design to take into account of retained, removed and new trees.

- 4.4.5 The RPAs are, by definition, two-dimensional; they do not provide

information on soil volume, which is three-dimensional. Any attempt to imply available soil volume from simple circular representations can only be considered as speculation. Similarly, the use of RPAs cannot identify the presence of features such as high bulk density, which is an indication of soil compaction. That is why site investigations are imperative when considering the density and depth of root growth, and why simplistic RPAs can only at best, provide a rudimentary assessment of tree root growth.

4.4.6 When no site investigation data are available, the only way of attempting to represent density of root growth is to increase or decrease the extent of the area of the theoretical RPAs, which does not provide an accurate assessment as there is no correlation between the two.

4.4.7 Item 4.6.2 of BS 5837 relates to the shape of Root Protection Areas; it states:

*“... 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.”* (Emphasis added).

4.4.8 The use of polygons provides some flexibility in the representation of RPAs, to take into account specific site-related features. They need not be square or rectangular, but should encompass the basic calculated area. The pictures of planes along Millbank (See pages 32-34 below) confirm that the root development of trees, does not necessarily comply with circular BS 5837 RPAs.

4.4.9 There is no comment within BS 5837 to stipulate that it is unacceptable to have different shaped RPAs on the same site, and there is no comment that RPAs cannot overlap.

4.4.10 BS 5837 accepts, by necessary implication, that all roots of any type or size, i.e. smaller or greater than 25mm diameter, can be severed outside the theoretical RPAs of trees without hurting them, and that new healthy regrowth will take place.

4.4.11 Simplistic theoretical RPA calculations cannot provide more accurate information compared to when physical site investigations are carried out.

## 5.0 TREE ROOT INVESTIGATIONS

- 5.1.1 The concept of the design and location of the development have been based throughout on the retention of all of the Planes, i.e. no tree removal will be required.
- 5.1.2 To assist in the assessment of the proposed development, Sharon Hosegood Associates (Hosegood) were instructed to carry out a Ground Penetrating Radar survey to identify the location and density of roots within the proposed area of development. The use of Ground Penetrating Technology was selected as it was identified as being the least disruptive and least destructive method of identifying the depth and density of significant tree roots. This work was undertaken on the 27<sup>th</sup> of February 2018.
- 5.1.3 Hosegood produced a detailed technical report on their investigations, and recommendations, dated the 23<sup>rd</sup> of March 2018 (Ref: SHA621), with subsequent follow-up reports dated the 1<sup>st</sup> of November 2018, and the 19<sup>th</sup> of April 2019.
- 5.1.4 Canopy Consultancy Limited were additionally instructed to carry out a tree root survey of the Planes within the open space, so as to determine the extent of root activity from the Planes into Victoria Tower Gardens. The survey was undertaken between the 3<sup>rd</sup> and 14<sup>th</sup> of September 2018, and was carried out using a combination of air-spades, hand digging, and a mini-digger.
- 5.1.5 Air-spades use a powerful jet of air to move soil from around roots causing them minimal harm. They are used widely within the arboricultural industry to excavate trenches through areas containing extensive roots. Their use is identified in item 7.2.1 of British Standard 5837 where it states:

“... Such excavation should be undertaken carefully, using hand-held tools **and preferably by compressed air soil displacement.**” (Emphasis added).

- 5.1.6 Following the initial design and layout of the proposed development Bartlett was commissioned to produce an updated and revised Arboricultural Impact Assessment report, to accompany a revised planning application. Their brief was to:

*“discuss the constraints posed by the trees; the proposed development in relation to those trees, potential impacts of proposed development; and*

provide recommendations for tree management and protection where appropriate.”

**Plan produced by Gustafson, Porter and Bowman showing the locations of the root surveys.**



- 5.1.7 In order to assist Bartlett, Canopy Consultancy were commissioned to carry out additional detailed rootzone investigations along the western boundary of Victoria Tower Gardens, i.e. at the public entrances and the interface with the pavement. This work was carried out in April 2019, and was conducted using a combination of air-spade technology and hand-digging.
- 5.1.8 Bartlett produced their updated report on the 26<sup>th</sup> of April, 2019.
- 5.1.9 The Head of Arboricultural Services has declined to accept the results of the extensive Air-Spade and Ground Penetrating Radar Investigations, asserting they are incomplete and inconsistent (See the plan on page 18 above, identifying the extent and positioning of the investigations).
- 5.1.10 In relation to the Ground Radar investigations, the Head of Arboricultural Services notes (see page 64 of the Planning sub-committee report) that the introduction of new software modified the initial findings, stating that:
- “These findings are incomplete, unsubstantiated, and do not reflect a soundly based arboricultural assessment of root distribution.”* (Emphasis added).
- 5.1.11 I disagree with the above highlighted statement.
- 5.1.12 No evidence has been provided to confirm that the Head of Arboricultural Services has the technical knowledge to interpret the Ground Radar investigations.
- 5.1.13 In my experience it is common practice with all state-of-the-art investigation techniques for upgrades of software to be introduced, so as to provide the most accurate assessments. Just because new software is introduced does not mean that the investigations are invalid.
- 5.1.14 The Head of Arboricultural Services has compared the Ground Radar results with those of the Canopy Consulting trench investigations. However, in my opinion, she has failed to appreciate that the Ground Radar investigations consisted of assessing wide swathes of the site, whereas the trenching investigations consisted of solitary, narrow trenches.
- 5.1.15 In my opinion, the wealth of site investigations has provided no evidence to indicate that the structural integrity, or long-term viability of the trees would be significantly harmed as a result of the proposed development.

5.1.16 Under the heading “Tree root investigations” on page 63 of the Westminster City Council Planning Sub-committee report it is asserted that the submitted investigation reports are contradictory; they state:

*“Taking into account the constraints on tree root distribution set out above, the roots found in the trenches and the known deep rooting habit of London planes to 5 or more metres in depth, it is a reasonable arboricultural judgement that significant roots of the trees will be severed in order to accommodate the excavation. If the applicant seeks to demonstrate the case that the impact on the trees as a result of root loss is limited as a result of the excavation, additional deeper trench investigations will be required within VTG. If the applicant is also relying on a judgement that trees roots are growing to a significant degree below the pavement and carriageway of Millbank, additional investigation will also be required outside the gardens.”* (Emphasis added).

5.1.17 The Head of Arboricultural Services has based her claim that the root investigations and assessments are contradictory, on two premises, i.e.

- her analysis of the constraints on root distribution, based on the misinterpretation of the BS 5837 RPA calculations;
- the claim that London plane trees root to depths of 5.0 metres or more.

5.1.18 In my opinion, the site investigations do not validate the claim that the roots of the plane trees would be down to five metres depth, or more, and they do not confirm to me that the trees would be harmed, or killed, if the proposed development were to go ahead. No scientific evidence has been provided to confirm that planes are capable of producing roots down to depths of 5.0 metres, or more, away from their root plates.

5.1.19 In my view the root investigation results are in line with the research findings of Dr Martin Dobson (See Appendix B).

5.1.20 In my opinion, there is no requirement to carry out additional trench investigations either in, or outside, the curtilage of Victoria Tower Gardens.

5.1.21 I consider there is no justification for the Head of Arboricultural Services to disregard the most up-to-date investigations, and base her assessment on theoretical RPA calculations, and unsupported assumptions about the

potential depth of plane tree roots.

5.1.22 The Head of Arboricultural Services places emphasis on the fact that assessments should be based on sound arboricultural assessments, but her misinterpretation of the data prevented her doing so.

5.1.23 In my opinion, the Head of Arboricultural Services failed to fully appreciate that:

1. BS 5837 theoretical RPAs are not precise, and that some degree of error is inevitable;
2. the RPA calculations are primarily used for individual, free-standing trees, not groups;
3. there is no mention in BS 5837 as to how RPAs of groups should be calculated, and no mention is made to consider overlapping RPAs in groups;
4. RPAs do not need to be circular;
5. there will be no physical difference of spatial root spread when depicted in squares compared to circles;
6. the RPA calculations do not include the density of root growth;
7. the trees are healthy, and will quickly regenerate healthy, new roots;
8. some die-back of roots of mature trees occurs naturally each winter, and new root growth is produced in spring, which does not necessarily occur at the extremities of the root system;
9. adequate contiguous soil would allow the root growth of the trees to extend in a north-south direction, allowing a reduction of between 10% and 20% of the RPAs on the sides of the trees closest to the development;
10. significant roots will be beneath the pavement, and beneath the carriageway of Millbank, i.e. adequate to accommodate the requirements of the trees;
11. had any root severance occurred beneath the pavement in the past, healthy new growth would have rapidly been produced;
12. no roots will be severed beneath the pavement, and the flags will act as an efficient method of ground protection;
13. BS 5837 accepts that it is possible to sever any roots outside the theoretical RPAs without harming trees, i.e. to allow trees to continue to survive and grow;
14. dead wood is a natural phenomenon in mature trees, and does not necessarily indicate that a tree is unhealthy;
15. the proposed mitigation procedures indicated by Bartlett would have a significant beneficial influence on the growth of new roots.

## 6.0 THE VISUAL AMENITY AND HEALTH OF THE PLANES

### 6.1 BS 5837 CATEGORY RATINGS

6.1.1 All of the planes appear healthy with BS 5837 category ratings of “A” and “B”. They have a high visual amenity to the locality.

6.1.2 The trees are located within the Westminster Abbey & Parliament Square Conservation Area, and are therefore legally protected by the Conservation Area legislation. None of the planes on site is protected with a Tree Preservation Order.

6.1.3 The definition for category “A” trees in BS 5837 is as follows:

*“Trees of high quality with an estimated remaining life expectancy of at least 40 years.”*

6.1.4 The arboricultural qualities of category “A” trees are defined as follows:

*“Trees that are particularly good examples of their species, especially if rare or unusual; or those that are essential components of groups, or formal or semi-formal arboricultural features (e.g. the dominant and/or principal trees within avenues.”*

6.1.5 Category “A” trees should have nothing wrong with them, and have safe life expectancies of over 40 years. They would not be given a rating of “A” if they were showing any signs of lack of annual growth, natural deterioration, or any un-remediable defects.

6.1.6 There should be no reason to suspect that sympathetic root severance would adversely affect category “A” trees.

6.1.7 The definition for category “B” trees is as follows:

*“Tree of moderate quality with an estimated remaining life expectancy of at least 20 years.”*

6.1.8 The arboricultural qualities of category “B” trees are defined as follows:

*“Trees that might be included in category A, but are downgraded because of impaired condition (e.g. presence of significant **though remediable defects**, including unsympathetic past management and storm damage),*

*such that they are unlikely to be suitable for retention beyond 40 years; or trees lacking the special quality necessary to merit the category A designation.” (Emphasis added).*

- 6.1.9 Category “B” trees are healthy, and have safe life expectancies of up to forty years, or more. They do not exhibit any lack of vigour, or deterioration, and should be capable of regenerating new, healthy growth if minor root severance is carried out; if not they should be classified as category “C”.
- 6.1.10 The majority of the trees (46 out of 51) have BS 5837 ratings of “A”, with only 5 having ratings of “B”.
- 6.1.11 The planes are in the region of 120-130 years of age. Planes are considered to have a biological life expectancy under typical conditions in parks and gardens in lowland Britain, in the range of 250-350 years, i.e. the trees within Victoria Tower Gardens still have over half their remaining life expectancy (agreed during discussions for the SoCG – 3rd September 2020).
- 6.1.12 The projected life expectancy of the planes in this instance make the BS 5837 category ages underestimates.
- 6.1.13 I consider the proposed development will not reduce the safe life expectancy of the trees, or adversely influence the visual character of the Conservation Area through loss of, or harm to, the plane trees.
- 6.1.14 In my opinion, all of the planes within Victoria Tower Gardens appear healthy, and will not be adversely affected by sympathetic minor pruning of their roots and branches.

## **7.0 IS THE PROPOSED DEVELOPMENT LIKELY TO LEAD TO THE LOSS OF SOME OF THE LONDON PLANES?**

### **7.1 IMPACT ON RETAINED TREES**

7.1.1 The City of Westminster Head of Arboricultural Services is of the opinion that:

*“The impact on the trees is underestimated because **the Root Protection Areas (RPAs) are not plotted in accordance with BS5837:2012, and because the impact of tree root damage is likely to be greater than that anticipated in the submitted documentation.** (Emphasis added.)*

7.1.2 Item 4.4 of this Proof of Evidence describes the production of BS 5837 Root Protection Areas.

7.1.3 During the production of their reports Bartlett recognised the limitations of using circular RPAs, and they acknowledged that some tree-related constraints were present on the site. They concluded that the use of circles in this instance, would not provide a representative image of the spatial root development of the trees. To address this issue, but to still comply with BS 5837, they utilised both circles and polygons (See the plans on pages 25 and 26 below).

7.1.4 Bartlett recognised that if the RPAs of the Planes on the eastern side were plotted using circles only, and were centred on the trunks of the trees, the RPAs would be encompassing the river Thames where there is a significant change in level (see the plan on page 26 below). To compensate for this, they produced the RPAs using polygons, which increased the theoretical spatial root development towards the west, i.e. towards the proposed building; providing a more realistic impression of the expected root extent.

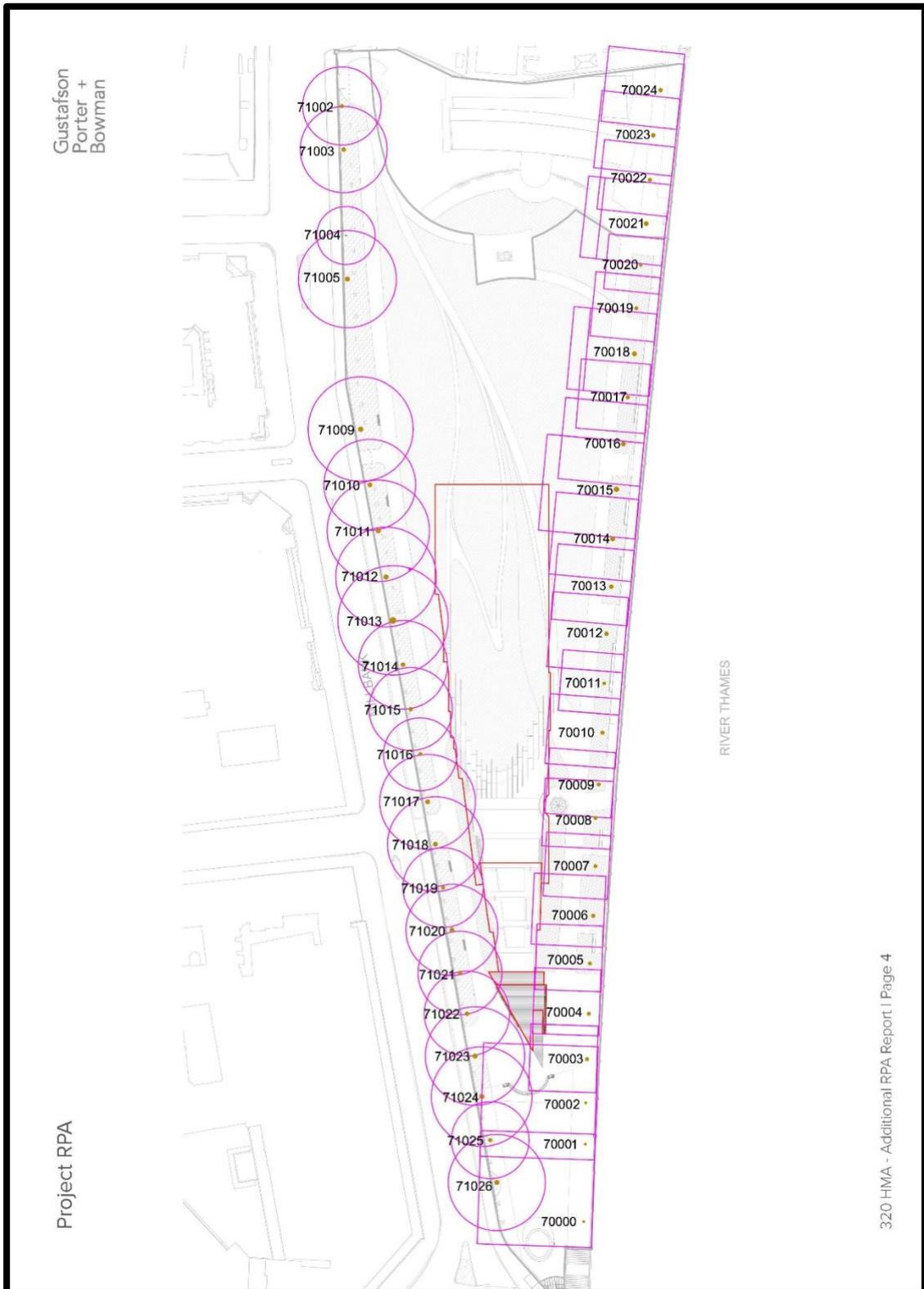
7.1.5 The Head of Arboricultural Services appears to have used the theoretical circular RPAs as the de-facto figures for the root distribution of the Planes at Victoria Tower Gardens, and discounts the results of the extensive, state-of-the-art site investigations as being inadequate, or possibly misleading.

7.1.6 In my opinion, item 4.6 of BS 5837 - Root protection area (RPA), and the locations of solitary trees growing off site, along Millbank and elsewhere (see pages 32-34 and 36-37 below) clearly identify the claim made by the Head of Arboricultural Services in relation to inappropriate plotting of the RPAs is incorrect, and inconsistent.

**Plan provided by Gustafson, Porter and Bowman showing the Root Protection Areas of the trees plotted using circles.**  
**Note that the circular representation places the expected root growth on the eastern side well away from the proposed building.**



**Plan provided by Gustafson, Porter and Bowman, showing the British Standard Root Protection Areas of the Plane trees at Victoria Tower Gardens using circles and polygons.**



7.1.7 I consider the methodology selected by Bartlett Consulting i.e. to use a combination of theoretical circles and polygons, with site-specific investigations, was compliant with BS 5837, and reflects a soundly based arboricultural assessment of likely root distribution.

## **7.2 THE LIKELIHOOD OF PREFERENTIAL ROOT GROWTH ALONG THE EASTERN SIDE OF THE GARDENS**

7.2.1 The plan on page 28 below, provided by Gustafson, Porter and Bowman, indicates the actual distances between the plane trees and the edges of the proposed footprint of the construction. The plan on page 29 shows the area of encroachment (shaded areas) of the RPAs.

7.2.2 The Head of Arboricultural Services makes the following statement in the Planning Sub-Committee report:

*“It is self-evident that the trees are unlikely to be rooting beyond the retaining wall towards the River Thames. The Arboricultural Impact Assessment sets out that the RPAs are plotted as a square to allow better protection of root growth parallel to the retaining wall as well as a better liner[sic] area of protection within the open space, but there is no sound arboricultural reason to assess the trees as having a square RPA.”*

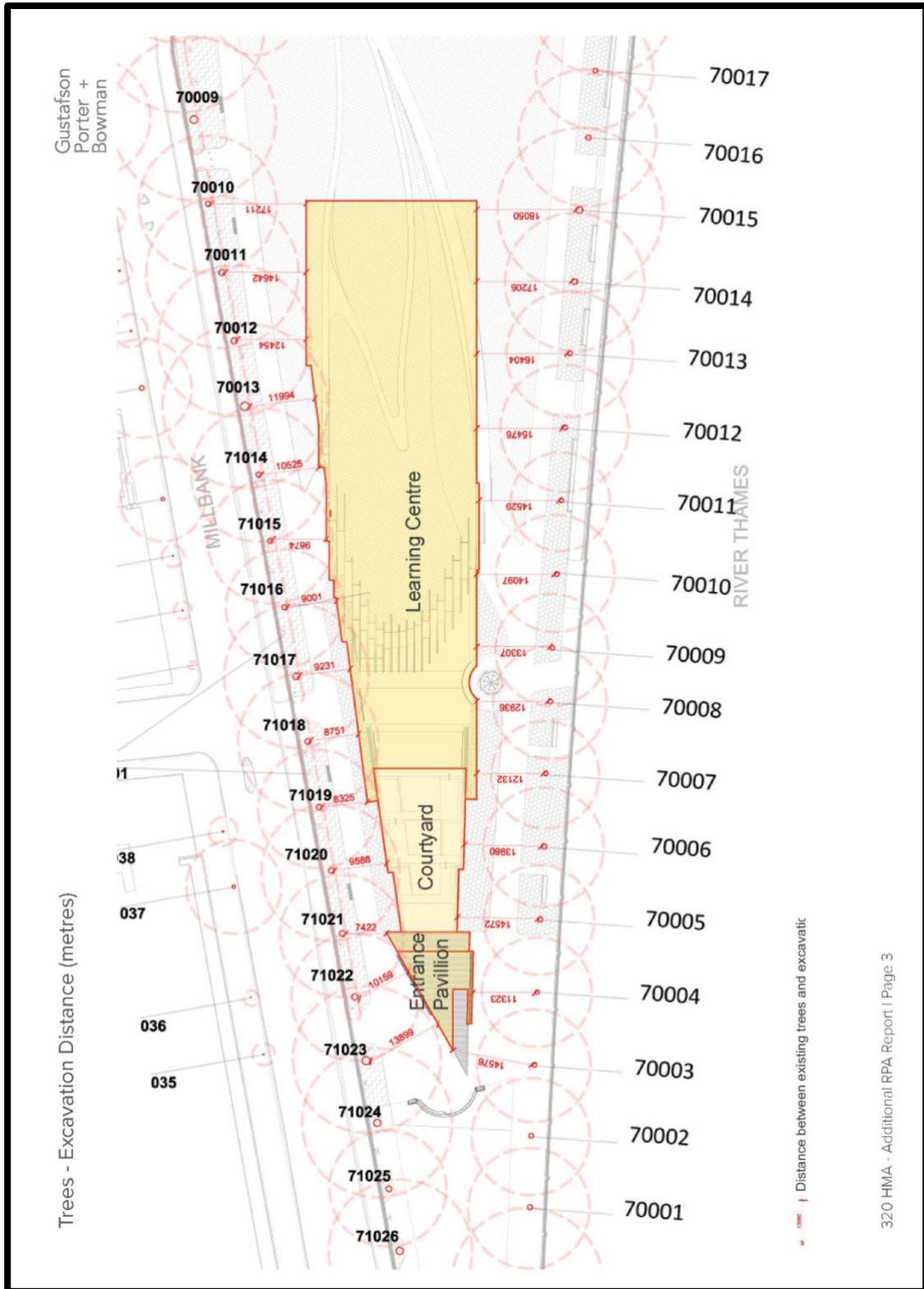
7.2.3 The Head of Arboricultural Services continues:

*“It is more likely that the trees are rooting preferentially westwards, into VTG, and less likely that the RPAs of the trees overlap on a north to south axis. As such, the trees are likely to be rooting into a larger proportion of the proposed excavation envelope than currently depicted, and into areas where other development and construction activity is proposed.”*  
(Emphasis added).

7.2.4 I know of no research to prove the planes along the eastern boundary would produce preferential root extension growth away from the river wall. Roots often intermingle, as well as graft and grow together.

7.2.5 When trees grow, they typically send out their roots randomly to utilise the available soil nutrient and moisture resource; the greatest percentage of moisture absorbing roots are closest to their trunks. Just because roots on one side of a tree may eventually encounter a barrier, does not necessarily mean the tree will produce additional roots on the opposite side of its trunk. The roots simply proliferate between the tree trunk and barrier.

**Plan provided by Gustafson Porter and Bowman showing the actual distances between the centre of the planes and the edge of the proposed excavations.**



**Plan provided by Gustafson, Porter and Bowman highlighting the theoretical areas of encroachment (shaded) of the proposed buildings into the RPAs**



- 7.2.6 There is no evidence available to indicate that the roots of the planes have ever fully exhausted the available moisture and nutrient resource within the soil close to the trees. Had this happened the trees would have suffered, and would have exhibited reduced annual extension growth, and in severe cases they would have wilted. No record of such excessive soil drying has been provided. My inspection of the trees and soil conditions highlighted no indication of any lack of extractable moisture or oxygen close to the trees. The visual appearance of the trees show they are healthy and are making acceptable annual extension growth.
- 7.2.7 The Head of Arboricultural Services has not described any mechanism to show that roots adjacent to the boundary wall have triggered extraordinary root extension growth within Victoria Tower Gardens, i.e. specifically towards the west. No acknowledgement has been made in relation to the fact that additional root growth would be produced in a north to south direction.
- 7.2.8 I have seen no available evidence to suggest that there were so many roots present in the soil that they prevented other root development, i.e. akin to a pot-bound plant, and I know of no reason to prevent new root growth from naturally occurring between the trees. Roots often intermingle in the soil and it is commonplace for natural root grafting to occur.
- 7.2.9 The plans on pages 28 and 29 above provided by Gustafson, Porter and Bowman, indicate the theoretical RPAs of the trees. Note that the RPAs overlap each other in a north to south direction whichever shape is used. This is a typical representation of RPAs and indicates that rooting between the trees is normal and expected. Westminster City Council regularly accept that RPAs indicate that rooting between trees is commonplace.
- 7.2.10 The plot of the RPAs on page 29 above confirms that the square RPAs overlap, clearly indicating that the roots would effectively spread out radially from the tree trunks, just as it would if circular plots were utilised. Just because the edges of the theoretical RPAs are straight does not mean that the roots would not spread out radially, as with circular plots.
- 7.2.11 I consider the comment by the Head of Arboricultural Services in relation to the likelihood of the RPAs not overlapping on a north to south axis is unsustainable. The RPAs are simply representations of the theoretical root spreads of the trees, and in my opinion, there is an extremely high probability that significant actual root development will have occurred between the trees within the rows.

7.2.12 In my view there is adequate distance between the trees and the proposed development to allow their continued healthy growth.

### **7.3 THE LIKELIHOOD OF ROOT GROWTH OUTSIDE VICTORIA TOWER GARDENS**

#### **ROOTS IN THE PAVEMENT OF MILLBANK**

7.3.1 The following statement is made on page 63 of the City of Westminster Planning Sub-committee report:

*“With regard to the rooting of these trees below the pavement on Millbank, the Arboricultural Impact Assessment says, ‘a proportion of each tree root plate will be found under the pavement’. **This may or may not be the case, and is not supported by any root investigation**, but with reference to the Planning Utilities Statement December 2018, it appears there are constraints to rooting below the pavement.”* (Emphasis added).

7.3.2 The photograph on page 32 below shows a large, mature plane located within the pavement along Millbank. The pavement is narrow (4.0 metres wide), with the boundary wall of the River Thames to the rear, and the carriageway of Millbank at the edge of the pavement. The tree has a trunk diameter of 920mm, measured 1.5 metres above ground level.

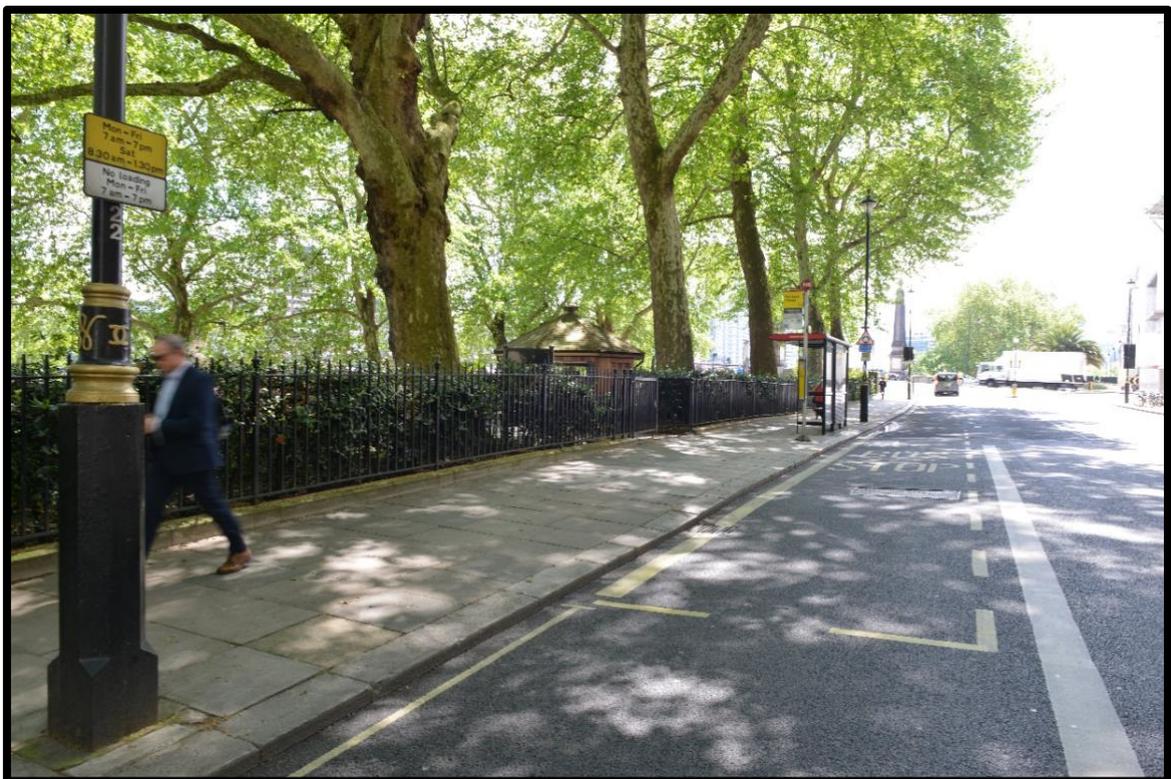
7.3.3 All the roots of the plane must be either beneath the pavement, or beneath both the pavement and the carriageway; there is simply no other place for them to be. The distance of the centre of the tree trunk along Millbank, from the river boundary wall to the edge of the carriageway, where all its roots must be present, is less than the distance of the centres of the trees within the Victoria Tower Gardens and the edge of the carriageway.

7.3.4 In my opinion, this makes a mockery of the claim that few, if any, roots will be beneath the pavement adjacent to Victoria Tower Gardens (see the second picture on page 32 below), and that RPAs should only be plotted as circles.

**Picture taken on the 6th of August 2020 of a large plane on Millbank.**



**Picture taken on the 10th of May 2019 showing the proximity of the Victoria Tower Gardens plane trees to the public pavement and Millbank.**



7.3.5 The pictures below, taken at the time of my site visits on the 10<sup>th</sup> of May 2019, and the 6<sup>th</sup> of August 2020, show a large plane tree located within the pavement on the opposite side of Millbank to Victoria Tower Gardens.

7.3.6 The plane is growing within the 6.0 metre wide pavement, close to a multi-storey building; the foundations of which will be extensive, and the likelihood of any roots from the tree encroaching beneath them must be remote. There are hundreds of large plane trees growing in similar positions and conditions, throughout the city. For example, the planes growing along the Embankment to the west of the Palace of Westminster are growing in restricted conditions.

**Picture showing a large plane growing within the pavement along Millbank, opposite Victoria Tower Gardens.**

**Note the comparable distance of the tree to the carriageway with those within the gardens.**



**Picture taken on the 10<sup>th</sup> of May 2019 showing the base of the plane in the pavement adjacent to the carriageway.**



**Picture taken on the 6<sup>th</sup> August 2020 showing a close-up of the base of the plane tree with large structural, buttress roots growing towards the kerb and carriageway.**



- 7.3.7 If no roots could possibly be growing beneath the carriageway, then all the roots of the plane must be beneath the public pavement. This means that if no root growth had been produced beneath the carriageway of Millbank, there must be adequate room for all the roots of the tree to grow beneath the restricted area of pavement only.
- 7.3.8 The picture on page 33 above indicates the position of the plane in the narrow strip of pavement, and the position of the trees along the western boundary of Victoria Tower Gardens. For comparative purposes, the second picture on page 32 shows the distance between the trees in Victoria Tower Gardens, and the edge of the carriageway.
- 7.3.9 The distance of the solitary tree, shown in the top picture on page 34, from the building to the edge of the carriageway, where all its roots must be, is similar in distance to the trees within the Victoria Tower Gardens to the edge of the carriageway. The tree is clearly smaller than the trees within the Gardens, as it was not planted at the same time, but there are no signs to indicate that it is unhealthy in any way, and will not continue to grow.
- 7.3.10 The position of the solitary plane opposite the Gardens would suggest that it would be possible for most of the roots of the planes within Victoria Tower Gardens to be beneath the pavement. This is clearly highly unlikely to have occurred, but confirms that the use of theoretical RPA calculations, can be unreliable, and must be used with extreme caution.
- 7.3.11 In my opinion, the claim that it is unlikely that significant numbers of roots of the planes will be along the western side of Victoria Tower Gardens, i.e. beneath the pavement, is unsustainable.

## **7.4 ROOTS BENEATH THE CARRIAGEWAY OF MILLBANK**

- 7.4.1 The Westminster City Council Planning Sub-committee states the following on page 62 of their report:

*“Whilst it is possible that there are structural roots below the carriageway of Millbank, it is improbable, and is not supported by any root investigation. Given that tree roots are opportunistic, and will grow preferentially into areas where moisture, nutrient and aeration are more favourable, a sound arboricultural judgement is that it is more likely that the trees are rooting preferentially eastwards into VTG, and it is less likely that they are rooting to any extent below the carriageway of Millbank.”*  
(Emphasis added).

7.4.2 As long as the soil conditions are suitable for growth, i.e. with adequate moisture, nutrients, oxygen and drainage, tree roots will proliferate. There is no evidence to show that they would grow preferentially into Victoria Tower Gardens, if the conditions under the carriageway are suitable for healthy growth.

7.4.3 The following pictures indicate that if no roots could have developed beneath the carriageway, they must have stopped at the kerb edge, which in my opinion, is extremely unlikely.

7.4.4 The picture below shows the large plane on Millbank in a very narrow section of pavement next to the river Thames. The massive structural root grows directly towards the road, and it has lifted the kerb.

**Picture taken on the 6<sup>th</sup> of August 2020 showing the lifting of the kerb caused by the buttress root.**



**Picture taken on the 6<sup>th</sup> of August 2020 showing the movement of the kerb by the large buttress roots.**



**Picture showing a large plane located adjacent to a road (off site). Large structural roots have moved the kerb, and have developed beneath the carriageway.**



7.4.5 The picture on page 37 above is of a large plane located off the site showing large structural roots lifting the kerb, and growing beneath the carriageway.

7.4.6 The second picture on page 34 of this Proof of Evidence confirms the presence of buttress roots on the solitary tree on the opposite side of Millbank to Victoria Tower Gardens, adjacent to the kerb. If its buttress roots could not grow beneath the carriageway, they must have run along the edge of the pavement for a considerable distance; they would not have simply died when they reached the carriageway edge. This pattern of growth would not be identified within any theoretical RPAs.

7.4.7 It is key to note that every tree and every situation is different, and that how Bartlett Tree Experts plotted the RPAs was considered most appropriate.

## 7.5 IDENTIFICATION OF THE REQUIREMENT TO PRUNE THE ROOTS OF THE PLANES

7.5.1 Bartlett have recognised that some root pruning will be required to allow the development to go ahead. The tables below identify the trees, their locations, diameter of roots, and their implications in relation to the development.

Western Interface of Proposed Development and Tree RPA				
Tree Ref	Root Ref	Diameter & Depth	Aspect of Memorial	Implications
T71022	R25	· 50 mm · 900 mm	· Entrance Pavilion	· Retained · Shallow building foundations above root · No pruning or direct damage
T71021	R24 – R22	· 40 mm – 30 mm · 900 mm – 1.0 metre	· Entrance Pavilion	· Retained · Shallow building foundations above roots · No pruning or direct damage
T71020	R21 – R19	· 60 mm – 20 mm · 800 mm – 900 mm	· Pavilion Courtyard	· Retained · Retaining wall to terminate above roots · Level changes to incorporate roots · No pruning or direct damage · Root R19 dead at time of investigation
T71019	R18 - R16	· 15 mm – 40 mm · 800 mm – 1.0 metre	· Pavilion Courtyard	· Retained · Retaining wall to terminate above roots · Level changes to incorporate roots · No pruning or direct damage
T71018	R15 – R14	· 100 mm (R15) · 50 mm (R14) · 900 mm – 1.0 metre	· Pavilion Courtyard · Basement Box	· Pruning required to facilitate development
T71017	R13 – R12	· 20 mm – 60 mm · 400 mm – 900 mm	· Basement Box	· Pruning required to facilitate development
T71016 to T71014	R11 – R04	· 10 mm – 60 mm · 500 mm – 700 mm	· Basement Box	· Pruning required to facilitate development · Root 10 was severed and pruned during works
T71013 to T71012	R03 – R01	· 15 mm – 20 mm · 500 mm – 900 mm	· Landforms	· Retained · No pruning or direct damage

Eastern Interface of Proposed Development and Tree RPA				
Tree Ref	Root Ref	Diameter & Depth	Aspect of Memorial	Implications
T70006	R26 – R27	- 50 mm (R26) - 400 mm (R26)	- Pavilion Courtyard	- Retained - Shallow building foundations above root - No pruning or direct damage - R25 pruned during investigations
T70007	R28	- 30 mm - 1.0 metre	- Pavilion Courtyard	- Retained - Shallow building foundations above roots - No pruning or direct damage
T70008	R29 – R30	- 35 mm – 40 mm - 700 mm	- Pavilion Courtyard - Basement Box	- Pruning required to facilitate development
T70009	R31 – R32	- 30 mm – 35 mm - 900 mm	- Basement Box	- Pruning required to facilitate development
T70010	R33 – R36	- 20 mm – 50 mm - 230 mm – 900 mm	- Basement Box	- Pruning required to facilitate development
T70011	R37 – R40	- 15 mm – 50 mm - 500 mm – 900 mm	- Memorial Fins	- Retained – R37, 50 mm diameter - Bespoke foundations for memorial fins - Roots R38 – R40 pruned during investigations
T70014 to T70015	R41 – R43	- 20 mm – 45 mm - 400 mm – 900 mm	- Basement Box	- Pruning required to facilitate development

7.5.2 The Head of Arboricultural Services does not accept that any root severance should be allowed, even though it is recognised arboricultural practice that some root severance is acceptable.

7.5.3 In my opinion, the pruning of the roots identified by Bartlett will not harm the trees in any way which would have consequences for the health, or longevity, of any of the affected trees.

## 7.6 TREE ROOTZONE COMPENSATION MEASURES - MITIGATION

7.6.1 In the email from the Head of Arboricultural Services to Mr David Dorward (Development Planning) on the 19<sup>th</sup> of March 2019, in relation to refusal of the application she states:

*“I support the refusal of planning permission for the proposal on the basis of likely loss or damage to valuable trees in Victoria Tower Gardens, and the inadequacy of the information submitted to explain and mitigate the likely impact of the proposal on the trees, and the inadequacy of the tree details.”* (Emphasis added).

7.6.2 Section 5.0 of the Bartlett report (V3) dated the 16<sup>th</sup> of November 2018, covers the detailed mitigation techniques that they envisage carrying out during, and after, the proposed development works. The Bartlett submission includes the following mitigation works:

- i. root pruning using clean and sharp handsaws or secateurs;
- ii. immediately following root pruning the application of Potassium Phosphite on the cut surfaces;
- iii. the wrapping of exposed roots with pre-soaked Pulvium Zeba™ gel pack and hessian where roots are to be left uncovered for any length of time, or the re-covering of roots with soil immediately after the pruning operation;
- iv. application as a soil drench of Potassium Phosphite for all retained trees to stimulate tree vitality and root development, and improve the trees' resistance to diseases;
- v. spot treat for pruned roots;
- vi. applications of sucrose as a soil drench for all trees that have been root pruned;
- vii. soil nutrient analyses to be carried out to determine any nutrient deficiencies, unfavourable soil pH values, and adequacy of soil organic matter;
- viii. application in the form of a soil drench of slow-release tree fertiliser to maintain key levels of nutrients;
- ix. improvements to the footpath network, courtyard plaza, and landforms.

7.6.3 In item 2.5.7 of Mr Mackworth-Praed's report he accepts:

*“It is fair to note, however, that Bartlett Consulting has proposed a programme of soil improvement and treatment measures designed to mitigate the impact of the anticipated root pruning/severance and promote the recovery of the trees thus affected, thereby responding to the requirements of para. 5.3.1 (b) as cited above.”*

7.6.4 In order to improve the water and oxygen availability, the existing concrete and tarmac surfaces will be improved with permeable materials, including a layer of Geocell to minimise load on the soil, and prevent future compaction. These measures, in conjunction with the soil amelioration, will improve the overall quality of the soil and landscape for tree root growth.

7.6.5 It is worthy of note that the Head of Arboricultural Services does not identify what she considers to be the extent of additional root encroachment into the theoretical RPAs produced by Bartlett.

- 7.6.6 In my opinion, even if some minor additional incursion occurred, it would not harm the trees, as the proposed mitigation would encourage rapid re-generation of the roots.
- 7.6.7 In my opinion, the claim by the Head of Arboricultural Services that Bartlett did not provide adequate tree mitigation proposals, and that the trees would be harmed is incorrect. I consider that appropriate mitigation and remedial measures to minimise any adverse impact on the trees have been identified.
- 7.6.8 I consider that the proposed mitigation measures comply with good arboricultural practice.

## **8.0 TREE CANOPIES**

8.1.1 Under the heading “Tree canopies” on page 64 of the Westminster City Council Planning Sub-committee report it is asserted that:

*“The Arboricultural Impact Assessment identifies 9 trees to be pruned by lifting the canopies to provide clearance either for vehicular access or the proposed memorial fins. **Whilst the proposals for pruning are not considered contentious**, the need for additional tree pruning for operational, site logistics and construction management reasons, or in order to account for dieback or dysfunction in the tree canopies as a result of the cumulative impacts of the proposal, are likely to be greater than identified.”* (Emphasis added).

8.1.2 The trees are all healthy and have been pruned in the past. No significant die-back has been identified as being caused by the pruning. Plane trees can withstand extremely severe pruning of their canopies, such as pollarding.

8.1.3 There is no requirement for any severe pruning to be carried out on the Victoria Tower Gardens site, and there should be no loss of visual amenity of the trees to the Conservation Area.

8.1.4 Healthy trees produce a balance between their root systems and their branch/leaf structure. The balance of growth is known as the root:shoot ratio, and it ensures that the trees have enough roots to provide adequate moisture and nutrients to support the branches and leaves. If the root:shoot ratio of a healthy tree is altered to any extent, the tree will rapidly produce new growth to reinstate the balance.

8.1.5 The severing of some roots of the Planes would affect their root:shoot ratios to a minor extent. However, as the trees are healthy, they can withstand even heavy pruning (which is not proposed here). I consider that there is a high probability that after pruning the trees would rapidly re-balance the root:shoot ratio producing new roots close to the pruning points, with no ill effects to the trees.

8.1.6 The importance of the balance of the root:shoot ratio is an accepted principle within the arboricultural industry, which the Head of Arboricultural Services appears not to have considered, as she makes no mention of this point in her analysis.

## **9.0 TREE PROTECTION MEASURES.**

9.1.1 In the memorandum to Mr David Dorward from the Head of Arboricultural Services, dated the 19<sup>th</sup> of March 2019, she states:

*“Given the complex nature of the proposed development, the intensity and nature of the proposed construction activity and the limited nature of the impact assessment, **insufficient detail has been provided to demonstrate that the trees could be protected adequately for the duration of construction.**”* (Emphasis added).

9.1.2 In my opinion, it will be perfectly possible to provide adequate physical protection of the trees during the proposed development. The protection will comply with the guidelines of BS 5837. In this instance I consider the proposal by Bartlett to be appropriate, although if the Head of Arboricultural Services were to suggest added protection, it could be incorporated into the scheme.

9.1.3 I consider that the issue relating to tree protection could be covered by a planning condition, and should not be used as a reason for refusal of the development.

## **10.0 THE INCONSISTENCY OF THE LOCAL AUTHORITY'S ACCEPTANCE OF BS 5837**

10.1.1 The Head of Arboricultural Services has placed great reliance on the use of BS 5837 Root Protection Areas, both in relation to the extent of possible root development, and the harmful effects of excavations within them.

10.1.2 The following photographs identify sites within Westminster where scant regard has been placed on the use of RPAs. They show the construction works at the Westminster Ceremonial Streetscape Project (WCSP). The pictures form part of a series included in a publication entitled "Green Park Wall Working around Tree Roots". The Westminster City Council, and Mr Jeremy Barrell (acting as a project arboriculturalist), were involved in the project. Mr Barrell is currently acting as an independent consultant objecting to the proposed development at Victoria Tower Gardens on the grounds that the excavations would sever the roots of the planes.

**Picture showing the extensive excavations right up against one of the plane trees on the Green Park Wall site.**



10.1.3 The picture above shows the location of a large, mature London plane tree. It indicates the following important points.

- The physical tree protection is right up against the trunk of the tree, and totally ignores its RPA. For the protection to comply with BS 5837 it should be around the periphery of the RPA.
- The depth of the large root is within 1.0 metre of the soil surface, which corresponds to the research by Dr Martin Dobson. There are no signs to suggest that any roots go down to depths of 2.0 metres, never mind, 5.0 metres or greater.
- Extensive excavations have been carried out right up to the trunk of the tree totally disregarding its RPA. This does not follow BS 5837 recommendations, and is bad arboricultural practice.
- The smaller roots of up to 25mm in diameter, and possibly greater, have been totally decimated by the excavation works, which is at odds with the recommendations in BS 5837.

10.1.4 I find it difficult in the extreme to reconcile the fact that the inconsistent decision making by Westminster City Council allowed such work, which posed a significant risk of long-term damage to the tree; but they have objected to the proposal at Victoria Tower Gardens, where no significant encroachment of the RPAs will occur.

10.1.5 The first picture on page 46 below identifies the following:

- apart from the solitary root, all other roots have been severed, which completely disregards the guidance in BS 3837;
- there is no evidence to indicate that any of the root severance followed good arboricultural practice, as jagged, ripped roots are visible. Two low brick-built walls have been constructed close to the site of the exposed root, taking no regard of the RPA of the tree;
- The works do not comply with the recommendations of BS 5837, and totally flaunt the use of RPAs.

**Picture showing the construction of a brick tunnel enclosing the plane root on the Green Park Wall site.**



**Picture showing concrete above the large root of the tree.**



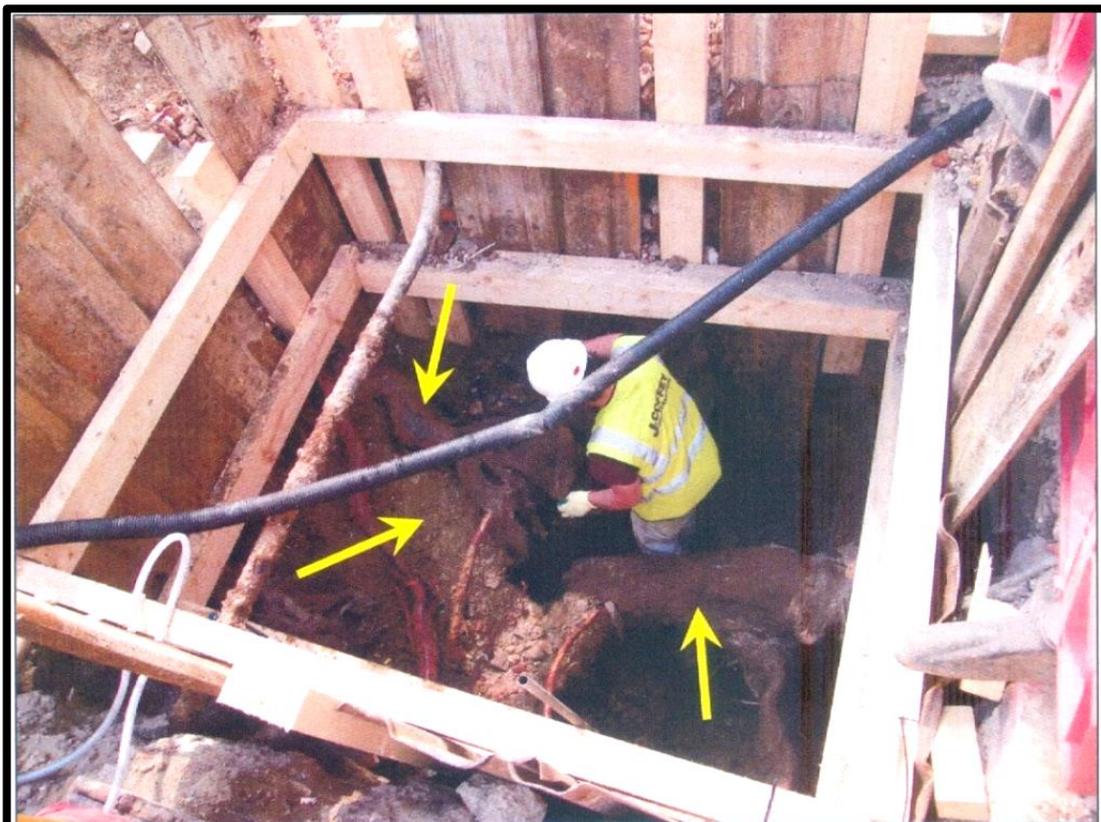
10.1.6 The second picture above shows the following:

- the large root has been totally enclosed by concrete which is completely contrary to the guidelines in BS 5837;
- the works totally disregard the use of the tree's theoretical RPA.

10.1.7 The following picture shows detail of tree protection and arboricultural works at the Connaught Hotel, Carlos Place, London, WK1 2AL, as accepted by the Head of Arboricultural Services. The arboricultural consultant was Mr Jeremy Barrell.

10.1.8 The picture shows an extensive excavation right up against the basal trunk of a large plane tree. The text claims the excavation showed large roots of 20-30cm diameter and greater, at depths of 4-5m below ground level. The excavation actually seems more in the order of 1.5m-2.0m deep.

**Scanned copy of Figure 2 of Mr Barrell's report.**



**Figure 2:** Plane roots uncovered during excavations outside the Connaught Hotel, Mayfair, in 2011, showing roots (yellow arrows) of 20–30cm and greater diameters, at depths of up to 4–5m below ground level.

**Picture showing the finished development around the base of the London plane outside the Connaught Hotel.**



10.1.9 The picture above shows the finished development around the plane tree outside the Connaught Hotel. It highlights the following:

- the whole surface appears to be covered with close fitting flagging, which will prevent some, if not all, moisture entering the soil;
- the ornamental water feature is within the theoretical RPA of the tree;
- the Head of Arboricultural Services at Westminster City Council allowed the work, which posed a significant risk of long-term damage to the tree.

10.1.10 In my opinion, the two examples of development above show a gross inconsistency in applying the guidelines of BS 5837 compared with the proposed development at Victoria Tower Gardens.

## **11.0 ANALYSIS OF THE DAVID ARCHER ASSOCIATES REPORT**

### **11.1 INTRODUCTION**

11.1.1 I have carried out a detailed analysis of Mr Mackworth-Praed’s report and appendices. I attach as Appendix “C” a paragraph by paragraph detailed response to his report. Since receiving his report I have had an opportunity to revisit the site in an attempt to verify his data.

11.1.2 The report produced by Mr Mackworth-Praed has largely been based on BS 5837 theoretical root protection areas (RPAs) even though their use is recognised by arboricultural practitioners as being notional, and that it is normal practice to incorporate actual investigation data whenever possible.

11.1.3 The plan on page 18 of this Proof of Evidence identifies the location of the extensive root investigations carried out on the site.

11.1.4 Item 2.1.8 of Mr Mackworth-Praed’s report states the following relating to the use of physical investigations when investigating the presence of tree roots:

*“It is worth noting, in this context, that at no point does BS 5837 refer to, or recommend, the use of invasive excavations as a means of seeking to assess the extent of a tree’s root system, or as a means of assessing the likely effects of development upon it. Similarly, there are no references in the document to, or recommendations for, the use of any non-invasive means of determining the extent of a tree’s root system, such as root radar (although this may be due to the latter only having been developed in recent years).”* (Emphasis added).

11.1.5 The above highlighted text is incorrect, as item 4.3.1 “Soil Assessment” of BS 5837, states the following:

**“A soil assessment should be undertaken** by a competent person to inform any decisions relating to: (Emphasis added)

- the root protection area (RPA);
- tree protection;
- new planting design; and
- foundation design to take into account of retained, removed and new trees.

11.1.6 Item 7.2.1 of BS 5837 covers ways of avoiding physical damage to trees during demolition or construction. It states:

*“... However, limited manual excavation should be undertaken carefully, using hand-held tools **and preferably by compressed air soil displacement.**”* (Emphasis added).

11.1.7 The highlighted text above confirms that BS 5837 actually recommends the technique of “Air-Spading” when carrying out site investigations.

11.1.8 The use of invasive, and non-invasive techniques to investigate root systems is standard arboricultural practice. The Head of Arboricultural Services invariably requires site related investigations, such as “air-spade” testing on any site where she considers there is a question as to the possible influence of development on trees.

11.1.9 It is worthy of note that Bartlett was one of the pioneering companies that carried out the first investigations into the use of “Air-spade” techniques, and are leading exponents in the analysis of such investigations.

11.1.10 I know of no local authority tree officer that does not accept the use of techniques such as “Air-spading”. In my experience such investigations are commonplace, and comply with the recommendations of BS 5837.

11.1.11 Mr Mackworth-Praed considers that all of the site investigation data carried out using the most up-to-date techniques, are unreliable, and cannot be used in this instance. Although his figures are theoretical, he considers they should take precedence over such data, and that his figures are precise, i.e. with no degree of error.

11.1.12 In my opinion, Mr Mackworth-Praed’s stance is at odds with standard arboricultural practice, and more specifically, with the recommendations of BS 5837. He is also at odds with the typical recommendations of the Head of Arboricultural Services.

11.1.13 I find the position of David Archer Associates incredible, as they attempt to bring into question the use of site-related techniques to quantify the extent and size of tree root systems. I would be amazed if they have never recommended the use of equipment such as “Air-spades” on development sites.

11.1.14 In my opinion, the claim made by Mr Mackworth-Praed in relation to on-site investigations brings into question the reliability of his report.

## **11.2 THE RELEVANCE OF THE GROUP CLASSIFICATION OF THE PLANES**

11.2.1 The group classification of the planes is important in this instance, as all of the theoretical RPA calculations have been carried out as if the trees were individual specimens – they are not.

11.2.2 Both Bartlett and Mr Mackworth-Praed have considered the production of the RPAs as individuals, although Bartlett Consulting have accepted some flexibility in the theoretical, nominal calculations, and have supplemented them by actual site investigations, as per the BS 5837 recommendations. Conversely, Mr Mackworth-Praed has placed almost total reliance on them, and rejects the use of site investigations.

11.2.3 The note in item 4.4.2.3 of BS 5837 defines the term “group”. It states the following:

*“The term “group” is intended to identify trees that form cohesive arboricultural features either aerodynamically (e.g. that provide companion shelter), visually (e.g. **avenues and screens**) or culturally, including for biodiversity (e.g. parkland or wood pasture), in respect of each of the three sub-categories (See 4.5). (Emphasis added).*

11.2.4 In my opinion, there should be no disagreement that the two rows of plane trees form groups, not individual specimens.

11.2.5 Item 4.4.2.3 of the BS 5837 states the following:

*“Trees growing as groups or woodland should be identified and assessed as such where the arboriculturist determines that this is appropriate. **However, an assessment of individuals within any group should still be undertaken if there is a need to differentiate between them, e.g. in order to highlight significant variation in attributes (including physiological or structural condition).** (Emphasis added).*

11.2.6 There is no need to differentiate between individual plane trees within Victoria Tower Gardens.

11.2.7 In item 1.6.2 of Mr Mackworth-Praed's report relating to the visual amenity of the planes he states:

*"... They are of very high amenity value, as individuals, as a group, and in their contribution to the wider townscape and to the significance of heritage assets..."*

11.2.8 I consider the planes have very high visual value as two groups, one on either side of the site. This point becomes important when carrying out the RPA calculations, as they have been carried out by Mr Mackworth-Praed, as if the trees were individual specimens not as groups. The RPA calculations in BS 5837 are based on free-growing specimens. There is no methodology to calculate the influence of groups.

### **11.3 RE-INSPECTION OF THE PLANES**

11.3.1 During Mr Mackworth-Praed's site visit a member of David Archer Associates re-inspected the trees, and took a series of measurements, which were subsequently used to increase the size of some of the Root Protection Areas (RPAs).

11.3.2 The re-measurements are important as the RPAs of the trees are calculated using the trunk diameters, and have been used by Mr Mackworth-Praed to claim that the Bartlett figures are inaccurate.

11.3.3 During my site visit on the 6<sup>th</sup> of August 2020, I attempted to verify the measurements produced by Mr Mackworth-Praed's assistant.

11.3.4 The critical point to note in relation to the updated measurements is that I found them to be imprecise. The fact that the measurements are imprecise is confirmed in the notes section of the Tree Schedule in Appendix 1 of Mr Mackworth-Praed's report where it states the diameters are measured in millimetres to the nearest 10mm.

11.3.5 Item 1.6.4 of Mr Mackworth-Praed's report identifies the increase in diameters; i.e. 10mm to 20mm (max. 40mm) on the west side, and between 5mm to 10mm (max 20mm) for the trees along the east. When the 10mm margin for potential error is taken into account, these figures are insignificant.

11.3.6 Mr Mackworth-Praed accepts that it is impossible to draw firm conclusions from such a limited sample, identifying the potential of variance caused by

the small sample size, and by measurements taken by different surveyors. However, he does not explain in his text there is up to 10mm allowance in his figures, as this would highlight that they are effectively meaningless.

11.3.7 It is also important to note Mr Mackworth-Praed considers that as some increase in trunk diameter has occurred, it must have increased the radial spread of the RPAs. However, this is unsound, as new root growth could quite easily be produced away from the extremities of the theoretical RPAs, i.e. they could be produced within the area of existing roots. It is also important to note that in mature trees there is some natural die-back of roots each winter, followed by new root growth in spring. The new root growth need not be produced at the extremities of the root systems, and therefore does not necessarily mean that the extent of the theoretical RPAs will increase, especially during such a short period of time. Mr Mackworth-Praed does not appear to consider this issue.

11.3.8 Mr Mackworth-Praed accepts that it is impossible to draw firm conclusions from his measurements, but states the following in item 1.6.6 of his report:

*“Although the recorded increases in trunk diameters involve only relatively small measurements, **they are not without significance**, in that for trees of the size and maturity present in this case, they typically translate into appreciable increases in the sizes of their root protection areas (‘RPAs’) as calculated according to BS 5837.”* (Emphasis added).

11.3.9 In my opinion, the assertion that two years of trunk growth of mature, i.e. 120-130-year-old plane trees, will significantly affect their actual root spreads is simply fanciful, and highlights the inherent deficiencies of placing reliance on simplistic theoretical RPA calculations. Mr Mackworth-Praed’s measurements are imprecise, and he crudely uses the figures to produce a direct extension of the RPAs, without taking into consideration the age, and seasonal growth pattern of the root systems.

## **11.4 RECENT GROWTH RATE OF THE TREES**

11.4.1 Mr Mackworth-Praed has attempted to use the recent average trunk diameter figures, which are clearly questionable, to suggest that the trees along the eastern side may not be growing at the same rate as those on the west.

11.4.2 As the site is open along the River Thames with the trees to the west being in a more sheltered location, there would be a natural difference in growth habit and rate.

11.4.3 It is common for trees to grow at varying rates, even when in groups, as the soil may not be consistent throughout a site, and greater exposure may be apparent on different sides of their crowns. All of the trees are large, and healthy, and there is no visual difference between the two rows from a distance.

11.4.4 I consider Mr Mackworth-Praed's assertion to be unsound.

## 11.5 LATERAL CANOPY GROWTH

11.5.1 In item 1.6.5 of his report Mr Mackworth-Praed claims that his measurements show there have been minor differences between the lateral canopy spreads of the trees since the Bartlett measurements were taken.

11.5.2 The claim by Mr Mackworth-Praed that there have been minor differences in the lateral canopy spreads of the trees attempts to suggest that his assistant carried out detailed measurements of the tree canopies, and that his figures are accurate. He makes no mention about the measurement conventions in BS 5837. In my opinion, he indirectly attempts to infer that although minor, the difference in extension growth is consistent with his claimed increase in trunk diameters, as it would be illogical to claim increased trunk growth with no canopy extension.

11.5.3 The claim in relation to differences in canopy extension is unrealistic, and misleading. The trees are growing in two rows, and it is impossible to obtain any meaningful crown extension growth between the trees (North-South).

11.5.4 Item 4.4.2.6 of BS 5837 states the following in relation to measurement conventions (note this is based on free-standing trees, not groups):

*“a) height, crown spread and crown clearance should be recorded to the nearest half a metre (crown spread should be rounded up) for dimensions up to 10m and the nearest whole metre for dimensions over 10m.”*  
(Emphasis added.)

11.5.5 During my site visit on the 6<sup>th</sup> of August 2020, I found no discernible differential increase in lateral canopy growth of the planes.

11.5.6 In my opinion, the claim by Mr Mackworth-Praed relating to increased differential canopy growth is meaningless.

## **11.6 MODIFICATION OF THE SHAPE OF BS 5837 ROOT PROTECTION AREAS**

11.6.1 In my opinion the basis of the modification of the RPAs of the trees by Mr Mackworth-Praed is flawed; they are not precise.

11.6.2 In item 2.2.3 of Mr Mackworth-Praed's report he states the following in relation to the modification, and plotting of the RPAs:

*“The depictions of the RPAs on the TCP, initially as circles of the required radii under the BS 5837 formula, are indicated by light broken circles of the relevant colours centre on each tree's trunk. **However, in line with BS 5837 advice, these initial circles have been modified, to take into account of the obstructions or barriers to root growth represented by the river wall on the east side of VTG, and by the carriageway of Millbank to the west.**”* (Emphasis added).

11.6.3 The above highlighted text confirms that Mr Mackworth-Praed accepts that polygons can be used to depict RPAs, and that he used them in his report. This appears at odds with the viewpoint of WCC's Head of Arboricultural Services in her email to Mr David Dorward (dated the 19<sup>th</sup> of March 2019) in which she criticises the use of polygons despite them being plotted in line with BS 5837 advice (as noted by Mr Mackworth-Praed and referenced above) and states:

*“The impact on the trees is underestimated **because the RPAs are not plotted in accordance with BS5837:2012**, and because the impact of tree root damage is likely to be greater than that anticipated in the submitted documentation. It is likely that the proposal will result in loss of or damage to trees.”* (Emphasis added).

11.6.4 Item 2.2.4 of Mr Mackworth-Praed's report states the following:

*“To offer some comment on the differences between our depictions of the trees' RPAs and those shown in the applicant's submitted reports is appropriate. In the Bartlett Consulting AIA of December 2018, the RPAs of the trees along the eastern boundary are plotted as squares of equivalent area of those of initial circular plots, aligned to the river wall. At 5.2.1 of their report, it is stated that “In this zone of the RPA for these trees has*

*been plotted as a better liner area of protection within the open space. This notional representation of the RPA meets the recommendations of Clause 4.6.2 and 4.6.3 of BS 5837:2012 providing adequate levels of protection for the entire root system and root environment.”*

## **11.7 THE PERCEIVED IMPORTANCE OF THE RPAs OF THE PLANE TREES**

11.7.1 In item 2.1.7 of Mr Mackworth-Praed’s report he states the following:

*“The importance of the RPA as a fundamental principle of BS 5837 is **hard to overstate**, as references to the importance of safeguarding it from disruption, excavation, soil compaction or other construction-related disturbance abound throughout the guidance. **The ‘default position’ taken within the standard is that structures, excavations, underground services, and construction activity should be located outside the RPAs of trees to be retained; and that the most reliable way to ensure satisfactory tree protection is to preserve the RPA completely undisturbed.**”* (Emphasis added).

11.7.2 Mr Mackworth-Praed fails to explain how it is possible to identify the position of subterranean features without carrying out site investigations.

11.7.3 In my opinion, the above highlighted text confirms the inconsistency of the Head of Arboricultural Services assessments, as identified in the examples in item 10 of this Proof of Evidence.

## **11.8 THE UNRELIABILITY OF THE CLAIM THAT PLANE ROOTS EXTEND DOWN TO OVER 5.0 METRES OUTSIDE THEIR ROOT PLATES.**

11.8.1 The Head of Arboricultural Services places significant reliance on her claim that planes produce roots to below 5.0 metres, and has used this assertion in declining to accept the results of the Air-Spade and Ground Penetrating Radar Investigations – she states:

*“Taking into account the constraints on tree root distribution set out above, the roots found in the trenches and **the known deep rooting habit of London planes to 5 or more metres in depth**, it is a reasonable arboricultural judgement that significant roots of the trees will be severed in order to accommodate the excavation and it is likely that trees will be lost or harmed as a result.”* (Emphasis added).

- 11.8.2 No evidence has been identified by the Head of Arboricultural Services to confirm that plane roots grow down to depths of over 5.0 metres outside their root plates, and no mention has been made that the likelihood of roots being down to 5.0 metres at the edges of the proposed excavations is remote. Mr Mackworth-Praed remains silent on this subject, and does not question Dr Martin Dobson's research.
- 11.8.3 The photographic evidence shown in item 10 of this Proof of Evidence identifies the typical depth of plane roots, and that they correspond with the research carried out by Dr Martin Dobson.
- 11.8.4 It is notable that Mr Mackworth-Praed has remained silent on this topic, and fails to identify how Bartlett Consulting could physically disprove the claim by the Head of Arboricultural Services, without decimating the tree root systems. The Head of Arboricultural Services has failed to identify fundamental issues relating to the practicalities, and methodology of excavating down to 5.0 metres without severing any roots of the planes below 25mm diameter.
- 11.8.5 I know of no research that identifies that plane roots grow down to depths of over 5.0 metres outside their root plates. I consider the claim by the Head of Arboricultural Services on this matter to be unsubstantiated.

## **11.9 FLEXIBILITY OF THE EXTENT OF RPAs.**

- 11.9.1 The theoretical BS 5837 RPAs are not precise, and some flexibility should be allowed in their use.
- 11.9.2 Throughout Mr Mackworth-Praed's report he calculates his theoretical BS 5837 RPA's as being from free-standing individual trees. He classifies the RPAs as being de-facto figures, and allows for no flexibility, which is clearly unrealistic under the circumstances as he is using simplistic calculations based on trunk diameters only.
- 11.9.3 In item 2.5.6 of his report Mr Mackworth-Praed states:

*“Secondly, Dr Hope’s contention as to 10% -20% of the RPA being “typically accepted” as being capable of being impacted upon without risk is also not correct, as the relevant recommendations cited above make clear, in relation to the necessity for adequate contiguous rooting volume to be provided in order to compensate for significant RPA encroachments. In this case, the “flexibility” of 10%-20% of the RPA*

*suggest by Dr Hope as being acceptable for encroachment by excavation or construction is simply not available, as has been shown.*” (Emphasis added).

11.9.4 Mr Mackworth-Praed does not object to the principle of utilising a 10%-20% degree of flexibility, but asserts that in this instance there is no suitable contiguous rooting volume to compensate for such an encroachment; this is incorrect.

11.9.5 It should be noted that simplistic BS 5837 RPA calculations do not encompass the volume of the soil; they are “area” measurements.

11.9.6 Mr Mackworth-Praed objects on the grounds that there is no contiguous rooting volume available to compensate for the 10%-20% incursion. However, he fails to consider the consequences of the planes growing within a group, and that contiguous area and volume would be available between, and around the trees. There is no structural impediment to prevent additional contiguous compensatory growth to be produced in a north-south direction, and there are no indications that additional root growth cannot be accommodated. I consider this a fundamental error on his part.

## **11.10 THE MISINTERPRETATION OF THE BS 5837 ROOT PROTECTION AREAS**

11.10.1 In item 1.6.6 of his report Mr Mackworth-Praed uses the RPA calculations, inferring that any increase in trunk diameter must increase the outward extent of the RPAs. This is inaccurate for the following reasons:

- His recent measurements are not precise, and it is impossible to draw firm conclusions from them (see item 11.3 above).
- He does not provide detail on the methodology of calculating the RPAs of groups of trees (see item 11.2 above).
- He does not accept that the RPAs beneath the pavement would be very narrow, and very elongated; they would bear no resemblance to the typical BS 5837 RPA shapes (see item 7.3 above).
- He does not accept that there would be adequate area beneath the pavement to accommodate the growth requirements of the trees (see item 7.3 above).
- He does not accept that the root density along, and beneath, the pavement, would be increased compared to at the extremities of the roots within the Gardens, and that the BS 5837 RPA calculations do not take this into consideration. The only way of representing

affected density of root growth is to increase or decrease the area of the RPA, which does not provide an accurate assessment as there is no correlation between the two (See 7.3 above).

- He fails to accept that roots on the pavement side of the trees would not stop growing, and they would increase in density (See 7.3 above).
- He fails to accept there is adequate contiguous area between the trees to allow growth in a north-south direction, and that they will not be harmed during the development (see item 11.9 above).
- He asserts that no roots would be present beneath the carriageway of Millbank (see item 7.4 above). I disagree.

### **11.11 THE UNRELIABILITY OF THE CLAIMED INCREASED EXTENT OF THE PLANE TREE ROOTS**

11.11.1 In item 2.5.13 Mr Mackworth-Praed states the following in relation to the implementation of his RPAs:

*“On this basis, I consider that the piling and excavations required for the construction of the UKHMLC basement and memorial courtyard **represent a clear risk of causing harm, in the form of die-back and possible decline, to the London Planes on the western boundary of VTG** which would be affected by them, due to the significant encroachments into their RPAs which the proposed excavations would entail.”* (Emphasis added).

11.11.2 All of the planes are healthy, and are exhibiting no signs of decline, or significant die-back. The presence of dead wood within the canopies of the trees is a natural phenomenon. As the trees are healthy, they will produce rapid, healthy new growth.

11.11.3 In my opinion, the highlighted section of the above statement by Mr Mackworth-Praed unequivocally identifies that he considers, the trees that could possibly be harmed are along the western boundary.

11.11.4 The last sentence of item 2.5.13 of Mr Mackworth-Praed’s report states:

*“Although on our assessment the excavations **would be beyond the limits of the RPAs of trees on the eastern side of VTG**, the evidence presented on the applicant’s behalf suggests that **the possible harm to them cannot be fully discounted.**”* (Emphasis added).

11.11.5 I consider the above highlighted statement clearly accepts that the proposed development will be outside the RPAs of the trees along the eastern side of Victoria Tower Gardens. This confirms that there should be no disagreement as to the extent of RPAs on the eastern side, whatever method of calculation is used. As the construction will be outside the RPAs of the trees, the risk of any damage by root severance must be considered remote.

11.11.6 Mr Mackworth-Praed continues in item 2.5.13:

*“As well as causing direct severance and loss of significant roots within their RPAs, the presence of the basement walls would represent a permanent loss of available rootable soil volume for these trees, **which would inhibit their capacity to recover effectively from injury through new root growth.**”* (Emphasis added).

11.11.7 I disagree with the above statement. There is no evidence to even suggest that the area of soil identified by the theoretical RPAs has been filled with roots to the extent that no further root activity would be possible. The specific site investigations clearly identify the potential for increased root activity. Tree roots are produced to utilise the available soil and nutrient resource, and following the construction, they will simply continue to develop within the available resource.

11.11.8 In my view all the roots identified for pruning by Bartlett would not harm the trees in any way which would have consequences for their health, or longevity. I do not consider that any of the plane trees would be lost.

## **11.12 HOSTILE VEHICLE MITIGATION (HVM) MEASURES.**

11.12.1 In section 2.6 of Mr Mackworth-Praed’s report he makes comment on the proposed hostile mitigation measures, and their siting within the RPAs of the London planes along the western boundary of Victoria Tower Gardens. Mr Mackworth-Praed considers that the required excavations within the RPAs, close to the trunks of the trees would cause significant damage.

11.12.2 Mr Mackworth-Praed has made the claim that the proposed construction of the works has not been considered as a constraint (Item 2.6.5 of his report). However, this is patently incorrect, as his own text demonstrates that Bartlett has paid considerable attention in this respect.

11.12.3 Bartlett has accepted that the mitigation measures will be close to the

trees along the western boundary, and that some minor excavations will be required within the RPAs of some of the trees. However, they confirm the precise position of each post is not required to be fixed, and that some flexibility will be required to avoid known tree stems and previously identified roots. Such flexibility was to ensure no physical damage to the basal areas of the tree trunks.

11.12.4 Bartlett accept that some fibrous roots will require pruning/removal. I consider the severance of such roots is inevitable, but will not cause any medium to long term damage, as the trees are healthy, and the roots will rapidly regenerate once the construction works are complete.

11.12.5 The Canopy Consultancy survey of April 2019 proved all locations and while some fibrous roots may need pruning, there will be no pruning of significant tree roots required.

11.2.6 The verification of the positioning of excavations can be physically carried out using hand-held equipment, such as augers, to identify the presence of significantly sized roots, without the need for extensive excavations. In my view the use of such augers would minimise any soil disturbance, or severance of tree roots. This work could be carried out prior to any root severance occurring, and would allow for modification of the bespoke construction works if required. This would be good arboricultural practice, enabling the safe retention of any significant roots. Mr Mackworth-Praed never recognised this option in his report.

11.12.7 Although, the use of hand-held augers would minimise the risk to tree roots, it would also be possible to carry out excavations using an “Air-Spade”, a widely accepted technique, which would allow any excavations to be carried out without damaging any of the roots with diameters of over 25mm.

11.12.8 I note Mr Mackworth-Praed does not recognise the use of “Air-Spades” as being compliant with BS 5837, and that he did not suggest this technique in his report as a means of carrying out the investigations and work with minimal damage to the roots.

11.12.9 In item 5.3.8 of Bartlett’s Impact Assessment report, dated the 26<sup>th</sup> of April 2019 they confirm:

*“... The overall design can be altered to suit the existing site conditions by utilising existing areas of hard standing and to purposely avoid tree stems and any identified tree roots lessening potential impacts.”*

11.12.10 I agree with the above statement.

11.12.11 Item 3.5.8 continues:

*“The various designs will have a combined encroachment of approximate 202m<sup>2</sup> however, it is worth noting that adjustments to the design can be provided where necessary to minimise the impact upon the respective trees. Whilst the trees will experience an increased area of impermeable hard surfacing within the trees notional RPA, it is considered that this impact can be effectively offset by the various improvements made to the preexisting hard standing pedestrian footpaths throughout the Victoria Tower Gardens discussed below.”* (Emphasis added).

11.12.12 Bartlett recognised the necessity for managing the trees correctly during the construction phase. In item 5.3.9 they state:

*“Therefore a programme of tree health care has been provided as part of this development proposal to mitigate and compensate for the root pruning and loss of rooting environment by improving existing and remaining rooting environment and soil, as well as creating new rooting zones.”*

11.12.13 Item 5.3.9 continues as follows:

*“A table has been provided below for reference, showing the calculated rooting area for the eastern and western row of London plane trees (those directly impacted by development) and quantifying the level of ingress through proposed development with the level of improvements to the rooting environment. **This demonstrates through percentages that recommended mitigation and tree health care can effectively compensate for the anticipated combined impacts of proposed development.**”* (Emphasis added).

Table 05: Indicative RPA Impacts vs. Improvements

Tree Group	Total Group RPA m <sup>2</sup>	RPA Lost to Memorial m <sup>2</sup>	RPA Lost to Security m <sup>2</sup>	Services in RPA (total number)	Hard Surfacing Improved for Rooting m <sup>2</sup>
West (T71026 – T71002)	11,318.7	157.7 (-1.3%)	202 (-1.78%)	x3 (Area Not Calculated)	1,769 (+35.3%)
East (T7003 – T70015)	5,009.3	203.5 (-4.0%)	N/A	x1 (Area Not Calculated)	1,613 (+14.3%)

1.12.14 In my opinion the minimal loss of theoretical RPA would not significantly adversely affect the growth, or longevity of the trees.

### 11.13 UNDERGROUND SERVICES.

11.13.1 In item 2.7 of his report Mr Mackworth-Praed questions the siting of the underground services, and attempts to infer that the use of the NJUG guidelines would be inappropriate, leading to the possible severance of significant roots.

11.13.2 Mr Mackworth-Praed identifies that the service trenches are to be 2.0 metres wide, and 1.0 metre depth. He is critical of the use of the NJUG guidelines, and states that no information has been provided to explain how the services will be installed. The technique is actually straightforward.

11.13.3 In item 2.7.6 of his report Mr Mackworth-Praed states:

*“The details provided in the AIA Addendum therefore fall significantly short of the recommendations in BS 5837 relating to the installation of underground services, and it is worth citing these for comparison.”*

*“7.7.1 Mechanical trenching for the installation of underground apparatus and drainage severs any roots present and can change the local soil hydrology in a way that adversely affects the health of the tree. For this reason, particular care should be taken in the routeing and methods of installation of all underground apparatus. Wherever possible, apparatus should be routed outside RPAs. Where this is not possible, it is preferable to keep apparatus together in common ducts. Inspection chambers should be sited outside the RPA.*

*7.7.2 Where underground apparatus is to pass within the RPA, detailed*

*plans showing the proposed routeing should be drawn up in conjunction with the project arboriculturalist. In such cases, trenchless insertion methods should be used (See table 3), with entry and retrieval pits being sited outside the RPA. Provided that that[sic] roots can be retained and protected in accordance with 7.2.2, excavation using hand-held tools (see 7.2.1) might be acceptable for shallow service runs.”*

11.13.4 In item 2.7.7 Mr Mackworth-Praed is of the opinion:

*“It has not been demonstrated that the NJUG “broken trench” technique would be suitable or feasible for each of the different service types proposed, or that it would provide sufficient assurance that damage could be satisfactorily averted. I therefore consider that appropriate or adequate safeguarding against this risk has not been provided for, or in the documentation submitted on behalf of the applicant.”* (Emphasis added).

11.13.5 The services are proposed to be flexible, i.e. not require rigid conduits. This flexibility would allow the positioning of the services to avoid roots. Bartlett has cited the use of the NJUG method of preparing the service routes. This is a recognized method of positioning services through tree root systems. It is also possible to undertake an alternative safe method such as using Air-Spades. This would expose the roots along the service routes, which would allow the safe placement of the services. It would be acceptable to provide greater detail through the AMS prior to the commencement of construction works.

11.13.6 The secondary service route could be accomplished using Air-spades, as described above. It will be within an area of hard-surfacing, and this would need to be broken. The hard surfacing would act as a ground protection measure, minimizing the area of excavation. The use of an air-spade would mitigate any potential impact of the excavation on any roots of tree numbers 71017 and 71018. It would be possible to use the NJUG method, but in my opinion, there would be no significant damage if an air-spade was utilised.

11.13.7 The route should be within the area disturbed by the installation of the piles and should not encroach any further on the RPA This could be installed as mentioned above, without causing harm to the trees.

11.13.8 The technique involved where trees 70000, 70001 and 70002 are concerned will be as per the method outlined above, without causing harm to the trees.

#### **11.14 THE RELOCATION OF THE SPICER MEMORIAL, AND CAFÉ KIOSK.**

11.14.1 In item 2.8 of his report Mr Mackworth-Praed makes comment on the possible harm to the planes during the re-siting of the Spicer memorial.

11.14.2 Mr Mackworth-Praed accepts in item 2.8.2 of his report that the recommended measures for the existing foundations of the memorial are sensible and appropriate, i.e.

*“... any below ground foundations are retained and covered with soil and turf to prevent damage to roots which may have become entwined with the foundation or are located under the foundations. Alternatively, foundations can be broken-up and removed using hand-tools, under arboricultural supervision, to prevent any direct root damage.”*

11.14.3 The shallow foundation will sit within current hard standing, i.e. with no existent roots. Piling locations will be proven in advance of construction.

11.14.4 Bartlett confirm that the new foundations will remain within an area of hard landscaping, and they accept that it would encroach into the notional (theoretical) RPAs of the planes. Bartlett address this issue by stating:

*“Therefore new foundations will have to be of a low impact and bespoke design, using modern building techniques. As within notional tree root protection areas these foundations should be within existing hard surfacing and/or pre-existing excavations. Foundations will need to be load bearing to prevent any new soil compaction or disturbance.”*

11.14.5 Bartlett conclude by stating that:

*“These matters can be detailed in an Arboricultural Method Statement following the granting of planning permission; however this operation is considered to be of low impact on the London Plane trees.”*

11.14.6 I agree that the use of a Method Statement would be appropriate as described by Bartlett Consulting.

11.14.7 In item 2.8.5 of his report Mr Mackworth-Praed makes comment in relation to the encroachment of the proposed café footprint. He claims it occupies 7.2% of his notional RPA, and a 10% occupation of his RPA by the main service corridor, bringing its total to almost 18%. He considers that this is a significant proportion of the tree's notional RPA. However, as throughout his report he fails to accept that his notional RPA calculations are not precise, and that an encroachment of his RPAs of up to 20% would be possible as adequate contiguous rooting area would be available to compensate for any incursion.

### **11.15 SOIL BUILD-UP/NEW LANDFORM.**

11.15.1 In section 9.0 of his report Mr Mackworth-Praed questions the potential risks to the trees posed by the increased soil levels, i.e. compaction/lack of oxygen.

11.15.2 The pictures on page 46 of this Proof of Evidence identify a large root which is enclosed in brickwork, and covered with concrete. The concrete would form a dense layer that would act as a compacted barrier over the root, reducing the ingress of both moisture and air. It appears that ducts have been incorporated along the sides of the concrete to compensate loss of open soil. Comparable ducting could be utilised on the Victoria Tower Gardens site.

11.15.3 In item 2.9.4 of Mr Mackworth-Praed's report he is of the opinion that I treat the matter lightly. However, in item 2.9.7 he states:

*“Whilst the measures suggested in Dr Hope's report could potentially mitigate the additional risks to some extent, these do not appear to have been embodied within other plans and documentation submitted on the applicant's behalf.”* (Emphasis added).

11.15.4 In my opinion, the measures I have suggested will mitigate any additional risks. In summary, these are:

1. Prevent possible compaction, loss of aeration, and adverse drainage by the use of well-aerated, specially sourced topsoil, with appropriate textural characteristics, and the incorporation of air vents within the raised area.
2. Areas susceptible to physical damage during construction will be protected throughout using ground protection measures.

3. The surfacing for pedestrian paths adjacent to the landform, and within the RPAs, will be provided using permeable materials, which will create a more hospitable environment where greater density of roots would be expected to grow, closer to the trees.

## **11.16 CONSTRUCTION SITE SET-UP AND MANAGEMENT**

11.16.1 In item 2.10 of his report Mr Mackworth-Praed questions the appropriateness of the site protection measures prior to and during the proposed development, with special reference to soil compaction.

11.16.2 In my opinion, the main potential problem would be the loss of soil structure within the upper levels of the operational areas, not compaction. Any compaction could actually be relieved quickly using air pressure jets, without damaging the trees. Mr Mackworth-Praed makes no comment on this option.

11.16.3 To avoid loss of surface structure, and compaction, it is standard practice to protect exposed areas with ground-protection. Although Mr Mackworth-Praed has attempted to highlight the potential problems he fails to accept that adequate ground protection can be provided. He also fails to accept that it would be possible to increase the areas of ground protection where any additional potential risk is identified. This could be checked and implemented following regular assessments by the project arboriculturist.

## **11.17 TREE PROTECTION PLANNING**

11.17.1 The CMP sets out all necessary measures to be undertaken in advance of works commencing on site, as well as an initial phasing of site operations when working in close proximity to the trees.

11.17.2 The CMP describes in detail the physical tree protection measures required to prevent both direct and indirect damage to the trees prior to, and during, all approved development, in compliance with Clause 6 of BS 5837:2012. A draft Tree Protection Plan (TPP) has also been included within the CMP, in accordance with Clause 5.5 of the BS 5837.

11.17.3 The Head of Arboricultural Services states the following in relation to tree protection:

*“Given the complex nature of the proposed development, the intensity and nature of the proposed construction activity and the limited nature of the*

*impact assessment, insufficient detail has been provided to demonstrate that the trees could be protected adequately for the duration of construction.” (Emphasis added).*

11.17.4 The claim that ‘insufficient detail’ has been provided is incorrect as BS 5837 is taken as the reference document, and details of build-ups and foundations are described in the application.

11.17.5 In my opinion, it will be possible to provide adequate protection of the trees during the proposed development. The protection will comply with the guidelines of BS 5837. In this instance I consider the proposal by Bartlett to be appropriate, and has been dealt with in the CMP. If the Head of Arboricultural Services were to suggest added protection, it could be incorporated into the scheme.

11.17.6 I consider that the issue relating to tree protection could be covered by a planning condition, and should not be used as a reason for refusal of the development. I note that Mr Mackworth-Praed remains silent on this issue.

## **11.18 ABOVE-GROUND EFFECTS – TREE CANOPIES**

11.18.1 The Head of Arboricultural Services states the following in relation to the pruning of the plane tree canopies:

*“The AIA Dec 18 identifies 9 trees to be pruned by lifting the canopies to provide clearance either for vehicular access or the proposed memorial fins. **Whilst the proposals for pruning are not considered contentious, the need for additional tree pruning for operational, site logistics and construction management reasons, or in order to account for dieback or dysfunction in the tree canopies as a result of the cumulative impacts of the proposal, are likely to be greater than identified.**” (Emphasis added).*

11.18.2 Item 2.11 of Mr Mackworth-Praed’s report addresses the management of the tree canopies. In item 17.11.2 he states:

*“In terms of the extent of pruning necessary, **I also agree that this is unlikely to be significantly damaging or disfiguring to the trees concerned.** However, the commitment in the RCMP to utilise a form of piling rig that can be deployed beneath the trees’ canopies (referred to as the ‘Martello technique’), thereby reducing the likelihood of contact between the piling rig and the outlying branches of trees above it, is*

*welcome, and should be embodied as a form requirement in the event of the scheme being permitted.”*

11.18.3 In my opinion, the above text accepts that the canopies of the trees should not be harmed during the initial development process.

11.18.4 In item 2.11.3 of Mr Mackworth-Praed’s report he comments on the Phase 2 construction, and considers that a broad strip of construction access down the eastern side of the scheme might result in the need for additional pruning.

11.18.5 The Head of Arboricultural Services and Mr Mackworth-Praed have accepted that pruning would not harm the trees, and it is generally accepted within the arboricultural industry that planes can withstand even severe pruning; which is not proposed here. The trees within Victoria Tower Gardens have been pruned on a number of occasions in the past, and they have produced healthy regrowth, with no signs of significant decay, or deterioration. They are making average, healthy, annual extension growth. There is no arboricultural evidence to indicate that pruning the trees back to their previous pruning points would harm them.

**Picture taken on the 10<sup>th</sup> of May 2019 showing the previous pruning of the planes.**



11.18.6 Only minor pruning will be required to the trees to allow the proposed development to go ahead. The pruning of the trees will assist the balance of the root:shoot ratio following construction, which will be an important factor in negating any possible stress levels in the trees. The importance of the balance of the root:shoot ratio is an accepted principle within the arboricultural industry, which the Head of Arboricultural Services, and Mr Mackworth-Praed, appear not to have considered. They make no mention of this point in their submissions.

11.18.7 In my opinion, the minor pruning requirement will under the circumstances, be advantageous, and will not form part of any cumulative damage to the trees. The pruning will actually ensure the healthy balance between above and belowground parts of the trees.

11.18.8 In my view the mitigation proposals recommended by Bartlett will minimise any possible accumulation factors following the development.

## **12.0 THIRD PARTY REPRESENTATIONS**

### **12.1 THE INITIAL REPORT PRODUCED BY MR JEREMY BARRELL**

12.1.1 Mr Jeremy Barrell, an arboricultural consultant, produced an independent report on the tree-related aspects of the proposed development at Victoria Tower Gardens, dated the 4<sup>th</sup> of February 2019. He has since produced a small supplementary report dated the 18<sup>th</sup> of May 2019.

12.1.2 It should be noted that some of what Mr Barrell states within his reports, especially in relation to his comments on the Bartlett submissions, are his personal opinion only, and in some instances are not based on readily available peer-reviewed facts. In my opinion, the technical aspects of Mr Barrell's assertions must be examined closely, as they do not all appear to be substantiated by reliable data.

### **12.2 POTENTIAL DEEP ROOTING IN PLANE TREES**

12.2.1 In item 4.3 of Mr Barrell's initial report he makes comment on the potential of plane trees to develop deep rooting systems of between 4.0 and 6.0 metres, and sometimes deeper. Mr Barrell cites his experience in the subsidence and planning sectors in London. I must say that his experience is divergent to mine in relation to plane tree root development.

12.2.2 In justification of his claim, Mr Barrell cites his experience of root development of a plane outside the Connaught Hotel in Mayfair, London (see Figure 2 on page 72 below, and items 10.1.7-10.1.10). However, in my opinion, his evidence does not justify the claim that the roots are at a depth up to 5.0 metres were present. In my view the picture does not provide accurate detail in relation to the depth, or location of the roots.

12.2.3 No information has been provided by Mr Barrell to confirm the distance of the roots from the base of the trunk of the tree, although Figure 2 suggests that the roots are adjacent to the basal trunk, not several metres away. The horizontal beam at the bottom of the picture appears to be up against the trunk of the tree. This is critical, as it is generally accepted within the arboricultural industry, and by research, that large diameter roots are produced close to the trunks of trees, and that they rapidly reduce in size the further they are from the trunk. Mr Barrell does not discuss this, or its implications, in his report. The location of the roots close to the basal trunk would be consistent with the research carried out by Dr Dobson.

**Scanned copy of Figure 2 of Mr Barrell's report.**



12.2.4 I have seen no research evidence to prove that plane tree roots over 30.0 centimetres in diameter and to depths of 4.0 metres to 6.0 metres, or deeper, can develop at distances of between 7.5 metres and 17.0 metres from trees, i.e. where the development of the buildings at Victoria Tower Gardens is in relation to the planes. Mr Barrell has not provided any research, or peer-reviewed data to confirm his assertion. He has not provided a copy of his report identifying the conditions of the site.

12.2.5 Figure 2 of Mr Barrell's report was taken from an elevated position. It purports to claim that the large 30.0 centimetre diameter roots are up to 5.0 metres (16½ft) below ground level, i.e. the base of the trunk of the tree where the roots emanate is over 5.0 metres above the level of the soil in the picture, and over 6.0 metres above the exposed roots. In my opinion, Figure 2 does not justify this claim in any way.

12.2.6 Figure 2 shows that the excavation is supported (shuttered) by vertical wooden planks butting up against each other, with two levels of wooden,

horizontal supporting cross-members. In the top left-hand corner of the picture there are three vertical planks the tops of which are in the region of only 1.0 metre above soil level. The visible soil around the outside of the top of the pit appears to be at the same depth as the top of the excavation. There are no indications that the depth of shuttering, and the roots are down to 5.0 metres as claimed.

12.2.7 Figure 2 shows that the operative is bent over slightly, and he is standing below the level of the roots in the pit; i.e. it is clear that the roots are at, or slightly above, his knees. His feet are simply not 4.0 metres to 5.0 metres below the level of the surrounding ground.

12.2.8 For the exposed roots to be at the depth Mr Barrell claims, the base of the trunk of the tree would have to be between 4.0 metres and 5.0 metres above the roots, which is clearly not the case.

12.2.9 Having viewed Figure 2 my assessment is that the large, 30cm+ diameter roots emanated directly from the base of the trunk of the tree, and were within 1.0 metre of ground level at their lowest point; not 4.0 to 5.0 metres as claimed by Mr Barrell. The depth of the roots appears fully consistent with the research carried out by Dr Dobson. Mr Barrell has provided no evidence to confirm how far the large roots extended.

12.2.10 In my opinion, the photographic evidence provided by Mr Barrell does not prove that large roots of over 300mm to 400mm diameter, and at a depth of between 4.0 and 5.0 metres, would be anywhere near the position where the buildings are to be constructed at Victoria Tower Gardens. In my opinion, the probability that such roots will be present adjacent to the proposed excavations is remote.

### **12.3 MR BARRELL'S SUPPLEMENTARY REPORT**

12.3.1 Following on from a site meeting with Ms Milne and Mr Donncha O'Shea on the 17<sup>th</sup> of May 2019, Mr Barrell produced a small updated report on the proposed development, dated the 18<sup>th</sup> of May 2019.

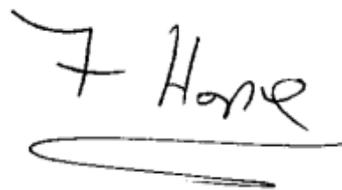
12.3.2 Having read Mr Barrell's supplementary report, I find it adds nothing significant in respect of the proposed development.

### **13.0 SUMMARY AND CONCLUSIONS.**

- 13.1 In my opinion, adequate information has been provided to carry out a meaningful assessment of the proposed development. I consider the claim of inadequacy and misleading information, has arisen by the misinterpretation of the data by the Head of Arboricultural Services.
- 13.2 In my opinion, adequate information has been provided to enable an assessment of whether the proposed development would be likely to lead to the loss of some of the London plane trees.
- 13.3 In my opinion, the proposed development will not lead to the loss of any of the London planes.
- 13.4 The current proposal is to construct the United Kingdom Holocaust Memorial and Learning Centre within the grassed area in the centre of Victoria Tower Gardens.
- 13.5 The London planes along the eastern and western sides of Victoria Tower Gardens form large, healthy, groups of mature specimens with a high visual amenity to the Conservation Area. They are an important feature and should be retained on the site. The current proposal has been designed to retain all of the planes.
- 13.6 BS 5837 has been utilised to provide guidance on the tree-related aspects of the development. One of the main sections of BS 5837 is the provision of a theoretical calculation, providing what is known as the Root Protection Area (RPA). This provides an “estimate” of the area of expected root spread of trees, and is typically used at the commencement of the design phase, incorporating site-specific investigation data.
- 13.7 The RPA calculations are based on the trunk diameter of trees, and are typically used for individual specimens. They are used as an aid during the development process. The Local Planning Authority has incorrectly implied that the theoretical figures are precise, and allow for no degree of error or flexibility. I consider this to be untenable.
- 13.8 Extensive site investigations have been carried out using the most up-to-date techniques, in order to identify the extent of the tree root systems. These were carried out by professional organisations, one of which holds the Royal Warrant. The investigations have been ignored by the Local Planning Authority. This appears to me to be unreasonable and illogical.

- 13.9 The Local Planning Authority has relied solely on the use of theoretical RPA calculations, and has ignored the wealth of site investigations. They have questioned the RPA figures provided by the developers, and have recalculated them. The recalculated figures expand the theoretical root spreads of the trees on the western side of Victoria Tower Gardens.
- 13.10 The arboricultural expert for the Local Planning Authority has stated that the use of site investigations is not within the parameters of BS 5837, which is clearly at odds with the British Standard, and normal arboricultural practice. He has failed to meaningfully address issues on the growth of roots beneath the pavement and carriageways.
- 13.11 The comments of the Head of Arboricultural Services on the planning application are simplistic, and in my opinion, misguided. They are at odds with her previous accepted practices. Evidence has been made available confirming her sanctioning of extensive excavations within theoretical RPAs, with scant regard to the health of tree roots, which is at odds with her current position.
- 13.12 The Head of Arboricultural Services has made claims in relation to the depth of rooting of the planes, which have not been substantiated by the Local Planning Authority arboricultural expert.
- 13.13 Minimal pruning of the trees will be required, which will not harm the trees.
- 13.14 Appropriate mitigation processes have been identified to minimise the influence of the construction works on the trees.
- 13.15 Appropriate physical protection complying with the recommendations of BS 5837 have been incorporated within the scheme.
- 13.16 In my opinion, there is no available evidence to confirm that any of the plane trees would be harmed, in any way which would have consequences for their continued health and longevity, or killed, if the proposed development were to go ahead.

© Dr Frank Hope.  
4th September 2020

A handwritten signature in black ink that reads "F Hope". The signature is written in a cursive style with a long horizontal flourish underneath the name.

DR FRANK HOPE

**APPENDIX -A-**

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### FORENSIC ARBORICULTURAL CONSULTANT ###

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# Dr Frank Hope

## PROFESSIONAL QUALIFICATIONS AND EXPERIENCE

Dr Hope has been involved with the land-based industries for the past 48 years. During this time he has worked for local government, the Royal Horticultural Society, the Institute of Groundsmanship and private industry. In the early 1970's he trained at the RHS Gardens Wisley and later became a practical arborist in the gardens. For four years he was a lecturer in Horticulture and Arboriculture at the Cheshire College of Agriculture, and has more recently been a part-time lecturer to the BTEC National Diploma course in Countryside management, at the Cambridgeshire College of Agriculture. He has been an Arboricultural and Horticultural examiner for the Royal Forestry Society, the Royal Horticultural Society and the Institute of Groundsmanship.

The majority of his work is based in East Anglia, and London, although he has taken commissions throughout the world. For example, in the 1980's he was involved in the management and harvesting of a 26,000 acre hardwood crop in Malaya. He carries out technical projects for a range of organisations on both Arboricultural and general Horticultural subjects, and has been involved in the proposed re-development of the Elephant and Castle, and the area around Waterloo station in London. He specialises in both legal and planning aspects of trees.

He has been a technical adviser to the Jockey Club and Racecourse Association, and organised all their training courses for over five years.

During 1997, Dr Hope was one of three people commissioned by the Arboricultural Association to develop a computerised model capable of assessing the future risk of subsidence damage to buildings when trees are growing close-by. He has also given the Association advice on the Arboricultural Appendix to the ISE handbook.

Over the past 25 years, Dr Hope has been involved in over 3,500 cases involving trees and subsidence damage to buildings. He regularly gives evidence in court, and has experience as a single joint expert. Notable cases in which he has been involved are Siddiqui & Sohanpal -v- London Borough of Hillingdon, Loftus Brigham -v- London Borough of Ealing, Dayani -v- London Borough of Bromley, Berent -v- Family Mosaic & The London Borough of Islington, Robbins -v- London Borough of Bromley, Battley -v- Wycombe District Council, and Middleton – v- Surrey County Council.

For five years (until April 2003), Dr Hope acted for the Office of the Deputy Prime Minister as an Inspecting Officer on Tree Preservation Order Appeals, which provided him with a detailed insight into this topic.

In addition to having a Doctorate and a Master's degree in Biological Sciences (based on Arboricultural and Horticultural research), Dr Hope holds the National Diploma in Arboriculture (RFS), which is the premier practical qualification for Arboriculture, and the National Diploma in Horticulture (now the Master of Horticulture), administered by the Royal Horticultural Society. The Master of Horticulture is the world premier qualification for general horticulture. Dr Hope is a past examiner for the final stages of the Master of Horticulture qualification. His personal qualifications are at the highest level; the major ones are as follows:

Doctor of Philosophy (Ph.D): University of Bath, Biological Sciences Dept. The Development of a computerised Plant Establishment and Growth Model for use with Landscape Trees and Shrubs.

Master of Philosophy (M.Phil.): University of Bath Biological Sciences Dept. The Development of a Computerised Information Retrieval System for Decorative Plant Selection.

National Diploma in Horticulture: Administered by the Royal Horticultural Society.

National Diploma in Arboriculture (N.D.Arbor): Royal Forestry Society.

National Certificate in Arboriculture (Distinction): Royal Forestry Society.

Wisley Diploma in Horticulture:	Royal Horticultural Society.
Advanced Diploma in Horticulture:	Writtle Agricultural College.
Certificate of Education:	Wolverhampton Teacher Training College, (Wolverhampton Polytechnic).

### **SOME PUBLISHED WORKS**

Recognition and Control of Pest and Diseases of Farm Crops	Blandford Press 1980 ISBN 0 7137 0995
The Garden Planner	Hardback - Collins 1981 Softback - Fontana 1981 Softback - Pilot 1983 ISBN 0 00 4116622 Co-author of each edition
QL Gardener Manual	Sinclair Research 1985 ISBN 1 850 160449
The New Organic Grower	Cassall Publishers 1990 ISBN 0 304 34013 8
Turf Culture	Blandford Press 1978 ISBN 0 7137 0873 5
Turf Culture - A manual for the Practising Groundsman	Cassall 1990 ISBN 0-304-31854-X
Rasen	German Edition of Turf Culture ISBN 3-8001-5038-7
NVQ Levels 1 & 2 manuals	Technical author for the British Association of Landscape Industries (BALI) instruction manuals for general horticulture and turf culture at levels 1 and 2, for the National Vocational Qualifications.

Numerous articles on Horticulture, Arboriculture and computers in a range of magazines, e.g. Horticulture Week, The Groundsman, Personal Computer World.

### **SOME PUBLISHED SOFTWARE**

Horticultural Key	Quanta magazine.
Plant Selector II	A.J. Harding Molimerx Ltd.
Computerised Ornamental Plant Retrieval System	University of Bath.
Genus Plant Selector	Intersearch Ltd.
Plant Establishment and Growth Model	University of Bath.
QL Gardener	Sinclair Research.

DR FRANK HOPE

**APPENDIX -B-**

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### FORENSIC ARBORICULTURAL CONSULTANT ###

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*Appeal on behalf of the Secretary of State for Housing Communities and Local Government.*



## Tree Root Systems

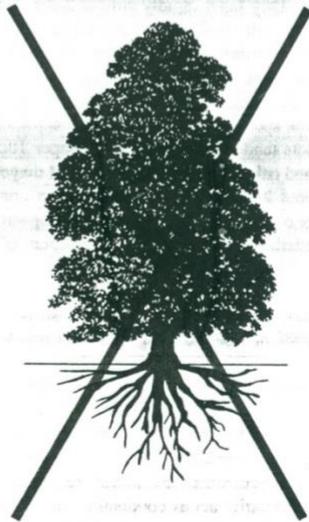
by Martin Dobson, Arboricultural Advisory and Information Service

### Summary

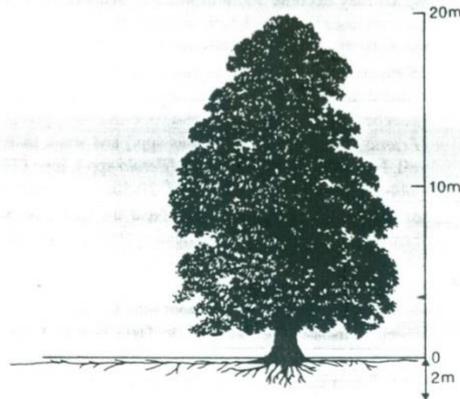
The development and structure of tree root systems are described. They are wide spreading, extending radially in any direction for distances often in excess of the tree's height. Roots grow predominantly near the soil surface - over 90% of all roots, and virtually all the large structural supporting roots, are in the upper 60cm of soil. Soil disturbance within the rooting area should be avoided, as this can significantly affect tree stability and moisture uptake.

### Introduction

1. This Note provides an overview of the development and structure of tree roots. Useful reviews can also be found in Perry (1982, 1989), Helliwell and Fordham (1992), Sutton (1969, 1991) and Dobson and Moffat (1993).



**Figure 1.** This is the commonly held idea of what a tree's root system is like. In fact it is quite wrong.



**Figure 2.** A tree's root system is typically fairly shallow (frequently no deeper than 2 m), but is wide-spreading, with the majority of roots found in the upper 60cm of soil.

2. Tree roots absorb water and nutrients from the soil, serve as a store for carbohydrates and form a structural system which supports the trunk and crown. The nature of this system is frequently misunderstood, probably because it is concealed below ground. A common misconception is that the root system is a 'reflection' of the trunk and branches (Figure 1). In fact, *a tree's root system is surprisingly shallow, dominated by long, relatively small, lateral roots spreading out close to the soil surface* (Figure 2) rather than by a deeply penetrating taproot. It is uncommon for trees to have roots deeper than about 2m, though exceptionally some small (a few mm in diameter) roots can extend to 5m or more. Most roots are found close to the soil surface, with 90% or more of all roots located in the upper 60cm. Whilst the typical depth of tree roots has been exaggerated, root spread has often been underestimated - they usually extend outwards well beyond the branch spread ('drip line').

### Root system development

3. Initially a germinating seed has a single root, the radicle, or taproot, which grows vertically downwards provided soil conditions are suitable. Elongation is most rapid during the first 2 or 3 years but decreases with tree age and increasing soil depth. Horizontally growing side roots (laterals) form at an early stage and soon become largely responsible for structural support. Development of the taproot then declines with the result that only a small proportion of trees have a sizeable taproot at maturity. In fact, it is hard to distinguish a taproot at all in many mature trees, as injury to the juvenile taproot tip often occurs, for example, by the browsing of soil fauna, root rot, failure to penetrate hard or compact soil layers, or for nursery stock, by undercutting/transplanting. Species often thought of as 'taprooted', such as oak (*Quercus* spp.), pine (*Pinus* spp.) and fir (*Abies* spp.), appear to have a stronger inherent tendency to retain a distinct taproot, than species such as poplar (*Populus* spp.), willow (*Salix* spp.) and spruce (*Picea* spp.), but frequently the taproot does not persist even in these species. Intact taproots are usually largest just beneath the trunk and taper until they reach a depth of 0.5-1m, where they often divide into several smaller, but nevertheless downwardly growing, roots.
4. Lateral roots near the soil surface thicken over successive years, eventually becoming the large woody roots of the framework root system of a mature tree - there are usually between four and eleven such roots which may become 30cm or more in diameter close to the stem. They taper rapidly until at 2-3m distance they are usually only 2-5cm in diameter, by which stage they have lost much of their rigidity and physical strength. It is here that they tend to break when root plate failure occurs, e.g. in a storm (Cutler *et al.*, 1990). Beyond the 'zone of rapid taper', lateral roots extend outwards in a broad zone for many meters, without appreciable further decrease in size - typically maintaining a diameter of 1-2cm. They are sparsely branched, perennial, woody and rope-like in appearance. In some species, e.g. ash (*Fraxinus* spp.), cherry (*Prunus* spp.), thorn (*Crataegus* spp.) and some pines these roots tend to grow within the upper 10cm of soil. In other species, e.g. birch (*Betula* spp.), lime (*Tilia* spp.) and oak, the lateral roots descend diagonally ('oblique laterals') to a depth of 20-50cm at a distance of about 2m from the trunk and then continue growing outwards horizontally. Near the trunk, some branches of these deeper laterals grow upwards to form a wide-spreading superficial system of rope-like roots, usually restricted to the upper 15cm of soil. Although most rope-like roots are only 5-15m long, some can be 25m or more in length.
5. Roots branching from the upper side of laterals grow upwards and divide profusely in the surface soil, which is usually well-aerated, to form fans or mats of thousands of fine (<2 mm diameter) non-woody 'absorbing' or 'feeder' roots. In woodland, they grow horizontally between the 2 to 3 year old fallen leaves. Root fans permeate and hold together the litter over a considerable area; each one can occupy a thin horizontal layer of 300 cm<sup>2</sup> or more. Associated with these roots are much finer, thread-like, mycorrhizae. Mycorrhizae are symbiotic fungi which grow on or in roots, an association which is mutually beneficial to both the tree and the fungus. They are extremely efficient at nutrient absorption, especially phosphorus, and many trees cannot survive without them. Fine roots and their mycorrhizae are jointly responsible for moisture and nutrient uptake, whilst the perennial woody roots primarily act as conducting vessels to and from the trunk. Fine roots have a life span ranging from a few days to several years - on average surviving for 1-2 years.

6. Roots branching from the lower side of the laterals are known as 'sinkers roots' and usually occur within a few metres of the stem. They are usually 1-2cm in diameter, grow downwards, and in contrast to the taproot or oblique laterals, divide at their extremities into fine, non-woody roots.

#### **Root distribution**

7. The variability of soil conditions and the presence of obstacles and barriers to root growth result in variable and unpredictable distribution within the general overview already presented. This is because *root growth is opportunistic, occurring only where the soil environment can sustain it*. Roots proliferate wherever they encounter favourable conditions, which is why the greatest root concentration is found close to the soil surface where the soil is loosest, and water, oxygen and nutrients are most readily available. Soil bulk density increases and aeration decreases with increasing soil depth and consequently root numbers and size decline sharply with depth (see paragraphs 11-13), thus below 1m it is rare to find many roots which are larger than a few mm in diameter.

#### **Root depth**

8. The deepest roots are usually found directly below, or near to, the trunk as tap, oblique lateral or sinker roots. Maximum root depth varies greatly, from only 10-20cm in waterlogged peaty soils to, exceptionally, tens of metres in loose, well-aerated soils or fissured rock. However, there is no such thing as an intrinsically 'deep rooted' or 'shallow rooted' tree species (Sutton, 1969). All trees can develop a deep root system (2-3m deep) if soil conditions allow. Apparent differences in rooting ability depend on the genetically determined capacity of roots to tolerate difficult soil conditions such as poor aeration and compaction. It is this propensity which results in the root systems of some trees being deeper than others under the same conditions.
9. Whilst genetic characteristics of a tree play some part in rooting pattern, soil conditions are of overriding importance. Thus, downward penetration of tree roots can be halted by excessive stoniness, ironpans, compact soil layers (especially compact clays), bedrock, poor aeration and high or perched water tables. Even taproots are unable to continue downwards when they reach such conditions - they either turn horizontally or die back. Where deep roots die, several replacement root tips can develop just behind the dead tissue and these in turn either become horizontal or die. Obstructions in the soil at shallow depths are common in the UK, and thus it is not surprising that a survey of the root plates of windthrown trees in southern England after the storms of 1987 and 1990 revealed that 44% of root plates were shallower than 1m, 95% were shallower than 2m and the deepest root plate was only 3m (Cutler *et al.*, 1990). This pattern accords well with the large amount of data available from excavations of root systems which indicate that *average root depths are typically in the range 1-2m*.

#### **Root spread**

10. Root spread is not confined to the area delineated by a downward projection from the branch tips as has often been supposed. Excavation has revealed that roots can grow for a considerable distance beyond the branch spread; typically extending outwards for a distance equivalent to at least the tree's height, and in some cases (particularly in infertile or compacted soils) up to 3 times tree height. Roots distant from the trunk are usually very close to the soil surface (Figure 2). Obstacles in the soil such as rocks, kerbs or building foundations provide a physical barrier to root extension (see Marshall *et al.*, in preparation). Roots meeting such obstacles are typically deflected by them and once clear of the obstruction they often resume their original direction of growth.

## **Factors affecting root distribution**

### *Soil bulk density*

11. Root growth declines sharply with increasing density of soil; optimum growth being achieved at approximately  $1.2 \text{ g cm}^{-3}$  or less. In heavy clay soils, growth effectively ceases at a bulk density of about  $1.6 \text{ g cm}^{-3}$ , and in lighter sandy soils at about  $1.7 \text{ g cm}^{-3}$ . Compaction can be a natural feature on some sites, e.g. caused by glaciation, or it can be induced, e.g. by repeated passage of vehicles over the soil surface. Where soils have been compacted it is often difficult to establish trees because the roots fail to penetrate into the soil effectively. Trees growing in such soils develop a very shallow root system with a greater number of lateral roots in the relatively less dense surface soil (Dobson and Moffat, 1993). Roots reaching a compact subsurface horizon tend to deform or branch profusely and continue laterally above the plane of compaction. If these roots encounter a pathway through the compact layer, e.g. following a fissure or decayed root channel, they may resume downward growth. If soil beneath the obstruction is favourable then roots may proliferate, producing a two-tier root system. Established trees that experience sudden compaction of the soil (for example by movement of machinery on construction sites) frequently suffer root death, and crown dieback often occurs because of the inability of the tree to adapt quickly to the rapid change in soil conditions.

### *Soil aeration*

12. In order for roots to survive, oxygen must be available in the soil immediately surrounding them. Oxygen supply to roots is governed by soil structure and texture; in loose or coarse textured soils the air gaps between the soil particles are relatively large and so atmospheric oxygen diffuses readily into the soil, and the waste product of respiration, carbon dioxide, can diffuse away. This process is inhibited in fine textured (clayey), waterlogged and compacted soils because pore spaces are small and may also be filled with water - gaseous diffusion is 10,000 times quicker in air than in water.
13. Poor soil aeration, especially that produced by prolonged waterlogging inhibits the growth of new roots, and can result in the death and decay of a large proportion of the existing root system. Trees standing in such conditions tend to be characterised by very shallow, plate-like root systems where roots are confined to the upper, more aerobic soil. The roots of dormant trees tolerate periods of poor aeration better than those of actively growing trees because their respiration rate is reduced and they need less oxygen.

### *Fertility*

14. Fertile soil encourages the growth of shoots relative to roots and increases the branching of roots. Roots of established trees proliferate in areas of moist soil that are rich in nutrients, especially nitrogen and phosphorus. In general, soils with low fertility produce root systems characterised by long, slender, poorly branched surface roots, whereas sites with higher fertility produce root systems that are well branched and descend deeper into the soil (provided it is sufficiently loose and oxygen is available).

## **Tree roots and the water table**

15. It is a common misconception that trees are heavily dependent upon the water table for moisture during dry summer months. In most parts of the UK the water table is situated deep in the soil, well beyond the reach of tree roots, and contributes nothing to meeting the water demand of trees. Trees, and other vegetation, are usually wholly dependent on recent rainfall and the water stored in the soil (Helliwell and Fordham, 1992). Moffat (1995) has demonstrated that the water requirement of trees in most parts of the UK and for most soil types, even during dry summers, is available in a soil depth of about 1.5 m. In the rare cases where roots are within reach of the water table, they quite often proliferate just above it, in the 'capillary fringe' but they are unable to grow into the saturated pores of the water table because of poor aeration. Helliwell (1993) gives further information about water tables and trees.

## Practical implications

16. *Tree roots may extend radially a distance equivalent to at least the height of the tree and are located primarily in the upper 60cm of soil.* The main structural roots are usually found in the upper 30cm, and taper substantially within about 3m of the trunk. The vast majority of fine absorbing roots are even closer to the soil surface. Thus, *any soil disturbance within the rooting zone will damage tree roots and should be avoided.* Within the rooting area the following should especially be avoided:-
- soil stripping and site grading
  - trenching, even a shallow (<150 mm) trench (see NJUG, 1995)
  - soil compaction by movement of vehicles or storage of materials
  - deposit of toxic or impermeable materials

The nearer to the trunk that such operations occur, the greater the damage and loss of roots. This will increasingly reduce the ability of the tree to absorb sufficient water to sustain the foliage - dieback of the crown may result. *If roots greater than 20cm are cut within 2-3m of the trunk, stability may be affected and the tree made dangerous.*

17. There is considerable misinformation about the damage that can be caused by tree roots. It is true that under some circumstances they may cause damage to built structures. However, direct damage is rare and usually only occurs when trees are situated less than 1-2m away from lightly loaded structures such as boundary and garage walls, paving slabs and kerbs (BS 5837: 1991). However, the direct pressure exerted by tree roots can be measured and is surprisingly small (MacLeod and Cram, in preparation). Indirect damage to structures may occur where tree roots contribute to the drying of shrinkable clay soils where foundations are inadequate to accommodate movements (see Biddle, 1992 for more detailed information). Guidelines exist for determining the appropriate depth of foundations for new houses on clay soils (NHBC, 1992).

## References and further reading

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Published by:-

July 1995

Arboricultural Advisory and Information Service  
Alice Holt Lodge  
Wrecclesham  
Farnham  
Surrey  
GU10 4LH

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The Arboriculture Research and Information Note Series is supported by the Forestry Commission.

DR FRANK HOPE

**APPENDIX -C-**

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### **ANALYSIS OF THE REPORT OF MR MACKWORTH-PRAED RELATING TO THE PROPOSED DEVELOPMENT AT VICTORIA TOWER GARDENS, MILLBANK, LONDON.**

#### **Scope and use of the report**

The scope and use of this document consist of the following:

- The production of a paragraph-by-paragraph analysis/commentary of the report produced by Mr Mackworth-Praed, for Westminster City Council;
- the notes are prepared to be read in conjunction with my Proof of Evidence. Some of the comments are, by necessity, repetitive, as they address similar issues included throughout Mr Mackworth-Praed's report.

#### **Analysis of the text – paragraph-by-paragraph**

##### **Introduction**

1.1.1 –

1.1.2 No comment

1.1.3 No comment

##### **1.2 Report Author**

1.2.1 No comment

##### **1.3 Site description and proposals**

1.3.1 No comment

1.3.2 No comment

1.3.3 This confirms the principal tree species, i.e. London plane (*Platanus x acerifolia*), and that there are 26 trees along the western side and 25 along the eastern side. It also recognises that some smaller species are present at the northern end.

The numbers are correct, and confirmed by Bartlett Tree Experts (Bartlett). They acknowledge the discrepancy was caused by a lack of access at the time of the initial survey. They were all updated in 2020 accordingly.

1.3.4 No comment

#### **1.4 Documents considered**

1.4.1 The full list of documents used in Mr Mackworth-Praed's assessment are included in Appendix 6 of his report.

#### **1.5 Site visit and tree survey**

1.5.1 No comment

1.5.2 Re-surveying the trees is an acceptable operation. However, the changes in dimensions are imprecise, small and insignificant. Later in his text Mr Mackworth-Praed uses them in an attempt to assert the RPAs of some of the trees would need to be increased as a result.

1.5.3 This point identifies that Bartlett did not include/identify all of the trees. Bartlett initially did not mention the missing trees as they considered they could not get near them, and that they would not be adversely affected by the proposal in any event.

The trees were subsequently surveyed by Bartlett prior to resubmission of their Arboricultural Impact Assessment.

1.5.4 The actual survey work appears compliant with the relevant sections of British Standard (BS) 5837, although the schedule is important as it identifies the margin of potential error in the trunk diameter measurements. This is not specified in the text.

1.5.5 There is some confusion on the numbering of the trees on site. The plans produced by Bartlett clearly identify the numbering of the trees they included. This item outlines how Mr Mackworth-Praed addressed the issue to correlate the tree numbers within his report. It should not be an issue.

1.5.6 What Mr Mackworth-Praed did with the plans, and schedule appears logical. No further comment.

#### **1.6 General findings and observations**

1.6.1 The vast majority of the trees (46 out of 51) have BS 5837 ratings of "A", with only 5 with ratings of "B". It would be normal practice to identify the sub-categories, of which there are three, but in item 1.6.1 Mr Mackworth-Praed explains the category ratings cover their quality and landscape value.

In the schedule Mr Mackworth-Praed identifies that category "B" trees have a minimum of 20 years life expectancy. Their expectancy is up to 40 years, i.e. between 20 and 40 years, although they can live longer.

The categorisation of the trees is very important in this instance, as Mr Mackworth-Praed considers that the trees could be harmed, or killed, following root severance, and that there may also be some impact on the crowns following pruning. Category “A” and “B” trees are healthy, and should be making good annual extension growth. They should be quite capable of regenerating new roots and branches following pruning. There is no reason they should decline with the pruning being suggested.

- 1.6.2 I disagree with the point being made about the planes having very high visual value as individuals, as their visual value is within two groups, one on either side of the site. This point becomes important when carrying out the theoretical RPA calculations, as they have been carried out as if the trees were individual specimens not as groups. You should note that the RPA calculations in BS 5837 are based on free-growing specimens. There is no specific method of calculation to differentiate groups from individuals.
- 1.6.3 This states that there is no disagreement with the visual assessment. However, the quoted text does not actually identify that the trees have very high value as individuals; it is commenting on all of the trees.
- 1.6.4 Whilst it is agreed that re-surveying of the trees is a sensible approach, in doing so Mr Mackworth-Praed has highlighted possible inaccuracies in his measurements in the sense that the critical point to note with the updated measurements is that they are not precise. The notes in the Tree Schedule of Appendix 1 state the diameters are measured in millimetres to the nearest 10mm.

It is common for variance in measurements produced by different surveyors, as the height where the measurements of trunk diameters are taken (1.5m) is usually estimated, not measured precisely. Any change in the level of the ground around individual trees can also have an impact on the point of measurement. Loose bark plates, as found on planes, can have a significant impact.

Item 1.6.4 identifies the increase in diameters; i.e. 10mm to 20mm (max. 40mm) on the west side, and between 5mm to 10mm (max 20mm) for the trees along the east. The degree of error (10mm) in the measurements means they cannot reasonably be used to infer any significant growth, or the justification to modify the tree RPAs.

Mr Mackworth-Praed attempts to infer that a comparison between his and Bartlett’s figures indicate a difference in trunk diameters. However, he makes no mention that for any comparison to be meaningful, it is implicit that the all the tree measurements carried out by Bartlett, i.e. the base measurements, must have been precise. He accepts that his measurements are imprecise.

The statement comparing the Eastern and Western lines of trees is subjective, and when the margin for potential error in the trunk diameters is taken into account the comparisons are meaningless. The report accepts that it is impossible to draw firm conclusions from the data, but then suggests that it could be an indication that the trees on the eastern side may be less vigorous than those along the western side. It does not recognise that the trees were planted over a 35-year period from north to south. The two rows of trees appear similar from a distance, and are healthy, hence their BS 5837 category ratings.

It is also important to note Mr Mackworth-Praed considers that as some increase in trunk diameter has occurred, it must have increased the radial spread of the RPAs. This is incorrect as the new growth of the roots could well be within the existing root spread.

In mature trees there is some natural die-back of roots each winter, followed by new root growth in spring. The new root growth need not be produced at the extremities of the root systems, and therefore does not necessarily mean that the extent of the RPAs will increase, especially during such a short period of time.

- 1.6.5 This point claims that there have been minor differences between the lateral canopy spreads of the trees. Any such increase of the canopy spreads would be small, and Mr Mackworth-Praed acknowledges that no specific conclusions can be drawn. As a point of clarification, it is extremely difficult to measure canopy spreads of large trees precisely unless technical equipment is used to place the measuring device vertically with the edge of the canopy. Also, each surveyor will not necessarily measure from the trunk at exactly the same point. Some inspectors measure from the outer edge of the trunk, not its centre.

Item 4.4.2.6 of BS 5837 identifies that the measurements of crown dimensions is by necessity inaccurate. It states that measurements can vary by up to one metre.

The trees are healthy, and it is not contested that some natural annual growth will be produced. The planes are between 120 years and 130 years of age, and they will naturally lose some branches and twigs each year. If they are healthy, as identified by their BS 5837 ratings, regrowth will occur, but this need not extend the canopy to any significant extent. In my opinion, any such minor increase in canopy is academic.

Any perceived increase in the RPA needs to distinguish that which is due to 'growth', and that which is due to the difference in method of plotting and calculation. Conflating the two causes confusion.

- 1.6.6 This begins the crux point in relation to the theoretical root development of the Planes.

Mr Mackworth-Praed uses the basic form of the RPA calculations, i.e. inferring that any increase in trunk diameter must increase the outward extent of the RPAs. This is not accurate, as the figures he uses are not precise, and he does not take into account the roots could be produced within the existing extent of root growth.

Mr Mackworth-Praed claims that there would be no roots beneath the carriageway of Millbank, and does not accept that the root density along, and beneath, the pavement, would be increased compared to at the extremities of the roots within the Gardens. The roots on the pavement side would not stop growing, and they would increase in density. This is illustrated throughout London, such as the large plane located on the river side, further along Millbank from the site (See the pictures below, and other examples in my Proof). The use of theoretical RPAs cannot provide data on root density, and rooting depth, as the RPAs are two-dimensional. Site investigations are required to obtain such information.

The following pictures show the large plane in a very narrow section of pavement next to the river Thames. The large structural root grows directly towards the road, and it has lifted the kerb. If Mr Mackworth-Praed were correct, the root would have had to have stopped at the kerb edge, and all of the roots would have been beneath the pavement. Any BS 5837 RPA for this tree would have to be a very narrow, very elongated rectangle constrained by the road and the embankment wall.

**Picture taken on the 6th of August 2020 of a large plane on Millbank.**



**Picture taken on the 6<sup>th</sup> of August 2020 showing the movement of the kerb by the large buttress root.**



**Picture taken on the 6<sup>th</sup> of August 2020 showing the lifting of the kerb caused by the buttress root.**



- 1.6.7 The smaller trees towards the northern end of the Gardens could be removed and be replaced elsewhere without losing any short-term visual amenity. The cherry is in a particularly poor condition.

## **1.7 Statutory protection and tree management**

- 1.7.1 No comment.

- 1.7.2 This identifies the inspection and management of the trees. The trees have BS 5837 category ratings of “A” and “B”, and are inspected at least once a year. This is good arboricultural practice. It is stated that they are actually inspected three to four times per year to check for Massaria. However, there is no indication that any Massaria has ever been found within the trees. No link can therefore be made with the disease and the presence of some dead branches in the canopies of 21 trees. Any potential problems with the disease would occur even if no development took place.

No mention is made that the trees are of such an age that it is inevitable that some dead wood will be present. The trees are healthy, and the presence of some dead wood is a natural phenomenon. The dead wood would have been removed on safety grounds, as the trees are located within a highly used location. Dead wood will occur even if the development does not go ahead.

- 1.7.3 I agree with this statement.

## **2. Arboricultural Impact Assessment (AIA)**

- 2.1.1 Agreed – that BS 5837 should be taken as an industry standard publication for guidance and recommendations; not as a specification.
- 2.1.2 Bartlett did use BS 5837, and modified the RPAs after due consideration. The British Standard accepts that modifications of the RPAs can be carried out to suit site specific criteria. Note the example pictures of the works granted by Westminster City Council at Green Park in my Proof of Evidence, where the development within the RPA does not comply with the strictest interpretation of the British Standard. This would be totally at odds with Mr Mackworth-Praed’s position throughout his report.
- 2.1.3 There is no mention or acknowledgement that the RPA calculations are theoretical. Mr Mackworth-Praed bases the whole of his assessment on the BS 5837 RPAs. The RPAs are represented as two-dimensional “area” measurements; they do not include any assessment of volume, which is three-dimensional. There is no acknowledgement by Mr Mackworth-Praed of the importance of soil volume in consideration of the RPA.
- 2.1.4 The RPA calculations are primarily for individual, free-standing trees. Mr Mackworth-Praed quotes section 4.6.2 “Root Protection Areas (RPAs)”. There is no mention in the British Standard, or in his text, as to how the RPAs of groups of trees should be calculated, or any mention of the overlapping of RPAs within groups. The use of theoretical RPAs alone cannot identify the spatial root extent of trees within groups, as they will be intermingling with each other.

The only practical way of assessing the extent of roots within groups is to carry out site specific investigations; something that Mr Mackworth-Praed does not identify as being a valid procedure (See item 2.1.8 below). This is a key point as he actually claims that BS 5837 makes no comment on the appropriate use of site investigations. This is incorrect, as item 4.3 (Soil Assessment) covers the issue. Item 4.3.1 states:

*“A soil assessment should be undertaken by a competent person to inform any decisions relating to (Emphasis added):*

- *the root protection area (RPA); (Emphasis added)*
- *tree protection;*
- *new planting design; and*
- *foundation design to take account of retained, removed and new trees”.*

In my opinion, this brings into question the validity of all Mr Mackworth-Praed’s assessment of RPAs.

Item 4.6.2 of the BS does list the factors to be taken into account in deviating from the original circular RPAs. The modified RPAs produced by Bartlett considered the relevant factors.

- 2.1.5 I agree that the RPAs are not intended to represent, enclose, or protect the entirety of a tree’s root system, and that root systems will frequently extend considerably beyond the canopies of trees. This is important in relation to the planes. Mr Mackworth-Praed has plotted the RPAs of the planes overlapping each other, and he accepts that they will extend past the trunks of adjacent trees.

There is no supporting evidence to justify the claim that the roots would stop in a north to south direction where he has shown the edge of the RPAs. Any such extension would be contiguous with the edge of his calculated RPAs.

Mr Mackworth-Praed does not fully address the issue of the trees growing within the carriageway of Millbank. He simply states it is impossible for roots to be there. If all the roots are beneath the pavement, i.e. not under the road, the roots would have to run for massive distances away from the trees, and well past their canopy spreads along the road.

- 2.1.6 I agree that the RPA should not be confused with the structural root-plate. I also agree that the structural root-plate is critical to a tree’s anchorage and stability. There is no reason to suspect that the anchorage or stability of any of the planes will be compromised if the development goes ahead. Mr Mackworth-Praed’s main concern is the roots at the extremities of his RPAs (other than right up against the trunks).

I agree that the RPA is a “judgment”; it is not precise. The paragraph accepts that it is possible to sever any roots outside the theoretical RPAs without hurting trees, i.e. to allow the trees to continue to survive and grow.

Mr Mackworth-Praed once again refers to the link between the RPA area and the volume of the soil beneath it. As the RPA is an area measurement, it is unsound to attempt to infer any volume characteristics without site investigations.

- 2.1.7 Mr Mackworth-Praed stresses the importance of the RPA, and says its importance cannot be overstated. He comments on the default position, and stresses the most reliable way is to preserve the RPA completely undisturbed. He considers that no infringement of the RPAs should be allowed.

It is recognised throughout central London that the balanced needs of development require infringements of the RPAs. Westminster City Council have granted developments in the past that have incorporated significant infringements into RPAs, such as can be seen at Green Park.

- 2.1.8 Mr Mackworth-Praed states that at no point does BS 5837 refer to, or recommend the use of, invasive site excavations as a means of seeking to assess the extent of a tree's root system, or as a means of assessing the likely effects of development on it. He goes on to state that there is nothing in BS 5837 to indicate that non-invasive techniques, such as ground radar, are acceptable.

As mentioned in item 2.1.4 above BS 5837 makes specific comment on the appropriate use of site investigations. Item 4.3 (Soil Assessment) covers the issue. Item 4.3.1 states:

*“A soil assessment should be undertaken by a competent person to inform any decisions relating to (Emphasis added):*

- *the root protection area (RPA); (Emphasis added)*
- *tree protection;*
- *new planting design; and*
- *foundation design to take account of retained, removed and new trees”.*

- 5.1.5 BS 5838 actually identifies acceptable techniques used for site investigations. Item 7.2.1 states:

*“... Such excavation should be undertaken carefully, using hand-held tools **and preferably by compressed air soil displacement.**” (Emphasis added).*

Mr Mackworth-Praed appears to be of the opinion, that the only acceptable way of assessing the extent of tree RPAs is to use the theoretical calculation of BS 5837. He simply will not accept any investigations, even though site investigations are invariably carried out on development sites involving trees, and their use is specified in the British Standard.

Later in his report he explains why he considers the site investigations are unreliable. However, the text above indicates that he would not accept the results of the investigations, in any event, even if his concerns on the methodology and interpretation of the results had not existed. He would have claimed that they did not comply with the BS 5837 system.

The development team's position is that the Arboriculture industry uses investigations to qualify / quantify potential impacts of development within RPAs as standard practice. The use of tree root radar surveys to minimise the disruption to the rootzone of a tree is a sensible, and professional approach.

## 2.2 Tree constraints plan

- 2.2.1 The plan in Appendix 2 shows the recalculated RPAs as per Mr Mackworth-Praed's assessment. The RPAs stop at the wall along the river, which is logical. On the western side they stop at the edge of the carriageway. No roots are considered present beneath the carriageway. He considers it impossible for roots to be there, which is at odds with the planning sub-committee comment on page 62 of their report, which states that:

*“Whilst it is possible that there are structural roots below the carriageway of Millbank, it is improbable, and is not supported by any root investigation.”* (Emphasis added).

My example photographs of planes along Millbank and on other sites indicate that Mr Mackworth-Praed is incorrect, as roots can be seen at the edge of the carriageway, and that their buttress roots are growing towards and beneath them. As mentioned previously, there is a high probability that they are beneath both the pavement and carriageway.

The shape of Mr Mackworth-Praed's RPAs has been modified to extend the roots significantly into the Gardens. I agree with the locations, and numbers of the trees; not the extent and shape of their RPAs. I disagree with the extent of the RPAs, as they are based on what I consider unreliable data. I also do not consider the canopies to be exact.

- 2.2.2 The canopy spreads are not precise, but I do not consider them to be critical. The difference between the figures and Bartlett's is minor. Item 4.4.2.6(a) of BS 5837 identifies the potential inaccuracy.
- 2.2.3 Mr Mackworth-Praed has modified the shapes of the RPAs, claiming they take into consideration the boundary wall and edge of the carriageway, as per the guidance in BS 5837. He has then added the area of cut off directly to the site side of the RPAs, extending some of them considerably towards the development. I do not agree with this, as root growth would almost certainly have occurred within the existing calculated areas, especially in a north-south direction on both sides of the site, and there would be no requirement to extend the diameters of the RPAs.

The use of theoretical RPAs is intended to provide an indication of the expected spatial root development of a tree (usually free-standing, i.e. isolated). The aim of changing the shape is to provide a good projected representation of where roots will be expected to be, but the BS RPAs does not allow root density to be taken into consideration.

Mr Mackworth-Praed has attempted to claim that there would be no roots under Millbank, and that there would be no possibility of any increased density of rooting between the trees and the edge of the carriageway; thus allowing him to add to the radius of the RPA on the eastern side of the trees growing on the western side of the

site. However, he has totally ignored that there would be a high likelihood of increased root density between the trees and the edge of the carriageway. The single tree on the opposite side of Millbank, and other trees along Millbank, show there is adequate space for roots to develop within restricted areas, but Mr Mackworth-Praed's RPA calculations would not show this. To provide a more realistic RPA you would have to increase the size and shape of the RPAs within the area where additional growth is to be expected. In this instance that would be between the trees and the carriageway, and would result in an elongated RPA running parallel with the edge of the carriageway. As mentioned previously it would be of rectangular shape.

There is no evidence available to indicate that the roots in this area would stop growing, and that additional growth would take place on the eastern side of the trees. Similarly, the shape of the RPA within the Gardens should provide a realistic representation of the root growth between the trees in the rows, with greater north-south overlap. It is generally accepted that additional root activity would develop close to the trees, not at the extremities.

- 2.2.4 This section outlines what Bartlett did when they plotted the RPAs as squares.
- 2.2.5 Mr Mackworth-Praed identifies later in his report that even by his calculations, the proposed development will be outside their RPAs on the eastern side, which should not affect the trees. Mr Mackworth-Praed's circular RPAs on this side would be smaller than the current Bartlett rectangular representation. Therefore, the Bartlett RPA is more appropriate in this context.

What Mr Mackworth-Praed has attempted to do is to claim that using a square RPA does not show the likely disposition of the tree roots, as they would be expected to extend in a circular pattern. The square RPAs are notional, i.e. not hard on the ground. As the roots extend from the trees they will not grow just vertically and horizontally (north/south), they will naturally grow out in an average spreading pattern. They will not stop at the edges of the straight lines. You will naturally get a spreading pattern of growth extending outwards away from the trees if you use any theoretical shape.

Mr Mackworth-Praed cites "the entire root system and root environment". I think that it is important to note that his depiction of the RPAs does not protect the entire root systems – the roots will continue to grow outwards. The wording related to the significant roots depicted by the edges of the RPAs.

In my view there will be no difference in the spatial development of the roots shown in the squares compared to those in the modified RPAs depicted by Mr Mackworth-Praed.

The depiction of Mr Mackworth-Praed's RPAs along the western side is shown as part of a circle. If the carriageway is a hard boundary, as proposed by Mr Mackworth-Praed, then the roots in the pavement would almost certainly form a rectangle to this edge, not a semi-circle. Also, the overall root growth would almost certainly run in a north to south direction, and therefore, should have been rectangular, not semi-circular on this side of the trees. Had this been a solitary tree such as on the other side of the road, and his assumptions had been considered valid, then the theoretical RPA would almost certainly be a long rectangle in the north-south direction.

- 2.2.6 Mr Mackworth-Praed is correct that Bartlett did depict the RPAs on the western side as unmodified circles. They do extend up to half way across the pavement and carriageway of Millbank. He states that Bartlett used this depiction, as it was used at competition stage before their involvement in the project. Bartlett have noted that they believe there is a percentage of tree roots possible under the carriageway, therefore they have retained the circular RPA. This is common in the drawing of RPA's adjacent to streets in London, and is evident in a review of other Westminster City Council applications that include trees adjacent to carriageways.

Bartlett clearly considered the depiction as acceptable, otherwise they would have changed it in their reports, diagrams and calculations. It should be noted that the competition RPA showed circles along the eastern edge with the embankment. Bartlett did not agree that this was acceptable and modified it to squares.

- 2.2.7 I do not think that just because the judgment was made prior to Bartlett's involvement it necessarily makes their assessment unreliable.

Mr Mackworth-Praed then goes on to say it is highly unlikely that any roots of the trees would be under the carriageway of Millbank. He talks about typical roadway construction, high bulk densities, and absence of nutrient content of road construction materials. He basically says that in his opinion the sub-surface and soil would be impenetrable to any root growth.

The pictures that I have provided show examples where there is a very high probability that structural roots will be beneath the carriageway. Mr Mackworth-Praed has not addressed the pictures in my Peer Review report. In my opinion, it would be extremely unlikely for the roots of the trees to stop abruptly along the edge of the carriageway. I consider that roots will have extended beneath the carriageway. I do accept that there could be a reduction in the numbers of roots present. However, when calculating BS 5837 RPAs, they do not take into consideration the actual number and density of roots. Mr Mackworth-Praed is of the opinion that roots could not possibly be present.

- 2.2.8 Mr Mackworth-Praed accepts that a proportion of roots can be expected to be under the pavement, but attempts to bring into question the longevity of the roots, as they could possibly have been severed at some time in the past. I have seen no evidence to support this claim, and consider it speculation.

The trees are healthy and had any root severance taken place in the past, they would have rapidly regenerated to re-balance the root:shoot ratio (the balance between roots and top-growth). This is clear as a visual inspection will confirm.

Mr Mackworth-Praed cites that the paving flags along the side of the carriageway would drastically reduce the amount of moisture and oxygen for root growth. He does not explain why the solitary trees along Millbank can grow healthily, when the vast majority of rainfall falling on the pavement would immediately run to the edge of the pavement and would be carried away from the tree roots.

If Mr Mackworth-Praed were correct, and no roots could be produced beneath the carriageway on Millbank, then all of the roots of the planes would have to be beneath

the pavement. This demonstrates that there is adequate space beneath the pavement for healthy growth of the trees. If the BS 5837 RPAs for the trees were plotted as per Mr Mackworth-Praed's methodology, the RPA would have to be a long narrow rectangle.

The position of the planes in the Gardens are at a greater distance from the edge of the carriageway to that of the tree further along Millbank. The width of the pavement on the tree further down Millbank is very small. This shows that you do not need to have a large circular shaped RPA for healthy growth to occur.

2.2.9 Mr Mackworth-Praed voices his concern once again in relation to protecting all of the roots of the trees.

No excavations are to be carried out along the roadside, and no roots will be severed. The pavement, and the carriageway, will protect the whole of the roots along the roadside.

2.2.10 This is the summary of why he modified the RPAs in towards the proposed development:

- he does not accept that any roots could be beneath the carriageway;
- he does not accept that there will be a greater proportion of roots beneath the pavement compared to the outer extremities of the RPAs within the site;
- he has made no allowance for the likelihood that adequate rooting area would be available for the natural root development on the roadside section of the trees;
- there is no mention in his RPA calculations to indicate that there is a high probability of dense root growth beneath the pavement, and to some extent beneath the carriageway, compared to the less dense areas of roots within the Gardens;
- he does not explain why all of the roots of the tree on the opposite side of the road, and the one lower down Millbank, could develop in such a restricted area, which bears no resemblance to his depiction of the RPAs in the Gardens.

## **2.3 Tree impact plans**

2.3.1 This states that Mr Mackworth-Praed has based his impact plans on his interpretation of the RPA calculations. The plans simply show what their RPAs look like.

The impact plans assume that the shapes of the RPAs are correct, even though they do not fully address the issues of calculating the RPAs which I have raised in earlier.

What the plans do show is that there should be no problem with the location of the development along the eastern side of the Gardens. This is something all parties can now agree on.

## **2.4 Incursions into root protection areas.**

2.4.1 All of item 2.4 is based on Mr Mackworth-Praed's assessment of the RPAs of the trees. The validity of the RPAs should be addressed in detail as I have highlighted above. I consider it key to everything else in his report.

I accept that some incursion would occur, but disagree with its extent. Just because it is claimed an incursion into his RPAs will take place, does not mean that any significant damage would occur to the trees, and in any event, the proposed mitigation would compensate, and encourage healthy new growth.

- 2.4.2 This explains the convention used in the plotting of Mr Mackworth-Praed's RPAs.
- 2.4.2-
- 2.4.5 These sections explain the production of the plans and tables. They are based on Mr Mackworth-Praed's RPA calculations. It is unclear whether the percentage difference with the Bartlett calculations takes into consideration the difference between the two seasons of growth.
- 2.4.6 This simply mentions that there are differences between Mr Mackworth-Praed's and my impacts on the trees.
- 2.4.7 This indicates that Mr Mackworth-Praed's RPAs show an increase in their extent within the grassed area, towards the development (towards the east). It also accepts that on the eastern side in some cases the RPAs do not extend quite as far as the square representations provided by Bartlett.

The plotting of Mr Mackworth-Praed's RPAs along the western side do not comply fully with BS 5837. As mentioned previously, the root growth would have extended further to the north and south compared especially on the roadside to Mr Mackworth-Praed's plotting, and to have carried out a reasoned assessment it would have been logical to use squares, or even rectangles, to even out the overlapping extremities of his circles. Simply by changing the RPAs to squares or rectangles would automatically reduce the external edge of the RPAs closest to proposed works. Mr Mackworth-Praed has failed to accept that the soil around all of the trees is contiguous; which is a fundamental flaw in his thinking.

- 2.4.8 The difference in the percentage figures is caused by the inappropriate drawing of the RPAs; i.e. by his failure to identify the actual constraints on the site.
- 2.4.9 The RPAs of the Bartlett plans do not specifically take into consideration the service routes and structures such as the Spicer memorial. The overlap with the kiosk, Spicer memorial, and service intrusion is not fully detailed in the Arboricultural Impact Assessment for one, or two reasons:
- as the data was not available (i.e. to be designed by the contractor);
  - or too difficult to ascertain (i.e. ducts through the ground).

This information is set out in principle in the documents and would typically be conditioned as an Arboricultural Method Statement (AMS) to be issued prior to construction.

- 2.4.10 This is the point where Mr Mackworth-Praed accepts that not all of his incursions into his RPAs will result in the same degree of impact, and introduces the topic of

mitigation. I cannot stress too much that the calculation of Mr Mackworth-Praed's RPAs is fundamentally incorrect, and his RPAs are based on a false premise.

- 2.4.11 This note outlines what BS 5837 says in relation to the possible encroachment of the RPAs. The point on 7.1.1 of the BS basically states that you should preserve the RPAs completely undisturbed. The pictures I have included in my Proof showing examples of incursions into RPAs clearly identify that Westminster City Council grants permission to developments that require significant incursions into the RPAs, and also extensive pruning of tree roots.

The quote on BS 7.1.2 states that it is possible under certain circumstances for trees to tolerate some incursion of their RPAs. Mr Mackworth-Praed cites that age is a factor, but does not acknowledge that the trees are healthy, and producing acceptable annual growth. The age and vigour of the trees are not significant factors in this instance, as can be seen by their visual appearance.

The BS supports the principal that development in the RPA of mature trees is possible, and that mature trees can recover from roots being professionally pruned, with regrowth of new tree roots.

- 2.4.12 This states that all parts of the root system, but especially the fine roots, are vulnerable to damage. It continues by stating that mature trees recover slowly, if at all, from damage to woody roots.

The trees are healthy, and there are no signs of any reduction of healthy growth. If the severance of roots follows good arboricultural practice as identified in the Bartlett report, there should be no reason they would not regenerate quickly, especially when suitable remedial mitigation is provided.

This is a small item in the report, but is of critical importance when considering the severance of roots. Westminster City Council regularly allows developments that require the severance of large amounts of roots. I would add that BS 5837 actually states that roots of up to 25mm can be severed without harming trees and accepts that larger roots can be severed following advice from an arboriculturist.

BS 5837 accepts that all roots, of any size, located outside the RPAs can be severed. This must indicate that the BS acknowledges that severance of such roots would not harm the trees, otherwise it would not be allowed.

It appears Mr Mackworth-Praed considers that no root severance within any RPAs should be carried out. This is one of his primary issues, but he does not cover it in detail, and does not acknowledge that Westminster City Council regularly allow roots to be severed.

If we start with the fact that some tree roots have to be cut, the methodology of pruning, as identified in the BS, and suggested in the Bartlett report, would minimise any medium to long-term damage. The pruning would prevent the majority of die-back, and would encourage rapid new growth, as would the application of mitigation measures.

As some roots have to be cut at the points identified by Bartlett, there will clearly be exposed cut surfaces. However, this would also occur when pruning at the points identified by Mr Mackworth-Praed. The only difference would be a reduction of the length of pruned roots identified between the two pruning points. Both cut root ends would result in the same damage, other than the increased small roots emanating from the larger severed roots. This should have minimal impact.

In relation to Mr Mackworth-Praed's claim that if the roots at the extremities of the Bartlett RPAs are cut, they will kill masses of minor roots; it should be noted that this will also occur where Mr Mackworth-Praed considers the roots should be cut.

## **2.5 UKHMLC Footprint and Basement.**

- 2.5.1 Mr Mackworth-Praed is correct that any roots encountered in the excavations for the piling mat would be severed during the work. Similarly, the process of inserting the piles would also sever all of the roots encountered. However, he does not explain that his RPA calculations are not precise, and does not identify the number and size of roots that he considers would be affected. He does not identify the length of his root severance compared to that of Bartlett's assessment.

Mr Mackworth-Praed fails to mention that in any event, new growth would be rapidly produced (stimulated by appropriate mitigation), at the pruning points, and also closer to the trunk of the tree.

- 2.5.2 I must stress that this section is based on Mr Mackworth-Praed's assessment of the extent of the RPAs, which is significantly different to those of Bartlett. In my opinion, his RPA calculations are unsound.

In my professional experience it is acceptable to use an incursion into the RPAs of trees of between 10% and 20%, as the RPA calculations are not precise. Mr Mackworth-Praed's only concern in this instance is that he considers there is no contiguous room for the roots to develop in a north-south direction. This is incorrect.

Even using Mr Mackworth-Praed's figures (2% to 17.8%) they would be well within the range of the typically accepted incursion (10%-20%).

Mr Mackworth-Praed effectively accepts that there would be no significant incursion on the eastern side. This means that even using his own figures, there is no justification to claim that the trees along the eastern side of the site would be harmed in any way. This is a key point.

- 2.5.3 This quotes BS 5837 item 5.3.1. It emphasises that the Standard recommends that structures should be outside the RPAs of retained trees, but accepts that where there is an overriding justification for construction within the RPAs technical solutions may be available to prevent damage.

The first point Mr Mackworth-Praed identifies covers the lack of a contiguous area to compensate for the loss of the calculated RPAs. He covers this in item 2.5.4.

The second point relates to mitigation to encourage healthy new growth.

- 2.5.4 Mr Mackworth-Praed is of the opinion there are no compensatory rooting areas away from the areas of encroachment. He cites the presence of the barrier wall of the River Thames, and the carriageway of Millbank.

What Mr Mackworth-Praed fails to acknowledge is that there are contiguous areas to the north and south of the trees. They simply form part of the overall available soil area. What he is attempting to do is suggest that the roots would stop at the extremities of the RPAs in a north to south direction. This is clearly incorrect, as he accepts that roots naturally spread out for long distances through the soil mass. None of the roots within this north to south direction would be harmed, as they would not require pruning. It is also important to note that the extent of natural growth to the north and south could actually be far greater than 20%.

The last sentence is important, as he is stating that BS 5837 item 5.3.1(a) cannot be satisfied. At this point it should be noted that the trees growing further along Millbank would find it difficult to satisfy the RPA criteria, as the River wall is within a metre and half of the trees, and the kerb is within 500mm of the trees. This is a key point.

- 2.5.5 Mr Mackworth-Praed effectively accepts that planes are known to tolerate crown pruning and root severance better than many other species.

The British Standard accepts that the use of theoretical RPAs should be used as guidelines, i.e. to aid design. That is the principal function of RPAs, when no site investigation data are available. It is simply untenable to attempt to claim that theoretical RPAs are so accurate that no degree of error should be applied.

I consider it reasonable, and sensible, to allow some degree of error when using RPAs. In my experience local authorities, including Westminster, regularly recognise that some flexibility is acceptable.

- 2.5.6 As a guideline, BS 5837 does recommend throughout the use of the theoretical RPAs to protect trees. However, it accepts that some root severance is acceptable in certain circumstances. The claim that the BS states that no root severance should ever take place is incorrect, and appears a pedantic use of the BS.

It is necessary to mention here the incursion and damage to the roots within the RPAs of the trees identified in the photographs I have included in my report (see The Inconsistency of the Local Authority's acceptance of British Standard 5837). They show considerable incursion into the RPAs, and that significant roots have been damaged. The actions carried out on those sites showed minimal regard to safeguarding the protection of the trees within the RPAs.

I disagree with the penultimate sentence of item 2.5.6. The pictures I have just cited demonstrate that Westminster City Council accepts that considerable incursion of the RPAs is acceptable.

As I have already mentioned, there is adequate contiguous room on site to enable excavation and construction to take place; Mr Mackworth-Praed simply does not address the issue appropriately.

2.5.7 In this point Mr Mackworth-Praed agrees that the mitigation measures put forward by Bartlett would comply with item 5.3.1(b) of the British Standard. This should also satisfy the planning committee's point regarding the acceptability of development within the RPA.

2.5.8 In this item Mr Mackworth-Praed identifies that the Bartlett reports accept that some roots great than 25mm diameter will be severed on both sides of the site. However, at this point he does not specify what medium to long-term damage, if any, the severance will have on the trees.

BS 5837 (7.2.3) accepts that roots greater than 25mm can be severed if their influence is assessed by an arboriculturist. Bartlett made such an assessment. The NJUG guidelines also accept pruning of roots over 25mm diameter.

The point made in relation to the trees along the eastern side is irrelevant, as Mr Mackworth-Praed has accepted that the construction will be outside his RPAs.

2.5.9 Mr Mackworth-Praed disagrees with the use of site investigations, but now cites them to make a point.

This section identifies that roots of up to 100mm (majority between 30mm-50mm) were found, and that it would be likely others would be present at depth. It points out that more roots of similar size at deeper depth have not been specifically identified. It does not identify if any medium to long-term damage would occur if the roots were severed.

Once again Mr Mackworth-Praed uses the information in relation to the eastern row of trees, but he does not comment on the fact that they are outside his theoretical RPAs, and could be severed without hurting the trees in accordance with the guidance of BS 5837.

2.5.10 It is accepted that the roots larger than 25mm on the east side of the site occur at, or just beyond the perimeters of the RPAs that Mr Mackworth-Praed produced. He has not mentioned that it is possible for roots of a same diameter to have developed in a north-south direction, which would not be severed, i.e. harmed in any way, and he has not accepted that they would not harm the trees as the pruning points would be outside his RPAs.

Mr Mackworth-Praed comments that the roots found on the western side of the site are well within his RPAs, based on his own incorrect assumptions. However, the roots could be severed without harming the trees in the medium to long-term. The mitigation works would stimulate rapid new growth within the RPAs.

2.5.11 The majority of moisture and nutrient extracting roots are produced close to the trunks of trees, with the density of such roots being far less close to their extremities. The roots that have to be severed for the development will have no influence on the

stability of the trees, and the percentage of the severed roots will be extremely small compared to the overall root systems.

The point made about severing larger roots would deprive the tree of sustenance is unsound in the medium to long-term. There is a very high probability that the majority of fibrous roots will be between the point of severance and the base of the tree. It is also critical to note that Mr Mackworth-Praed has made the assumption, that all new growth will have to be produced at, or very close to, the point of severance. This is incorrect, as the likelihood is that the new growth will occur at the tips of the smaller sub-lateral roots, closer to the trunk of the tree.

If the severance of the larger roots, would adversely affect the trees by reducing large quantities of feeding roots, it would be illogical for the British Standard to sanction their severance once they extend past the perimeter of the theoretical RPAs.

The photographic evidence which I added to my Proof clearly identify that Westminster City Council has been willing on other developments to allow all of the lateral roots to be severed with roots over 25mm in diameter. If the Council considered that the work would have been harmful to the trees, it would not have allowed it to be carried out. The trees in Victoria Tower Gardens are healthy, and the regrowth of their roots would be rapid. There is more than enough soil available to allow this to happen.

- 2.5.12 This identifies that Bartlett have stated where roots of over 10cm are pruned, or where there is a higher number of roots pruned in the area of the basement box, it would be reasonable to expect some dieback or decline in the parent tree. They continue that as mature trees, these London Planes may be more susceptible to physiological stress due to root pruning. I disagree with Bartlett's view on this topic.

The trees are healthy, with BS 5837 category ratings of "A" and "B". Once the roots are severed, they will regenerate quickly to re-balance the root:shoot ratio. There are no signs to indicate that there will be any significant die-back, or stress. The mitigation measures will encourage rapid, healthy growth. As the trees are mature, they will naturally contain some dead wood. This is not necessarily a sign of deterioration, or stress, but a natural phenomenon. The trees have been inspected regularly, and dead wood has been removed. This dead wood has nothing to do with the proposed development, and it will continue to occur even if the development does not go ahead. It cannot justifiably be used to assert the trees will be under stress once the development is undertaken.

- 2.5.13 This claim is based on Mr Mackworth's assessment of the RPAs, and in my opinion, the influence on the trees will be much less than he is suggesting. Healthy London planes can cope with severe pruning as can be seen with the pollarding carried out throughout the city. Healthy trees will regenerate after pruning. In fact, research on subsidence damage has shown that the more severe you prune a tree the greater the speed of regrowth. If the trees were liable to decline after pruning, they should have been classified as BS category "C" trees, not "A" and "B".

Notice the comment was made relating to the trees on the western side, not those along the east. This accepts that there is no justification to assume the eastern-side trees will

be harmed, even to a minor degree. If there were any risk of decline to the western row of trees, it should also occur to those along the east. Mr Mackworth-Praed has asserted that these trees are making less growth than those on the west, but if correct, it would mean that the eastern trees should show most deterioration and decline, not those to the west. The risk of possible harm to the trees on the east is minimal as he has accepted that the BS would allow their roots to be severed at the edge of the RPAs without causing damage.

The basement walls would present a permanent reduction of the available rootable area of soil, but this would not inhibit their capacity to recover, as there would be more than ample volume for additional root growth. The roots would simply grow in a different direction. The landscape proposals also increase the depth of usable soil through the removal of hardstanding beneath the impermeable asphalt paths. There are no indications that there will not be enough soil available for new growth. The trees will simply utilise the remaining available soil.

## **2.6 Hostile Vehicle Mitigation (HVM) measures**

2.6.1 This explains that the mitigation measures are shown on their two plans.

2.6.2 It is correct that the features require to be within the RPAs of the trees along the western side. The excavations will be small, but close to the structural root plates. As Bartlett state there will be some flexibility in the positioning of the foundation slabs, rafts and collapsible bollards. The locations have already been proven through on-site survey by Canopy Consultants in April 2019, which was witnessed by Westminster City Council Head of Arboricultural Services.

The design proposals for the HVM is an improvement beyond existing proposals for security walls and foundations such as installed in Green Park. Foundation sizes have been minimised, so as to maintain flexible positioning and deeper foundations. They do not require any pruning of roots but can be formed around existing roots.

2.6.3 The detailed structural design of the foundations has not been finalised to date, which does indicate the possibility of design changes. This would occur once the contractor's design detail has been verified, based on the known survey information. It is normal to condition the submission of these details to Westminster City Council as part of the Arboricultural Method Statement (AMS) prior to the commencement of construction.

2.6.4 The proposed protective measures are reasonable, suitable and appropriate to protect the trees. The use of an impermeable membrane would prevent any leachate from the concrete affecting the roots. This is normal arboricultural practice. Note the picture that I have included in my proof showing the way roots can be protected, and which Westminster City Council has accepted on other sites.

Mr Mackworth-Praed accepts that the site investigations carried out by Canopy Consulting indicated that there would be no significant damage caused to roots.

2.6.5 It is unclear why the works should have a "significant" impact as nothing presented could suggest this. All relevant information was included in the Arboricultural Impact

Assessment report and planning drawings. It should be recognised that the total area of incursion is extremely small, and that no tree roots require pruning to install the foundations. The alternative HVM design as per Green Park would be considerably more impactful, requiring a strip foundation the length of Victoria Tower Gardens.

## **2.7 Underground services**

2.7.1 This outlines the positioning of the proposed underground utilities.

2.7.2 The services are proposed to be flexible, i.e. not require rigid conduits. This flexibility would allow the positioning of the services to avoid roots. Bartlett has cited the use of the NJUG method of preparing the service routes. This is a recognised method of positioning services through tree root systems. It is also possible to undertake an alternative safe method such as using Air-Spades which BS 5837 recognises. This would expose the roots along the service routes, which would allow the safe placement of the services. It would be acceptable to provide greater detail through the AMS prior to the commencement of construction works.

2.7.3 The secondary service route could be accomplished using Air-spades, as described above. It will be within an area of hard-surfacing, and this would need to be broken. The retained hard surfacing would act as a ground protection measure, minimising the area of excavation. The use of an air-spade would mitigate any potential impact of the excavation on any roots of tree numbers 71017 and 71018. It would be possible to use the NJUG method, but in my opinion, there would be no significant damage if an air-spade was utilised.

2.7.4 The route should be within the area disturbed by the installation of the piles and should not encroach any further on the RPA This could be installed as mentioned above, without causing harm to the trees.

2.7.5 The technique involved where trees 70000, 70001 and 70002 are concerned will be as per the method outlined above, without causing harm to the trees.

2.7.6 This compares the guidelines in BS 5837 with what is being proposed for the underground services.

Item 7.7.2 of BS 5837 accepts that using hand-held tools might be acceptable for shallow service runs. The use of air-spades actually allows the insertion at depth without severing significant roots. It is proposed to use such trenching techniques, with flexible laying along the length of the route.

It is worthy of note that the Head of Arboricultural Services allowed investigation trenches looking for roots to be excavated by Canopy Consulting using spades, Air-Spades, and even a mini-digger. The operations would have severed tree roots, and some would not comply with BS 5837 in this respect. She clearly considered this was an acceptable method of investigation.

Due to overlapping RPA's, it is not possible to provide alternative routes. It is proposed to locate the service at the mid-point to minimise disturbance. From review of previous

applications on the site, it is not clear how the current proposals fall short in detail. The level of disturbance required to install the current playground in 2014 was not considered unacceptable to The Royal Parks or Westminster City Council. It is evident in other developments in Westminster that large excavations have been granted that excavate up to the trunks of trees.

Item 7.7.2 of BS 5837 states that plans should be prepared showing proposed positioning. It states that in such cases trenchless methods should be used. Bartlett have identified the proposed routes and have indicated that the services will not harm the tree roots.

- 2.7.7 This summarises the author's opinion, but he has not accepted that air-spading would prevent the requirement for severing any significant roots.

## **2.8 Relocation of the Spicer Memorial and Café Kiosk**

- 2.8.1 This covers Mr Mackworth-Praed's perceived potential problems with siting the Spicer memorial and café kiosk.

- 2.8.2 Mr Mackworth-Praed has accepted that the foundations of the Spicer Memorial should be left in situ, or be broken out using hand tools. Additional ground protection measures could be laid if any problems are identified. This should not harm any tree roots.

- 2.8.3 It will be possible to identify the position of roots within the areas of the Spicer Memorial and café before any construction is carried out. There is flexibility in the positioning of foundations so as to minimise potential damage. Bartlett confirm that the structures will be constructed on bespoke foundations that are a contractor design. Details would be submitted for approval as part of the AMS prior to the commencement of construction.

- 2.8.4 The use of cell-web is referred to in the design proposals and would be acceptable for sub-base of benches and street furniture to minimise compaction of soils beneath. However, these foundation bases would be insignificant in relation to overall spatial development of the roots of the trees.

Mr Mackworth-Praed has failed to identify the numbers and sizes of roots that would be severed, and what medium to long-term impact they will have on the longevity of the trees.

The use of cell-web is referred to in the design proposals and would be acceptable for the foundations of the Spicer memorial. It would be possible to identify any roots within the proposed siting of the memorial to avoid pruning. Once again, the percentage of RPA affected would be small compared to the trees' overall spatial development.

- 2.8.5 Mr Mackworth-Praed accepts that the features are relatively small. In my opinion, their influence would be extremely minor. The percentage figures cited are based on his own theoretical RPA calculations. He has made no allowance for contiguous root development away from the proposed development. The site investigations do not confirm the presence of significant roots in the potential landscape foundation depth.

- 2.8.6 I did not make mention of these in my peer review, other than commenting on the typically accepted 10% to 20% incursion. I was assessing if Bartlett had followed good arboricultural practice; not going into specific detail on construction methods. I believe they did follow good arboricultural practice when developing the Arboricultural Impact Assessment.
- 2.8.7 The location and size of the foundations of the Spicer Memorial and Café Kiosk do not require the significant pruning of tree roots and minimise any infringement on the RPA of adjacent trees. Mr Mackworth-Praed's assertion is based on a skewed calculation of his RPAs.

Mr Mackworth-Praed considers that the proposal could adversely affect the trees physiological health, and viability. However, he makes no comment on the fact that they have high BS 5837 category ratings, and are quite healthy. There will be no medium to long-term adverse influence on the trees, as they will rapidly regenerate healthy new growth.

## **2.9 Soil build-up/new landform.**

- 2.9.1 This covers the increased depth of soil at the northern end of the development where the Memorial fins are to be located. It accepts that the increased levels are progressively raised. It explains the ultimate height of the banking.
- 2.9.2 This outlines the possible damage that can occur to tree roots when soil levels are changed. I agree that this can happen if no remedial construction measures are taken to prevent it. However, the description by Mr Mackworth-Praed is generic, and does not fully take into account site specific conditions, selection of materials, construction, and proposed mitigation.

I refer to the pictures of the Westminster Ceremonial Streetscape Project in my Proof of Evidence showing that it is possible, and acceptable to Westminster City Council, to cover tree roots with dense concrete, which would prevent movement of both oxygen and moisture from entering the soil around tree roots. This would have far greater impact on the trees than adding open, free-draining soil, with air ducts, as specified for on the Victoria Tower Gardens site.

Just because it is theoretically possible for increased level changes to damage trees if not carried out correctly, it does not mean that trees will necessarily be damaged. The selection of suitable materials and construction is paramount, and will prevent damage from occurring.

- 2.9.3 The Arboricultural Impact Assessment states that the installation of the capping beam and basement roof will take place ahead of the landform construction. Therefore, landforms and level changes are not an impact. Further north, the gradients of soils installed are not excessively deep and will not have an impact on any potential existing tree roots. It will be possible to prevent compaction, loss of aeration, and adverse drainage. The surfacing for pedestrian paths adjacent to the landform, and within the RPAs, will be provided by utilising permeable materials. This will create a more

hospitable environment where the greater density of roots would be expected, closer to the trees.

- 2.9.4 The depth of infill soil is minor, and will not have the level of impact suggested by Mackworth-Praed.
- 2.9.5 The figures are based on Mr Mackworth-Praed's RPAs, and do not take into consideration the actual site investigations.
- 2.9.6 The two trees are small, and have a low visual amenity to the Conservation Area. They could be replaced by new, healthy trees without adversely affecting the visual amenity of the site.
- 2.9.7 The RPAs are Mr Mackworth-Praed's representations. The mitigation measures would alleviate any problems with the additional soil levels, and would not impact on the trees. Compare the use of concrete above the roots on other sites, with that of specifically sourced soil.

Mr Mackworth-Praed accepts that the suggestions I made could potentially mitigate the additional risks to some extent. I made the suggestions after all of the development proposals had been made, and it was not in my remit to produce a detailed specification on the topic.

Mr Mackworth-Praed has effectively accepted that it would be possible to construct the mounds without affecting the trees as long as my suggestions are followed. A detailed specification could be produced in the AMS to prove that the tree roots would not be harmed.

## **2.10 Construction site set-up and management**

- 2.10.1 I agree that significant adverse impacts can be caused during temporary operations or activities - if the operations are carried out incorrectly.

The comments relating to significant adverse impacts by temporary operations are generic. In my opinion, it is unrealistic to consider that Bartlett would allow inappropriate operations to be carried out. Adequate soil protection will be afforded to prevent the issues raised by Mr Mackworth-Praed.

- 2.10.2 This just identifies that the soil should be adequately protected prior to commencement of operations, using Ground Protection measures. These are described in Bartlett's Arboricultural Impact Assessment Addendum. The comment is simply generic.
- 2.10.3 As always, the figures cited are based on the author's RPAs. They are effectively irrelevant as long as adequate ground protection is put in place.
- 2.10.4 The use of cell-web is a recognised method of constructing semi-permanent roadways. The specification for the cell web construction would be provided by cell web, to ensure adequate protection. These are described in Bartlett's Arboricultural Impact Assessment Addendum and the landscape details.

2.10.5 It would be a simple operation to lay appropriate ground protection in the region of the trees identified. This need not be of a cell-web type, and could simply consist of protective metal or plastic sheeting. There would be no need for any of the trees' roots to be damaged.

2.10.6 I have covered this aspect earlier.

2.10.7 This is based on Mr Mackworth-Praed's RPAs. As mentioned throughout, in my opinion, his RPAs are incorrect. The Arboricultural Method Statement (AMS) could be produced to prove the trees would not be harmed. You would not actually need to use cell-web, as ground protection sheeting could also be utilised.

Adequate ground protection could be achieved, and where any additional risk is identified, it would be a straightforward task to increase it.

2.10.8 The provision of ground protection along the eastern side is purely to ensure that no damage will occur to the tree root systems. The AMS would be provided to ensure that the measures are appropriate. The use of ground protection is to prevent any compaction of the soil. There will be no reason for the tree roots not to function properly.

2.10.9 Additional protection could be supplied around these trees. The current reference to best practice and BS 5837 in the Arboricultural Impact Assessment recognises this. This is a laboured point, as everybody wants to safeguard the trees.

2.10.10 Some flexibility will be required. If adequate ground protection is afforded, as it certainly will be, all of the protected areas will be available for construction operations. The ground protection measures would ensure that the soil would not be damaged during spoil removal.

2.10.11 This is just his conclusion.

## **2.11 Above-ground effects – tree canopies**

2.11.1 This basically accepts that some pruning will be required, and that the trees requiring pruning have been correctly identified.

2.11.2 It is accepted that the pruning is unlikely to be significantly damaging, or disfiguring. Mr Mackworth-Praed accepts the use of the specified piling rig.

2.11.3 The trees are all healthy and have been pruned in the past. No significant die-back has been identified as being caused by the pruning. Plane trees can withstand extremely severe pruning, such as pollarding. There is no requirement for any severe pruning to be carried out on the Victoria Tower Gardens site, and there should be no loss of visual amenity of the trees to the Conservation Area. Pruning would have a beneficial influence in relation to the regrowth of any severed roots, as the removal of some wood would balance the root:shoot ratios, encouraging healthy new root growth. There are

no signs to indicate that the proposed pruning would adversely affect the trees, or adversely affect the visual character of the Conservation Area.

### **3. Other concerns, and conclusions**

#### **3.1 Root investigations – Simply a heading.**

##### **3.1.1 This is Mr Mackworth-Praed’s introduction to the soil investigations.**

I consider it important to note that Mr Mackworth-Praed would not accept the soil investigations in any event, as he considers they do not comply with the wording of BS 5837. His position is simply unrealistic, as it is not possible to identify the soil characteristics using a two-dimensional model, such as theoretical RPAs, without carrying out such operations. His RPAs compel speculation on soil volume, whereas the use of site investigations as specified by BS 5837 allow the collection of volumetric data.

Mr Mackworth-Praed attempts to question the validity of the investigations carried out by Sharon Hosegood, and those by Canopy Consulting. The Hosegood investigations encompass non-invasive testing of wide swathes of the site, whereas the trenches of Canopy Consulting are narrow, and allow the identification of solitary roots at specific points on the site.

It is extremely difficult to compare and contrast the investigations, as by necessity, Canopy Consulting severed large numbers of small roots to carry out their testing procedure, whereas Sharon Hosegood did not. This is extremely important close to the soil surface.

In my opinion, the approach which Bartlett followed in relation to soil investigations was sensible and professional.

##### **3.1.2 This introduces the Hosegood February 2018 report. The report describes the location of scan lines selected to understand potential density of tree roots within an RPA, and what may need to be pruned. The difference in RPA diameters will mean some scan lines will be outside these locations.**

The Hosegood investigations consisted of a series of strips formed by overlapping lines on both sides of the Gardens. They started 500mm from the trees and moved outwards to a distance of approximately 12.0 metres. Mr Mackworth-Praed uses the distances to show the lines are within his RPAs.

The overlay Mr Mackworth-Praed has produced is based on his RPAs, which in my opinion are incorrect.

##### **3.1.3 This is a copy of the Sharon Hosegood conclusions dated 23<sup>rd</sup> March 2018. Sharon Hosegood does not include any arboricultural analysis of her data, whereas Canopy Consulting do.**

Note that the conclusions do not relate to specific trees, or specific numbers and sizes. They mainly cover the depths at which roots are present through the whole width and length of the investigations, and the density of roots present. She concludes that the rooting is typical for the species, and that the structural integrity of the roots and their function should be preserved.

It is relevant to note that the results would be in line with the research carried out by Dr Martin Dobson, especially when considering the very high densities of roots within the top 10cm of the soil on the western side of the site. The invasive investigation carried out by Canopy Consulting resulted in the severance of these roots to enable checking the soil at lower levels.

The Hosegood investigations on the eastern side of the site were also broadly in line with Dr Dobson's research.

I agree that the results indicate rooting has taken place in a typical manner.

- 3.1.4 This discusses the investigations Canopy Consulting carried out in September 2018. It identifies the numbers of trenches, and their positions in relation to the siting of the building, plus the locations of roots and their dimensions.

It is important to note that the Head of Arboricultural Services attended the investigations, and was quite happy with the method of excavation utilised, i.e. invasive where roots were severed; she even sanctioned the use of a mini-digger.

Where possible the investigations were carried out to a depth of 1000mm, and as mentioned above involved the severance of some roots within the trenches. I fail to see how roots could be avoided using a mini-digger.

The observations section of the report identifies that the majority of roots were found between 600mm and 1000mm, which was to be expected, and corresponds to the research of Dr Dobson. However, it also identifies that low numbers of fibrous roots were found at various depths. This is significant as they are where the vast majority of available moisture would be expected, indicating that the main area of fibrous roots would be closer to the trees. This is not in contradiction with the Hosegood report.

Trenches 1-6 were excavated along the western side of the site, and the report identified that they encompassed the theoretical RPAs of 13 trees, with a total of only twelve roots with diameters greater than 2.5cm. Only 8 with roots of 50mm, and 1 root of up to 100mm.

Mr Mackworth-Praed states that "The remaining 60% of roots uncovered are deemed to be significant. Their size suggests they are likely to be the start of a substantial rooting area used for the uptake of water and nutrients." This is incorrect, as they would actually be a continuation of the rooting area. The majority of feeding roots would be close to the tree, not necessarily at the extremities of the roots.

Mr Mackworth-Praed's assertion is in reality academic, as British Standard 5837 allows the severance of all roots, of whatever size, to be severed outside their theoretical

root protection area. If his assertion were correct, which I do not agree with, it would mean that the British Standard sanctions the severance of extensive roots. I do not believe the British Standard accepts the severance of large quantities of significant roots; it goes against the main tenet of the Standard.

The data show that on average each tree had only 1 root over 25mm diameter. The severance of these roots would have no medium-term influence on any of the trees, in any event, as they would be regenerated rapidly.

Trenches 7-11 along the eastern side identify they encompass the RPAs of 8, possibly 9 trees, with a total of only 14 roots over 2.5cm, and only 8 roots of 50mm or over. Only four roots had diameters of 50mm.

The data show that on average each tree had only 1.75 roots over 25mm diameter. The severance of these roots would have no medium-term influence on the trees.

Mr Mackworth-Praed has not carried out an analysis of the report conclusions, or the risk of the trees being harmed if the roots over 25mm were severed.

- 3.1.5 The companion report of Sharon Hosegood dated the 1<sup>st</sup> of November 2018 consisted of a re-analysis of the original data, based on updated software. This is normal practice for the use of any equipment, not just ground radar. The results were amended, and Mr Mackworth-Praed has asserted that they are unreliable.

The amended findings identify low densities along the building line, which corresponds with the findings of the Canopy Consultancy excavations. Therefore, the low rooting density at further distances from the London Plane trees is confirmed when the actual data and results of both the non-invasive root radar as well as invasive air-spade investigations are compared. The findings themselves are not contradictory and correlate well.

It should also be noted that it would appear that Mr. Mackworth-Praed did not carry out any detailed analysis of the data and findings which corresponded with each other, but extrapolated individual text, commentary and opinions from the arborists which did contradict with each other. This is why the Bartlett's Impact Assessment must be read as the over-riding document. Mr. Mackworth-Praed is also silent on whether the root pruning as identified by Bartlett would be harmful to the trees.

I note that Mr Mackworth-Praed does not carry out any detailed analysis of the data, and does not identify if the severance of the roots would be harmful.

- 3.1.6 This quotes the conclusions of the third report produced by Sharon Hosegood. Mr Mackworth-Praed acknowledges that Ground Engineering Ltd carried out a borehole and trial pit investigation in a number of locations within Victoria Tower Gardens. He does not appear to carry out an analysis of their findings, presumably because he accepts them.

Sharon Hosegood submitted a third report, dated the 7<sup>th</sup> of June 2019. The conclusions of the report indicate that most roots are within a depth of 1.2 metres, but accepts that

some roots will probably be present down to a depth of 2.0 metres, based on one trial pit. The results are in line with the excavations carried out by Canopy Consulting.

- 3.1.7 Mr Mackworth-Praed uses printed results of the reports to identify a number of inconsistencies. The range of depth of roots in the Canopy Consulting report was between 600mm and 1000mm, which are in line with the Hosegood findings.
- 3.1.8 There is a difference between the various Hosegood reports. However, this is to be expected when new, improved analytical software is introduced. The point about the roots being blown away by the air-spade investigations in the upper horizons is probably incorrect, as Canopy Consulting severed extensive roots with diameters of up to 25mm during their investigations. I see nothing wrong with Sharon Hosegood accepting that some roots would be beneath 2.0 metres depth. It provides a realistic appraisal and does not contradict any other findings.
- 3.1.9 There was no surface level of compaction as described in the Canopy Consulting report. The top 200mm of soil was described as being topsoil. Between 200mm and 800mm the soil was described as compacted infill comprising small scale aggregate, clay and soil. From 800mm to 1000mm it was described as loose infill material comprising ash, dry soil and sand.

Soils Engineering Ltd carried out site investigations, and their results were incorporated in the MOLA report dated May 2029.

I attended the site at the time of the Soil Engineering investigations, and saw no layer of compacted soil, i.e. with a bulk density that would prevent tree root growth. It should be noted that high bulk density clays are used to cap landfill sites, and are of such density that moisture and oxygen cannot penetrate. That is why piping on such sites is incorporated to allow for the removal of methane gas. The soil profile of the Victoria Tower Gardens site showed no signs of an equivalent soil structure.

The soil description of trial pit 1 described the “Park soil” to be 1.0 metre thick. The other excavations identified it to be between 1.1 metre, and 750mm thick. A layer of firm mid brown clay (0.30 m thick) was recorded at 1.25 below ground level, followed by a deposit of dark yellowish-brown sand (0.20m thick) at 1.0 metre below ground level.

At no point do the descriptions of the soil profiles suggest that the soil was compacted to the point where root development could not occur, i.e. there was no mention of any high bulk densities.

Mr Mackworth-Praed states that “looser” bulk density was observed below 60cm. What he is actually attempting to claim is that the bulk density of the soil was “reduced” below 60cm, which would clearly make the topsoil shown in the various pits of the Soils Engineering report to be compacted. This is not true.

The root plan view from trial pit TPO1 of the MOLA report show the depths and diameters of the roots identified within the trial pit. The roots are shown throughout the profile.

Mr Mackworth-Praed claims the majority of roots would be below 60cm, which is what would be expected for normal tree root growth. The majority would be between ground level and 1.0 metre.

Mr Mackworth-Praed has consistently attempted to assert that it is unacceptable to offset sections of the RPAs, claiming there is no contiguous room to compensate. This is incorrect, as the trees form continuous rows, with overlapping root systems.

- 3.1.10 Citing his opinion on the conflict of investigation results, Mr Mackworth-Praed concludes the investigations are of limited usefulness. I consider there to be no conflict in the investigations, and that they are informative.

In my opinion, the critical issue in this item is where Mr Mackworth-Praed states that such investigations should not be carried out because they are not specified in BS 5837. This means that he would not have accepted them in any event, as he states they do not comply with the British Standard. They are actually compliant.

What Mr Mackworth-Praed fails to accept is that the British Standard actively encourages the use of investigations. The use of simplistic RPAs should only be utilised when site investigation data are unavailable. They should not be used to override actual investigations. Every tree officer I know, including the Westminster City Council Head of Arboricultural Services, accepts soil investigations as being valid to identify the presence, depths and density of roots, which Mr Mackworth-Praed's theoretical two-dimensional RPAs cannot do.

Mr Mackworth-Praed cites page 14 of the Arboricultural Impact Assessment addendum. The investigations were practical, not theoretical, and the results did provide "real-life" information in relation to the distribution and morphology of the tree root systems. Mr Mackworth-Praed has not mentioned that the theoretical RPAs do not take into consideration the numbers, depths and diameters of roots; they are simply circular, or modified shapes showing the possible extent, not density of roots. At best they can only provide a guess as to where roots may be.

Bartlett is correct in that the calculation for determining the RPAs, as set out in the British Standard, is not based on any scientific research, but is an artificial construct. In real terms this means that RPAs should not be used rigidly, but used as a guide, when no investigation data are available.

- 3.1.11 This is where Mr Mackworth-Praed states there is no flexibility allowed in BS 5837, and that the investigations should not have been carried out, which in my opinion is nonsense. He just does not accept that the RPA calculations are theoretical and cannot be precise.

I refer to my discussion covering item 3.1.10 above.

## **3.2 Conclusions**

- 3.2.1 This is incorrect, as Mr Mackworth-Praed has placed too much emphasis on his theoretical RPAs. He fails to accept that they should only be used when site

investigation data are unavailable, and that they do not provide information covering density and soil volume.

3.2.2 Mr Mackworth-Praed claims that Bartlett incorrectly, and inappropriately, represented their RPAs as circles along the western side, making the claim that it would be impossible for roots to be beneath the carriageway of Millbank. Mr Mackworth-Praed failed to address the root-related issues of the trees along Millbank. Bartlett did not include all of the trees, as they explain in their report.

3.2.3 Once again, Mr Mackworth-Praed bases this on his RPAs. Each of the identified potential adverse effects were addressed by Bartlett, and adequate mitigation was proposed. No over-reliance was placed on the pruning of roots.

Mr Mackworth-Praed is incorrect in his assertion that no available contiguous compensatory rooting volume is available. The trees are growing in two separate lines on opposite side of the site. There are no physical barriers between the trees within the rows. There is ample contiguous volume in a north-south direction. His theoretical RPAs would not have identified the volume available for the growth of the roots. He places emphasis on the use of BS 5837, but does not address the clear limitations of using the British Standard, especially for the trees growing along Millbank.

3.2.4 The Construction Management Plan takes the Arboricultural Impact Assessment and BS 5837 as its guiding principles with respect to tree protection, vehicle management and protection to damage of trees roots through compaction. No tree loss (other than the small trees at the northern end) is required for the development to go ahead. The proposal has always been to retain the planes in situ.

The impact of all of the works around the trees has been addressed, and where necessary mitigation has been proposed. Although the project does not require any significant works within the theoretical RPAs, the pictures of developments included in my report, and sanctioned by Westminster City Council, show that planes are quite capable of works being carried out in their theoretical RPAs, and that they can withstand extensive root severance when necessary.

3.2.5 The extensive investigations, and suggested mitigation, will prevent damage occurring to the planes. The trees are healthy, and will be capable of rapidly regenerating healthy new growth. All risks have been set out in the Arboricultural Impact Assessment and evaluated. Bartlett do not consider they are of sufficient extent or degree to result in significant harm or loss as a result of decline and dieback induced by the effects of the construction.

3.2.6 This is just covering him; so that he can have a second chance to address additional issues.

### **Appendix 1 – Tree Schedule**

This is a basic 5837 schedule. The important points are the BS 5837 category ratings of “A” and “B” indicate the health, and safe life expectancy of the trees, and the trunk diameters are all rounded to the nearest 10mm, which is significant as emphasis is

placed on them in item 1.6.4 of the report. They clearly show the measurements are not precise. No allowance has been given in the calculations for the rounded data.

### **Appendix 2 Tree Constraints Plan**

Plan showing the calculated RPAs of the trees, with a cut-off at the edge of the carriageway, and River Thames boundary wall. There is no allowance made for the possibility of the RPAs being rectangular in a north-south direction which would reduce the radius of the RPA on the development side of the trees.

### **Appendix 3 – Tree Impact Plans**

The impacts are based on their incorrectly calculated RPAs.

### **Appendix 4 – Tree Impact Schedule**

Once again, these are based on their incorrectly calculated RPAs.

### **Appendix 5 Tree Impact Bar Charts**

As 3 and 4 above.

**Appendix 6** - List of documents considered.

### **Appendix 7**

No comment.