

THE SPINNEY
HIGH ROAD
ESSENDON

ARBORICULTURAL
IMPACT
ASSESSMENT &
METHOD STATEMENT

ACD
ENVIRONMENTAL

Ecology
Archaeology
Arboriculture
Landscape Architecture

for

LIME
INTERIORS

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Date:	07/03/2016
Revision:	
Ref:	PRI19764aia_ams

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1. Executive Summary

- 1.1. The site is a single residential address covering approximately 2 acres. There is a single detached house with access via a gravel driveway. The proposal is for the demolition of the existing detached dwellinghouse (Use Class C3) and construction of two new architect-designed dwellinghouses (Use Class C3).
- 1.2. This impact assessment is intended to evaluate the direct and indirect effects of the proposed design on the trees on site, and where necessary recommends mitigation.
- 1.3. The development proposals are in accordance with BS5837:2012 'Trees in relation to design, demolition and construction – Recommendations'. Adequate protection can be provided to ensure all retained trees are protected throughout development in the form of barriers and/or ground protection.
- 1.4. With the exception of T9, a B category Beech tree, all of the A and B category trees are to be retained and protected throughout the development. In mitigation for the removal of T9 a replacement Beech tree will be planted in a position where it can achieve full size.
- 1.5. All of the trees proposed for removal are in the lower two categories, C and U. These are small fruit trees, and Hawthorn trees which are not of a quality that should represent any constraint to development. The trees removed will be mitigated for with replacement planting on a one for one basis of native trees.
- 1.6. Where proposed new hard surfaces encroach into the RPA of trees highlighted for retention, sensitive surface construction will be required.
- 1.7. The site layout has been assessed in terms of shading and future pressure to prune. Given the orientation of the site, and the relationship between the proposed buildings and the retained trees, the juxtaposition is viable for long-term tree retention. T1 - T8 will cast shade on the proposed house. However these are Common Lime trees which tolerate pruning well, and there would be a number of pruning options available should any be required, as part of any future management on the site.
- 1.8. The Arboricultural Method Statement (AMS) has been compiled in conjunction with the Tree Protection Plan (TPP) for the purpose of feasibility and planning, as per Figure 1 of BS5837:2012. These detail any mitigation which will be necessary to ensure the protection of retained trees throughout the development.

2. Introduction

- 2.1. ACD Environmental was instructed in March 2016 to prepare the following Arboricultural Impact Assessment and Method Statement . Reference should be made to the appended Tree Protection Plan (PRI19764-03).
- 2.2. This Method Statement is to be made available to all operatives on site during the construction process, so that they understand the scope and importance of the measures set out for tree protection. Implementation of the protection methods and other details within this report are integral to ensuring protection for the retained trees.
- 2.3. For details of trees to be retained, and locations and types of special protection methods, reference should be made to the latest revision of Tree Protection Plan (ref: PRI19764-03), which should be displayed prominently on site for all staff to see.
- 2.4. To ensure accuracy and avoid future costly adjustments, the Tree Protection Fence and Ground Protection must be set out by a surveyor with all node points being marked clearly on site for the fencing contractor to work to. The autocad version of the Tree Protection Plan is available on request.
- 2.5. This report is based on the recommendations given in BS5837:2012 'Trees in relation to design, demolition and construction – Recommendations'.
- 2.6. Trees on the site are subject to Tree Preservation Order by Welwyn Hatfield Borough Council reference TPO03 W4. For details of the area included see Appendix 3 below.
- 2.7. The controlling authority is Welwyn Hatfield Borough Council who can be contacted at: The Campus, Welwyn Garden City, Hertfordshire, AL8 6AE.
- 2.8. Any questions relating to the content of this report should be directed in the first instance to: ACD Arboriculture, Courtyard House, Mill Lane, Godalming, Surrey GU7 1EY, 01483 425 714/07796 832 490, quoting the site address and report reference number.
- 2.9. The following abbreviations have been used throughout this document:
 - Root Protection Area – RPA
 - Construction Exclusion Zone- CEZ
 - Tree Protection Plan – TPP
 - Tree Protection Fencing – TPF

3. Arboricultural Impact Assessment

- 3.1. The site is a single residential address covering approximately 2 acres. There is a single detached house with access via a gravel driveway. The proposal is for the demolition of the existing detached dwellinghouse (Use Class C3) and construction of two new architect-designed dwellinghouses (Use Class C3).
- 3.2. The site also has significant permitted development rights for several extensions and outbuildings under permitted development rights (see Welwyn Hatfield Council ref (S6/2015/1203/HH) as well as a Certificate of Lawfulness (see Welwyn Hatfield Council ref S6/2015/0727/LUP). This permission extends across the site and foundations for one of the outbuildings are currently underway.
- 3.3. This impact assessment is intended to evaluate the direct and indirect impacts on the trees on the site in relation to the proposed development. Any potential tree impacts are identified as per BS5837:2012 section 5.4, and details are given of proposed mitigation.
- 3.4. Any potentially damaging activities proposed in the vicinity of retained trees are identified, such that mitigation to significantly reduce or avoid this impact can be detailed in the Arboricultural Method Statement and Tree Protection Plan as recommended in BS5837:2012 section 5.4.2.
- 3.5. The development proposals are in accordance with BS5837:2012 'Trees in relation to design, demolition and construction – Recommendations'. Adequate protection can be provided to ensure all retained trees are protected throughout the development.
- 3.6. The tree survey for the site is at Appendix 2 of the Tree Report for the site ACD reference PRI19764.
- 3.7. This assessment is based upon the supplied layout drawing by Chassay Studio Drawing Number 1511-A-20 rev A dated 23.02.2016.
- 3.8. **Evaluation of impact of proposed tree losses**
 - 3.8.1. Those trees which are to be removed are shown with a red dashed canopy outline, on the Tree Protection Plan ACD reference PRI19764-03.
 - 3.8.2. Care has been taken with the design proposals to design around the constraints represented by the higher category trees.
 - 3.8.3. One B category Beech tree T9 is proposed for removal. This is from a total of 36 B category trees included in the tree survey. Excepting this tree all of the A and B category trees are to be retained and protected throughout the development. In mitigation for the removal of T9 a replacement Beech tree will be planted in a position where it can achieve full size.
 - 3.8.4. 27 C category trees are proposed for removal. These include a number of small fruit trees, which have some value in their garden context, but are readily replaceable.

20 of the C category trees to be removed are from G3. These are of low individual quality, with sparse crowns for their age and species. They are located within the interior of the site and have limited significance in the wider landscape. They are not of a quality that should represent any constraint to development. The trees removed will be mitigated for with replacement planting on a one for one basis with native species trees.

- 3.8.5. In support of the development proposals, BS5837:2012 section 5.1.1 states: The constraints imposed by trees, both above and below ground should inform the site layout design, although it is recognised that the competing needs of development mean that trees are only one factor requiring consideration. Certain trees are of such importance and sensitivity as to be major constraints on development or to justify its substantial modification. However, care should be taken to avoid misplaced tree retention; attempts to retain too many or unsuitable trees on a site can result in excessive pressure on the trees during demolition or construction work, or post-completion demands for their removal.
- 3.8.6. It is therefore deemed acceptable to remove the listed trees and, as part of the detailed landscape design for the scheme, include suitable and sustainable replacements as and where appropriate.
- 3.8.7. Within the site further tree removals are proposed as good arboricultural practice. These trees are 4 U category trees which are in poor condition, and with limited life expectancy. This work could be carried out as part of good property maintenance, regardless of any development on the site.

3.9. **Trees to be pruned**

At this time tree surgery works are not anticipated (excluding tree removals). Should any become necessary it should comply with BS3998:2010 Tree Work or more recently accepted arboricultural good practice, and be approved by the LPA and project arboriculturist prior to any commencement.

3.10. **Protection for retained trees**

BS5837:2012 section 6.2.1. states: 'All trees that are being retained on site should be protected by barriers and/or ground protection (see 5.5) before any materials or machinery are brought onto the site, and before any demolition, development or stripping of soil commences. Where all activity can be excluded from the RPA, vertical barriers should be erected to create a construction exclusion zone. Where, due to site constraints, construction activity cannot be fully or permanently excluded in this manner from all or part of a tree's RPA, appropriate ground protection should be installed (see 6.2.3).' As such, protection for all retained trees is shown on the Tree Protection Plan according to this specification.

3.11. **Barriers**

BS5837:2012 figure 2 recommends a default specification for protective barrier. This is a weld mesh panel design, mounted upon a well braced scaffold framework. This is perfectly adequate for this site where there are to be areas of high intensity

development. Given the scale of the site, where it is likely there will be much lower pressure in terms of construction activity, it is suggested that 1.2m chestnut pale fencing (or similar) clearly indicated as Tree Protection Fencing by signage would be entirely adequate. All tree protection fence should be erected before any works start on site whatsoever.

3.12. **Ground protection**

To allow construction access between the two halves of the site, the existing driveway can be used. This is within the RPAs of trees T1 - 3 and is currently a gravel drive. To ensure there is no unnecessary compaction of the soil or rutting from heavier construction vehicles, the use of ground protection as specified in BS5837:2012 section 6.2.3 is detailed in the Arboricultural Method Statement and indicated on the Tree Protection Plan.

3.13. **Demolition**

To ensure damage does not occur to trees highlighted for retention, tree protection fencing must be erected prior to ANY plant machinery entering site whatsoever. This should be subject to a pre-commencement site meeting between the developer, their project arboriculturist and a representative from the Local Authority. No special demolition procedures need be observed on this site, other than respecting the tree protection fencing.

3.14. **New Hard Surfaces within RPAs**

- 3.14.1. In order to minimise impact on the trees where the proposed footpath is proposed in the RPAs of T3 and T4, sensitive surface construction will be required in the form of a no-dig surface. It is anticipated that using no dig surface means that installation of permanent hard surface in this area is unlikely to cause significant adverse impact on the trees to be retained.
- 3.14.2. As per the recommendation of BS5837:2012 section 7.4.2.3, the new permanent hard surfacing does not exceed 20% of any existing unsurfaced ground within the RPA.
- 3.14.3. To avoid root damage, a no-dig approach must be taken, limiting the impact on the trees:
- 3.14.4. The use of a three dimensional cellular confinement system, such as 'Cellweb' is an acceptable approach, which aims to fulfil the above design criteria. This system maintains the passage of oxygen and water to root systems; avoids root loss through severance or asphyxiation and minimises the potential for soil compaction. It is achieved by laying a Geotextile membrane directly onto unchanged soil levels, with a three dimensional cellular confinement system ('Cellweb') laid on top filled with no fines granular fill, with a porous finishing surface. See specification on Tree Protection Plan (PRI19764).

- 3.14.5. Retained trees must first be protected during all stages of the development including demolition, by the erection of fencing as specified on the Tree Protection Plan (TPP). Installing the surface may require the re-positioning of the tree protection fencing to a secondary location in line with and associated method statement.
- 3.14.6. The area must be protected during all stages of the development including demolition, by ensuring the surface is installed, with a sacrificial tarmac surface (or trackway) if required, prior to any construction or demolition traffic entering the site.
- 3.14.7. The Arboricultural Method Statement describes installation of a typical no-dig surface. This follows the recommendations set out in Section 7.4 of British Standard 5837:2012. The author of this report is not an engineer and therefore detailed engineering design and analysis must be carried out by a suitably qualified engineer. However, any design must be approved for use by the project arboriculturist.

3.15. **Construction within RPAs**

It is confirmed that there is no construction proposed within the RPAs of retained trees.

3.16. **Shade and future pressure to prune**

- 3.16.1. The site layout has been assessed in terms of shading and future pressure to prune. Given the orientation of the site, and the relationship between the proposed buildings and the retained trees, the juxtaposition is viable for long-term tree retention, and it is considered that shading by trees is unlikely to be a concern to future residents. As a result, it is considered unlikely that there would be any undue pressure to remove trees, or excessively prune from any future occupants.
- 3.16.2. Both houses are set in large gardens where there will be a choice of full sunshine, and shade, at different times throughout the day.
- 3.16.3. T1 - T8 will cast shade on the proposed house. However these are Common Lime trees which tolerate pruning well, and there would be a number of pruning options available should any be required, as part of any future management on the site. The trees are deciduous, and are not in leaf between the end of September and mid May (BRE350 1990 Figure 17) i.e. in the winter months when there is more of a requirement for natural light.

3.17. **Services**

It is fundamental to tree protection that infrastructure design is sensitively approached, as trenching close to trees may damage roots and affect tree health and stability. Details of services have not been provided at the time of writing. The Tree Protection Plan, showing the constraints posed by retained trees will be passed to the infrastructure engineers to inform their design, ensuring that all services avoid areas of potential conflict. As per BS5837:2012 Figure 1, once further details become

available as part of the detailed/technical design for the site, the TPP and AMS will be revised to incorporate these details for services for inclusion in the Tender documentation.

3.18. Levels and Landscaping

Full details of any changes in ground levels on site remain to be finalised. Any alterations to levels close to trees may damage roots and affect tree health and stability. Unless no-dig methodology is proposed for installation of surfaces within RPAs the original levels in these areas must be noted, retained, and integrated into the engineering design of the site. Landscaping operations within the RPAs of retained trees must be carried out in a sensitive manner and be subject to a detailed method statement and arboricultural supervision.

3.19. Boundaries

All plot boundaries will need to be designed, positioned and installed to avoid damage to retained trees. When within RPAs, this will include hand excavation of all post holes, and the lining of any post holes with a non porous membrane to stop leachates from the concrete damaging tree roots.

4. Arboricultural Method Statement

**TO BE READ IN CONJUNCTION WITH THE APPENDED TREE PROTECTION
PLAN REFERENCE: PRI19764-03**

4.1. Phasing of operations for tree protection

4.1.1. Implementation of tree protection measures on the site must be carried out in the following order

- 1) Tree removals and access facilitation pruning
- 2) Accurate erection of tree protection measures
- 3) Site accessible to construction/demolition traffic
- 4) Demolition/site clearance
- 5) Construction
- 6) Removal of tree protection fencing
- 7) Remedial tree surgery
- 8) Sign-off visit from project arboriculturist.

4.1.2. The above phasing must not be changed without approval from the project arboriculturist and agreement with the Council.

4.2. Restrictions within tree protection areas

4.2.1. Inside the exclusion area of the fencing, the following shall apply:

- No mechanical excavation whatsoever
- No excavation by any other means without arboricultural site supervision
- No hand digging without a written method statement having first been approved by the project arboriculturist.
- No lowering of levels for any purpose (except removal of grass sward using hand tools)
- No storage of plant or materials
- No storage or handling of any chemical including cement washings
- No vehicular access
- No fire lighting

4.2.2. In addition to the above, further precautions are necessary adjacent to trees:

- No substances injurious to tree health, including fuels, oil, bitumen, cement (including cement washings), builders sand, concrete mixing and other chemicals shall be stored or used within or directly adjacent to the protection area of retained trees
- No fire shall be lit such that flames come within 5m of tree foliage.

4.3. **Avoiding damage to stems and branches**

- 4.3.1. Care shall be taken when planning site operations in proximity of retained trees to ensure that wide or tall loads, or plant with booms, jibs and counterweights, can operate without coming into contact with retained trees. Such contact can result in serious injury to them and might make their safe retention impossible.
- 4.3.2. Consequently, any transit or traverse of plant in proximity of trees shall be conducted under the supervision of a banksman, to ensure that adequate clearance from trees is at all times maintained. In some circumstances, it may be impossible to achieve this without pruning works known as 'access facilitation pruning'.
- 4.3.3. Access facilitation pruning shall be kept to the barest minimum necessary to facilitate development and shall be carried out in strict accordance with the guidance below (Tree Surgery). Under no circumstances shall construction personnel undertake any tree pruning operations.

4.4. **Tree protection fencing**

- 4.4.1. The Tree Protection Plan (see the latest revision of: PRI19764-03) shows the alignment of Tree Protection Fencing (TPF), which is to be installed prior to any of the following taking place:
- Demolition
 - Plant and material delivery
 - Soil stripping
 - Utility installation
 - Construction works
 - Landscaping
- 4.4.2. Stages for installation of TPF:
- 1) Hand clearance of any vegetation to allow clear working access.
 - 2) Setting out of fencing points
 - 3) Fencing erected
 - 4) Site accessible to demolition/construction traffic
- 4.4.3. To ensure accuracy and avoid future costly adjustments, the Tree Protection Fence must be set out by a surveyor with all node points being marked clearly on site for the fencing contractor to work to.
- 4.4.4. Once erected, all TPF will be regarded as sacrosanct, and will not be removed or altered without prior recommendation by the project arboriculturist and approval of the local planning authority.
- 4.4.5. The typical TPF construction is suitable for areas of high intensity development, and shall comprise of interlocking weld-mesh panels, well braced to resist impacts by attachment to a scaffold framework that is set firmly into the ground. A detailed specification can be found on the TPP.

- 4.4.6. Should any alternative method of barrier construction be proposed, consultation with the project arboriculturist will be obtained to clarify the efficacy of the revised design prior to informing the local planning authority and obtaining their consent.
- 4.4.7. Once the exclusion zone has been protected by barriers and/or ground protection, construction work can commence.
- 4.4.8. All weather notices should be erected on the barriers (for example see figure below).



Figure 1: Tree Protection Sign (digital copies available for download at: www.acdarb.co.uk)

4.5. Ground protection

- 4.5.1. The specification for Ground Protection is shown on the Tree Protection Plan. Any alternative specification to be installed must be capable of supporting the expected loads and avoiding rutting, compaction and damage to the soil. As advised in BS5837:2012 section 6.2.3:
- 4.5.2. New temporary ground protection should be capable of supporting any traffic entering or using the site without being distorted or causing compaction of underlying soil. The ground protection might comprise one of the following:
- for pedestrian movements only, a single thickness of scaffold boards placed either on top of a driven scaffold frame, so as to form a suspended walkway, or on top of a compression-resistant layer (e.g. 100 mm depth of woodchip), laid onto a geotextile membrane;

- b) for pedestrian-operated plant up to a gross weight of 2 t, proprietary, inter-linked ground protection boards placed on top of a compression-resistant layer (e.g. 150 mm depth of woodchip), laid onto a geotextile membrane;
- c) for wheeled or tracked construction traffic exceeding 2t gross weight, an alternative system (e.g. proprietary systems or pre-cast reinforced concrete slabs) to an engineering specification designed in conjunction with arboricultural advice, to accommodate the likely loading to which it will be subjected.

4.5.3. Stages for ground protection installation¹:

No plant machinery to be used in the area of ground protection for whatever reason

- 1) Dismantle primary TPF and re-erect in secondary location as shown on TPP
- 2) Any shrubs, saplings or trees to be removed, are to be cut, or ground out to just below ground level rather than grubbed or winched out, which can damage roots of retained trees.
- 3) Lay woven geotextile over existing ground surface by hand
- 4) Cover the area with compressible layer, woodchip for example, using hand tools only
- 5) Cover compressible layer with side butting scaffold boards or plywood boards
- 6) Confirm surface is acceptable for use with project arboriculturist
- 7) Area ready for construction access

4.5.4. To ensure accuracy and avoid future costly adjustments, the Ground Protection must be set out by a surveyor with all node points being marked clearly on site for the fencing contractor to work to.

4.5.5. There is to be no-excavation within ground protection area whatsoever. This includes installation of services and associated utilities.

4.6. **Site storage, parking, welfare facilities**

4.6.1. The site will require provision for; site storage, contractor parking, welfare facilities, temporary services/drainage, material drop of points, etc.

4.6.2. No details of these provisions are available at the time of writing of this report.

4.6.3. None of the above provisions will be sited within RPAs of retained trees without the input or the project arboriculturist and the consent of the Local Authority.

¹For protection from foot traffic only

4.7. Tree surgery and removal

- 4.7.1. Those trees which are to be removed are shown with a red dashed canopy outline, on the Tree Protection Plan ACD reference PRI19764-03.
- 4.7.2. All trees to be removed are indicated on the Tree Protection Plan.
- 4.7.3. If any further surgery works are proposed, it will be submitted to, and approved by the council before being carried out.
- 4.7.4. All work will be carried out in accordance with BS 3998:2010 Recommendations for Tree Work, industry best practice and in line with any works already agreed with the Council.
- 4.7.5. The tree surgery contractor is responsible for carrying out any relevant health and safety risk assessment, and insurance, prior to any work being carried out.
- 4.7.6. The statutory protection afforded by the Wildlife and Countryside Act and Countryside and Rights of Way Act will be adhered to. If further advice is required, particularly if bats are discovered during tree work, it will be obtained from Natural England or other competent persons and recommendations adhered to.
- 4.7.7. The stumps of any trees removed from within the Construction Exclusion Zone or the RPAs of retained trees will be either; cut flush to ground level and left in situ or ground out using a stump grinder. They will not be winched out.
- 4.7.8. All operations shall be carefully carried out to avoid damage to the trees being treated or neighbouring trees. No trees to be retained shall be used for anchorage or winching purposes.

4.8. Soft landscaping within RPA

- 4.8.1. All landscaping and associated ground preparation within exclusion zones will be carried out sensitively to ensure root damage is mitigated as much as is practicable. At no time is any heavy plant to be used within any protected area. Removal of existing vegetation will be carried out by hand, turf may be removed using a mechanical turf stripper or by hand.

Turfing

- 4.8.2. Stages for turfing gardens and open spaces:

No plant machinery² to be used in the area for whatever reason

- 1) Remove TPF to allow access to area.
- 2) Do not reduce any high spots or excavate in any way.
- 3) Existing poor quality turf may be removed with a turf stripper.
- 4) Use good quality top-soil to level any low-lying areas and hollows, and provide a fine tilth to lay turf on. This imported soil must not result in a level increase of more than 100mm in any area.
- 5) Import turves by hand in wheelbarrow
- 6) Lay turves

Planting

- 4.8.3. Should the soil be compacted or have a poor structure which may hinder the development of any new planting, soil decompaction techniques may be used upon consultation with the project arboriculturist.

- 4.8.4. Stages for planting within tree protection areas:

No plant machinery to be used in the area for whatever reason

- 1) Remove TPF to allow access to area.
- 2) Remove existing vegetation by hand, turf may be removed using a mechanical turf stripper.
- 3) Do not reduce any high spots or excavate in any way.
- 4) Import good quality top-soil by hand (with wheelbarrow) into area.
- 5) Level to a depth of no more than 100mm with hand tools
- 6) Dig individual planting pits for each plant by hand (including hedging which must not be trench planted)
- 7) Any mulch should also be imported and spread by hand.

- 4.8.5. No works will be carried out within any protected areas if the soil moisture is of a level likely to allow compaction to occur.

² Including rotovators

4.9. Installation of underground services within RPAs

4.9.1. If for whatever reason installation within RPAs is required the project arboriculturist and local authority must be notified prior to any tree protection barrier removal and the following details adhered to.

4.9.2. Stages for installing services within tree protection areas:

No plant machinery to be used in the area for whatever reason

- 1) Contact project arboriculturist to hold pre-start site meeting and 'toolbox' talk before starting work
- 2) Remove just enough tree protection fencing to allow access to area and facilitate trenching
- 3) Remove any surface vegetation or existing hard surfaces using hand tools
- 4) Using an air-pick excavate the trench, keeping to minimum dimensions required.
- 5) If roots over 10mm diameter are encountered they will be retained, and kept damp by covering with hessian (re-wetted as required)
- 6) Feed in services
- 7) Back fill trench with 200-300mm depth of excavated soil, or a mixture of excavated and imported top-soil (to BS3882:1984), firming down with heels
- 8) Repeat step 7 until trench is filled.
- 9) Re-erect tree protection fencing as per approved plan

4.9.3. The method of excavation above, for trenching within RPA's, is using an 'air-pick' or similar. This tool utilises compressed air to remove soil from around tree roots causing minimal damage and can be run off a typical site compressor. ACD can provide details of contractors supplying Air-pick services if required.

4.9.4. Alternatively trenchless technology, such as thrust boring can be used in some instances and is particularly effective as it can pass directly under the tree, at a depth which is likely to avoid almost all impact on roots of the subject tree. As no access/thrust pits will be located within the RPAs of the subject trees, the need for arboricultural supervision is limited.

4.9.5. Reference can be made to National Joint Utilities Group publication Volume 4 (NJUG Vol4) for guidance, but any approach must be approved by the project arboriculturist and brought to the attention of the local authority tree officer.

4.10. No-dig footpath construction

4.10.1. To ensure that tree roots, within the ground under this proposed surface, continue to survive during and after construction a cellular system such a CellWeb (Geosynthetics Ltd, 01455 617139, www.geosyn.co.uk) of 75mm depth is to be used³.

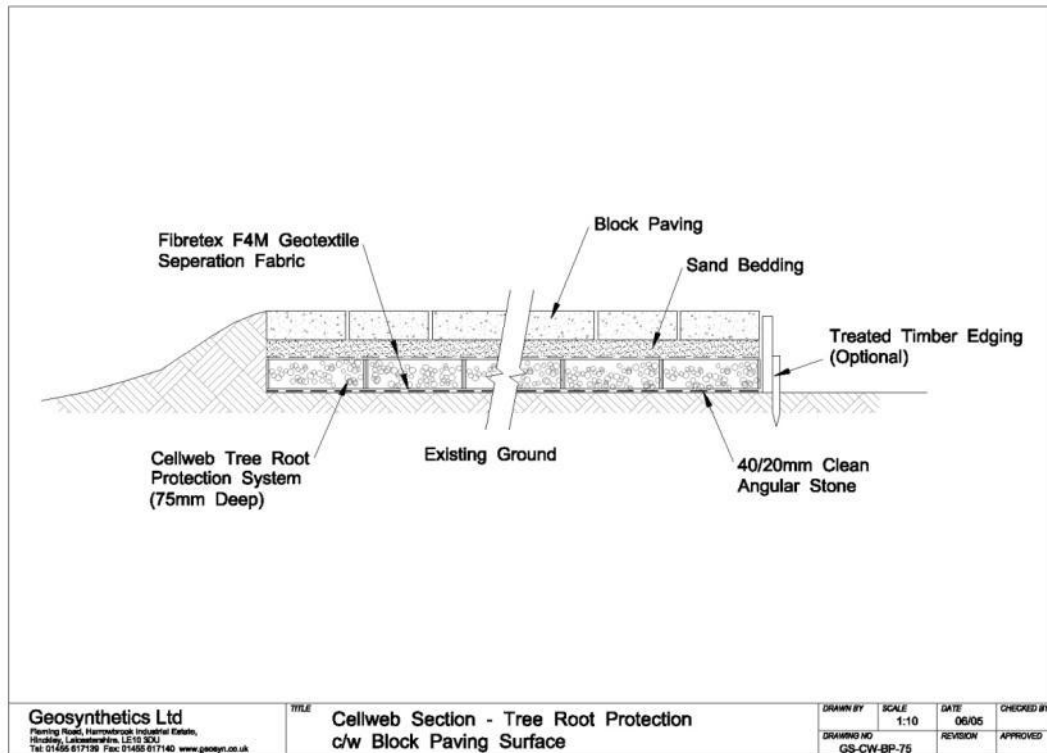


Figure 2 Cellular system profile

4.10.2. Stages for Installation of the cellular confinement surface:

- 1) Contact project arboriculturist to hold pre-start site meeting and 'toolbox' talk before starting work.
- 2) Dismantle TPF to allow access to protected area.
- 3) Remove existing vegetation by using a specific herbicide (as advised by a specialist) or manual removal with hand tools only. Agreed removal of shrubs, saplings or trees, within the protected areas of retained trees are to be cut, or ground out to just below ground level rather than grubbed or winched out, which can damage roots of retained trees.
- 4) Retain all original ground levels after vegetation removal. No excavation whatsoever.
- 5) Install a non-woven Geotextile (such as Fibretex F4M) directly over soil grade level (levelled where necessary, by non-compacted washed sand) and fix in place.

³This approach describes installation of a typical no-dig surface. The author of this report is not an engineer and therefore detailed engineering design and analysis must be carried out before installation.

- 6) Lay the cellular system over the Geotextile, which is secured open under tension during the infill process with steel staples or wooden pegs.
- 7) Install kerbs and edgings directly on top of existing soil grade level. For light structures, a treated peg and board may be acceptable. For more substantial structures, railway sleepers, haunched concrete with road pins, drilled kerbstones, gabions or cast in situ kerbs will be appropriate.
- 8) Fill the cellular system ensuring any plant machinery stands only on already filled areas. Typical infill consists of no fines angular granular material 20-40mm, which will remain un-compacted.
- 9) Install porous wearing surface.
 - Small Block Paving
 - Lay a second layer of Geotextile separation fabric over the infill.
 - Lay a sharp sand-bedding layer to recommended depth.
 - Place block paviors as per manufacturer's instructions.
 - Washed Gravel
 - Place second layer of Geotextile separation fabric over the filled cellular confinement system.
 - Place pea shingle/ gravel to required depth.
 - Porous Asphalt

4.10.3. Any variation to the above specification must meet the following design criteria for low-invasive surfaces to provide the conditions for continued tree survival and growth:

- Maintain oxygen diffusion through new surface to rooting area (5-12% by volume⁴)
- Maintain sufficient passage of water to the rooting area (12-40% by volume⁵)
- Maintain existing ground levels to avoid root damage (severance and/or asphyxiation)
- Avoid compaction by maintaining a soil structure sufficient to sustain root growth (soil bulk density below 1.4g/cc⁶)

4.10.4. Site analysis of the soil type and its structural characteristics will be required prior to determining the specific depth of products to be adopted, for example: footpaths normally require a depth of 75mm.

⁴ Tree Roots in the Built Environment 2006, Roberts Jackson Smith HSO

⁵ Tree Root Growth Requirements, Dr Kim. D. Coder, University of Georgia. July 2000

⁶ Arboriculture, Tree Management of Shade Trees and Vines 2004, Harris, Clarke, Matheny

4.11. Installation of boundary fencing within protected areas

4.11.1. Stages for installing wooden fence posts:

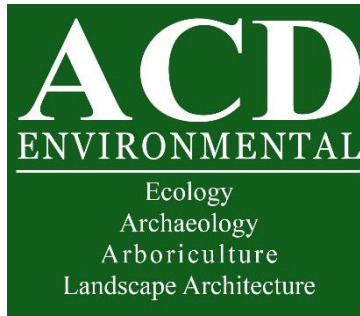
No plant machinery to be used in the area for whatever reason

- 1) Remove TPF to allow access to area.
- 2) Dig post holes using hand tools, avoiding damage to the protective bark covering larger roots. Roots smaller than 25mm diameter may be pruned back using either secateurs or a hand saw, leaving a clean cut.
- 3) Damage or severance of roots above 25mm diameter must be avoided. If roots of this size are discovered, the hole should be relocated. If there are a large number of such roots it may be necessary to relocate the hole by half a fence panels length and adjust the fence panels accordingly.
- 4) Line hole with non porous lining, for example durable polythene bag.
- 5) Insert post and fill post hole with concrete to ground level.
- 6) Trim polythene to ground level

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07 March 2016

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