Arboricultural Impact Assessment and Tree Protection
Scheme to BS 5837:2012

12 South Avenue, Coventry, CV2 4DR

Client: Mrs S McFadden
Author: Daniel Simpson M.Arbor.A HND.For
Date: 16th January 2016
Revision A
CONTENTS

PART 1- EXECUTIVE SUMMARY................................................................. 3
PART 2 - GENERAL INFORMATION.............................................................. 4
PART 3 - ARBORICULTURAL IMPACT ASSESSMENT................................. 7
PART 4 – TREE PROTECTION..................................................................... 10

APPENDIX I – THE AUTHOR

APPENDIX II – NOTICE FOR TREE PROTECTION BARRIERS

APPENDIX III – GROUND PROTECTION INFORMATION

APPENDIX IV – TREE PROTECTION PLAN
PART 1 - EXECUTIVE SUMMARY

Tree Survey

1.1 On the 30th April 2016 I carried out a tree survey. I recorded five individual trees and three groups of trees which are detailed in the tree survey report dated 5th May 2016.

Proposed Development

1.2 The proposal is to build a new dwelling with new access through an existing outbuilding and associated landscaping.

Arboricultural Impact Assessment

1.3 One group of trees is to be removed and some minor pruning to a single tree may be needed to facilitate construction. All the best quality trees are to be retained. Retained trees are to be protected. The arboricultural impact is relatively low if protection measures are adopted.

Tree Protection Scheme

1.4 Proposals for tree protection to mitigate identified impacts are provided including barriers, ground protection, special surfaces and arboricultural methodology.
PART 2 - GENERAL INFORMATION

The Author / Surveyor

2.1 My name is Daniel Simpson, details of my qualifications and experience can be found in Appendix I.

Revision

2.2 The previous version of this scheme showed the outbuilding demolished. Now this structure is retained the trees are better protected. Access through the existing building restricts size of vehicles that can be brought onto site and provides ground protection.

Brief From Client

2.3 To assess the impact of proposed development and provide a tree protection scheme for retained trees.

Documents Referred To

2.4 The British Standard Institute publication BS 5837:2012 ‘Trees in relation to design, demolition and construction - Recommendations’ is referred to throughout this report. This is a nationally recognised standard typically used by Local Planning Authorities (LPAs) to assess planning applications. It is frequently referred to in planning conditions to enforce protection or control of works that may be harmful to trees both on and off the site.

2.5 This document should be read in conjunction with my tree survey report dated 5th May 2016. Other documents received from the client and others working on the project are listed below:

- 186-02-00
- 186-02-01
- 186-02-30-P2
- 186-30-31-P2
- 186-30-32-P2
- 186-05-01-P1
- 186-05-31-P2
- 186-05-32-P2
Limitations

2.6 This report was prepared for use by our client in accordance with the terms of the contract and for planning purposes only. It is not a substitute for a tree condition, insurance, or mortgage service. Information provided by third parties used in the preparation of this report is assumed to be correct. The contents are copyright and may not be duplicated or used by third parties without the written consent of Tree Reports Ltd.

Printing

2.7 This report is compiled into a single pdf file designed for electronic release. If printing this document, please note that the plan drawings may be a different size or orientation to the standard A4 / portrait of the rest of the report. It is necessary to print plans at the full size for scaling.

Terms and Definitions

2.8 Arboricultural Method Statement – guidelines for specified working operations near trees to avoid any harmful impact as defined within BS 5837:2012. This can cover a range of works from tree work to operating cranes, installing foundations or services and guidelines for how special engineering must perform to function as a tree protection measure.

2.9 Conservation Area – an area of land designated through planning legislation, within which no tree above 7 centimetres stem diameter (at 1.3m above ground level) can be lopped, topped or removed without following a process of notifying the LPA. There are certain notable exceptions in the cases of dead or dangerous trees.

2.10 Ground Protection – in this context the term refers to a method for preventing the ground from being disturbed, usually within the Root Protection Areas of retained trees. Other uses include protection areas to be planted. The way ground protection should be designed to perform is typically described within an Arboricultural Method Statement.

2.11 Local Planning Authority – Typically a department of the local council that manages planning and protected tree issues.

2.12 Root Protection Area (RPA) – a minimum recommended area that should not be disturbed to ensure successful retention of retained trees described in ‘BS 5837:2012 Tree in Relation to Construction’. An RPA should be regarded as sacrosanct and in these areas development and construction works should be avoided where possible.
2.13 **Tree Preservation Order (TPO)** – a legal document that specifies certain trees for protection under the Town and Country Planning Act. It makes it necessary to make an application to the LPA to work on them (with notable exceptions). And a criminal offence to otherwise damage or destroy them.

2.14 **Tree Protection Plan** – as defined within BS 5837:2012. This shows (for example) the layout of the proposed development and protective measures for retained trees and trees to be removed. This is intended to be used for planning purposes and also as a reference on-site during development.
PART 3 – ARBORICULTURAL IMPACT ASSESSMENT

3.1 INTRODUCTION

3.1.1 BS 5837:2012 provides a methodology for determining the above and below ground constraints presented by trees on and adjacent to the site.

3.1.2 Typical risks to trees during construction include collision with stems and branches and the loss of rooting area. Trees are also at risk indirectly from construction activity such as ground compaction. Where trees are to be retained it is important to ensure their retention is sustainable by reducing the scope for future problems from root and branch growth.

The Proposed Development

3.1.3 The proposal is to divide the garden of an existing dwelling to construct a new dwelling. Access will be through an existing outbuilding and there will be associated landscaping.

3.2 OBSERVATIONS

Tree Works

3.2.1 Tree group G1 is to be removed and this contains only low value exotic conifers and a small apple tree. T2 may also be removed to facilitate construction. It is a category C trees and trees of this quality should not constrain planning according to BS 5837:2012.

Root Protection Areas

3.2.2 With G1 removed the footprint of the proposed dwelling is nor within the RPA of retained trees.

3.2.3 Due to the ground levels it should be possible to construct a non-dig surface to an arboricultural methodology to mitigate the potential impact on tree roots. This means roots will continue to thrive underneath the new surface. Effectively this means there is no loss of RPA.
Material and Equipment Storage

3.2.6 There is ample space in the rear garden for storage outside of root protection areas. Materials plant and equipment must not be stored within Root Protection Areas.

Above Ground Constraints

3.2.7 Retained trees must be protected with barriers to prevent collision. Work under the tree canopies and access will be needed. Therefore careful supervision of works where tree canopies are exposed are required.

3.2.8 Some minor pruning of the southern lower canopy of T1 may be required to facilitate construction. This would be less than 5% of the total canopy volume. Reduction of the longer branches to the South would help reduce pressure on the base of the tree, as the tree has a substantial lean to the south. There is no external sign at the moment that the tree sum is under dangerous amounts of stress. I do not consider the amount of work required to be a threat to the health and longevity of the tree.

3.2.9 The photograph below looking at T1 to the North shows how there is crown clearance in excess of 5 metres high to the edge of the tree crown to the East. Therefore access pruning is not required.
3.3 CONCLUSIONS

3.3.1 I see no reason why planning permission should not be granted as the overall impact is relatively low if the measures proposed in the next section are implemented.
PART 4 – TREE PROTECTION

4.1 GENERAL

Distribution

4.1.1 It is important to ensure everyone involved in the planning and design of the proposed development is aware of this report and has access to a copy as soon as it is released.

Responsibilities

4.1.2 Successful implementation of tree protection measures and long term tree retention depends on co-ordination between the project manager, site manager and other personnel involved in the development.

4.1.3 The project manager shall ensure that:

- the site manager and all other personnel are provided with this document;
- all planning conditions relating to underground works, services, trees and landscaping are cleared before development commences;
- all requirements of this Tree Protection Scheme are adhered to;
- the site manager is updated of any approved changes or variations to this document.

4.1.4 The project manager shall ensure that:

- a copy of this document with the plan in appendix V is easily accessible for site personnel to refer to before and during the time construction activity is taking place;
- all personnel working on the site are made aware of the tree protection plan and arboricultural method statements covering any activities they will undertake. This duty includes delegating the task of briefing personnel in the absence of the site manager.
- The tree protection measures remain in place until the construction phase of development is completed, except with the written consent of the LPA.
- site personnel are updated of any approved changes or variations to the approved tree protection measures.

4.1.5 All personnel must work in accordance with this document at all times, or in accordance with any subsequent approved variation.
Procedures for incidents

4.1.6 If any breach of the approved tree protection measures occurs:

☐ The Local Planning Authority Tree officer (or other Planning Officer) and Tree Reports Ltd shall be notified.
☐ The site manager must be informed immediately.
☐ Swift action must be taken to halt the breach and prevent any further breach.
☐ Damage mitigation measures appropriate to the scale of the incident will be deployed where required.

Prohibited Activities

4.1.7 The following must not be carried out under any circumstances:

☐ Cutting down, uprooting, damaging or otherwise destroying any retained tree.
☐ Lighting a fire within 10 metres of the canopy of any retained tree.
☐ Equipment, signage, fencing, tree protection barriers, materials, components, vehicles or structures shall not be attached to or supported by a retained tree.
☐ Mixing cement, chemical toilets and other use or storage of anything that would be harmful to trees shall not take place within, or close to a Root Protection Area (RPA). The distance away from the RPA must be sufficient, and the slope of the site must be such that contamination of soil in the RPA would not occur if there were spillage, seepage or displacement.
☐ No plant or equipment or vehicle with a hydraulic arm such as a mini digger shall be operated within striking distance of the stem and branches or the RPA of any retained tree unless otherwise specified in this report.

4.1.8 No alterations or variations shall be made to the approved tree protection measures without written approval from the LPA.

4.2 PROTECTIVE BARRIERS SPECIFICATION

Barriers

4.2.1 Barriers shall be installed and removed in accordance with the timing of operations above and laid out in accordance with the appended Tree Protection Plan. The barriers must be installed before any development commences and remain in-situ until the construction phase is complete. It shall not be moved or modified in any way at any time except in accordance with this report or by written agreement with the Council.
4.2.2 The appended notice should be used to create all weather notices that must be added to the tree protection barriers or suitable intervals.

4.3 Tree Protection Barrier Design

4.2.3 2 metre tall welded mesh panels standing in rubber or concrete feet joined using a minimum of two anti-tamper couplers installed so they can only be removed from inside the protected area. The fence couplers should be at spaced least 1 m apart, but uniformly across the whole barrier. These panels must be supported within the protected area with struts attached to a base plate secured by ground pins as per figure 1a. Use ground pins (e.g. due to underlying services or structural roots), the struts can be mounted on a block tray as per figure 1b.

Figure 1 – above ground stabilising systems:

a) Stabilizer strut with base plate secured with ground pins

b) Stabilizer strut mounted on block tray
4.3 GROUND PROTECTION & PARKING AREA

4.3.1 Within the areas of ground protection and non-dig surface indicated on the Tree Protection Plan ground protection is to be deployed as follows. It shall be a temporary measure beyond the proposed new surface footprint, and as a permanent sub-base within the area of non-dig design. The non-dig design and will affect finished levels.

**Specification**

4.3.2 Outline designs for temporary ground protection can be found below according to the required use.

4.3.3 Additional Information about the proposed proprietary ground protection system is appended including a full installation method statement.

**Installation Method Statement**

4.3.4 Ground protection shall be installed and removed in accordance with the timing of operations specified in this report. It will be laid out as indicated on the Tree Protection Plan. Ultimately, the existing soil structure in RPAs must remain undisturbed.

4.3.5 The ground levels in the proposed site access area are uneven and void spaces must be made up by adding inert freely draining granular material such as sand (not builders’ sand due to the salt content) or 20-40mm no-fines aggregate.

4.3.6 The ground protection will be installed using the ‘roll it out’ method in which the surface is constructed with machinery working forward from the surface as it is constructed. Refer to the full method statement appended for the full installation details.
Temporary Ground Protection – Loads Up To 6 Tonnes

Scale 1:10

Notes

1. There must be no deviation from using the specified products/materials and alternatives to the specified products and materials may not be used without written permission from the Local Planning Authority.

2. This drawing must be read in conjunction with the approved Arboricultural Method Statement and Tree Protection Plan.

3. This design is to be approved by an engineer or other competent person prior to installation.
Temporary Ground Protection – Loads Up To 30 Tonnes

20/40mm Clean / No Fines Angular Stone

Cellweb Tree Root Protection System (150mm)

Surface – Organic Matter (Existing)

Treetex T300 Geotextile Separation Fabric or Terram Standard Geotextile

Existing Ground Level – Soil Structure Undisturbed

Scale 1:10

Notes

1. There must be no deviation from using the specified products/materials and alternatives to the specified products and materials may not be used without written permission from the Local Planning Authority.

2. This drawing must be read in conjunction with the approved Arboricultural Method Statement and Tree Protection Plan.

3. This design is to be approved by an engineer or other competent person prior to installation.

Tree Reports
Tree and Woodland Consultants
Temporary Ground Protection — Loads Up To 60 Tonnes

Scale 1:10

Notes
1. There must be no deviation from using the specified products/materials and alternatives to the specified products and materials may not be used without written permission from the Local Planning Authority.

2. This drawing must be read in conjunction with the approved Arboricultural Method Statement and Tree Protection Plan.

3. This design is to be approved by an engineer or other competent person prior to installation.
4.4 WORKS WITHIN OUTBUILDING FOOTPRINT

4.4.1 In the area marked on the tree protection plan and within the root protection areas, the existing floor shall be retained where possible. If this is not possible the surface shall be broken up with motor manual tools, with care not to retain any subsoil or made ground below. A new surface must be laid on top of the existing undisturbed soil / made ground. Alternatively the subsoil / made ground may be disturbed if excavation by hand tools down to a depth of 600mm reveals no roots. If roots in excess of 25 millimetres are found then the subsoil / made ground must be retained undisturbed.

4.4.2 If hand digging reveals roots less than 25mm diameter these may be pruned with sharp secateurs leaving a cut of the minimum diameter possible to minimise infection.

4.5 TREE WORK

4.5.1 Tree T1 Southern lower canopy shall be pruned where necessary in accordance with BS 3998:2010. The pruning shall go no further than allowing 0.2m clearance from the scaffolding required for building the house.

4.6 LANDSCAPING

Boundary Fence

4.6.1 Altering ground levels in order to install the new boundary fence is not permitted. The fence design must consider the risk of damaging tree roots in root protection areas. Post locations are to be hand dug carefully and any roots up to 25mm diameter may be pruned with sharp secateurs leaving a pruning wound of the smallest diameter possible to minimise risk of infection. If roots in excess of 25mm diameter are found the hole will be carefully backfilled and the location of the post moved.
4.7 SCHEDULE OF WORKS / TIMING OF OPERATION & SUPERVISION

4.7.1 Development must be organised in the following order:

<table>
<thead>
<tr>
<th>Works (in order from first to last)</th>
<th>Arboricultural Supervision Required?</th>
<th>When?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree Works as per this report.</td>
<td>No</td>
<td>On completion</td>
</tr>
<tr>
<td>Create site access.</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>Install barriers and ground protection within area shown on tree protection plan and within proposed parking / turning area.</td>
<td>Yes</td>
<td>On completion</td>
</tr>
<tr>
<td>Ground Works.</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>Construction.</td>
<td>Yes</td>
<td>One visit during</td>
</tr>
<tr>
<td>Removal of barriers and ground protection outside of parking area footprint.</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>Landscaping including constructing new boundary fence and adding top layer to special non-dig surface.</td>
<td>Yes</td>
<td>On completion for sign off.</td>
</tr>
</tbody>
</table>
APPENDIX I

THE AUTHOR

Brief overview of career to date

- Five years in practical arboriculture as a self-employed Climbing Arborist.
- Eighteen months - Surveyor / Consulting Arboriculturalist for a private consultancy
- Four years - Senior Tree and Landscape Officer in a Local Planning Authority.
- In 2010 I established Tree Reports Ltd and began working as an Independent Arboricultural Consultant

Qualifications

<table>
<thead>
<tr>
<th>Qualification</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lantra Professional Tree Inspector, Writtle College, Essex</td>
<td>July 2008</td>
</tr>
<tr>
<td>EDEXCEL Higher National Diploma in Forestry, National School of Forestry</td>
<td>Jan 2007</td>
</tr>
<tr>
<td>CIEH – Risk Assessment (Credit), Warwickshire College</td>
<td>June 2001</td>
</tr>
<tr>
<td>BTEC National Diploma: Arboriculture (Distinction), Warwickshire College</td>
<td>July 2000</td>
</tr>
</tbody>
</table>

Professional Memberships

<table>
<thead>
<tr>
<th>Membership</th>
<th>Since</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consulting Arborist Society - Professional</td>
<td>Since 2012</td>
</tr>
<tr>
<td>Arboriculture Association – Professional</td>
<td>Since 2004</td>
</tr>
</tbody>
</table>
APPENDIX II

NOTICE FOR TREE PROTECTION BARRIERS
This area contains trees which must be retained as part of the planning permission. Additional legal protection may also apply e.g. a Tree Preservation Order. Removing or damaging trees in this area may be a breach of planning permission. Damage to protected trees may lead to a criminal conviction and / or a fine.

Only the site manager may permit for the removal or moving of tree protection measures. This should always be in accordance with the planning permission.
APPENDIX III

GROUND PROTECTION DETAILS
Introduction

CellWeb TRP® is a cellular confinement system that confines aggregate materials and makes them stronger. This behaviour allows the depth of pavement construction to be reduced. It also minimises compaction of soils below road pavements constructed using the CellWeb TRP® tree root protection system. CellWeb TRP® is used around the world to provide cost effective road and railway construction.

Cellular confinement was developed by the US Army Corps of Engineers during the 1970s to allow construction of roads for military equipment quickly and easily using whatever local soil material was available (especially across beaches). Since then the method has been developed and it is now routinely used in road and rail construction as well as in tree root protection. There is an extensive research base that demonstrates the performance of cellular confinement and it is a method of pavement construction that is recognised by the US Federal Highways Administration.

Characteristics of CellWeb TRP®

Pokharel et al (2009) stated that about one fifth of pavement failures in the US occur due to either weak subgrades or inefficient load transfer from the sub-base. CellWeb TRP® can improve the strength of road pavement construction to deal with these problems. It is a three dimensional interconnected honeycomb of cells made from HDPE. The cells are filled with aggregate sub-base and laterally confine the material when it is loaded, thus increasing the bearing capacity of the layer. This results in a thinner layer of aggregate being required to achieve the same performance.

It also allows uncompacted open graded aggregate to be used in the sub-base construction which is a vital part of any tree root protection system.

CellWeb TRP® is available in a range of height and aspect ratios to suit different load applications.

Use of CellWeb TRP® in RPAs

The use of CellWeb TRP® tree root protection system for building roads, car parks and other vehicular pathways includes a sub-base infill material of 20mm to 40mm which does not need to be compacted. This immediately provides a layer of material that will absorb compaction energy applied to the top of materials placed over it. Compaction of soils by construction machinery does not extend to a great depth. This is the reason why earthworks materials are normally placed in thin layers because compaction only occurs in the top few hundred mm at most. With the lightweight compaction plant used on most development sites the maximum depth that compaction will extend to is between 150mm and 200mm. Thus, if an 80mm layer of asphalt is placed over a 150mm deep CellWeb TRP® system the compaction reaching the base of the construction and the natural soil will be minimal. This effect was demonstrated by Lichter and Lindsey (1994) where a trial area was trafficked by a front-end loader and only suffered significant compaction of the soil to a depth of 100mm.

The use of CellWeb TRP® also spreads the wheel loads from traffic. There has been extensive research published on the performance of these systems from the original work by the US Army Corps of Engineers (Webster 1981) to more recent studies such as that by Emersleben and Meyer (2008).

The research shows that CellWeb TRP® acts as a stiff raft to distribute wheel loads and reduce their magnitude at the base of the construction by 30% to 36% (without any asphalt or other surfacing). Once the surface is taken into account, the pressure applied by traffic to soil below roads or pavements constructed using no-dig methods will be significantly reduced and thus compaction will also be reduced. Note, compaction is not prevented but it is reduced, thus maintaining the soil bulk density at levels that are suitable for tree root growth.

The effectiveness of the CellWeb TRP® no-dig construction in reducing soil compaction has been demonstrated in trials carried out by the Environmental Protection Group Limited. Two parking bays were constructed over a fine sand soil, one with a CellWeb TRP® cellular confinement sub-base. The parking bays were surfaced with asphalt and then used by cars for four weeks on a daily basis. It is well known that compaction of soils occurs in the first few passes of a vehicle, so the maximum adverse effects on compaction of soil below the pavement should have been achieved. In situ density tests were carried out on the sand below the pavement before and after construction (Figure 1).
The results in Figure 4 show that compaction of the soil below the CellWeb TRP® pavement was noticeably lower than that below the normal pavement. The increase in compaction below the normal pavement is similar to the increase found on a number of construction sites by Alberty et al (1984).

The use of layers of uncompacted material has also been shown by others to reduce compaction of natural soil by construction plant (Lichter and Lindsay 2004). However, these were temporary layers intended to be removed after construction was finished and they are not suitable for incorporation into a permanent car park surface. Nonetheless, it does demonstrate the effectiveness of no-dig techniques using CellWeb TRP®. It is important to note that the specific properties of cellular confinement systems (eg material type, strength, welding at joints, perforations, etc) will affect how each one behaves in trials such as this. Therefore the results are only applicable to the CellWeb TRP® system.

Note: So called tree root protection systems that use Type 1 sub-base or any similar material that requires compaction will not prevent compaction of soils around the tree roots. Type 1 is also not very permeable to air and water and will limit the availability to roots. Therefore geogrid reinforced Type 1 is not suitable for tree root protection.

References


Water and Oxygen Transfer Through the System

Water and oxygen are the lifeblood of trees without which they will wither and die. It is important to design developments in and around the root protection area (RPA) of existing trees to maximise the availability of water and oxygen to the roots. This can be achieved in a number of ways using the CellWeb TRP® tree root protection system.

The main causes of reduced water and oxygen availability for tree roots are:

- compaction of the soil around the roots
- covering the ground surface with impermeable cover which prevents water infiltration.

Both of these effects can be reduced or prevented by using CellWeb TRP® tree root protection within an appropriately designed road or car park surface.

Compaction of Soil

The use of CellWeb TRP® tree root protection system for building roads, car parks and other vehicular pathways includes a sub-base infill material of 20mm to 40mm which does not need to be compacted. This immediately provides a layer of material that will absorb compaction energy applied to the top of materials placed over it. CellWeb TRP® also spreads the wheel loads from traffic which reduces compaction, thus maintaining the soil bulk density at levels that are suitable for tree root growth.

The effectiveness of the CellWeb TRP® no-dig construction in reducing soil compaction has been demonstrated in trials carried out by the Environmental Protection Group Limited (See Fact Sheet 1).

Water and Oxygen Availability

The CellWeb TRP® tree root protection system is constructed using 20mm to 40mm gravel infill and has perforated cell walls. The pore spaces between the aggregate particles are greater than 0.1mm in diameter and are therefore defined as macropores (Roberts 2006). This open structure is far more permeable than typical soils and allows the free movement of water and oxygen within it so that supplies to trees are maintained as shown in Figure 1. The use of continuous permeable surfacing and intermittent gaps in impermeable surfacing are recognised ways of providing water and air infiltration pathways through a pavement surface into the tree root zone (Ferguson 2005).

The CellWeb TRP® system incorporates the Treetex® geotextile at the base. This is a very robust geotextile that is resistant to puncturing. Crucially for tree root protection it does not have a water breakthrough head that other geotextiles may have. Therefore it will always be free draining and will not limit oxygen availability to the roots.

Breakthrough Head

All geotextiles are by their nature permeable, however in order to develop optimum water-flow performance, some types of geotextiles (eg, thermally bonded types) require a minimum depth of water to develop over them.

Therefore a layer of up to 50mm of water can build-up over some geotextiles after rainfall. Treetex® needle punched geotextiles however remains free draining at all times as it has “zero breakthrough head” which means it does not require a build up of water to permeate.
If the CellWeb TRP® sub-base layer is covered by a layer of permeable block paving the rate of oxygen transfer through the system is estimated to be around $1 \times 10^{-4} \text{ g/s/m}^2$ using simple diffusion theory. For a natural sandy soil the rate of transfer to the same depth is around $7 \times 10^{-5} \text{ g/s/m}^2$. Therefore even on the most aerated of natural soils the CellWeb TRP® tree root protection system does not restrict oxygen supply to tree roots.

Water ingress will also be maintained at the levels similar to a natural sites as water simply passes through the pavement. Permeable block paving and porous asphalt have infiltration rates that are very large (typically $>2500\text{mm/h}$) in comparison with most rainfall events. The infiltration rate is also far higher than natural soils (infiltration rate for sand is quoted as $>20\text{mm/h}$ by Hillel 1998). Thus the pavement allows rainfall to soak into the soil as it would naturally (there will be some reduction as some water soaks into the blocks and gravel as the rainfall passes through).

**TABLE 1 - CHARACTERISTICS OF ROOT SYSTEMS OF MATURE EUROPEAN BROADLEAVED AND CONIFEROUS TREE SPECIES GROWING ON WELL AERATED, SANDY SOILS**

<table>
<thead>
<tr>
<th>Species</th>
<th>Tolerance to Oxygen Deficiency</th>
<th>Species</th>
<th>Tolerance to Oxygen Deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ash</td>
<td>Medium-high</td>
<td>Japanese Larch</td>
<td>Medium</td>
</tr>
<tr>
<td>Aspen</td>
<td>High</td>
<td>Lime</td>
<td>Low</td>
</tr>
<tr>
<td>Birch</td>
<td>Low</td>
<td>Norway Maple</td>
<td>Medium</td>
</tr>
<tr>
<td>Beech</td>
<td>Low</td>
<td>Norway Spruce</td>
<td>Very low</td>
</tr>
<tr>
<td>Common Alder</td>
<td>High</td>
<td>Red Oak</td>
<td>Medium-high</td>
</tr>
<tr>
<td>Corsican Pine</td>
<td>--</td>
<td>Scots Pine</td>
<td>Medium</td>
</tr>
<tr>
<td>Douglas Fir</td>
<td>Medium-low</td>
<td>Sessile Oak</td>
<td>High</td>
</tr>
<tr>
<td>English Oak</td>
<td>High</td>
<td>Silver Fir</td>
<td>High</td>
</tr>
<tr>
<td>European Larch</td>
<td>Medium</td>
<td>Sycamore</td>
<td>Low</td>
</tr>
<tr>
<td>Hornbeam</td>
<td>Medium</td>
<td>White pine</td>
<td>Very low</td>
</tr>
</tbody>
</table>


If the CellWeb TRP® is covered by impermeable asphalt or similar materials the aeration of the sub-base can be promoted from the side of a paved area. This is achieved using gravel filled conduits to connect the sub-base to the surface, allowing oxygen into the layer from where it can freely travel to the root area. Open areas that are normally provided immediately around the tree will also be beneficial in allowing oxygen into the CellWeb TRP® layer. Oxygen can flow horizontally through the CellWeb TRP® because of the perforated walls.

Notwithstanding the above, some trees are more tolerant than others to a deficit of oxygen (Table 1). The use of permeable surfaces over the CellWeb TRP® is advisable where pavements are to be constructed over trees with a low tolerance to oxygen deficit.

**References**


Pollution in Urban Runoff

It has been suggested that pollution from run-off could damage tree health in certain concentrations. Pollution is present in run-off from car parks, roads and even roofs. There are a wide variety of pollutants including heavy metals, oil, fertilisers, pesticides, salts, pathogens and sediment that can cause environmental damage if discharged into rivers or groundwater (CIRIA 2007).

Where permeable pavements are constructed over the CellWeb TRP® tree root protection system the pavement construction will filter out and retain most pollutants. This fact sheet will discuss the extensive evidence base that demonstrates how effective permeable surfaces are at removing pollution. It will explain how they remove pollution from run-off before it reaches the soil below and how robust trees are to the levels of pollution found in run-off.

The effects of de-icing salt on trees are discussed in a separate Fact Sheet No 5.

There is research available which reveals that the pollutant loads from small areas of car park or small roads, where the majority of no-dig installations are used, are much less than for main roads or larger car parks (CIRIA 2003). Such low levels are unlikely to damage tree health. Sustainable drainage systems positively encourage the use of trees and other plants to treat the pollution that is present in run-off from hard surfaces.

Pollution Removal in Permeable Pavements

The effective removal of pollution from run-off by permeable surfaces has been well known since the late 1990s. This early work is summarised in CIRIA Report C582 (CIRIA 2002) and it showed that permeable pavements filter out sediment and act as bio reactors to degrade oil based pollutants. The sediment is filtered as it passes through the fine pores in the surface (either in porous asphalt or in the grit jointing material between blocks) which is where the majority of pollution is trapped (Legret and Colandini 1999, Shackel and Pearson 2005). If it passes this surface filtration layer it will be trapped on geotextiles either within or at the base of the construction. The CellWeb TRP® tree root protection system will always have a Treetex® geotextile at the base over the subgrade. This has properties that make it robust enough to survive in contact with the 20mm to 40mm aggregate.

Worldwide research has generally shown that run-off that has passed through permeable pavements has low concentrations of pollutants, especially metals, oils and bacteria (Wilson 2007). This includes research in countries where the geotextile is generally only provided at the base of the construction. The percentage removal of various contaminants from a permeable pavement is shown in Figure 1. In this case the pavement was sealed and the water collected from a manhole at the outfall. It did not have an upper geotextile in the pavement. Similar findings have been reported by Mullaney and Jefferies (2011).

All permeable pavements tend to use an open graded sub-base that is similar to the 20mm to 40mm aggregate used in the Cellweb TRP® and therefore this material will help remove pollution in a similar manner. More recent research has confirmed that day to day pollution removal does not depend on a geotextile at high level in the pavement (Mullaney and Jefferies 2011) but that geotextiles in the construction can be beneficial if there are larger spills of oil (Puehmeier and Newman 2008). The Treetex® geotextile provided at the base of CellWeb TRP® pavements will reduce the risk of any excessive pollution passing through the system into the soil below. Because of the pollution load and treatment that clearly occurs within the pavement there will not be a significant build up of pollutants within the soil below it.

![Figure 1 Pollution removal from permeable pavements (Kirkpatrick et al 2009)](image-url)
Ability of Trees to Deal with Pollution

Many trees are able to remove a wide variety of pollutants from soil. One of the more recent developments is stormwater forestry (United States Department of Agriculture (USDA) 2006). The USDA states that ‘Trees also show enormous potential to remove other pollutants, such as metals, pesticides, and organic compounds.’ The report does go on to suggest that some tree species may be damaged by pollutants in stormwater and this will require consideration on a site-by-site basis. However, these adverse effects can be minimised by careful design of the pavement drainage; for example, by using no-dig permeable pavements that filter out most pollutants before they reach natural soils.

Contaminates in runoff are typically not at concentrations that can adversely affect most riparian tree species. Excess nitrogen and phosphorus in soils are quickly taken up by trees with oxygen rich rhizospheres, because osmosis can happen freely. When nutrients are available trees take advantage of the windfall. Additionally, robust resilient trees are able to metabolize contaminates (heavy metals, inorganic and organic compounds) into their carbon rich heartwoods.

Bioretention areas are widely used in North America to collect and treat runoff in landscaped areas. A study by Toronto and Region Conservation (2009) involved extracting and testing soil cores extracted from three bioretention facilities in the Greater Toronto Area. These varied in age from 2 to 5 years and showed metal and PAH levels comparable to nearby reference sites that were not affected by runoff. The pollution concentrations were below Ontario background concentrations. The testing was repeated at one facility after two years which showed no change in contamination levels. This tends to suggest that pollutant loads from small paved areas will not significantly affect trees.

Benefits of Permeable Paving with Cellweb Tree Root Protection

Research has clearly shown that the majority of pollution is removed from runoff within the permeable pavement structure (which will include the CellWeb TRP® tree root protection system). Thus the low levels of pollution that are realised from the base of a CellWeb TRP® tree root protection system are unlikely to damage tree health.

The reduced compaction and highly permeable nature of the CellWeb TRP® tree root protection system (see Fact Sheet 1) will help to preserve the health of trees within developments. In addition there are clear benefits in attenuating and treating rainfall runoff using permeable pavements combined with the CellWeb TRP®.

References


This brochure is produced to give an example of the products we supply and how, subject to your own testing, our products may be used. Nothing in this brochure shall be construed so as to make any ascertain or give any warranty as to the fitness for purpose of any of our products in respect of any specific job. You should satisfy yourself through your own testing as to the suitability of our products for any specific purpose and rely solely on such testing and/or the advice of any professional(s) you commission. While we ensure as far as is possible that all information given in this brochure is accurate at the time of print, information and examples given in this brochure are by way of illustration only and nothing contained in this or any other promotional literature produced by us shall in any way constitute an offer or contract with you or shall be relied upon by you as a statement or representation of fact.
Method Statement

For The Installation of
Cellweb Tree Root Protection System.

When considering damage to tree roots, in applications of vehicular access and parking, the risk of oxygen depletion caused by compaction of subsoil’s, site clearance damaging the root source and type of reinforcement are areas which need to be given due consideration.

Other risk factors are:

- Creating an impermeable surface
- Causing a rise in the water table due to construction
- Increasing ground level
- Contamination of subsoil’s
1. **Compaction**

When looking at site conditions and use, the following information should be considered to enable a load bearing structure capable of supporting traffic to be proposed:

- Californian Bearing ratio (CBR) – Standard test method for measuring soil strength
- Soil types
- Water table
- Maximum load (vehicles)
- Acceptable rut depth
- Reinforcement type: Cellweb Cellular Confinement 150mm deep

Type and Depth of engineered infill material: Clean, angular. Usually 40mm to 20mm.

2. **Dig (site strip)**

Site stripping does damage some root structure prior to construction; however, the use of no-dig construction elevates the access road requiring edge protection.

3. **No dig**

3.1. Remove surface vegetation

Use a suitable herbicide suitable for the specific vegetation and not harmful to the tree root system.

3.2. Place geotextile separation filtration layer

Use a Treetex T300 non woven Goetextile over the prepared sub-grade. Overlap dry joints by 300mm. The three dimensional cell structure, is formed by ultrasonically welding polyethylene (perforated) strips / panels together to create a three dimensional network of interconnecting cells. A high degree of frictional interaction is developed between infill and the cell wall, increasing the stiffness of the system.

3.4. Edge restraint

A treated timber edging is usually acceptable.

4. **Cellular Confinement and Backfill Material.**

Expand the Cellweb 2.56m wide panels to the full 8.1 metre length. Pin the Cellweb panels with staking pins to anchor open the cells and staple adjacent panels together to create a continuous mattress. Infill the Cellweb with a no fines angular granular fill (typically 4-20mm) within each open cell. The use of cellular confinement reduces the bearing pressure on the subsoil by stabilising aggregate surfaces against rutting under wheel loads. Comparisons between cellular confinement and traditional aggregate and geogrid-reinforced structures demonstrate a 50% reduction in construction thickness of the granular material.
Hi Daniel,

Please see below for a breakdown of weights and pressures.

- For vehicles we use the Gross Vehicle Weight (GVW) to determine the depth of the Cellweb. The value refers to the total weight as a guidance, but the design considers the radius of the loaded area which is function of tire pressure and wheel load: \[ R = \frac{L}{\sqrt{p}} \]
  
  Where
  
  \( R \) = radius of contact (m)
  
  \( L \) = wheel Load (kN) (to applied factors for rigid bodies)
  
  \( p \) = tire pressure (kPa)

- Once the depth of the Cellweb is determined, it's necessary to check if additional subbase beneath the Cellweb is required. The thickness of the Cellweb is function of the CBR or Undrained Shear strength of the subgrade (in Tree root protection areas to consider the existing ground without excavation), the loadings and the properties of the infill material.

  **Guidance:** Values of max Gross Vehicle Weights (GVW) for each Cellweb:

  - Cellweb 100mm: max GVW = 6 ton
  - Cellweb 150mm: max GVW = 30 ton
  - Cellweb 200mm: max GVW = 60 ton

  **Design:** Values of max axle load for each Cellweb:

  - Cellweb 100mm: max axle load = 2 ton/axle (20 kN/axle)
  - Cellweb 150mm: max axle load = 6 ton/axle (60 kN/axle)
    - Delivery vehicles = 40 kN/axle (approx.)
    - Std Construction traffic, bin lorries, fire engines = 60 kN/axle
  - Cellweb 200mm: max axle load = 14.5 ton/axle (145 kN/axle)
    - Heavy construction traffic = 80 kN/axle
    - HGVs = 115 kN/axle
    - Abnormal vehicles = 145 kN/axle (approx.)
APPENDIX IV

TREE PROTECTION PLAN