Tree Survey, Arboricultural Impact Assessment and Tree Protection Plan

For Proposed Development Site At the Former Lunan House, Guthrie Street, Friockheim

Tuesday 17th January 2023

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PART 1 - EXECUTIVE SUMMARY

1.1 Proposal

The proposal is to construct residential dwellings on land at the former Lunan House site at Guthrie Street. A tree survey is required, written in accordance with British Standard Institute publication BS 5837:2012 'Trees in relation to design, demolition and construction - Recommendations'.

1.2 Tree Survey

A tree survey was carried out by the surveyor on 12th January 2023. The trees were recorded as T369-T400, and thirty-two trees were surveyed. All trees surveyed were assigned to the category A, B, C or U classification.

1.3 Arboricultural Impact Assessment

It is proposed to retain 10 of the 32 trees surveyed. This includes trees 371, 372, 374, 376, 378, 379, 386, 396, 397 and 398 of which 4 are Category B trees and 6 are Category C trees. These trees are spruce, wild cherry and an apple tree. It is proposed to fell 22 of the 32 trees surveyed. This includes 5 category B trees 370, 373, 375, 377, and 394 which are maple, beech, spruce, sycamore, and wild cherry. BS5837 recommends retaining Category B trees where this is feasible, in this case it is not practical to retain the 5 Category B trees due to the location of the trees in relation to the development footprint. This also includes felling 17 Category C trees 369, 380, 381, 382, 383, 384, 385, 387, 388, 389, 390, 391, 392, 393, 395, 399, 400. The trees are Category C trees and BS5837 states that there are no development constraints on removing Category C trees. These trees include the cypress and western hemlock trees and the majority of the fruit trees.

There will be a loss of a tree cover due to the felling of these trees. It is recommended that tree and hedge planting are incorporated as part of the landscaping at the site to compensate for the loss of the twenty-two trees in the medium to long-term. It is recommended for the planting on the site that as a minimum the number of new trees planted matches the number lost and ideally at least three trees are planted for every tree lost. Planting hedgerows at suitable boundary locations would provide a realistic way to incorporate replacement planting and would also enhance the site for biodiversity. It is recommended that replacement fruit trees are planted to replace the lost fruit trees. There is opportunity to improve the diversity of the tree species in the area by new planting with a selection of native trees. Species such as field maple, sweet chestnut, dogwood, hazel, hawthorn, beech, holly, Scot's pine, sessile oak, rowan, broad-leaved lime, and domestic fruit trees will enhance the habitat.

The proposed development impacts the roots of eight trees. These trees are 371, 372, 374, 376, 386, 396, 397 and 398. Where excavation is required within RPAs non-mechanical excavation is proposed and cutting roots greater than 2.5cm diameter is to be avoided. Where excavation is not required a no-dig surface methodology is recommended such as using a 3D cellular confinement system. It is not anticipated that the RPAs of other retained trees will be directly impacted by the work. However, in the event work is required which may encroach into any RPA, work must be non-mechanical excavation using hand tools or use a no dig surface method. Arboricultural methodology must be adopted for any works in the RPAs of retained trees in case tree roots are discovered. It is anticipated that the impact of the proposed development can be satisfactorily mitigated against to ensure that there is no detrimental long-term impact to RPAs at the site. The RPAs of all trees on the site which are in the vicinity of, but out-with, the proposed development footprint can be safely protected from compaction or other disturbance by ground marking.

1.4 Tree Protection

Tree protection specifications for tree protection barriers are provided, together with general advice on tree retention, working in RPAs, and an arboricultural method statement for tree works is provided.

PART 2 - GENERAL INFORMATION

2.1 Brief From Client
A tree survey is required written in accordance with British Standard Institute publication BS 5837:2012 'Trees in relation to design, demolition and construction - Recommendations'.

2.2 Proposed Works
It is proposed to construct residential dwellings at the former Lunan House site, Guthrie Street.

2.3 Documents Referred To
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 LPAs to assess planning applications.

2.4 Documents Received
27722-01 Topographical 1-500 (A1), Existing and Proposed Site Plans

2.5 Limitations
2.5.1 This report was prepared for use by our client in accordance with the terms of the contract and for planning purposes only. Information provided by third parties used in the preparation of this report is assumed to be correct.

2.5.2 All trees have been inspected from ground level only using established visual assessment methodology. This is primarily a survey to assess the general health, condition, value, and life expectancy of existing trees as part of the planning and design process. This report is not a detailed document on tree safety.

2.5.3 Trees are dynamic living organisms, whose health and condition can be subject to rapid change, depending on a number, of external and internal factors. The conclusions and recommendations contained in this report relate to the trees at the time of inspection. The findings and recommendations are valid for twelve months and it is strongly recommended that trees are inspected at regular intervals and after extreme weather events for reasons of safety.

2.5.4 Whilst every effort has been made to detect defects within the trees inspected, no guarantee is given as to the absolute safety or otherwise of any individual tree. Extreme climatic conditions can cause damage to apparently healthy trees.

2.5.5 The findings and recommendations contained within this report are based on the current site conditions. The construction of roads, buildings, service wayleaves, removal of shelter, and alterations to established soil moisture conditions can all have a detrimental impact on the health and stability of retained trees. Accordingly, a re-inspection of retained trees is recommended on completion of any development operations.

2.5.6 This report has been prepared for the use of the client and their appointed agents. Any third party referring to this report or relying on information contained within it does so at their own risk.

2.6 Personnel
Emma has worked in the environmental sector for eighteen years, including thirteen years predominantly focused on woodland management, during which time she has gained a wealth of experience and expertise. Emma has been qualified in arboriculture and ground level tree operations for sixteen years, has carried out tree surveys for ten years, and holds the Lanta Professional Tree Survey and Inspection Award. During the last eight years she has worked as an ecological and arboricultural consultant for Tay Ecology with lead responsibility for development projects. She graduated with a BSc from University of Edinburgh, has a Postgraduate Diploma in Environmental Management and is a member of the Arboricultural Association and Institute of Environmental Management and Assessment.

PART 3 – TREE SURVEY

3.1 METHODOLOGY

3.1.1 Trees on and adjacent to the proposed development site where these trees may be impacted by the proposed work were surveyed on 12th January 2023. Trees are numbered T369-T400. All trees surveyed were assigned to the category A, B, C or U classification.

3.1.2 Data was collected in accordance with the requirements of British Standard 5837:2012. All observations were from ground level, with the aid of binoculars, without detailed or invasive investigations. Measurements were taken using a tape measure, clinometer, and laser measure. Where this was not possible or reasonably practical, measurements have been estimated by eye.

3.1.3 The trees were surveyed and assessed impartially and irrespective of the proposed development. Management recommendations should be implemented regardless of any proposed development for reasons of sound arboricultural management or safety.

3.1.4 BS 5837:2012 requires retention of better quality (category A and B trees) where possible. Planning permission overrides a Tree Preservation Order and Conservation Area. Furthermore, trees are a material consideration in the UK planning system irrespective of their legal status. It is therefore not considered necessary to highlight or give additional merit to trees that have legal protection.

3.1.5 All category A, high & B moderate quality and value trees will, where possible, be retained on development sites, and should influence and inform the design, site layout, and in some cases the specific construction methods to be used. The root protection areas of these trees will generally form a construction exclusion zone, although under certain circumstances it may be possible to build within these areas providing that appropriate, specifications have been agreed between the local planning authority, the consulting arboriculturist and the developer/client.

3.1.6 As regards category C trees; under normal circumstances these would not normally be required to be retained in a development context, unless in a location that they do not represent a significant constraint on the proposal. See relevant note at foot of Cascade diagram BS 5837:2012.

3.1.7 All category U trees should be removed for reasons of sound arboricultural practice or health & safety, irrespective of any development proposals.

3.1.8 Trees may be recorded as group or woodland where:

i) The canopies touch.
ii) The trees have more group value than individual merit.
iii) They are part of a formal landscape feature like an avenue.
iv) It is impractical to record them individually.

3.1.9 Where trees within groups or woodlands etc. are recorded together, it may be necessary to record individual trees where it is necessary to distinguish them from others, this may be required initially, e.g., if a tree is in category U, or at a subsequent stage as the design process evolves.

3.2 ANALYSIS

3.2.1 Site Description

The proposed development site is located at the site of the former Lunan House which is accessed from Guthrie Street. The site predominantly comprises the existing buildings, the access road and car parking. To the rear of the property to the south-west are a selection of predominantly mature planted broadleaved and non-native coniferous species, these include a collection of fruit trees, mainly apple. To the north-west of the building are a cluster of planted non-native conifer trees with a border of broadleaved trees along the edge of the car park.

3.2.2 Species

The scientific names for the species recorded only in common names are as follows:

Common Name	***Scientific Name***	**Number**
Sycamore	*Acer pseudoplatanus*	1
Maple sp.	*Acer spp.*	1
Silver birch	*Betula pendula*	1
Lawson cypress	*Chamaecyparis lawsoniana*	6
Beech	*Fagus sylvatica*	1
Orchard apple	*Malus domestica*	6
Spruce sp.	*Picea spp.*	4
Wild cherry	*Prunus avium*	7
Plum	*Prunus domestica*	2
Willow sp.	*Salix spp.*	1
Western hemlock	*Tsuga heterophylla*	2

3.2.3 Categories

The trees recorded are 28% Category B, 72% Category C trees. The distribution of categories of individual trees is as follows:

BS 5837 Category	Number of Trees	% Trees
A	0	0
B	9	28
C	23	72
U	0	0
Total	32	100

3.2.4 Life stage

94% mature, and 6% semi-mature trees recorded.

The life stages recorded for individual trees are summarised as follows:

Life Stage	Number of trees	% of Trees
Young	0	0
Semi-mature	2	6
Mature	30	94
Over-mature	0	0

3.3 Tree Survey Schedule

Ref.	Species	Hgt. (m)	DBH (mm)	Branch spread (m)				Clr (m)	Life stage	General observations/vigour	Condition	ERC	Cat.	RPA (m)	Recommendations / Timescale
				N	E	S	W								
369	L.cypress	5	120x5	1.5	1.5	1.5	1.5	0.5E	M	Shaped/pruned shrub / moderate	Fair	10+	C2	3.22	No work required
370	Maple sp.	14	640	6	6	6	6	2.5E	M	Pollarded above 2m / good	Good	20+	B2	7.68	No work required
371	Spruce sp.	16	390	4	4	4	4	4W	M	Good	Good	10+	C2	4.68	No work required
372	Spruce sp.	15	280	2	2	2	2	2S	M	Snagged branches / moderate	Fair	10+	C2	3.36	No work required
373	Beech	14	620	9	9	9	9	2S	M	Pollarded above 2.5m / good	Good	20+	B2	7.44	No work required
374	Spruce sp.	16	410	4	4	4	4	3E	M	Good	Good	20+	B2	4.92	No work required
375	Spruce sp.	16	430	4.5	4.5	4.5	4.5	1.5S	M	Reduced canopy / moderate	Fair	20+	B2	5.16	No work required
376	Silver birch	14	460	6	6	6	6	6SW	M	Minor decay / moderate	Fair	20+	B2	5.52	No work required
377	Sycamore	14	600	7.5	7.5	7.5	7.5	2S	M	Good	Good	20+	B2	7.20	No work required
378	W.cherry	5	160;150; 100	4	4	4	4	1.5S	M	3 stems / moderate	Fair	10+	C2	2.89	No work required
379	W.cherry	6	480	4.5	4.5	4.5	4.5	2.5E	M	Moderate	Good	20+	B2	5.76	No work required
380	Apple	6	260;190; 160	4	4	4	4	0.5N	M	3 stems / moderate	Fair	10+	C2	4.31	No work required
381	Plum	4	150;120; 100	2	2	2	2	1S	M	3 stems / moderate	Fair	10+	C2	2.60	No work required
382	Apple	4	120;120	2	2	2	2	1E	M	2 stems / moderate	Fair	10+	C2	2.04	No work required
383	Apple	2	80;80;60	1	1	1	1	0.5S	SM	3 stems, damaged stem / low	Poor	10+	C2	1.54	No work required
384	Apple	6	190;130	3	3	3	3	1S	M	Lean south / good	Good	10+	C2	2.76	No work required
385	Apple	6	250	4	4	4	4	1E	M	Good	Good	10+	C2	3.00	No work required
386	W.Cherry	5	220;120	4	4	4	4	0.5N	M	2 stems / moderate	Fair	10+	C2	3.01	No work required
387	W. hemlock	10	370	3	3	3	3	2W	M	Good	Good	10+	C2	4.44	No work required
388	L.cypress	12	470	3	3	3	3	2.5W	M	Good	Good	10+	C2	5.64	No work required
389	L.cypress	10	340	2	2	2	2	3N	M	Good	Good	10+	C2	4.08	No work required
390	L.cypress	12	380	3	3	3	3	3N	M	Good	Good	10+	C2	4.56	No work required
391	W.hemlock	12	310	3	3	3	3	3W	M	Good	Good	10+	C2	3.72	No work required
392	L.cypress	12	380	2	2	2	2	3E	M	Good	Good	10+	C2	4.56	No work required
393	Willow	8	180; 140x4	3	3	3	3	0.5S	M	Moderate	Fair	10+	C2	3.99	No work required
394	W.Cherry	9	420	4	4	4	4	2W	M	Pollarded above 2m / moderate	Fair	20+	B2	5.04	No work required
395	W.Cherry	5	140;120	1.5	1.5	1.5	1.5	1W	M	Moderate	Fair	10+	C2	2.21	No work required
396	W.Cherry	4	150;140; 120	3	3	3	3	2S	M	3 stems / moderate	Fair	10+	C2	2.85	No work required
397	W.Cherry	6	420	4	4	4	4	2S	M	Good	Good	20+	B2	5.04	No work required
398	Apple	6	310	3	3	3	3	2S	M	Good	Good	10+	C2	3.72	No work required
399	L.cypress	4	150;150	1	1	1	1	1E	M	Shaped/pruned shrub / moderate	Fair	10+	C2	2.55	No work required
400	Plum	3	100x4	1	1	1	1	0.5E	SM	Self-seeded near wall / moderate	Fair	10+	C2	2.40	No work required

KEY

Ref: Reference number assigned to that item with a code to help identification such as T = tree

Hgt: Height of the tree in metres rounded up to the nearest half metre.

DBH: 'Diameter at Breast Height' – the stem diameter measured in millimetres at 1.5m above ground level, to the nearest 10mm. Where the ground around the base of the tree is not level this is taken 1.5m above the upper side of the slope.

Crown Spread: The crown spread is given to four cardinal points, rounded up to the nearest half metre.

Clr: 'Crown clearance' is the height of the lowest branch above ground level, with the general direction it is growing to a cardinal point.

Life Stage: Recorded with codes as follows, and relative to the species of the tree: Y – Young; SM – Semi-mature; M – Mature; OM - Over-mature; D – Dead.

General observations: includes notes on structural defects, physiological problems, special features, decay, and management recommendations. Please note that management recommendations do not constitute a specification for any required works.

Condition: Good = Healthy tree with no major defects, considerable life expectancy, with good shape or form; Fair = Healthy tree with easily remedied defects, shorter life expectancy, with reasonable shape or form; Poor = Tree with significant structural defects and/or decay, low vigour, under stress, limited life expectancy and with inferior shape and form; Dead = Dead, dying, and dangerous trees, very, low vigour, severely limited life expectancy, serious structural defects and/or decay.

ERC: 'Estimated remaining contribution', recorded in a range of years is the amount of time the tree can realistically be retained for.
<10 - Unsuitable for retention; 10-20 - Can be retained in the short term; 20-40 - Will continue to offer benefits for the foreseeable future; 40+ - Good longevity potential

Cat.: 'Category grading', a full explanation of the categories is given in an excerpt from BS 5837:2012 in the cascade chart, appendix 2.

RPA: 'Root protection area', appears on the survey plan and is calculated by multiplying the stem diameter using one of three methods specified in BS 5837:2012 depending on the number of stems the tree has. This should be considered an indication only as various factors may influence the size and shape of the RPA, such as past and present site conditions, and ground constraints such as roads, underground services, soil type, drainage, and topography.

3.4 Tree Constraints Plan - see below and separate pdf 1

A tree constraints plan has been produced for the site. The trees were recorded as T369-T400. The morphology of tree roots is influenced by past and present site conditions and tree management, e.g., soil type, drainage, and local topography. The RPAs of trees may be exaggerated.

Tree Constraints Plan

Site at Guthrie Street

SCALE : 1 : 500 @ A4

DATE : 17/01/2023

MAP FILENAME : Guthrie Street TCP

N

Prepared by Tay Ecology Ltd
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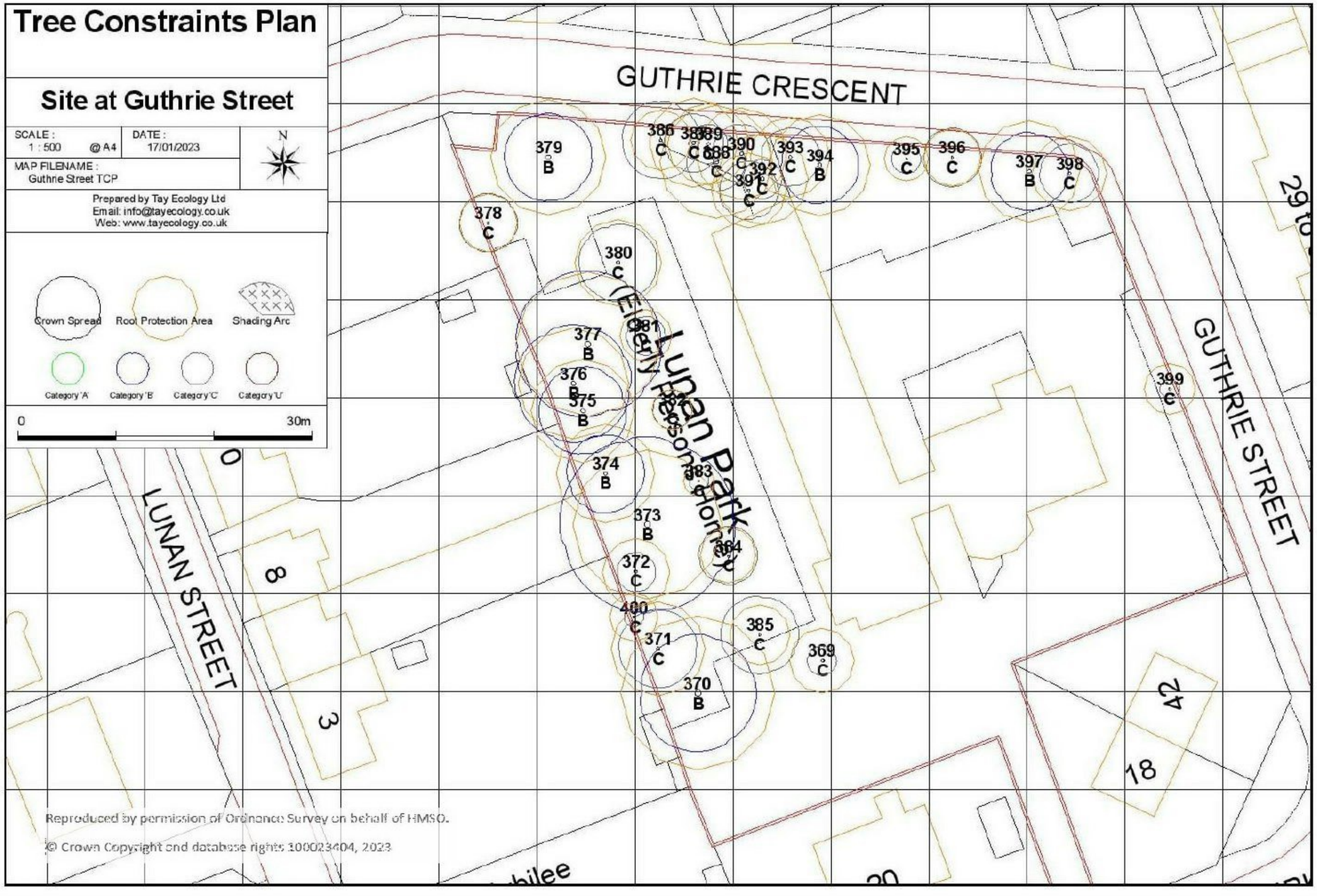
Crown Spread | Root Protection Area | Shading Arc

Category 'A' | Category 'B' | Category 'C' | Category 'U'

0 30m

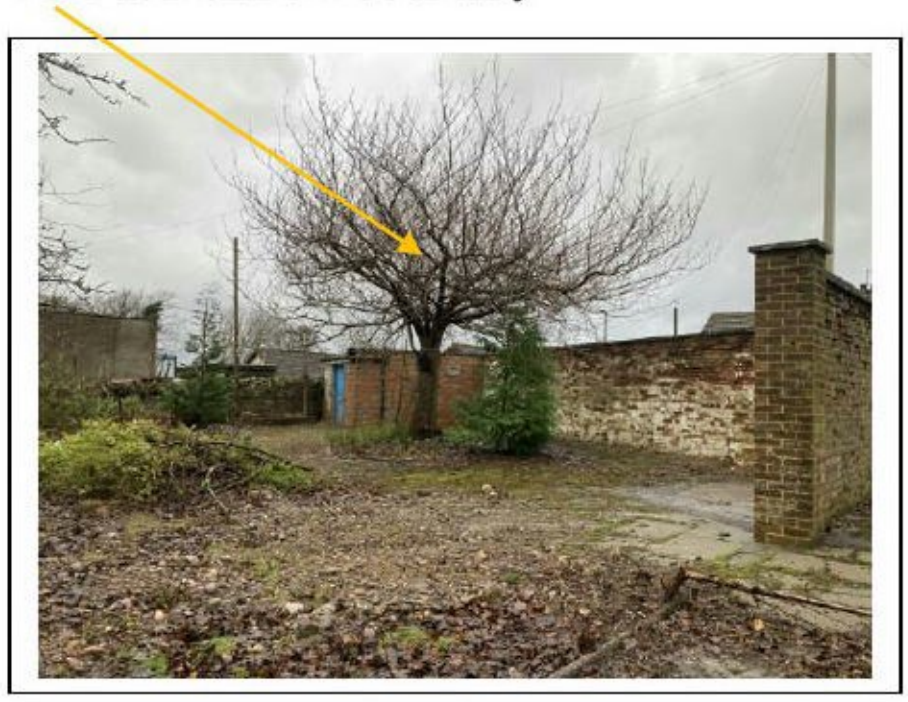


3.5 Photographs

NNW at rear of building from T370 and T385

SSE along rear boundary T374 and T373

T379 on northern boundary



SSE from rear of building T380 to T385

Northern boundary conifers inc. T386-T392

North-west from Guthrie Street T397-T390

PART 4 – ARBORICULTURAL IMPACT ASSESSMENT

4.1 TREE RETENTION

It is proposed to retain 10 of the 32 trees surveyed. This includes trees 371, 372, 374, 376, 378, 379, 386, 396, 397 and 398 of which 4 are Category B trees and 6 are Category C trees. These trees are spruce, wild cherry and an apple tree. Table 5 shows the tree retention and tree loss.

Table 5 Tree retention/loss

Tree	Category	Species	Retain / Remove
369	C2	L.cypress	**Remove**
370	B2	Maple sp.	**Remove**
371	C2	Spruce sp.	**Retain**
372	C2	Spruce sp.	**Retain**
373	B2	Beech	**Remove**
374	B2	Spruce sp.	**Retain**
375	B2	Spruce sp.	**Remove**
376	B2	Silver birch	**Retain**
377	B2	Sycamore	**Remove**
378	C2	W.cherry	**Retain**
379	B2	W.cherry	**Retain**
380	C2	Apple	**Remove**
381	C2	Plum	**Remove**
382	C2	Apple	**Remove**
383	C2	Apple	**Remove**
384	C2	Apple	**Remove**
385	C2	Apple	**Remove**
386	C2	W.Cherry	**Retain**
387	C2	W. hemlock	**Remove**
388	C2	L.cypress	**Remove**
389	C2	L.cypress	**Remove**
390	C2	L.cypress	**Remove**
391	C2	W.hemlock	**Remove**
392	C2	L.cypress	**Remove**
393	C2	Willow	**Remove**
394	B2	W.Cherry	**Remove**
395	C2	W.Cherry	**Remove**
396	C2	W.Cherry	**Retain**
397	B2	W.Cherry	**Retain**
398	C2	Apple	**Retain**
399	C2	L.cypress	**Remove**
400	C2	Plum	**Remove**

4.2 LOSS OF TREES

It is proposed to fell 22 of the 32 trees surveyed. This includes 5 category B trees 370, 373, 375, 377, and 394 which are maple, beech, spruce, sycamore, and wild cherry. BS5837 recommends retaining Category B trees where this is feasible, in this case it is not practical to retain the 5 Category B trees due to the location of the trees in relation to the development footprint.

This also includes felling 17 Category C trees 369, 380, 381, 382, 383, 384, 385, 387, 388, 389, 390, 391, 392, 393, 395, 399, 400. The trees are Category C trees and BS5837 states that there are no development constraints on removing Category C trees. These trees include the cypress and western hemlock trees and the majority of the fruit trees.

There will be a loss of a tree cover due to the felling of these trees. It is recommended that tree and hedge planting are incorporated as part of the landscaping at the site to compensate for the loss of the twenty-two trees in the medium to long-term. It is recommended for the planting on the site that as a minimum the number of new trees planted matches the number lost and ideally at least three trees are planted for every tree lost. Planting hedgerows at suitable boundary locations would provide a realistic way to incorporate replacement planting and would also enhance the site for biodiversity. It is recommended that replacement fruit trees are planted to replace the lost fruit trees. There is opportunity to improve the diversity of the tree species in the area by new planting with a selection of native trees. Species such as field maple, sweet chestnut, dogwood, hazel, hawthorn, beech, holly, Scot's pine, sessile oak, rowan, broad-leaved lime, and domestic fruit trees will enhance the habitat.

4.3 INCURSION INTO ROOT PROTECTION AREAS

The proposed development impacts the roots of eight trees. Table 6 shows the impacted RPAs. These trees are 371, 372, 374, 376, 386, 396, 397 and 398. Where excavation is required within RPAs non-mechanical excavation is proposed and cutting roots greater than 2.5cm diameter is to be avoided. Where excavation is not required a no-dig surface methodology is recommended such as using a 3D cellular confinement system.

It is not anticipated that the RPAs of other retained trees will be directly impacted by the work. However, in the event work is required which may encroach into any RPA, work must be non-mechanical excavation using hand tools or use a no dig surface method. Arboricultural methodology must be adopted for any works in the RPAs of retained trees in case tree roots are discovered. It is anticipated that the impact of the proposed development can be satisfactorily mitigated against to ensure that there is no detrimental long-term impact to RPAs at the site.

The RPAs of all trees on the site which are in the vicinity of, but out-with, the proposed development footprint can be safely protected from compaction or other disturbance by ground marking. Ground protection requirements will depend on the intensity of work around any individual tree in this area. RPAs are indicated on the plans as being centred around each stem, note that the actual protection area is often skewed because localised features (such as road surfaces, local topography etc.) make rooting conditions unfavourable on one or more sides of the tree.

Table 6 Impacted RPAs

Tree	Category	Species	Estimated % RPA impacted
371	C2	Spruce	**15**
372	C2	Spruce	**30**
374	B2	Spruce	**15**
376	B2	Silver birch	**30**
386	C2	Wild cherry	**5**
396	C2	Wild cherry	**10**
397	B2	Wild cherry	**30**
398	C2	Apple	**15**

4.3.2 Protective Fencing

BS 5837 requires the installation of protective fencing to protect trees to be retained during construction operations. The fence creates a physical barrier between the construction area and the Construction Exclusion Zone (CEZ). The line that a protective fence takes is based upon the calculation of Root Protection Areas but also requires the physical constraints of the site to be taken into consideration. The provisional Tree Protection Plan gives an indicative positioning for the placement of protective fencing and construction exclusion zones. A specification for protective fencing is given in Appendix 3.

4.3.3 Changes in Ground Level and Surfaces

Changes in ground levels and surfaces within the RPAs of trees to be retained can be detrimental to tree health and stability. Excavations which result in root severance and soil compaction can have serious implications for the long-term future health and stability of the tree. Increasing levels and changing surfaces within root protection areas can be equally damaging as this may result in anaerobic conditions at rooting level resulting in tree root disease and death. Therefore, it is essential that trees to be retained must have their RPAs protected from any changes in in levels. Permeable surfacing materials are recommended to be used in the construction of any surfacing that encroaches on RPAs to allow for percolation of water and gas diffusion.

Where excavation is required within RPAs non-mechanical excavation is proposed. A no dig surface methodology, for example a 3D cellular confinement system should be used to avoid negative impacts to RPAs in other areas. This would raise the level of the ground in the identified area. Rose (2020) states that a no dig surface can cover over 20% of any RPA. Where the ground level is raised in any RPAs a permeable surface material is recommended to allow air and water to percolate.

4.3.4 Installation of Services

Traditionally the installation of underground services is carried out by the digging of open trenches and installation of the service(s) prior to backfilling. It is widely recognised that this methodology is detrimental to the health of trees where the digging of trenches involves the severance of tree roots. Overhead services can also come into conflict with tree canopies resulting in unnecessary pruning or tree removal. To minimise any impact on trees all services should, wherever possible, be located out-with the root protection areas and crown spreads (for overhead cables) of retained trees. Where services must be installed in root protection areas excavation must be non-mechanical and roots greater than 2.5cm diameter retained. National Joint Utilities Group guidance to be followed during installation using trenchless methods and/or hand-dug broken or continuous trenches. The use of a compressed air-powered tool, or AirSpade is recommended for service installation.

4.3.5 During Construction

Where construction vehicles are required to temporarily enter any RPA, a preference will be given to the use of small construction vehicles and ground protection will be used. Ground protection requirements will depend on the intensity of work around any individual tree in such areas. Where materials storage is required, this will be outside of any RPAs of trees to be retained.

4.4 ABOVE GROUND CONSTRAINTS

4.4.1 Canopies and Shading

The canopies of retained trees can be protected with barriers where any work takes place or where any machinery to be used on site which may impact the canopies.

4.4.2 Future Tree Inspections

Due to the time lapse between the initial survey and start of any development work a further inspection of the trees should form part of the formal risk assessment process carried out prior to commencement. This initial assessment of the trees was carried out on the basis that a follow-up inspection would be undertaken within one year and the advice given on tree condition reviewed on an annual basis or after extreme weather events.

4.5 CONCLUSIONS

It is proposed to retain 10 of the 32 trees surveyed. This includes trees 371, 372, 374, 376, 378, 379, 386, 396, 397 and 398 of which 4 are Category B trees and 6 are Category C trees. These trees are spruce, wild cherry and an apple tree. It is proposed to fell 22 of the 32 trees surveyed. This includes 5 category B trees 370, 373, 375, 377, and 394 which are maple, beech, spruce, sycamore, and wild cherry. BS5837 recommends retaining Category B trees where this is feasible, in this case it is not practical to retain the 5 Category B trees due to the location of the trees in relation to the development footprint. This also includes felling 17 Category C trees 369, 380, 381, 382, 383, 384, 385, 387, 388, 389, 390, 391, 392, 393, 395, 399, 400. The trees are Category C trees and BS5837 states that there are no development constraints on removing Category C trees. These trees include the cypress and western hemlock trees and the majority of the fruit trees.

There will be a loss of a tree cover due to the felling of these trees. It is recommended that tree and hedge planting are incorporated as part of the landscaping at the site to compensate for the loss of the twenty-two trees in the medium to long-term. It is recommended for the planting on the site that as a minimum the number of new trees planted matches the number lost and ideally at least three trees are planted for every tree lost. Planting hedgerows at suitable boundary locations would provide a realistic way to incorporate replacement planting and would also enhance the site for biodiversity. It is recommended that replacement fruit trees are planted to replace the lost fruit trees. There is opportunity to improve the diversity of the tree species in the area by new planting with a selection of native trees. Species such as field maple, sweet chestnut, dogwood, hazel, hawthorn, beech, holly, Scot's pine, sessile oak, rowan, broad-leaved lime, and domestic fruit trees will enhance the habitat.

The proposed development impacts the roots of eight trees. These trees are 371, 372, 374, 376, 386, 396, 397 and 398. Where excavation is required within RPAs non-mechanical excavation is proposed and cutting roots greater than 2.5cm diameter is to be avoided. Where excavation is not required a no-dig surface methodology is recommended such as using a 3D cellular confinement system. It is not anticipated that the RPAs of other retained trees will be directly impacted by the work. However, in the event work is required which may encroach into any RPA, work must be non-mechanical excavation using hand tools or use a no dig surface method. Arboricultural methodology must be adopted for any works in the RPAs of retained trees in case tree roots are discovered. It is anticipated that the impact of the proposed development can be satisfactorily mitigated against to ensure that there is no detrimental long-term impact to RPAs at the site. The RPAs of all trees on the site which are in the vicinity of, but out-with, the proposed development footprint can be safely protected from compaction or other disturbance by ground marking.

4.6 ARBORICULTURAL IMPACT ASSESSMENT – see separate pdf 2

Arboricultural Impact Assessment Plan

Site at Guthrie Street

SCALE : 1 : 500 @ A4

DATE : 17/01/2023

MAP FILENAME : Guthrie Street AIA

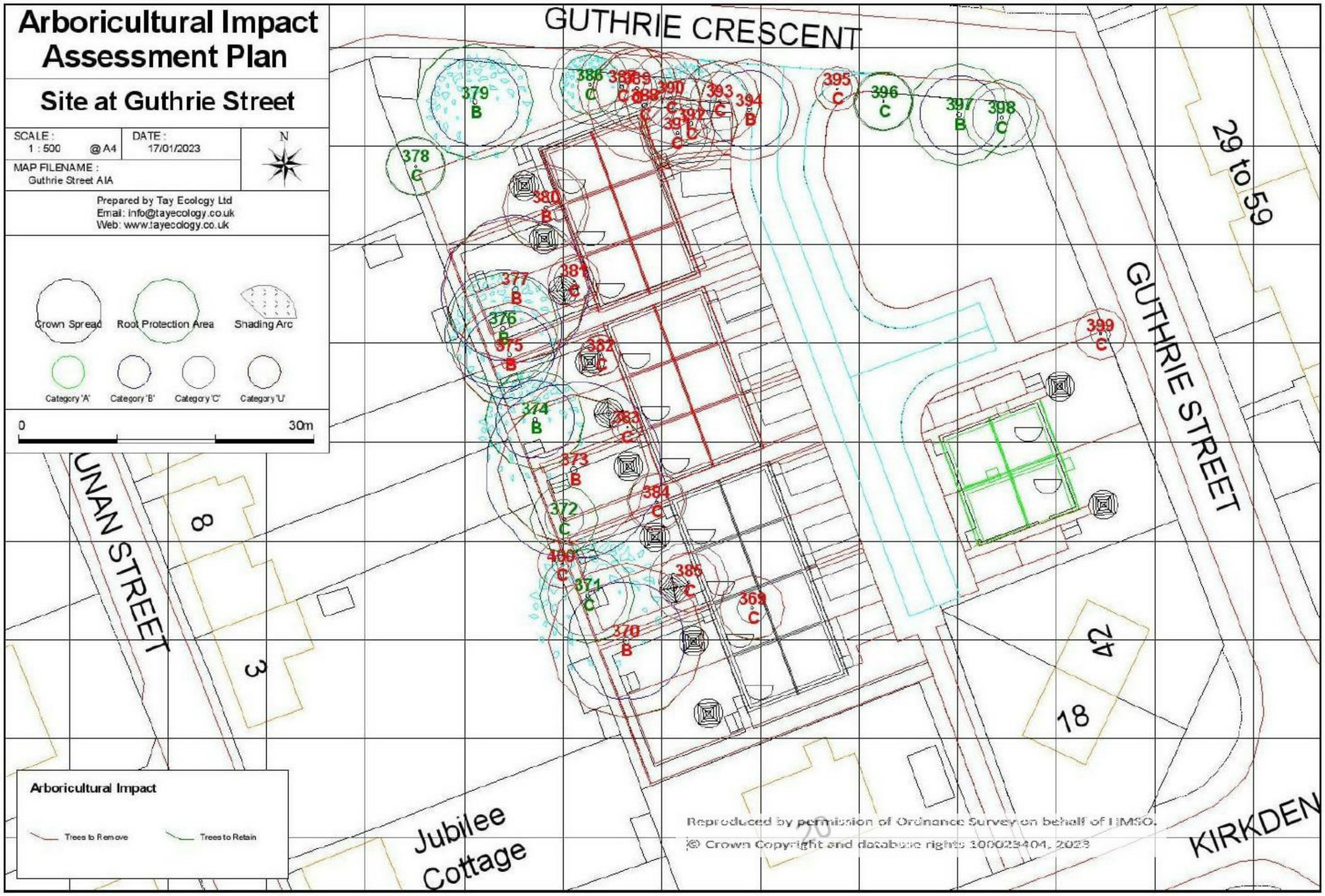
N

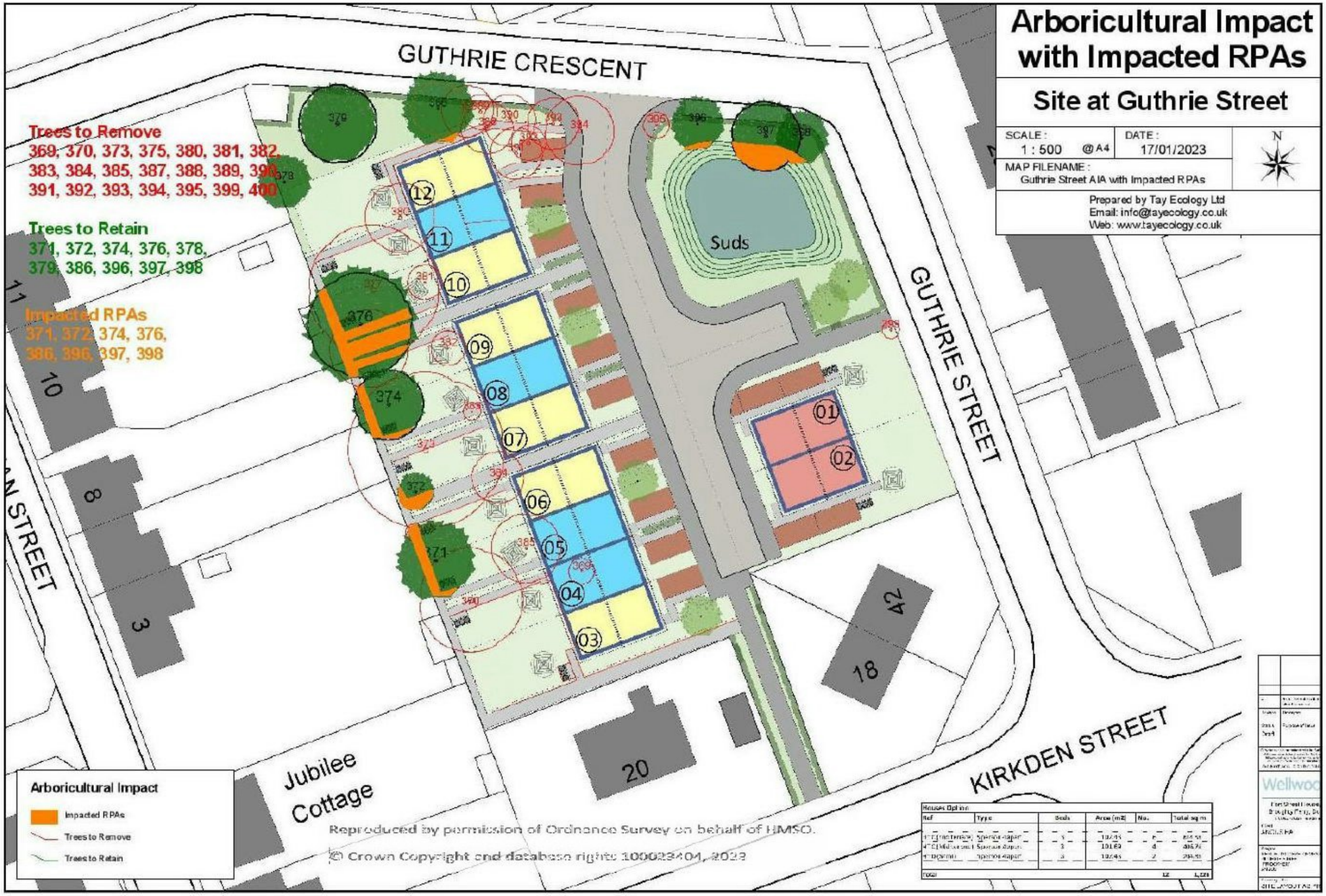
Prepared by Tay Ecology Ltd
Email: info@tayecology.co.uk
Web: www.tayecology.co.uk

Crown Spread | Root Protection Area | Shading Arc

Category 'A' | Category 'B' | Category 'C' | Category 'U'

0 30m




Arboricultural Impact with Impacted RPAs
Site at Guthrie Street
SCALE : 1 : 500 @ A4
DATE : 17/01/2023
MAP FILENAME : Guthrie Street AIA with Impacted RPAs
Prepared by Tay Ecology Ltd
Email: info@tayecology.co.uk
Web: www.tayecology.co.uk
N
Trees to Remove
369, 370, 373, 375, 380, 381, 382, 383, 384, 385, 387, 388, 389, 390, 391, 392, 393, 394, 395, 399, 400
Trees to Retain
371, 372, 374, 376, 378, 379, 386, 396, 397, 398
Impacted RPAs
371, 372, 374, 376, 386, 396, 397, 398
GUTHRIE CRESCENT
GUTHRIE STREET
KIRKDEN STREET
Suds
Jubilee Cottage
01
02
03
04
05
06
07
08
09
10
11
12
Arboricultural Impact
Impacted RPAs
Trees to Remove
Trees to Retain
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PART 5 – TREE PROTECTION PLAN

5.1 GENERAL

5.1.1 The client and agent 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 Plan are adhered to.
□ the site manager is updated of any approved changes or variations to this document.

5.1.2 The client and site manager shall ensure that:
□ a copy of this document with the tree protection plan 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 are left 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 to approved tree protection measures.

5.1.3 Procedures for incidents
If any breach of the approved tree protection measures occurs:
□ The LPA Tree officer or other Planning Officer and Tay Ecology are informed.
□ 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 incident, deployed where required.

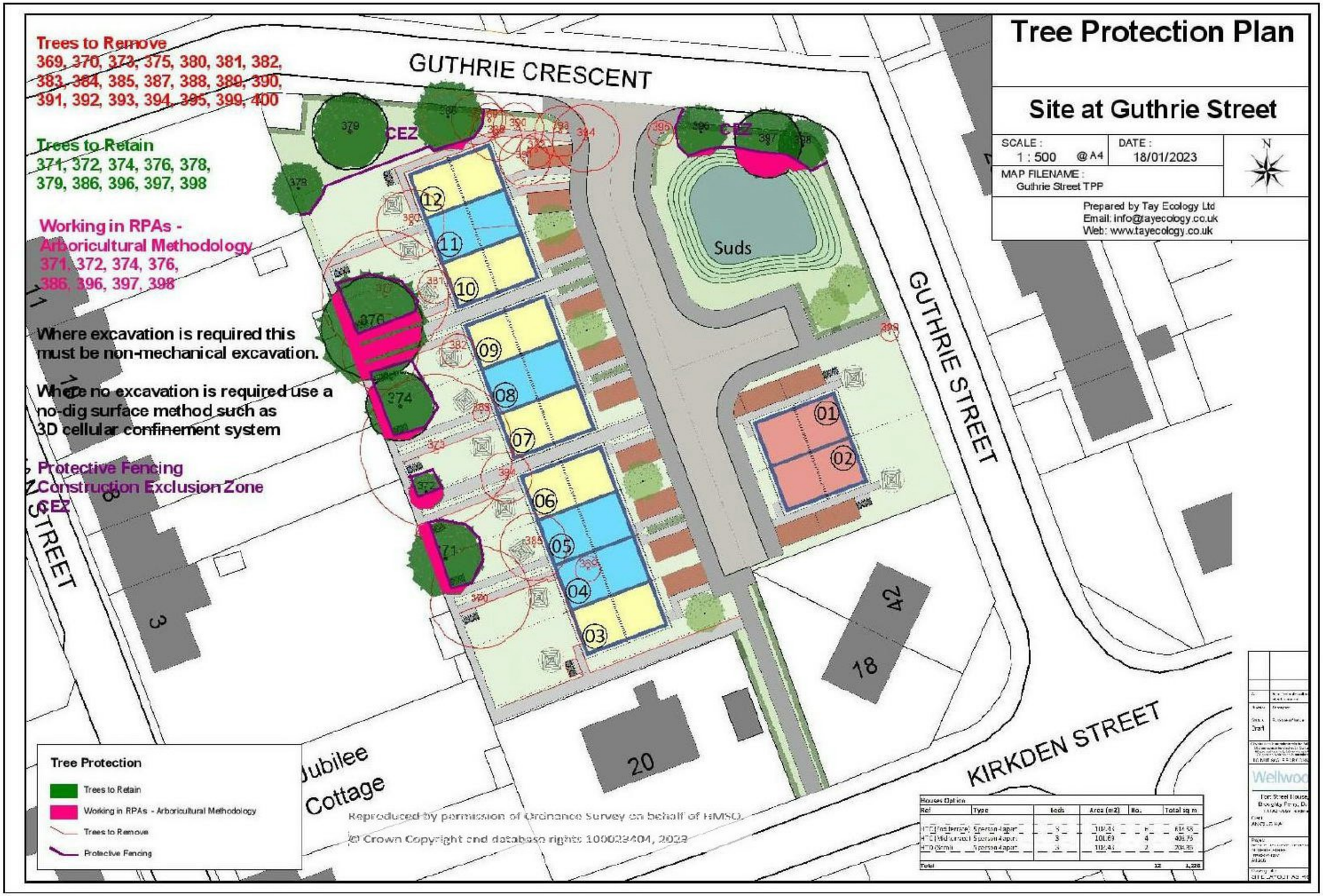
5.1.4 Prohibited Activities
The following must not be carried out under any circumstances:
□ Cutting down, uprooting, damaging or otherwise destroying any retained tree.
□ Lighting a fire within 10 metres of the canopy of any retained tree.
□ Equipment, signage, fencing, tree protection barriers, materials, 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 site slope must be such that contamination of soil in the RPA would not occur if there were spillage, seepage, or displacement.
□ No plant 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.

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

5.1.6 Timing and order of operations
The development must be carried out in the following order unless otherwise agreed in writing with the LPA. Each step must be completed before moving onto the next:

i. Tree felling.
ii. Mark out RPAs of retained trees.
iii. Installation of tree protection barriers and temporary ground protection in areas indicated on plan.
iv. Construction.
v. Removal of the remaining ground protection and barriers.

5.2 TREE PROTECTION PLAN



5.3 PROTECTIVE BARRIERS AND GROUND PROTECTION

5.3.1 Protective barriers, ideally at the limit of the RPA, or in positions to be agreed within the RPA once further detailed proposals are available, are required to enclose a sufficient RPA to ensure that trees to be retained survive the development process. The aim of any barrier is to exclude any construction activity which may damage tree health. Appropriate distances to be measured from the base of trees are as in the Tree Survey Schedule RPA.

5.3.2 Any 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 appended notice, Appendix 5 Tree Protection Notice, should be used to create all weather notices that must be added to the tree protection barriers or suitable intervals. In the event of any panel or support becoming damaged, this must be immediately reinforced by adding panels with the designs below as appropriate.

5.3.3 Tree protection barriers
The default specification is a vertical and horizontal scaffold framework, braced to resist impacts, Appendix 3. The vertical tubes are spaced at a maximum interval of 3m and these are driven securely into the ground. Welded mesh panels are securely attached to the frame. During installation it is important to consider the position of below ground services and structural roots, which must not be damaged. Where these constraints prevent the use of this specification, an alternative specification is given.

5.3.4 Alternative tree protection barrier design
2 metres high 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 1m 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, Appendix 3.

5.3.5 Protective barriers should be adapted to fit the site requirements and may include improvised structures around specific trees.

5.3.6 The supervising tree consultant should confirm that the tree protection barriers have been installed as agreed before any significant site work starts.

5.4 ARBORICULTURAL METHOD STATEMENT FOR WORK WITHIN RPAS

5.4.1 EXCAVATION IN RPAS

5.4.1.1 In the event any excavation in RPAs is required do not mechanically excavate. Any tree roots found up to 25mm diameter can be pruned back with sharp secateurs leaving a wound of the smallest diameter possible. If any roots over 25mm are found, these must be retained undamaged, and further advice sought from the supervising tree consultant. Cut exposed roots to be removed cleanly 10-20cm behind the final face of the excavation. Protect roots temporarily exposed, but to be retained, from drying out by covering with damp hessian sacks or boards. Use an inert granular material mixed with top-soil or sharp sand around retained roots greater than 25mm width before light compaction.

5.4.2 SURFACING

5.4.2.1 Where any new surfacing encroaches into any RPA and no excavation is required, a no-dig surface is preferentially recommended where up to approximately 20%, or more if required (Rose, 2020) of the RPA will be impacted. The design of such a construction needs to be sensitive to the requirements of tree roots, substantial enough to withstand the proposed structure and practicable in terms of ease of fabrication. The no-dig method involves construction of a surface with no excavation or soil stripping. All construction takes place above ground level. Appendix 4 Example of no-dig surface installation method.

5.4.2.2 BS 5837 recommends that three-dimensional cellular confinement systems are an appropriate sub-base for installing surfacing in RPAs. Most products are made from heavy-duty plastic that is pulled apart to open into cells. These are then filled with washed stone, after the product is spread over the ground and pinned in place. This forms a base layer that acts as a floating raft, spreading the load across the whole construction width. The base layer can be topped with a variety of finishes.

5.4.2.3 Tay Ecology is not qualified to recommend any specific construction method in terms of durability or structural integrity and any proposed construction should be approved by a structural engineer prior to implementation, however, with regards to trees, the following comments are made:

- Severance of roots and soil compaction should be avoided.
- Air and water must be able to diffuse into the soil beneath the engineered surface. Toxic substances which could leach into the ground must be avoided, as should substances which affect the pH value of the soil, for example limestone.

5.4.2.4 Existing ground vegetation may be killed using a suitable herbicide. Care must be taken to select a herbicide which does not damage the tree roots within the treated area. Once the vegetation has died, the dead organic matter should be removed. This helps prevent the future build-up of anaerobic conditions or settlement due to decomposition.

5.4.3 GROUND PROTECTION

5.4.3.1 Where it has been agreed during the design stage, and shown on the tree protection plan, that vehicular or pedestrian access for the construction operation may take place within the RPAs, the possible effects of construction should be addressed by a combination of barriers and ground protection. The position of the barrier may be shown within the RPAs at the edge of the agreed working zone but the soil structure beyond the barrier to the edge of the RPAs should be protected with ground protection.

5.4.3.2 BS 5837:2012 allows for the use of ground protection in conjunction with protective fencing. Where temporary access for small scale machinery is needed within the RPAs ground protection should be used. Ground protection should be of sufficient strength and rigidity to prevent soil disturbance and compaction. A geotextile membrane should be used to prevent contamination of soil below by toxic substances. Where access to the site occurs within RPA areas on existing hard surfaces no additional root protection is required.

5.4.3.4 For pedestrian movements within the RPAs the installation of ground protection in the form of a single thickness of scaffold boards on top of a compressible layer laid onto a geotextile or supported by scaffold is acceptable. For wheeled or tracked movements within the RPAs the ground protection should be designed by an engineer to accommodate the likely loading and may involve the use of proprietary systems or reinforced concrete slabs.

5.4.3.5 The supervising tree consultant should confirm that the ground protection has been installed as agreed before any significant site work starts.

5.4.4 LANDSCAPING

5.4.4.1 For any landscaping in RPAs avoid soil compaction around existing trees. Any cultivation within RPAs should be undertaken by hand, but no heavy mechanical cultivation should occur. Decompaction measures if required include forking, spiking, soil augering and tilted radial trenching.

5.4.5 POLLUTION PREVENTION

5.4.5.1 To prevent pollution in RPAs make provision for emergency spillage clean-up; mix cement and wash vehicles as far away from RPAs as possible; use bunding and impermeable membranes to prevent liquid contaminants reaching RPAs; use impermeable membranes to prevent leachates from poured concrete contaminating RPAs; keep pollution control measures in place until there is no significant risk of RPA contamination.

5.4.6 SUMMARY OF ARBORICULTURAL SUPERVISION

1. Mark out the RPAs of retained trees.
2. Ensure that the tree protection barriers are installed and fixed to the ground in the correct position and as specified.
3. Oversee any excavation required within any RPAs.
4. Ensure that any cellular containment system is installed as per the manufacturers Recommendations.
5. Undertake regular site visits to ensure that the works are in accordance with the Tree Protection Plan and Arboricultural Method Statement.

PART 6 – REFERENCES

BSI Standards Publication, 2012 *"British Standard 5837:2012 Trees in relation to design, demolition and construction – Recommendations"*

BSI Standards Publication, 2010 *"British Standard 3998:2010 Tree work – Recommendations"*

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PART 7 – APPENDICES

APPENDIX 1 TERMS AND DEFINITIONS

1.0 Arboricultural Method Statement
Guidelines for specified working operations near trees to avoid any harmful impact as defined within BS 5837:2012, may cover works from tree work to operating cranes, installing foundations or services and guidelines for engineering performance to function as a tree protection measure.

1.1 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.

1.2 Root Protection Area (RPA)
A minimum recommended area for tree protection in 'BS 5837:2012 Trees in Relation to Construction'. In these areas works should be avoided where possible. Where work in these areas cannot be avoided, it should be carried out in accordance with a Tree Protection Plan and / or Arboricultural Method Statement.

1.3 Tree Constraints Plan
As defined within BS 5837:2012. This plan shows above and below ground constraints that may impact on a planning proposal such as the tree branch spread and Root Protection Area.

1.4 Tree Preservation Order (TPO)
A type of land charge which specifies certain trees for protection under the Town and Country Planning Act (1990) that 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.

1.5 Conservation Area
Normal TPO procedures apply, if a tree is not covered by a TPO, written notice to the LPA detailing any proposed work must be given at least 6 weeks before work starts. Notice of work is not required where the tree has a diameter of less than 75mm, measured 1.5m above the ground, or 100mm diameter if thinning to enable the growth of other trees.

APPENDIX 2 TREE CATEGORY CODES

Cascade chart for tree quality assessment from BS 5837:2012

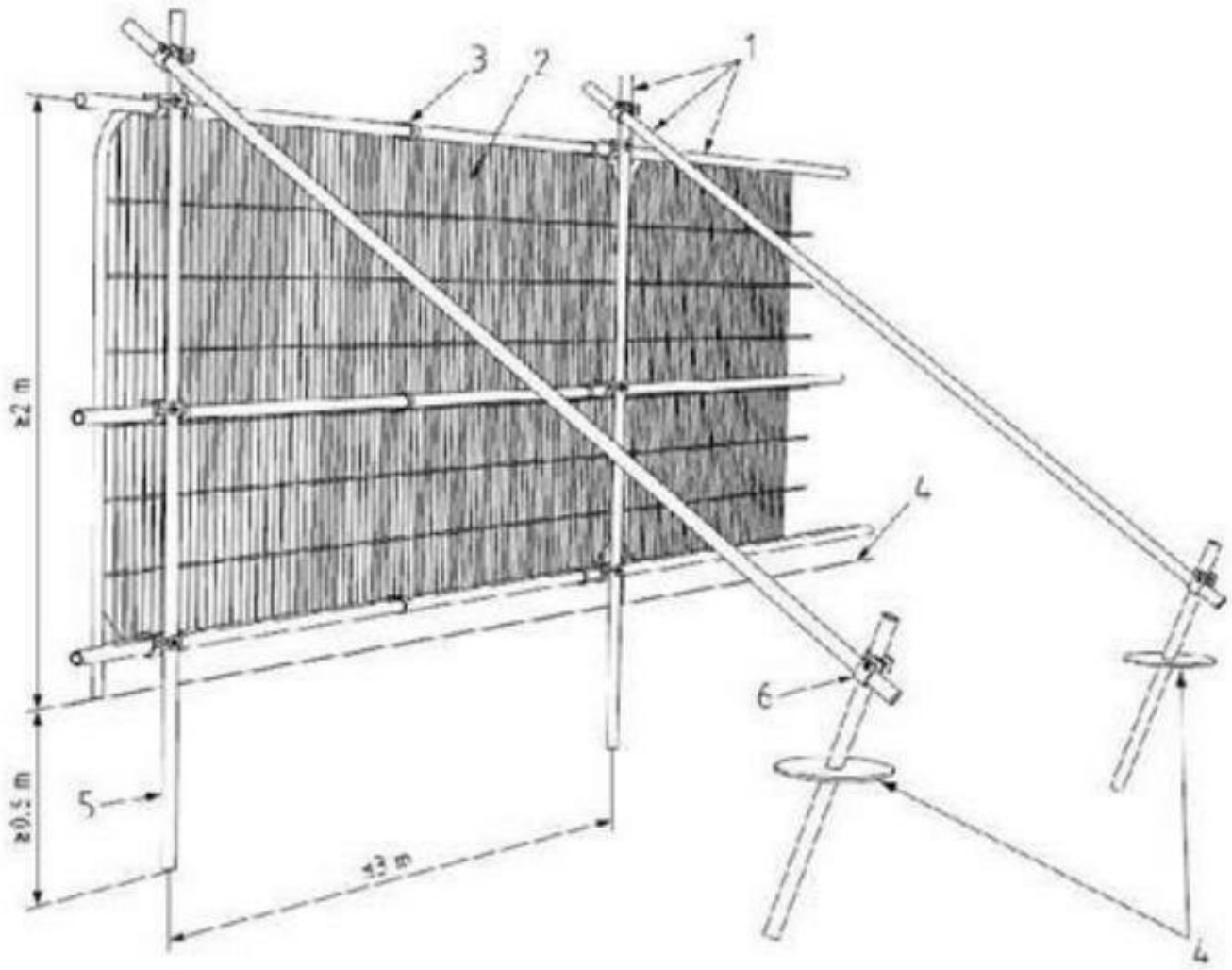
Category and definition	Criteria (including subcategories where appropriate)			Identification on plan
Trees unsuitable for retention				
Category U Those in such a condition that they cannot realistically be retained as living trees in the context of the current land use for longer than 10 years.	Trees that have a serious, irremediable, structural defect, such that their early loss is expected due to collapse, including those that will become unviable after removal of other category U trees (eg. Where, for whatever reason, including the loss of companion shelter cannot be mitigated by pruning) Trees that are dead or are showing signs of significant, immediate and irreversible overall decline. Trees infected with pathogens of significance to tree health and/or safety of other trees nearby, or very low-quality trees suppressing adjacent trees of better quality. *NOTE Category U trees can have existing or potential conservation value which it might be desirable to preserve.*			Dark red
Trees to be considered for retention				
	1 Mainly arboricultural qualities	2 Mainly landscape qualities	3 Mainly cultural values, including conservation	
Category A Trees of high quality with an estimated remaining life expectancy of at least 40 years.	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 (eg. The dominant and/or principal trees within in an avenue).	Trees groups or woodlands of particular visual importance as arboricultural and/or landscape features.	Trees, groups or woodlands of significant conservation, historical, commemorative or other value (eg. Veteran trees or wood-pasture).	Light green
Category B Trees of moderate quality with an estimated remaining life expectancy of at least 20 years.	Trees that might be included in category A but are downgraded because of impaired condition (eg. Presence of significant though remediable deflects, including unsympathetic past management and storm damage), such that they are unlikely to be suitable for retention for beyond 40 years; or trees lacking the special quality necessary to merit the category A designation.	Trees present in numbers, usually growing as groups or woodlands, such that they attract a higher collective rating than they might as individuals; or trees occurring as collectives but situated so as to make little visual contribution to the wider locality.	Trees with material conservation or other cultural value.	Mid blue
Category C Trees of low quality with an estimated remaining life expectancy of at least 10 years, or young trees with a stem diameter of below 150mm.	Unremarkable trees of very limited merit or such impaired condition that they do not qualify in higher categories.	Trees present in groups or woodlands, but without this conferring on them significantly greater collective landscape value; and/or trees offering low or only temporary/transient landscape benefits.	Trees with no material conservation or other cultural value.	Grey
NOTE: Whilst 'C' category trees will usually not be retained where they would impose a significant constraint on development, young trees with a stem diameter of less than 150 mm should be considered for relocation.				

APPENDIX 3 PROTECTIVE FENCING SPECIFICATION

5.2.3 The default specification is a vertical and horizontal scaffold framework, braced to resist impacts, as per figure 1 below. The vertical tubes are spaced at a maximum interval of 3m and these are driven securely into the ground. Welded mesh panels are securely attached to the frame. During installation it is important to consider the position of below ground services and structural roots, which must not be damaged. Where these constraints prevent the use of this specification, an alternative specification is given below.

Figure 1 is taken from BS5837:2012 'Trees in Relation to Design, Demolition & Construction – Recommendations' and illustrates the systems to be employed for ensuring an adequate Construction Exclusion Zone about retained trees. Refer to BS5837:2012 for further details.

Figure 1 – default tree protection barrier specification



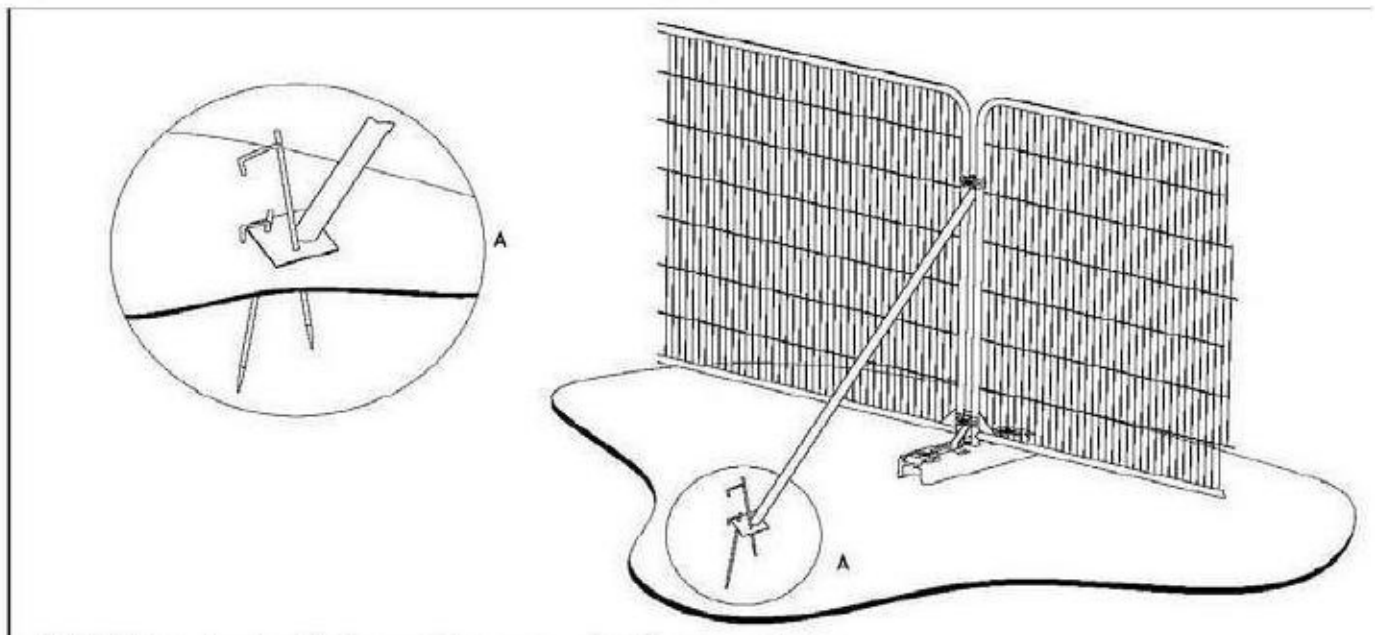
1. Standard scaffold poles
2. Heavy gauge 2m tall galvanized tube and welded mesh infill panels.
3. Panels secured to uprights and cross members with wire ties.
4. Ground level.
5. Uprights driven into the ground until secure (minimum depth 0.6m)
6. Standard scaffold clamps

5.2.4 Alternative tree protection barrier design
2 metres high 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 1m 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 2a.

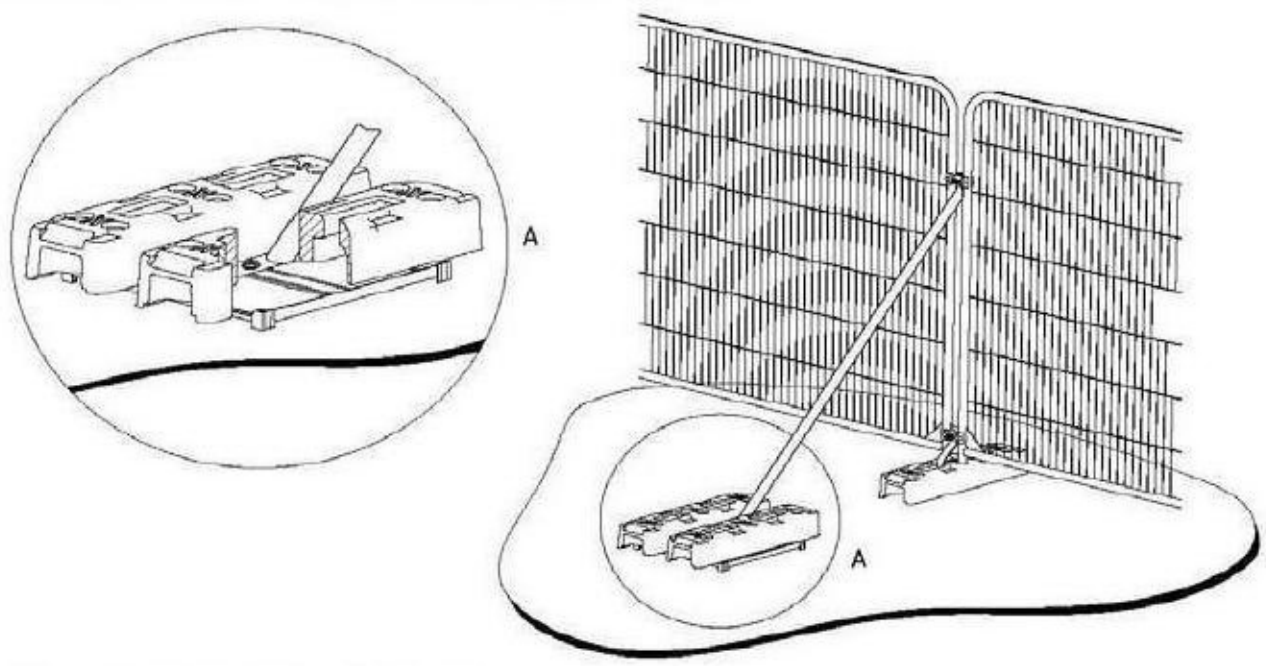
Where the fencing is installed above retained hard surfacing and/or it is otherwise not feasible to use ground pins (e.g., due to underlying services or structural roots), the struts can be mounted on a block tray as per figure 2b.

Figure 2 is taken from BS5837:2012 Trees in Relation to Design, Demolition & Construction – Recommendations and illustrates the systems to be employed for ensuring an adequate Construction Exclusion Zone about retained trees. Refer to BS5837:2012 for further details.

Figure 2 – above ground stabilising systems



a) Stabilizer strut with base plate secured with ground pins



b) Stabilizer strut mounted on block tray

Tree Root Protection Using Cellweb TRP®

Fact Sheet 2: Water and Oxygen Transfer Through the Cellweb TRP® System

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 or 4mm to 20mm clean angular stone 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 or 4mm to 20mm 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.

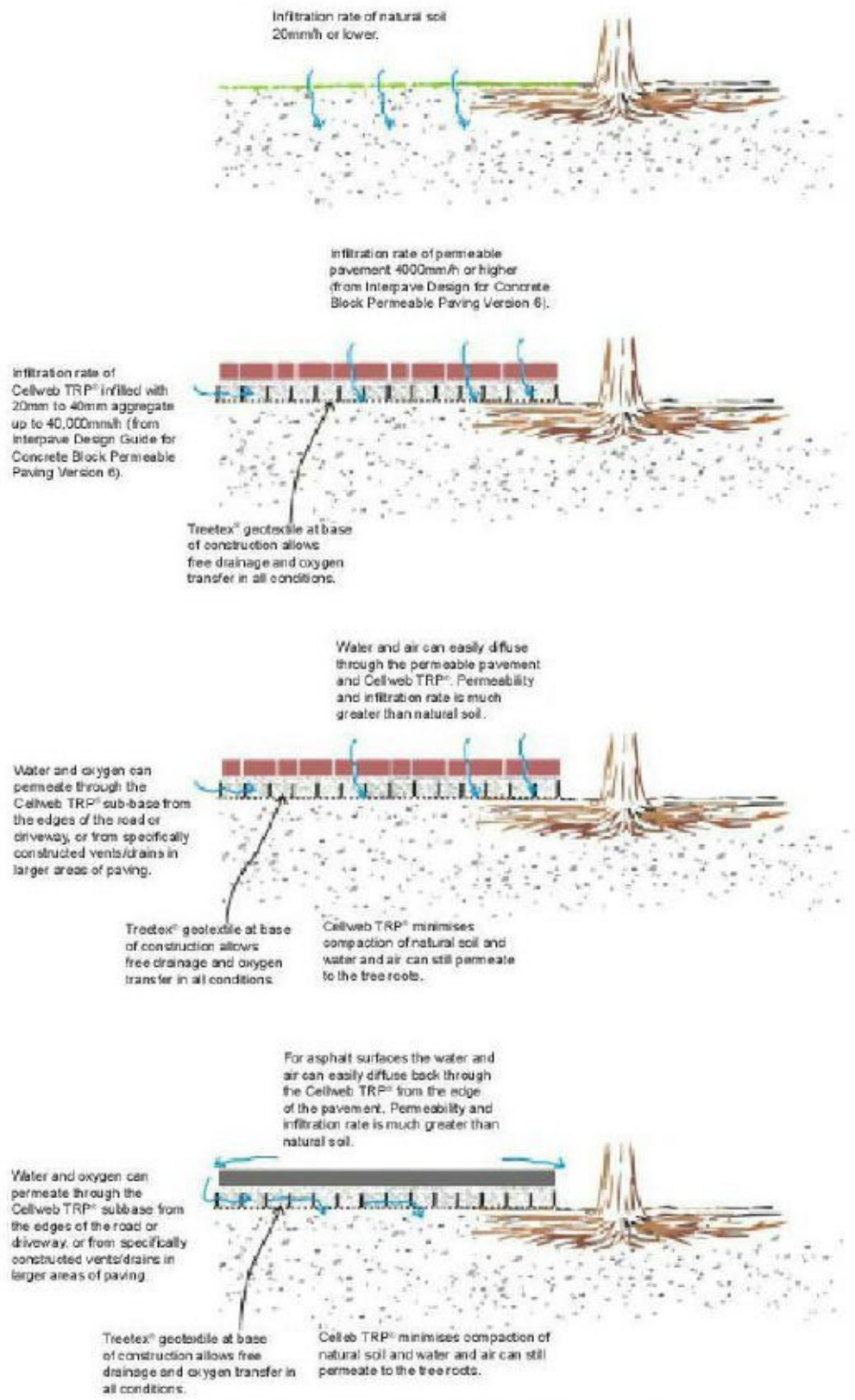


Figure 1 Water and oxygen availability in Cellweb TRP® tree root protection pavements

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.

Tree Root Protection Using Cellweb TRP®

Fact Sheet 2: Water and Oxygen Transfer Through the Cellweb TRP® System

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 x 10-4 g/s/m² using simple diffusion theory. For a natural sandy soil the rate of transfer to the same depth is around 7 x 10-5 g/s/m². 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 > 2500mm/h) in comparison with most rainfall events. The infiltration rate is also far higher than natural soils (infiltration rate for sand is quoted as >20mm/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

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

From Roberts et al (2006)

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.

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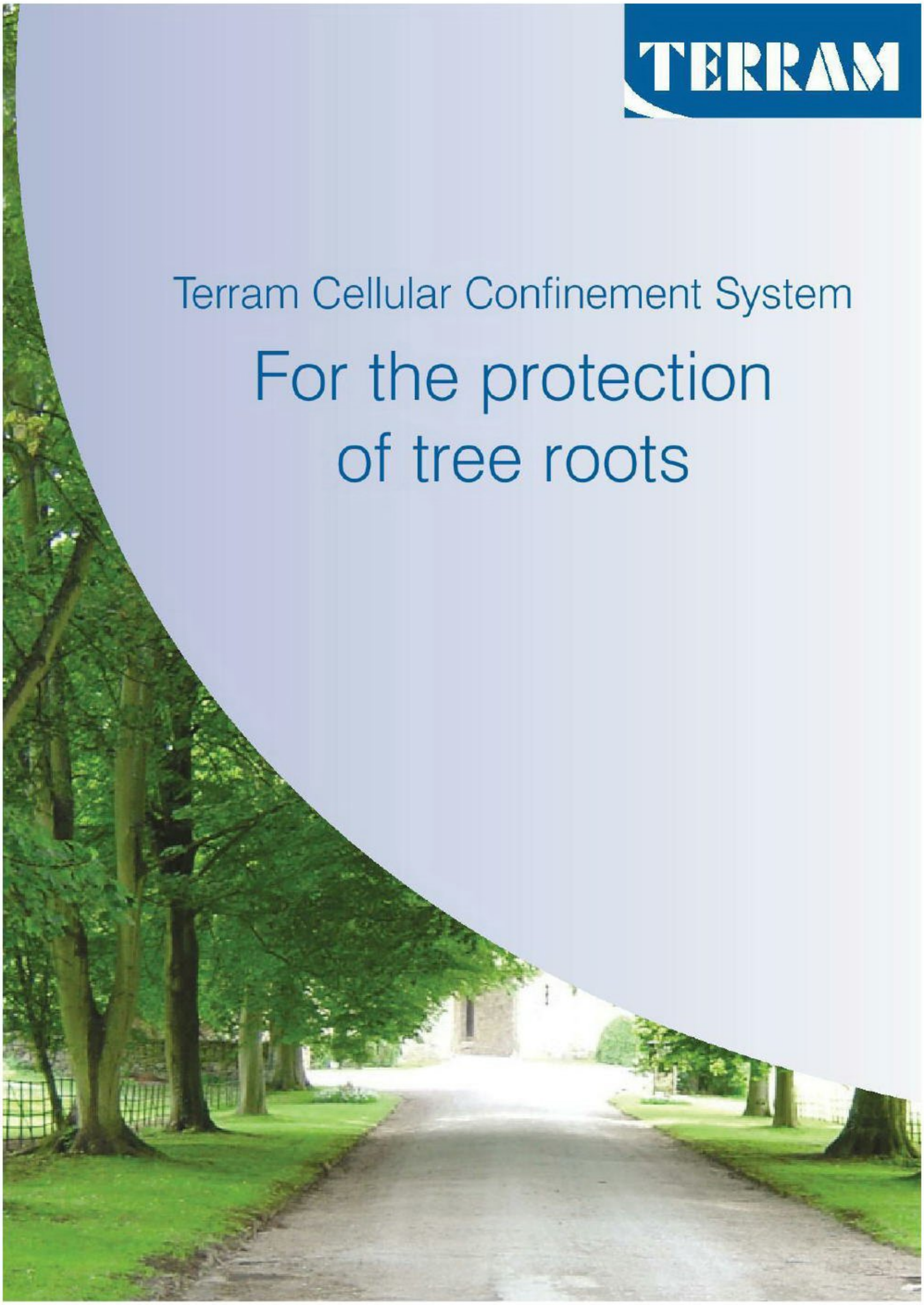
TERRAM

Terram Cellular Confinement System

For the protection of tree roots



Cellular Confinement Systems

The perfect no-dig ground reinforcement system.
Provides above-ground load bearing for paths and driveways whilst preventing soil compaction and protecting tree roots.

Damage to tree roots during driveway construction

The conventional method for constructing paths, drives and roads involves excavating soil to enable the installation of a sub-base that will adequately support traffic loads. Unfortunately this method of construction can badly damage trees since a by-product of the excavation is root severance. Most people don't realise that trees are very sensitive to disturbances in the soil around them. The reason for this is that, contrary to popular belief, trees do not have massive roots that go down deep into the soil but rather have lots of relatively small roots (frequently only a few centimetres in diameter) which spread out from the tree very close to the soil surface for quite large distances (often equal to the height of the tree).

If you imagine a tree system as a wine glass standing on a dinner plate you will have a roughly accurate idea of the above and below ground proportions of a tree (Figure 1). It may come as a surprise to learn that about 80-90% of all tree's roots are in the upper metre of soil (Figure 2). These roots serve two purposes: anchorage and absorption of moisture. If even relatively small roots are severed, for example by digging a trench, the tree can begin to suffer symptoms of drought stress as it is no longer able to obtain all its water needs. In addition the tree may become unstable as cutting the roots is a bit like cutting the guy ropes on a tent.

Figure 1

It is not only root severance that may harm trees but also compaction of the soil. If the root zone of a tree is not protected during development then the soil may become compacted by vehicles or heavy machinery moving repeatedly over the ground (Figure 3). The effect of compaction is to close up pores in the soil which contain air and water. The tree's roots then begin to suffer from both a lack of oxygen and a lack of moisture, and, as the soil becomes denser, roots find it hard to penetrate the soil. All this can lead to a dieback of the root system and frequently dieback of the tree. Raising of soil levels has a similar damaging effect as it deprives roots of oxygen and creates a build up of harmful carbon dioxide around the roots.

So, How Do Tree Roots Grow?

People often wrongly assume that tree roots are thick and grow down into the soil for many metres (Figure A). In reality tree roots:

- Are usually only large near to the trunk and get thinner the deeper and further from the tree they go. At a distance of just 3-4 metres from the trunk most roots are no bigger than a few centimetres in diameter.
- Spread outwards from the trunk, more or less parallel with the soil surface, rather than growing downwards (Figure B).
- Can spread horizontally in any direction for a distance equivalent to at least the tree's height.
- Are usually relatively shallow; 80-90% of a tree's roots are in the upper metre of soil. Few roots reach depths of more than about 2-3 metres and at this depth they are only a few millimetres in diameter.

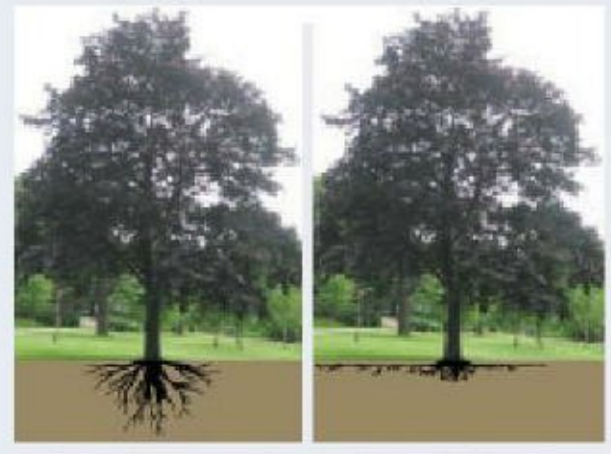


Figure A: Incorrect *Figure B: Correct*

Figure 2

British standard for trees in relation to construction and APN1

In recognition of the fact that trees are sensitive to disturbance the British Standards Institution has published recommendations on how to protect trees during development. In line with the earlier British Standard (BS 5837: 1991) the most recent guide, published in September 2005 (see further reading), recommends that there should be a 'root protection area' in which development should not be permitted.

In most cases this area has a radius equal to twelve times the trunk diameter and forms an exclusion zone around the tree protected by means of robust fencing. This guidance had the effect of prohibiting the installation of roads, driveways and parking areas near to trees. But In 1996 the Arboricultural Advisory and Information Service published Arboricultural Practice Note 1 Driveways Close to Trees (APN1) which suggested that driveways could be installed within the root protection area provided roots and the soil were not damaged.

The conditions set out for a suitable system were as follows:

- Roots must not be severed
- Soil should not be compacted
- Free movement of oxygen and carbon dioxide into and out of the soil should be maintained
- Water infiltration into the soil should not be impeded

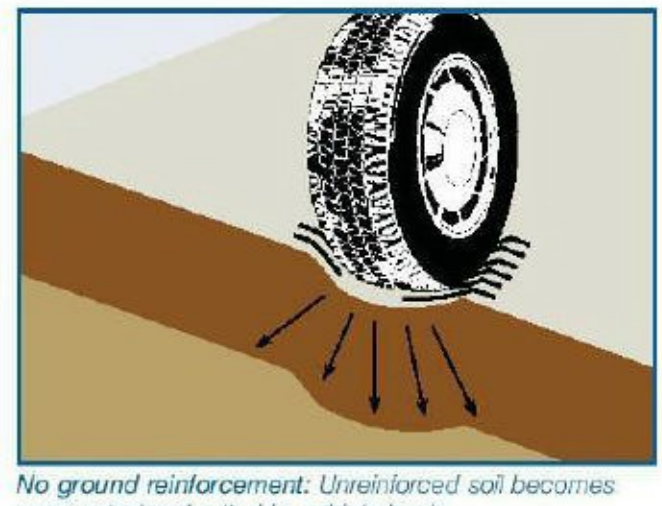
Thus, APN1 advised that driveways could be installed within the root protection zone provided that an above-ground, no-dig construction was used. This advice was incorporated into the recent British Standard which recommended that the most effective means of achieving this was through the use of a three-dimensional cellular confinement system.

Terram Geocell ground protection

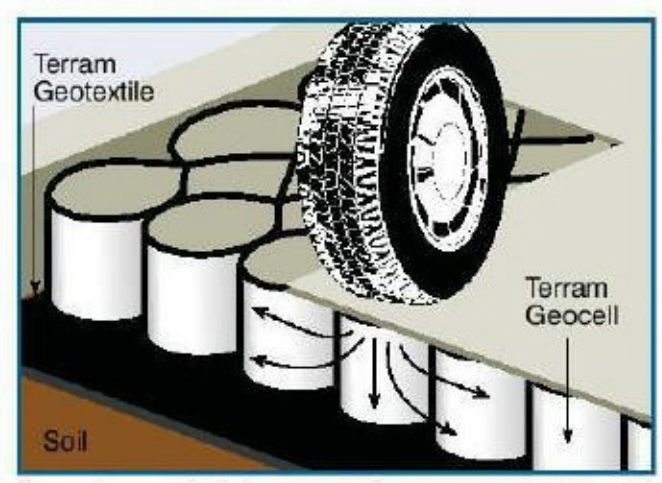
Terram Geocell is an ideal solution for providing ground reinforcement within tree protection areas. It confines fill material within its strong yet flexible cell structure in order to provide a stable base for traffic and an even load distribution (Figures 3 and 4). A big advantage of Terram Geocell over other products is that the geotextile material is permeable and allows lateral movement of air and water.

Terram Geocell is suitable for permanent woodland trails, paths, driveways, roads and parking areas.

It may also be used as temporary ground reinforcement where access to a site is limited by the presence of trees. Once operations on site are completed the temporary surface can easily be removed and the ground left undamaged.



No ground reinforcement: Unreinforced soil becomes compacted and rutted by vehicle loads



Geocell ground reinforcement: Forces are spread laterally reducing loads on the underlying soil

Figure 3. The Geocell distributes loads evenly in order to prevent rutting

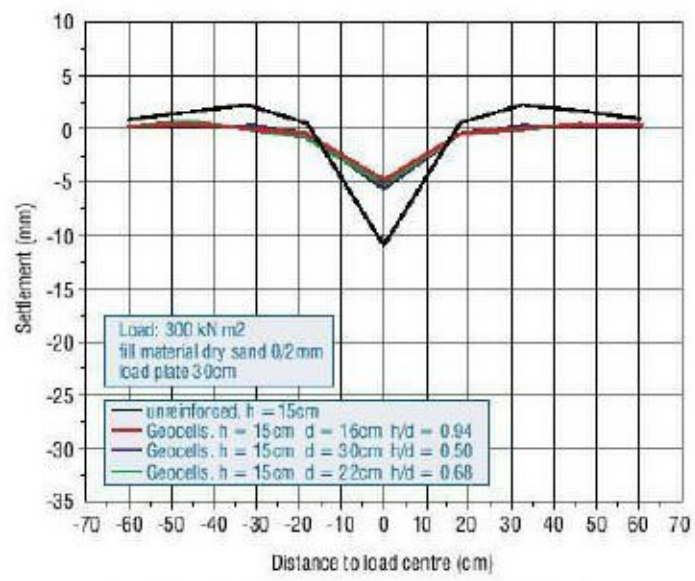


Figure 4. Static loading tests of up to 300kN/m2 revealed only minimal deflection (<5mm) of the surface of filled Geocell

Figure 5

Getting the design right

Every application will be slightly different so it is important to have the input of an engineer and arboriculturist together in order to design the right solution for an installation near to trees. The arboriculturist will be able to advise on tree protection issues and the engineer will be able to specify details such as cell depth, fill type (Figure 5) and load bearing capacity.

For example, the design of a pedestrian footpath may be less rigorous than that of an access road that may have to withstand the load of a heavy crane or a lorry.

But there are some principles that should be considered in every application (see Figure 6):

- **The ground must be protected at all stages during installation - there is no point in installing a ground protection system when soil or roots have already been damaged by other site activities**
- **Terram Geotextile should be used underneath the Geocell to prevent fill materials penetrating the soil**
- **The fill material should be granular and should permit water and air flow**
- **Any edgings should be carefully designed to avoid excavation and root severance**
- **A permeable and gas-porous wearing course should be installed above the Geocell**
- **In most cases the driveway or parking area should not exceed 20% of the root protection area.**

If correctly designed and installed the Geocell cellular confinement system should allow paths, drives and parking areas to be located within a tree's protection zone, thus enabling development that might not otherwise be permitted by local authorities.

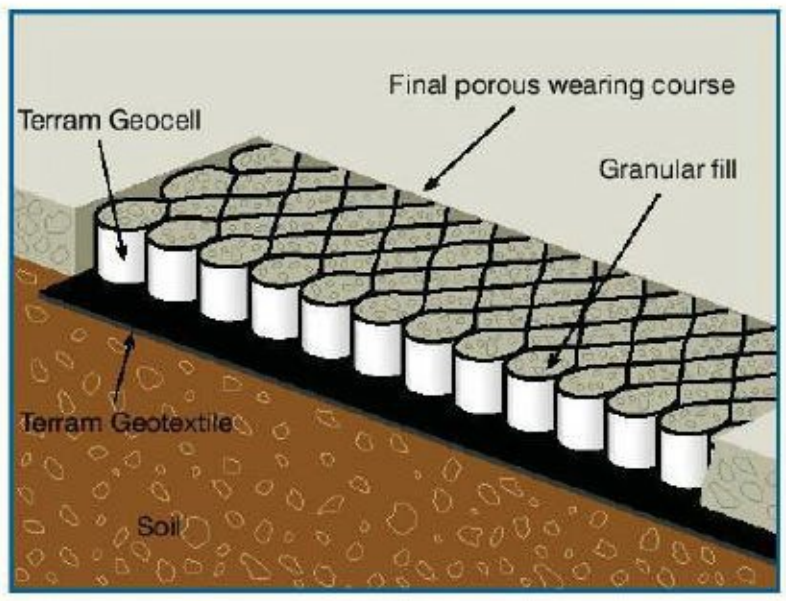


Figure 6. Components of an above-ground load-bearing platform suitable for vehicles

Example installation

Driveway construction

1 Remove grass and other vegetation and the upper organic layer of soil by hand digging. Arisings should be wheel-barrowed out of the tree protection area. Machinery (even low ground pressure tracked vehicles) should not be used due to the danger of soil compaction

2 Small depressions may be filled with sharp sand

3 Lay out Terram Geotextile over the driveway area

4 Lay out Terram GeoCell and carefully peg in place

5 Fill the cells working from the area furthest from the tree first. Further filling should be carried out using the filled Geocell as a platform

6 Install a permeable wearing course, e.g. porous tarmac, block paviours on a sharp sand base (a further layer of Terram above the filled Geocell will be needed in this case to prevent the sand mixing with the granular fill below).

Conclusion

BS5837 Trees in Relation to Construction and APN 1 allow the careful development of paths, drives and roads within the root protection area of trees provided an above-ground, no-dig construction is used.

The use of Terram Geocell as a ground reinforcement platform is therefore an ideal solution that can facilitate such development near to trees which might not otherwise be permitted due to fears of damage to soil structure and tree roots.

Further reading

BS 5837: 2005 Trees in Relation to Construction - Recommendations. British Standards Institution

Dobson, M. (1995): Tree Root Systems. Arboriculture Research and Information Note 130/ARB/95. Arboricultural Advisory and Information Service, Farnham.

Patch, D. and Dobson, M. (1996). Driveways Close to Trees. Arboricultural Practice Note 1. Arboricultural Advisory and Information Service, Farnham.

Nicholson, R. (2001). APN1, BS5837 & PPG 3, Guidance for Trees: Conflict or Complement? Arboricultural Journal 25, 361 - 376.

Products Available	Panel size	Depth	Cell Diameter
Erocell 22/20	5.0m x 10.1m	200mm	220mm
Erocell 25/15	7.0m x 10.0m	150mm	250mm
Erocell 25/10	7.0m x 10.0m	100mm	250mm

The cell depth and diameter is dependent upon specific site conditions

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Recommendations for use are a guide and purchasers must determine the suitability of the product for their intended use. Terram Ltd assumes no liability for claims beyond the replacement value of our product.

APPENDIX 5 TREE PROTECTION NOTICE

TREE PROTECTION BARRIER – ACCESS PROHIBITED

DO NOT TAMPER WITH THIS BARRIER OR REMOVE IT

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.