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Site Details: 27 Oakhill Avenue, London, NW3 7RD

Prepared for: The Basement Design Studio Ltd.

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Title: TBDS_27OA_AIA_001

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Report Index

1.0 – Summary of Instruction

A tree survey and report in accordance with BS 5837:2012 (Trees in relation to design, demolition and construction recommendations) was commissioned by our client, The Basement Design Studio, to support an application for planning consent in respect of development proposals at the above address.

The development proposal relates to:

- The construction of a basement and lightwell beneath the existing raised rear patio and part of the rear garden at the above property.

Instructions were to:

- Carry out a tree survey in accordance with the British Standard BS 5837:2012 (Trees in relation to design, demolition and construction recommendations) to:
    - Prepare an Arboricultural Impact Assessment to evaluate the direct and indirect effects of the proposed design and associated construction activity on nearby trees.
    - Categorise the trees at and adjacent to the site to ascertain their suitability for retention.
    - Identify the tree constraints to the development to assist with feasibility, conception and design.
    - Make recommendations for measures to be taken to protect the retained trees during the development process, to safeguard their short and long term health and condition, including those trees which are situated on adjacent properties / land to the proposed development site.
    - Provide all relevant tree data including species, dimensions, life stage, condition assessments and make preliminary management recommendations.
    - Highlight the arboricultural implications that the development process may have on the retained trees and provide a method statement to show the necessary controls required to mitigate those identified implications.
    - Produce findings in a written report for submission to the local planning authority.

The BS 5837:2012 study provides an assessment of the impacts the development process may have on the trees at and adjacent to the site and vice versa, including recommendations for the implementation of necessary control measures.

2.0 – Report Limitations – (*The scope of this report is restricted by the following limitations*)

- All observations of tree conditions were from ground level within the boundaries of the development site and at street level, a visual assessment of external features only, assisted as required by the use of binoculars, a metal probe and a rubber mallet (used for audible resonance testing) where necessary. Below ground tree roots and buried parts were not inspected.
- A topographical survey of the development site was not provided prior to the tree survey.
- Tree positions and distances from existing structures were manually measured at the time of the tree survey, as site conditions allowed, for plotting onto the site plans supplied by The Basement Design Studio.
- The provided site plans are used to create the Tree Constraints and Tree Protection Plans.
- All measurements of tree heights and crown spreads and crown clearance are recorded to the nearest half metre for dimensions up to 10m and to the nearest metre for dimensions over 10m.
- Stem diameters are measured to the nearest 10mm or where inaccessible, estimated based on the visible features and characteristics of the tree in question.
- Neighbouring trees were inaccessible for close inspection.
- Detailed background information is not known concerning the past history of the site, the soil type, geology or hydrology of the environs. No inspection material has been acquired by Tree Sense Arboricultural Consultants for assessment by a laboratory.
- Geotechnical analysis and soil assessment will be necessary at the site to understand the soil structure and sub soil conditions in respect of the scheme feasibility.
- The recommendations made in this report relate to the assessment of the trees and their surroundings at the time of inspection. Treatment recommendations assume that the client understands that tree management is a continuing process, requiring regular attention and that as part of this process the condition of the trees should be thoroughly reassessed at regular, timely intervals, with hazard checks after periods of likely tree stress, e.g. after periods of severe weather.
- Weather conditions were dry and bright on the day of the survey.
- Where a tree is subject to a Tree Preservation Order (TPO) and/or stands within a designated Conservation Area, it will be necessary for the tree owner or his/her appointed agent to ensure appropriate compliance with planning requirements, before any recommended, non-urgent treatments can be undertaken. (See Section 12).

2.1 – Time Limits

It should be understood that trees are not static objects, but growing, living organisms; and their condition, size and relationship to buildings and other trees can change significantly and sometimes unpredictably over a period of time. Therefore this report has a validity period of 12 months from the date of publication and is subject to any suggested management recommendations being undertaken within the correct time frames.

2.2 – Severe Weather Limitations

Impacts of severe drought, storm, inundation, land slip or subsidence are not covered by this report.

3.0 – Background and Process

The proposal for the construction of a basement and lightwell beneath the existing rear patio and rear garden is currently in the initial feasibility, planning and design stage. The arboricultural survey in accordance with BS 5837 : 2012 Trees in relation to design, demolition and construction recommendations was commissioned to be undertaken as part of the initial feasibility study and planning stage of the process.

The elements of the arboricultural survey at this stage in the process were to undertake the tree survey, categorise the trees and identify the tree constraints to the development, with a view to assisting with the conceptual design and feasibility of the proposal. The tree survey was commissioned after an initial design proposal had been prepared and therefore the tree constraints initially may not have been taken fully into consideration.
The identified tree constraints should inform and assist with the final design, including any necessary engineering solutions and demolition/construction methods which will need to be explored in respect of minimising damage to retained trees in the short and long term, both above and below ground level. Additionally, the identified constraints will also determine the specification and positioning of tree protection measures to be employed at the site to safeguard the trees above and below ground throughout the development process.

Following the identification of tree constraints, an Arboricultural Impact Assessment evaluates the identified direct and indirect effects of the proposed design in relation to nearby trees. The assessment will consider the effect of any tree loss or damaging activities proposed in the vicinity of retained trees. Activities such as:

- Removal of existing structures or hard surfacing.
- Installation of new hard surfacing.
- The location and dimensions of proposed excavations or alterations in ground levels.

In addition to the permanent works, account should be taken to the buildability of the scheme in terms of access, plant machinery use, adequate operational space and provision for the storage of materials including topsoil, without inflicting damage to the retained trees. Post development pressure on nearby trees must also be closely considered and assessed.

As well as an evaluation of the extent of the impact on existing trees, the arboricultural impact assessment includes and details within this document:

a) The tree survey;

b) Trees selected for retention, clearly identified (e.g. by number) and marked on a plan with a continuous outline;

c) Trees to be removed, also clearly identified (e.g. by number) and marked on a plan with a dashed outline or similar;

d) Trees to be pruned, including any access facilitation pruning, also clearly identified and labelled or detailed as appropriate;

e) Areas designated for structural landscaping that need to be protected from construction operations in order to prevent the soil structure being damaged;

f) Evaluation of impact of proposed tree losses (if applicable);

g) Evaluation of tree constraints and production of a draft tree protection plan including details of tree protection measures;

h) Issues to be addressed by an arboricultural method statement where necessary in conjunction with input from other specialists associated with the project.

4.0 – General Observations

The property at 27 Oakhill Avenue features a semi detached, two storey dwelling with a well maintained front garden and spacious private garden to the rear.

The front garden features a hard surfaced pathway on the western side, leading from the street to the front of the dwelling, with an expanse of lawn and a small mixed hedge line on the eastern side. Side access is available along the western side of the dwelling, leading directly into the rear garden via a gated access point.

The rear garden is predominantly lawn at the lower level below the raised patio area, which is situated directly off of the rear elevation of the dwelling. Two trees were identified in the rear garden amongst numerous smaller shrubs and ornamental planting around the garden borders.
A young variegated *Ilex aquifolium (Holly)* is located close to the east side boundary, 8.5m from the rear elevation of the dwelling and a semi mature *Prunus.sp (Purple Leaved Cherry)* is located on the western side of the garden, 2.1m in from the west boundary and 17m from the rear elevation of the dwelling.

No other on site trees were identified, however a number of trees located in neighbouring residential properties were considered as part of the BS 5837:2012 study, plus one street tree growing close to the front boundary of the property on Oakhill Avenue. Due to their close proximity to the development site, these neighbouring trees were considered as they could potentially pose a constraint to the proposal. The trees identified in neighbouring residential gardens were inaccessible in terms of obtaining accurate stem measurements and structural assessment.

All trees considered in the BS 5837:2012 study are shown on the Tree Constraints / Tree Protection Plans in Sections 8.0 and 9.1 respectively.
Details of all the individual trees surveyed for inclusion can be found in the Individual Tree Data Table in Section 5.0 below.

5.0 – Individual Tree Survey Data

Tree No.	Species	Height (m)	Stem Diameter (mm)	Branch Spread (m)	First Significant Branch Height and Direction of Growth (m)	Canopy Height (m)	Life Stage	General Comments Inc. Physiological and Structural Condition	Preliminary Management Recommendations	Estimated Remaining Contribution (Years)	Category
1	*Prunus.sp* *(Purple Leaved Cherry)*	10	225	N – 2 E - 2 S – 2 W – 2	4 - N	4	SM	Physiological Condition – Good Structural Condition – Fair Some minor deadwood visible in the crown.	_	20	B 1
2	*Ilex aquifolium* *(Holly)*	6	120	N – 2 E - 2 S – 2 W – 2	2 - E	2	Y	Physiological Condition – Good Structural Condition – Good	_	20	B 1
3	*Acer pseudoplatanus* *(Sycamore)*	11	300	N – 4 E - 4 S – 4 W – 4	4 - E	4	Y	Physiological Condition – Good Structural Condition – Good Street tree growing in front of the property on Oakhill Avenue.	_	20	B 1
4	*Fraxinus excelsior* *(Common Ash)*	14	600 Est.	N – 5 E - 4 S – 3 W – 5	4 - N	4	M	Physiological Condition – Fair Structural Condition – Fair Growing in a neighbouring garden to the west. Abundant, dense Ivy growth has engulfed the entire stem and the majority of the crown framework. What can be seen of the crown framework by way of visible limbs and top section of the main stem has been used to assist with estimating the stem diameter measurement at 1.5m. Appearance suggests the tree has been pollarded historically. Major and minor deadwood visible in the visible crown. The tree is not under the management control of the applicant.	_	<20	C 1

Tree No.	Species	Height (m)	Stem Diameter (mm)	Branch Spread (m)	First Significant Branch Height and Direction of Growth (m)	Canopy Height (m)	Life Stage	General Comments Inc. Physiological and Structural Condition	Preliminary Management Recommendations	Estimated Remaining Contribution (Years)	Category
5	*Acer pseudoplatanus (Sycamore)*	15	600 Est.	N – 4 E - 4 S – 4 W – 5	6 - W	6	M	Physiological Condition – Fair Structural Condition – Fair Growing in a neighbouring garden beyond the rear southern boundary and one property along to the east. Part of a group of mature trees along the property boundary line (T5 – T8). Abundant, dense Ivy growth has engulfed the entire stem and the majority of the crown framework. What can be seen of the crown framework by way of visible limbs and top section of the main stem has been used to assist with estimating the stem diameter measurement at 1.5m. The tree is not under the management control of the applicant.	_	20	B 1,2
6	*Acer pseudoplatanus (Sycamore)*	10	500 Est.	N – 4 E - 3 S – 3 W – 6	4 - W	4	M	Physiological Condition – Fair Structural Condition – Fair Growing in a neighbouring garden beyond the rear southern boundary and one property along to the east. Part of a group of mature trees along the property boundary line (T5 – T8). Abundant, dense Ivy growth has engulfed the entire stem and the majority of the crown framework. What can be seen of the crown framework by way of visible limbs and top section of the main stem has been used to assist with estimating the stem diameter measurement at 1.5m. The tree is not under the management control of the applicant.	_	20	B 1,2

Tree No.	Species	Height (m)	Stem Diameter (mm)	Branch Spread (m)	First Significant Branch Height and Direction of Growth (m)	Canopy Height (m)	Life Stage	General Comments Inc. Physiological and Structural Condition	Preliminary Management Recommendations	Estimated Remaining Contribution (Years)	Category
7	*Acer pseudoplatanus (Sycamore)*	15	400 Est.	N – 3 E - 4 S – 3 W – 5	5 - W	5	M	Physiological Condition – Fair Structural Condition – Fair Growing in a neighbouring garden beyond the rear southern boundary and one property along to the east. Part of a group of mature trees along the property boundary line (T5 – T8). Abundant, dense Ivy growth has engulfed the entire stem and the majority of the crown framework. What can be seen of the crown framework by way of visible limbs and top section of the main stem has been used to assist with estimating the stem diameter measurement at 1.5m. The tree is not under the management control of the applicant.	_	20	B 1,2
8	*Acer pseudoplatanus (Sycamore)*	15	500 Est.	N – 2 E - 4 S – 4 W – 6	5 - W	5	M	Physiological Condition – Fair Structural Condition – Fair Growing in a neighbouring garden beyond the rear southern boundary and one property along to the east. Part of a group of mature trees along the property boundary line (T5 – T8). Abundant, dense Ivy growth has engulfed the entire stem and the majority of the crown framework. What can be seen of the crown framework by way of visible limbs and top section of the main stem has been used to assist with estimating the stem diameter measurement at 1.5m. The tree is not under the management control of the applicant.	_	20	B 1,2

Key to Table 5.0

1) Height describes the height of the tree from ground level in metres
2) Stem Diameter is the Diameter of the trunk in millimetres at approx 1.5m from ground level. For multi stemmed trees, a single stem diameter equivalent (SE) is calculated and is indicated beneath the measurements of each separate stem. (Est.) indicates the stem diameter was estimated due to the tree being obscured and/or inaccessible to measure.
3) Branch Spread is the length of branch spread from the centre of the tree in the direction of each cardinal point in metres
4) First Significant Branch Height and Direction – Clearance height from the ground of the first major structural branch of the trees' crown and it's direction of growth
5) Canopy Height is the distance between the canopy branches and ground level in metres
6) Life Stage is represented as: Y= young, SM = Semi Mature, EM = Early Mature, M= Mature, OM = Over Mature, V = Veteran
7) Estimated Remaining Contribution is an indication of the minimum useful contribution the tree will provide
8) Preliminary Management Recommendations indicate the need for tree surgery work before construction activity begins
9) Category grading is based on tree categorization guidelines provided within The British Standard 5837:2012 Trees In relation to design, demolition and construction recommendations (See 6.0 below)

Major deadwood = over 25m diameter, Minor deadwood = under 25mm diameter

5.1 – Tree Data Notes

The trees detailed in Table 5.0 above are those to be considered as potentially affected by the proposed basement development project.

T4 – T8 are all growing on neighbouring properties in close proximity to the development site and were inaccessible to accurately asses or measure. Additionally, in all cases of these neighbouring trees, the stems were covered with dense Ivy growth and located behind boundary fencing. Therefore, the estimates of their stem diameters at 1.5m from ground level have been made based on the overall size and form of the trees and the visible sections of their stems and crown frameworks.

Recommendations for tree surgery work may have been made in the interest of good tree management and are not necessarily required in relation to the proposed development project.
Any tree surgery work recommended must be undertaken following the correct procedures relating to trees protected by Tree Preservation Orders or which are growing within a designated Conservation Area. (See Section 12).

All recommended tree work must be undertaken in accordance with guidelines set out in BS 3998 : 2010 (Recommendations for tree work).

The following sections provide information regarding the categorisation of the surveyed trees and the tree constraints which have been identified at the site.

6.0 – Tree Categorisation

The purpose of Tree Categorisation as detailed in BS 5837:2012 (Trees in relation to design, demolition and construction Recommendations), is to identify the quality and value of existing tree stock, allowing informed decisions to be made concerning which tree(s) should be retained or removed should development occur. This process is the starting point of the tree survey, following a land survey and should, ideally, be undertaken before any site design or layout is proposed.

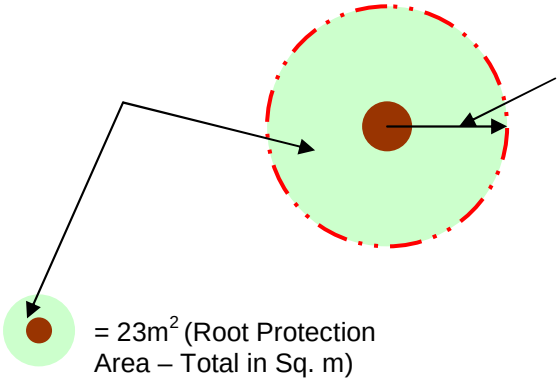
Once it has been established which trees can and are suitable to remain and are worthy of retention, the necessary measures to protect them throughout the course of the development project should be undertaken.
The following sections relate to the protection of the trees categorised for retention, during the construction process at the development site, and to trees which are growing adjacent to the development site. The first of these sections identifies the tree constraints to the development, which is required to assist with the design proposal and ensure the correct levels of tree protection measures are applied.

7.0 - Tree Constraints

The tree constraints are the influences the trees will have below and above ground level in relation to the development area. The below ground restraints are represented by the trees Root Protection Area (RPA), the above ground restraints are represented by the trees size and position, including shading patterns caused by crown density and spread which may affect light into newly developed buildings.

7.1 - RPA (Root Protection Area) – (Below Ground Constraints)

The RPA radius is taken from the centre of the tree stem, encircling the tree to give the RPA Area (example based on T1 shown below) **:



2.7m from the centre of the tree stem = (Root Protection Area - Radius)

= 23m^2 (Root Protection Area – Total in Sq. m)

** Tree root systems do not necessarily show the symmetry indicated in the above example, the development of all roots is influenced by the availability of water, nutrients, oxygen and soil penetrability. As far as these conditions allow, the root system tends to develop sufficient volume and area to provide physical stability.

The following table indicates the Root Protection Areas (RPA) for the trees which were surveyed and categorised as suitable for retention. The RPA's have been calculated using the measurements collected at the time of the survey and detailed in Table 5.0, using formulae detailed in BS 5837:2012 Trees in relation to design, demolition and construction recommendations – Section 4.6 and Table D.1.

Tree No.	RPA Radius (m)	RPA Area (m^2)
1	2.7	23
2	1.4	6
3	3.6	41
4	7.2	163
5	7.2	163
6	6	113
7	4.8	72
8	6	113

7.2 – Above Ground Constraints

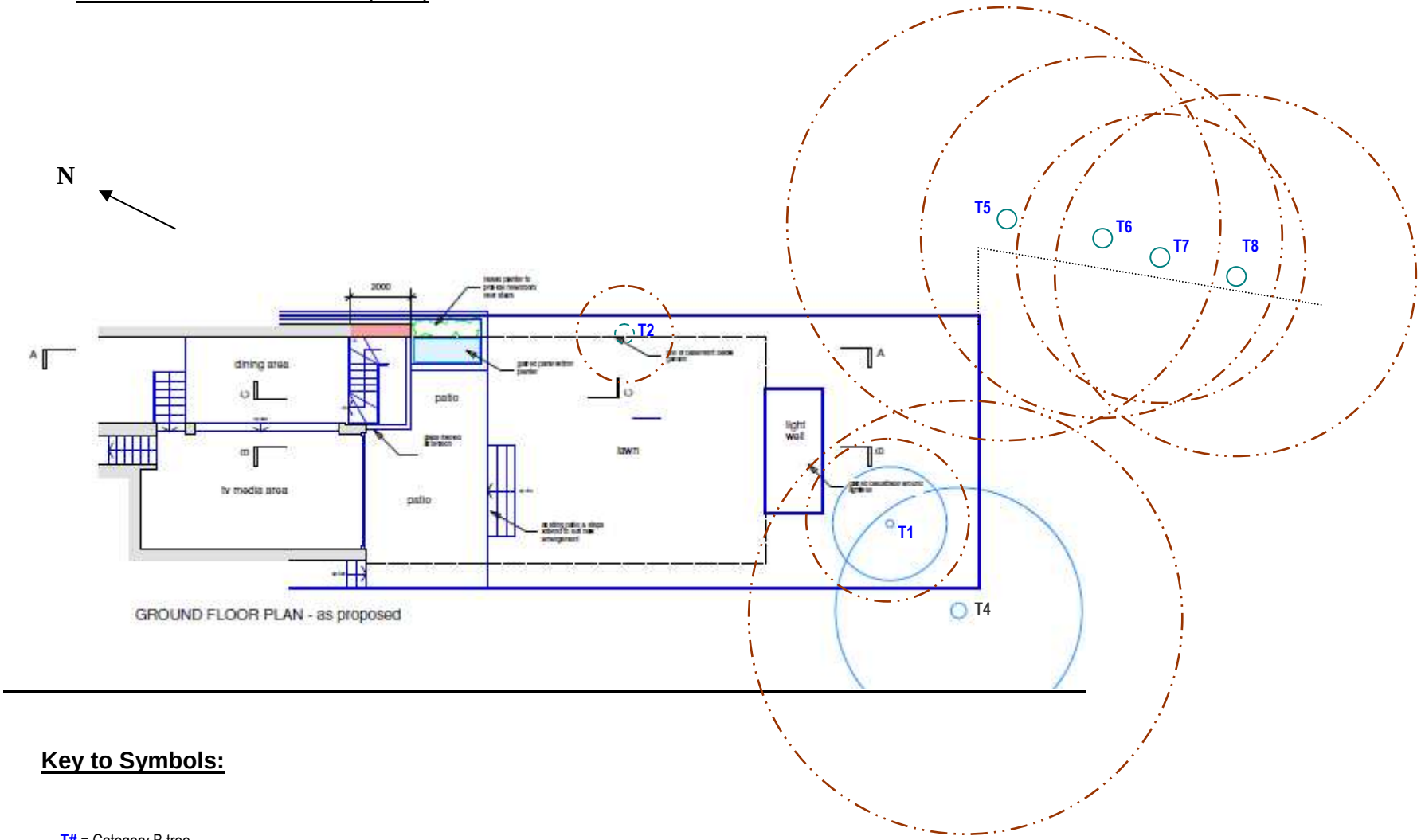
The above ground constraints caused by tree heights and the spread of branches can pose constraints to the development project in respect of demolition work, new building design, position and operational space requirements.
For example, if the lateral branch spread of a tree extends into areas where development activity is likely, there is a risk of potential direct impact from site machinery and construction activity on the tree crowns which may cause damage to branches. Tree stems and exposed buttress roots are also above ground constraints which need to be considered in respect of possible impact damage to them. Post development pressure is also of material consideration in respect of future tree pruning requirements and frequency following completion of the development.

Shading issues should also be considered in respect of tree size, form and position in relation to the proposed new structure.
Species characteristics such as density of foliage, and whether trees are deciduous or evergreen are important factors to consider in respect of shading issues which may affect light levels into the proposed dwelling.

Any proposals for above ground service installations such as telecommunication cables should also be considered with close reference to the above ground constraints posed by the trees at the development site, their location and their crown spreads.

The Tree Constraints Plan (TCP) and Tree Protection Plan (TPP) in Sections 8.0 and 9.1 below, indicate the above and below ground constraints of all relevant trees at and adjacent to the site, with comments relating to the identified constraints in Sections 8.1 and 8.2.

8.0 – Tree Constraints Plan (TCP)



Key to Symbols:

T# = Category B tree

T# = Category C tree

= Root Protection Area (RPA)

8.1 - Tree Constraints Plan Notes:

The Tree Constraints Plan (TCP) in Section 8.0 is provided for illustrative purposes only, and is shown to approximate 1:200 scale based on the site plan provided by The Basement Design Studio.

The TCP is provided only to indicate the position, category and numbering of the surveyed trees and provide an indication of the tree constraints by showing a graphic of the calculated Root Protection Areas (RPA) and the relevant tree crown spreads (if the crown spreads are deemed to potentially hinder operational restrictions).

RPA measurements can be found in the RPA table in section 7.1, Crown spread measurements can be found in table 5.0 above.
Only the RPA measurements detailed in section 7.1 are to be used to measure out and determine the positioning and installation of the Construction Exclusion Zone (CEZ) fencing and ground protection at the site, unless otherwise advised. (I.e. when low crown spreads travel further than the calculated RPA and require exclusion, CEZ fencing must be extended if possible to enclose the branches).

As described in section 7.1 above, tree root systems do not necessarily show the symmetry indicated in the above Constraints Plan, the development of all roots is influenced by the availability of water, nutrients, oxygen and soil penetrability. As far as these conditions allow, the root system tends to develop sufficient volume and area to provide physical stability.

Using the formula described in BS 5837:2012 Trees In relation to design, demolition and construction Recommendations (Section 4.6 of the standard), the calculated RPA should be shown as a nominal circle on the Tree Constraints Plan with a radius based on 12 times the stem diameter for a single stem tree.

RPA calculations for T4 – T8 were made using estimated stem diameters as all neighbouring trees were inaccessible to measure.
Additionally, all neighbouring tree stems were completely obscured from view at 1.5m from ground level, by the presence of dense Ivy growth on the stems and boundary fencing. Stem diameters were estimated based on the size and form of each individual tree and the visible sections of their respective stems and crown frameworks.

8.2 – Tree Constraints Assessment & Findings

The identified constraints shown on the Tree Constraints Plans (TCP) in Section 8.0 were established following the tree survey, using data collected at that time.
The tree constraints are to be used to assist with the final design and feasibility of the project and to determine the layout of tree protection measures to create the Construction Exclusion Zones (CEZ) at the site.

In terms of constraints to the development proposal below ground level and the impact on Root Protection Areas (RPA), the only trees which are deemed to be impacted upon are T1, T2 and T4. All other trees considered as part of the BS 5837:2012 study are shown to not have RPA spreads into the area where excavations for the new basement construction is to occur. T3 is a street tree growing at the front of the site and is not shown on the TCP.

T2 appears to be the greatest affected in terms of RPA impact, however it should be noted that this tree is a young, ornamental tree that is small in form and planted in the eastern border of the rear garden. It is recommended that this tree is removed prior to the basement development and a new tree planted on completion.

T1 is also growing on site but shows only a marginal crossover into the proposed area where the lightwell is to be excavated.

The neighbouring T4 also shows a marginal crossover of its RPA into the area where the main basement and lightwell excavations are proposed.

In both cases, the crossover of the basement proposal is at the extremity of both respective RPA's. No major, supportive roots will be encountered at these extremities only fine, feeder roots may be encountered.
Any loss of feeder roots at these points will be minimal and will not detrimentally impact on the physiological health or life processes of the trees.
Tree feeder roots regenerate all year round, particularly when roots become dysfunctional. For example, this includes root loss occurring due to low temperature extremes during the winter months, or if the soil environment becomes waterlogged or compacted, restricting oxygen into the soil which is a necessary requirement for root survival and function.

Typically, tree feeder roots will be found in the top 600mm of the subsoil.
Using T4 as an example, the sector of crossover would amount to approximately $1.2m^2$ of the nominal RPA shown which has a total area of $163m^2$. Therefore any feeder roots encountered and lost within this sector would equate to less than 1% of the root network.
Whereas in the case of T2, the young Holly tree, the sector impacted upon based on the nominal circle shown for its RPA would be 50%. Loss of 50% of the root system would likely result in the decline and loss of the tree, hence it is recommended that this small tree is removed prior to the development.

All other trees included in the BS 5837:2012 assessment do not show RPA crossover into the area where excavations are required to construct the basement and lightwell. There are no above ground tree constraints to the development proposal. (i.e. low crown branches).

T1, T4, T5 and T6 are shown to feature sectors of their RPA's within the boundaries of the site, but not necessarily crossing over the basement footprint. These areas will warrant exclusion from associated construction activity to protect them from soil compaction and contamination. (See Sections 9.0 – 10.1 below)

Tree protection measures must be installed at the site to create Construction Exclusion Zones (CEZ) to safeguard the trees and their respective RPA's from the detrimental effects of construction activity etc. The Tree Protection Plan (TPP) in Section 9.1 indicates the layout of the required CEZ measures.
All of the relevant arboricultural implications are addressed in Sections 10.0 and 10.1 below, detailing what control measures are required to mitigate the identified implications to the trees.

9.0 – Construction Exclusion Zone (CEZ) – (General)

Retained trees in close proximity to the site must be protected by barriers and/or suitable ground protection before any materials or machinery are brought onto the site, and before any demolition, development or soil stripping commences.

Where all activity can be excluded from the tree's Root Protection Area (RPA), vertical barriers are to be erected to create a Construction Exclusion Zone (CEZ). Where, due to site constraints construction activity cannot be fully or permanently excluded in this manner from all or part of a trees' RPA in unmade ground, suitable temporary ground protection is to be installed over exposed RPA sectors.

The RPA measurements of the surveyed trees (as shown in section 7.1 above) are used to help determine the Construction Exclusion Zone (CEZ) around the trees, protecting them during the construction phases to eliminate the possibility of damage above or below ground level.
The CEZ is created by fencing off the area and/or installing suitable ground protection that is fit for purpose, using the calculated distance of the trees' RPA Radius as shown in the table in section 7.1 above.
The CEZ is required so that the calculated RPA's of trees remain undisturbed during the development process by excluding all activity from the area, or by protecting any exposed RPA sectors from pedestrian and vehicular traffic with suitable ground protection if exposed outside of the barrier fencing.
The CEZ should also be positioned to protect tree stems, buttress roots and any low tree branches which may travel beyond the calculated RPA. In these cases, barrier fences should be extended to incorporate the low crown branches behind them if possible.

The storage of building materials also must not occur within the CEZ. An area for storage of materials, fuels, spoil and the mixing of cement and concrete will be determined during the planning phase to ensure the RPA's of the trees are not affected. (See Arboricultural Method Statement (AMS) 10.1 below).
Materials which can be considered as contaminates such as cement, concrete mixings, spoil and fuels, whose accidental spillage would cause damage to a tree, should be stored and handled well away from the outer edge of any tree RPA. This also includes vehicle washings and care must be taken to ensure that sloping ground will not allow for contaminates to travel into the CEZ.

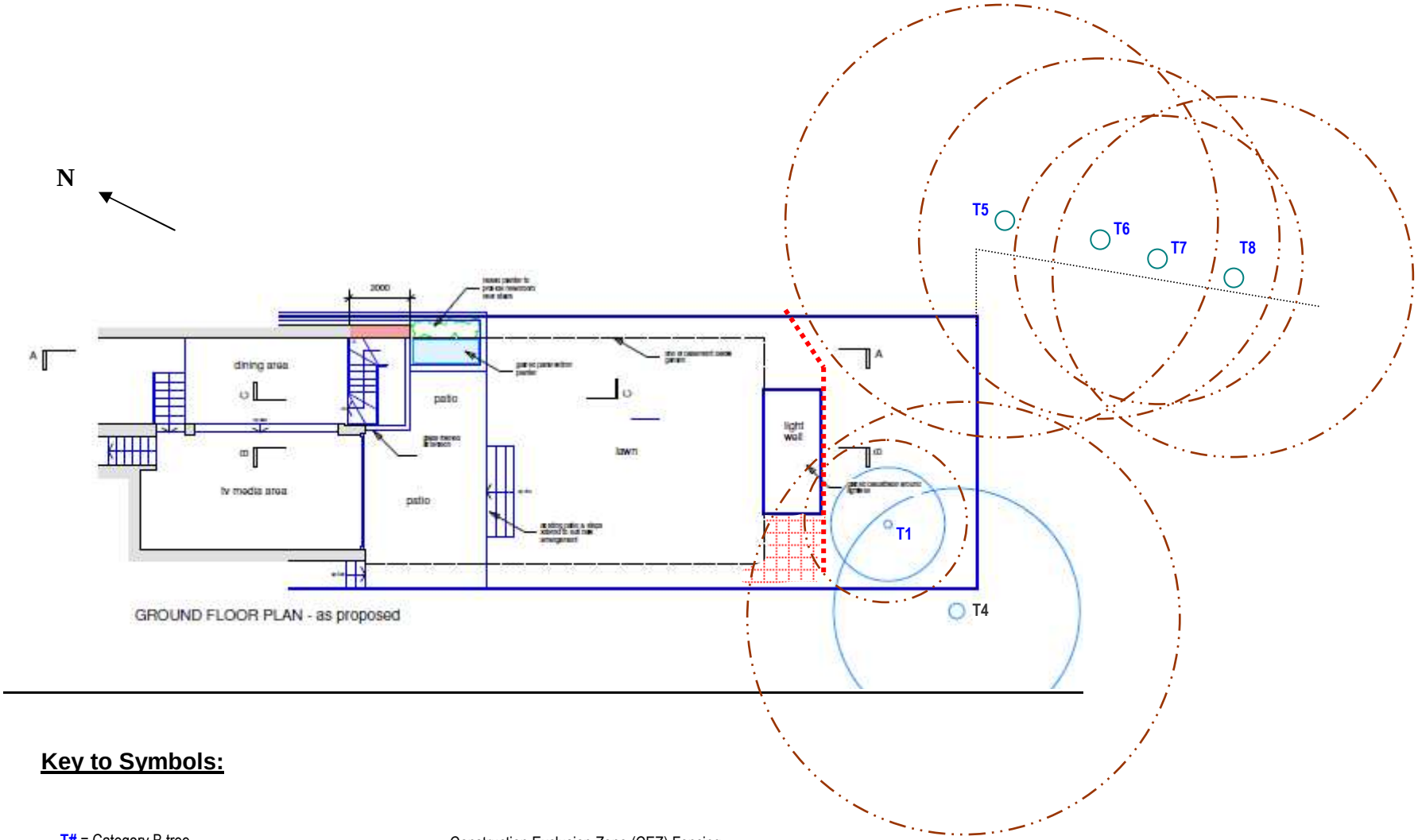
Fires on site should be avoided if possible. Where they cannot be avoided, they should not be lit where heat could affect foliage or branches. The potential size of the fire and wind direction should be taken into account when determining the fires location and it should be attended at all times until safe enough to leave. Notice boards, cables or other services must not be attached to the tree stems.

The CEZ must be considered as sacrosanct and not removed or altered without prior consultation with a Tree Sense Arboriculturist. The fencing should also display a sign with words to the effect of "Construction Exclusion Zone – Keep Out".

Care must also be taken to ensure that any site activity involving any cranes or vehicles with booms, jibs and counterweights can operate without coming into contact with the protected tree(s). CEZ fencing should be extended to encapsulate low spreading branches if they travel beyond the calculated RPA.

Direct impact from vehicles with tree crowns and stems can cause irreparable damage and may make their safe retention impossible. Consequently, any transit or traverse of plant in proximity to trees should be conducted under the supervision of a banksman, to ensure that adequate clearance from trees is maintained at all times.

9.1 – Tree Protection Plan (TPP)



Key to Symbols:

T# = Category B tree

T# = Category C tree

= Root Protection Area (RPA)

= Construction Exclusion Zone (CEZ) Fencing

= Temporary Ground Protection

9.1.1 – Tree Protection Notes

The above Tree Protection Plan (TPP) is for illustrative purposes only, and is shown to approximate 1:200 scale based on the proposed site drawing supplied by The Basement Design Studio.
The TPP is provided only to indicate the position, category and numbering of the surveyed trees to be retained and provide an indication of the tree constraints by showing a graphic of the calculated Root Protection Areas (RPA) and any relevant tree crown spreads if applicable.

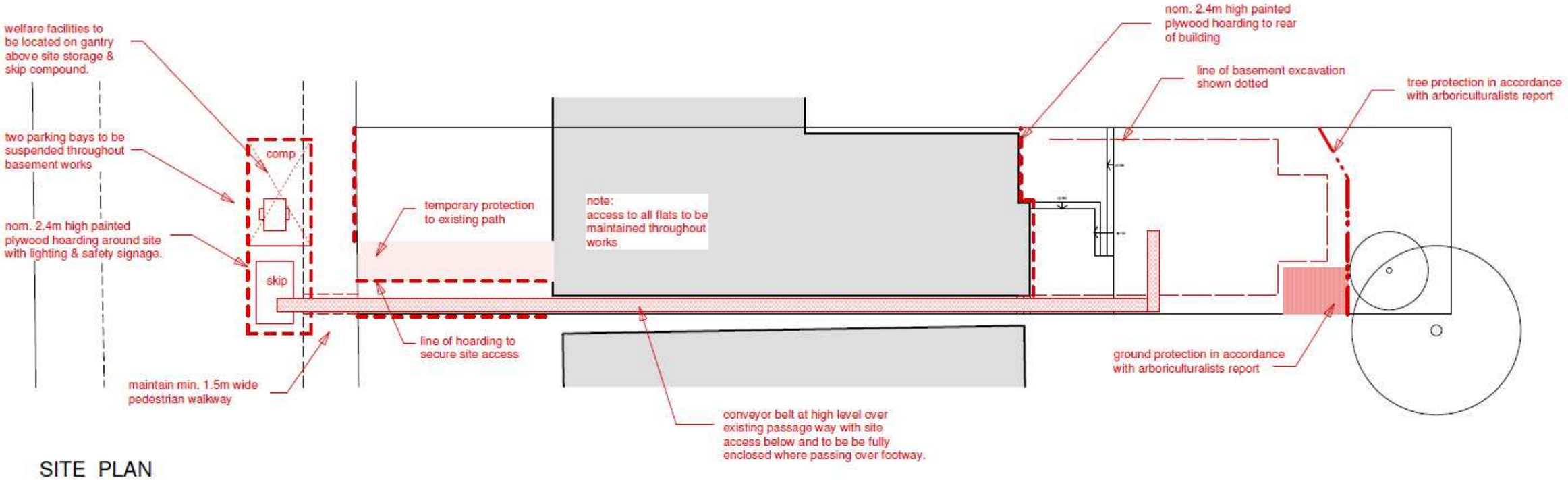
Positions of barrier fencing and ground protection measures (if required) are shown on the plan and are to conform to the specifications detailed in Sections 9.2 and 9.3 respectively.
Do not scale from this drawing, all dimensions to be checked on site using details provided in Sections 5.0 and 7.1.

The Construction Exclusion Zone (CEZ) shown indicates barrier fence positioning to exclude construction activity from T1, T4, T5 and T6 from their RPA sectors which are calculated to feature inside the site boundaries. RPA's for T7 and T8 do not enter the boundaries of the development site.
Ground protection is to be installed over exposed RPA sectors which cannot be excluded by CEZ fencing due to the operational and access restrictions this would cause.

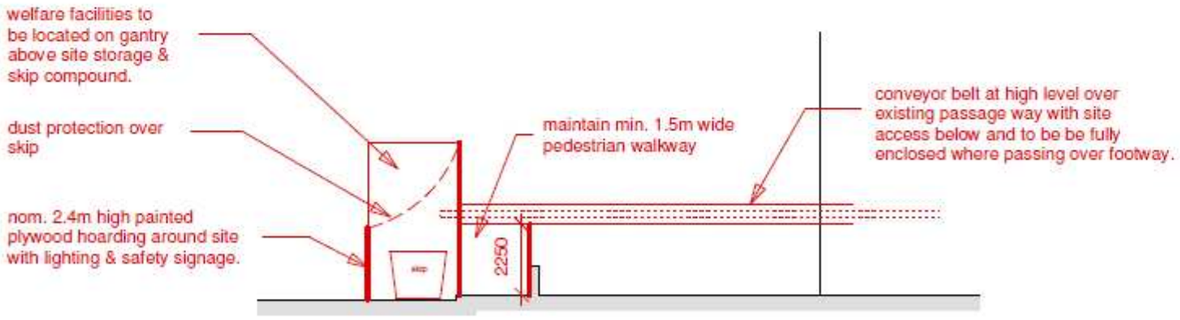
The indicated barrier fence line and ground protection areas to create the CEZ are suggested as the simplest and most effective layout to exclude all construction activity from the trees above and below ground level, including any RPA sectors exposed outside of the CEZ fencing.

Tree protection measures are to be installed before development work begins and after any preliminary management recommendations have been completed. CEZ's are to remain in place throughout the course of the development process until completion and must be the final part of the work site to be dismantled and removed.

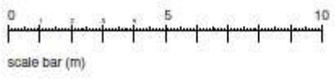
9.1.2 – Site Layout – (Not To Scale)



SITE PLAN



SECTION

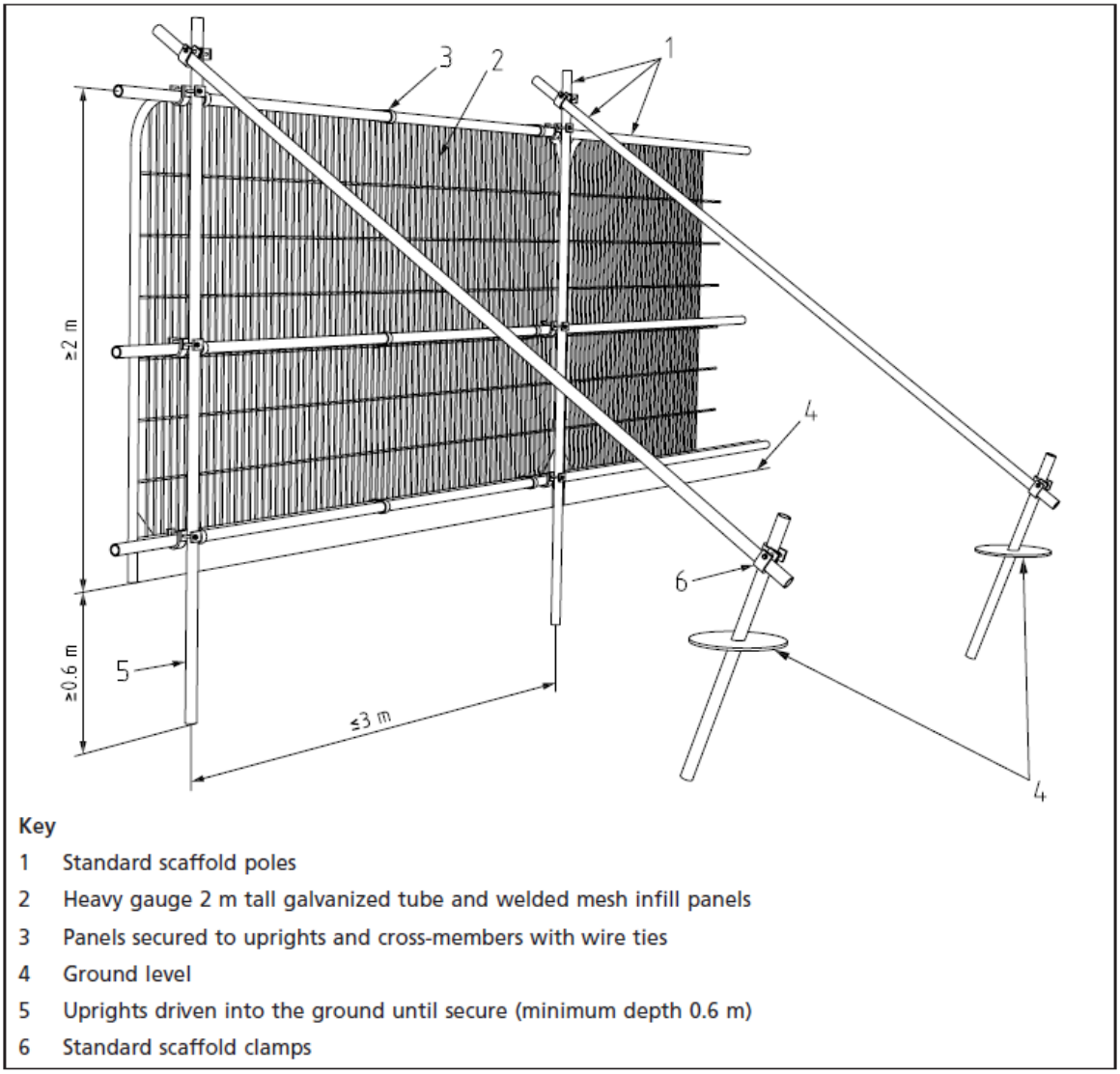


The above drawing provided by The Basement Design Studio indicates the set up of the development site. Areas are defined for the storage of building materials, waste, skips and temporary site welfare facilities. The site layout drawing is provided here as an informative only and will also be submitted in full as a separate document by the development team.

The following sections detail Construction Exclusion Zone fencing and ground protection specifications as detailed in BS 5837:2012 Trees in relation to design, demolition and construction recommendations.

9.2 - Protective Barrier Specification

Figure 2 Default specification for protective barrier

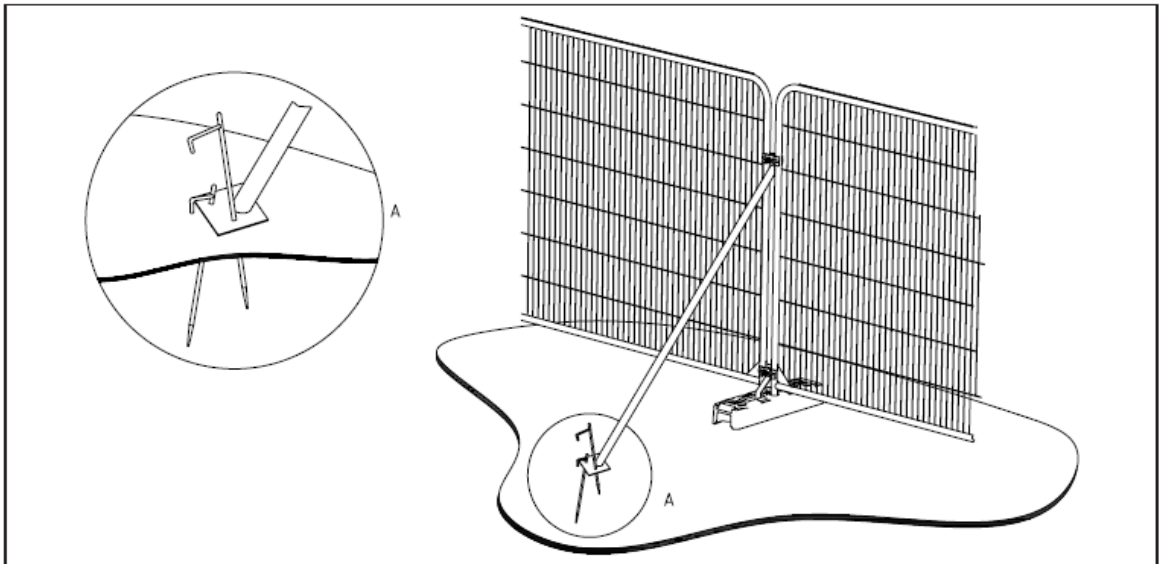


Key

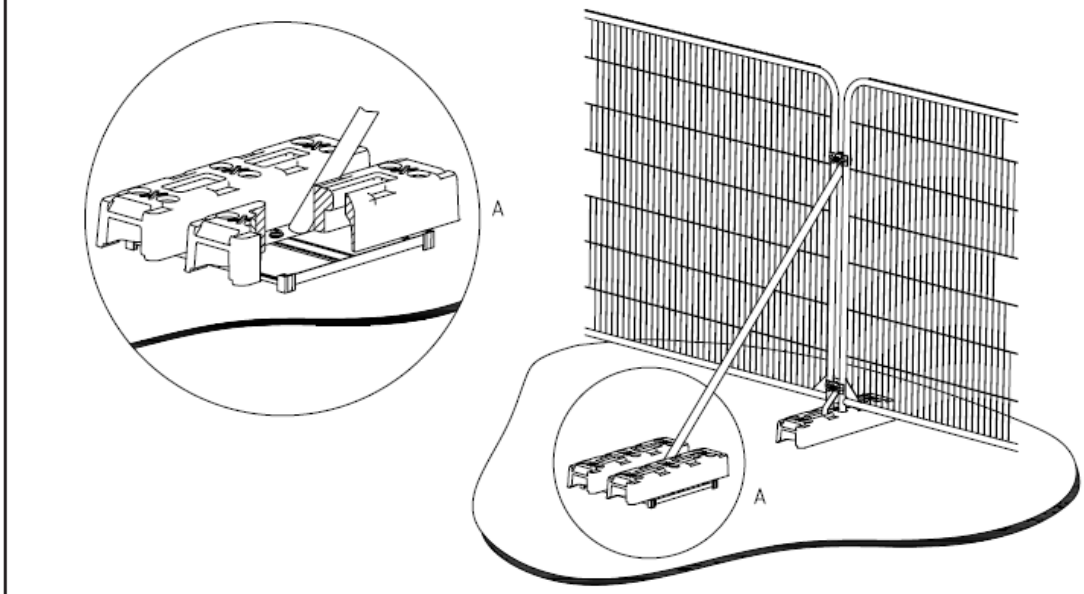
1 Standard scaffold poles
2 Heavy gauge 2 m tall galvanized tube and welded mesh infill panels
3 Panels secured to uprights and cross-members with wire ties
4 Ground level
5 Uprights driven into the ground until secure (minimum depth 0.6 m)
6 Standard scaffold clamps

N.B - Barrier fencing should be fit for the purpose of excluding construction activity and appropriate to the degree and proximity of work being undertaken around them. In most cases, barrier fencing should conform to and be installed to the specification shown in figure 2 above. This specification of fencing is preferred as it is resistant to impact, can be re used and allows for inspection of the protected area.

Figure 3 Examples of above-ground stabilizing systems



a) Stabilizer strut with base plate secured with ground pins



b) Stabilizer strut mounted on block tray

N.B – Depending on the intensity of construction activity, site circumstances and associated risk of damaging incursion into a tree's RPA, an alternative level of protection may be suitable in place of the default level of protection.

Figure 3 and 3a above gives an example of above ground stabilising systems which may be appropriate in certain circumstances.

In the case of the development project at 27 Oakhill Avenue, fencing should be used to the default specification shown in Figure 2.
No storage of bulk materials, construction waste or preparation of building materials is permitted inside the Construction Exclusion Zone. (See Arboricultural Method Statement (AMS) in Section 10.1.

9.3 - Ground Protection Specification

Where construction working space or temporary construction access is justified within the RPA, this should be facilitated by a set-back in the alignment of the tree protection barrier.

In such areas, suitable existing hard surfacing that is not proposed for re-use as part of the finished design should be retained to act as temporary ground protection during construction, rather than being removed.

Where the set-back of the tree protection barrier would expose unmade ground to construction damage, new temporary ground protection should be installed as part of the implementation of physical tree protection measures prior to work starting on site.

New temporary ground protection should be capable of supporting any traffic entering or using the site without being distorted or causing compaction of underlying soil.

The ground protection might comprise one of the following:

a) For pedestrian movements only, a single thickness of scaffold boards placed either on top of a driven scaffold frame, so as to form a suspended walkway, or on top of a compression-resistant layer (e.g. 100 mm depth of woodchip), laid onto a geotextile membrane;

b) For pedestrian-operated plant up to a gross weight of 2 t, proprietary, inter-linked ground protection boards placed on top of a compression-resistant layer (e.g. 150 mm depth of woodchip), laid onto a geotextile membrane;

c) For wheeled or tracked construction traffic exceeding 2 t gross weight, an alternative system (e.g. proprietary systems or pre-cast reinforced concrete slabs) to an engineering specification designed in conjunction with arboricultural advice, to accommodate the likely loading to which it will be subjected.

In all cases, the objective should be to avoid compaction of the soil, which can arise from the single passage of a heavy vehicle, especially in wet conditions, so that tree root functions remain unimpaired.

For wheeled or tracked movements, within a tree RPA, the ground protection should be designed by an engineer to accommodate the likely loading. A "no dig" solution must be used to avoid root loss due to excavation. In addition the structure of the hard surface should be designed to avoid localized soil compaction. The use of a three dimensional cellular confinement system (CCS) acting as a load suspension layer is recommended and will avoid localized soil compaction by evenly distributing the carried weight over the track width and wheelbase of any vehicles that will use the access. (See Section 9.3.1).

Temporary ground protection measures suitable for the transit and operation of tracked plant machinery is to be installed at the site where the exposed RPA sectors of T4 an to a lesser degree T1, would otherwise be subjected to soil compaction. The specification level is detailed and highlighted in bold italics above and further details are provided below in Section 9.3.1.

9.3.1 - Cellular Confinement System Sub Base (CCS)

A CCS sub base is designed to be installed without the need for excavation into the soil, therefore eliminating the need for severance of tree roots.

The CCS system comprises of an expandable cellular mattress that is then filled with a clean stone sub base above a geotextile membrane. The honeycomb-like structure is made of robust high density polythene (HDPE) that is simply stretched out and filled with clean angular material. The strength of the structure comes from the binding together of the infill, but with a CCS system this is achieved without compaction and without reduction in permeability.

Perforated cell walls allow the infill to bind with the contents of the adjacent cell, but with sufficient space for movement of water and air to nearby underlying tree roots. As the infill contains no fines and the geotextile layers prevent clogging from particles washing into the system, the structure remains permeable and protects the roots for the lifetime of the tree.

Quick and easy to install, CCS systems also dramatically cut down the depths of sub base required by as much as 50% and significantly reduce surface rutting, increasing the long term performance of the finished surface and ensuring that tree roots remain protected from vertical loads.

A CCS system can be used to create a temporary or permanent surface solution where required to protect underlying tree roots against the adverse effects of soil compaction.

The following links provide further details and information regarding this type of sub base system which is specifically designed for surface installations where tree roots are present.

http://www.geosyn.co.uk/products/cellweb-trees.asp?product_id=21

http://www.geosyn.co.uk/brochures/CellWebTRPV2b.pdf

10.0 – Arboricultural Impact Assessment (AIA)

The potential direct and indirect impacts on the trees which may arise from the proposed development and related construction activity, (identified following the tree constraints survey and after due consideration to them and the intensity of activity required for the overall development proposal) are as follows:

- **Soil compaction in tree root protection areas caused by**:
  - Development activity – pedestrian and plant movement around the site throughout the course of the development project;
  - Storage of bulk building materials at the site;
  - Skips and storage of bulk building waste before collection and removal from the site;
  - Temporary site unit positions and contractor's car parking areas.

- **Root severance caused by:**
  - Excavations for the proposed basement and lightwells;
  - Excavations for the installation of new underground services, including drainage and soakaways;
  - The removal of any existing hard surfaces.

- **Soil contamination caused by:**
  - Spilt or discharged building materials (including fuels and spillages resulting from the mixing and preparation of cement and concrete);
  - Building waste storage either short or long term (including skips).

- **Direct damage to trees above ground level (stems and crowns) caused by**:
  - Storage of building materials against tree stems and buttress roots;
  - Vehicle collision with tree stems and crown branches;
  - Travel paths of crane booms and jibs coming into contact with tree crowns;
  - Fixing temporary lighting / signage etc to tree stems and branches;
  - Pruning of branches to facilitate operational space for the development;

- **Restriction of aqueous and gaseous exchange in the soil caused by:**
  - Non permeable hard surface installation in outside areas.

Site specific controls relating to mitigation measures to be implemented in respect of these implications can be found in the Arboricultural Method Statement 10.1 below.

10.1 – Arboricultural Method Statement (AMS)

The table below indicates the potential Arboricultural Implications at the site during the construction phases and details the appropriate control measures to be employed.

Implication	Control
• **Soil compaction in Root Protection Areas (RPA)**	• All tree RPA's where accessible in the rear garden, including those shown for neighbouring trees, are to be excluded from access by the installation of Construction Exclusion Zone (CEZ) fencing at the site. • Protective fencing to create a Construction Exclusion Zone (CEZ) is to be installed to the layout design shown in the Tree Protection Plan 9.1 and to specifications detailed in section 9.2 without deviation. • Fencing positions must be established on site using only the calculated RPA data provided in Section 7.1 and measurements must be checked on site at the time of installation. • All pedestrian and vehicular access will be excluded entirely by the CEZ fencing. • Bulk building materials are to be stored outside of the CEZ. It is proposed that all building materials are to be stored in secure hoardings erected at the front of the site in suspended parking bays. (See Site Layout in Section 9.1.2). • Temporary site facilities such as washroom, welfare and site office structures are to be located in secure hoardings in front of the site in suspended parking bays. (See Site Layout in Section 9.1.2). • Contractor's car parking will be available on the public carriageway (Oakhill Avenue). • Parking suspension will be in place to allow parking for vehicles associated with the project. • Skips will be located at the front of the property in suspended parking bays on Oakhill Avenue for ease of removal and replacement and enclosed behind well lit site hoardings. (See Site Layout in Section 9.1.2). • Ground protection is to be installed over the area where RPA sectors of T1 and T4 would otherwise be exposed to compaction damage by pedestrian and plant activity outside of the CEZ fence line. (As shown on the TPP Section 9.1 and as detailed in Section 9.3 & 9.3.1) • The ground protection specification must be fit for purpose. The required specification must be suitable for wheeled or tracked construction traffic exceeding 2 t gross weight, to accommodate the likely loading to which it will be subjected without causing compaction of the soil beneath. • The ground protection measures are to incorporate a no dig method of installation. The use of a three dimensional cellular confinement system (CCS) is recommended. (See Section 9.3 & 9.3.1) • All tree protection measures (both fencing and ground protection) must be installed before any materials or machinery is brought on to the site. • Access from the front of the site on Oakhill Avenue to the rear garden will be via the existing side access on the west side of the property. • A site layout plan is provided only as an informative of the site set up in Section 9.1.2. • A fully detailed Site Layout Plan is to be provided separately by The Basement Design Studio.

• **Root severance**	• T1, T2 and T4 are shown to feature sectors of their calculated RPA's crossing over the footprint for the proposed basement and lightwell. • T2 is a young tree which should be removed before development, as the calculated loss of 50% of the root spread would result in the tree declining and would be unlikely to recover. • T1 and T4 cross over marginally at their respective RPA extremities. Roots encountered at this distance will be regenerating feeder roots. Any root loss or disturbance will be minimal and will not have an adverse physiological impact on the tree's health, with less than 1% of the total RPA for each tree being affected by excavations. • All other trees considered in the BS 5837:2012 study are shown to feature RPA's which do not crossover the area where the basement and lightwell are proposed. • Any roots encountered outside of the calculated RPA's (if at all) during the excavation work, will be feeder roots which regenerate with each growing season. Any minor root loss caused by excavations will be negligible and will not adversely impact on the physiological wellbeing of the trees. • Full specification and details concerning the suitability of the basement design including greater detail of the construction methodology will be provided separately by the development team / project engineers, with due consideration to the tree constraints detailed in this report. • Geotechnical analysis and soil assessment will be necessary at the site to understand in greater detail the soil structure and sub soil conditions. • No excavations have been proposed to be required for the installation of new underground services such as drainage and water mains pipes or soakaways etc inside of tree RPA's. • If required, their locations and positions will need to be determined with consideration to the below ground tree constraints shown in this report and with further consultation with the project Arboriculturist. • Any tree roots which are exposed during the course of excavation works will be immediately wrapped or covered to prevent desiccation and protect from temperature changes whilst exposed and advised to the project Arboriculturist. • Any roots exposed over 25mm in diameter will not be severed without prior consultation with the project Arboriculturist. • All existing hard standings at the site are to remain in situ.

• **Soil contamination**	• Bulk building materials and waste (including skips) will be stored outside of the Construction Exclusion Zone (CEZ) in designated areas inside secure hoardings at the front of the site. (See Site Layout in Section 9.1.2). • Contaminate materials such as oils, fuel, chemicals and gases will be stored and handled away from the CEZ protecting tree RPA's and are to be stored and handled in accordance with the Control of Substances Hazardous to Health Regulations 2002 (COSHH). • The preparation of building materials will occur only in designated areas outside of the Construction Exclusion Zone. • Consideration will be given at all times to ensure that sloping ground will not allow for any contaminating substances to travel into areas where tree RPA's may be affected. • A Site Layout Plan is provided as an informative only in Section 9.1.2. • A fully detailed Site Layout Plan is to be provided separately by The Basement Design Studio, with due consideration to tree constraints and tree protection requirements as detailed in this report.
• **Direct damage to trees above ground level (stems, buttress roots and crowns)**	• All building materials to be used at the site will be stored outside of the protective Construction Exclusion Zone (CEZ) fencing in the designated storage areas at the front of the site. (See Site Layout in Section 9.1.2). • Vehicle and plant machinery will only operate in areas outside of the CEZ. Tree stems and buttress roots will be excluded and safeguarded against vehicle collision damage by the CEZ barriers. • All tree stems and buttress roots which are considered to be at risk of construction activity damage will be enclosed behind the CEZ barrier fencing and/or existing boundary fencing in the case of neighbouring trees. • The combination of CEZ and boundary fencing will exclude all access to trees above ground level. • T3 is a street tree located outside of the site boundaries on Oakhill Avenue. 2m hoarding should be erected around the tree to protect the stem from direct impact at the front of the site where construction activity will be high. • Exclusion by fencing or hoarding around T3 will eliminate the potential for materials to be stored against the stem and buttress roots. • Crown heights have been measured and in all cases do not pose a height clearance constraint to the development. • The CEZ barriers will remain in situ throughout all phases of the development to completion and will be the last apparatus to be removed from the site. • No crane use has been proposed to be used at the site. • No signage or temporary lighting is permitted to be fixed to any tree stem or branch. • Other than the pre determined removal of T2, no other tree surgery works are proposed to any of the other trees included in the assessment. • Site hoardings and fencing will display relevant signage with words to the effect of "Construction Exclusion Zone – Keep Out".
• **Restriction of aqueous and gaseous exchange in the soil**	• No new areas of non-permeable, hard surfacing are proposed in areas where tree RPA's are shown, or where currently unmade ground features at the property.

11.0 - Report Summary

This report has been produced following a tree survey conducted in accordance with BS5837:2012 Trees in relation to design, demolition and construction recommendations, for the purpose of implementing tree protection measures during the construction phases of the proposed development.

The information produced within this report follows an initial site survey conducted on the 24th June 2014. The report provides an assessment of the trees associated with the above development site based on information supplied by the development team and observations recorded at the time of the survey.

Following the identification of the tree constraints at the site, it was established that T2, a young Holly tree should be removed as the construction of the basement beneath the existing rear garden will result in an unacceptable loss of roots which would cause unrecoverable stress to the tree.

The Root Protection Areas (RPA) of T1 and T4 are shown to be marginally impacted upon where the proposed basement and lightwell are shown to crossover, based on the current design.
The impact at the extremities of their respective RPA's would be minimal, with no major roots or great abundance of feeder roots lost.
The potential loss of feeder roots (which regenerate each growing season) has been calculated to be less than 1% of the total Root Protection Areas shown for each of these trees. This minor incursion will not cause excessive stress, or impact greatly on the function of the trees' root system.

From an arboricultural standpoint, excavations to construct the new basement and lightwell are acceptable as the current design proposes, however care must be taken throughout the process and if any major sized roots (over 25mm diameter) are encountered, the project Arboriculturist should be informed.

In terms of associated site activity, the Construction Exclusion Zone (CEZ) fencing and temporary ground protection measures required at the site will ensure the safeguarding of trees above and below ground level.
T1 is the only tree retained in the rear garden and will be excluded from all associated activity above ground by the CEZ fencing.
T3, the street tree at the front of the site, will be safeguarded by installing 2m high hoarding around the stem. The CEZ fencing at the rear as indicated on the Tree Protection Plan (TPP) in Section 9.1 will exclude all construction activity from the shown RPA's of T1, T4, T5 and T6 to prevent compaction and/or contamination of the soil in these areas.
Where sectors of the RPA's shown for T1 and T4 are exposed outside of the CEZ for operational and access reasons, temporary ground protection is to be installed. The ground protection measures must be fit for purpose and conform to the specifications as detailed in Section 9.3 and in the Arboricultural Method Statement Section 10.1.
The ground protection is necessary as the entire RPA's of T1 and T4 cannot be wholly excluded by CEZ fencing due to the operational and access restrictions this would cause. As a result, the CEZ fencing is to be set back as proposed, with temporary ground protection ensuring that the underlying soil in the exposed RPA sectors does not suffer from compaction or contamination during the development process.

All building material storage areas, site facilities, material preparation areas and general access around the site by operational staff will not be restricted by the CEZ fencing.

11.0 - Report Summary – Cont'd

If any design changes are made to any aspect of the proposed development project due to the identified tree constraints, operational restrictions, geotechnical concerns or otherwise, revisions or additions to tree protection, damage mitigation measures and site layouts will need to be made and a revised report produced.

As well as conforming to measures in accordance to BS5837:2012 Trees in relation to design, demolition and construction recommendations, depths of any proposed excavations should as part of the planning phase, be considered in line with recommendations published in N.H.B.C Chapter 4.2 – Building near trees.
Methods for the installation of services in the proximity of trees (above and below ground) should conform to those detailed in NJUG vol. 4.
Full detailed specification of the development project and engineering methods etc. will be supplied by the development team separately.

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12.0 – Legal and Planning Consents

- Appropriate legal and planning consent should be gained before undertaking any tree work; for example if the tree(s) are subject to a Tree Preservation Order (TPO), permission must first be obtained from the Local Authority. Permission is not required for emergency tree work on dead, dying or dangerous TPO trees; however the Local Authority should be advised.
- Six weeks notice is required to be given to the local authority via a Section 211 Notice for any proposed tree surgery work on trees situated within a designated Conservation Area.
- Tree owners have a responsibility as a common law duty of care, as well as responsibilities under statutory law, to ensure that trees growing within the boundaries of their property are maintained to reduce to an acceptable level the risk of potential harm befalling other people or property.
- In the course of undertaking any tree work, the client is advised to ensure that operational assessments and procedures are in place, and to take due consideration of the legal requirements.

- Key legislation includes (but is not restricted to):

    - The Wildlife and Countryside Act (1981)
    - Occupiers Liability Act (1957/84)
    - Highways Act (1980/86)
    - Town and Country Planning Act (1990/Regulations 1999/Amendment 2008/09)
    - Anti-Social Behaviour Act (2003) – Part 8 (High Hedges)
    - The Countryside Rights of Way Act (2000)
    - The Conservation (Natural Habitats etc.) Regulations (1994)
    - The Badgers Act (1992)

13.0 - Publications

- Other publications which are relevant to the development proposal to which further reference is advised includes but is not restricted to:

    - National House Building Council (N.H.B.C) Chapter 4.2 – (Building near trees);

    - National Joint Utilities Group (NJUG) Volume 4 – (Guidelines for the planning, installation and maintenance of utility apparatus in proximity to trees).

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