



Document No.2189AIA – Arboricultural Impact Assessment BS 5837:2012 – Trees in relation to design, demolition and construction – Recommendations

Day Nursery at East Midland Zoological Society, Burton Rd, Atherstone CV9 3PX

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1.0 Introduction

1.1 Introduction

At the request of the Client, an arboricultural survey of the trees on and adjacent to East Midland Zoological Society, Burton Rd, Atherstone CV9 3PX was undertaken on 13th April 2026 by Ecologist Richard Billingsley BSc (Hons) Ecology. This Arboricultural Impact Assessment (AIA) identifies potential conflicts between the proposed development and the existing tree stock and provides measures to avoid or mitigate adverse effects, in accordance with BS 5837:2012.

1.2 Client brief

The proposed development will include the construction of three new buildings with associated hard surfaces being used as pathways and car parking.

1.3 Site location and description

1.3.1 Site Location

The site is located at East Midland Zoological Society (Twycross Zoo), Burton Road, Atherstone, Warwickshire, CV9 3PX. Twycross Zoo lies in a predominantly rural setting to the west of Atherstone, accessed from the A444 Burton Road, with the surrounding landscape characterised by a mix of managed grounds, scattered tree cover, hedgerows and open countryside. The site falls within National Character Area (NCA) 72: Mease/Sence Lowlands, as defined by Natural England. This NCA is characterised by a gently rolling lowland landscape centred on the rivers Mease, Sence and Anker, with a generally rural character and a landscape pattern of agricultural land, hedgerows, scattered woodland and occasional parkland trees.

1.3.2 Site Description

The site is located adjacent to the main zoo car park and comprises an enclosed area of modified grassland bounded by non-native hedgerows and lines of mature poplar trees. Within the enclosed area there is also an ornamental cherry tree and a fir tree, which contribute to the site's localised ornamental character.

Slightly to the south of this enclosed area, but still within the wider site boundary, the land comprises further areas of modified grassland containing two horse chestnut trees and a young *Prunus* tree. To the south-east of the site there is an additional row of mature poplar trees, which further reinforce the boundary vegetation and contribute to screening and enclosure. Overall, the site is characterised by managed grassland, ornamental planting, and linear tree features associated with the wider zoo setting.



Figure 1.3: Location satellite images taken using Google Earth showing trees within and surrounding the property

1.4 Proposed Development

The proposed development involves the construction of new buildings being used for a kitchen, nursery and home education block.

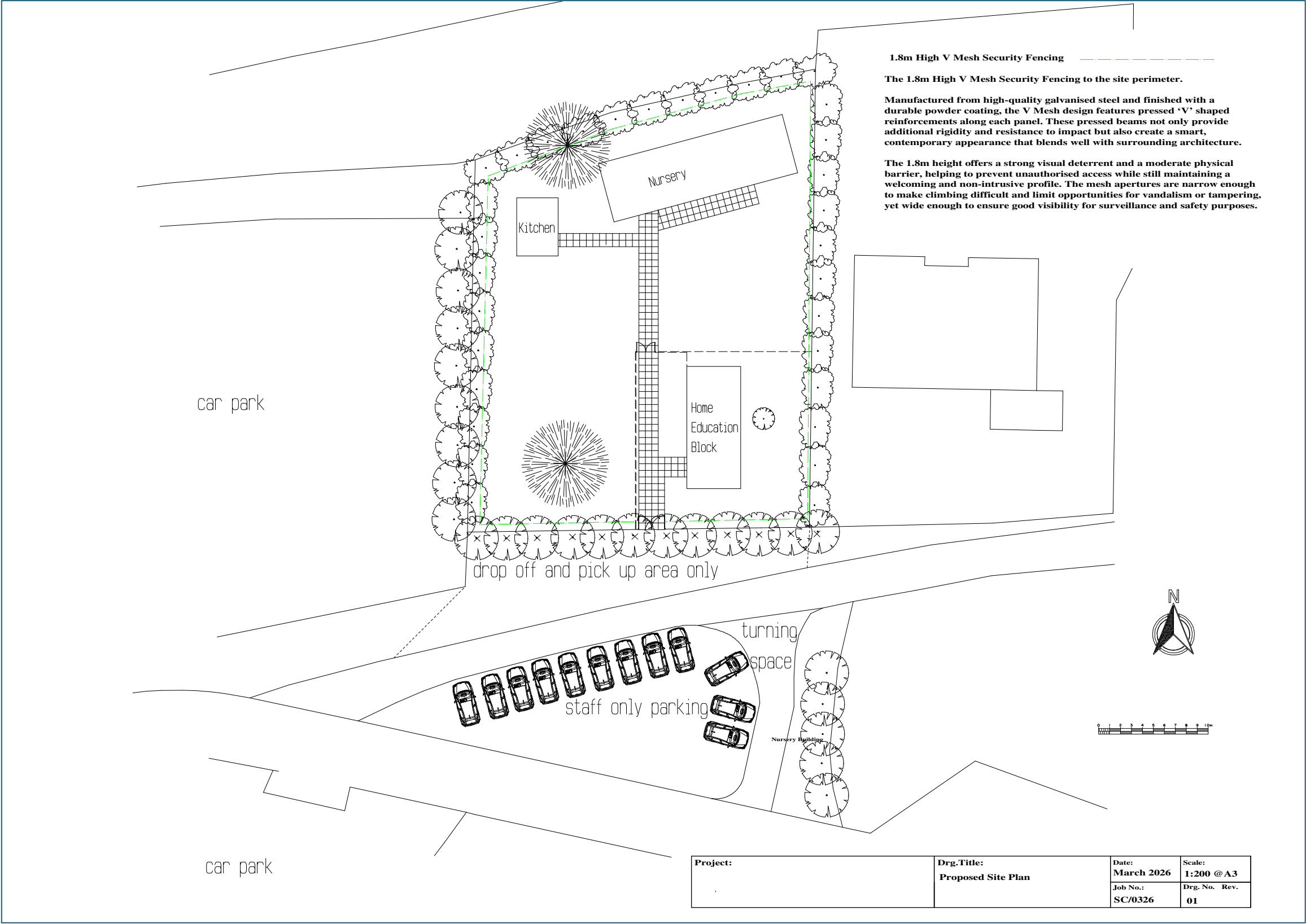


Figure 1.5: Proposed Block Plan

1.5 Landscape and Ecological Enhancement Scheme

DJOGS have provided a L&EES in support of the application. The scheme includes the planting of 6 new trees within the site and a further 23 new native trees within a forest schools area which will be developed as part of the day nursery offer.

2.0 SURVEY METHODS

2.1. Desktop Searches

Desktop searches were conducted to evaluate the landscape context of the trees, including online searches for Tree Preservation Orders and Conservation Areas relevant to the site.

2.2 Site Survey

The site was surveyed to establish the tree positions in respect to significant on-site features. A photographic record of the trees and their relationship to the site was made and used within this document. The survey was conducted by Ecologist Richard Billingsley on 13th April 2026. Trees outside the assessed area of impact were not surveyed.

2.3. Condition Status

To determine the status of the trees within the site, an arboricultural survey has been undertaken, assessing the condition and constraints of each tree. The survey has been carried out in accordance with BS 5837:2012.

Individual trees were visually assessed and a schedule prepared listing tree number, species, trunk diameter at 1.5 m above ground level, tree height, crown spread (radius), age class and estimated remaining years. Specific observations and management recommendations were recorded where relevant.

The condition of each tree was assessed according to the following categories:

- **Category A:** Trees of high quality and value. Significant trees that are structurally sound and can be retained in the long term (i.e. >40 years) or trees that can be retained in the long-term following remedial tree surgery. Colour code on the plan – light green.
- **Category B:** Trees of moderate quality and value. Trees that may live 15–40 years, or trees that may live for more than 40 years but whose removal may be required in that timeframe to allow development of retained trees. Trees that are defective but could be retained in the medium term by remedial tree surgery. Colour code on the plan – mid-blue.
- **Category C:** Trees of low quality and value. Trees that can only be retained in the short term (i.e. 5–15 years) and that have little landscape impact due to poor form or condition. Trees having a stem diameter of <150 mm at 1.5 m above ground level that could be replaced. Colour code on the plan – grey.
- **Category U:** Trees that are dead, dying or diseased and will become dangerous soon (within years). Colour code on the plan – red.

Categories A, B and C have further sub-categories regarding the reasons for tree retention:

1. Mainly arboricultural values
2. Mainly landscape values
3. Mainly cultural values, including conservation

2.4 Root Protection Area (RPA)

The RPA is derived from the stem diameter (in millimetres) at 1.5 m above ground level. The RPA radius (m) is calculated as:

$$\text{RPA radius (m)} = \text{stem diameter (mm)} \times 12 \div 1000$$

and the RPA area (m²) as:

$$\text{RPA area (m}^2\text{)} = \pi \times \text{radius}^2.$$

3.0 RESULTS

3.1 Tree Constraints Plan

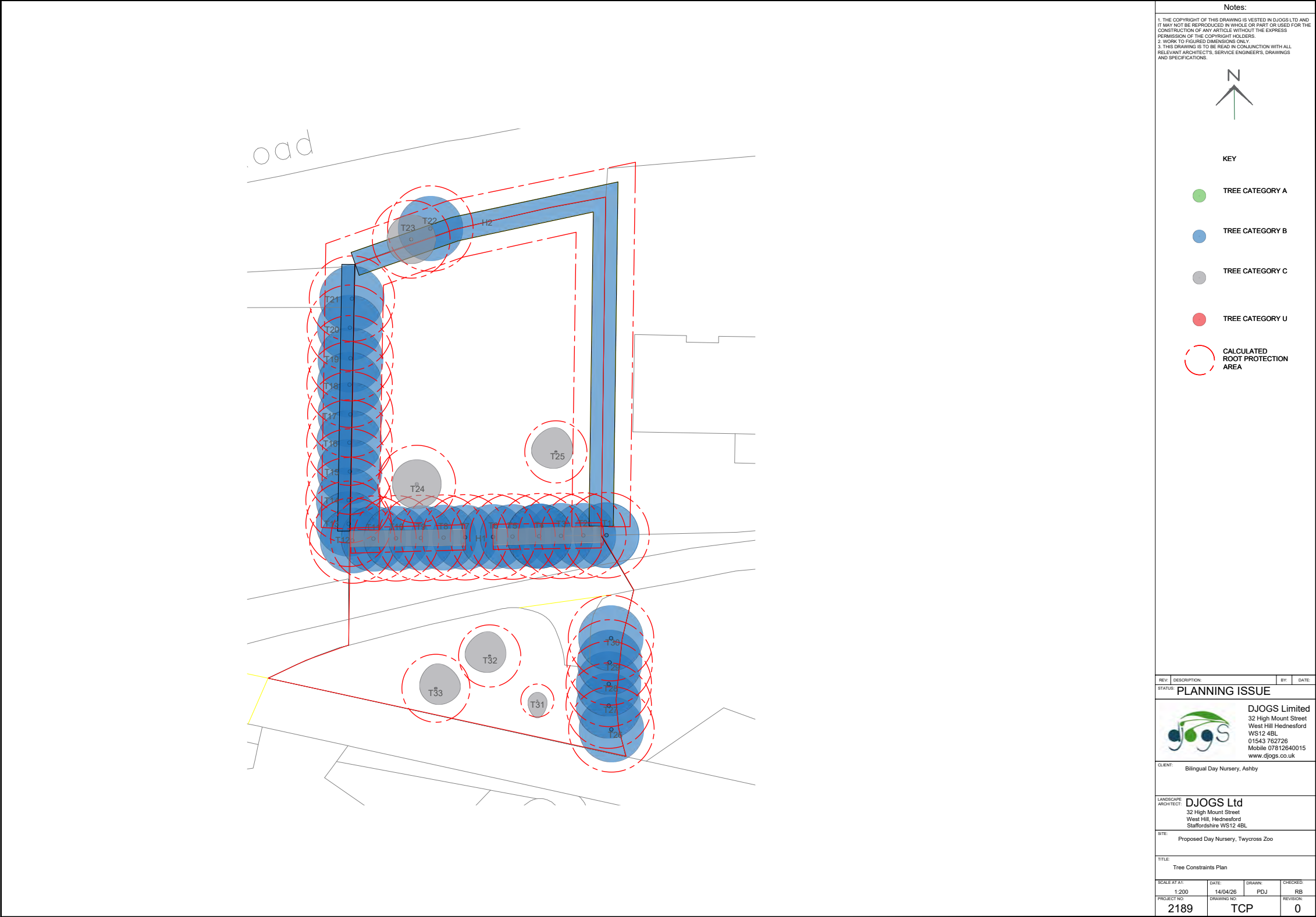


Figure 3.1: Tree Constraints Plan (TCP)

3.2 Tree Table following site survey

Ref	Species	Age	Height (m)	Crown Spread (m)				Stem diameter (mm)	Vitality	Remaining useful contribution (years)	Comments	Management	category	RPA radius (m)
				N	S	E	W							
T1-T22	Poplar	M	9	4	4	4	4	300-440	F	20+	All planted together 2m apart none show any cavities, lvy or peeling bark		B2	5.28
T23	Lawson Cyprus	M	8	3	3	3	3	400	F	20+	Planted before surrounding hedgerow there is taller		C2	4.8
T24	Fir	M	8	3	3	3	3	400	F	20+	Single standing fir tree oversailing the grassland losing lower branches due to shading		C1, C2	4.8
T25	Ornamental Cherry	M	4	3	2	2	3	320	F	20+	Single standing, blossoming with peeling bark		C2	3.84
T26-T30	Poplar	M	9	4	4	4	4	350-440	F	20+	Line of trees used for screening		B2	5.28
T31	Prunus	Y	2	1	2	1	1	170	F	20+	Shows evidence of management		C2	2.04
T32	Horse Chestnut	M	5	3	2	2	3	320	F	20+	Shows evidence of management		C2	3.84
T33	Horse Chestnut	M	5	3	2	3	2	350	F	20+	Shows evidence of management		C2	4.2
H1	Lawson Cypress	Y	3	1	1	1	1	130	F	20+	Young recently planted hedgerow being used for screening		C2	1.56
H2	Lawson Cypress	M	7	3	3	3	3	300	F	20+	Tall hedgerow enclosing the site		B2	3.6
*Estimated dimension due to outside of development boundary line; (b) denotes basal diameter used. Y=young, EM=early mature; SM=semi-mature; M=Mature; OM=Over mature; VG=very good; G=good; F=fair; P=poor; D=Dead														

Figure 3.2: Table of Results following tree survey

3.3 Table of Results (Summary)

The site survey recorded thirty-three individual trees (most forming linear features) and two hedgerows that may be affected by the proposed development (refer to Figure 3.1, Tree Constraints Plan, Section 3.1).

Tree Summary

CATEGORY	A	B	C	TOTAL VIABLE	U
INDIVIDUAL TREES	0	27	6	33	0
GROUPS OF TREES	0	0	0	0	0
HEDGEROWS	0	1	1	2	0
WOODLAND	0	0	0	0	0

3.4 Photographic Record

		
T24 Non-native coniferous tree used as an ornamental tree, lower branches are losing their needles due to shading from the surroundings.	North side of the site showing H2 enclosing the area, the canopy is continuous.	Line of Poplar trees to the south of the site all of the trees were planted at the same time and have a 2m planting distance.
		
T25 Ornamental cherry showing extended branches upwards.	Coniferous hedgerow with a line of Poplar trees.	East side of the site with Cypress hedgerow.

		
West side of the site outside of the boundary the hedgerow has been cut back to allow for more room for parking for the zoo resulting in poor visual amenity.	Line of Poplars South side of the enclosed part of the site.	South-East of the site a line of Poplars, T26-T30.
		
T32 Horse Chestnut, Ornamental tree	T33 Ornamental Horse Chestnut tree	T31 Young Prunus tree.

4.0 SURVEY ANALYSIS

4.1 Tree Health

The surveyed tree stock is comprised predominantly of mature specimens, with a smaller number of young trees and hedgerow elements. Recorded vitality for all surveyed trees is F (fair), indicating that while the trees are currently viable, none were assessed as being in notably good or very good condition. Most specimens nevertheless have an estimated remaining useful contribution of 20+ years, suggesting that despite fair vitality they are expected to continue contributing for the medium to long term.

The poplars at T1–T22 and T26–T30 appear to be broadly uniform mature groups with no significant defects noted; specifically, T1–T22 are described as having no cavities, ivy, or peeling bark. The Lawson cypress at T23 is also in fair condition, although it is noted to be subordinate to the adjacent hedgerow. T24, a single standing fir, is experiencing loss of lower branches due to shading, which is a minor physiological response rather than a serious structural defect. T25, the ornamental cherry, is described as blossoming with peeling bark; this may reflect ornamental characteristics or localised bark condition, but no acute safety concerns are indicated in the schedule. Trees T31, T32 and T33 all show evidence of prior management, with no further adverse observations recorded. The hedgerow cypress elements H1 and H2 also appear serviceable, with H1 recently planted and H2 forming a taller enclosing boundary feature.

Overall, the tree stock is in fair and generally serviceable condition, with no comments in the schedule indicating major structural instability, severe decline, or imminent failure. Management requirements appear limited at present, though continued monitoring and routine arboricultural maintenance would be appropriate.

4.2 Value to Wildlife

The surveyed trees provide moderate ecological value, primarily through their role as linear boundary vegetation, screening, and enclosed structure across the site. While the schedule records no cavities, ivy, or peeling bark in the main poplar group at T1–T22 and therefore limited obvious roosting or nesting features in those specimens, the grouped arrangement of these trees still offers habitat opportunities for common birds, invertebrates, and foraging species.

The line of poplars at T26–T30 and the boundary cypress elements, particularly H2, are likely to be of value as shelter and commuting habitat, especially where they contribute to screening and enclosure. T23 and the hedgerow specimens H1–H2 also reinforce boundary vegetation structure, which can be valuable to small birds and other fauna. The ornamental cherry at T25 may provide some additional seasonal value through blossom, with potential benefit to pollinating insects. The horse chestnuts T32 and T33 and the fir T24 contribute to species diversity within the site and therefore increase the range of habitat niches present.

Overall, although the schedule does not identify significant veteran features or high-value microhabitats, the tree stock is still likely to provide baseline wildlife value through canopy cover, shelter, nesting opportunity, and connective green infrastructure.

4.3 Landscape and Cultural Value

The trees make a meaningful landscape contribution to the site, particularly through screening, enclosure, and the establishment of boundary structure. The poplar groups at T1–T22 and T26–T30, both categorised B2, are of the greatest arboricultural and visual significance within the schedule. Their collective form and consistent dimensions suggest that they contribute positively to site character and screening. The latter group is explicitly described as a line of trees used for screening, while H2 is noted as a tall hedgerow enclosing the site, indicating clear visual and functional landscape importance.

Most of the remaining trees fall into Category C, meaning they are of lower individual quality but still contribute locally to amenity and site character. T24, although listed as C1/C2, has some visual presence as a single standing fir oversailing adjacent grassland. T25, the ornamental cherry, is likely to provide some seasonal amenity through flowering display, although its small stature limits its wider landscape influence. T31, T32, T33, and H1 appear to contribute more modestly as localised ornamental or boundary features rather than dominant landscape elements.

No specific historical or cultural associations can be identified from the schedule alone. However, the tree stock contributes to the softened, enclosed, and screened character of the site, with the B-category trees being the most important in arboricultural and visual terms.

4.4 Trees, Root Protection Areas and Canopy in Relation to Proposed Development

The proposed development has been laid out to avoid significant conflict with most retained trees and hedgerows. However, the proposed buildings extend within the Root Protection Areas (RPAs) of T2–T6, T20, T21, and hedgerows H1 and H2. In addition, the proposed pathway will intercept the RPAs of T4–T8.

Trees T25 and T31–T33 will be removed to facilitate the proposed development, while the remaining trees and hedgerows will be retained and protected in accordance with BS 5837:2012 throughout the construction period. The hedgerow canopy will require protection during the works to avoid accidental damage. However, the retained trees generally have high canopies and are therefore unlikely to be disturbed by construction workers or vehicles during the development process.

Where the pathway is located within the RPA, it will be constructed using permeable surfacing and a no-dig approach and is therefore not expected to result in significant harm to retained trees. Any excavation required will be undertaken carefully using hand tools only, to minimise root disturbance and preserve the existing soil structure. Subject to these measures, and the installation of suitable tree protection fencing, the impact of the proposed development on retained trees is considered acceptable.

5.0 Assessment of implications of development

5.1 Tree Retention Plan

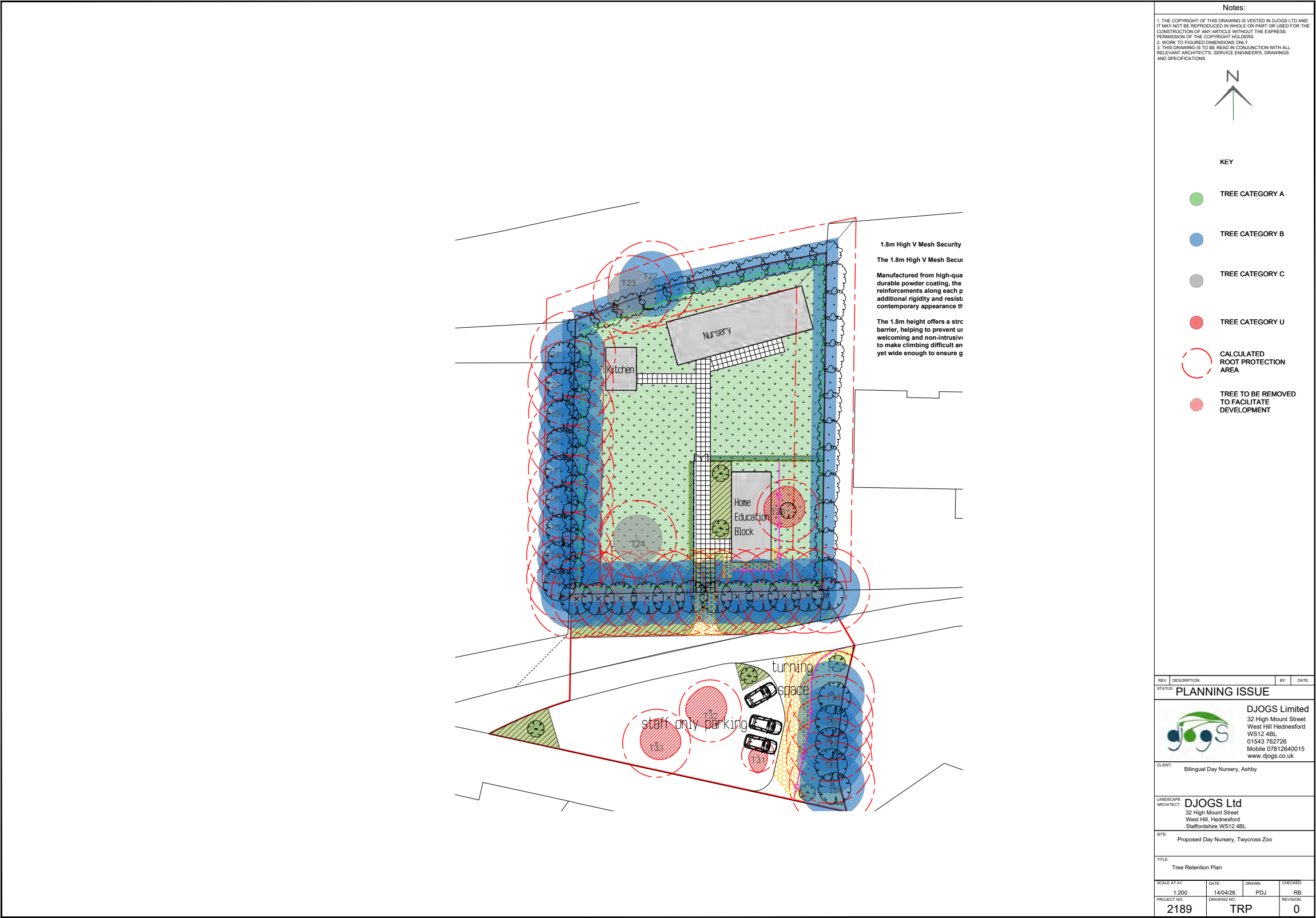


Figure 5.1: Tree Retention Plan (TRP)

5.2 Implications of Development

- Four low quality trees are to be removed (T25, T31-T33) to facilitate the proposed development.
- There are thirty-three trees and two hedgerows which may be affected by the proposed development.
- All retained trees and hedgerows will require protection in accordance with BS 5837:2012 throughout the construction period, including tree protection barriers, temporary ground protection within RPAs and the use of hand tools only within RPAs.
- Some overlap of building footprint with retained tree and hedge RPAs is likely however this is not expected to be significant. The construction of buildings using mini-piles and avoiding slab bases is recommended to reduce potential root impact.

5.3 Summary of Tree to be Removed

CATEGORY	A	B	C	U	TOTAL VIABLE
INDIVIDUAL TREES	0	0	4	0	4
GROUPS OF TREES	0	0	0	0	0
HEDGEROWS	0	0	0	0	0
WOODLAND GROUPS	0	0	0	0	0

6.0 SUMMARY, RECOMMENDATIONS AND CONCLUSION

6.1 Summary

- The proposed development will include the construction of three new buildings with associated hard surfaces being used as car parking, the development also involves the construction of a path to gain access to the buildings which will be done using permeable surfacing.
- There are thirty-three trees and two hedgerows within the site boundary.
- Four low quality trees will require removal to facilitate the proposed development.
- The remaining trees and hedgerows will require protection in accordance with BS 5837:2012, this can be achieved using Appendix A (Tree Protection Plan).
- The proposed buildings extend into the Root Protection Areas of several retained trees and hedgerows; therefore, any works within these areas will need to be carried out in accordance with Section 7.4 of BS 5837:2012, as set out in Appendix B, including the use of hand digging and other no-dig or low-impact construction methods where required to avoid damage to roots and soil structure.

6.2 Recommendations

Pre-construction

- Remove 4 trees as prescribed within 2189TRP.
- Protect all retained trees throughout the works in accordance with BS 5837:2012, as shown on Tree Protection Plan 2189TPP (Appendix A).
- Install Tree Protection Fencing (TPF) and ground protection exactly as detailed on 2189TPP prior to any site set-up, demolition, or groundworks.
- Any trees where new hardstanding or parking is proposed within 1m of the stem base should be carefully considered and designed to avoid adverse impacts on root collars and soil conditions. Where hard surfacing is required in proximity, appropriate construction methods should be employed, and the maximum practicable area of soft landscaping should be retained around retained and newly planted trees, within the constraints of access and parking requirements.
- The fenced areas will form Construction Exclusion Zones (CEZs); they must remain undisturbed for the duration of demolition and construction unless explicitly agreed works are required within them under arboricultural supervision.
- No vehicles, plant or mechanical excavation within CEZs; any approved activity must use hand tools only (or low-impact methods under supervision).
- Site offices, welfare units, material lay-down and storage areas, mixing bays and contractor parking must be sited outside all RPAs/CEZs.
- Service routes and utilities (including drainage, ducts and cables) must be designed and installed to avoid RPAs. Where incursions are unavoidable, works are to follow a written method statement and be undertaken by hand-dig/air-spade under arboricultural supervision.
- Provide clear signage on the TPF (at least every third panel) and brief all site operatives at a pre-start toolbox talk on the purpose of the fencing and CEZ rules; the fencing must not be moved, cut or climbed.
- Maintain all protective measures in good order and retain them in place until practical completion, unless the project arboriculturist authorises staged removal.

The following precautions should be observed when working near to the construction exclusion zone.

- No fires should be lit on site.

- No spoil, plant, machinery, construction materials or vehicles should track or be stored within the fenced area or be leant against the fence panels.
- No fuel, chemicals or other contaminated liquids must be discharged in proximity to trees or where they may flow towards tree Root Protection Areas.
- No construction activity of any kind should take place within the fenced areas, and fencing must not be moved unless supervised by the project arboriculturist or their suitably experienced deputy (e.g. Ecological Clerk of Works).
- No spoil or materials are to be stored or leant against fencing.
- Damage to fencing must be reported to the site manager and rectified as soon as possible. All fencing should be maintained so that it is fit for purpose.

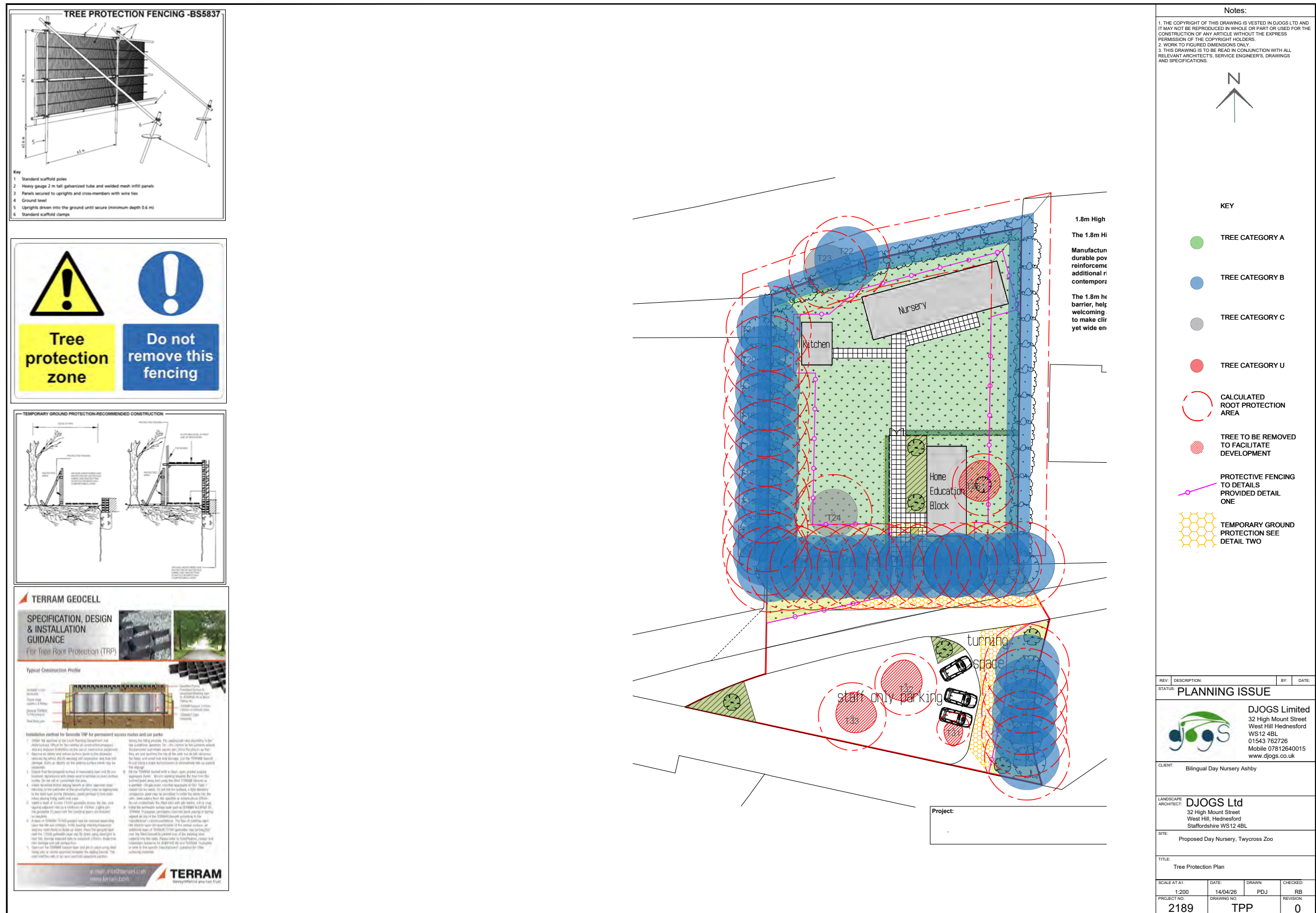
Post-construction

- All tree protection barriers to be removed once the build is complete and signed off.

6.3 Conclusion

The proposed development is considered acceptable in arboricultural terms, provided all advised protective measures are implemented throughout the construction period. This will include the installation and maintenance of tree protection fencing and temporary ground protection in accordance with BS 5837:2012. Some trees will require removal to facilitate the proposed development; however, subject to these measures, the impact on the retained trees and hedgerows is considered acceptable.

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[Appendix B: Section 7.4 BS5837 \(2012\)](#)**Permanent hard surfacing within the RPA**

NOTE This subclause does not apply to veteran trees, where it is recommended that no construction, including the installation of new hard surfacing, occurs within the RPA.

7.4.1 General

Where permanent hard surfacing within the RPA is considered unavoidable, site-specific and specialist arboricultural and construction design advice should be sought to determine whether it is achievable without significant adverse impact on trees to be retained.

NOTE Specialist arboricultural advice includes, for example, advice on the tolerance of a tree species to the installation of a permanent hard surface within the RPA or tolerance of salt damage (see 7.4.2.4).

7.4.2 Design recommendations

7.4.2.1 The design should not require excavation into the soil, including through lowering of levels and/or scraping, other than the removal, using hand tools, of any turf layer or other surface vegetation. If it is intended to use the new surface for construction access, it is essential that the extra loading and wear arising from this are taken into account during the design process.

7.4.2.2 The structure of the hard surface should be designed to avoid localized compaction by evenly distributing the loading over the track width and wheelbase of any vehicles expected to use the access.

7.4.2.3 New permanent hard surfacing should not exceed 20% of any existing unsurfaced ground within the RPA.

7.4.2.4 If the new surface is likely to be subject to de-icing salt application, an impermeable barrier should be incorporated to prevent contamination of the rooting area. Run-off should be directed away from the RPA (see also 8.6.5).

7.4.2.5 Where a permeable surface is to be used by vehicular traffic, a geotextile should be used at the base of construction to help prevent pollution contamination of the rooting area below.

7.4.2.6 Permeable hard surfacing can result in soil volume moisture content remaining at or near field capacity for long periods. Where there is a risk of waterlogging, the design should incorporate appropriate land drainage (see also 4.3 and 8.6.5). Land drainage within the RPA should be designed to avoid damage to the tree and the soil structure, e.g. sand slitting formed by compressed air soil displacement with the slits set radially to the tree.

7.4.2.7 The hard surface should be resistant to or tolerant of deformation by tree roots and should be set back from the stem of the tree and its above-ground root buttressing by a minimum of 500 mm to allow for growth and movement. Resulting gaps may be filled using appropriate inert granular material.

NOTE 1 Appropriate sub-base options for new hard surfacing include three-dimensional cellular confinement systems. Alternatively, piles, pads or elevated beams can be used to support surfaces to bridge over the RPA or, following exploratory investigations to determine location, to provide support within the RPA while allowing the retention of roots greater than 25 mm in diameter.

NOTE 2 The use of two-dimensional load suspension systems is not recommended for surfaces intended for use by vehicles.

7.4.2.8 When designing the hard surface, account should be taken of finished levels in relation to adjacent structures, including damp-proof courses, garage slabs and links to existing vehicular cross-overs.

NOTE Attention is drawn to the Building Regulations 2010 [8], the Building (Scotland) Regulations 2004, as amended [9] and the Building Regulations (Northern Ireland) 2000 [10], in respect of the need for accessible thresholds.

7.4.2.9 If a permeable surface is to be used by construction traffic, this should be protected with a temporary sacrificial surface laid over a geotextile separator to ensure that its permeability is retained (i.e. interstices should not become blocked during construction).

7.4.3 Edge supports

The excavation needed for the placement of kerbs, edgings and their associated foundations and haunchings can damage tree roots. Within the RPA, this should be avoided either by the use of alternative methods of edge support or by not using supports at all.

NOTE For example, where kerbing is required for light structures, such as footpaths, above-ground peg and board edging might be acceptable. Where areas of hard surface require edge support, the use of sleepers (pinned in place where required), gabions or other non-invasive ground-contact structures, including the use of proprietary products, can provide appropriate solutions.

7.4.4 Precautions

7.4.4.1 The soil structure including the area beneath the proposed new hard surface should be protected from compaction during installation. This may be achieved by:

- a) the use of temporary ground protection in accordance with 6.2.3 to safeguard the working area;*
- b) constructing the new surface with machinery working forward from the surface as it is constructed (known as “rolling out”).*

7.4.4.2 Where a herbicide is used to control vegetation prior to construction of hard surfacing, the manufacturer's guidance should be strictly followed and care should be taken to avoid any damaging effects on trees or other vegetation to be retained.

NOTE The use of appropriate geotextiles can provide a barrier that inhibits weed growth but allows water and gases to pass freely.

7.4.4.3 The ground should not be skimmed to establish the new hard surface at the former ground level. Loose organic matter and/or turf should be removed carefully using hand tools. The new surface should then be established above the soil.

7.4.4.4 Raising levels should be achieved by use of a granular material which remains gas- and water-permeable throughout its design life.

7.4.4.5 Due to the highly alkaline leachate produced during the curing of wet concrete, concrete should not be poured within the RPA unless an impermeable liner has been installed.

7.5 Special engineering for foundations within the RPA

7.5.1 The use of traditional strip footings can result in extensive root loss and should be avoided. The insertion of specially engineered structures within RPAs may be justified if this enables the retention of a good quality tree that would otherwise be lost (usually categories A or B). Designs for foundations that would minimize adverse impact on trees should include particular attention to existing levels, proposed finished levels and cross-sectional details. In order to arrive at a suitable solution, site-specific and specialist advice regarding foundation design should be sought from the project arboriculturist and an engineer. In shrinkable soils, the foundation design should take account of the risk of indirect damage (see A.1.4).

7.5.2 Root damage can be minimized by using:

- piles, with site investigation used to determine their optimal location whilst avoiding damage to roots important for the stability of the tree, by means of hand tools or compressed air soil displacement, to a minimum depth of 600mm.
- beams, laid at or above ground level, and cantilevered as necessary to avoid tree roots identified by site investigation.

7.5.3 Where a slab for a minor structure (e.g. shed base) is to be formed within the RPA, it should bear on existing ground level, and should not exceed an area greater than 20% of the existing unsurfaced ground.

7.5.4 Slabs for larger structures (e.g. dwellings) should be constructed with a ventilated air space between the underside of the slab and the existing soil surface (to enable gas exchange and venting through the soil surface). In such cases, a specialist irrigation system should also be employed (e.g. roof run-off redirected under the slab). The design of the foundation should take account of any effect on the load-bearing properties of underlying soil from the redirected roof run-off. Approval in principle for a foundation that relies on topsoil retention and roof run-off under the slab should be sought from the building control authority prior to this approach being relied on.

7.5.5 Where piling is to be installed near to trees, the smallest practical pile diameter should be used, as this reduces the possibility of striking major tree roots, and reduces the size of the rig required to sink the piles. If a piling mat is required, this should conform to the parameters for temporary ground protection given in 6.2.3. Use of the smallest practical piling rig is also important where piling within the branch spread is proposed, as this can reduce the need for access facilitation pruning. The pile type should be selected bearing in mind the need to protect the soil and adjacent roots from the potentially toxic effects of uncured concrete, e.g. sleeved bored pile or screw pile.

7.6 Subterranean construction within the RPA

7.6.1 Where it is proposed to form subterranean structures, e.g. basement extensions, within the RPA, it is essential to avoid excavating down through rootable soil if trees are to be retained. In some cases, it might be technically possible to form the excavation by undermining the soil beneath the RPA.

7.6.2 The following factors should be considered, in light of site-specific and specialist arboricultural, engineering and geotechnical advice:

- the future growth potential of the tree.
- the minimum depth of overburden (i.e. that overlying the roof of the proposed structure) required for retention in situ to ensure the survival of the tree and its stability against the wind.
- the potential for vibration-induced granular flow within the retained overburden, caused by the undermining process, to destabilize the tree through reduced root adhesion.
- the mass of the tree and of the retained overburden.
- the potential for ponding (i.e. perched water table) and the need for a drainage/runoff control system.
- the potential for adverse effects on local soil hydrology, and the possible impact of these on tree health.

7.7 Underground and above-ground utility apparatus

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

7.7.2 Where underground apparatus is to pass within the RPA, detailed plans showing the proposed routeing should be drawn up in conjunction with the project arboriculturist. In such cases, trenchless insertion methods should be used (see Table 3), with entry and retrieval pits being sited outside the RPA. Provided that roots can be retained and protected in accordance with 7.2.2, excavation using hand-held tools (see 7.2.1) might be acceptable for shallow service runs.

NOTE The suitability of these for differing applications is summarized in Table 3.

Table 3 Trenchless solutions for differing utility apparatus installation requirements					
Method	Accuracy	Bore dia. ^{A)}	Max. sub. ^{B)} length	Applications	Not suitable for
	mm	mm	m		
Microtunnelling	<20	100 to 300	40	Gravity-fall pipes, deep apparatus, watercourse/ roadway undercrossings	Low-cost projects due to relative expense
Surface-launched directional drilling	≈100	25 to 1 200	150	Pressure pipes, cables including fibre optic	Gravity-fall pipes, e.g. drains and sewers ^{C)}
Pipe ramming	≈150	150 to 2 000	70	Any large-bore pipes and ducts	Rocky and other heavily obstructed soils
Impact moling ^{D)}	≈50 ^{E)}	30 to 180 ^{F)}	40	Gas, water and cable connections, e.g. from street to property	Any application that requires accuracy over distances in excess of 5 m

^{A)} Dependent on strata encountered.

^{B)} Maximum subterranean length.

^{C)} Pit-launched directional drilling can be used for gravity fall pipes up to 20 m subterranean length.

^{D)} Impact moling (also known as thrust-bore) generally requires soft, cohesive soils.

^{E)} Substantial inverse relationship between accuracy and distance.

^{F)} Figures given relate to single pass: up to 300 mm bore achievable with multiple passes.

7.7.3 Above-ground apparatus (including CCTV cameras and lighting) should be sited to avoid the need for detrimental tree pruning. In this regard, the current and future crown size of the tree should be assessed. Tree branches can be pruned back with care to provide space, though it is not appropriate for repetitive and significant tree work to be an initial design solution unless this is a suitable management outcome for the tree. Pruning should be undertaken in accordance with BS 3998:2010.