Arboricultural Survey, Impact Assessment and Method Statement

For

Renovation of an existing dwelling and the installation of a new garden studio

At

35a Broadhurst Gardens, South Hampstead, North-west London

Client: Mr Jeff Shapiro

Prepared by: Andrew Cunningham FdSc (Arb), Tech Cert (AA), M.ArborA

ACAC

10TH APRIL 2021

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INDEX

APPENDICES:

1. EXECUTIVE SUMMARY

1.1 The site is located at 35a Broadhurst Gardens, South Hampstead which incorporates a small garden area to the rear.

1.2 During the survey four items that were identified consisting of three individual trees and one tree group. The majority of these were identified as moderate quality (Category B) with a useful life expectancy of 20 years.

1.3 The proposals are for the development of an existing dwelling and the construction of a new garden studio.

1.4 The existing trees are considered a benefit to the site and it is the intension to retain these as they offer good screening to the adjacent properties.

1.5 Ash tree T1 is considered too large for its location and it is recommended that the canopy be reduced to ensure adequate space to mature. It is also recommended the that mature ivy is removed from its stem. These recommendations are irrespective of the development proposals and in accordance with good arboricultural management.

1.6 The impacts to the retained trees can easily be managed by working in accordance with an approved Arboricultural Method Statement (AMS). If recommendations set out within this report are implemented and adhered to, then the current proposals are acceptable from an arboricultural perspective.

2. INTRODUCTION

2.1 Andrew Cunningham Arboricultural Consultant (ACAC) was instructed by Mr Jeff Shapiro to undertake a tree survey at 35a Broadhurst Gardens, a private dwelling located within South Hampstead, north-west London. Hereafter, this will be described as 'the site'.

2.2 The development proposals are for the renovation of the main dwelling, as well as the installation of a garden studio to the south of the main dwelling within the rear garden.

2.3 The scope of the instruction was to visit the site and to survey relevant trees, hedges and shrub masses in accordance with *BS5837:2012 'Trees in relation to design, demolition and construction – recommendations.'*

2.4 The purpose of the tree survey is to identify the arboricultural constraints within the site. This will allow appropriate tree protection measures to be implemented during the construction phase and to ensure any impacts to retained trees are kept to an acceptable level.

2.5 It has been requested that ACAC provides the following;

- All survey data in tabular form
- A Tree Survey and Constraints Plan relating to all trees/vegetation on site
- An Arboricultural Report to discuss findings
- An Arboricultural Impact Assessment (AIA)
- A Combined Tree Retention/Removal and Protection Plan
- An Arboricultural Method Statement (AMS) including Phasing of Works.

3. LIMITATIONS OF THE REPORT

3.1 This arboricultural report has been drafted in relation to the current development proposals. It should be read in conjunction with the Tree Constraints, Retention/Removal and Protection Plans.

3.2 It is not the purpose of this report to identify and evaluate risk or set out detailed tree work specifications.

3.3 Any management recommendations set out within this report are of an advisory and preliminary nature only which relate to the site in its current context.

3.4 It is beyond the scope of this report to highlight direct or in-direct damage that existing trees could cause to structures on site, whether through annual growth or tree related subsidence.

3.5 In order for tree owners to reasonably comply with Duty of Care responsibilities; they should consider a schedule of tree risk management. This professional tree inspection process should contain a brief to evaluate the degree of risk posed (if any) by trees on the site and to specify appropriate management if necessary.

3.6 Trees are living organisms as well as self-supporting dynamic structures. Their physiological and structural condition can change rapidly in response to a wide range of biotic/abiotic factors. They have the potential to fail structurally, without prior manifestation of any reasonably observable symptoms. It is therefore not possible to categorically state that any tree is 'safe'.

3.7 Physical alterations to site conditions subsequent to the date of the tree survey could have the potential to change/invalidate the findings and recommendations within this report.

3.8 Findings and any recommendations set out in this report will only be valid for a maximum of **12** months.

4. INFORMATION PROVIDED

4.1 To Allow ACAC to carry out the tree survey and draft the associated report the following information was provided;

- General layout – J and Z Construction Ltd – 03.11.20
- Screw-pile specification – Pile Tech Rev 24-09-2018

5. STATUTORY TREE AND WILDLIFE PROTECTION

5.1 Camden Council (CC) has confirmed (via e-mail) that the site is located within the South Hampstead Conservation Area and none of the trees within the site are currently protected by a Tree Preservation Order (TPO). Below is general advice regarding TPO's;

5.2 A TPO prevents the cutting down, uprooting, topping, lopping, wilful damage or wilful destruction of trees or woodlands without the prior consent of the Local Planning Authority (LPA).

5.3 It is also an offence to carry out any works to a tree in a Conservation Area with a trunk diameter greater than 75mm diameter at 1.5 height without formal consent from the Local Planning Authority (LPA).

5.4 Anyone who commits an act in contravention of a TPO is liable, on conviction in a Magistrates Court, to a fine of up to a £20,000. For a serious offence, a person can be committed for trial in the Crown Court and if convicted, can be liable for an unlimited fine.

5.5 On many non-residential sites there is also a statutory restriction relating to tree felling that relates to quantities of timber that can be removed within set time periods. Therefore, you must obtain a felling license from the Forestry Commission if you plan to remove more than 5 cubic metre's of timber within a calendar quarter (3 months).

5.6 Although preliminary visual checks from ground level of likely wildlife habitats are made at the time of surveying, detailed ecological assessments should be made by a suitably qualified Ecologist. This falls outside the scope of the Arboriculturist.

5.7 Trees which contain holes, splits, cracks and cavities could potentially provide a habitat for bats in addition to birds and small mammals. It is recommended that in line with any accompanying specialist advice, any tree works should only be carried out following a detailed climbing inspection to the tree to ensure that protected species or their nests/roosts are not disturbed. If any are found, the Project Manager, Site Owner or Consulting Arboriculturist should be informed and appropriate action taken as recommended by a Statutory Nature Conservation organisation such as Natural England.

5.8 It is advised that tree/hedgerow works are carried out with the understanding that birds will generally nest in trees, hedges and shrubs in summer months (March and August). Ideally, operations should be avoided during this period however, visual inspection can be carried out by the contractor before works commence.

5.9 Any proposed tree works must adhere to the statutory controls outlined above.

5.10 It should be noted that the Ancient Tree Forum (ATF) highlights many of the trees within the site are important in the terms of either being Veteran, Ancient or Notable within the local and wider area. Government guidance states that trees of this age should be given due consideration when located close to a proposed development.

Sources: The Town and Country Planning Act 1990, the Wildlife and Countryside Act 1981 (as amended), The Countryside and Rights of Way Act 2000 (as amended), The Conservation of Habitat and Species Regulations 2010. National Planning Policy Framework (2012), Standing advice on ancient/veteran trees - Forestry Commission and Natural England (2014),

6. SITE DESCRIPTION

6.1 The site is located at 35a Broadhurst Gardens, South Hampstead which incorporates a small garden area to the rear. The property is currently vacant.

6.2 The character of the local area is urban with densely situated domestic dwellings with associated gardens.

6.3 There are a number of early-mature to mature trees within the rear gardens of dwellings located on Broadhurst Gardens.

6.4 The site is contained by brick walls on all boundaries with the main dwelling to the north.

6.5 Access into the site is from an access passage located along the western edge of the main dwelling.

6.6 Below are photographs recorded during the tree survey;

Photograph 1: Looking south towards Ash T1 located within the rear garden. Note mature ivy growing throughout canopy.

Photograph 2: Looking south-east along southern boundary wall. Note existing prefabricated garden shed and proximity of Ash T2 to boundary wall.

Photograph 3: Looking south along eastern boundary of rear garden. Note proximity of existing shed to stem of Ash T1.

Photograph 4: Looking west long southern boundary of rear garden. Cypress T3 located within neighbouring garden.

7. SURVEY FINDINGS

7.1 During the survey a total of four items were identified and assessed in accordance with BS5837:2012. The table below summarises tree survey finding;

Category/Survey items	Tree	Groups	Hedgerows	Total
A	0	0	0	**0**
B	3	0	0	**3**
C	0	1	0	**1**
U	0	0	0	**0**
Total	**3**	**1**	**0**	**4**

7.2 Of the four survey items that were identified, three were individual trees and one was a tree group.

7.3 All individual trees were identified as moderate quality (Category B). These items were in mostly good structural and physiological condition which are prominent within the local landscape with good visual amenity. These trees are likely to contribute the arboricultural resource for somewhere in the region of twenty years.

7.4 One tree group (located off-site) was identified as low quality (Category C). These trees were in good condition but were more modest in size and less significant within the local landscape. The group is likely to have a useful life expectancy of somewhere in the region of 10 years.

7.5 No trees on or adjacent to the site were identified as high quality (Category A) or as Category 'U' (considered unsuitable for retention in the sites current context).

8. PRELIMINARY TREE CONSTRAINTS - GENERAL

8.1 Below ground constraints, or root protection areas (RPAs), for the surveyed trees have been plotted onto the tree survey plan for the site. These are represented as a circle centred on the base of each tree stem with a radius of 12 times stem diameter measured at 1.5m above ground level.

8.2 With reference to BS5837:2012, a root protection area (RPA) is defined as "a layout design tool indicating the minimum area around a tree deemed to contain sufficient roots and rooting volume to maintain the tree's viability, and where the protection of the roots and soil structure should be treated as a priority". The default position when considering design layout in relation to RPAs should be that structures are located outside the RPAs of trees to be retained".

8.3 BS5837:2012 states (4.6.2) that, "where pre-existing site conditions or other factors indicate that rooting has occurred asymmetrically, a polygon of equivalent area should be produced." The BS goes on to state that, "modifications to the shape of the RPA should reflect a soundly based arboricultural assessment of likely root distribution," and that any deviation from the original circular plot should take into account:

- Morphology and disposition of roots;
- Topography and drainage;
- Soil type and structure;
- Likely tolerance of the tree to root damage/disturbance based on factors such as species, age, condition and past management.

8.4 Root systems can be damaged in a number of ways as follows:

- Severance of a root will destroy all parts of the root beyond that point. This can affect the overall functionality of the tree but also more importantly affect the trees stability which could cause a safety risk.
- Soil compaction, which may occur from storage of material or passage of heavy equipment over the root area, can restrict and even prevent gaseous exchange through the soil, which can lead to reduced functionality and potentially decline and death. This also the case with raising soil levels.
- Lowering the soil level will strip out the mass of roots near the surface.
- Spillage of chemicals, oils etc.

9. ARBORICULTURAL CONSTRAINTS - ON SITE

9.1 The main constraints in relation to the arboricultural resource relate to Ash trees T1 and T2 located on the southern boundary of the site. These were of a size where their rooting areas will cover most of the small rear garden where the development is proposed. Off-site Cypress T3 also is a consideration as its rooting area enters the site where some ground works are proposed.

10. ARBORICULTURAL IMPACT ASSESSMENT (AIA)

10.1 With reference to BS5837:2012 *'Trees in relation to design, demolition and construction'*, this AIA evaluates the direct and indirect effects of the proposed design on the site's arboricultural resource.

10.2 The AIA considers the effects of any tree loss required to implement the proposed development as well as any potentially damaging activities proposed in the vicinity of retained trees. BS5837:2012 suggests that such activities might include:

- Removal of existing buildings, infrastructure and hard surfacing;
- Installation of new hard surfacing that includes car parking;
- Installation of underground services;
- Excavations of trenches and changes in ground level;
- The viability of the proposed development in terms of access, adequate working space, provision for storage of materials including topsoil.

10.3 With reference to BS5837:2012, the AIA includes an evaluation of the impact posed by the proposed development on the retained trees and vegetation on site.

Proposed tree losses

10.4 The trees on site are considered to be a benefit to the proposals as they offer good screening to adjacent dwellings. Therefore, there is no intension to remove any of the existing trees on site.

Demolition and site clearance

10.5 There is an existing prefabricated shed located in close proximity to Ash T1 and also T2. The proposals will require the removal of this shed which has the potential to damage these trees if not carried out in the appropriate manner. Therefore, the stages of the demolition and removal of the sheds should adhere to recommendations set out within the Arboricultural Method Statement (AMS) at **Sections 12/13** of this report.

Facilitation pruning

10.6 The proposed layout indicates that only minor facilitation pruning will be needed in the form of minor canopy lifting to allow adequate space for construction. These works are considered routine and should have a limited impact to the overall health of these trees.

10.7 It was noted during the survey that Ash tree T1 had been subject to past canopy reductions. It now has significant regrowth from previous pruning points and has become oversized for its location. As the land use changes it may be beneficial to reduce the canopy of this tree by 3-4m (20% of total height) to allow for future growth. An indication of the extent of pruning is shown on the Tree Retention/Removal and Protection Plan at **Appendix 3**.

10.8 During the survey the tree appeared to be in good health (good bud density) with no obvious indications of Ash Dieback (Hymenoscyphus fraxineus), however, this should be a consideration in future management with regular inspections. More information regarding Ash Dieback can be found at the forest research website (www.forestresearch.gov.uk).

10.9 Mature ivy was also noted during the survey to the stem and canopy of Ash T1. This will offer good habitat for birds and insects but does also obscure any structural (cavities) or physiological (fungal infection) defects the tree may present. Therefore, as part of good arboricultural management, it is recommended that the ivy is removed from the stem and canopy and the tree is re-inspected for any defects which may impact its useful life expectancy.

Tree protection

10.10 The site has very limited access and space, which results in no heavy plant machinery being able to access the site. The development proposals close to trees T1 and T2 are reasonably limited in nature, therefore, on this occasion it is considered that tree protection will not be required.

10.11 Any existing concrete surfaces should be left in-situ if possible, which will offer ground protection to underlying tree roots if a micro-excavator is utilised during the construction phase of the project.

Concrete removal within Root Protection Areas (RPA)

10.12 During the site visit it was noted that there were numerous concrete foundation/paths close to Ash trees T1, T2 and Cypress tree T3. If possible, these should be retained and left in situ which will limit disturbance to underlying tree roots. If these need to be removed, it should be undertaken with a mechanical hand breaker, then removed by hand in to wheelbarrows before removing from site.

10.13 It may be possible to utilise a micro-excavator if this is either positioned away from root protection areas or positioned on temporary ground protection such as 'Ground Guard'. The Arboriculturist will offer guidance as needed.

Foundations

10.14 The proposed layout shows the new garden studio positioned within the RPAs of retained Ash trees T1 and T2. To limit the impact to the underlying roots, a screw pile foundation will be utilised. The specification and spacing should be designed by a suitable qualified Engineer.

10.15 These should be installed in accordance with the manufacturers method statement as well as recommendations set out within the AMS of this report (**Sections 12/13**).

Services and Drainage

10.16 The proposed layout indicates that there will be drainage required to service a bathroom in the new garden studio. This will link to the existing drainage to the north for the main dwelling. The screw pile foundation for the garden studio will create a void beneath the building (see image below), it should be possible to lay the new drainage pipe/services on to existing levels which will mitigate the need for excavations within the RPAs of adjacent trees. If this is not possible and excavations are required within RPAs of retained trees, then these should be undertaken with hand tools to ensure minimal damage to underlying tree roots.

Photograph 5: Screw pile foundation with void beneath building.

10.17 Any excavations within the RPAs of Ash trees T1 or T2 should be undertaken in accordance with recommendations set out within the AMS.

Levels and Landscaping

10.18 It is anticipated that the levels within the garden area will remain unchanged, however as the garden is being landscaped, any level change required within the RPAs of T1 or T2 should be implemented with hand tools only to ensure minimal damage to roots of retained trees.

Storage of materials

10.19 Space within the site is limited and therefore consideration should be given to the location of storage of materials, etc. When the existing building are removed, the resulting debris should be taken away from site and not stored close to trees.

11. TREE PROTECTION PLAN

11.1 A Tree Retention/Removal and Protection Plan (TRRP) is included at **Appendix 3**.

11.2 In accordance with BS5837:2012 the TRRP is superimposed onto the proposed site layout plan and based on the topographical survey. Any hard surfacing and structures within the RPAs of trees to be retained are shown on the TRRP. In addition, where relevant, the TRRP shows the following information, accompanied by descriptive text as required:

- Precise locations of protective barriers (if required)
- Other protection measures necessary e.g. temporary ground protection

11.3 The preparation of the TRRP has considered the following factors where relevant:-

- Site construction access;
- Intensity and nature of construction activity;
- Contractors car parking;
- Phasing of construction works;
- Availability of special construction techniques;
- Spatial requirements

11.4 The tree protection measures shown on the TRRP demonstrate the feasibility of the proposed development in relation to retained trees.

12. ARBORICULTURAL METHOD STATEMENT (AMS)

12.1 The aim of the AMS is to ensure protection of all retained trees on site during the installation of the new garden studio and associated groundworks.

12.2 It gives clear guidance to how this surface will be installed which has the potential to impact retained trees within the site.

12.3 The information contained within the AMS is in accordance with *BS5837:2012, Trees in relation design, demolition and construction – Recommendations.*

12.4 Before construction activities commence on site the Project Manager must brief all site operatives to ensure they understand and comply to the contents of the AMS. This 'induction' should be documented by the Project Manager for future reference.

12.5 The AMS should be made available to all site operatives during the construction phase of the project to ensure understanding of the scope and importance of the tree protection specified for the site.

12.6 The AMS is a bespoke document that is relevant to the planning permission for the site. If there are any deviation from this, the Arboriculturist (ACAC) should be informed so that they can evaluate any additional impacts to retained trees and specify any further tree protection measures as appropriate. Camden Council (CC) should be notified of any deviation to the AMS before any works commence.

12.7 The following abbreviations have been used throughout this document:

- Arboricultural Method Statement – AMS
- Tree Retention/Removal and Protection Plan – TRRP
- Root Protection Area – RPA
- Construction Exclusion Zone – CEZ
- Tree Protection fencing - TPF

12.8 Arboricultural contacts for the project

i. Arboriculturist – Andrew Cunningham (ACAC) – 07879050389 – andrew@cunninghamtrees.co.uk

ii. Tree and Landscape Officer (CC) – 020 7974444 – planning@camden.gov.uk

iii. Project Manager – TBA

12.9 General guidance for construction operatives

i. Do not undertake any construction activity that does not comply with the AMS and TRRP.

ii. Do not carry out any work within the CEZ without guidance from ACAC.

iii. Prohibited activities within the CEZ are as follows:

- No mechanical excavation whatsoever (unless under supervision from ACAC)
- No hand digging without an AMS (or guidance from ACAC)
- No altering of ground levels
- Storage of materials/machinery,
- Parking of vehicles/plant,
- Depositing of soil or rubble,
- Lighting of fires or disposal of liquids/chemicals.

iv. Fires on site should be avoided on site. If unavoidable, they must be positioned away from any retained trees so not to cause damage to foliage, bark etc.

v. Any materials whose accidental spillage would cause damage to a tree, should be stored and handled well away (down slope where relevant) from the outer edges of root protection areas of retained trees on site.

13. PHASING OF OPERATIONS

13.1 The phasing of the project should be carried out in the following order:

i. Facilitation pruning
ii. Demolition of existing outbuilding.
iii. Removal of existing hard surfacing
iv. Installation of new garden studio (including screw pile foundation)
v. Final Landscaping

Tree Removals and Facilitation Pruning

13.2 All tree works shall be carried out by a suitably competent and qualified Arborist and in accordance with industry best practice (*BS3998:2010 Tree work – Recommendations).*

13.3 All tree work operations must be carried out in-line with the contractor's own site-specific Risk Assessment and Method Statement that shall be approved prior to commencement of works by the Project Manager.

13.4 All tree work operations will be carried out not to damage or impact adjacent retained trees. No retained trees should be used for anchorage.

13.5 All arisings shall be removed from site unless agreed with Project Manager.

Installation of temporary Tree Protection Barriers/Ground Protection

13.6 As access into the site is limited, no heavy plant machinery will be utilised. Therefore, no temporary tree protection fencing will be required. The existing concrete surfacing will offer ground protection to underlying roots if left in situ until removed.

Demolition of existing garden sheds

13.7 The existing prefabricated concrete shed is in close proximity to Ash tree T1. The removal of this shed could potentially damage this tree (direct impact damage) if not undertaken in an appropriate manner.

13.8 Therefore, the technique of 'top-down, pull back' should be employed. The sheds are constructed in small sectional pieces which will make their removal reasonably easy by hand.

13.9 All debris from the removals should be removed from site and not stored close to trees or within their RPAs.

Removal of existing concrete foundations/paths

13.10 An existing concrete slab which was used for the foundation of existing sheds and concrete paths will require removal to implement proposals.

13.11 It is proposed that a mechanical hand breaker be utilised to break up the surfaces to manageable pieces and then loaded into wheelbarrows and taken from site. Under no circumstances should spoil material be piled up and stored close to trees or within their RPAs.

13.12 A micro-excavator may be used. This should be positioned outside RPAs or on existing concrete surfaces. If this is not possible, then a temporary ground protection should be used as a precaution.

Foundations for new garden studio

13.13 The new building will be positioned on screw pile foundation (Pile-tech) which will limit potential damage to underlying tree roots.

13.14 These will be installed in accordance with the manufacturer's specification (included at Appendix 4). An Engineer will be responsible for size and spacing of the piles. As the building is reasonably lightweight, this should limit the size and number of piles required.

13.15 During installation, exploratory trail pits should be hand dug to in the position that the screw piles will be situated. This will help establish whether major roots are present within these areas. If major roots are encountered, then the location of the pile should be re-located to an area where no roots are present.

Excavations within RPAs for service installation/Landscaping

13.16 Any excavations required within the RPAs of retained trees should be carried out with hand tools only. This will ensure minimal damage to underlying tree roots.

13.17 Under no circumstances should a mechanical excavator be utilised to excavate trenches or grade soils within the RPAs of retained trees.

13.18 If during hand excavations, roots are encountered then these should be pruned in accordance with BS5837:2012. Roots up to 25mm should be pruned to a suitable side shoot with sharp saw or secateurs. Any roots encountered larger than 25mm or present in clumps, then advice should be obtained from the Arboriculturist.

13.19 Any exposed roots should be covered at the earliest convenience to ensure minimal desiccation and potential death.

13.20 If possible, any drainage or services from the new garden studio should utilise the void beneath the building and on existing ground levels until outside the RPA.

13.21 The Arboriculturist will be on hand to offer guidance where possible.

APPENDIX 1

TREE SURVEY SCHEDULE AND METHODOLOGY

TREE SURVEY SCHEDULE

Site: 35a Broadhurst Gardens, South Hampstead, London

Date: 6th April 2021

Client: Mr Jeff Shapiro

TREES

Tree ID	Species	Height	Stem dia	Est	Spread								Crown clearance height					Life stage	General observations	Structural condition	Physiological condition	ULE	Quality grading	RPA radius	RPA area
					N	Est	S	Est	E	Est	W	Est	1st branch	Est	1st branch direction	Canopy height	Est								
T1	Ash (common)	18.0	500	-	6.0	-	6.5	#	6.0	-	6.0	-	8.0	-	South	8.0	-	M	Large tree located on southern boundary, oversized for small garden location. Mature ivy to stem/mid canopy. Canopy reduced in past, now with substantial regrowth. Ivy limited visual inspection. Existing concrete plinths/concrete shed located 1m from stem. No obvious signs of canopy dieback (ash dieback). Minor hung up limb within canopy. Remove ivy from stem and re-inspect. Consider canopy reduction if land use changes/remove hung up limb.	Fair	Fair	20+	B1	6.0	113
T2	Ash (common)	12.5	270	-	5.0	-	5.0	#	1.5	-	5.0	-	2.5	-	North	2.5	-	EM	Tree located close to southern boundary. Suppressed by neighbouring trees, unbalanced canopy and weighted to west. Offers screening to neighbouring dwellings. Historic raised levels at base. Located 0.5m from boundary wall.	Good	Good	20+	B2	3.2	33
T3	Cypress (Monterey)	11.5	300	-	3.0	-	3.0	-	2.5	-	3.0	-	2.5	-	North	2.5	-	EM	Tree located within neighbouring garden, typical form but young. Limited access to base - measurements estimated.	Good	Good	20+	B2	3.6	41

GROUPS

Group ID	Species	Height range	Est	Stem numbers	Maximum Stem diameter	Average radius	Average canopy height	Life stage	General observations	Structural condition	Physiological condition	ULE	Quality grading	RPA radius	RPA area
G1	Holly, Cherry laurel	8-9	#	5	200	3.0	4.0	EM	Off-site group located within neighbouring garden, measurements estimated. Good screen to neighbouring building.	Good	Good	10+	C2	2.4	18

TREE SURVEY METHODOLOGY

- The tree survey was carried out with reference to methodology set out in *BS5837:2012 'Trees in relation to design, demolition and construction – Recommendations'.*
- Trees were surveyed (from ground level) individually or as groups where it was considered that they had grown together to form cohesive arboricultural features. However, where it was considered that there was an arboricultural need to differentiate between attributes trees within groups/woodlands were also surveyed as individuals
- Within the tree survey schedule, each surveyed tree (T), group (G) or woodland (W) on or adjacent to the site is given a *reference number* which refers to its position on the tree survey constraints plan.
- Also shown on the tree constraints plan are root protection areas (RPA).
- **Tree species** are listed by common name only.
- Heights are measured in metres. They are recorded to the nearest half metre for dimensions up to 10m and to the nearest whole metre for dimensions over 10m.
- **Trunk diameters** are measured in millimetres and are rounded to the nearest 10mm. Single stemmed tree diameters are measured at 1.5m above ground level or, where a fork or swelling makes this impractical, at the narrowest point beneath. Diameters of multi-stemmed trees are calculated as 'combined stem diameters' (as per guidance set out within BS5837:2012).
- **Branch spreads** are taken at the four cardinal points to derive an accurate representation of the tree crown. They are recorded up to the nearest half metre for dimensions up to 10m and to up the nearest whole metre for dimensions over 10m.
- **Crown clearance** is expressed both as existing height above ground level of first significant branch along with its direction of growth, and also in terms of the overall canopy.
- **Canopy radius** is an average measurement of the radius of the tree canopies within the group.
- **Hedge width** is an average measurement of the overall width of the hedge along its length.
- Estimates. Where any other measurement has had to be estimated, due to inaccessibility for example, this is indicated by a "#" suffix to the measurement as shown in the tree survey schedule.
- **Life stage** is defined as Y – young (stake dependent), SM - Semi-Mature (still capable of being transplanted without preparation, up to 30cm girth and not yet sexually mature), EM – Early Mature (not yet having reached 75% of expected mature size), M – Mature (anything else up to

normal life expectancy for the species), OM – Over Mature (anything beyond mature and in natural decline), V – Veteran.

- **General observations** are recorded in relation to a tree's structural and/or physiological condition (i.e. the presence of any decay and physical defect) and /or any preliminary management recommendations that may be appropriate.
- **Physiological condition** is described as Good (no indications of impaired physiological function and in optimum condition for age and species), Fair (with indicators of reduced vitality. Some intervention may be required), Poor (with significantly impaired physiological function for age and species).
- **Structural condition** is described as Good (without any observable significant biomechanical structural weaknesses), Fair (with minor biomechanical structural flaws. Some remedial action may be required), Poor (with significant biomechanical weaknesses requiring intervention particularly where risk management is required).
- **Useful life expectancy (ULE)**, or the length of time a tree's is estimated to be able to make a useful contribution, is expressed in years as: <10, 10+, 20+, 40+
- **Quality** of individual trees, groups of trees and woodlands is assessed in terms of quality and benefit within the context of proposed development and graded into one of four categories (A, B, C and U) which are differentiated on the tree survey constraints plan by the colours highlighted below:

Category A	Trees of high quality with an estimated remaining life expectancy of 40 years. Retention is desirable.
Category B	Trees of moderate quality with an estimated remaining life expectancy of at least 20 years. Retention is desirable.

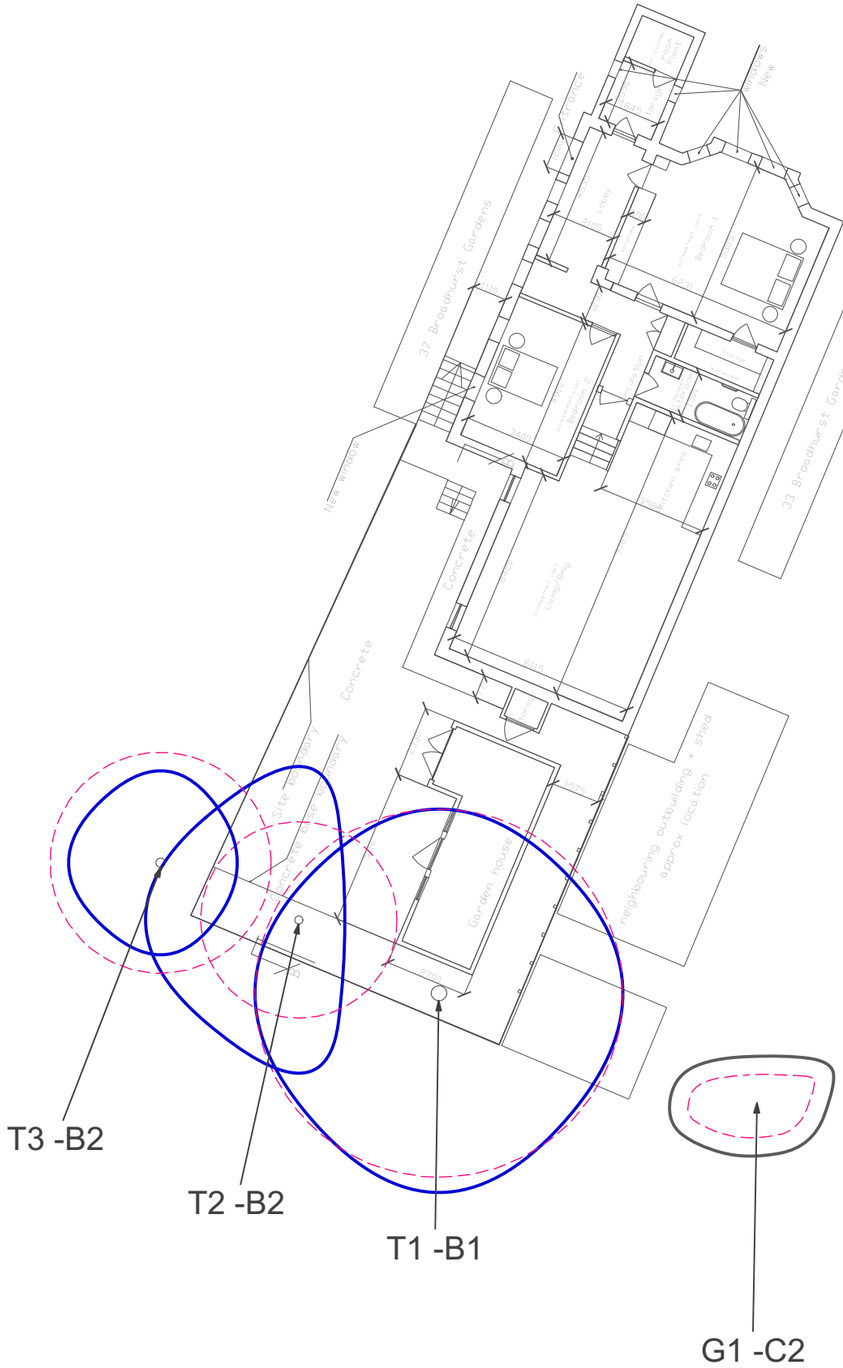
Category C	Trees of low quality with an estimated remaining life expectancy of at least 10 years, or young trees with a stem diameter below 150mm. Trees could be retained but are not considered a significant constraint to the development.
Category U	Unsuitable for retention. Trees in such a poor condition that they cannot realistically be retained as living trees in the context of the current land use for longer than 10 years. These trees may have high conservation value.

- A, B and C trees have also been given a sub-category of 1, 2 or 3 which reflects their arboricultural, landscape or cultural and conservation values. Each sub-category has an equal weight, for example a B1 tree has the same retention priority as a B3 tree.
- The tree survey schedule also describes each tree's root protection area (RPA) in terms of radius (metres) and overall area (sq metres).
- This survey is for planning purposes only and is not intended as a tree condition survey. However, the base line data may be used as a guide for future detailed tree surveys if required.

APPENDIX 2

TREE SURVEY AND CONSTRAINTS PLAN

Tree No	Species	RPA Radius M	RPA Area M2	Category
T1	Ash (common)	6	113	B1
T2	Ash (common)	3.2	33	B2
T3	Cypress (Monterey)	3.6	41	B2
G1	Holly, Cherry laurel	2.4	18	C2



N

0 2 4 6 8 10

Metres

KEY **BS 5837 : 2012 Categories**

- Tree Category A - High Quality
- A Category - Hedgerow, Group, Woodland
- Tree Category B - Moderate Quality
- B Category - Hedgerow, Group, Woodland
- Tree Category C - Low Quality
- C Category - Hedgerow, Group, Woodland
- Tree Category U - Unsuitable for Retention
- Root Protection Area to BS 5837:2012
- Shrub Mass / Offsite Tree / OOS (Out of scope)

Plan derived from aerial imagery and should not be relied on for scale

35A BROADHURST GARDENS, SOUTH HAMPSTEAD

TREE SURVEY & CONSTRAINTS PLAN

DWG NO- ACU_043_01
DATE- 08/04/2021
DRAWN BY - SD
SCALE - 1:200 @ A3

REVISION-
SHEET- 1/1
APPROVED BY - AC
CLIENT - JEFF SHAPIRO

ACAC

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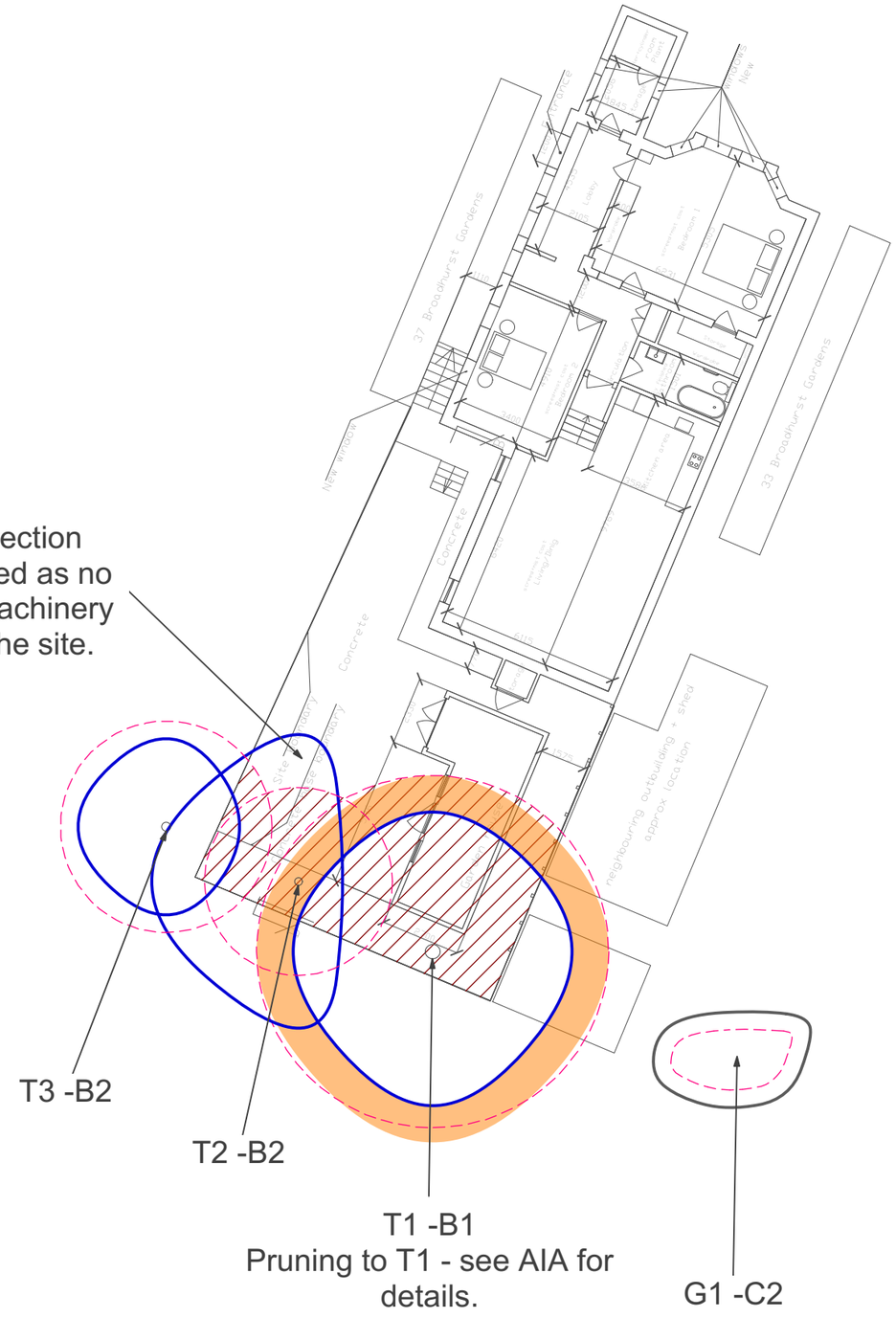
APPENDIX 3

TREE RETENTION/REMOVAL AND PROTECTION PLAN

Tree No	Species	RPA Radius M	RPA Area M2	Category
T1	Ash (common)	6	113	B1
T2	Ash (common)	3.2	33	B2
T3	Cypress (Monterey)	3.6	41	B2
G1	Holly, Cherry laurel	2.4	18	C2



KEY **BS 5837 : 2012 Categories**

- Tree Category A - High Quality
- A Category - Hedgerow, Group, Woodland
- Tree Category B - Moderate Quality
- B Category - Hedgerow, Group, Woodland
- Tree Category C - Low Quality
- C Category - Hedgerow, Group, Woodland
- Tree Category U - Unsuitable for Retention
- Root Protection Area to BS 5837:2012
- Shrub Mass / Offsite Tree / OOS (Out of scope)
- Trees to be removed to allow development proposals to be implemented.
- All works within root protection areas of retained tree to be carried out in accordance with recommendations set out within AIA/AMS.
- Recommended tree pruning - see AIA for details.

Plan derived from aerial imagery and should not be relied on for scale

N

0 2 4 6 8 10

Metres

35A BROADHURST GARDENS, SOUTH HAMPSTEAD

TREE RETENTION/REMOVAL & PROTECTION PLAN

DWG NO- ACU_043_02
DATE- 09/04/2021
DRAWN BY - SD
SCALE - 1:200 @ A3

REVISION-
SHEET- 1/1
APPROVED BY - AC
CLIENT - JEFF SHAPIRO

ACAC

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APPENDIX 4

SCREW PILE SPECIFICATION

Piletech Screw Pile Specification

Contents

1.0 SCOPE

This specification covers the procurement, design, manufacture, installation and certification of steel screw piles and shall be read in conjunction with the job specific Construction Drawings and the Piletech Pile Design Summary.

This document sets out default requirements. In some instances these requirements will be modified to suit particular projects. These modifications will be identified on either Drawings or within the Piletech Pile Design Summary. The order of precedence shall be:

1. Piletech Design Summary
2. Construction Drawings
3. Piletech Screw Pile Specification

2.0 ROLES AND RESPONSIBILITIES

The roles and responsibilities pertinent to this specification are summarised below:

2.1 Engineer (Clients Advisor/Representative)

The “Engineer” shall be responsible for providing sufficient information to the Pile Designer to allow the design of the screw piles to the required performance requirements. As a minimum, the information shall include the following:

- Design life, structure importance level and specific durability requirements.
- Providing piling RL with respect to current ground levels.

- Compression, tension and lateral structural loads at each individual pile location including all relevant raw loads or load combinations in accordance with NZS1170.
- Pile performance requirements, specifically the maximum permissible deflection or displacement of the pile under serviceability and ultimate limit state loading.
- Design documentation relevant to the screw pile design such as geotechnical report(s), architectural and structural drawings or structural design calculations.
- Identify any ground effects that may impart additional load on the screw pile foundations. This may include alterations in groundwater, ground settlement or seismic hazards.
- Any specific tolerance requirements outside of default tolerance of AS2159.
- Specific material and test requirements outside of the default requirements of this specification.
- Any specific requirement for pre-construction or during production load testing and acceptance criteria for testing.
- Identify the need for a peer review of the pile design.

The Engineer shall be responsible for undertaking the following:

a) Review of the Piling Contractor's methodology for executing any pre-construction or during production load testing.
b) Review of the Piling Contractor's methodology for executing the installation of the screw piles, ie the Pile Design Report.
c) Review of the Pile Designers screw pile design specifically the interface of the screw pile and superstructure design to ensure cohesive design parameters and properties.

2.2 Piling Contractor

The Piling Contractor shall be responsible for constructing and installing the screw piles in accordance with the Piletech Pile Design Summary, Construction Drawings and this Specification. The Piling Contractor shall be responsible for preparing a Producer Statement – Construction (PS-3).

The Piling Contractor shall be responsible for ensuring that all plant and equipment used for the project is safe and reliable, and capable of delivering the necessary torque for the screw pile design requirements.

The Piling Contractor shall be responsible for ensuring appropriate and trained personnel are provided for the management and installation of the screw piles.

The Piling Contractor shall commission the Pile Designer.

2.3 Pile Designer

The Pile Designer shall be a Chartered Professional Engineer (CPEng) trained and suitably experienced in screw pile design. The Pile Designer shall be responsible for the design of the screw pile system, including but not limited to:

a) Interpretation and inference of the geotechnical information available.
b) The geotechnical and structural design of each element of the screw pile in accordance with this specification (allowing for installation and design loads on the screw pile).
c) The design of the screw pile to superstructure/foundation connection (if within their design scope).

d) Durability of the screw pile elements.
e) The pile capacity and performance for all relevant load cases.
f) Determination of appropriate design references if requirements fall outside of this standard specification.

The Pile Designer shall also be responsible for:

a) Providing a Design Producer Statement (PS-1) by a Chartered Professional Engineer (CPEng) experienced in the design of screw pile foundations.
b) Producing a Pile Design Report (Piletech Pile Design Summary) outlining the assumptions and requirements of their design which shall accompany their Producer Statement - Design (PS-1).
c) Commission a peer reviewer for the pile design (PS-2) by a Chartered Professional Engineer (CPEng) experienced in the design of screw pile foundations, if required. It is the responsibility of the Pile Designer to ensure adequate experience of the peer reviewer in screw pile design and construction.
d) Monitor the screw pile installation and load testing at a frequency which shall be at the discretion of the Pile Designer.
e) Provide a Construction Review Producer Statement (PS-4).

3.0 STANDARD SPECIFICATIONS

This specification shall be read in conjunction with the following Standards, which are deemed to form part of this Specification. In the event of this Specification being at variance with any provision of these Standards, the requirements of this Specification and Construction Drawings shall take precedence. Reference to any Standard shall mean the latest edition of the standard and shall include any amendments thereto and any Standard in substitution thereof. All design, materials and workmanship shall comply with these Standards unless expressly noted otherwise.

Primary Standard:

- AS 2159 – Pile design and installation

Secondary Standards:

- AS 1163 – Structural steel hollow sections
- API5L – API Specification for line pipe 5L
- AS/NZS 1170 – Loadings standard
- AS/NZS 1554 – Welding of steel structures
- NZS 3101 – Concrete structures
- NZS 3404 – Steel structures
- SNZ TS 3404 – Durability requirements for steel structures and components
- NZS 3104 – Specification for concrete production
- NZS 3109 – Concrete construction
- AS/NZS 3678 – Structural steel – hot-rolled plates, floorplates and slabs
- AS/NZS 4671 – Steel reinforcing materials
- AS/NZS 2980 – Qualification of welders for fusion welding of steels
- NZS 4781 – Code of practice for safety in welding and cutting
- AS 4100 – Steel Structures
- AS 3978 – Non-destructive testing – Visual inspection of metal products and components

Other Standards or Guidelines may include:

- MBIE/NZGS Earthquake geotechnical engineering practice – Module 4
- NZ Building Code Verification Method B1/VM4
- IPENZ Practice Note 28: Screw piles: Guidelines for design, construction and installation
- NZTA bridge manual
- Eurocode 4

4.0 PILE DESIGN

4.1 General

Pile design shall comply primarily with AS 2159 and the New Zealand Building Code and all standards mentioned above.

The pile design shall take account of all applicable permanent or temporary loading conditions, such as but not limited to; gravity loads, seismic loads, tension loads, lateral loads, wind loads, snow loads, hydrostatic loads, torsional loads and negative skin friction effects combined in accordance with NZS 1170 Loading Standard.

An appropriate geotechnical reduction factor shall be determined using the risk assessment procedures of AS2159 unless determined otherwise by the Pile Designer.

4.2 Ground Conditions

Ground conditions are to be assessed using all available geotechnical information. Geotechnical conditions and assumptions are to be established considering recommendations from the geotechnical report as well as the Pile Designers past experience with screw piles in similar materials. The Pile Designer should draw upon past load testing where possible to support their geotechnical design assumptions.

4.3 Pile Shaft

The pile shaft shall be designed to suit the required axial and shear loads and moments for both in service loads and installation stresses.

The shaft shall be designed for the combined effects of axial loading and moment in accordance with AS 4100, or Eurocode 4 where concrete infill is present. Alternative analysis using software packages such as L-Pile may also be appropriate.

Consideration should be given to any allowed section loss due to corrosion.

Where applicable, consideration of the effects of eccentric loading or buckling mode of failure shall be considered.

4.4 Helices

The helix steel grade, diameter, thickness and pitch shall be calculated and designed to suit the applied loads, loading conditions and the specific geotechnical substrata. The helix shall be designed with consideration to both structural and geotechnical capacity to ensure both installation and the design loads can be achieved. In particular the soil pressure distribution due to helix flexure should be considered.

Geotechnical and structural design of the helix shall be in accordance with PJ Yttrup and Abramson "Ultimate Strength of Screw Piles in Sand" (Australians Geomechanics Society Vol 38, No1, March 2003) unless otherwise noted.

The helices shall be sized as to minimise the risk of spinning (where the penetration rate drops below 1 pitch per revolution causing a column of disturbed soil).

4.5 Joints (Splices)

Splices shall be designed to ensure the transfer of the required installation and permanent loads, which may include moments.

Joints can be welded, pinned or mechanical connections. Splices shall take account of potential corrosion effects for the design life of the structure. Water ingress and durability impacts shall be considered if pinned or mechanical connections are specified.

4.6 Welds

All welds associated with the screw pile, including the helix welds and splices, shall be designed as Structural Purpose (SP) category for Grade E48XX (grade 480MPa electrode) consumables suitable for seismic conditions as per the manufacturers recommendations. The size of weld should take account of potential corrosion effects for the design life of the structure.

The Pile Designer shall detail the type of weld (butt weld or fillet weld), the size of the weld (leg length for fillet welds) and the joint type in accordance with AS/NZS 1554.

4.7 Durability

The screw piles shall have sufficient durability to be able to withstand the design loads over a minimum of 50 years lifetime, unless specified otherwise by the Engineer, in accordance with the NZ Building Code. For unprotected steel, the Pile Designer shall consider the long term corrosion rate in accordance with SNZ TS 3404 – Durability requirements for steel structures and components.

In the absence of detailed soil test data or a geotechnical engineer's recommendation, a 'Moderate' exposure classification shall be taken for the exposure classification for steel piles in soil.

Where helices are founded in soils at depths where free oxygen is very low, the exposure classification should be reduced to 'Mild'.

The Pile Designer may use any combination of surface coatings, sacrificial steel thickness and/or cathodic protection to ensure durability requirements are met. Where protective coatings are used, and the coating life cannot be ensured to be 50 years, the Pile Designer shall make an allowance for section loss after the coating is lost. Installation effects on surface coatings shall also be considered.

4.8 Pile to Foundation Connection

Where the pile to foundation connection falls within the design scope of the Pile Designer, the Pile Designer shall design the connection to transfer all axial loads, shear loads and moments. The Pile Designer may adopt either a pinned, partially fixed, or fully fixed pile head connection to the foundation. This would need to correspond to the requirements of the lateral design of the pile.

Where moment transfer is required between the pile and foundation, the Engineer [Structural] will need to confirm that the ground beams/superstructure can accommodate the moments as provided by the Pile Designer.

In general, the design of the connection shall be in accordance with NZS3101. Where there is reliance on concrete bond to CHS this shall be designed in accordance with Eurocode 4, Section 6.7.4.3.

Where steel annulus are used to transfer axial loads or moments these must be structurally designed to take account of the flexural strength of the steel plate.

Alternative connections such as shear studs, dowel bars or bolts may be used as detailed by the Pile Designer.

4.9 Pile Embedment Length

The design pile lengths shall be correlated and confirmed with respect to the available site specific geotechnical information including but not limited to liquefaction, strata suitability and necessary separation from softer layers that may affect pile performance or stiffness.

Piles shall be designed to overcome all potential failure modes such as cone pull-out, compressive or tensile bearing failure, compressive or tensile punching failure or the effects of a change in material properties resulting from seismic activity or changes in water table.

Pile grouping effects shall also be considered in the above analysis.

4.10 Pile Design Report and Certification

The Pile Designer shall produce a Pile Design Report (Piletech Pile Design Summary) detailing:

a) Design Loads
b) Durability design
c) Applicable standards and reference documents (ie Geotechnical report, drawings, etc.)
d) Geotechnical strength reduction factors
e) Load testing requirements
f) Founding stratum and design soil properties
g) Design methodology and how specific loads such as seismic, lateral and settlement are addressed
h) Estimated pile length
i) Pile splice details
j) Connection design between pile and foundation

This Pile Design Report shall accompany a Design Producer Statement (PS1) for submission to the Engineer and local authority.

4.11 Liability

The Pile Designer shall carry Professional Indemnity Insurance for the sum of $1,000,000.

5.0 MATERIALS

5.1 Pile Shaft

The pile shaft shall be manufactured from steel circular hollow section (CHS) and shall comply with API5L (minimum grade X52) and AS1163 (minimum grade C350) unless otherwise specified by the Pile Designer.

In addition to the tolerance requirements of the above specifications, CHS procured under this specification must have a wall thickness tolerance of ±5% of specified wall thickness.

In addition to the mechanical testing requirements of the above specifications, CHS procured under this specification must have tensile testing performed in both the transverse and longitudinal directions for pipes with outside diameter (D) greater than 168mm.

Testing and compliance certificates from the manufacturer of the CHS must be maintained on record and be presented upon request. Pipe used on the project must be able to be related back to a specific Heat number as detailed on a Mill Certificate.

5.2 Helices

Helices should be manufactured from steel plate compliant to AS/NZS 3678 with a minimum specified steel grade of 350MPa, and no greater than 500MPa.

5.3 Concrete

Infill concrete, where specified by the Pile Designer, shall have a default minimum 28 day strength of 30MPa unless detailed otherwise by the Pile Designer. Concrete shall be sourced from a certified batching plant.

Slump tests or cylinder samples may be required at the discretion of the Pile Designer.

5.4 Pile End Plugs or other plates

Pile toe end plugs or other plates should be manufactured from steel plate compliant to AS/NZS 3678 with a minimum specified steel grade of 350MPa.

5.5 Bolts, Studs, Pins

All bolts, studs or pins shall be compliant to AS/NZS 1111 and 1112 with a minimum specified steel grade 8.8.

5.6 Reinforcing Steel

Reinforcement bars shall be either Grade 300E or Grade 500E to AS/NZS 4671 as designated in the Construction Drawings or Pile Design Report. All reinforcing bars shall be deformed bar unless otherwise noted.

6.0 MANUFACTURE

6.1 Fabrication

Sections forming the pile shaft shall be of the sizes and wall thickness indicated on the Construction Drawings or in the Pile Design Report.

Where CHS is to be cut using a mechanical saw. Cuts are to be straight and at an angle as specified in the Construction Drawings or Pile Design Report ±1%. The height difference between any low and high point in the cut must not exceed 5mm.

Components must be manufactured such that they fit well together without excessive gapping. As a maximum, the gap must not exceed the root gap tolerance of the appropriate weld procedure for a given welded joint.

6.2 Welding

All welding required in the manufacture of the screw piles must be of the type and size specified in the Construction Drawings or Pile Design Report.

Welded joints shall be welded in accordance with the requirements of AS/NZS 1554. All joints shall:

a) Be of the type and size specified in the Construction Drawings or Pile Design Report.
b) Be performed using an appropriate Weld Procedure Specification (WPS) approved by the Pile Designer
c) Be performed by a welder holding appropriate and current qualification certificates for the size and type of weld being undertaken in accordance with either AS/NZS 1554 or AS/NZS 2980
d) Have all welds undertaken on permanent pile features (helices and spliced joints) inspected by an independant 3rd party weld inspector with appropriate qualifications required under AS/NZS 1554 and at a frequency and type as described in Section 8 of NZS 3404 – Part 1.

All weld inspection records must be compiled and provided to the Pile Designer at the completion of the project, including welder qualification records and 3rd party testing reports.

Welding consumables must be Grade E48XX (grade 480MPa electrode) consumables suitable for seismic conditions as per the manufacturers recommendations and as approved by the Pile Designer.

Prior to welding, the surfaces to be welded must be clean, free from grease or residue and cut and retained at the appropriate positions as required by the Weld Procedure Specification.

6.3 Helices

Helices are to be manufactured to the size and plate thickness provided in the Construction Drawings or Pile Design Report.

Helices are to be mechanically pressed by suitable means to ensure a true helix is formed which meets the following criteria:

a) The pitch at the inside and outside of the helix must be equal (±4% of flange width but no greater than 10mm)
b) The gradient of the spiral should be constant
c) Any radial measurement across the helix should be perpendicular to the shaft (±4% of flange width but no greater than 10mm)

When multiple helices are welded to a shaft, the plates shall be spaced at a multiple of the helix pitch.

6.4 Handling and Storage

All operations such as handling, transporting, lifting and pitching of materials shall be carried out in such a manner as to prevent damage to the materials and/or their coatings.

CHS should be stored and stacked on suitable supports on firm ground, in a manner which will eliminate excessive handling stresses or other damage.

Any materials that result in damage or permanent stress must not be used in pile manufacture.

6.5 Material Test Reports

The Piling Contractor must ensure that all piles or pile components are fabricated from materials that have traceable records which indicate the origins, chemistry and mechanical properties of the steel or other materials.

Where required to prove compliance of material standards, material test certificates to the relevant Standards shall be provided prior to installation of production screw piles.

7.0 INSTALLATION

7.1 General

Pile installation shall generally comply with AS 2159.

7.2 Equipment

Installation equipment shall be selected that is capable of safely and accurately installing the designed pile in the given conditions. It shall be capable of applying installation torque equal to the torque required to meet the pile design loads and installation torque requirements and shall be capable of applying downward pressure and torque simultaneously.

The hydraulic torque pile driving head must have clockwise and anti-clockwise rotational capabilities. The hydraulic torque pile driver shall be a rotary type motor with equal forward and reverse torque capabilities.

The installation equipment must have a mechanism for continual monitoring of the torque being applied to the pile. The torque monitoring system shall be either part of or an independent device in-line with the installation unit. Hydraulic relationships to torque may be used, but must be calibrated with electronic torque transducers periodically to ensure pressure to torque relationship. Machine settings and torque heads must be kept the same as their calibrated state. Should machine settings or plant setup change, recalibration with an electronic torque transducer would be required.

Calibration of this device should be performed on a regular basis to ensure proper performance and consistent output results. Calibration records should be available for inspection by the Engineer or Pile Designer on request.

All equipment must be capable of safely delivering the design torque and lifting requirements. All securing hardware, pins, locking pins and other installation elements must be properly located, and capable of restraining all possible torsional, axial and bending moment forces applied during pile installation and compliant in all respects with the appropriate safely standards ruling construction plant and equipment within the workspace.

Operators should be appropriately trained in the installation of screw piles. If not using a torque transducer, operators must not restrict the full flow of hydraulic oil to the torque head.

7.3 Installation Tolerances

The Piling Contractor shall make all necessary provisions to the installation procedure, installation, initial positioning and inclination of piles as to achieve installation of the piles within the specified tolerances as per Section 7.2 of AS2159:2009 unless otherwise stated in the Construction Drawings or Pile Design Report or instruction from the Engineer. For **vertical** piles the tolerance shall be:

- Pile heads shall be within ±75mm in plan location shown on drawings
- Pile heads shall be within ±20mm of vertical level shown on drawings
- Piles shall not be more than 4% angle from vertical.

A reference system shall be utilised for each pile to monitor and determine pile location during installation and as a final 'as built' record.

If records show that piles have been installed outside of specified tolerances, the Piling Contractor shall provide the Pile Designer and Engineer with details of measures to be adopted to enable the piles to comply with the specification. Forcible correction of laterally displaced piles shall not be made, unless the Piling Contractor can demonstrate that the strength, integrity and durability performance of the pile will not be adversely affected.

7.4 Welding and Weld Testing

Welded joints shall be welded in accordance with the requirements of AS/NZS 1554. All joints shall:

a) Be of the type and size specified in the Construction Drawings or Pile Design Report.
b) Be performed using an appropriate Weld Procedure Specification (WPS) approved by the Pile Designer
c) Be performed by a welder holding appropriate and current qualification certificates for the size and type of weld being undertaken in accordance with either AS/NZS 1554 or AS/NZS 2980
d) Have the welds inspected by an independant 3rd party weld inspector with appropriate qualifications required under AS/NZS 1554 and at a frequency and type as described in Section 8 of NZS 3404 – Part 1.

All weld inspection records must be compiled and provided to the Pile Designer at the completion of the project, including welder qualification records and 3rd party testing reports.

Welding consumables must be Grade E48XX (grade 480MPa electrode) consumables suitable for seismic conditions as per the manufacturers recommendations and as approved by the Pile Designer.

Prior to welding, the surfaces to be welded must be clean, free from grease or residue and cut and retained at the appropriate positions as required by the Weld Procedure Specification.

7.5 Pile Records

Pile installation records shall include, but not be limited to, the following:

- Contract Name/Project Name/Client Name
- Project Location
- Pile Reference Number
- Pile description (shaft and helix size)
- Pile load details
- Installation torque requirements (or installation pressures as appropriate)
- Length and embedment of pile
- Installation torques at set intervals (usually 0.5m) as agreed with the Pile Designer
- Installation equipment used (eg Excavator and torque head used)
- Date of installation
- Piling Operator
- Installed position relative to design position and inclination of pile
- Specific operators notes, eg. if pile is not on pitch (vertical displacement per revolution of pile is less than helix gate)

7.6 Penetration Rate

The rate of penetration should be monitored throughout the installation of the pile. Where a pile is not penetrating at a rate close to one helix pitch per revolution of the pile, the Pile Designer shall be notified. The depths at which this occurs should be noted on the installation records.

7.7 Concrete Placement

Where applicable, the pile shaft shall be filled with concrete to the strength and requirements as described in the Construction Drawings or Pile Design Report. Concrete shall in general be supplied and installed in accordance with NZS 3109. Concrete shall be delivered using either a line or a boom pump, but can be delivered directly from the truck where required.

Prior to concrete being poured in a pile, the pile must be checked to ensure no water or debris are in the base of the pile shaft. If water or debris is in the pile shaft this shall be removed prior to pouring concrete. The Pile Designer should be notified if any water has entered the pile shaft during construction.

Concrete dockets shall be retained and presented to the Pile Designer / Engineer as evidence of conformance to the specification.

Where concrete testing is required, samples shall be taken at site from the back of the truck. Sampling from the batching plant may be acceptable at the discretion of the Pile Designer. All sampling/testing is to be undertaken by a qualified technician provided by the Concrete Supplier.

7.8 Reinforcing Steel Placement

Where applicable, reinforcing steel shall be placed in accordance with the details on the Construction Drawings or Pile Design Report. Reinforcing steel shall be installed in accordance with the requirements of NZS 3109.

Critical dimensions such as spacing between bars, edge distance of bars to CHS and upstand of bars into foundation must be adhered to with positional tolerances of ±10mm.

Steel reinforcing must be clean and free of grease or dirt prior to placement.

Steel certificates should be obtained from the reinforcing supplier as evidence of the steel grade and quality. These should be provided to the Pile Designer and Engineer.

7.9 Certification

The Piling Contractor shall provide a Construction Producer Statement (PS-3). Appropriate evidence of material certificates, installation records and inspections must accompany the PS-3 and be presented to the Pile Designer and Engineer.

The Pile Designer shall review the construction documentation for conformance with the Pile Design, Construction Drawings and Specification and shall provide a Construction Review Producer Statement (PS-4). Where items of the construction are found to be unsatisfactory they are to be rectified to the satisfaction of the Pile Designer and/or Engineer prior to issuing the PS-4.

7.10 Supervision / Inspections

The Piling Contractor shall provide the opportunity for the Pile Designer or Engineer to witness or inspect any element of work as it progresses. Particular items such as load testing or concrete pouring shall be notified to the Pile Designer.

7.11 Installation Criteria / Signoff

Pile installation criteria shall be specified by the Pile Designer. All piles upon installation shall be referred to the Pile Designer for conformance with their design and 'sign off' of the pile. Only the Pile Designer, or delegate of, shall approve piles as conforming. Only piles approved as conforming shall be progressed to concrete filling and handover to the client.

7.12 Unforseeable Ground Conditions

Where ground conditions differ from that expected from the Geotechnical Report or any other relevant geotechnical information provided, the Piling Contractor shall immediately provide notice of the ground conditions to the Pile Designer. The Piling Contractor may also need to notify the Engineer if a Variation or Extension of Time were to be sought for the unforeseeable ground condition.

7.13 Handling and Storage

All operations such as handling, transporting, lifting and pitching of materials shall be carried out in such a manner as to prevent damage to the materials and/or their coatings.

CHS should be stored and stacked on suitable supports on firm ground, in a manner which will eliminate excessive handling stresses or other damage.

Any materials that result in damage or permanent stress must not be used in pile manufacture.

8.0 LOAD TESTING

Load tests may be called for by the Pile Designer to verify design assumptions and pile performance or to validate the use of less conservative geotechnical reduction factors. The

Pile Designer shall provide detail on the maximum test loads and sequence of loads to be tested to the Piling Contractor to set up and perform the test(s).

8.1 Procedure

The test procedure shall be in general accordance with AS 2159, Section 8. The piling Contractor shall provide a method statement for the load testing to the Pile Designer for approval. The method statement shall contain the following information:

a) The programme of testing, detailing the timing and sequence of each load test
b) The general arrangement of testing equipment.
c) Details of the measuring equipment at the head and toe of the pile.
d) Confirmation of the available load and stroke of the testing apparatus.

The test shall use load cells where possible, but may use hydraulic pressure comparisons at the discretion of the Pile Designer. If hydraulic pressure is to be used then it shall be done so with a calibrated gauge and system.

8.2 Test Acceptance

Test acceptance, unless otherwise documented in the Construction Drawings or Pile Design Report, shall be as per AS 2159. The test results shall be forwarded to the Pile Designer and the Engineer for their approval of the test results.

9.0 PROTECTION OF EXISTING SERVICES/STRUCTURES

The Piling Contractor shall take all care to ensure that no damage is caused by any of the piling works to any existing structure, property or service.

10.0 COMPLETION

10.1 General

On completion of the piling works, the Piling Contractor shall leave the site and the Contract Works clean and ready for immediate use by following trades. The Piling Contractor shall remove all offcuts and debris.

10.2 Certification

The Piling Contractor shall provide the Engineer with a full suite of applicable producer statements including Design Producer Statement, Design Review Producer Statement, Construction Producer Statement and Construction Review Producer Statement.