ARBORICULTURAL ASSESSMENT REPORT (Review 2015)

Client:	Mr E. Drewitt
Site:	30 Queens Drive, Ashburton, Canterbury
Scope:	Review & discussion of the visual tree assessment (VTA) for the Silver lime *Tilia tomentosa* growing in the rear of the property.
Author:	Ed Sard
Date:	2ND July 2015 DRAFT

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1.0 Introduction

Background

1.1 In 2014, Treetech Specialist Treecare Ltd. received instructions from David Harford of Urbis Ashburton 2012 Ltd, on behalf of Mr E. Drewitt (the owner of 30 Queens Drive),to carry out an arboricultural condition assessment on the protected Silver Lime *Tilia tomentosa* growing within 30 Queens Drive, Ashburton.

1.2 Subsequently a report was commissioned to assess the condition of the tree and provide recommendations for future management.

1.3 The site was inspected on Thursday 3 April 2014 by Martin Gohns (Senior Consultant Arborist) for Treetech Specialist Treecare Ltd and the details incorporated within this report determine his findings and the conditions found on that day.

1.4 Martin Gohns report provided data on tree parameters, an assessment of condition and action for risk management.

1.5 A second site inspection was carried out on Monday 15th June 2015 by Chris Walsh (Managing Director of Treetech Specialist Treecare Ltd) and Ed Sard (Consultant Arborist) for Treetech Specialist Treecare Ltd.

2.0 Scope of review

2.1 The objective of the initial assessment was to deliver advice to the tree owner on the health and structural integrity of the tree and provide recommendations for risk management to meet their duty of care, insofar as is reasonably practicable, that people and property are not exposed to unreasonable levels of risk.

2.2 This subsequent report is viewed as being a discussion document by Ed Sard which encompasses both Martin Gohns assessment and the correspondence received from Ashburton District Council, dated 14th February 2014 which included a Tree Safety & Health report by Walter Fielding – Cotterell (Council Arborist) dated 21st January 2014.

3.0 Qualifications & Experience

Ed Sard

3.1 My name is Edward Sard. I hold a Technicians Certificate in Arboriculture (UK) and the Professional Tree Inspection qualification gained in the UK. I also hold an ISA (International Society of Arboriculture) Tree Risk Assessment qualification gained in New Zealand in February 2015. I have worked in the arboricultural and horticultural industries for 22 years, with the last 8 years specialising in landscape management and arboricultural consultancy.

3.2 I am a currently employed by Treetech Specialist Tree Care Ltd as a Consultant Arborist and have held this position for 11 months. My role includes tree inspection of the street tree and park tree asset and providing technical support for Christchurch City Council. Work includes detailed inspection and condition assessments of notable and protected trees, preparation of arboricultural implication reports for construction and providing technical advice with regard to tree and design conflicts. Work also includes tree condition assessments, reports and resource consent applications. My role also includes the management of the Waimakariri District Council tree maintenance contract.

3.3 Prior to my current role I was employed in the UK by Pegasus Planning Group (PPG) as a Consultanting Arborist and held this position for 3.5 years. My role included the preparation of Arboricultural Implication reports for construction, including Tree Protection plans, Tree and Landscape Visual Assessments, Tree Inspections and condition reports. I also liaised with local authorities with regard to issues relating to Tree Preservation Orders (TPO's).

Martin Gohns

3.4 Martin Göhns holds a Technicians Certificate in Arboriculture (UK) and a National Certificate in Nursery Practices (UK). He holds a professional tree inspection qualification gained in the UK and an ISA (International Society of Arboriculture) Tree Risk Assessment qualification gained in New Zealand in April 2014. He has worked in the arboricultural and horticultural industries for 32 years with the last 12 years, specialising in arboricultural consultancy.

3.5 At the time of the tree assessment, Martin Gohns was employed by Treetech Specialist Tree Care Ltd as the Senior Consultant Arborist and had held this position for 6 months. His role included tree inspection of the street tree and park tree asset and providing technical support for Christchurch City Council, detailed inspection and condition assessments of notable and protected trees, preparation of arboricultural implication reports for construction and provide technical advice with regard to tree and design conflicts, tree condition assessments and reports, resource consent applications and expert witness, transplant feasibility assessments, contract and financial management.

3.6 Prior to his senior consultant position with TreeTech, Martin Gohns was employed by The Specimen Tree Company Ltd in Auckland as a consultant arborist and held this position for just over 3 years. His role included the preparation of arboricultural Implication reports for construction, preparation of evidence and the attendance of hearings regarding resource consent applications and recent plan change reviews, transplant feasibility studies, tree inspections and condition reports and contract management.

3.7 He was previously employed in New Zealand by Christchurch City Council for 14 months as an arborist/contract manager responsible for the management and replacement planting of the city's road reserve trees.

3.8 Prior to emigrating to New Zealand Martin Gohns was employed by one of the leading environmental consultancies in the UK as principal consultant, primarily responsible for delivering tree risk management on large tree populations for local

authorities estates and retirement villages, tree root and building investigations, implication reports for construction and contract management. He held this position for 6 years.

4.0 Survey methodology

4.1 The tree was inspected by Martin Gohns on 3rd April 2014 using an industry recognised system of Visual Tree Assessment (VTA).

4.2 The tree was assessed for risk, taking into account features such as general health, vigour, condition of the trunk, branches and foliage, buttress roots, the presence of decay fungi and other indicators of health status and mechanical defects which may affect structural stability.

4.3 Tree height was measured using a Hahlöf digital clinometer. Stem girth was measured at 1.4m above ground level using a metric diameter tape. Crown dimensions were measured with a metric 30m tape. Stem numbering within Martin Gohns report was consistent with the arborist report prepared by Walter Fielding - Cottrell dated 21 January 2014.

4.4 The tree was inspected from ground level by a qualified arborist experienced in Visual Tree Assessment and qualified in Professional Tree Inspection.

4.5 In addition to the ground based VTA assessment an aerial inspection of the canopy was carried out. No invasive testing was carried out or samples taken for analysis.

4.6 Tree height was measured using a Haglöf electronic clinometer. Tree girth was measured using a metric trunk diameter tape.

4.7 The assessment of the potential risk posed by the tree from stem and/or branch failure is a culmination of the potential target, the likelihood of failure impacting the target and potential consequences. In order to determine the potential risk trees or parts of the tree pose, matrices commonly used in risk management across multiple industries have been used which are outlined in Appendix B of this report.[1]

5.0 Observations (Martin Gohns 3rd April 2014)

5.1 The tree has an asymmetrical canopy orientated to the south due to being suppressed to the north from an Oak tree located to the north-western corner of the property. The Oak had recently been felled at the time of my inspection with sawdust visible on the ground. The stump of the felled tree is approximately 9.2m from the subject tree.

5.2 The height of the tree has been measured at 19.7m. North-south canopy spread has been measure at 17.1m and east-west canopy spread of 19.5m. The tree is 12.5m from Mr Dewitt's house and within falling distance of the neighbouring house at 32 Queens Drive.

[1] ISO. 2009. *International Standard: Risk Management–Risk Management Techniques* Appendix B

5.3 The structure of the tree consists of three main stems which emanate from the base of the tree. Stem #1 leans to the south-east and is closest to Mr Dewitt's house. Stem #2 orientates to the west and stem #3 orientates to the north-east. Two large pruning wounds were evident at the stem base, to the north-west, indicating historic stem removal.[2] These wounds were much smaller in diameter than the existing three stems. Included bark was noted at the attachment points of the three stems. Included bark is an internationally recognised and well documented structural weakness in trees.

5.4 Average buttress root flare for the tree species was noted at the stem base with no visible defects noted. No fungal brackets were observed. The area immediately beneath the tree was laid to lawn and no obstacles were present prohibiting a complete visual inspection of the soil surface. There was evidence of saturated ground or ponding around the root zone at the time of my inspection.

5.5 The stem base was probed for signs of cavities with one cavity observed to the west of the tree at the junction of stem 1 and stem 3. An approximate 29 cm penetration was observed. The stems sounded with hammer up to approximately 2.0m in height no significant decay detected, this is well recognised and widely used non-invasive method for detecting decay in trees.

5.6 The tree had an approximately 60% live crown (to total height) ration. Pruning wounds were evident on the lower sections of the stems as a result of previous branch removal to raise the canopy of the tree. Although asymmetrical the canopy had a fully formed branch structure. No sign of apical dieback or significant deadwood was present that would indicate the tree was in decline or in poor health. No foliage was present at the time of my inspection.

5.7 A non-invasive Cobra bracing system has been installed at approximately half the total height of the tree, connecting stems #1 and #2 and #1 and #3. Two Cobra bracing systems were evident, which have been installed at different times. The most recent installation was a 4 ton system in 2013 confirmed by the date end caps installed.[3] An earlier installation is present which is smaller in diameter than the 2013 system and is indicative of a 2 ton system.[4]

5.8 The earlier Cobra system connecting both stem #1 and #2 (east-west) and stem #1 and #3 (north-east – south-west) was noted has being at high tension. The system has been installed at natural forks in the branch structure. Incremental growth of the trees stems has partially included the points of attachment.[5] There is evidence of previous failure of a cobra brace between stem #1 and #2 with the remnants of the brace trees partially included.[6]

5.9 The Cobra system installed in 2013 has been installed above the earlier system. Significant slack was noted in the recently installed braces.

[2] Refer to picture 1
[3] Refer to picture 2
[4] Refer to picture 3
[5] Refer to picture 4
[6] Refer to picture 5

5.10 The installed braces connecting stems #1 and #2 are connected to the main stems at an approximate diameter >450mm.[7] The stems have a similar angle of lean and the tension between at the connecting points is likely to be similar.

5.11 The installed braces connecting stems #1 and #3 are connected via a secondary branch on stem #3 with an approx. diameter of 300mm and the main stem of #1 with an approx. diameter >450mm.[8] Significant end weight was noted on stem #1 which leans towards the property and is at a greater angle than stems #2 and #3. Due to the end weight noted the secondary branch attached of the Cobra system on stem #3 has been pulled into the adjacent secondary branch lateral with an approx. Diameter <200mm at the point of attachment.[9]

6.0 Discussion (Martin Gohns April 2014)

6.1 Multi-stemmed trees are potentially weaker than single stemmed trees; this is exacerbated in this instance by the presence of included bark preventing the incremental wood growth fusing together. Included bark is considered to be a significant structural defect in trees with the potential to give rise to stem failure due to the weak union created.

6.2 The installation of the Cobra system will have been an attempt to prevent the potential failure of the stems, the braces were noted as being under high tension. Mr Walter Fielding – Cotterell's report dated 21 January 2014 states that the system was installed in 1997. As stated in paragraph 5.7 above, the diameter of the previously installed system is indicative of a 2 ton system which I consider to be inadequate for the size of the stems of the tree which are likely to in excess of 4 ton.

6.3 In 2013 a second Cobra bracing system has been installed which is noted as being a 4 ton system confirmed by the date end caps installed.[10] This system has been installed incorrectly with significant slack noted in both braces.[11] This is unlikely to have the desired effect of supporting the stems in the event of failure due the extent of travel before the slack is taken up.

6.4 Due to the tension noted on the pre-existing braces, failure of these braces is considered likely. Mr Walter Fielding – Cotterell's report dated 21 January 2014 notes that when the recent Cobra system was installed in December 2013 one of the braces was found to be broken, this is likely to have been the brace between stems stem #1 and #2 (east-west) as noted in paragraph 5.8.

6.5 What is of most concern is the degree of lean of stem #1 towards Mr Drewitt's house and the inadequate attempt to mitigate the structural defect (included bark). The pre-existing brace is connected to a secondary branch, which in turn is supported by a lateral branch <200mm diameter which is supporting the entire weight of stem #1. With the pre-existing brace (indicative of a 2 ton system)

[7] Refer to picture 5
[8] Refer to picture 6
[9] Refer to picture 7 and 8
[10] Refer to picture 3
[11] Refer to picture 9

considered to be inadequate and the recently installed brace installed incorrectly with a large amount of slack, there is a high risk of stem failure.

6.6 At the time of my inspection an Oak located to the north-western corner of the property had recently been felled. From the google map images available[12], it is considered that the Oak will have been a large tree providing protection for the Lime form north/north-westerly winds. With this protection now removed the Lime is more venerable to wind exposure which will only increase the wind loading on stem #1 and the bracing system.

6.7 In the "Hazard abatement/remedial tree work" section of Mr Walter Fielding – Cotterell's report, he recommends the installation of a steel wire and eye bolt bracing system. This is an invasive system requiring drilling through the stems. Furthermore there is no recommendation for pruning to alleviate the end weight loading of the stems.

6.8 The installation of any bracing system to mitigate defects in trees generally is only part of the remedial works which normally would include pruning to mitigate the loading of the stem or branch being braced. The bracing should then be inspected on a regular basis to ensure that the installed system remains functional for the task intended. Neither pruning nor re-inspection of the proposed bracing system has been proposed in Mr Fielding – Cotterell's report. Furthermore I do not consider installing further bracing to support stem #1 is appropriate due to the structure of the tree. There are only three stems with no stem to the north to be able to successfully brace stem #1 to mitigate the lean towards Mr Drewitt's house.

7.0 Conclusions (Martin Gohns April 2014)

7.1 The defects in the tree and potential for stem failure have been documented in my report and within Mr Walter Fielding – Cotterell's report and therefore any failure would be considered foreseeable.

7.2 Mr Walter Fielding – Cotterell's report, dated 21 January 2014, recommends the installation of a steel wire and eye bolt bracing system but does not recommend remedial pruning or an inspection regime for the bracing. Bracing systems should be inspected on a regular basis to ensure that the installed system remains functional for the task intended. The installation of bracing systems may be appropriate for trees with local authority control, however this would be difficult to manage for trees within private ownership. The previously broken cobra brace documented in Mr Walter Fielding – Cotterell's confirms that managing installed bracing systems in privately owned trees is problematic and unlikely to mitigate the risks posed by the tree.

7.3 Due to the orientation of the three stems I do not consider installing further bracing to support stem #1 is appropriate to mitigate the potential risk of stem failure. There are only three stems with no stem to the north to be able to successfully brace stem #1 to mitigate the lean towards Mr Drewitt's house.

7.4 In view of the defects noted, inadequate and incorrectly installed bracing systems and significant end weight noted, I consider the tree to be a high risk based on the

[12] Refer to Tree Location Plan Appendix A

ISA matrices referenced in Appendix B. In view of the known structural defects identified within the tree, it is my opinion that removal of the tree is the only viable long term arboricultural solution to mitigate the risk posed by the tree.

8.0 Conclusions (Walter Fielding-Cotterell January 2014)

8.1 Structural condition of Silver Lime – Mr Fielding-Cotterell states, '*that the Silver Lime does have a major structural defect that presents a potential hazard to persons and property within falling distance of the tree'*. He goes on to comment on the presence of included bark within the Silver Lime and the fact that this condition is considered a major structural defect, exacerbated in this case, by '*the significant leans of the stems away from each other (see hazard evaluation form) and the imbalance of branch growth/weight where they've grown out towards the light.'* Mr Fielding-Cotterell continues stating, '*This condition can lead to a stem or stems splitting or breaking away completely at the point of contact, which given the large size of all the stems, is likely to have serious consequences for persons or property in the 23.0 metre radius falling zone'.*

8.2 The above comments are caveated by Mr Fielding-Cotterell with his observations at the time of his inspection (11/01/14) stating that the Silver Lime, '*showed no sign of splitting or breakage'*.

8.3 He goes on to comment that the defect was noticed by City Care arborists in 1997 and the three stems were subsequently supported by installing synthetic rope bracing to hold the stems together, thus avoiding likely failure. In terms of the structural condition and noted trunk faults with the three main stems, Mr Fielding-Cotterell believes, *'the wood characteristics and branch structure of this tree have the right combination of strength and pliability to resist failure in the long term'*.

8.4 Ground conditions/root stability – Mr Fielding-Cotterell comments on the soil of the site following information received from the owner Mr Drewett. The site comprises predominantly heavy clay and it is of interest that the following comments are made by Mr Fielding-Cotterell;

- *Clay soils, which are plastic in nature, usually have lower shear strength and are more susceptible to load bearing failure when saturated.*
- *This can affect a tree in the following ways and is applicable to the tree in question.*
- *When wet, clay soils are saturated, slippery and plastic, tree roots in tension (e.g as in high winds) are pulled more easily through the soil due to greatly reduced friction.*
- *On the opposite side of the tree to the wind direction, the soft ground under the root plate subjected to increased compression and the high load bearing forces, may fail.*
- *In saturated soil conditions the combined effect will make the tree more prone to windthrow.*

8.5 At the time of Mr Fielding-Cotterell's inspection there were no reported concerns regarding stability of the Silver Lime, '*with the trunk buttresses and basal root*

flares at ground level being well developed and sound, indicating that the Lime has an extensive and strongly supportive root plate'.

8.6 Hazard abatement/remedial tree work – Mr Fielding-Cotterell comments on, '*the structural defects described in the section with the structure and condition of the Silver Lime, require urgent abatement/remedial work'.* He identifies that previous synthetic rope cable support (Cobra) was installed in 1997, but one of the cables was found to be broken in December 2013. The causes of the breakage are listed and whilst Mr Fielding-Cotterell identifies that specially designed synthetic rope systems have been approved and used to support trees for some years. He does not advocate the use of synthetic rope cable in this particular case, '*where failure of any of the stems could result in the loss of life and/or major damage to property*'. However, in relation to the Silver Lime, he believes that, *'the safest method is to install (on all three stems) galvanised multi-strand wire steel ropes attached to galvanised eyebolts drilled through the centre of the stems'.*

8.7 Damage to Property – Mr Fielding-Cotterell comments that, '*slight damage has been caused, not to the house itself, but pathways and a garden feature'*. Although difficult to confirm without physically breaking open and lifting the seal to determine whether roots are the cause, the presence of a large tree with a well established root system is highly likely to be causing varying levels of damage to pathways and garden features. This factor appears to be a consideration for readers of the report as opposed to a significant reason for future tree removal.

8.8 Suitability of Lime tree for protection – To assess the worthiness of the Silver Lime for protection, Mr Fielding-Cotterell, '*carried out an independent evaluation of the tree using the Heritage Tree Criteria/Evaluation System contained in the ADC District Plan'.* He found that the tree had been incorrectly identified as a Tilia x europaea – Common Lime. The tree was in fact a Tilia tomentosa – Silver Lime. The Silver Lime tree is identified as being quite rare and Mr Fielding-Cotterell qualifies his evaluation score of 40 points.

9.0 Discussion (Ed Sard June 2015)

9.1 In my opinion, the principle discussion point and focus within the context of this application, involves the viability and practicality of retaining a tree which has clearly been identified by both Martin Gohns and Walter Fielding-Cotterell as being a tree with major structural defects within a residential built area. The emphasis should be on the health and safety risks of retaining a large tree with multiple high targets within 20m radius of its trunk and the consequences, including accountability of bracing the tree to minimise these risks.

9.2 The health and vigour of the tree is not in question. There is no evidence or suggestion of twig or branch dieback that would indicate that the health and vigour of the tree is in decline. Both original authors also agree that there were no symptoms indicating that the tree is infected by disease organisms.

9.3 Mr Fielding-Cotterell comments on the longevity of Lime trees and their ability to withstand a wide range of climatic conditions, atmospheric pollution and injurious activites, yet still be able to maintain attractive, entire crown forms. Estimated to be 100 years plus, Mr Fielding-Cotterell believes that, '*provided the three individual*

stems are cabled together as prescribed in this report, I believe the Future Safe Useful Life Expectancy (FSULE) of the Lime to be forty (40) years'. As arboriculturalists, many of our assumptions as to the health and structural integrity of trees are made based on our personal experience which encompass scientific studies, industry recognised guidelines and known life cycles of trees in northern/southern hemispheres. Added to a multitude of external factors such as manmade intervention, site changes and adverse weather events, the dynamics of a tree can and do change. By their very nature, trees are an unknown entity, who ultimately determine the course of their existence within a specific growing environment with and without human intervention. I believe it is difficult and potentially dangerous to suggest that any tree, be it defected or not, can be successfully retained and managed without any risk to people or property for a specified time. I agree that industry approved guidelines allow arborists to make informed decisions on tree life expectancy but they should only be used as a guide. In this situation, the question should be, Can any qualified arborist categorically say that this tree will not fail and that no parts of the tree will fail within the next 40 years even with hazard abatement/remedial tree work?

9.4 The tree has survived for 100 years and within that period, a number of extreme weather events have taken place. Clearly, the Silver Lime survived a number of extreme weather events without the existing bracing. However the tree is now larger with greater loads to the structural defects and is surrounded by residential housing. The discussion should not be about what was there first, but more about whether the tree can be safely retained now, in a changed environment and what are the acceptable risks for both the tree owner, the neighbours and the local authority.

9.5 There appears to be some difference in opinion between Mr Gohns and Mr Fielding-Cotterell with regard to appropriate bracing techniques and its use in private trees. Mr Gohns identifies the constraints both financially and practically of installing and managing bracing systems in private trees. He specifically details the existing dynamic (Cobra/synthetic rope) bracing within the Silver Lime and counteracts the use of invasive bracing methods advised by Mr Fielding-Cotterell. Mr Fielding-Cotterell favours a static galvanised multi-strand wire steel rope attached to galvanised eyebolts drilled through the centre of the stems. A total of three stems would be cabled. There are numerous studies available determining the various benefits and disadvantages of both dynamic and static bracing. However, there is no defined scientific study determining the failure rate of braced trees in high target areas. There will always be a possibility of whole tree or part structural failure within braced trees with identified structural weakness. You are potentially dealing with significant loads/forces coupled with engineered man made materials which can and do fail. Therefore, it is difficult to make a clearly defined informed choice on hazard abatement work that is guaranteed to work. Whilst the doubt is there and if the targets cannot be practically removed, the real risk remains. The question is, what is an acceptable risk to today's local authorities/tree owners and if they have identified one (as in this instance), can they justify that risk, who will pay for the hazard abatement/continued monitoring and what happens if property is damaged or there is loss of life/injury to people.

9.6 Reference has been made to extreme weather events, soil ground conditions at the site and the fact that the Silver Lime has survived unscathed both pre and post cabling. One of the greatest storms in England since records began accounted for the destruction of thousands of trees predominantly in south east of England in 1987. I personally observed trees of all species and age, regardless of structural composition, bracing, health or growing environment uprooted as whole trees. Hurricane force winds from a non-prevailing wind direction levelled trees, some of which were hundreds of years old in minutes. Factors such as seasonally late leaf retention, change of prevailing wind direction and ground moisture levels were contributing factors and goes to highlight the dynamics of natural events and its unpredictability. Fortunately the loss of life was negligible but the economic outfall and change in landscape was severe. What this highlights, is that with the best will in the world, we cannot accurately predict how trees will respond in adverse weather when linked to other tree characteristics/factors and whether cable braced or not. When high target areas are added to the scenario, the risk parameters change.

9.7 The following comments by Martin Gohns add weight to the above discussion namely; '*At the time of my inspection, an Oak located to the north-western corner of the property had recently been felled. From the google map images available[13], it is considered that the Oak will have been a large tree providing protection for the Lime form north/north-westerly winds. With this protection now removed the Lime is more venerable to wind exposure which will only increase the wind loading on stem #1 and the bracing system*'.

9.8 Assessment of the evaluation score of 40 points carried out by Mr Fielding-Cotterell using the Heritage Tree Criteria/Evaluation System has been completed. There is no indication that Mr Fielding-Cotterells evaluation was incorrect and every arborist's assessment with such a system is open to interpretation. At the time of writing, the consequences resulting from the tree being incorrectly identified in the Ashburton District Plan as a Tilia x europaea (Common Lime) and not a Tilia tomentosa (Silver Lime) are not known. The legality involving such an error falls outside the arboricultural parameters of this report but is worthy of mention for completeness, as Mr Fielding-Cotterell also comments on the error.

9.10 It is important to consider the impact of retaining a tree with identified significant structural defects in a residential area. The question should be, 'What is an acceptable risk'? As the home owner, Mr Drewitt is exposed to the risk of structural failure on a daily basis. This risk also encompasses his immediate neighbours. It could be implied that with the listing of the tree on the district plan, the risk becomes a forced risk on the homeowner. Their ability to control and manage the tree risk is limited by the protection status of the tree and the costs involved in hazard abatement/re-medial tree work. Whilst it may be in the best interest for the local authority to represent the tree with listing in the District Plan, the interest and well being of Mr Drewitt also needs careful consideration. Do the recommended hazard abatement measures reduce the risk to an acceptable level, where Mr Drewitt and his neighbours no longer feel unsafe in their homes?

9.11 Mitigation measures are worthy of mention when discussing potential tree removal, as they are an important part of arboricultural decisions for all parties. Opportunities exist in a variety of ways to plant for the future, with the right trees being planted in the right place. New tree planting should consider the

environment, species and impact within the locality. If significant trees have to be removed on safety grounds, then all attempts should be made, to mitigate removal with an acceptable number of replacements in the right environment. Mitigation planting has the potential to benefit the wider community for the longer term. When considering the community of Ashburton and the valuable asset of the Domain, an opportunity exists to plant a number of replacement trees which could include Silver Limes in an area of high usage. The arboricultural, amenity and landscape value of the trees would be maximised and would contribute to the treed environment for decades to come.

Ed Sard

Consultant Arborist
Treetech Specialist Treecare Ltd

Appendix A - Tree Location Plan
Appendix B – ISO 2009 Risk Matrix
Appendix C - Tree Survey Data
Appendix D - Tree Photographs

Tree location Plan **Appendix A**

(ISO). 2009 matrices. **Appendix B**

International Standard: Risk Management–Risk Management Techniques

Likelihood Matrix

Likelihood of Failure	Likelihood of Impact			
	Very low	Low	Medium	High
Imminent	Unlikely	Somewhat likely	Likely	Very likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Risk Rating Matrix

Likelihood of Failure& Impact	Consequences of Failure			
	Negligible	Minor	Significant	Severe
Very likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

Tree Survey Data

Appendix C

Species	Ht (m)	Diam (m) at 1.4m	Canopy spread (m)	Age class	Condtn	Risk target	Target use	Failure part	Likelihood of failure	Impact	Consequence	Observations
Silver Lime *Tilia tomentosa*	19.7	Stem #1 0.63 Stem #2 0.87 Stem #3 0.78	N/S 17.1 E/W 19.5	M	Poor	People/ buildings	Constant/ Intermittent	Main stem/ Major branch	Probable	Likely	Severe. Dwellings within 1x falling distance	Asymmetrical canopy. 3 x stems. Existing cobra brace between #1 and #2 stem. Historic brace (2t) under tension. New 2 x brace slack (4t). Stem #1 braced from #3 stem historic brace (2t) under severe tension - new brace (4t) under tension. North stem secondary branch - cobra braces attached supporting the entire stem#1. Secondary branch noted as touching fork which is taking full load of stem #1. Significant end Weight noted on all stems. No fungal brackets observed. Buttress roots probed for signs of cavities - stem #1 junction with stem #3 - 29 cm penetration. Centre probed with 10 cm penetration though build-up of leaf litter. 2 x stems removed 30 cm diameter. Some reactive growth observed. Stems sounded with hammer no significant decay detected.

Tree data Key

Age Class

Y	Young: Recently planted or establishing tree that could be transplanted without specialist equipment, i.e. up to 12 - 14cms stem girth.
S/M	Semi-mature: An established tree but one which has not reached its potential ultimate height and having significant growth potential.
E/M	Early-mature: A tree reaching its ultimate potential height, whose growth rate is slowing down but will still increase in stem diameter and crown spread.
M	Mature: A mature specimen with limited potential for any significant increase in size.
O/M	Over-mature: A senescent or moribund specimen with a limited safe life expectancy. Possibly also containing significant structural defects with associated safety and/or duty of care implications.

Overall condition has been categorised as good, fair, poor or dead.

Good	A healthy specimen with good vigour, form, long life expectancy and no significant defects.
Fair	Tree of average vigour and form. Minor defects may be present but not significant structural stability.
Poor	Tree with low vigour or poor form, significant defects present and/or possible limited life expectancy.
Dead	Tree in a severe state of decline with limited future or dead.

Photographs **Appendix D**

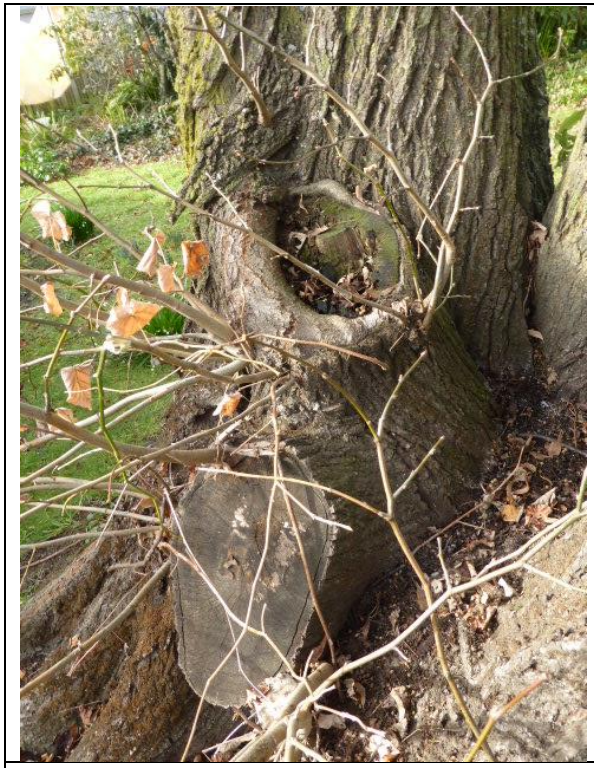		
Photo 1: previously removed stems	Photo 2: Orientation of the stems	Photo 3: Recently installed Cobra system

	
Photo 4: Recently installed 4 ton system on top. Previously installed in the bottom indicative of a2 ton system. Note this brace is under high tension. Stump of the recently removed Oak visible to the rear boundary.	Photo 5: Previously failed cobra system partially included at the point of attachment.

	
Photo 6: The installed braces connecting stems #1 and #3 are connected via a secondary branch on stem #3 with an approx. diameter of 300mm	Photo 7: The secondary branch supporting Stem #1 has been pulled into the adjacent secondary branch lateral with an approx. Diameter <200mm

	
Photo 8: The secondary branch supporting Stem #1 has been pulled into the adjacent secondary branch lateral with an approx. Diameter <200mm	Photo 9: Incorrectly installed 4 Ton Cobra brace with significant slack in the system note.