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Memo

To: Maureen Glassey – Principal Advisor, Auckland Council

From: Andrew Benson – Urban tree ecophysiologist, The Tree Consultancy Company

cc:

Date: 13th October 2020

Re: PRELIMINARY summary of findings – Western Springs Pines

Dear Maureen

The following information pertains to assessments of 198 standing pine trees (*Pinus radiata*) in Western Springs, Auckland, carried out between 21st September and 9th October 2020. It is a concise summary of our methods and findings and is provided as **PRELIMINARY** only. We expressly indicate at this stage that the data have not been fully checked and it may be that some of the numbers presented will change by the end of the week pending full data analysis and review.

Methods summary

Data capture

All site work was undertaken by two persons. Using known tree locations and numbering (Cammick, 2013), the following parameters were recorded for each tree during the initial phase of the assessment.

- Trunk circumference at 1.4 m (measured).
- Tree height (measured).
- Live crown height (measured) – the height to the lowest foliage-bearing branch.
- Crown radius (estimated) – the farthest radial branch spread.
- Live crown volume (estimated) – an approximate percentage of live foliage on the branches.
- Trunk / crown azimuth (measured) – the direction of natural lean.

The following parameters were then computed.

- Trunk diameter at breast height (DBH).
- Height to diameter ratio (H:D) (Mattheck et al., 2002; Watt and Kirschbaum, 2011).
- Tree safety factors (Niklas, 2000; Detter et al., 2020) based on H:D distribution data for representative trees at the lower and upper ends of the sample population as well as the mean.
- Uncompacted live crown ratio (LCR) (Bechtold and Patterson, 2011).

Risk assessment

A VALID tree risk-benefit assessment was undertaken on all trees during a second assessment phase. The main target considered was the formal walking track and its occupants during normal operation. Additional targets included private properties, zoo structures (e.g. fences and buildings) and exposed wastewater infrastructure. Using the computed safety factors and H:D ratios, a site-specific approach to assessing risk was developed in consultation with the VALID developers. At time of writing, we have not reviewed the third-party QTRA assessment. This information will follow.

Harvest systems operations assessment

An assessment of harvesting options was undertaken by the New Zealand School of Forestry (University of Canterbury). The goal of the harvest systems assessment was to review the current harvest plan (Ridley Dunphy, 2018) and if possible, propose alternatives, including whether staged removal (removing all of the trees in blocks or groups) is feasible.

Results summary

Tree characteristics

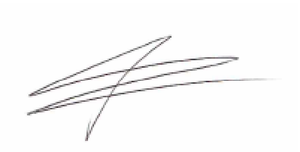
- The overall condition of the trees is sub-optimal because of the species' underlying physiology (Brodribb et al., 2004; Rodríguez-Gamir et al., 2019) and known limitations to growth (Ryan and Yoder, 1997).
- The stand of trees has been in decline since 1988 (Langston. P. W, 1988; Collett, 2018) and because of the above, will continue to decline.
- There are currently 31 standing dead trees (16%).
- There are currently 57 trees with < 50% live crown volume (29%).
- There are currently 83 trees with > 70% live crown volume (42%).
- Tree safety factors ranged from 0.44 to 1.26 (mean = 0.87) based on H:D ratios. The safety factor is computed using a known wind speed (22.5 ms^{-1}) and defines an order of magnitude at which stem breakage could be expected to occur. In essence, it is a measure of the tree's reliability to resist wind loading (Niklas, 2002). Most trees have a safety factor of at least 4.5 (Mattheck and Breloer, 1994), meaning they can withstand wind loads 4.5 times greater than the normal wind load.
- Trees in the pine forest could be expected to experience stem breakage when wind speeds exceed 9.9 ms^{-1} (35.6 kmh^{-1}).
- Stem breakage is the most common mode of failure in the forest (Collett, 2018).

Risk assessment

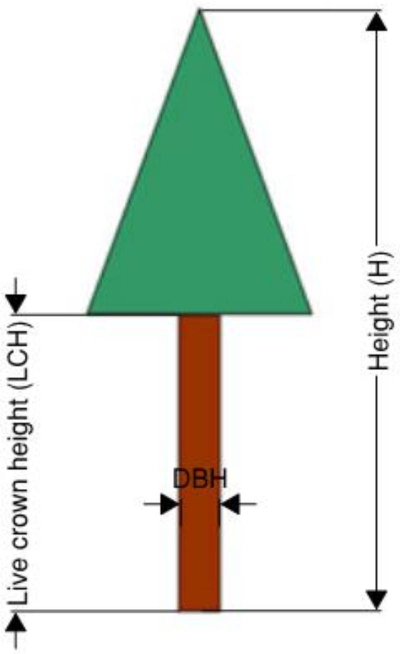
- Based on the most likely mode of tree failure (stem breakage) and the recorded trunk azimuths, there are:
    - 139 'Acceptable' risks (70%)
    - 7 'Tolerable' risks (4%)
    - 50 'Not tolerable' risks (25%)
    - 2 'Not acceptable' risks (1%)
- The overall risk to pedestrians using the path during normal operation is 'Unacceptable'.

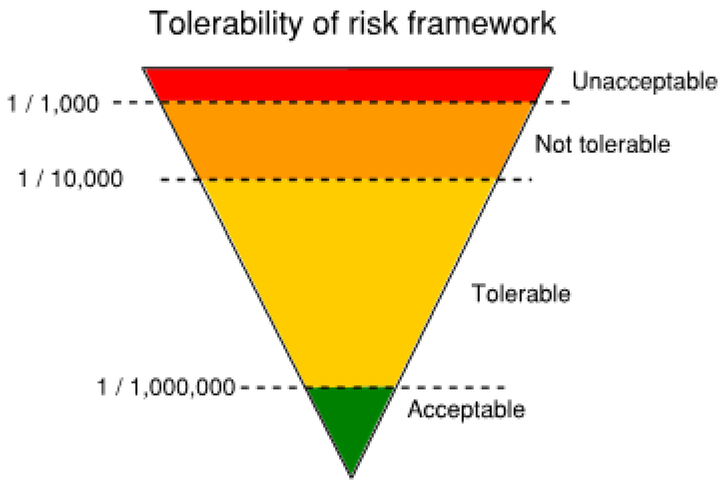
Harvest systems operations

- The current harvest plan (Ridley Dunphy. ESCP-01 - Rev E) is excessive in terms of engineering requirements and environmental impacts (e.g. collateral damage to the understorey).
- An alternative 'low-impact' harvest plan is being developed – currently as a working draft.
- The alternative harvest plan does not require permanent engineering, e.g. formed roads, batter slopes, retaining walls and sediment ponds. Tracks can be allowed to revegetate naturally once harvesting is complete.
- It is possible to remove all trees in three spatially discrete stages (south east, central area, northern area), although there is no commercial or operational advantage to doing so.



Andrew Benson Ph.D., BSc, FdSc





Live crown ratio = (H – LCH) / H

H:D = H / D

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Trees (from survey)	Stream (from survey)
Trunk azimuth	Overland flow paths (from survey)
Target area	SWMH
Path (from survey)	SW pipe
Bridge (from survey)	SSMH
Staircase (from survey)	SS pipe

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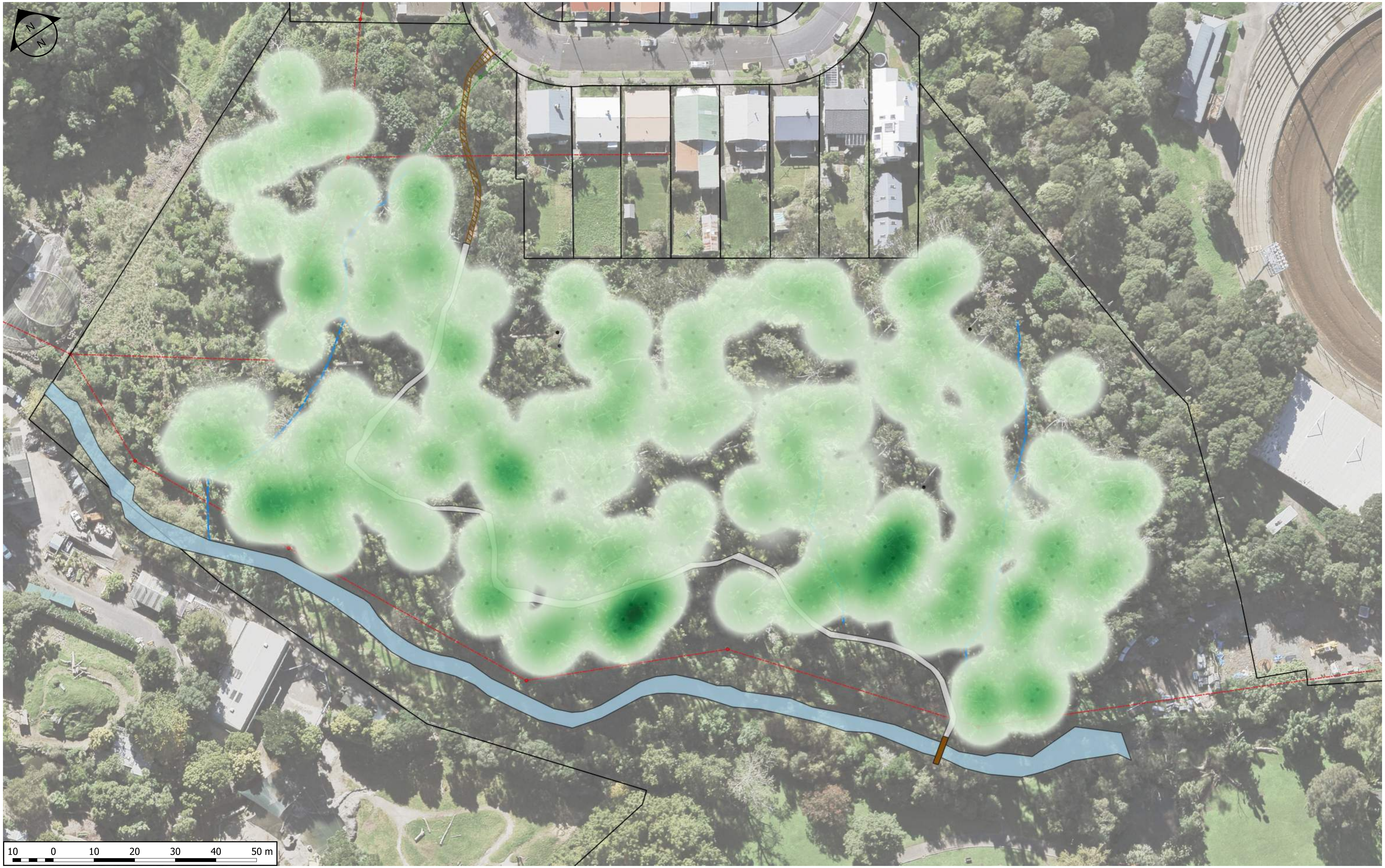
Western Springs Pine Forest
Tree location plan
PRELIMINARY

The TREE CONSULTANCY COMPANY

Job ref	1717		
Drawing	001	Rev	A
			9/10/2020



Live crown volume (%)

Dead tree

50 %

100 %

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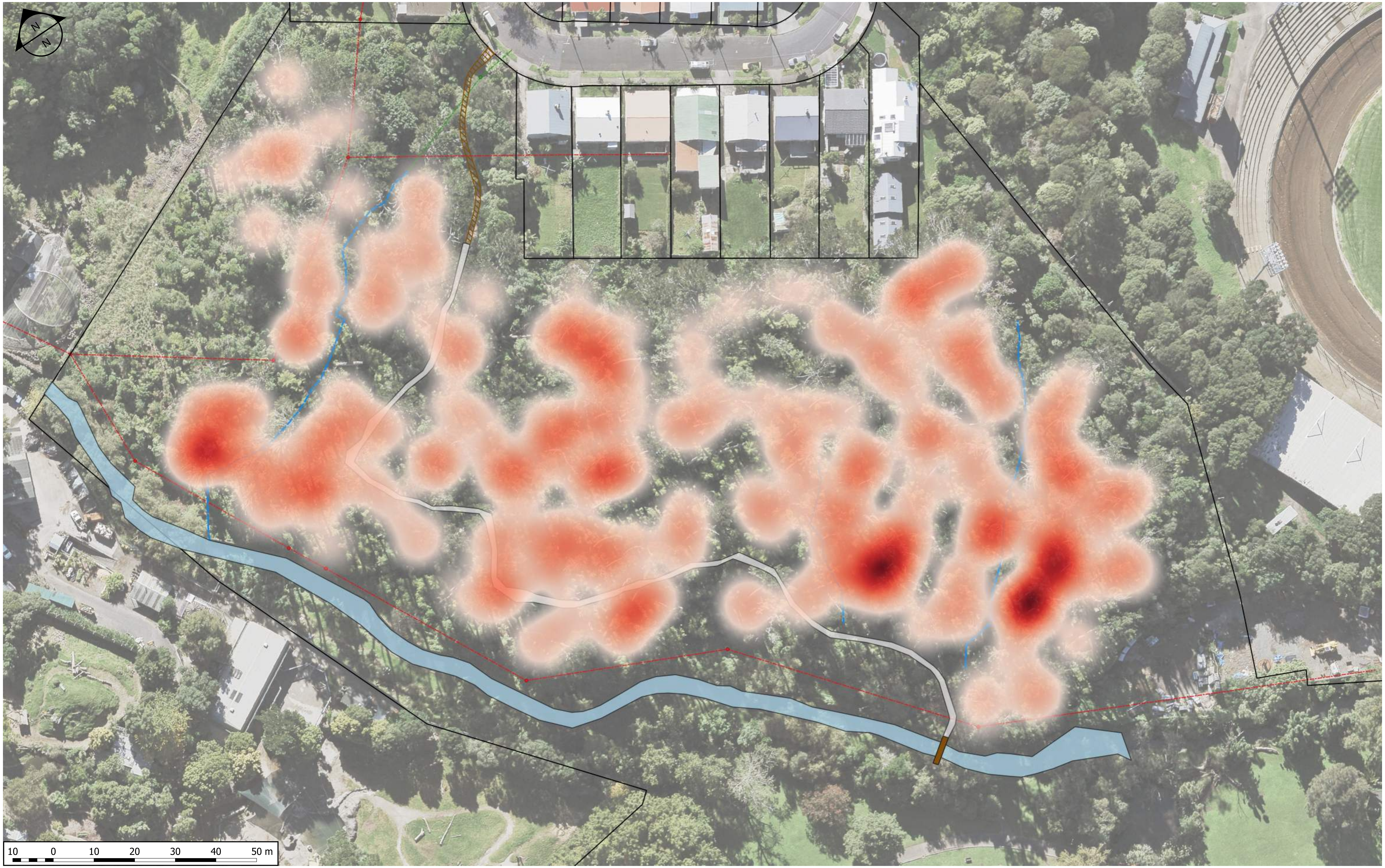
Western Springs Pine Forest
Tree condition plan
PRELIMINARY

The TREE CONSULTANCY – COMPANY –

Job ref	1717
Drawing 002	Rev A 12/10/2020



Height to diameter ratio (H:D)

15:1 47:1 62:1

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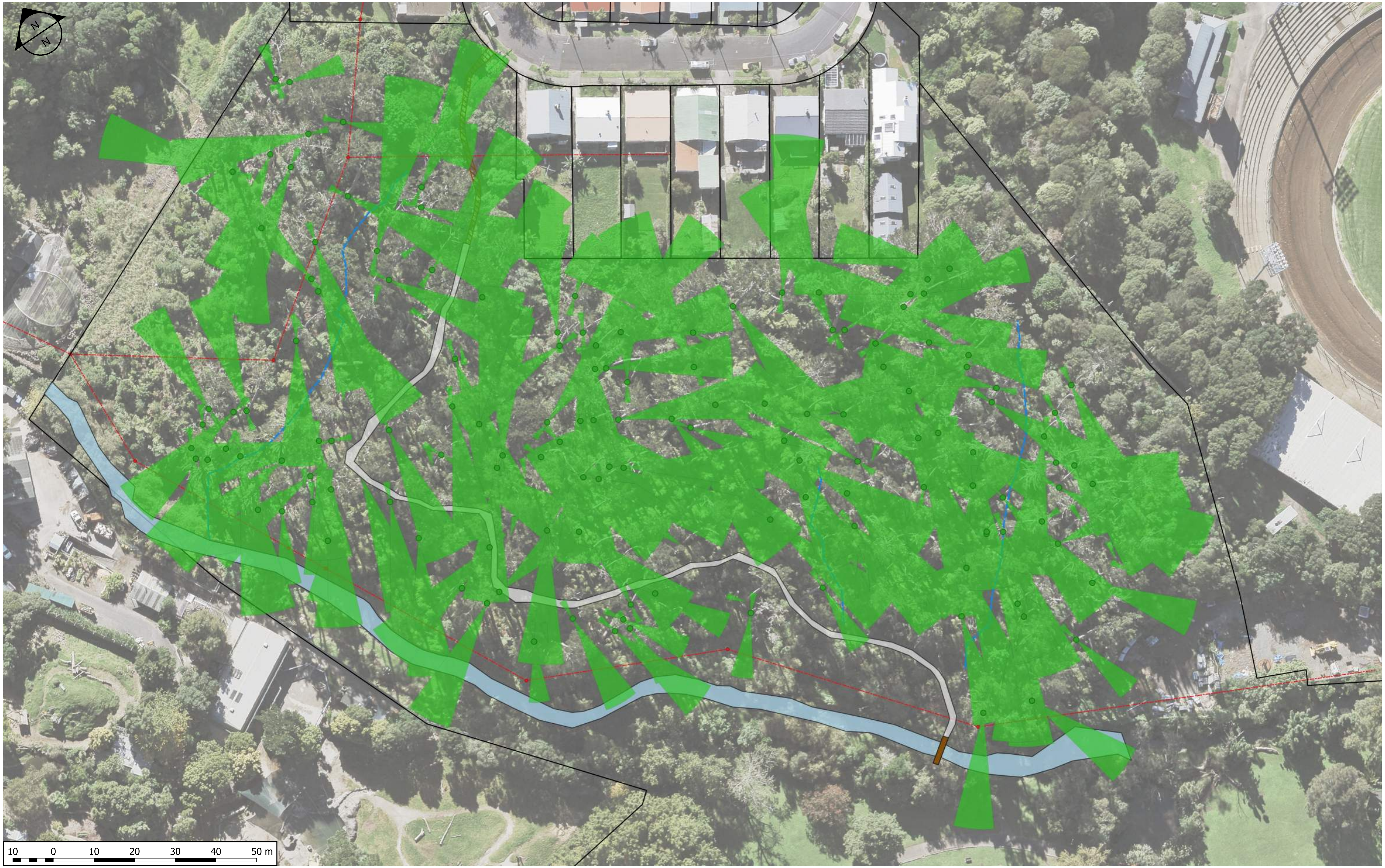
Western Springs Pine Forest
Height : Diameter ratio plan
PRELIMINARY

The TREE CONSULTANCY – COMPANY –

Job ref	1717
Drawing 003	Rev A
	9/10/2020



Trees (from survey)	Fall zones		
Acceptable	Acceptable	Path (from survey)	SWMH
Tolerable	Tolerable	Bridge (from survey)	SW pipe
Not tolerable	Unacceptable	Staircase (from survey)	SSMH
Unacceptable	Not tolerable	Stream (from survey)	SS pipe
		Overland flow paths (from survey)	

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Western Springs Pine Forest
Acceptable risks plan
PRELIMINARY

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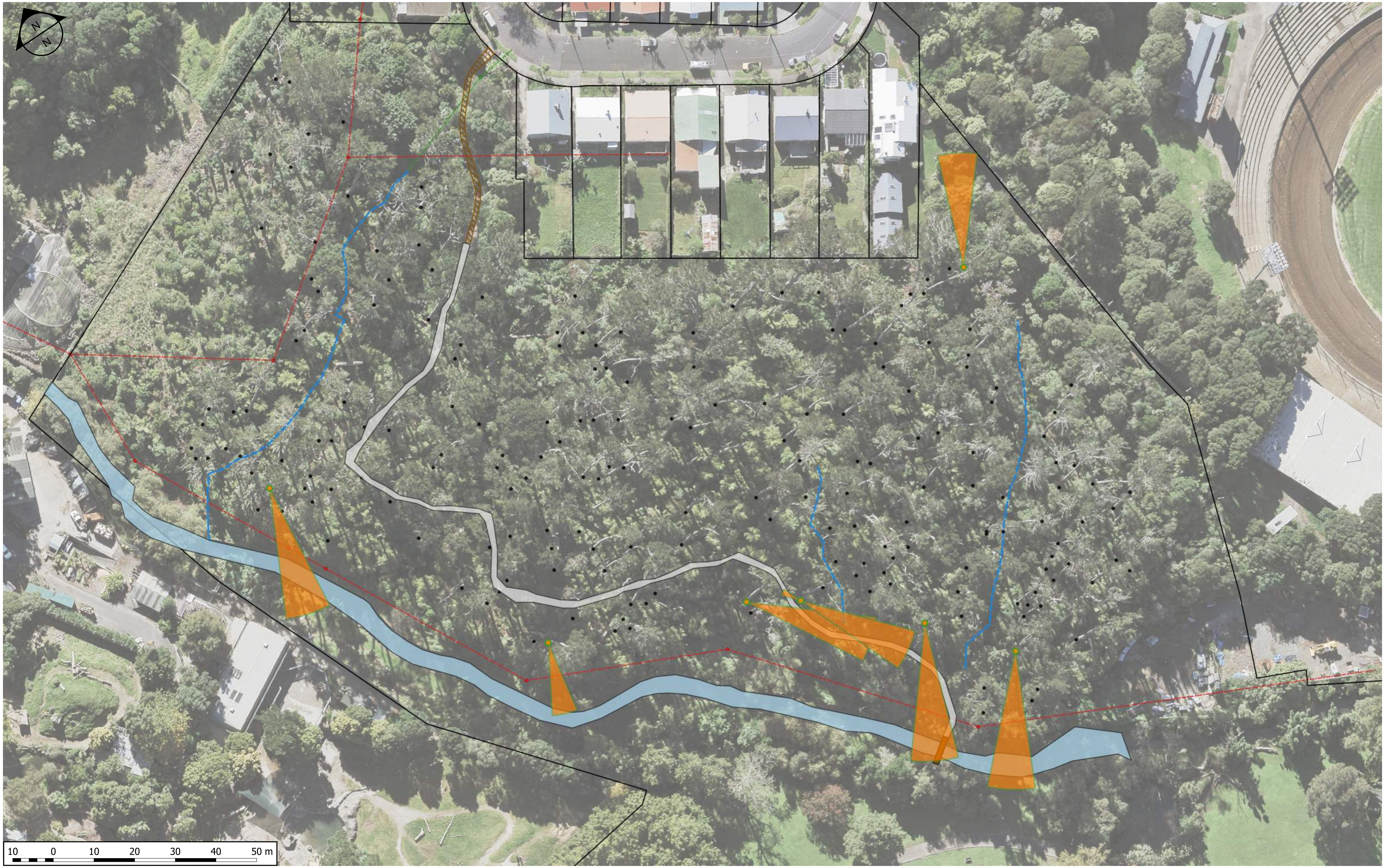
Job ref	1717
Drawing 004	Rev A
	12/10/2020



Trees (from survey)	Fall zones		
Acceptable	Acceptable	Path (from survey)	SWMH
Tolerable	Tolerable	Bridge (from survey)	SW pipe
Not tolerable	Unacceptable	Staircase (from survey)	SSMH
Unacceptable	Not tolerable	Stream (from survey)	SS pipe
		Overland flow paths (from survey)	

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Tolerable risks plan
PRELIMINARY

The TREE CONSULTANCY – COMPANY –

Job ref	1717		
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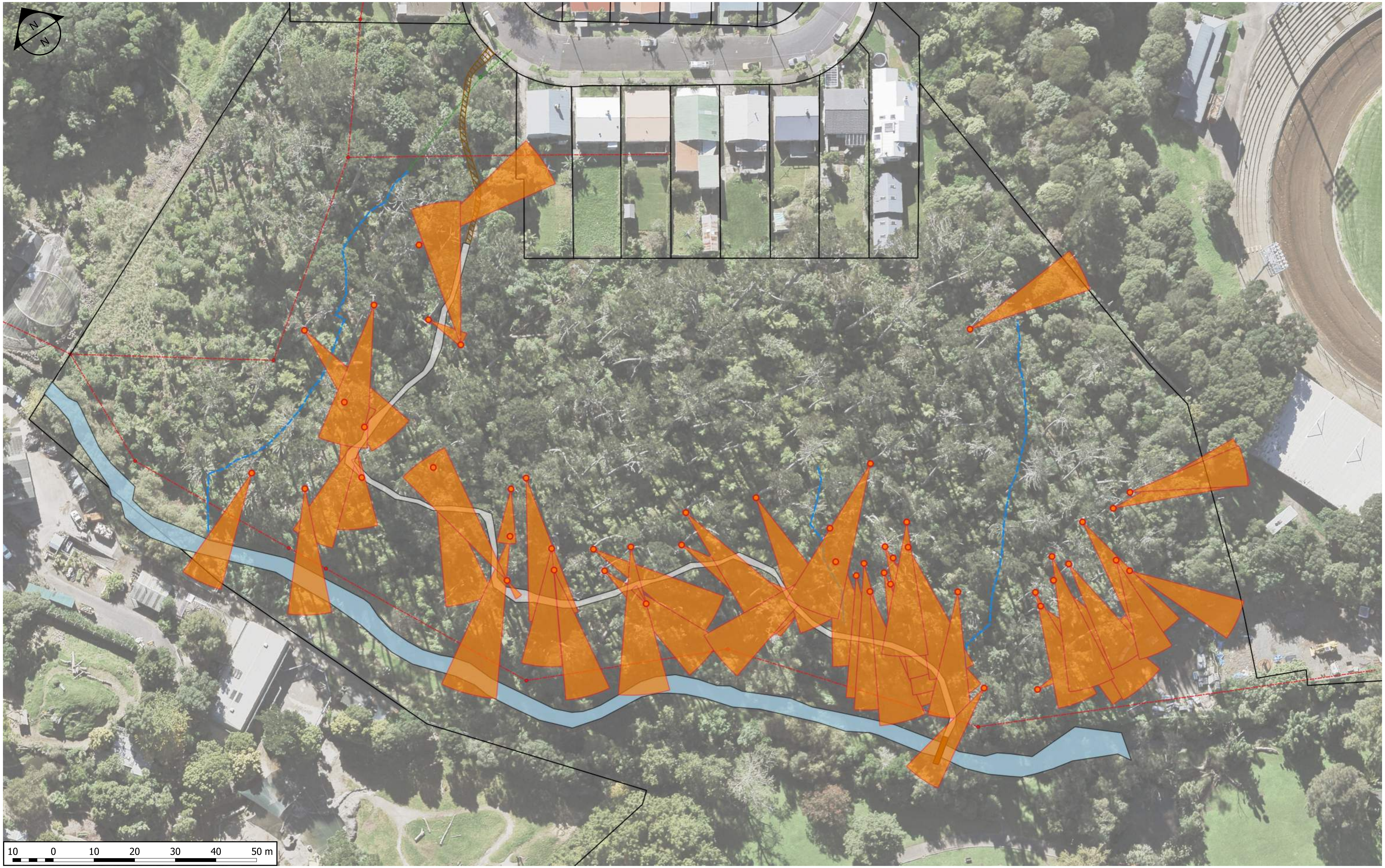
			9/10/2020



Trees (from survey)	Fall zones		
Acceptable	Acceptable	Path (from survey)	SWMH
Tolerable	Tolerable	Bridge (from survey)	SW pipe
Not tolerable	Unacceptable	Staircase (from survey)	SSMH
Unacceptable	Not tolerable	Stream (from survey)	SS pipe
		Overland flow paths (from survey)	

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Western Springs Pine Forest
Not tolerable risks plan
PRELIMINARY

The TREE CONSULTANCY – COMPANY –

Job ref	1717
Drawing	006
Rev	A

12/10/2020

Trees (from survey)	Anticipated fall zones		
Acceptable	Acceptable	Path (from survey)	SWMH
Tolerable	Tolerable	Bridge (from survey)	SW pipe
Not tolerable	Not tolerable	Staircase (from survey)	SSMH
Unacceptable	Unacceptable	Stream (from survey)	SS pipe
		Overland flow paths (from survey)	

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Western Springs Pine Forest
Unacceptable risks plan
PRELIMINARY

The TREE CONSULTANCY – COMPANY –

Job ref 1717
Drawing 007
Rev A
9/10/2020