Arboricultural Assessment of Norfolk Island Pines Kaikoura Esplanade.

David James
tree services

Tim Lovejoy

21st April 2021

Arboricultural Assessment

Site Address: Kaikoura Memorial Gardens and Esplanade

Affected Trees: 57 Norfolk Island Pines, *Araucaria heterophylla*

Commissioned by: Mike Russell, Kaikoura District Council

Date of Report: 6th May 2021

Report Compiled by: Tim Lovejoy, David James Tree Services

Executive Summary

David James Tree Services Limited has undertaken an arboricultural inspection of 57 Norfolk Island Pines (*Araucaria heterophylla*) trees located in ANZAC Park and along the Esplanade at Kaikoura.

The trees assessed are not thriving in terms of health, with some also identified as having structural defects.

A variety of mitigation options are considered to improve growing conditions and tree health so that the trees may be retained, as well as pruning recommended to eliminate or mitigate existing or potential hazards and associated risk to people and/or property from structural problems.

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Site Location:

The following aerial maps indicate the location of the 57 trees in 5 groups:

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1.0 Introduction

1.1 Mike Russell of Kaikoura District Council has requested David James Tree Services Ltd Limited to prepare an arboricultural assessment of 57 Norfolk Island Pines at ANZAC Park and along the Esplanade.

1.2 The purpose of this report is to assess the current and future health and identify any existing or potential hazards associated with the trees and level of risk of damage or injury to people and property.

1. 3 This report contains:

- Ground based observations and measurements made during a site visit on 21st April 2021.
- An assessment of the general location and growing conditions of the site
- Assessment of tree health, structure, and form
- Identification of any existing or potential defects that may affect hazards and risk
- Discussion of causes and effects of observed defects and problems.
- Options for mitigation of risk and any residual risk
- Recommendations

1.4 Please refer to the photographs within Appendix of this report.

1.5 Measurements of tree height and DBH (diameter at breast height, 1.4m) are contained in the main body of this report.

1.6 In the context of this report a hazard is defined as any agent or situation that could cause harm or damage to people or property. Risk is defined as the likelihood of a negative effect arising from a hazard.

Generally, there can never be no risk from large trees such as the trees subject to this investigation.

1.7 A site visit was made on Wednesday 21st April 2021. The weather was overcast, but fine and cool with a moderate southerly breeze.

1.8 Investigation Limitations. This was a walk by inspection only.

2.0 Site Overview

2.1 The trees are an established.....

2.2 The trees are in a varied but mostly difficult and restricted growing environment.

2.3 The trees are open grown, exposed to wind from most directions and can be expected to be well adapted to frequent high wind events. There is evidence of some past small and

medium branch failure. Given frequent strong wind events this is well within what can be considered normal.

2.4 There are no apparent problems of root plate stability, though there are some trees with indicative potential root issues (see individual trees below).

3.0 Arboricultural Assessment

3.1 Summary:

Tree species: Common Name: Norfolk Island Pine, Norfolk Pine

Botanical Name: *Araucaria heterophylla*

Dimensions: Height: Average height of all trees is 20m. (individual tree heights are below).

Special Value: The trees were planted at intervals at the beginning of the twentieth century as a feature avenue along the foreshore. Such avenues have become emblematic in many seaside resorts in New Zealand. Beach towns such as Ohope, Gisborne, Mt Maunganui, and Orewa all have similar (but not as extensive) beach front Norfolk Pine plantings.

These trees provide significant landscape and amenity value for Kaikoura.

Additionally, such large trees provide a range of ecological and environmental services that are not easily replaced.

Protected: The author of this report has no knowledge of the level of protection (if any) of the trees.

Age Class: Estimated at 100+ years.

Structural Character: In all trees there is a single trunk (some individual trees have one or more competing leaders, see **4.5** below) with a whorled branched crown.

Maturity: The trees are mature specimens.

Health: The trees show varying states of health, from fair to dead, none are thriving.

Form: Pyramidal, excurrent form with evenly whorled branch structure.

Pruning History: Crown lifting and removal of major deadwood only.

Root Zone: Varies from garden bed, grassed sea frontage to heavily compacted metalled pathway to sealed surfaces. There is no evidence of root plate instability.

4.0 Discussion

4.1 There are several factors that are in all probability contributing to the general lack of vigour evident in most of the trees.

4.2 Compaction of soil is an increase in density involving three inter-linked processes: compression, compaction, and consolidation. They are not necessarily sequential, separate, or even complete and are caused by physical compression, settling by vibration or drying out after flooding. It is likely that there will be more than one 'layer' of compaction depending on the history of use of the site.

Where compaction is present pore space is greatly reduced and agglomeration of particles altered. Water molecules are more tightly bound and become unavailable for plant use. Earthworks during construction, traffic volumes and storm water may all contribute to compaction of soils. The resulting consolidation leaves a medium bereft of the basic nutrient, water, and oxygen requirements for plant growth.

Many of the biological functions of plants are affected by compaction. Physical, physiological, and chemical disruption of these processes can have manifest symptoms both above and below ground.

While it is generally understood that compaction cannot easily be remedied there are some techniques that have been successful in mitigating the effects:

- Physical 'fracturing' of the compacted soil using compressed air to create pore space and improve aeration.

- Addition of organic soil amendments such as compost and mulch to try to re-establish a detritus energy web.

4.3 For several trees there is insufficient space allowed for root and trunk girth increments where built structures have been installed.

4.4 The uplift of the entire area during the 2016 earthquake has in all probability disrupted the water tables and other elements of soil structure which will also have an influence on tree health.

4.5 The trees will in many cases adapt successfully to changed growing conditions if conditions are improved where possible and do not worsen.

4.6 Co-dominant Stems and Included Bark are significant defects that can often lead to failure. Several trees have identified co-dominant or secondary leaders. (see photos). Pruning can remedy this in most cases.

Anzac Park tree photos

T1 compacted footpaths around root zone.

T2 Concrete path edge across root zone.

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T5 compacted footpath and concrete kerb over root zone.

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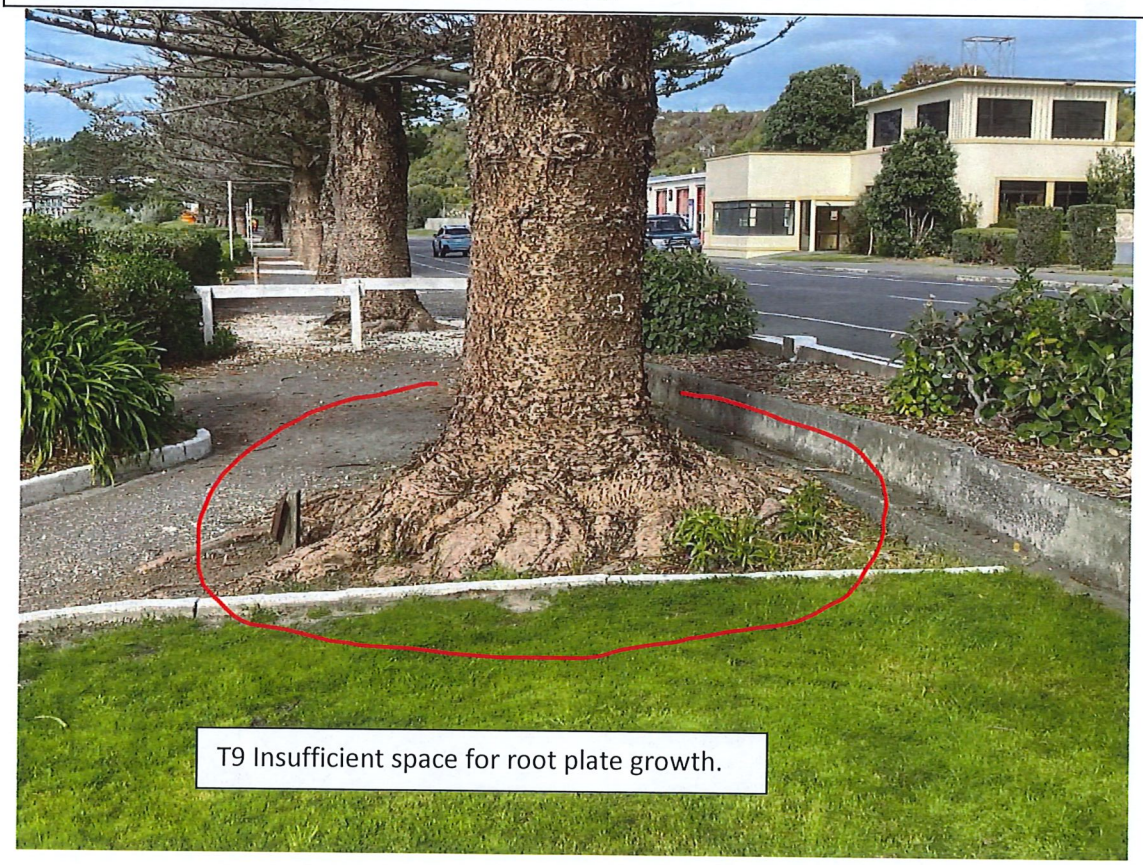
T8 Approximate area required for radial trenching and soil amendments to remedy compaction and section of planter to be removed.



T9 Insufficient space for root plate growth.

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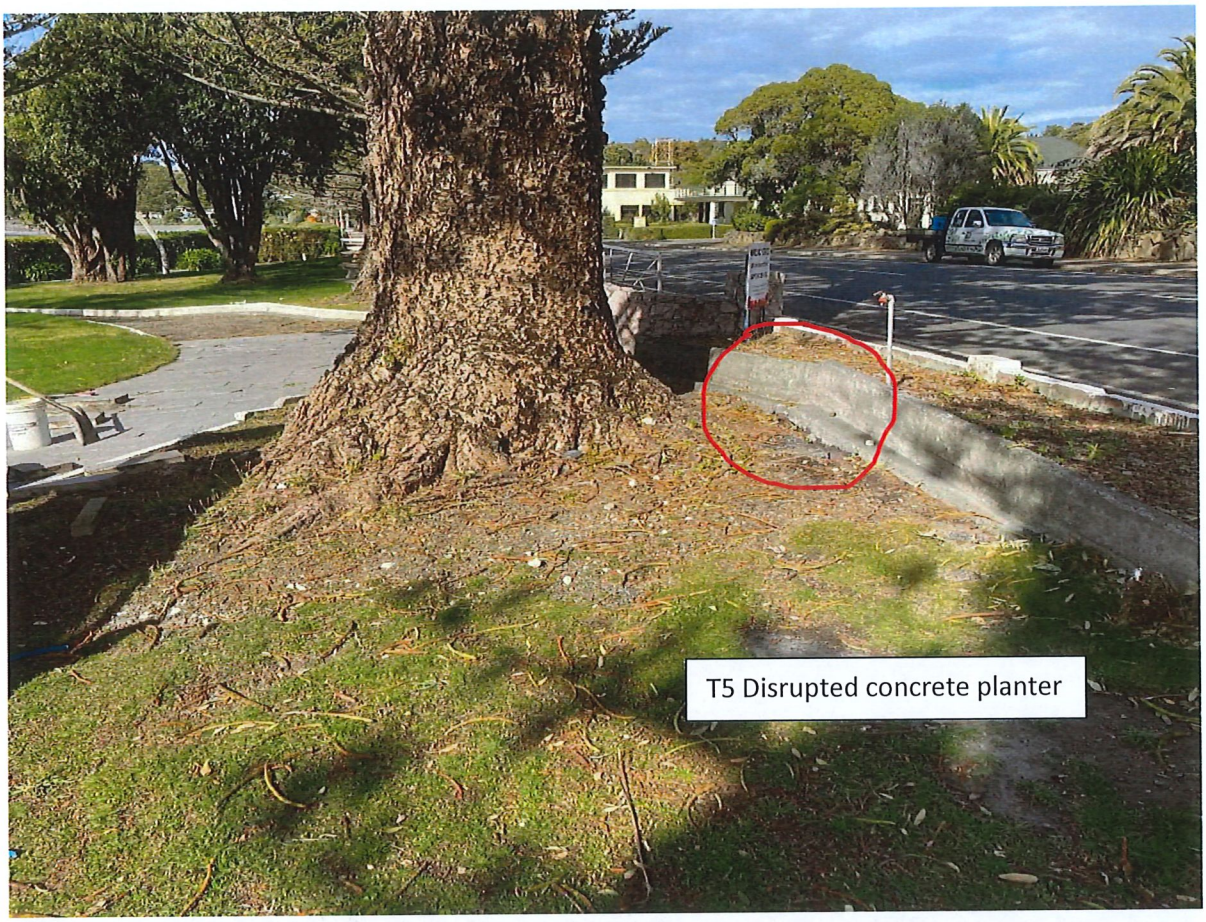

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Group One tree photos

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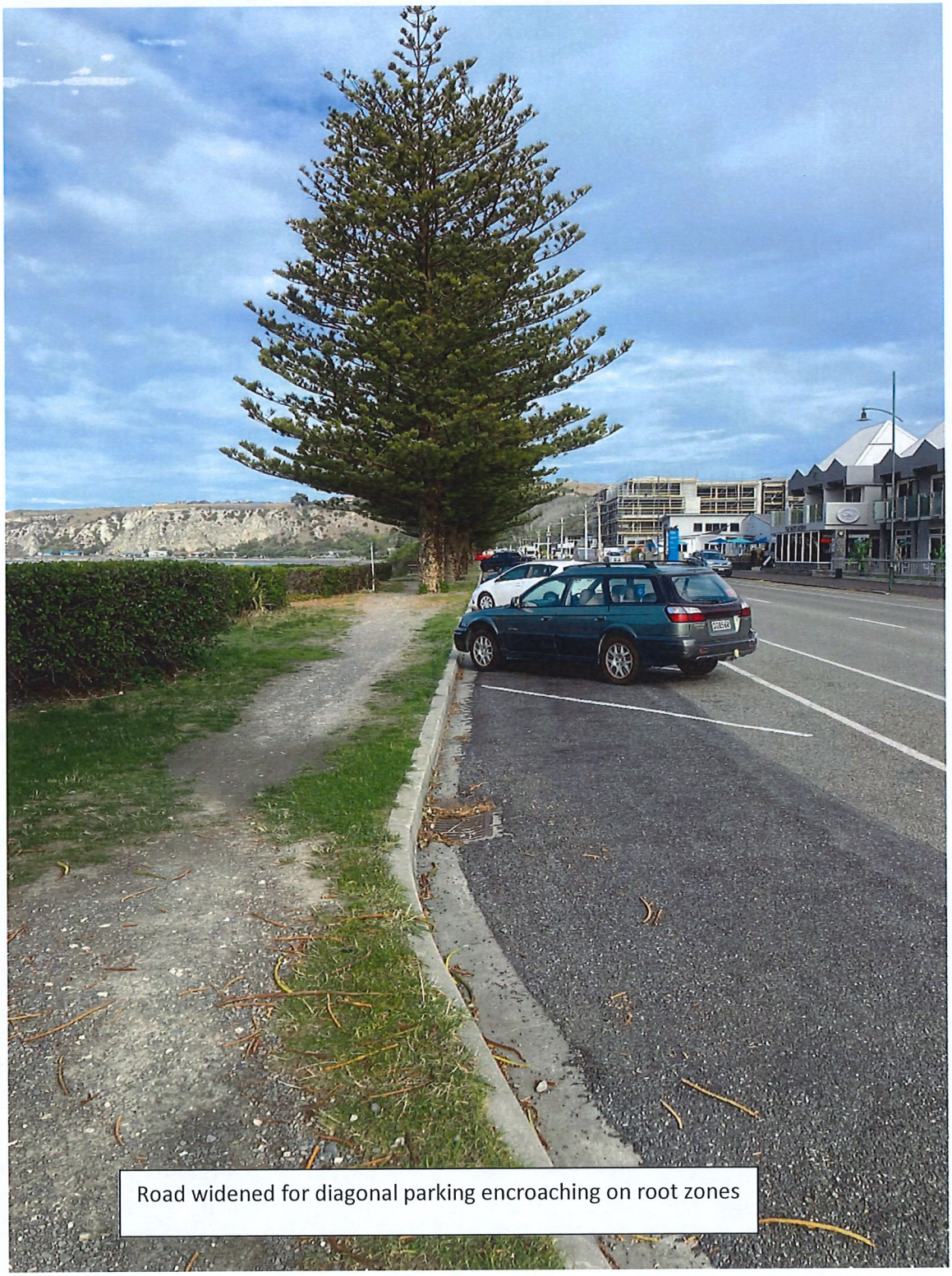
Group 2 tree photos



Road widened for diagonal parking encroaching on root zones

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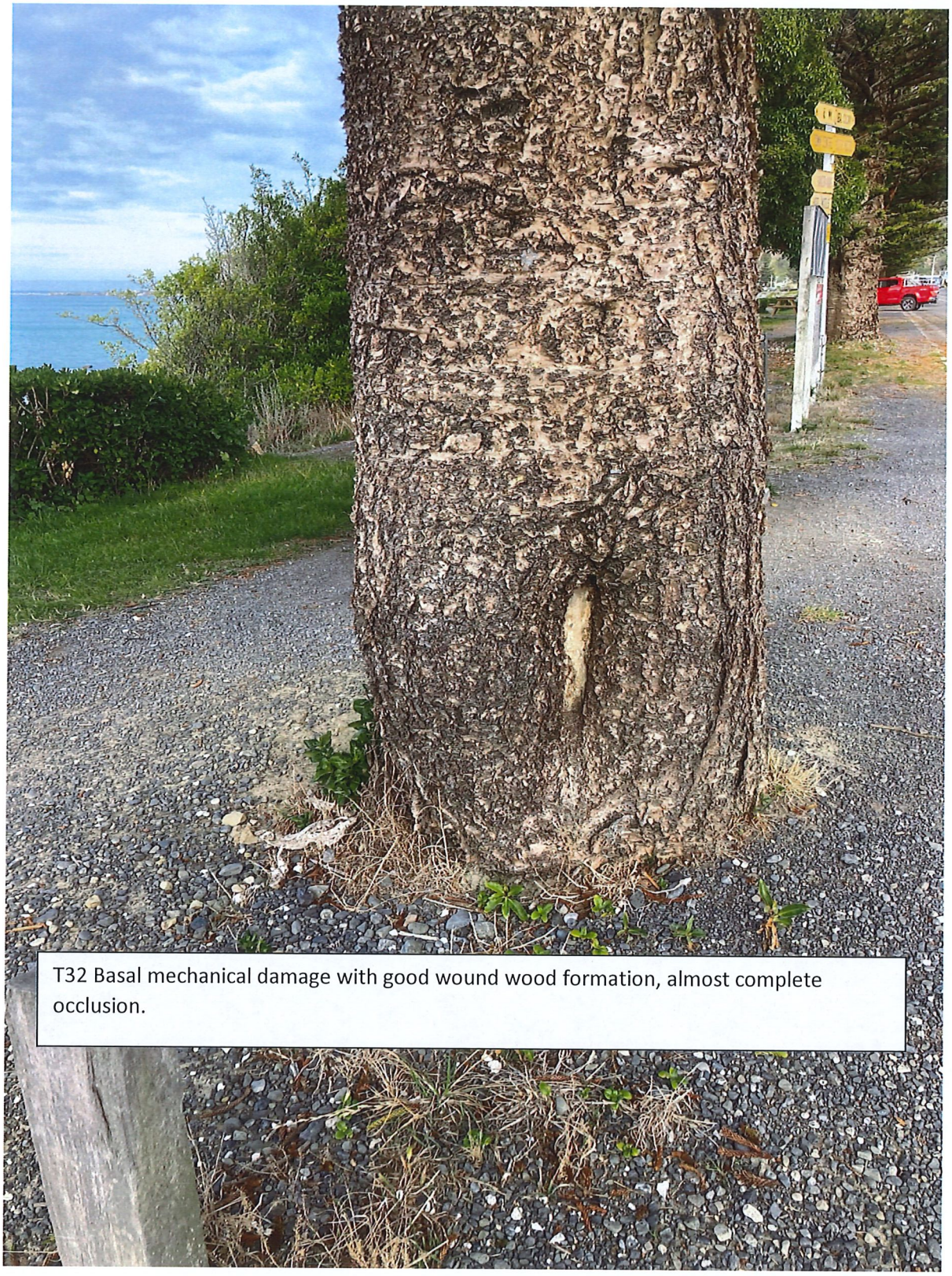

T32 Basal mechanical damage with good wound wood formation, almost complete occlusion.

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Road widened, kerb and channel and compacted metal over root zone.

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Group 3 tree photos

T37 two competing leaders (red arrows) and a secondary stem (yellow arrow).

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T40 Basal mechanical damage. Good wound wood occlusion

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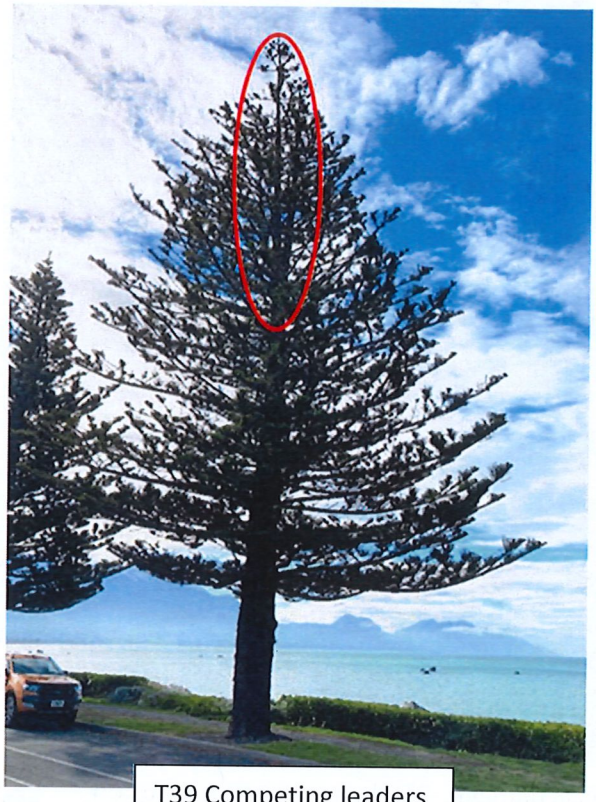
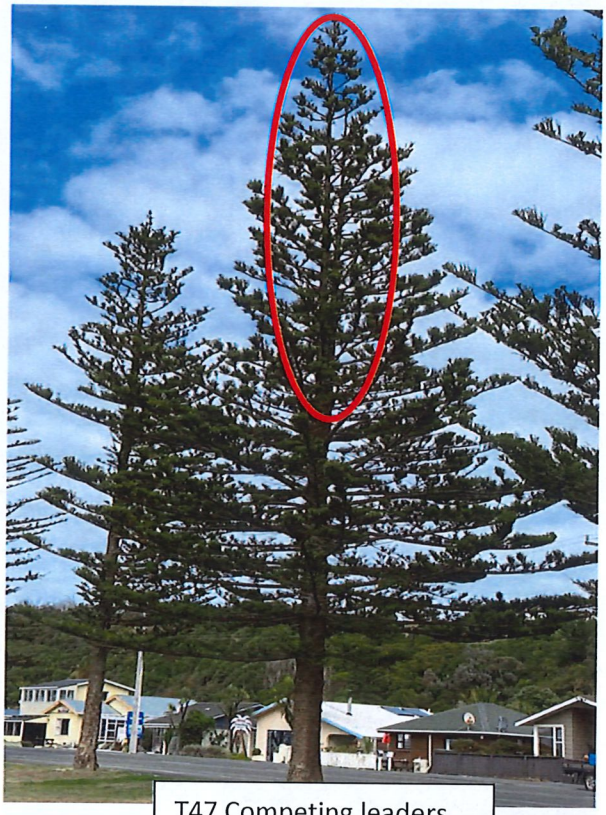
Group 4 tree photos



T39 Competing leaders



T47 Competing leaders

T49 Small basal mechanical damage, east side branches absent to approximately 15m

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Group 5 tree (T57) photos

T57 is the healthiest of all the trees inspected and is an example of the potential appearance of the trees if remediation/improved growing conditions is successful.

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T51 Example of minor girdling roots which seems common along the avenue

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T57 appears to have been the tree suffering the least adverse effects of built infrastructure, compaction, and possible subterranean earthquake related changes.

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						ANZAC Park trees		
	TREE #	**HT (m)**	**DBH* (cm)**	**Health**		**Form**		**Issues of concern/comments**
	1	23	90	Poor, stunted leaves throughout lower canopy		OK		footpath soil compaction across root zone.
	2	21	100	Poor, entire canopy sparse leaf coverage		OK		
	3	27	120	Fair, reasonable leaf cover, some healthy new growth		Double leader		Disrupting concrete wall, prune to leave single top
	4	21	90	Poor, sparse canopy		OK		Disrupting concrete wall
	5	29	150	Fair		OK		Disrupting concrete infrastructure and paved surface
	6	24	120	Very poor		OK		Root problems, some fungal fruiting bodies present
	7	20	85	Fair		OK		Will soon disrupt wall
	8	18	90	Fair/good		OK		Failed/stunted top?
	9	22	90	Very poor,very sparse canopy with deformed new growth		Secondary leader top 2m		Prune to leave single top
	10	20	80	Poor, stunted new growth, sparse canopy		Double leader, top 2.5m		Prune to leave single top
	11			Dead				Dead except for some minimal leaf. Not recoverable.
			* Diameter at breast height (1.4m)					

						Group 1 trees			
	TREE #	HT (m)	DBH* (cm)	Health		Form		Issues of concern/comments	
	12	25	100	Poor		OK		Road widening for car parking, root zone compaction	
	13	17	90	Poor		OK, lost top?		Bulge at 1.4m crowded branch removal wound wood?	
	14	19	80	Poor/Fair		Double leader		Prune to single top	
	15	25	100	poor/Fair		OK		None	
	16	20	100	Fair		OK		None	
	17	24	100	Fair		OK		None	
	18	22	125	Fair		OK		None	
	19	24	100	Poor/Fair		OK		None	
	20	23	95	Poor		OK		None	
	21	23	100	Poor		OK		None	
	22	24	130	Fair		Double leader from 1.5m		Suppress then remove 2nd leader over 3 seasons	
	23	23	130	Good		OK		None	
			* Diameter at breast height (1.4m)						

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TREE #	HT (m)	DBH* (cm)	Health		Group 2 trees Form		Issues of concern/comments
24	19	95	Good		OK		Small mechanical damage basal wound almost completely occluded
25	19	70	Fair/Poor		OK		None
26	20	95	Good (better than average)		OK		None
27	22	100	Good		OK		None
28	20	100	Good		OK		None
29	18	130	Good		OK		Basal damage
30	22	95	Good		OK		None
31	17	95	Fair		OK		None
32	22	95	Fair/Poor		OK		Basal damage

*Diameter at breast height (1.4m)

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Group 3 trees

TREE #	HT (m)	DBH* (cm)	Health		Form		Issues of concern/comments
33	25	120	Good		OK		Prune large epicormic shoot @1m
34	19	95	Poor/Fair		OK		None
35	18	80	Fair/Good		OK		None
36	24	95	Good		Secondary leader @ 16m		Prune to single top
37	23	90	Good		Multi-leaders (3)		Prune to single top
38	20	90	Good		Small secondary leader		Prune to single top
39	24	90	Good		Double leader		Prune to single top
40	21	90	Poor/Fair		OK		Basal wound nearly occluded
41	19	95	Fair/Poor		OK		None
42	23	95	Good		Lean to seaward, recurve from 15m		None
43	16	80	Fair/Poor		OK		None
44	21	100	Fair		OK		None
45	21	80	Fair		OK		None
46	19	70	Fair		OK		Old wound @ 1m seaward side, occluded

*Diameter at breast height (1.4m)

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Group 4 trees

TREE #	HT (m)	DBH* (cm)	Health		Form		Issues of concern/comments
47	22	90	Good		Secondary leader		Prune to single top
48	22	80	Fair		Secondary leader		Prune to single top
49	22	65	Fair		OK		Branches absent E. side to 15m, basal wound W. side
50	23	60	Poor		OK		Sparse canopy, malformed leaves, new growth OK.
51	19	80	Fair		OK		Minor girdling root
52	20	80	Fair/Poor		OK		None
53	22	90	Fair/Poor		OK		None
54	14	60	Fair/Poor		OK		None
55	24	100	Fair/Good		OK		None
56	20	90	Fair/Good		OK		Mechanical damage to surface root N side

*Diameter at breast height (1.4m)

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Conclusions:

These Norfolk Island Pines have significant Historic and amenity value that cannot be replaced in the short term. Many of these Norfolk Pines are not thriving. If no remedial action is taken it is probable that the trees will continue to decline at varying rates necessitating removal when they become irrecoverable, as is the case of T11 in Anzac Park. The aesthetic value of the trees as a feature of the Esplanade will decline accordingly.

The most significant contributory cause of the observed lack of vigour and (in the worst cases) malformed new growth is the compacted soils around the root zones. (**4.2**)

Compounding factors include the installation of built structures, and roading changes around the trees' root zones which further restrict the ability of the trees to acquire and process available nutrients.

It is also probable that changes to water tables after the 2016 earthquake uplift will have had an effect. The ground movement during the earthquake may also have exacerbated the compaction.

There are some inherent structural deficiencies present in a few trees which are noted in the tables above. These can be rectified with correct pruning.

Recommendations:

1. That proper pruning is carried out on the trees with identified structural issues to mitigate the likelihood of failure and associated risks of harm or damage occurring. Although likelihood of such failure is assessed as possible (i.e. likely only in extreme circumstances) pruning should be carried out as soon as resources allow.
2. Consideration be given to the following strategies to improve the future wellbeing of the trees and/or their replacement.
3. The improvement and protection of the root zones of the trees should be planned and implemented. Wherever possible the drip line of the canopy should be regarded as a minimum to ensure adequate soil volume. This will require the removal of some of the built infrastructure, remediation of compaction (by radial trenching) and amendment of soil. Wherever possible the exclusion of vehicle and foot traffic from root zones. Where this is impractical the installation of mitigation such as boardwalks should be considered. (see photos below)
4. Considering replacement of individual trees (if decline continues beyond remediation), or if removal and replacement of all (or groups of) trees is likely then provision should be planned for the creation of sufficient soil volume/space for the full size of replacement trees. Some of the above strategies will still be required. Additionally, if resources are available (i.e. some kind of plant nursery space) sourcing a number of young replacement trees to grow on so that larger grade (up to 200 litre/ 100-150mm trunk caliper) are available as required.

Radial trenching with air spade and soil amendment

Concept drawing of altered existing planter

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Concept drawing of boardwalk over root zone

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