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Kaiwaka Domain Kauri Walk - Risk Assessment and Recommendations

For Kaipara District Council

Risk Assessment and Recommendations

June 2019

REPORT INFORMATION AND QUALITY CONTROL

Prepared for:	Kaipara District Council Parks

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1 INTRODUCTION

Kaipara District Council Parks are undertaking an assessment of *Agathis australis* (kauri) located within local reserves and the associated risks and required remedial action to be considered in relation to kauri dieback disease (*Phytophthora agathicidia*; PA).

Testing for kauri dieback disease has occurred within the forest area of the Kaiwaka Domain (the Domain) and this testing has shown the area is currently free from kauri dieback. The current forest track at the Domain, named the kauri walk, passes over kauri roots and is located near groves of kauri trees.

1.1 Purpose of the Report

The purpose of report is to provide adequate information on management or mitigation options intended to reduce the risk of kauri dieback disease. The options are intended to inform Council officers decision making for an appropriate response for the Domain.

In order to inform this a detailed site assessment and mapping of the kauri located close to tracks within the Domain has been undertaken, along with a risk assessment to inform recommendations of approaches appropriate to the Domain. Proposed design responses and associated costings have subsequently been prepared to ensure the most cost effective and appropriate response to reduction of risk of kauri dieback contamination going forward. The recommendations follow current best practise in kauri dieback track design and risk reduction approaches within public spaces.

1.2 Background

The Domain has an area of forest that contains a significant number of kauri trees at different stages of development, including rickers through to very large specimens. The current track situation within this forest area allows direct contact between soil and walkers' footwear, which creates a potential pathway for the spread of the soil-borne pathogen responsible for Kauri Dieback disease (*Phytophthora agathicidia* (PA)), as well as direct damage to kauri roots that cross the path.

To mitigate these problems and ensure the ongoing survival of the kauri within the Domain, Kaipara District Council is reviewing the walking tracks in order to assess the risk associated with the current situation and to identify recommended responses.

PA, the pathogen that causes kauri dieback disease, was first recorded in the 1970's but misdiagnosed, before dying kauri alerted authorities in 2006, and the species was identified and formally named in 2015. The pathogen can sense a kauri tree's roots, and swim towards them using a tail-like flagella.[1]

PA is a soil-borne pathogen, with no airborne phase. It can be spread by just a pinhead of soil. Vectors potentially include anything that moves soil or plant material. Infected soil and spore movement could be passive (such as in water run-off downhill from infected sites), or active (such as in movement of soil on hikers' boots, vehicles, machinery, tools, feral animals such as pigs, domestic animals such as cattle, and movement of infected nursery material). The relative importance of these various pathways will be proportional to the volume of soil moved and the frequency and distance of such movement. The majority of long-distance dispersal is via human activity.

There is no cure for kauri dieback disease, and the disease kills most if not all the kauri it infects. Although there are physical symptoms it can take years for infected trees to show symptoms. Kauri dieback disease is threatening kauri with functional extinction. Oospores (resting spores) can be introduced into an area through the movement of contaminated soil, and natural spread through soil and water. Human activity poses the greatest risk of spread, but animals such as pigs have also been implicated. It only takes a pinhead of soil to move enough oospores to spread the disease.2

[1] https://www.kauridieback.co.nz/what-is-kauri-dieback/

[2] www.kauridieback.co.nz

Due to the soil borne infection potential tracks that allow direct contact between walkers' shoes (with dirt on them) and kauri roots increases the potential risk of spreading PA.

Despite scientists around the world having studied these types of pathogens for over a hundred years, there is no cure to eradicate Phytophthora from soil in a natural environment. However, it is possible to reduce the impact of the disease.

A Nation-wide approach aims to reduce the harmful effects of PA by preventing, where possible, the spread of PA and minimising its impacts on New Zealand's kauri forests, our culture, our communities and economy. Reducing the spread of this disease as much as possible, principally by controlling the spread of soil between sites, is of vital importance for the future of kauri.

Under the risk assessment undertaken by the Department of Conservation the Domain would be classed as a high risk area due to it being in public ownership and having sportsfields near the forest area. As no PA has been detected the forest area would be classed a "prevention zone" - Kauri forests where PA is undetected (but could still be present).

This report outlines and assesses recommendations in relation to the area being a prevention zone.

This report is also based on the agreed notion that wherever possible total closure of all forests with kauri to public access - including both diseased and non-symptomatic areas in not a desirable outcome. This option is not seen as preferred as total closure of all forests with kauri represents a significant loss of access for recreational purposes, and mana whenua groups. Enforcement and compliance for full closure is seen as problematic, as when communities feel alienated in this way, they are much less likely to comply. As such, recommendations are considered that allow for a reduction in risk while still maintaining some access to the forest area for local people.

1.3 Risk Reduction Options

Options to reduce the risk of PA spread, and that have been considered in development of the recommended responses in this report include the following:

1.3.1 Hygiene

The Department of Conservation (DOC) have tested a number of products to determine which disinfectant can be used in the forest, which is not only effective against the pathogen but is also safe to use by the public and environmentally friendly. Although there are other products available that are likely to be more effective against the pathogen, sterigene was found to have a better all-round profile in terms of having less of an impact on the environment and is safe to use compared to other disinfectants tested.

IMPORTANT NOTE: Sterigene will not kill spores if they are embedded in soil, hence the application of sterigene should only occur AFTER ALL soil is removed using a scrubbing brush and water.

Figure 1 - Photo showing example hygiene station at track entries with associated signage.

1.3.2 Track closures

Temporary or permanent track closures to prevent potential human and dog spread of PA.

Figure 2 - Photo showing example of track closure signage and barrier.

1.3.3 Boardwalks

In some instances the installation of boardwalks to prevent direct access of walkers' shoes to kauri roots has been implemented. This response reduces risk but does not remove it as soil from shoes can still fall through the boardwalks and associated hygiene methods should be used.

Figure 3 - Photographs showing construction of and finished boardwalk at Kitekite Falls, Piha - design specifically for PA.

1.3.4 Signage and Education

There has been some research undertaken on the understanding of public responses to signage linked to PA and this shows that providing some signage to highlight the issue is useful (with some types of signage more effective than others). Signage is usually linked to explaining track closures and/or describing requirements for behaviour changes for particular areas ie. use of hygiene stations.

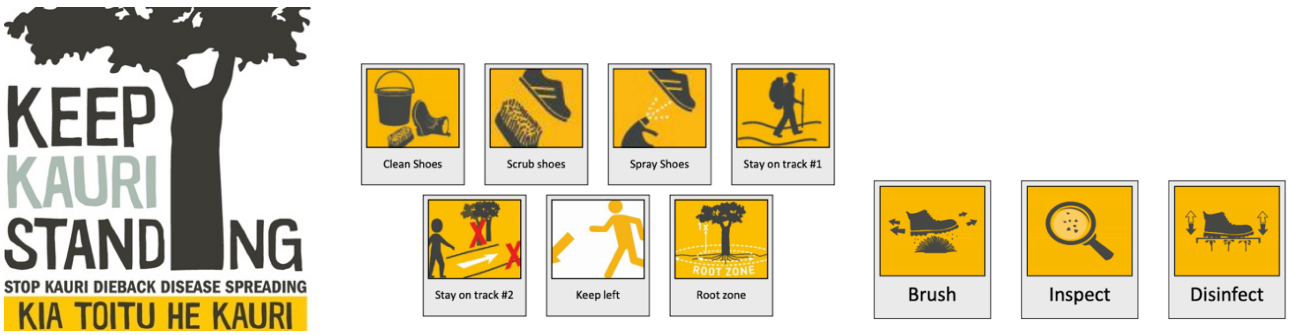

Figure 4 - Examples of signage for PA.

1.4 Methodology

The current kauri track at Kaiwaka Domain is located in extreme proximity to existing kauri. Although testing has occurred and there is no current evidence of PA within the Domain, the high public usage of the Domain creates a high risk for potential infection. The existing location and surfaces of the track allows direct contact between soil and walkers' footwear, which creates a potential pathway for the spread of the soil-borne pathogen responsible for kauri dieback disease, as well as direct damage to kauri roots that cross the path.

To mitigate these problems and create a safer, more user-friendly experience, it is proposed to assess and design an appropriate response for the Domain in relation to walking track upgrades and/or relocation and other protection measures in order for Kaipara District Council to determine the future approach for the walkways within the Domain.

1.4.1 Site Visit and Mapping

As site visit was undertaken on 3rd April 2019 by Renée Davies (landscape architect and ecologist) and Keren Bennett (ecologist).

The site visit included GPS mapping of all the tracks and GPS location of the main kauri or stands of kauri along the tracks. In addition the current track alignment and condition was assessed. The site visit also mapped with GPS co-ordinates the possible relocation option/s for the track to avoid the kauri trees and/or identification of particular approaches to the track to mitigate potential kauri infection.

Figure 5 - Aerial photograph showing the GPS co-ordinates of track alignments and associated kauri tree locations. Refer to **Appendix C** for full numbered list.

1.4.2 Assessment and feasibility report and track design

Following the site visit an assessment was prepared with an associated risk matrix that identified and assessed likely recreational outcomes for the current track and impact of each of the considered options on these outcomes. In addition, an assessment of the ecological effects and considerations associated with the track relocation was undertaken and an overall score provided in relation to improved outcomes the range of options possible. A series of maps were produced to show track locations and proposed track design. The recommendations also explored specific track design approaches that may be required. The design has utilised current best practise in kauri dieback access methodologies and approaches.

1.4.3 Costing

A high level costing for the implementation of the different options and responses has been provided in order to inform the feasibility report.

2 SITE DESCRIPTION

The tracks associated with the Domain are located within an area of bush on the western side of the Domain and bounded on the west and north by Gibbons Road. There are a number of tracks that have been established within the Domain, some of which are outside of the forested areas with others moving through the forest. The bush area is adjacent to a concrete walking and cycling track that runs around the perimeter of the Domain sports fields.

Figure 6 Aerial photograph showing location of tracks being assessed within broader area of Kaiwaka.

The entry to the tracks are located on Gibbons Road and from the edge of the forest within the Domain.

Figure 7 - Photos showing Kauri Walkway track and Gibbons Road track entries from the Domain.

Figure 8 - Photos showing Gibbons road track and Scout track entries from Gibbons Road.

The tracks that have been assessed as part of this report are those that enter into the forest environment. GPS mapping has provided an accurate indication of both the location of the kauri near the tracks and also the track alignment. The tracks have been identified and named for ease of description within this report as follows:

- Main kauri walk track
- Scout track
- Gibbons Road track
- Domain Track
- Informal track from carpark

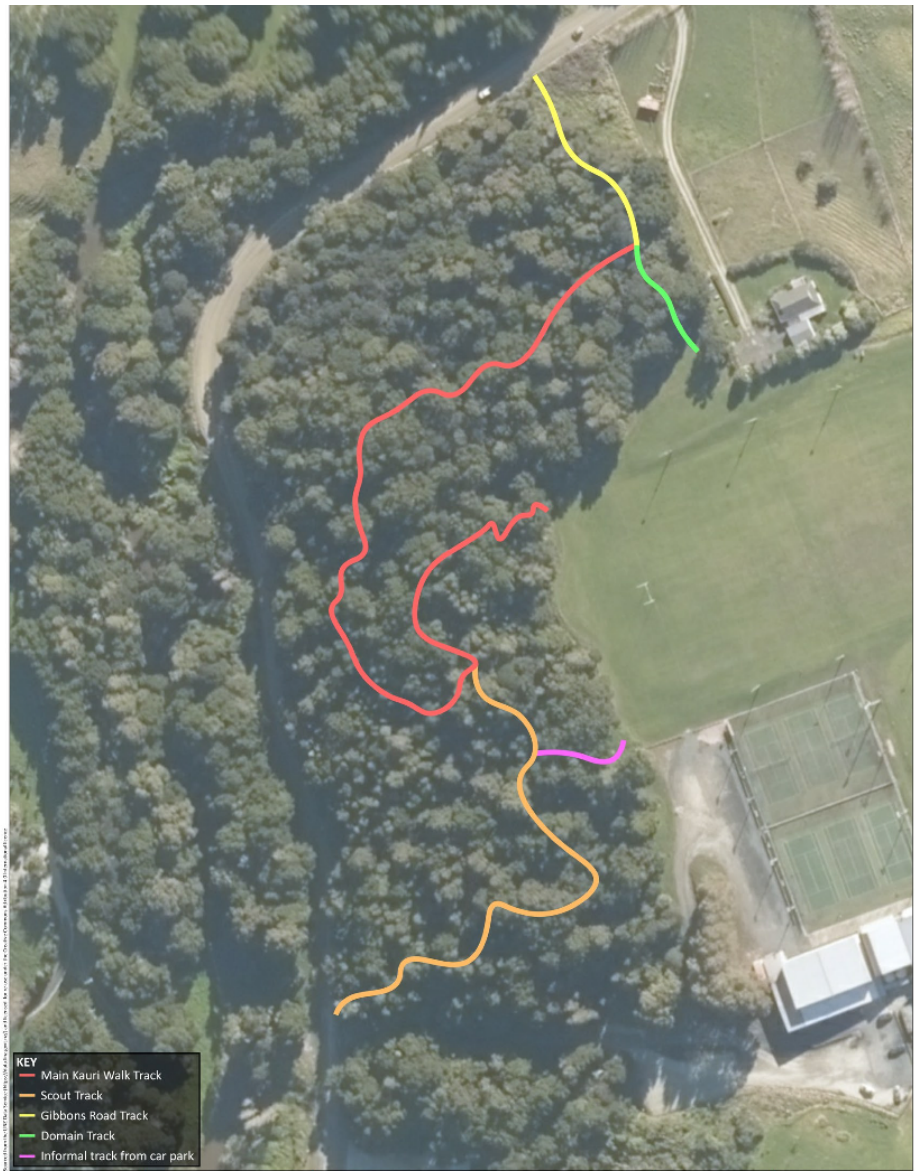

Figure 9 - Photograph showing the mapped tracks (A3 version provided in **Appendix B**).

2.1 Forest Environment Description

The existing tracks are all narrow tracks that weave through the forest understorey with a natural dirt and leaf litter surface. Runoff erosion has scoured the ground and exposed tree roots in some locations along the tracks. The cleared area of track varies in width but is generally between 500mm and 2000mm in width. Please refer to photos within **Appendix D** for further illustration.

The kauri located within the forest of the Domain range in age from small rickers through to relatively mature trees. Seedlings and saplings are abundant. There are well-established native forest surrounds the walking tracks.

Figure 10 - Photos showing range of kauri sizes within the Domain forest.

The forest at the Domain exhibits typical structure of the kauri forest type which is typified by dense canopies of kauri. Large kauri are prominent and scattered throughout the surrounding forest. Where large specimens are situated in close proximity to the walking surfaces their roots often intersect the dirt surface of the tracks. Other native canopy species of note at the site include totara (*Podocarpus totara*), rewarewa (*Knightia excelsa*), rimu (*Dacrydium cupressinum*), Kahikatea (*Dacrycarpus dacrydioides*), tanekaha (*Phyllocladus trichomanoides*).

Sub-canopy species included (but not limited to) nikau (*Rhopalostylus sapida*), mahoe (*Melicytus ramiflorus*), punga/tree fern (*Dicksonia squarrosa* and *Cyathea dealbata*), kawakawa (*Macropiper excelsum*), red matipo (*Myrsine australis*), kareao/supplejack (*Ripogonum scandens*), ti kouka (*Cordyline australis*).

Groundcover species included a range of fern species, kie kie (*Freycinetia banksia*) and *Coprosma* species.

Further descriptions specific to each track are outlined in Section 3.

Figure 11 - Photographs showing general understorey vegetation within forest area of the Domain.

2.2 General Issues

The site observations identified some key issues within the track system at the Domain, these are described in more detail as follows:

1. **Kauri root exposure** – in a number of locations the roots of kauri were visibly exposed within the track.

Figure 12 - Photos showing fine surface roots of kauri exposed within track alignment.

Figure 13 - Photos from Main kauri walk track showing exposed kauri roots and proximity of track.

2. **Operational issues** - for kauri on the edge of the forest at the carpark. There are some isolated kauri that sit out from the forest edge and these have had rubbish piled up over their root zones with weed infestation and are in direct access of damage.

Figure 14 - Photos showing large kauri by carpark and mound of weed and rubbish laid over kauri root zone.

3. **Forest edge** – along the eastern edge of the forest area adjacent to the Domain sports field there are a number of kauri located at the forest edge with no buffer between mowing activity and with direct access from people using the sports fields. This edge also has some weed invasion.

Figure 15 - Photos showing edge condition of forest and kauri exposed to mowing and with direct access from fields.

3 TRACK ASSESSMENT

3.1 Main Kauri Walk Track

This track moves through the most pristine part of the forest area with the least amount of edge effects and as such there is little weed invasion and the forest ecosystem is in good health and represents a typical kauri forest mix. There are an extensive number of kauri trees located on and directly adjacent to the track within this area. The list at **Appendix C** Indicates at least 68 kauri that are either directly on or within 1 – 5m of the track. In a number of instances the kauri are an integrated part of the track. As outlined in the general description of issues in Section 2.2 direct contact with kauri roots was observed and this track, due to the large number of kauri present within the track alignment, has a high risk of infection.

The area of forest in which this track is located is peppered with kauri throughout and the on-site assessment has determined that there is no area of the forest without kauri that would facilitate a track relocation to avoid kauri.

Figure 16 - Example photos of track going directly over kauri roots.

3.2 Scout Track

Scout track is accessed off the Main Kauri Walk track from the Domain and has an entrance at the Gibbons Road end of the main driveway entry to the Domain. The track is a forest experience short-cut up through to the Domain sports field area. This track has fewer kauri specimens within proximity to the track, with two key areas of kauri located close to the track along its length. As such this track has a lower risk than the Main Kauri Walk track in relation to potential effects on the kauri from walkers. The two sections where kauri are in close proximity to the track would be able to have short sections of boardwalks installed to reduce the risk to kauri roots. These sections would each be approximately 20m – 25m in length. The northern end of the Scout track links in with the existing Main Kauri Walk track and at this point kauri trees become more frequent. There is an existing informal track entry from the sports field down to Scout track that has no kauri on it and this offers potential to be developed as an alternative entry/exit point for Scout track.

Figure 17 - Photos showing examples of Scout track and vegetation with possible new entry in right hand photo.

3.3 Gibbons Road Track

Gibbons Road track starts at the three way junction between it, the Domain track, and Main Kauri Walk track. This track is located within bush edge and there are very few kauri within this track located in proximity to the track. The vegetation within this track is more open and there is more weed infestation. This track provides a short cut route from Gibbons Road up to the Domain and a number of users were observed using the track on the day of survey. The entry is a small desire line crushed through kikuyu grass and is low profile. It is likely that only local users would know of its existence and would regularly use it. The fewer numbers of kauri within this track means that boardwalking or minor track relocation would be possible to avoid the two kauri that are located in proximity to users within this particular section of track.

3.4 Domain Track

This is a track that connects the Domain to the northern end of the Main Kauri Walk track and then connects to Gibbons track. It is used by dog-walkers and walkers and runners as a connection through to Gibbons Road. This section of track does not have any kauri in close proximity to the track. Users might take a short cut through Scout track across the sports fields and connect to this track to get back to further north along Gibbons Road.

Figure 18 - Photo showing entry to Domain track from concrete path and sports-field area.

3.5 Informal Track from Carpark

There is an existing informal track from just north of the carpark area that links down to Scout track. This area does not have any kauri in close proximity and could be an alternative entry/exit point to access Scout track and avoid the denser areas of kauri further north.

4 DESCRIPTION OF OPTIONS

The range of options considered for the Domain tracks are discussed below.

4.1 Do Nothing

Leave the track in its current location and format with no adjustment.

4.2 Walkway Surface Upgrade with Boardwalk

Walkway surface upgrades would typically be undertaken within the existing footprint of the track, and include installation of boardwalks and raised stairs, as appropriate for a given site. The boardwalk structures provide walkers with physical separation from the ground and root area of kauri trees, thus reducing the risk of PA transmission.

The boardwalk structures are typically anchored to the ground with steel 'groundhog' foundations or wooden piles (as appropriate) driven into the ground to minimise disturbance. This is a proven construction technique commonly found throughout the Auckland region in bush environments to reduce the impact on vegetation. Groundhogs are to be used only where a minimum of 300mm embedment into stiff clay can be achieved.

4.3 Hygiene Stations

There are standard hygiene station designs that are located across the track entries so that users have to pass through them to access the tracks. Hygiene stations should be located at all track entries that are decided to be retained. These hygiene stations would include signage.

4.4 Educational Signage

This would provide a good level of information to Domain users on the reasons for the responses being put in place and to guide appropriate behaviours.

4.5 Protective Fencing

This would involve some post and rail fencing to be put in place in order to prevent public and dogs accessing key kauri that are located outside or at the edge of the forest area. This fencing could incorporate educational signage and would include appropriate underplanting to further assist in protection of the kauri specimens.

4.6 Dogs on Leads

There is a risk that dogs that are off lead can move off existing tracks and are potential vectors of PA. The Domain is used for dog walking but it may be that dogs on leads can be encouraged on the tracks to prevent potential dog movement off the forest tracks.

4.7 Track Closure

This would involve closing a track and in this instance this would likely be a permanent closure until such time as the risk of PA is eliminated. The track would require fencing across entry points to prevent access and signage to explain the importance of the track closure. It is recommended that some planting could occur to assist with preventing people walking through the adjacent forest to get back onto the track and the track would be allowed to naturally regenerate with no maintenance to keep it accessible.

4.8 Buffer Edge Planting

Planting of a dense native buffer edge to the forest area to create a distance between public and operational activity within the Domain and the sensitive forest edge.

4.9 Considerations For Works within the Domain

The implementation of some of the recommendations would require works within the dripline of native and protected vegetation. In order to safeguard vegetation to be retained, a Tree Protection Plan (TPP) would need to be implemented during the works. The TPP advises on preferred alignments for the boardwalks and fencing (with the aim of avoiding or minimising impacts on the most significant native trees) and addresses pre-start meeting requirements, arborist supervision, positioning piles to avoid significant root matter, PA hygiene control measures, temporary tree trunk and root zone protection, etc.

Removal of desirable vegetation would be kept to a minimum necessary to effectively deliver the boardwalks and fencing. It is expected that the limited vegetation removal proposed will be barely discernible in the context of the expansive bush-clad environment.

The following measures would also be considered important to mitigate any potential adverse ecological effects:

- Implementation of best practice sediment controls during construction;
- The boardwalk alignments would be chosen to avoid removal of large trees, and their function as wildlife habitats;
- As far as practical, avoidance of the peak breeding period for native birds by construction works (September to February);
- Placing felled vegetation that may provide habitat for arboreal geckos off to the side of the tracks to allow any animals present to self-relocate to adjacent vegetation;
- Adoption of best practice PA hygiene measures; and
- Pre-works site visit with the contractor to identify special ecological requirements.

5 OPTIONS AND RISK TABLE WITH COST ESTIMATES

The following table provides a summary of the options and risk assessment with associated high level cost estimates for each of the options proposed.

The table is structured to indicate the option(s) considered and the associated design response and degree of change. This design response is then assessed against a risk score and an overall level of compliance 'traffic light' report given for each option. The traffic light relates to the following levels of compliance and risk score:

Green – good level of compliance, low risk & response to issues is good to excellent. Score of 1 or 2.

Amber – moderate level of compliance, moderate risk & response to issues is adequate and/or in progress. Score of 3.

Red – low level of compliance, high risk & issues not addressed adequately. Score of 4 or 5.

A series of recommendations are made in relation to each option being assessed. These recommendations outline particular ways in which approaches may address the risks of PA infection and spread within the Domain.

High level costings are based on the following rates:

- $950 per lineal metre for 1.2 wide boardwalk with no kick edges or steps (current Auckland Council contractor costs).
- $25,000 for mark 2 hygiene station (proven to be the most effective with 100% of activity of users using).
- $80 per lineal metre for post and rail and wire fencing.
- $40 per lineal metre for waratah and sheep mesh fencing.
- $8,000 lump sum for signage.
- $50 per m^2 for native revegetation planting.

Track relocation was considered within the site assessment, however, as mentioned earlier in the report the density of kauri within the forest area of the Domain and the topography of the site mean that track relocation is not a viable option. Kauri are spread throughout the forest area and we were unable to identify any obvious kauri-avoidance tracks suitable on site during the site visit.

One small relocation of entry point for Scout track was identified.

Table 1 – Options and Risk Assessment with High Level Costs

Option	Description	Options						Boardwalks					Track Closures					Degree of Change	Location	Risk Score for PA	Risk Assessment	Cost
		Dogs on leads	Signage	Hygiene Stations	Fencing lone kauri	Barrier fencing	Buffer Planting	Main Kauri Walk	Scouts	Gibbons Rd	Domain	Informal	Main Kauri Walk	Scouts	Gibbons Rd	Domain	Informal			1-5 (1 = low; 5 = high risk)		
A	**Do nothing**																	None	Whole Domain	5	High risk of PA infection	**No cost**
B	**Buffer planting at forest edge**						✓											Minimal	Eastern edge of forest (av. 3m wide buffer) 666m^2	5	Some protection of edge kauri, risk to forest as a whole remains high	**$33,000**
C	**Dogs on leads on tracks**	✓																Minimal	Signs at entry to tracks	5	High risk of PA infection	**$8,000**
D	**Dogs on leads in whole Domain**	✓																Minimal	Signs at entries to Domain and tracks	5	High risk of PA infection	**$8,000**
E	**Signage and hygiene stations**		✓	✓														Minimal	Mark 2 hygiene stations at the 5 track entry points	4	Reduces risk of PA introduction, however direct infection pathways (exposed roots) are retained	$8,000 signs $125,000 hygiene station **Total:$133,000**
F	**Fencing lone kauri and buffer planting at forest edge**		✓		✓		✓											Minimal	222 lineal m of fencing alongside forest edge adjacent to carpark and driveway	4	Localised protection only, risk to wider forest remains high	$33,000 buffer planting $8,800 fencing $5,000 signage **Total: $46,880**
G	**Partial boardwalk and hygiene stations**		✓	✓				✓	✓									Moderate	Mark 2 hygiene stations at the 5 track entry points and boardwalk of 200m in areas of kauri on track	4	Removes direct contact to soil for those kauri in middle of track but leaves risk for kauri nearby and walking still occuring within kauri hygiene zone.	$180,000 boardwalk $100,000 hygiene stations $8,000 signage **Total: $288,000**
H	**Close Main Kauri walk track**	✓	✓	✓		✓	✓						✓					High degree		3	Risk to largest stand of kauri reduced. Risk of PA infection to marginal stands maintained	$8,000 signs $240 track barrier fence $33,000 vegetation buffer **Total: $41,240**

Option	Description	Options						Boardwalks					Track Closures					Degree of Change	Location	Risk Score for PA	Risk Assessment	Cost
		Dogs on leads	Signage	Hygiene Stations	Fencing lone kauri	Barrier fencing	Buffer Planting	Main Kauri Walk	Scouts	Gibbons Rd	Domain	Informal	Main Kauri Walk	Scouts	Gibbons Rd	Domain	Informal			1-5 (1 = low; 5 = high risk)		
I	**Close Main kauri walk track and part of Scout track, partial boardwalk, hygiene stations, fencing isolated kauri, buffer edge planting**	✓	✓	✓	✓		✓		✓	✓			✓	✓ (part)				High	60m of boardwalk on Scout track, 4 hygiene stations 2 on Scout track entries and 2 on Gibbons and Domain track entries, fencing isolated kauri and buffer edge planting and 3 track closure fences	2	Risk to largest stands of kauri reduced and mitigation measures put in place for tracks where kauri are located with provision of boardwalk.	$54,000 boardwalk $100,000 hygiene stations $8,000 signs $33,000 vegetation buffer $1,400 track closure fence $3,600 fencing lone kauri **Total: $200,000**
J	**Boardwalk Main Kauri Walk and Scout tracks**	✓	✓	✓	✓		✓	✓	✓									High	338 lineal metres boardwalk for Main Kauri Walk track and 197 lineal metres boardwalk for Scout track and signage, fence lone kauri	3	Risk to largest stand of kauri reduced through mitigation measure of boardwalk but potential damage to trees with installation works may increase risk.	$ 500,000 boardwalk $8,000 signage $100,000 hygiene stations **Total: $616,000**
K	**Full track closure with buffer planting at forest edge**		✓		✓	✓	✓						✓	✓	✓	✓	✓	High	Fence track entries, signage, vegetation buffer and fencing lone kauri by carpark	1	Risk to forest area reduced as no access provided for. Small residual risk with people accessing forest off-track.	$ 500 for track barrier fencing $8,000 for signs $33,000 vegetation buffer $8,000 fencing lone kauri **Total: $49,500**

6 CONCLUSION AND RECOMMENDATIONS

The site assessment has indicated that the Kaiwaka Domain and publicly accessible tracks in their current form pose a real risk in relation to the potential introduction of kauri dieback disease to the Domain forest area. The Domain is a well-used local asset with a school adjacent and regular daytime walkers and dog-walkers accessing the site through the forest tracks and experiencing the forest via the tracks. Some of the tracks also provide pleasant short-cuts between the nearby village centre of Kaiwaka and Gibbons Road at the northern end of the Domain.

With all options except full track closure, hygiene stations are a minimum requirement. These are a costly component of the preventative measures for PA introduction, as it is recommended that if hygiene stations are used that these be the proven most effective stations (with 100% compliance recorded by DOC), namely the 'Mark 2' hygiene station.

Full closure of all tracks was considered as an option, and with compliance, would offer a high degree of protection for the forest from the risk of PA introduction. However, this option is unlikely to be palatable to the local community, and persistent non-compliance, combined with no hygiene measures, would maintain the risk of PA introduction.

Our recommendation, based on the option that has best combination of retaining a degree of public recreational access to the forest while reducing as much as possible the risk of PA contamination, is Option I (see Table 1). This option provides for the second lowest level of risk while still maintaining the two key walkway linkages that might be used as short-cut access routes by local residents and users of the Domain. This option reduces the amount of costly infrastructure such as boardwalks, as the option includes closure of the Main Kauri Walk track with a high abundance of kauri close to the track, and a limited amount of boardwalk is required on the retained Scout track.

In summary, the track upgrades and associated preventative measures recommended include limited re-routing in one location, plus construction of two small sections of boardwalk, protective fencing of the isolated kauri at the carpark edge and installation of a forest buffer planting, hygiene stations and educational and explanatory signage. All these measures are recommended in order to create a more accessible, user-friendly experience and mitigate the spread and effects of Kauri Dieback disease within both the Domain and broader Kaipara District.

Appendix A:

Site Context Map

State Highway 1

Gibbons Road

Kaiwaka Domain

Entry road to Kaiwaka Domain

Kaiwaka-Mangawhai Road

Kaiwaka River

Kaiwaka Township

Oneriri Road

KEY

- Main Kauri Walk Track
- Scout Track
- Gibbons Road Track
- Domain Track
- Informal track from car park

N

Scale 1:4,000 @ A3

0 80 160m

AA4937 - Kaiwaka Kauri Walk Assessment

Kaiwaka Kauri Walk Assessment: Track Context

Figure prepared for Kaipara District Council by 4Sight Consulting.

Date: 16/04/2019
Version: 1.0
Drawn: Sam Hendrikse
Checked: Renèe Davies
Approved: Renèe Davies

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Appendix B:

Track Map

KEY
- Main Kauri Walk Track
- Scout Track
- Gibbons Road Track
- Domain Track
- Informal track from car park

N

Scale 1:1,000 @ A3

0 20 40m

AA4937 - Kaiwaka Kauri Walk Assessment

Kaiwaka Kauri Walk Assessment: Track Map

Figure prepared for Kaipara District Council by 4Sight Consulting.

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Appendix C:

GPS Co-ordinates and Descriptions

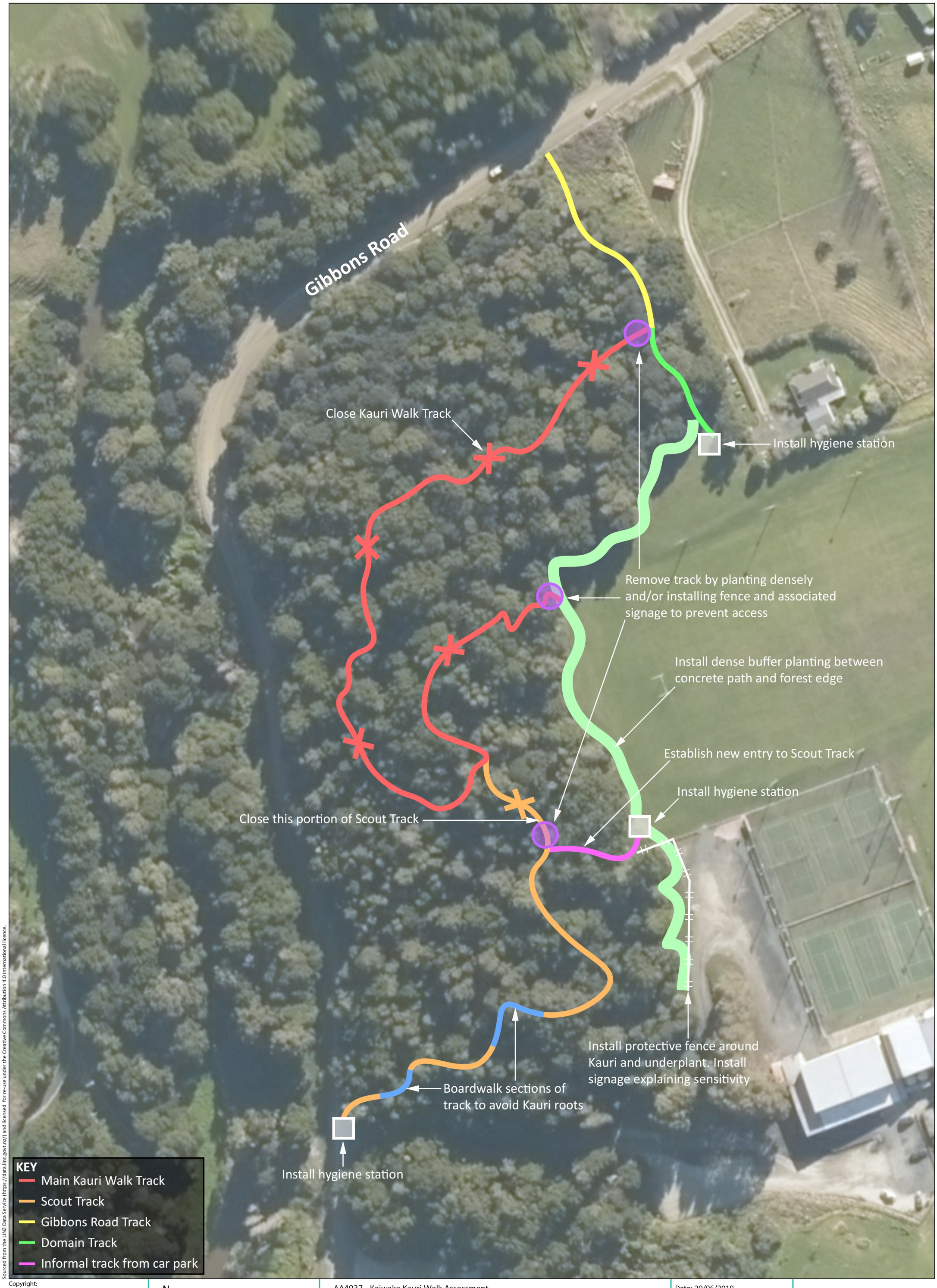
- 15-Kauri 1 by car park and outside of main bush area
- 16-Kauri 2 ricker on edge of bush
- 17-Large kauri 3 at edge by concrete path
- 18-Kauri 4 by concrete path
- 19-View from concrete path to entry of kauri walk
- 20-Kauri 5
- 21-Kauri 6
- 22-Kauri 7
- 23-Kauri 8
- 24-Path with no kauri on edge
- 25-View from path to kauri approx 6m from path
- 26-Kauri 9 3m from path
- 27-Kauri 10 1m from track
- 28-View from track to large grove of kauri
- 29-Kauri 11, 12, 13, 14, 15, 16 closest 2m and furtherest 15m
- 30-Kauri 17 right in middle of track
- 31-Kauri 18 4m from track
- 32-Kauri 19 behind seat on track
- 33-Kauri 20 5m off track
- 34-Split in track
- 35-Kauri 21 ricker on track
- 36-Kauri 22 on scout track in middle of track
- 37-Kauri 23 in group of kahikatea 1m from scout track
- 38-Kauri 24 6m from track
- 39-Kauri 25 1m from track
- 40-Kauri 26, 27, 28 29 group with 26 in middle of track
- 41-Kauri 30 on edge of track
- 42-Kauri 31 3m from track
- 43-Kauri 32, 33, 34 8m from track
- 44-Kauri 35, 36 right on track
- 45-Kauri 37, 38 large specimens right on track
- 46-Kauri 39 right on track large specimen
- 47-Kauri 40 10m from track
- 48-Group of kauri 41, 42, 43, 44, 45 right on track all large but one ricker all on or within 1m of track
- 49-Kauri 46 on track
- 50-Kauri 47, 48, 49, 50, 51 - range of sizes one very large 2 rickers
- 51-Kauri 52 on track
- 52-Kauri 53, 54 1m - 4m off track
- 53-Kauri 55, 56, 57 grouped on track and by seat
- 54-Kauri 58, 59, 60, 61, 62 Right on track in group
- 55-Kauri group of 7 (63, 64, 65, 66, 67, 68, 69)
- 56-Kauri 70, 71 1m from track
- 57-Split in track to Gibbons Road and domain
- 58-Kauri 72 1m from track
- 59-Kauri 73 10 m from track and large
- 60-Edge of bush
- 61-View to entry from Gibbons road
- 62-View from road
- 63-Entry to kauri walk from gibbons road
- 64-Kauri 74 5 m from track
- 65-Kauri 75 large, off track but accessible 6m
- 66-Track no kauri
- 67-Group of kauri off track but over 10m from track (76, 77, 78, 79, 80)
- 68-Kauri 81 5-7m from track
- 69-Kauri 82 on track
- 70-Kauri 83, 84, 85. On track and up to 3m away large specimens
- 71-Track
- 72-Track
- 73-Track
- 74-Track
- 75-Track
- 76-Kauri 86 on track
- 77-Kauri 87, 88. Small by track
- 78-Entry from domain track
- 79-Track
- 80-Track
- 81-Track
- 82-View from path
- 83-Possible new entry track
- 84-Possible new entry track

Appendix D:

GPS Location Photos

Appendix E:

Recommended Approaches



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Scale 1:1,000 @ A3

0 20 40m

AA4937 - Kaiwaka Kauri Walk Assessment

Kaiwaka Kauri Walk Assessment: Recommended Approach

Figure prepared for Kaipara District Council by 4Sight Consulting.

Date: 20/06/2019
Version: 1.0
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Checked: Renèe Davies
Approved: Renèe Davies

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