Appendix 6. Assessment of Ecological Effects

ASSESSMENT OF ECOLOGICAL EFFECTS FOR A PROPOSED ZIP LINE TOUR NEAR HUKA FALLS



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ASSESSMENT OF ECOLOGICAL EFFECTS FOR A PROPOSED ZIP LINE TOUR NEAR HUKA FALLS



View of kōhūhū-kānuka-whauwhaupaku forest within Huka Falls Scenic Reserve from Ferguson's Gully track. 26 June 2019.

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CONTENTS

1. INTRODUCTION 1

2. METHODS 1
   2.1 Overview 1
   2.2 Review of existing information 1
   2.3 Site visit 2
   2.4 Assessment of potential effects 2

3. OVERVIEW OF PROPOSED ZIP LINE OPERATION 2
   3.1 Overview 2
   3.2 Footprint of the proposed operation 3
   3.3 Construction methods 3

4. ECOLOGICAL AND STATUTORY CONTEXT 6
   4.1 Overview 6
   4.2 Atiamuri Ecological District 6
   4.3 Huka Falls Scenic Reserve 8
   4.4 Huka Falls (true left side) 9
   4.5 Upper Waikato River 9
   4.6 Ecological restoration in the area 9
   4.7 District plan provisions 11

5. VEGETATION AND HABITATS AT THE SITE 11

6. VEGETATION AND HABITATS AT SPECIFIC LOCATIONS 13
   6.1 Overview 13
   6.2 Tower 1 13
   6.3 Platform 2 14
   6.4 Platform 3 15
   6.5 Track from Platform 3 to Platform 4 15
   6.6 Platform 4 17
   6.7 Platform 5 17
   6.8 Platform 6 17
   6.9 Track from Platform 6 to Tower 7 20
   6.10 Tower 7 23
   6.11 Tower 8 23

7. FLORA 24

8. FAUNA 25
   8.1 Avifauna 25
   8.2 Bats 26
   8.3 Herpetofauna 26
   8.4 Aquatic fauna 26
   8.5 Pest animals 27

9. ECOLOGICAL VALUES 27

10. POTENTIAL ECOLOGICAL EFFECTS 27
   10.1 Overview 27

10.2 Loss and damage of vegetation 28
10.2.1 Clearance for platforms and towers 28
10.2.2 Clearance for zip lines 28
10.2.3 Clearance for tracks 29
10.2.4 Damage to tree roots 30
10.2.5 Damage to adjoining vegetation 30
10.3 Erosion and sedimentation 30
10.4 Effects on indigenous fauna 31
10.5 Increased human presence 31

11. OPTIONS TO AVOID OR MINIMISE POTENTIALLY ADVERSE ECOLOGICAL EFFECTS 32
11.1 Overall intent 32
11.2 Construction of zip line structures 32
11.3 Construction of tracks 33
11.4 Avoid and minimise effects on indigenous fauna 35
11.5 Management and education of participants 35

12. MITIGATION AND ECOLOGICAL RESTORATION 36
12.1 Overview 36
12.2 Pest animal control 36
12.3 Pest plant control and restoration planting 38

13. CONCLUSIONS 40

ACKNOWLEDGMENTS 41

REFERENCES 41

APPENDICES

1. List of vascular plants recorded at the site, 26 June 2019 43
2. List of avifauna recorded at the site, 26 June 2019 46
3. Additional site photographs 47

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1. INTRODUCTION

Sky Play Adventures are proposing to establish a series of zip lines and a river tour, approximately 4.5 kilometres north of Taupō township. The proposed location of the operation is within Huka Falls Scenic Reserve and also on the opposite side of the Waikato River within land administered by the Department of Conservation. Sky Play Adventures commissioned Wildland Consultants to prepare an assessment of the potential ecological effects of the proposed tour and an assessment of opportunities to undertake ecological restoration of indigenous vegetation and habitats at the site.

This report provides an assessment of the ecological values of the site; potential ecological effects of the tour and associated structures including zip lines; and options for avoiding, minimising, and mitigating potential adverse effects. Opportunities for ecological restoration are also addressed.

2. METHODS

2.1 Overview

Existing information relevant to the site was collated and reviewed. Following a meeting with the client, a site visit was undertaken to map, describe, and assess the ecological values of the site. An assessment of ecological effects was prepared which includes options to avoid, minimise, or mitigate any adverse effects of the tour and provides options for ecological restoration and enhancement.

2.2 Review of existing information

A preliminary meeting was held with the client on 5 June 2019, to develop an understanding of the proposed development.

Existing information on the site, surrounding environment, and ecological restoration projects within the surrounding area was compiled and reviewed.

The Department of Conservation Bioweb Database of threatened and uncommon plant species (version received 18 January 2019) was accessed in July 2019 to check for records within the vicinity of the site.

The Department of Conservation Bat Database was accessed in July 2019 for records within the vicinity of the site. A targeted field survey for bats was beyond the scope of this project.

A desktop assessment was undertaken of indigenous lizard species which may be present in and near the site. This involved evaluation of previous records in the area from the Department of Conservation's Bioweb Herpetofauna Database and evaluation of habitats present in the area and its potential suitability for relevant lizard species. A targeted field survey for reptiles was beyond the scope of this project.

The New Zealand Freshwater Fish Database (https://nzffdms.niwa.co.nz/) was accessed in July 2019 for records of aquatic fauna within the vicinity of the site.

2.3 Site visit

High resolution aerial photographs of the site (Taupō District Council Imagery 2016) were obtained and printed at a scale suitable for field use (1:1,500).

A site visit was undertaken on 26 June 2019 to evaluate the ecological values of the site and the potential ecological effects of the proposed operation. The proposed location for each zip line tower and walking track was visited on foot.

Vegetation and habitat types present within the site were identified, described, and mapped using aerial photographs for the site. Structural classes for vegetation and habitat types follow Atkinson (1985). Vegetation and habitat types, and key features identified during the site visit were later digitised using ArcGIS 10.6.

All vascular plant species observed during the site visit were recorded and are listed in Appendix 1.

Observations of indigenous and exotic avifauna were noted at the site during the site visit and are listed in Appendix 2. Additional avifauna records from 2017-2019 within about seven kilometres of the project area were obtained from eBird in July 2019.

Representative photographs were taken of the vegetation and habitat types, and views from key locations. Site photographs are provided throughout the report and in Appendix 3.

2.4 Assessment of potential effects

Ecological values of the site and potential ecological effects of the proposed tour were assessed. Potential ecological effects during both construction and ongoing operation were considered.

Options to avoid, minimise, or mitigate any potential adverse effects of the tour were evaluated. Options were developed for ecological restoration and enhancement of ecological features and values at the site and in the surrounding area.

3. OVERVIEW OF PROPOSED ZIP LINE OPERATION

3.1 Overview

This section has been compiled from information supplied by the client.

Sky Play Adventures propose to establish a river tour to showcase the story of the Waikato River. Aims of the tour are to increase the awareness of a wide range of people about the cultural significance of the river and the natural environment. Zip lines will be used as a way for people to experience the wonder of the river from another angle. The tour is intended to be suitable for a range of ages and designed with the intention of minimising the fear of participants in relation to height.

The proposed tour will include five zip lines which will cross above the Waikato River and a series of walking tracks (refer to Figure 1). A shuttle bus service will be used to transport participants from a welcome office to the start and end of the tour. The tour will start on the true right side of the Waikato River near the eastern margin of Huka Falls Scenic Reserve. The tour route will zig-zag downstream above the river and finish on the true left side of the river. For each section of zip line there will be a launching and landing platform positioned in relation to the topography of the site.

To enhance the participant experience Sky Play Adventures are eager to undertake activities to enhance the indigenous vegetation and habitats within the site. They have identified that there are likely to be opportunities to collaborate with Greening Taupō in restoring the Waikato River Corridor.

3.2 Footprint of the proposed operation

The venture will require the following features to be developed:

- Platforms and towers which will act as launching and landing locations for the zip lines. Five of these will be within the Huka Falls Scenic Reserve (SNA 216) and three (Platforms 2 and 5 and Tower 8) will be on the true left side of the river.
- Wire cable for the five sections of zip lines between the platforms and towers.
- Existing tracks (Huka-Aratiatia Walkway; total length of *c.*152 metres) will be used for a section of the tour between Platform 6 and Tower 7, and from Tower 10 to the shuttle bus stop or finish of the tour (Huka-Aratiatia Walkway, Te Totara Gully, Ferguson's Track; total length of *c.*890 metres) on Karetoto Road. Two sections of walking track will be constructed to intersect with the existing track between Platform 6 and Tower 7. An old track will be upgraded for the section of the tour between Platforms 3 and 4.
- A small pick-up area may be developed for the shuttle bus at the end of the tour. The location of this is yet to be confirmed although it will not be within the Scenic Reserve.

Tours will be run in groups of 10 people. It is estimated that 40,000 to 60,000 people will participate in the tours per year.

No toilet facilities will be developed along the tour route or within the Scenic Reserve. Tours will be undertaken during daylight hours only (about 8am to 5pm or 6pm depending on the time of year).

3.3 Construction methods

The tour route has been planned to enable the zip line to travel in a downriver direction based on differences in elevation of the hillslopes and the zip line platforms.

Platforms and towers will be constructed in relation to the topography of the site. The height of the launching and landing platforms of the proposed structures varies from *c.*0.8-13.6 metres above ground level (refer to Table 1).

Table 1: Height (metres) of the platforms for proposed zip line structures.

Structure	Approximate Height (m)
Tower 1	5.1
Platform 2	1.7 and 6.8
Platform 3	2.0
Platform 4	0.8
Platform 5	0.8 and 7.6
Platform 6	1.2
Tower 7	13.6
Tower 8	12.8

The footprint of each structure will be approximately 5.0 metres by 5.0 metres. To minimise the footprint of the structures, Platform 2 will have two levels: the landing platform for the incoming zip line from Platform 1 and the launching platform for the outgoing zip line towards Platform 3. Platform 5 will also have two levels - the landing platform for the incoming zip line from Platform 4 and the launching platform for the outgoing zip line towards Platform 6. A staircase - approximately 4.8 metres by 3.25 metres - will be required for Platforms 2 and 5, and Towers 1, 7, and 8. A small set of stairs to ground level will be required for Platforms 2, 3, 4, 5, and 6.

Sections of zip line will vary from *c.*182 to 572 metres (Table 2). Wire cables will pass above the platforms at *c.*3.2-15.8 metres above ground level and be fastened to the ground using a combination of stay cables, staunchions, cable support units, and cable tension units.

Table 2: Length (metres) of the proposed sections of zip line.

Section of Zip Line	Approximate Length (m)
Tower 1 - Platform 2	265
Platform 2 - Platform3	182
Platform 4 - Platform 5	264
Platform 5 - Platform 6	211
Tower 7 - Tower 8	572

Towers will be constructed from timber and steel (clad with timber). Safety barriers, balustrades, or fences will be attached to the towers to deter the general public from accessing the zip lines after hours.

Equipment and materials required to build the towers and tracks will be carried in by foot or lowered into place using a helicopter. A helicopter will be used in preference for transporting materials to locations within the Huka Falls Scenic Reserve. In some cases, sections of the towers may be constructed offsite and lowered into place by helicopter.

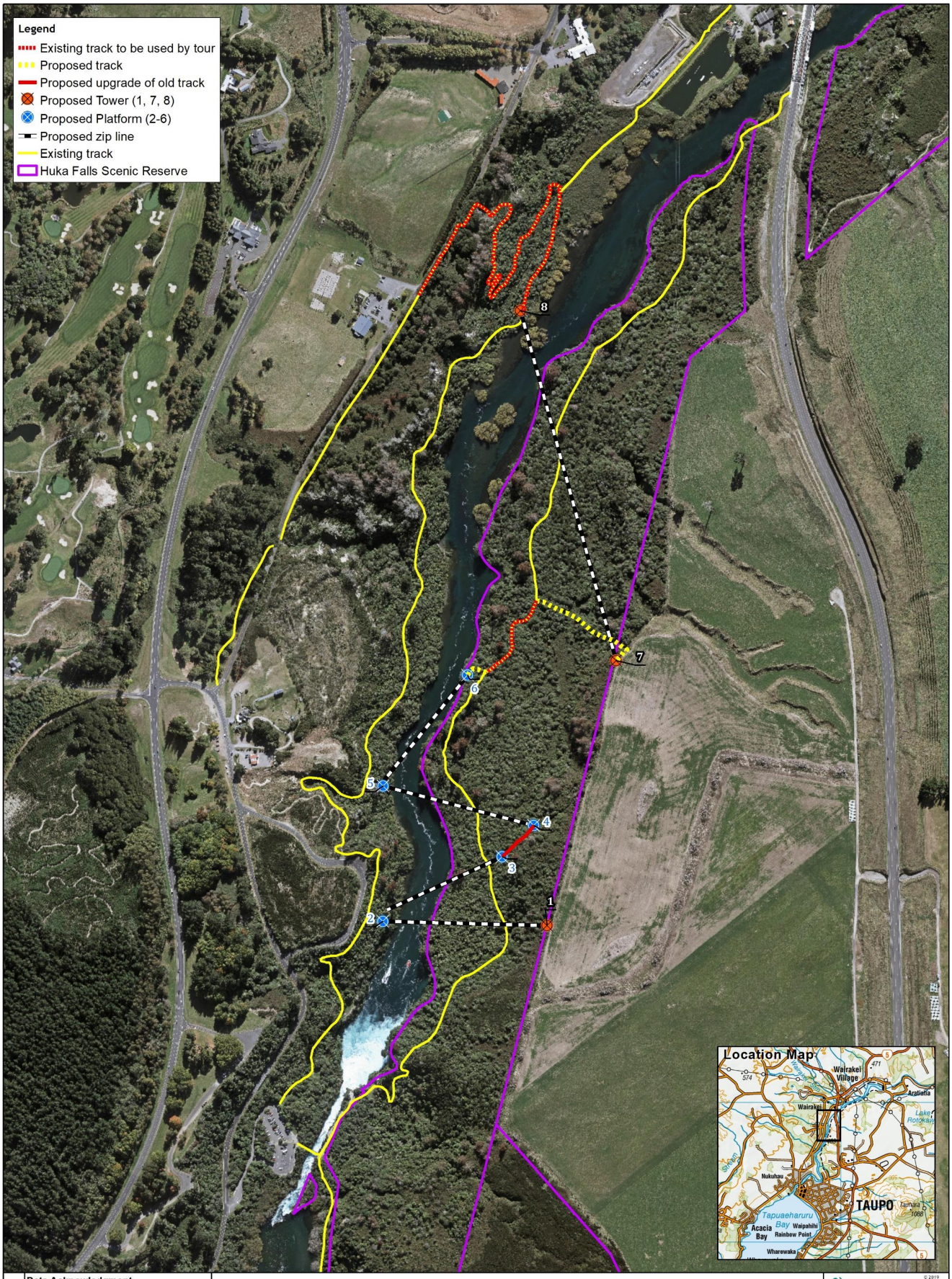


Figure 1. Overview of proposed tour route, Huka Falls

Temporary lead lines for the zip line will be laid using a helicopter. Then the permanent heavy gauge zip line will be laid by helicopter and fastened into position. Dead fall and small branches of vegetation which are within the safe operating area of the zip line will be assessed and trimmed as required.

Two walking tracks are to be formed. These tracks - *c.*295 metres total length and *c.*1.0 metre-wide - will have a 'hard' surface laid, such as pumice or gravel. Wooden steps will be constructed in sections of steeper terrain. Drainage will be installed along the proposed tracks. Some access routes will be required for maintenance.

4. ECOLOGICAL AND STATUTORY CONTEXT

4.1 Overview

The proposed operation will be undertaken on both sides of the Waikato River between Huka Falls and State Highway 1. This site is approximately 4.5 kilometres south of Taupō township, within Atiamuri Ecological District, Taupō District, and Waikato Region. The proposed operation will utilise existing tracks, and establish towers, zip lines, and an additional track within Huka Falls Scenic Reserve. Five proposed zip lines will span the Waikato River.

4.2 Atiamuri Ecological District

The following is based on Wildland Consultants (2009) and Spring-Rice (1996).

Atiamuri Ecological District (*c.*219,559 hectares) is centred on Atiamuri village. The western boundary is roughly between Horohoro Bluffs, Mangakino, Whakamaru, and Marotiri. The eastern boundary is roughly between Rerewhakaitu and Iwitahi. The southern boundary is near to Poihipi Road in the west and to the north of Taupō township and Tauhara in the east. The northern boundary roughly follows State Highways 38 and 5 to the Horohoro Bluffs.

Landforms

Landforms of Atiamuri Ecological District are characterised by volcanism and the Waikato River system.

The most striking visual feature of the Ecological District, particularly on the eastern side are steep-sided, more or less flat-topped rhyolite domes, formed by the extrusion of rhyolitic magma subsequently overlain with volcanic ash from the Taupō eruption. There are also rhyolite domes within the hilly landscape from Atiamuri south towards Lake Taupō.

South of the Waikato River are deeply dissected tephra deposits of the Taupō eruption which overlay the tilted ignimbrite sheet. The Reporoa Plains developed from the deposition of alluvial material following impoundment of the Waikato River by material ejected in the Taupō eruption 26,500 years B.P.

Soon after exiting Lake Taupō, the Waikato River becomes confined between steep cliffs of silicified sediments before plummeting *c.*15 metres over the Huka Falls. Numerous smaller rivers and streams, many spring-fed, emerge from the surrounding hills to join the Waikato River. Within Atiamuri Ecological District there are significant wetlands alongside the Waikato River and a sequence of impounded lakes behind hydro-electric dams.

Climate

Atiamuri Ecological District typically has warm, sometimes dry summers and cool winters with frequent ground frosts. Annual rainfall is *c.*1,200-1,600 millimetres (McEwen 1987) with a winter maximum. The prevailing wind is southwesterly, but northwesterly, westerly, and southerly winds are also common. Spring and summer are the windiest seasons (Spring-Rice 1996).

Vegetation

Prior to human arrival vegetation was mostly lowland mixed podocarp forest with submontane podocarp/broadleaved forest at higher-altitude sites. An extensive wetland occupied the Reporoa Basin, with numerous smaller wetlands scattered throughout the Ecological District. The numerous geothermal sites (such as Wairakei) supported distinctive scrub, shrubland, fernland, and mossfield vegetation. More than 90% of primary forest was destroyed by centuries of Māori fires, and by 1840, primary forest was generally restricted to the rhyolite domes and steep gullies. In 1840 approximately 90% of Atiamuri Ecological District was in fire-maintained secondary vegetation of bracken fernland, tussockland, and scrub (Leathwick *et al.* 1995).

Vegetation in the Ecological District changed little after initial European settlement until the early 1900s. From that time to the present, the combined effects of logging, land clearance, drainage and fires have removed 93% of the indigenous vegetation (Leathwick *et al.* 1995). Most has been converted to exotic pasture and plantation forests. The sequence of impounded lakes behind hydro-electric dams on the Waikato River have created significant aquatic habitats.

Introduced pest plants are common throughout the district. Grey willow (*Salix cinerea*) and crack willow (*Salix fragilis*) have extensively colonised remaining wetlands and river/lake margins. Wilding pines (*Pinus* spp.) are a particular threat in geothermal areas (Spring-Rice 1996).

Fauna

Early European accounts record the presence, and use by Māori, of indigenous kōkopu (*Galaxias* spp.), īnanga (*Galaxias maculatus*), and eels (shortfin (*Anguilla australis*) and longfin (*Anguilla dieffenbachii*)) in the streams and rivers. Kākahi (freshwater mussel, *Echyridella menziesi*) and kōura (freshwater crayfish, *Paranephrops planifrons*) were also gathered for food. The introduction of trout (rainbow (*Oncorhynchus mykiss*) and brown (*Salmo trutta*)), rudd (*Scardinius erythrophthalmus*), and goldfish (*Carassius auratus*) has had significant effects on aquatic ecosystems.

An extensive range of bird species was present in the Ecological District at time of European settlement and many were important food sources for Māori. Subsequent loss of habitat and introduction of predators has caused a decline in bird numbers and species. However, common forest birds are present and several rare/threatened indigenous bird species still occur here including: North Island kōkako (*Callaeas cinerea wilsoni*; At Risk-Recovering, as per Robertson *et al*. 2017), North Island brown kiwi (*Apteryx mantelli*; At Risk-Declining), New Zealand dabchick (weweia, *Poliocephalus rufopectus*; At Risk-Recovering), and spotless crake (pūweto, *Porzana tabuensis tabuensis*; At Risk-Declining).

Pekapeka (long-tailed bats, *Chalinolobus tuberculatus* "North Island"; Threatened-Nationally Critical, as per O'Donnell *et al*. 2017) are also present (Smith *et al.* 2017).

Indigenous brown skinks (*Oligosoma zelandicum*) and spotted skinks (*Oligosoma lineoocellatum*) were common in the Ecological District in the 19th century but the arrival of ship rats (*Rattus rattus*) and Norway rats (*Rattus norvegicus*) decimated skink populations. Geckos were apparently always uncommon, and have not been recorded for many decades (Spring-Rice 1996).

4.3 Huka Falls Scenic Reserve

Huka Falls Scenic Reserve covers *c.*116 hectares on the true right side of the Waikato River, between Lake Aratiatia in the north and Owen Delany Park in the south. The Reserve is generally less than 270 metres wide, from the edge of the Waikato River to the inland margin.

Huka Falls Scenic Reserve is also recognised as a Significant Natural Area (SNA 216 - Huka Falls Scenic Reserve) in the Taupō District Plan (Taupō District Council 2019) and is described in Wildland Consultants (2014a).

The Huka Falls are a site of national geopreservation significance and popular tourist site (Department of Conservation 2002). The Waikato River narrows from about 50-100 metres wide upstream to flow through the canyon at Huka Falls which is about 220 metres long and only about 15 metres wide. This constriction of the river creates a turbulent and fast flow of water over the falls at approximately 220,000 litres per second.

Vegetation types present within the reserve have previously been described as:

- Whauwhaupaku (*Pseudopanax arboreus*)-kōhūhū (*Pittosporum tenuifolium*) forest
- Tī kōuka (*Cordyline australis*) forest
- Kānuka (*Kunzea robusta*)-mānuka (*Leptospermum scoparium* agg.) scrub
- And, shoreline turf herbfield (Department of Conservation 2002).

A range of waterfowl and common forest birds have been recorded at this site previously (Department of Conservation 2002).

Pest plants recorded at this site include wilding pines, Himalayan honeysuckle (*Leycesteria formosa*), blackberry, gorse (*Ulex europaeus*), broom (*Cytisus scoparius*), willow, and climbing spindleberry (*Celastrus orbiculatus*) (Department of Conservation 2002).

Pest animals recorded at this site include brushtail possum (*Trichosurus vulpecula*), European rabbit (*Oryctolagus cuniculus cuniculus*), rats, and mustelids (Department of Conservation 2002).

4.4 Huka Falls (true left side)

An area of *c.*38 hectares on the true left side of the Waikato River alongside Huka Falls is also administered by the Department of Conservation but is awaiting gazettal (Department of Conservation 2002) and is not recognised as an SNA in the Taupō District Plan (Taupō District Council 2019). Whauwhaupaku-kōhūhū forest and kānuka-mānuka scrub occur within this area (Department of Conservation 2002).

A geothermal spring occurs on the margin of the Waikato River near the Hall of Fame Stream (Wildland Consultants 2014b). A small population of *Christella* aff. *dentata* ("thermal") (At Risk-Naturally Uncommon as per de Lange *et al.* 2018) occurs to the south of this confluence (Wildland Consultants 2014b). This geothermal spring is part of the Wairakei Geothermal Field (ibid.).

Similar pest plants and pest animals have been recorded at this site as within the Huka Falls Scenic Reserve (Department of Conservation 2002).

4.5 Upper Waikato River

The Waikato River is of very considerable cultural significance.

The Waikato River is the longest (425 kilometres long) river system in New Zealand. The river flows from Lake Taupō to the west coast at Port Waikato.

The ecology of the river varies in relation to changes in land use and human pressures along the river. Rapids and gorges would have originally characterised the upper and mid-reaches of the Waikato River.

Electricity generation is a major cause of changes in the river habitat. Eight dams have converted sections of the river above Karapiro to lakes or very slow-flowing environments. Parts of the river above Karapiro which have retained fast-flowing water experience rapid fluctuations in water level due to hydroelectric operations. In addition, there is some discharge of heat into the river from a geothermal plant (Environment Waikato 2008).

4.6 Ecological restoration in the area

Since 2014, restoration activities within the vicinity of Huka Falls Scenic Reserve and Taupō township have been undertaken by a collaborative organisation called

"Greening Taupō"[1]. Community partners of Greening Taupō are Project Tongariro, Kids Greening Taupō, Predator Free Taupō, Tūwharetoa Māori Trust Board, Taupō District Council, Bike Taupō, and Waikato Regional Council. Prior to this, independent conservation and restoration activities were undertaken by relevant parties such as the Department of Conservation, regional and district councils, and individual landowners.

Greening Taupō facilitates more than six projects in and around the Taupō region[1]. One of the major projects is the "Waikato River Corridor". This corridor includes land adjacent to the Waikato River from the State Highway 1 Taupō bypass bridge to the Control Gates Bridge. Key areas within the corridor are Department of Conservation reserves, Taupō District Council Reserves, Hipapatua (formally Reids Farm Recreation Reserve) and Owen Delany Park (Taupō District Council). This is an important wildlife corridor and one of the largest areas of indigenous habitat in close proximity to Taupō township.

Key tasks for the Waikato River Corridor are the control of pest plants, planting of indigenous plants, control of pest animals, enhancement of recreation opportunities, and improvement of cultural connections to the land.

The skills and expertise of many community partners are utilised for the Greening Taupō projects including Bike Taupō, the local tramping club, the Greening Taupō Wicked Weeders, and Kids Bike Taupō.

Restoration planting has been undertaken within the Waikato River Corridor for many years with sponsors including McDonalds and more recently the Hilton Lake Taupō Hotel.

In early 2015, Greening Taupō secured funding of $100,000 (spread over three years) from the Waikato Catchment Ecological Enhancement Trust (WCEET) for restoration work alongside the Waikato River above and below the Huka Falls. Since then, many of the wilding pines within this area have been poisoned or felled and a large area has been planted with indigenous species alongside the Rotary Track. A large planted area is being cared for by the local tramping club and support from the Greening Taupō Wicked Weeders.

Additional restoration undertaken with funding from the Waikato River Clean-up Trust has also been initiated below the Huka Falls to Aratiatia. Bike Taupō have been contracted by Greening Taupō to control wilding pines and to assist with the preparation of planting sites. Planting of indigenous species has been undertaken alongside the Aratiatia bike/walking track as a community event. Another site is being prepared for planting in 2019.

Additional restoration planting has been undertaken in several places along the nearby Wairakei Drive in 2017 and 2018.

[1] Greening Taupō (https://www.greeningtaupo.org.nz/). Accessed on 19 July 2019.

Other than wilding pines, there is currently no active trapping of pest animals or additional pest plant control within the stretch of river between the State Highway 1 Taupō bypass bridge and Huka Falls.

4.7 District plan provisions

Part of the proposed operation will be within Huka Falls Scenic Reserve, which is recognised as SNA 216 - Huka Falls Scenic Reserve in the Taupō District Plan (Taupō District Council 2019). Under the district-wide rules (Taupō District Plan, Section 4e.6.1), indigenous vegetation clearance within this SNA is a permitted activity because the vegetation clearance is within an area administered by the Department of Conservation and is for the purpose of structures and pedestrian use (Section 4e.6.1 Criteria i.f).

5. VEGETATION AND HABITATS AT THE SITE

Six broad vegetation and habitat types were identified based on vegetation structure and composition. Vegetation and habitats are mapped in Figure 2 and listed in Table 3, with descriptions of each type provided below.

Table 3: Vegetation and habitat types present at the site.

Vegetation and Habitat Type	
1.	Kōhūhū-kānuka-whauwhaupaku forest
2.	Whauwhaupaku-whekī-kōhūhū forest
3.	Tī kōuka forest
4.	Blackberry vineland
5.	Crack willow-grey willow treeland
6.	Tasmanian blackwood forest

1. Kōhūhū-kānuka-whauwhaupaku forest

Forest (*c.*8 metres tall) dominated by kōhūhū, kānuka, and whauwhaupaku. The relative dominance of these three species varies within this unit. Other species which are common in the canopy are māhoe, whekī, whekī-ponga, and makomako. Kōwhai and mamaku occur near the river margins in places. Tī kōuka occurs locally except near the boundary with tī kōuka forest (Vegetation and Habitat Type 3), where it is particularly common. Patches of blackberry, gorse, and broom occur in places, particularly on the eastern margin. Dead standing and several live wilding pines are present.

2. Whauwhaupaku-whekī-kōhūhū forest

Forest (*c.*8 metres tall) dominated by whauwhaupaku, whekī, and kōhūhū. Other species which are common in the canopy are māhoe, makomako, kānuka, rangiora, and whekī-ponga. Kōwhai occurs near the river margins in places. Patches of dead standing wilding pines are present and some live wilding pines remain.

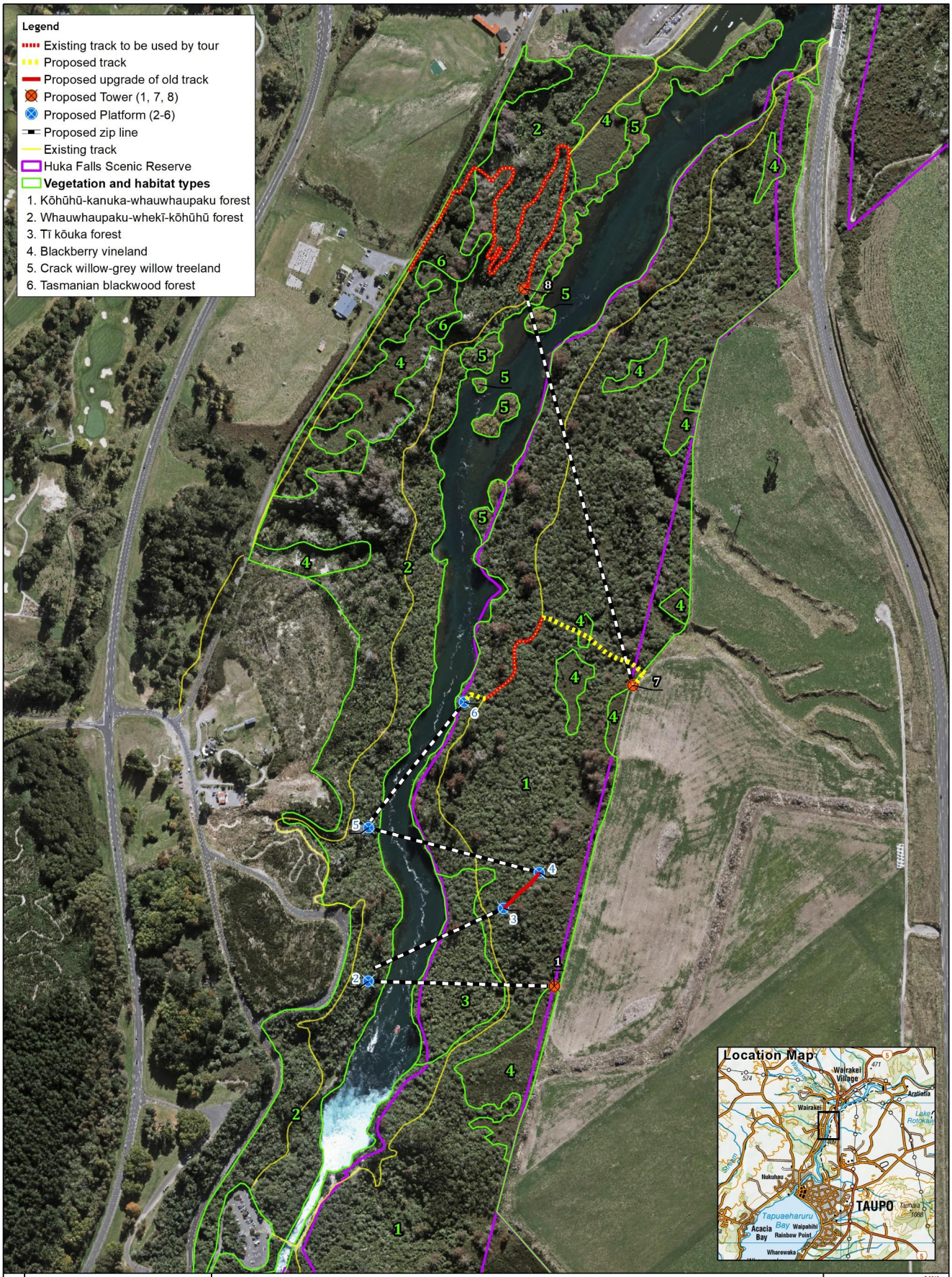


Figure 2. Vegetation and habitat types within the site of the proposed tour, Huka Falls

3. Tī kōuka forest

Forest dominated by tī kōuka (*c.*6 metres tall). There are scattered kōwhai, kānuka, and kōhūhū. A few kahikatea and a few dead standing wilding pines are present.

4. Blackberry vineland

This vineland is dominated by blackberry (*c.*2-3 metres tall) with bracken scattered throughout. Gorse, broom, and Himalayan honeysuckle are common. There is occasional Chinese privet (*c.*3 metres tall) and kōhūhū is scattered in places (*c.*6 metres tall).

5. Crack willow-grey willow vineland

Patches of crack willow and grey willow (both *c.*8 metres tall) occur along the margins of the Waikato River and on small islands within the river.

6. Tasmanian blackwood forest

Planted forest of Tasmanian blackwoods (*Acacia melanoxylon*) (*c.*10 metres tall). Naturalised saplings of Tasmanian blackwood are also present. Blackberry is common in the understorey. A few indigenous plant species are present including saplings of rimu and kōhūhū.

6. VEGETATION AND HABITATS AT SPECIFIC LOCATIONS

6.1 Overview

Descriptions of the vegetation and habitats present at each of the proposed tower, platform, and track locations are provided for the following sites shown in Figure 2:

- Tower 1.
- Platform 2.
- Platform 3.
- Track from Platform 3 to Platform 4.
- Platform 4.
- Platform 5.
- Platform 6.
- Track from Platform 6 to Tower 7.
- Tower 7.
- Tower 8.

6.2 Tower 1

The proposed start of the tour is near the eastern margin of Huka Falls Scenic Reserve. Vegetation within this location is vineland dominated by blackberry

(*c.*2 metres tall) (Plate 1), with occasional broom and gorse. Kōhūhū (*c.*6 metres tall) are present around the patch of blackberry vineland where the tower will be located.



Plate 1: View from proposed location of Tower 1 towards Platform 2 (in direction of arrow). 26 June 2019.

6.3 Platform 2

Platform 2 will be a combined landing platform for the zip line from Tower 1 and a launching platform for the zip line to Platform 3 (Plate 2).



Plate 2: Proposed location of Platform 2. 26 June 2019.

Vegetation at this location is forest comprising whauwhaupaku, whekī, and kōhūhū (*c.*6 metres tall) (Plate 3). There are occasional māhoe (*c.*5 metres tall) and rangiora (*c.*3 metres tall). There is a dense cover of kiokio and hangehange in the understorey.



Plate 3: View from proposed location of Platform 2 towards Platform 3. 26 June 2019.

6.4 Platform 3

Platform 3 is to be located at the lower end of an old forestry track. This will be a landing platform for the zip line from Platform 2 (Plate 4). Vegetation at this location is whauwhaupaku-māhoe forest (*c.*6 metres tall) with occasional tī kōuka and makomako (Plate 5). The understorey includes abundant Himalayan honeysuckle, and scattered ground ferns (hen and chicken fern, *Pneumatopteris pennigera*, and *Pellaea rotundifolia*).

6.5 Track from Platform 3 to Platform 4

A section of approximately 70 metres of an old forestry track (Plate 6) will be upgraded for use in the tour between Platforms 3 and 4. Vegetation along this track is forest of māhoe and whauwhaupaku (*c.*5 metres tall), with occasional patē, whekī, and tī kōuka. *Muehlenbeckia australis* is common in places. Ferns (including hen and chicken fern, hound's tongue fern, *Asplenium flaccidum*, and *Austroblechnum lanceolatum*) are scattered in the understorey in places.



Plate 4: View from proposed location of Platform 3 towards Platform 2. 26 June 2019.



Plate 5: Proposed location of Platform 3. 26 June 2019.



Plate 6: Old forestry track which will be upgraded for a track between Platforms 3 and 4. 26 June 2019.

6.6 Platform 4

Platform 4 is to be located towards the upslope end of an old forestry track. This will be a launching platform for the zip line to Platform 5 (Plate 7). Vegetation at this location is kōhūhū-māhoe forest (*c.*5 metres tall) with occasional whekī and tī kōuka (Plate 8). The understorey has very limited vegetation cover and is dominated by leaf litter.

6.7 Platform 5

Platform 5 will be a combined landing platform for the zip line from Platform 4 (Plate 9) and a launching platform for the zip line to Platform 6 (Plate 10).

This platform will be located on top of a cliff above the Waikato River, within an area which is currently dominated by kiokio. Whekī, whauwhaupaku, māhoe (*c.*6 metres tall), and horoeka occur around the patch of ferns.

6.8 Platform 6

Platform 6 will be a landing platform for the zip line from Platform 5. There is a patch of wind fallen kānuka at this location (Plate 11). Himalayan honeysuckle, and a few saplings of māhoe (*c.*2 metres tall) and Chinese privet are present. Kōhūhū, māhoe, and kānuka (*c.*5 metres tall) are present around the margins of the proposed location of Platform 6. Understorey species present include mingimingi, *Carex uncinata*, *Astelia fragrans*, and hound's tongue fern.



Plate 7: View from proposed location of Platform 4 towards Platform 5 (approximate location of Platform 5 is indicated by a circle). 26 June 2019.



Plate 8: Proposed location of Platform 4. 26 June 2019.



Plate 9: View from proposed location of Platform 5 towards Platform 6. 26 June 2019.



Plate 10: View from proposed location of Platform 5 towards Platform 6. 26 June 2019.



Plate 11: Proposed location of Platform 6. 26 June 2019.

6.9 Track from Platform 6 to Tower 7

It is proposed that participants will walk between Platform 6 and Tower 7. This walk will use a section (*c.*152 metres long) of the existing Huka-Aratiatia Walkway and require two sections of track to be developed.

The section of track to be developed from Platform 6 to the existing track is about 36 metres long. Vegetation within this route is forest of kōhūhū, māhoe, and kānuka (*c.*5 metres tall) with occasional horoeka, whauwhaupaku, kōwhai, ponga, and tī kōuka (Plate 12). Understorey species present include hangehange, mingimingi, Himalayan honeysuckle, rangiora, *Carex uncinata*, and hound's tongue fern.



Plate 12: Proposed location of track from Platform 6 to the existing Huka-Aratiatia Walkway. 26 June 2019.

The section of track to be developed from the existing track to Tower 7 is about 189 metres long. Vegetation within the lower half of this route is forest of kōhūhū and māhoe (*c.*8 metres tall) with scattered whekī and whekī-ponga (Plate 13). *Pneumatopteris pennigera* is common in the understorey, particularly along a shallow ditch. Other species present in the understorey include Chinese privet, *Pellaea rotundifolia*, *Carex uncinata*, and hound's tongue fern.



Plate 13: Lower half of the proposed track route from the existing Huka-Aratiatia Walkway to Tower 7. 26 June 2019.

Patches of blackberry vineland are present near halfway along the proposed route from Huka-Aratiatia Walkway to Tower 7 (Plate 14). There is occasional Himalayan honeysuckle, and Chinese privet amongst the blackberry.

Vegetation within the upper half of this proposed route is forest of kōhūhū and kānuka (*c.*8 metres tall), with local tī kōuka (Plate 15). Māhoe, Himalayan honeysuckle, whekī, whekī-ponga, and mingimingi are common in the understorey to *c.*4 metres tall. Blackberry, gorse, and bracken are interspersed throughout, particularly toward the upper slopes. Other species present in the understorey include rangiora, koromiko, Spanish heath, *Pellaea rotundifolia*, *Polystichum silvaticum*, and hound's tongue fern. Near the top of the hillslope the proposed route is within a steep-sided erosion gully.



Plate 14: View from a patch of blackberry vineland near halfway along the proposed track route from the existing Huka-Aratiatia Walkway to Tower 7. 26 June 2019.



Plate 15: View upslope on steeper section of the proposed route from the existing Huka-Aratiatia Walkway to Tower 7. 26 June 2019.

6.10 Tower 7

The proposed launch tower for the longest section of zip line is on the eastern margin of Huka Falls Scenic Reserve. Vegetation within the proposed location of this tower is vineland dominated by blackberry, bracken, and gorse (*c.*2-3 metres tall) (Plate 16). There are occasional kōhūhū (*c.*4 metres tall) on the downslope margin of this location.



Plate 16: View of proposed location of Tower 7 (indicated by circle). 26 June 2019.

6.11 Tower 8

Tower 8 is the final landing tower for the tour. It is located *c.*5-10 metres from the existing Te Totara Gully track. Vegetation within the proposed location of this tower is vineland dominated by blackberry (*c.*3 metres tall) intermixed with bracken (Plate 17). There is a dead standing whekī. Makomako, whekī (both *c.*5 metres tall), and mingimingi are present on the margins of the tower location. An emergent kānuka (*c.*9 metres tall) is present nearby. Whauwhaupaku, willow, kōhūhū, karamū, rangiora, kiokio, and patē are present near the river margins.



Plate 17: Proposed location of Tower 8. 26 June 2019.

7. FLORA

A total of 80 vascular plant species were recorded during the site visits, including 62 indigenous and 18 exotic plant species (listed in Appendix 1).

Two of the indigenous vascular plants recorded within the site, have a national-level threat classification (as per de Lange *et al.* 2018). Kānuka is classified as Threatened-Nationally Vulnerable and mānuka is classified as At Risk-Declining. These species are in the Myrtaceae plant family which is at risk of infection by myrtle rust (*Austropuccinia psidii*), a potentially devastating fungal disease which arrived in New Zealand in May 2017 and has no known treatment. Along with other species in the Myrtaceae family (including all species of rātā) the threat status of these species has been elevated as a precautionary measure based on the potential threat posed by myrtle rust. However, these species are otherwise common and widespread in the local environment.

A small population of *Christella* aff. *dentata* ("thermal") (At Risk-Naturally Uncommon) has previously been recorded on the true left side of the Waikato River, south of the confluence with the Hall of Fame Stream (Wildland Consultants 2014b). In New Zealand this fern species is generally restricted to frost-free areas with warmer climates such as Northland and Raoul Island. However, it survives at geothermal sites because of its ability to tolerate elevated soil temperatures.

8. FAUNA

8.1 Avifauna

Six indigenous and two introduced bird species were recorded during the site visits (Appendix 2). None of these birds are classified as Threatened or At Risk on a national-level (Robertson *et al.* 2017). They are considered to be common birds of secondary forest and riverside habitats.

Other birds which have been recorded at Huka Falls since 2017 are listed in Table 4. One of these species is a bird of terrestrial habitats which has a national-level threat classification of At Risk: pōpokatea (whitehead; At Risk-Declining). Four of these species favour freshwater habitats and have a national-level threat classification of At Risk: Australasian coot, little black shag, black shag (all At Risk-Naturally Uncommon), and pied shag (At Risk-Recovering).

In addition, kārearea/bush falcon (*Falco novaeseelandiae* "bush"; At Risk-Recovering) have been recorded on Lake Taupō foreshore (recorded on 22 October 2018, eBird https://ebird.org/hotspot/L4787356 accessed on 25 July 2019) and are likely to utilise habitats within the site from time to time.

Table 4: Birds recorded at Huka Falls between October 2017 and April 2019. Source: eBird[1].

Common Name	Scientific Name
Indigenous	
Australasian coot	*Fulica atra australis*
Black shag, kawau	*Phalacrocorax carbo novaehollandiae*
Kāhu, swamp harrier	*Circus approximans*
Little black shag	*Phalacrocorax sulcirostris*
Little shag	*Phalacrocorax melanoleucos brevirostris*
Miromiro, pied tomtit	*Petroica macrocephala toitoi*
New Zealand scaup, pāpango	*Aythya novaeseelandiae*
Paradise shelduck, pūtangitangi	*Tadorna variegata*
Pied shag	*Phalacrocorax varius varius*
Pōpokatea, whitehead	*Mohoua albicilla*
Shining cuckoo, pīpīwharauroa	*Chrysococcyx lucidus lucidus*
Spur-wing plover	*Vanellus miles novaehollandiae*
Warou, welcome swallow	*Hirundo neoxena neoxena*
White-faced heron	*Egretta novaehollandiae*
Exotic	
Californian quail	*Callipepla californica bunnescens*
Chaffinch	*Fringilla coelebs*
Common starling	*Sturnus vulgaris*
Dunnock	*Prunella modularis*
Goldfinch	*Carduelis carduelis*
Greenfinch	*Carduelis chloris*
Mallard	*Anas platyrhynchos*
Myna	*Acridotheres tristis*
Song thrush	*Turdus philomelos*
Yellowhammer	*Emberiza citrinella*

[1] Accessed on 25 July 2019 https://ebird.org/hotspot/L4046325.

8.2 Bats

It is highly likely that long-tailed bats (pekapeka; Threatened-Nationally Critical) utilise this site for roosting, foraging, and commuting. This is because long-tailed bats have been recorded in several locations nearby and in similar habitats. Long-tailed bats have been recorded near Wairakei Village (Smith *et al.* 2017) which is about four kilometres from the site at Huka Falls and in Tauhara Forest (Borkin and Parsons 2010) which is about nine kilometres from the site. The home range span of long-tailed bats is up to 19 kilometres (O'Donnell 2001).

Long-tailed bats utilise crevices and cavities in large trees or flaky tree bark for roosting (Sedgeley and O'Donnell 1999). They also roost in holes in dead standing trees (ibid.). Trees at the proposed site of the tour are suitable for bat roosts.

8.3 Herpetofauna

No reptiles or amphibians were observed during the site visit.

There are no recent records within 10 kilometres of this site in the Department of Conservation Bioweb herpetofauna database (Department of Conservation Bioweb herpetofauna database, accessed on 16 January 2019). Speckled skink (*Oligosoma infrapunctatum*; At Risk-Declining as per Hitchmough *et al.* 2016) was recorded near Wairakei Village in 1993 ((Department of Conservation Bioweb herpetofauna database, accessed on 16 January 2019). Auckland green gecko (*Naultinus elegans*; At Risk Declining) and forest gecko (*Mokopirirakau granulatus*; At Risk Declining) were recorded within 10 kilometres of the site of the proposed tour in about 1965 and 1930.

Understorey habitats (such as rocks and fallen branches) and leaf litter at the site may be suitable for terrestrial skink species. However, lizard populations are often in low densities in mainland New Zealand due to predation pressure and habitat modification. Indigenous lizards are highly cryptic and can be particularly difficult to find when in low numbers.

8.4 Aquatic fauna

Indigenous freshwater fish species recorded at Lake Aratiatia and likely to utilise the Waikato River below Huka Falls include longfin eel (*Anguilla dieffenbachii*; At Risk-Declining as per Dunn *et al.* 2018), shortfin eel (*Anguilla australis*), common bully (*Gobiomorphus cotidianus*), and common smelt (*Retropinna retropinna*)[1].

Exotic fish species recorded at Lake Aratiatia and likely to utilise the Waikato River below Huka Falls include brown bullhead catfish (*Ameiurus nebulosus*), rainbow trout, and goldfish[1].

[1] NZ Freshwater Fish Database (https://nzffdms.niwa.co.nz/), accessed July 2019.

Indigenous freshwater invertebrates including kōura (freshwater crayfish, *Paranephrops planifrons*) and freshwater shrimp (*Paratya* spp.) have also been recorded in this section of the Waikato River[1].

8.5 Pest animals

Possum (*Trichosurus vulpecula*) browse sign was noted during the site visit. The typical mainland suit of pest animals will be present within the site, including rats (*Rattus norvegicus* and *R. rattus*), mustelids (*Mustela* spp.), hedgehogs (*Erinaceus europaeus*), and feral cats (*Felis catus*). These species are all known to eat birds' eggs, and most will also kill chicks and adult birds.

Possums can also alter vegetation composition by heavily browsing favoured food trees, disrupting vital ecological processes such as flowering, fruiting, seed dispersal and germination, competing with indigenous wildlife for food. Possums also eat lizards and invertebrates.

9. ECOLOGICAL VALUES

The site of the proposed tour is of moderate to high ecological value. The vegetation present is predominantly secondary indigenous forest with a variable canopy of kōhūhū, kānuka, whauwhaupaku, whekī, and tī kōuka. Three indigenous vascular plants which have a national-level threat classification are present. Although there are patches of blackberry vineland and pest plants (most notably wilding pines and grey willow), indigenous vegetation has been regenerating at this site for quite some time and has developed a good quality forest canopy with young emergent podocarps (kahikatea, tōtara, and rimu) present in places. Secondary indigenous vegetation such as this is particularly significant in Atiamuri Ecological District because there is less than seven percent of the pre-human indigenous vegetation cover remaining (Leathwick *et al.* 1995).

The site also provides good habitat for indigenous birds (including some nationally At Risk species) and nationally threatened long-tailed bats. Indigenous freshwater fish (including a nationally At Risk species) and invertebrates utilise the section of river within the site. Indigenous lizards and reptiles have not been recorded at this site and if present are likely to be present in very low numbers. The location of the site alongside the Waikato River means that it is an important corridor for the movement of indigenous fauna throughout the wider landscape.

10. POTENTIAL ECOLOGICAL EFFECTS

10.1 Overview

Potential adverse ecological effects of the proposed operation relate to vegetation clearance, construction of walking tracks, construction of launching and landing structures, installation of zip lines, noise disturbance, and potential disturbance of fauna, each of which is discussed below.

10.2 Loss and damage of vegetation

10.2.1 Clearance for platforms and towers

The landing and launching structures have been designed with the intention of minimising the footprint on the landscape. However, some vegetation clearance will be required for construction of the platforms and towers, with the footprint of each structure to be approximately five metres by five metres. Additional staircases (of varying sizes) will be built for access to all structures. The height of the proposed structures varies from *c.*1.2-13.6 metres above ground level. The zip lines will pass above the structures at *c.*3.2-15.8 metres above ground level.

Towers 1, 7, and 8 are to be located in areas which are currently blackberry vineland. Although these areas would eventually regenerate to indigenous forest if left, they currently have low ecological value compared to the surrounding site. Vegetation clearance for construction of these towers will have less than minor ecological effects because this is an exotic-dominant habitat. In addition, the platforms of these towers will be more than five metres above ground level, so short indigenous vegetation may be able to regenerate underneath and surrounding the towers following construction.

Platforms 3, 4, and 6 are to be located in areas of modified secondary indigenous forest. Vegetation at the location of Platforms 3 and 4 is slightly younger than the surrounding forest because it has regenerated from the old forestry track. Vegetation at the location of Platform 6 is regenerating following a localised treefall. Exotic plants including Himalayan honeysuckle, blackberry, and Chinese privet are present at each of these three platform locations. Vegetation clearance for construction of these platforms will have minor ecological effects.

Vegetation clearance for Platform 5 would have minor ecological effects. This is because the patch of kiokio ferns at this location is of relatively young age compared to the surrounding forest. The lower level of Platform 5 will be about 0.8 metres above ground level which will allow for some regeneration of indigenous vegetation following construction. Some trimming of the surrounding indigenous trees may be required due to the height of this two-level platform (total height of about 11.6 metres).

Platform 2 is to be located within intact secondary indigenous forest. Ecological effects of vegetation clearance at this structure are likely to be greater than any of the other platforms and towers. Felling of small indigenous trees (including māhoe, whauwhaupaku, rangiora, whekī, kōhūhū) and clearance of indigenous understorey species is likely to be required in order to establish the foundations of the platform and construct the *c.*13 metre tall (total height) two-level platform. The lower level platform will be about 1.7 metres above ground level which will allow for some regeneration of indigenous vegetation following construction. Vegetation clearance for construction of Platform 2 will likely have moderate ecological effects.

10.2.2 Clearance for zip lines

The zip line will pass through the site at a variety of heights and over the structures at *c.*3.2-15.8 metres above ground level. As such, it is likely that the indigenous forest

canopy will be vulnerable to some degree of local disturbance. In places, selected individual trees and/or saplings may need to be trimmed to create an open gap that this large enough for users of the zip line to pass through. This will be required at the construction phase and potentially during regular maintenance. Excessive vegetation trimming may cause increased risk of localised windfall because of increased wind penetration into the forest canopy. Damage to indigenous vegetation, particularly larger indigenous trees is not only undesirable from an ecological standpoint, but also from an economic standpoint as these will be one of the main viewing attractions for users of the zip line.

It is unlikely that indigenous trees will need to be felled in order for the zip line to traverse through and above the forest canopy.

Zip line wire cables will be secured from the landing and launching structures into the ground using a combination of stay cables, staunchions, cable support units, and cable tension units. A relatively small area of vegetation clearance will be required for these anchors compared to the area of vegetation clearance required for construction of the platforms and towers.

The potential ecological effects of construction and maintenance of the zip line on vegetation are likely to be minor if damage to larger indigenous trees is avoided.

10.2.3 Clearance for tracks

Formation of the two sections of track (between Platforms 3 and 4 and between Platform 6 and Tower 7) will require some vegetation clearance. The track between Platforms 3 and 4 will be approximately 70 metres long. Two sections of track will be constructed between Platform 6 and Tower 7, firstly a 36 metre-long section from Platform 6, then a 189 metre-long section to Tower 7. Tracks will be approximately one metre wide.

It is likely that track construction will incorporate benching and use of wooden steps on sloping surfaces, drainage works, and hardening of track surfaces using pumice or gravel.

Clearance of vegetation for the track between Platforms 3 and 4 would have very minor ecological effects. This is there is because there is an old forestry track in this location. Vegetation on this hillside is secondary indigenous forest with sparse understorey vegetation. Felling of large indigenous trees should not be required.

Clearance of vegetation for the track between Platform 6 and Tower 7 would have minor ecological effects. This is because the secondary indigenous forest is relatively young and no large indigenous trees should require felling. Clearance of understorey vegetation will be required but the indigenous understorey species are widespread throughout the remainder of the site. Exotic species such as blackberry and Himalayan honeysuckle are present in places. The section of track on the hillslope and in the steep-sided erosion gully will require careful planning to prevent erosion.

A short section of track (5-10 metres long) may be required from Tower 8 to the existing track (Te Totara Gully Track). Less than minor ecological effects on

indigenous vegetation and habitats should result from construction of this track because no large indigenous trees should require felling and only common understorey plant species such as kiokio currently occur along this route.

10.2.4 Damage to tree roots

It is important that large lateral roots of indigenous trees are not severed during construction of the tracks and structures. If soil is excavated for construction, tree roots could be partially lost or damaged. Root loss or damage is likely to reduce nutrient and water uptake efficiency, and increase the vulnerability of a tree to wind throw, fungal pathogens, invertebrate damage (Ministry for Primary Industries 2013). Effects of root loss on tree health can be expected to be proportional to the area of the root system of a tree that is affected. Damage to tree roots could have major ecological effects, however with appropriate management, these effects can be reduced to minor.

10.2.5 Damage to adjoining vegetation

Equipment and materials required to build the structures and tracks will be carried in by foot or lowered into place by helicopter. In some cases, sections of the platforms and towers may be constructed offsite and lowered into place by helicopter.

Vegetation immediately adjacent to the proposed tracks and structures may be damaged by physical contact during construction or when construction materials are being transported. Any damage to the bark or branches of indigenous trees alongside the proposed track routes or structures may become a potential site for attack by fungal pathogens and/or insects. Such damage can also result in reduced nutrient and water uptake and loss of structural integrity (Ministry for Primary Industries 2013). Damage by physical contact may therefore lead to gradual declines in tree health and eventual tree death.

Trampling of understorey and groundcover vegetation by workers and machinery may also occur during construction of the tracks and structures. Damage to adjoining vegetation by physical contact and trampling could have moderate ecological effects, however with appropriate management, these effects can be reduced to less than minor.

10.3 Erosion and sedimentation

Removal of indigenous vegetation, and construction of the tracks, platforms, and towers has the potential to create erosion and sediment run-off during heavy rain events. Erosion is a particular risk along the upper sections of the proposed track to Tower 7 because there is already an erosion gully in this location.

The locations of the proposed platforms, towers, and tracks are generally some distance from waterways. The proposed location of Platform 5 is on top of a cliff, about 16 metres from the edge of the Waikato River. The location of Platform 6 is *c.*12 metres from the river and Tower 8 is *c.*17 metres from the river. It is unlikely that any sediment run-off from construction of the platforms and towers would adversely affect water quality in the Waikato River. There is a small ditch alongside

the proposed location of the track to Tower 7 near the existing Huka-Aratiatia Walkway. Construction of the track to Tower 7 alongside the ditch is unlikely to result in sediment loss because this is a relatively flat section of track.

Pumice or gravel will be used for the track surfaces. These materials occur naturally in the landscape and are likely to have less than minor ecological effects on waterways.

Erosion and sedimentation of waterways could have major ecological effects, however with appropriate management, these effects will be reduced to less than minor.

10.4 Effects on indigenous fauna

There is some likelihood, albeit limited, that birds, bats, lizards, and invertebrates using the site during the construction period will be subject to disturbance. Most birds and invertebrates that are potentially subject to disturbance are highly mobile and will be able to deal with localised disturbance. As such, it is expected that the potential displacement effects on birds and invertebrates will be less than minor.

It is highly likely that long-tailed bats utilise this site. For example, the flaking bark of kānuka and cavities in the large dead standing wilding pine trees provide habitat suitable for bat roosts. No large trees are to be felled, so no potential bat roosts will be affected or removed. There is potential, albeit slight, that long-tailed bats (if present) could be disturbed during installation of the zip line and associated structures, however, any potential effects on bats are very unlikely.

Indigenous skinks may utilise habitat at the locations of the proposed structures within the forest (Platforms 2, 3, 4, 5, 6, and Tower 8) and along the proposed track routes. Vegetation clearance associated with construction of these structures and tracks has the potential to disturb, or cause injury and/or mortality to indigenous lizards (skinks and geckos). Indigenous lizards are absolutely protected under the Wildlife Act (1953) which is administered by the Department of Conservation, and it is illegal to disturb or remove habitats of indigenous lizards without a Wildlife Authority Act issued by the Department. However, due to the lack of previous records of indigenous lizards at this site, the very localised nature of the structures, and the limited extent of new tracks, any potential effects on lizards are likely to be less than minor.

As discussed in Section 10.3, it is unlikely that any sediment run-off from construction will be in such levels that it will cause any degradation of the water quality in freshwater habitats of the Waikato River. With appropriate management the effects of erosion and sedimentation on aquatic fauna will be reduced to less than minor.

10.5 Increased human presence

Some noise and disturbance during the guided tours (and during construction) is expected. The tour is estimated to attract 40,000 to 60,000 participants per year (in groups of 10 people). Generally, a large number of people using a confined forest area may have effects on nesting and breeding of indigenous avifauna. However, the

Huka Falls Scenic Reserve is already a major tourist attraction, with more than 900,000 visitors per year (Department of Conservation 2002). Commercial jet boating and helicopter tours are undertaken to showcase the falls. There are existing walking and biking tracks on both sides of the river within this site. Any additional effects of noise disturbance on fauna within the site will likely be less than minor.

As the tour is intended to be guided by staff from Sky Play Adventures, participants are unlikely to venture off the tracks and into the wider forest. Trampling of understorey vegetation alongside the tracks is therefore likely to be minor.

There is potential for participants to accidentally drop litter or spread propagules of pest plants within the forest during the tour. Litter dropped along the track will detract from the natural values of the site.

If managed appropriately, the overall effects of increased human presence within the proposed tour route should be less than minor.

11. OPTIONS TO AVOID OR MINIMISE POTENTIALLY ADVERSE ECOLOGICAL EFFECTS

11.1 Overall intent

A major focus for construction and operation of the guided zip line tour should be to avoid or minimise adverse effects. This is because of the moderate to high ecological value secondary indigenous forest and habitats present alongside the Waikato River and within the Huka Falls Scenic Reserve. It will also be important to preserve the natural environment and ecological features for tour participants to enjoy.

The completed project should - with the noticeable exceptions of the formed walking tracks, platforms, towers, and zip line - look like a natural secondary forest ecosystem (allowing six months or so for the groundcover to recover following track construction).

Avoidance and minimisation of potential adverse ecological effects are addressed below.

11.2 Construction of zip line structures

Actions which should be undertaken to avoid and minimise ecological effects associated with vegetation clearance during the construction of the platforms and towers, and installation of the zip lines are outlined below:

- Clearance and trimming of large trees (particularly any indigenous trees over *c.*30 cm diameter at breast height (1.35 metres above ground level, dbh)) should be avoided. Where required, vegetation clearance should be limited to the immediate location of the platforms, towers, and zip line.

- Physical contact with indigenous trees (large branches, and trunks in particular) should be avoided when construction materials and tools are being transported and during construction.
- Defined low impact routes and helicopters should be used for carrying in construction materials and tools to reduce the area of understorey vegetation which is trampled.
- Where possible, indigenous understorey seedlings within proposed platform and tower locations should be removed carefully and then used for site rehabilitation.
- The proposed locations of platforms and towers should be assessed by a suitably experienced engineer, to ensure that the sites are stable and suitable for the proposed structures, and to avoid sediment loss during construction.
- Soil disturbance and erosion during construction should be avoided as much as possible. This is particularly important at Platform 5.
- Damage to roots of indigenous trees adjacent to the structures should be avoided.
- Materials used for platform and tower construction should be suited to the environmental conditions present. Options for platform and tower materials include treated timbers (dried well prior to use), steel, hardwood timbers, fibreglass, and glass.

Actions which should be undertaken following construction include (as required):

- Restoration of all natural drainage patterns.
- Restoration of natural ground surface.
- Restoration of natural soil, including a humus layer.
- Replacement of indigenous groundcover plants.
- Any vegetation trimming that is required for maintenance should be minimised and undertaken with care to avoid damaging indigenous trees (particularly any indigenous trees over *c.*30 cm dbh).

11.3 Construction of tracks

Actions which should be undertaken to avoid and minimise ecological issues associated with vegetation clearance in during track construction are provided below:

- Walking tracks should follow a path of 'least resistance' so that the clearance of indigenous trees can be avoided.
- Clearance or trimming of large indigenous trees (particularly any indigenous trees over *c.*30 cm dbh) should be avoided.
- Clearance should be limited to the width of the track (approximately 1 metre wide) and narrow shoulders which are no wider than required.

- Physical contact with indigenous trees (large branches, and trunks in particular) should be avoided when construction materials are being transported and during construction.
- Defined low impact routes and helicopters should be used for carrying in construction materials and tools to reduce the area of understorey vegetation which is trampled.
- Where possible, indigenous understorey seedlings within proposed track route should be removed carefully and then used for site rehabilitation.
- No large lateral roots of any indigenous tree should be cut or damaged.
- Soil compaction should be avoided as much as possible.
- Only 'clean' pumice or 'clean' gravel should be used, which is free of pest plant propagules and pest animals (such as plague skink (*Lampropholis delicata*). Any stockpiles of pumice, gravel, and/or cement should be stored securely prior to use in track construction, to prevent leakage onto the forest floor, or into waterways.
- Trees should not be marked with attachments that could result in bark damage (biodegradable flagging tape can be used to mark proposed track routes and removed when construction is completed).
- Track construction should avoid, as much as possible, alteration of the natural drainage patterns and natural ground surface levels. The creation of small impoundments should be avoided. The section of track in the steep-sided erosion gully below Tower 7 will require careful planning of track drainage to prevent erosion. Sedimentation of the ditch near the existing track (Huka-Aratiatia Walkway) and alongside the track to Tower 7 should be avoided.
- Participants should be constrained to the formal tracks and defined gathering points, to avoid ongoing incremental trampling damage to the forest floor.
- To limit use by the general public, any unformed routes should not be obvious from the existing tracks.

Actions to be undertaken following track construction include (as required):

- Restoration of all natural drainage patterns.
- Restoration of natural ground surface.
- Restoration of natural soil, including a humus layer.
- Replacement of indigenous groundcover plants.
- Removal of all markings and unnecessary artificial objects.
- Any vegetation trimming required for maintenance should be kept to a minimum and undertaken with care to avoid damaging indigenous trees (particularly any indigenous trees over *c.*30 cm dbh).

- Any large lateral roots of indigenous trees which become exposed on the tracks should be reburied.

11.4 Avoid and minimise effects on indigenous fauna

Actions which should be undertaken to avoid and minimise ecological effects on indigenous fauna include those described in the previous sections (such as minimizing vegetation clearance). Additional actions are described below:

Birds and Terrestrial Invertebrates

During construction, noise levels should be kept to a minimum, to avoid disturbance of avifauna.

Where possible, an indigenous forest canopy should be maintained above and around the structures and tracks to enable avifauna to be able to continue to move throughout the site.

Upon completion of the proposed tracks leaf litter will spread naturally over the track surfaces. This will improve the opportunities for terrestrial invertebrates to move across the trail. Soil invertebrates which are exposed during excavation should be relocated with the soil they were exposed within, into the surrounding vegetation.

Bats

No larger trees (including exotic trees such as wilding pines) should be felled as such trees provide suitable habitat for bat roosts.

Herpetofauna

Reptiles and amphibians are unlikely to be adversely affected due to the low likelihood of them being encountered and also because of the local effects of the proposal.

Aquatic Fauna

Appropriate management of erosion and sedimentation (as discussed in Sections 12.2 and 12.3) will avoid potential effects on aquatic fauna in the Waikato River.

11.5 Management and education of participants

Low noise levels from participants and guides during the tour should be encouraged. This will enhance the ecological experience for visitors and also minimise noise disturbance to the forest environment.

Participants should be constrained to the platforms, towers, and tracks, to avoid ongoing incremental trampling of understorey vegetation and compaction of soil adjacent to structures and tracks.

The importance of caring for the environment, ecological restoration and biosecurity should be actively promoted to participants. Education about pest animals and pest plants, and their control should be incorporated into track signage, promotional material, and the speeches of guides during the tour. Opportunities for participants to engage in activities such as Greening Taupō and Predator Free New Zealand should be explained. The introduction of species of fungi, bacteria, or plants and animals which do not occur naturally in indigenous forests can pose serious risks to natural ecosystems. All equipment used on the tour (clothing, footwear, or bags) should be free from plant seeds, plant fragments, pest animals, or excessive dirt. It is important that participants are instructed to carry any litter with them out of the forest. Promotion of environmental care and biosecurity is particularly suited to these types of trails because it leads to an increased general awareness of these issues in the participants who will be from other parts of New Zealand and other countries.

12. MITIGATION AND ECOLOGICAL RESTORATION

12.1 Overview

If the potential adverse effects which have been identified are avoided or minimised (as per Section 12), the proposed tour will result in minor ecological effects, primarily associated with construction of the platforms, towers, and walking tracks. The ecological effects of construction and operation should be mitigated by undertaking activities that enhance the ecological integrity of the vegetation and habitats at the site.

Options for mitigation at the site are intensive sustained pest animal control, pest plant control, and restoration planting.

12.2 Pest animal control

Overall Intent

Possums and rats are likely to be the pest animals having the greatest impacts on indigenous animals and plants within the site. Long-term intensive control of introduced pest animals would improve habitat quality and enhance the populations of indigenous fauna within the site and the wider Waikato River corridor. It is viable to implement intensive sustained pest animal control throughout the entire site because of its relatively small size, elongated shape, and the presence of a network of existing tracks.

To maximise the effectiveness of pest animal control, a pest animal control plan should be developed for the site and pest control operations should be coordinated with Greening Taupō, Predator Free Taupō, the Department of Conservation, and any other relevant landowners and stakeholders. The plan should be revised after 3-5 years because the priorities for pest animal management and monitoring may change.

Pest Animal Control Network

A network of bait stations and/or kill traps would be suitable for the control of possums, rats, and mustelids.

For ease of access, it would be suitable to install pest animal control stations alongside Karetoto Road, existing tracks (Huka-Aratiatia Walkway, Ferguson's Track, Te Totara Gully, Te Totara Gut, Café Track), proposed tracks, and the farm margin on the eastern side of the river. Approximate lengths of various sections which could be used for pest animal control stations are provided in Table 5.

Table 5: Lengths of potential pest animal control lines.

Description of Section	Length (km)
Huka Falls bridge to State Highway 1 Taupō bypass bridge (Huka-Aratiatia Walkway, eastern side of river)	2.14
Farm margin on eastern side of the river	1.41
Huka Falls Bridge to Taupō Wake Park (western side of river: Te Totara Gully, Te Totara Gut, Café Track)	1.89
Ferguson's Track along Karetoto Road and along Te Totara Gut (western side of river)	1.18
Proposed tracks (eastern side of river: Platform 3 to Platform 4, and Platform 6 to Tower 7)	0.29
Total	**6.91**

A total of approximately seven kilometres of pest animal control lines could be established between the Huka Falls bridge and the State Highway 1 Taupō bypass bridge, including *c.*3.8 kilometres on the eastern side of the river and *c.*3.1 kilometres on the western side of the river. Additional pest animal control lines could be interspersed between these lines at a later date, if required.

Pest animal control stations should be at installed at least 10 metres from tracks to reduce the likelihood of unwanted interference.

Traps for possums (e.g. Sentinel, Trapinator, Goodnature A12) should be installed at *c.*100 metre intervals. If the full length of pest animal control lines described above was used, approximately 70 traps would be required at this spacing.

Rat control traps (DOC 200, Victor, and/or Goodnature A24 self-resetting traps) should be installed at *c.*50 metre intervals. Bait stations could also be installed on the same lines, for the control of rats and mice. If the full length of pest animal control lines described above was used, approximately 140 rat stations would be required at this spacing.

DOC 200 traps will also catch stoats. A small number of DOC 250 traps could also be used as these are suitable for ferrets (and will also catch stoats).

Cage traps should be used to control feral cats. This trapping method enables any pet cats caught incidentally to be returned to their owners.

Maintenance of Pest Animal Control Network

Reinvasion of possums and rats from the surrounding area is likely to be rapid and ongoing, so control would need to occur year-round.

Traps should be checked at least monthly, however fortnightly checks are required between September and March to align with the breeding season of birds, which is when the risk of predation is highest. All pest control should be undertaken by suitably trained, skilled, and experienced personnel. Appropriate information needs to be provided for public and visitors to the area, to advise them of the use of baits and/or traps.

Once a pest animal control network has been established and is being implemented consistently across the site, it would be appropriate to extend pest control into indigenous forest alongside the Waikato River (particularly within Huka Falls Scenic Reserve), both upstream and downstream.

Monitoring

Pest animal monitoring should be implemented prior to the establishment of pest animal control and then as required. A series of chewcards could be located along the pest animal control lines to monitor the presence of pest animals and tracking tunnels could be used for rodent monitoring. Results of this monitoring should be used to adapt the pest control methods in response to changes in the species of pests detected or relative abundances.

There would be merit in undertaking five-minute bird count monitoring in association with pest control. This could provide baseline data for regular long-term monitoring of the outcomes of pest control. Standardised methods should be followed, as per Hartley and Greene (2012). Data should be analysed to assess any changes in bird species diversity and numbers over time. Monitoring locations should be evenly spaced along the pest animal control lines and are close to areas of key habitat for birds of interest (such as river margins). Any other animals observed during the bird monitoring should be recorded.

It is important that bird monitoring is undertaken at approximately the same time of year because the behaviour and chance of recording some birds varies with the seasons.

Although not required at this stage, in the future, it may be desirable to survey for the presence of indigenous lizards or bats at specific locations within the site. Detection of these animal groups could add a feature to the tour and potentially lead to further work to enhance the populations.

12.3 Pest plant control and restoration planting

Overall Intent

Ongoing control of pest plants which are currently present within the site would enhance the ecological values and enhance the experience of tour participants.

A weed management and restoration planting plan for the site should be developed in coordination with Greening Taupō, the Department of Conservation, and any other relevant landowners and stakeholders. The plan should include identification of the key areas for weed control and areas to be planted, weed control and planting prescriptions, monitoring and maintenance.

The plan should be revised after 3-5 years because the priorities for pest plant control, restoration planting, and monitoring will change.

Once pest plant control and restoration planting has been established and implemented consistently across the site, it would be appropriate to extend pest plant control into indigenous forest alongside the Waikato River (particularly within Huka Falls Scenic Reserve) both upstream and downstream.

Key Priorities

Key areas which would currently benefit from weed control are the patches of blackberry vineland and willow treeland.

Following weed control, the patches of blackberry vineland will be suitable for planting with indigenous species. Overtime, indigenous vegetation would naturally regenerate within these areas, however restoration planting will speed up this process and provide some mitigation for the tour.

Removal of the stand of Tasmanian blackwood forest on the edge of Karetoto Road could be considered in discussion with the landowners. Some (or all) of these trees could potentially be harvested. Following removal of the exotic trees, this area could be restored to indigenous forest.

Locally-sourced species should be used for planting that are representative of vegetation within Huka Falls Scenic Reserve. Restoration planting should include a range of early and mid-successional species (such as kōhūhū, mānuka, and kānuka), which will establish a canopy cover relatively quickly. Later successional species (such as tōtara) should also be planted at the same time. These are slower-growing species which are longer-lived and will create a tall indigenous canopy. Ongoing maintenance (including infill planting) and pest plant control will be required in any areas of indigenous planting for at least three to five years, until a contiguous indigenous canopy has established.

Regular ongoing control of wilding pines should be continued throughout the site. Poison-standing methods are preferred rather than felling because of the potential for bat roosts in large wilding pine trees. Dismantling of large wilding pines may be required for Health and Safety reasons near tracks (to prevent fall of decaying branches). Inspection of any trees which are to be dismantled (and are greater than 15 cm dbh with cavities that may be suitable for bat roosts) will be required by a qualified and approved bat ecologist endorsed by the Department of Conservation prior to dismantling.

Monitoring and Follow-Up Control

The aim of monitoring should be to rapidly detect pest plant species and to implement control as required. This is easy to do if an experienced observer checks these sites on a three-monthly basis and provides advice on the required control response(s). Pest plant control is most effective if it is undertaken while infestations are small. Follow-up control should be undertaken of any pest plant species.

13. CONCLUSIONS

The proposed Huka Falls guided zip line operation will be located within secondary indigenous forest in Huka Falls Scenic Reserve (SNA 216) and on the opposite (true left) side of the Waikato River. Huka Falls, at the southern end of this site, is one of the most visited natural attractions in New Zealand[1] There are existing walking and biking tracks, and commercial activities such as jet boating. This site is of moderate to high ecological value and is an important corridor for the movement of indigenous fauna throughout the wider landscape. The cultural and ecological significance of the Waikato River, and in particular the Huka Falls, is a key reason for the location of the proposed tour.

The largest potential ecological effects of the operation will result from clearance and trimming of vegetation during the construction and maintenance of five platforms, three towers, zip lines, and associated walking tracks. There is potential for adverse ecological effects if any larger indigenous trees are cleared or damaged, or if erosion was to occur, although this is unlikely. Construction of the platforms, towers, zip lines, and tracks can be undertaken in a low-impact manner. If the potential adverse effects which have been identified are avoided or minimised, the overall adverse ecological effects of the proposed zip line river tour will be minor.

There is also considerable potential for ecological enhancement and for increasing participant awareness of the importance of ecological restoration and caring for the natural environment. Minor adverse ecological effects of the proposed operation can be reduced to less than minor through mitigation. Intensive sustained pest animal control, weed control, and restoration planting should be planned and implemented. These works have the potential to create net environmental gains through improvement of the ecological condition of the site and improved habitat for indigenous fauna. Ecological restoration at this site will complement previous and current work within the Waikato River Corridor, such as that undertaken by Greening Taupō. This work should be an integral part of the 'story' associated with the zip line tour.

[1] https://www.doc.govt.nz/parks-and-recreation/places-to-go/central-north-island/places/taupo-area/things-to-do/huka-falls-tracks/

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LIST OF VASCULAR PLANTS RECORDED AT THE SITE, 26 JUNE 2019

Key
P = planted (not naturally occurring at the site)

INDIGENOUS SPECIES

Gymnosperms

Dacrycarpus dacrydioides	kahikatea
Dacrydium cupressinum	rimu
Podocarpus totara var. *totara*	tōtara

Monocot. trees and shrubs

Cordyline australis	tī kōuka, cabbage tree

Dicot. trees and shrubs

Aristotelia serrata	makomako, wineberry
Brachyglottis repanda	rangiora
Coprosma robusta	karamū, kāramuramu
Coprosma tenuifolia	
Dodonaea viscosa	akeake (P)
Fuchsia excorticata	kōtukutuku, kōnini
Gaultheria antipoda	tāwiniwini, koropuka, takapo, taupuku
Geniostoma ligustrifolium var. *ligustrifolium*	hangehange
Hebe stricta var. *stricta*	koromiko, kōkōmuka
Hoheria sexstylosa	houhere, lacebark
Kunzea robusta	kānuka
Leptecophylla juniperina var. *juniperina*	prickly mingimingi
Leptospermum scoparium agg.	mānuka
Leucopogon fasciculatus	mingimingi
Melicytus lanceolatus	māhoe wao
Melicytus ramiflorus subsp. *ramiflorus*	māhoe
Olearia rani var. *colorata*	heketara
Pittosporum eugenioides	tarata; lemonwood
Pittosporum tenuifolium	kōhūhū, rautāhiri, rautāwhiri
Pseudopanax arboreus	whauwhaupaku, puahou, five finger
Pseudopanax crassifolius	horoeka, lancewood
Schefflera digitata	patē
Sophora tetraptera	kōwhai
Weinmannia racemosa	kāmahi

Dicot. lianes

Clematis paniculata	puawānanga
Muehlenbeckia australis	puka
Rubus schmidelioides var. *schmidelioides*	tātarāmoa, bush lawyer

Lycopods and psilopsids

Tmesipteris lanceolata	

Ferns

Adiantum cunninghamii	huruhuru tapairu, maidenhair fern
Asplenium bulbiferum	mouku, hen and chicken fern
Asplenium flaccidum	makawe, ngā makawe o Raukatauri
Asplenium oblongifolium	huruhuru whenua
Asplenium polyodon	petako
Austroblechnum lanceolatum	rereti, nini
Cyathea dealbata	ponga, silver fern
Dicksonia fibrosa	whekī-ponga, kurīpākā
Dicksonia squarrosa	whekī
Diplazium australe	
Histiopteris incisa	mātātā, water fern
Hymenophyllum sanguinolentum	piripiri, filmy fern
Microsorum pustulatum	kōwaowao, pāraharaha, hound's tongue fern
Parablechnum novae-zelandiae	kiokio
Pellaea rotundifolia	tarawera, button fern
Pneumatopteris pennigera	pākau
Polystichum silvaticum	
Polystichum wawranum	
Pteridium esculentum	rārahu, bracken
Pteris tremula	turawera, shaking brake
Pyrrosia eleagnifolia	leather-leaf fern

Grasses

Austroderia fulvida	toetoe
Poa anceps agg.	

Sedges

Carex geminata agg.	rautahi
Carex uncinata	kamu matau a Maui, kamu
Machaerina sinclairii	toetoe tūhara, pēpepe
Schoenus tendo	wīwī

Monocot. herbs (other than orchids, grasses, sedges, and rushes)

Astelia fragrans	kakaha
Dianella nigra	tūrutu
Phormium tenax	harakeke, flax

Composite herbs

Senecio bipinnatisectus	Australian fireweed

NATURALISED AND EXOTIC SPECIES

Gymnosperms

Pinus radiata	radiata pine

Dicot. trees and shrubs

Acacia melanoxylon	Tasmanian blackwood
Buddleja davidii	buddleia
Chamaecytisus palmensis	tree lucerne
Cotoneaster glaucophyllus	cotoneaster
Cytisus scoparius	broom
Erica lusitanica	Spanish heath
Leycesteria formosa	Himalayan honeysuckle
Ligustrum sinense	Chinese privet
Rubus sp. (*R. fruticosus* agg.)	blackberry
Salix cinerea	grey willow
Salix ×fragilis	crack willow
Teline monspessulana	Montpellier broom
Ulex europaeus	gorse

Grasses

Dactylis glomerata	cocksfoot

Composite herbs

Erigeron sumatrensis	broad-leaved fleabane
Mycelis muralis	wall lettuce

Dicot. herbs (other than composites)

Digitalis purpurea	foxglove

LIST OF AVIFAUNA RECORDED AT THE SITE, 26 JUNE 2019

BIRDS

Indigenous

Anthornis melanura melanura	korimako; makomako; bellbird
Gerygone igata	riroriro; grey warbler
Prosthemadera novaeseelandiae novaeseelandiae	tūī
Rhipidura fuliginosa placabilis	pīwakawaka; North Island fantail
Todiramphus sanctus vagans	kōtare sacred kingfisher; New Zealand kingfisher
Zosterops lateralis lateralis	silvereye; tauhou

Introduced

Passer domesticus	house sparrow
Turdus merula	Eurasian blackbird

ADDITIONAL SITE PHOTOGRAPHS



Plate A3.1: A steeper section of the track between Platforms 3 and 4, which may require steps. 26 June 2019.



Plate A3.2: View from Tower 8 towards Tower 7. 26 June 2019.



Plate A3.3: Location of Tower 8 (arrowed) in relation to the existing track (Te Totara Gully Track). 26 June 2019.



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