AUDIT OF TERRESTRIAL ECOLOGICAL ASSESSMENT FOR THE FIORDLAND LINK EXPERIENCE PROPOSED MONORAIL DEVELOPMENT

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1. INTRODUCTION

The Department of Conservation (DOC) has received a revised concession application from Riverstone Holdings Ltd (RHL) to construct and operate a monorail and mountain bike track between the Mavora Lakes Road and Te Anau Downs, including the construction of terminus facilities at both ends of the proposed monorail. The route of the monorail is similar to the route that was assessed by a previous Wildlands' audit (Wildland Consultants 2007), but the revised application now includes a mountain bike trail and permanent maintenance road that were not envisaged in the previous application. DOC commissioned Wildland Consultants Ltd to undertake a technical audit of the environmental impact assessment (EIA) which accompanied RHL's concession application. The audit is required to cover the following aspects of the application:

- biodiversity/fauna (avifauna, invertebrates, aquatic, lizards, bats);
- vegetation clearance, weeds, and biosecurity;
- landscape regeneration, as it relates to visual effects;
- all ecosystems (including wetlands, freshwater, and terrestrial) that are potentially affected in the area covered by the application;
- noise associated with both the construction and operational phases of the project;
- hydrological effects;
- waste disposal;
- any other risks to the Director General of Conservation associated with the above disciplines that may result from the application being granted.

As part of the concession application process, RHL engaged experts in engineering, ecology, noise, landscape, and monorail operation. Those experts prepared reports which form the basis of the applicant's EIA.

The audit process for the revised application had particular regard to the following points:

- Whether RHL and/or its consultants have used accepted processes, methodologies, and industry standards in the application, EIA, and additional reports.
- Whether the contents of the application, EIA, and additional reports are factually correct.
- Whether there are any information gaps or omissions in respect of the activities proposed on public conservation land.
- Whether the applicant has identified all potential effects of the activities proposed on public conservation land, and whether the measures proposed to avoid/remedy or mitigate adverse effects are appropriate.

The landscape, engineering, noise, aquatic ecology, and monorail operational aspects of the audit were subcontracted to experts from other consultancies (Morgan Pollard Associates Ltd, MWH (NZ) Ltd, Bel Acoustic Consulting Ltd, and Ryder Consulting Ltd). This report comprises the audit of information pertaining to terrestrial ecology.

2. PROJECT OVERVIEW

The concession application is for the construction, operation, and maintenance of a monorail which would run from the Mararoa River (near the Mavora Lakes Road) for approximately 29.5 km through the Snowdon Forest Conservation Area. A road would also be constructed parallel to the monorail, with spur roads for access to the monorail. The road will remain in use after monorail construction, for monorail maintenance and mountain biking. RHL have applied for a 200 m-wide corridor in which the monorail, road, and spur roads would be located. The monorail route would cross private land after leaving Snowdon Forest, but the mountain bike trail would diverge in the Henry Creek catchment, and be located mostly in parcels of conservation land en route to Te Anau Downs. RHL have also applied to construct terminus facilities at a marginal strip on the eastern side of the Mararoa River, and at Te Anau Downs, which is located within Fiordland National Park.

Within the Snowdon Forest Conservation Area, the monorail route passes through beech (*Nothofagus* spp.) forest and valley floor grasslands and wetlands, crossing the Kiwi Burn, Whitestone River, and Upukerora River along the way. In the Henry Creek catchment, the mountain bike route crosses areas of regenerating scrub, beech forest, and wetlands.

3. AUDIT METHODS

As part of the previous audit (Wildland Consultants 2007), a site inspection was undertaken on 13 December 2006, during which a selection of potentially affected sites along the proposed monorail route were traversed on foot and viewed from the air. An additional site inspection was made on foot during 17-18 February 2010, when the monorail route from the Mavora terminus to the Whitestone River was walked, with a return journey via the upper Whitestone and Kiwi Burn to assess comparative vegetation and habitats. These site inspections included discussions with RHL's consultants and DOC field staff. RHL's concession application and associated EIA and subsequent reports were then assessed. Liaison with experts in other disciplines of the audit was undertaken where there was potential for effects to propagate across different disciplines.

The audit primarily assesses the report on terrestrial ecology by Mitchell Partnerships Limited (MP report) which is contained within Appendix I of the applicant's EIA, and accompanies the concession application. Two further reports prepared by Mitchell Partnerships were also reviewed, one detailing the results of a spring survey, and the other describing the terrestrial ecology of the mountain bike route where it diverges from the monorail route. To aid comparison, these reports are assessed sequentially, and headings used in this report match those in the MP reports, with the relevant

section numbers used in those reports included in brackets at the end of each heading. Other parts of the EIA were referred to where additional information from other disciplines was required.

4. AUDIT OF TERRESTRIAL ECOLOGY REPORT

4.1 Ecological assessment (Section 3)

4.1.1 Assessment methods (Section 3.3)

4.1.1.1 Vegetation (Section 3.3.3)

Vegetation associations were surveyed along the route over seven days in May 2009, when there was snow on the ground. It is acknowledged in the MP report that this would have reduced the detectability of some plant species. In addition, plant species that die back in autumn (e.g. most orchids) would not have been visible in May 2009.

Seventy 10m × 10m plots were established in forest at approximately 300 m intervals along the monorail route. Plot locations were saved as waypoints. It would have been much better to have selected waypoints a priori and navigated to these, as subjective placement of plots would easily bias interpretation of plot data. It would also have been better to have located plots in proportion to the extent of different forest types along the route. Failure to observe these techniques means that it is difficult to assess how representative the plot data are with respect to the different forest types occurring along the route. Diameter at breast height (dbh) and tree density were recorded at only 36 of the 70 plots. It is unfortunate that dbh was only measured at a subset of plots, because dbh data are critical for estimating basal area and stand volume. Canopy height, vegetation strata, species composition, and ground cover were measured at each plot, but this information could have been efficiently gained from observations that did not require plots to be set up, freeing up time for dbh measurement at all plots. The EIA does not provide any information on the location of plots, or the type of forest in which they were located.

Additional information showing plot locations was supplied on request at a later date. Comparison of this plot location information against Figure 7 of the EIA indicates that the 36 plot locations at which dbh was measured appear somewhat representative of the different forest types along the route.

4.1.1.2 Avifauna (Section 3.3.2)

Information about the avifauna of the proposed monorail route available from RHL (Mitchell Partnerships 2009) is derived from two field surveys and a desktop assessment based on the 'Atlas of Bird Distribution in New Zealand, 1999-2004' by Robertson *et al*. (2007). The surveys were:

- a two-day assessment in March 1995 (Lee & Elliott 1995)
- a seven-day assessment carried out in May 2009 (Mitchell Partnerships 2009)

Much of the information from the surveys was of a presence/absence nature. However, the May 2009 survey involved 75 five-minute bird counts (5MBCs), providing some quantitative information. The results of the counts are presented as the proportion of counts in which a species occurred and the mean number of individuals per count, but there is no analysis relating to species conspicuousness in the various habitat types traversed by the proposed monorail route. Also, there is no combined listing of the species recorded during all surveys, thus the fact that white-faced heron, mallard and redpoll were recorded by Lee and Elliott (1995) is not evident in the summary report (Mitchell Partnerships 2009).

As indicated in the preliminary audit carried out by Wildland Consultants (2009), the bird surveys, having all been carried out in autumn, lack seasonal information about the birdlife. As a result, migratory species that may be present along the proposed monorail route only in the breeding season (spring and summer) would not have been detected during the surveys (e.g. cuckoos, banded dotterel, New Zealand pied oystercatcher). Also, some resident species become fairly inconspicuous when moulting in autumn (rarely call and remain in thick cover), which would affect their conspicuousness evident from the autumn 5MBCs. In order to overcome this deficiency, a further survey was carried out in Nov-Dec 2009 (Mitchell Partnerships 2010), and comments about the resultant information are given under heading 5.1.2.

4.1.1.3 Other fauna (Section 3.3.3)

Lizards

No field survey for lizards along the proposed monorail route is planned by RHL on the basis that lizards "are notoriously difficult to detect" and because the development along "narrow linear routes … will have limited effects on lizard habitat" (Mitchell Partnerships 2010). While forest-dwelling species can be difficult to detect, partly because of their sparse distribution and nocturnal habits, species in grassland, tussockland and shrubland habitats, especially those associated with stony soils along rivers and streams, in appropriate weather, can be quite numerous and visible. There are skilled herpetologists available that could carry out a survey at an appropriate time of year, and detection techniques are available, such as pit-fall traps, artificial cover objects and captures per hour of searching. Several new species have been added to the New Zealand checklist of lizards in the last 20 years (Jewell 2008, Hitchmough 2007), particularly from alpine and shrubland environments. Thus, it would be prudent to carry out a lizard survey of the proposed route, especially to check for "scarce or unique areas of lizard habitat" (Mitchell Partnerships 2009) along the route, and because much of it has not have been surveyed previously by herpetologists.

Bats

While no surveys for bats had been carried out along the proposed route prior to 2009, given the presence of both the short-tailed bat (*Mystacina tuberculata*) and long-tailed bat (*Chalinolobus tuberculatus*) in the nearby Eglinton Valley, this task was a priority during spring-summer 2009 (see 5.1.3).

Invertebrates

No invertebrate survey is proposed along the monorail route because RHL considers that the narrow linear strip of vegetation to be removed during the development will be from widely distributed vegetation types, and that the invertebrate species impacted are expected to be widely distributed (Mitchell Partnerships 2009). While this may be true, no information is provided to give confidence that this is in fact correct. That the taxonomy of many New Zealand invertebrate species is uncertain, and that there is a lack of knowledge about invertebrates in the area are not suitable reasons for not carrying out an invertebrate survey along the proposed route.

4.2 Vegetation (Section 4)

4.2.1 Overall route description (Section 4.2)

The general description of the vegetation along the route is accurate. It is noted that, since the survey was taken, the monorail route has been altered slightly at the bluff above the Upukerora River, and the revised route has not been surveyed. Four general vegetation types are described, and seven habitat types. Wetland vegetation types on the Mararoa River terraces and close to the monorail route in the vicinity of the 27-28 km points are not listed among these types.

4.2.2 Vegetation along the route (Section 4.3)

4.2.2.1 Introduction (Section 4.3.1)

Over 250 indigenous plant species were recorded during the site survey and in previous surveys (Lee & Elliot 1995; Boffa Miskell 2006), which is a high richness of species. These species are listed in Appendix 3 of the MP report, but are not attributed to the different surveys. As the Lee and Elliot (1995) survey included the Dunton Swamp wetland, which is not traversed by the current monorail alignment, the Appendix 3 list is almost certainly inflated by the inclusion of wetland species not present on the current route. The list also contains duplicate names for the same entity, for example *Ranunculus multiscapus* is the current name for plants previously known as *R. lappaceus*.

4.2.2.2 Mararoa-Kiwi Burn (Section 4.3.2)

The more detailed comprehensive descriptions of vegetation associations along the monorail route contain many inaccuracies, for example the first paragraph in this section refers to *Coprosma parviflora* and *C. ciliata*, but neither of these species are known from the monorail site (c.f. Jane 2005). *Acrothamnus colensoi* and *Leucopogon colensoi* are both described from terrace grasslands in this section, but these are new and old names respectively for the same species. *Astelia grandis* is described from the Kiwi Burn tussock grassland vegetation which, if correct, represents a distribution extension for this species. Hall's totara is described as *Podocarpus cunninghamii* but this is a synonym of *P. hallii*.

Red beech (*Nothofagus fusca*) is said to dominate the monorail alignment from the 2.5-3 km points, and occur as an isolated stand at 4.5 km, but these red beech stands

are not mapped in Figure 7. In the 9-9.5 km section, the text states that *'The route appears to avoid stands of large red beech trees which are scattered and very tall…'* which suggests that the authors are uncertain with respect to avoidance. Given the 200 m corridor applied for, it seems likely that some of these scattered and very tall red beech trees are within the corridor and will be potentially affected.

The threatened yellow mistletoe (*Alepis flavida*) is described as "…common in these forests (Boffa Miskell 2006) but was less frequently encountered in 2009". In fact, the 2009 survey only recorded one occurrence of this species along the entire route (Section 4.5.3 of the MP report).

4.2.2.3 Kiwi Burn to Whitestone Flats (Section 4.3.3)

Red beech forest is described as occupying most of the 6.9-9 km section of the route, making this one of the most important red beech stands along the monorail route. Yellow mistletoe was again described as being present based on Boffa Miskell (2006), but was not observed in the 2009 survey.

4.2.2.4 Whitestone Flats to Whitestone/Upukerora Saddle (Section 4.3.4)

A stand of red beech is described 'at the saddle', which presumably relates to the saddle east of Limestone Hill, but this is not mapped in Figure 7. Yellow mistletoe was again described as being present, based on Boffa Miskell (2006), but was not observed in the 2009 survey. During the 2010 site visit undertaken as part of this audit, yellow mistletoe was observed at several locations on the forest margin along this part of the monorail route.

Tree falls are described as common at the end of the 'finger' draining into the Whitestone River, which has relevance for monorail operation. During the audit site visit, a sizeable recent tree fall event was present at approximately 9.5 km, on the edge of the Whitestone flats.

4.2.2.5 Whitestone/Upukerora Saddle to Upukerora River (Section 4.3.5)

This section has a mismatch between the text description and topographic information. The section is said to start at the 17 km point, which according to the 'Route and terrain types' map in the Engineering report (Appendix E, sheet 30) is located 1 km further back from the saddle, beside the 'finger'. This error may be responsible for some of the earlier mismatches between the text of the vegetation descriptions and Figure 7. Boffa Miskell (2006) is cited for yellow mistletoe records but none were seen during the 2009 survey. On page 38, the MP report notes that stands of dense understorey shrubs are '… *generally away from the marked route*'. The marked route is a linear feature within the 200 m corridor applied for, meaning that values distributed away from the marked route, but within the corridor, could still potentially be affected.

4.2.2.6 Upukerora River to private property boundary (Section 4.3.6)

The route is said to pass near two wetland areas, but no description of these wetlands is supplied. Ecologically important stands of red beech are described, particularly

between the 26-27 km points, but this section does not correspond to red beech forest in Figure 7. This again suggests a 1 km mismatch. The forest understorey is said to be different from other areas, indicating a broad gradient in forest composition along the monorail route. This corresponds to the change from the Livingstone Ecological District (ED) to the Upukerora ED.

4.2.2.7 Te Anau Downs terminus area

Taupata (*Coprosma repens*) is described from beech forest at Te Anau Downs, but it is very unlikely that this coastal species would be present here. It is not naturally found in the southern South Island, and if present would be regarded as a non-local native species. Ecotonal lakes shore sedgeland and forest is described, and a diverse turf containing native plant species in the lawn surrounding the motel buildings.

4.2.3 Results of tree diameter and height surveys (Section 4.4)

Only one of the 36 vegetation plots had a red beech tree with diameter greater than 100 cm, suggesting that red beech forest was under-represented in vegetation plot locations, or that they were located in gaps within red beech forest.

Comparisons of stem density and basal area within this section are made against mountain beech forests from other (unspecified) locations in New Zealand. A very high basal area value (121.5 m^2/ha) was obtained from the monorail forest plots, which is much higher than the highest comparison cited (94 m^2/ha). It is difficult to interpret these comparisons because the forests along the monorail route contained a mixture of mountain beech, red beech, and mixed beech forest types, whereas the compared forests were of mountain beech.

The MP report considers that the small plot sizes used (10 × 10 m rather than 20 × 20 m) may have artificially inflated basal area values. There is insufficient information in the methods section to assess how trees occurring on the margins of plots were treated. If stems on the margins of plots were only measured when their centres occurred within the plot, then there should be no bias arising from the use of small plot sizes. If however tree stems were measured wherever they touched the plot, small plots would have artificially inflated basal areas, because they have a greater perimeter:area ratio than do larger plots. Small plots would be associated with more variable basal area values, and the large basal area range (43-336 m^2/ha) described from plots reflect this. This variation means that more plots would be needed to accurately represent the true mean value, and sampling error (not plot size, but where plots are located) would be more likely to affect the results. In this context, the 29.5 km long monorail route, with a 200 m wide corridor, would have an area of 590 ha, and the 36 10 × 10 m plots would comprise a total of 0.36 ha, or 0.06% of the corridor. That is a very small proportion of the application area, meaning that sampling error is likely to be important. The subjective location of plots compounds this issue.

4.2.4 Threatened plant surveys (Section 4.5)

The assessment of threatened and uncommon plant species potentially present along the monorail route is comprehensive, and draws on the results of previous surveys,

information from herbaria, and information from the New Zealand Plant Conservation Network. During the 2009 survey, only one individual of one of these species (yellow mistletoe) was recorded. This certainly under-represents the number and abundance of threatened plant species present along the route.

The MP report notes that Boffa Miskell (2006) reported the presence of yellow mistletoe, but the MP report authors are uncertain whether this information was taken from Lee and Elliott (1995) or from the April 2004 Boffa Miskell survey. There is no need to be uncertain as to the origin of the Boffa Miskell (2006) records of yellow mistletoe, as they describe its distribution along the monorail route in much more detail than do Lee and Elliott (1995). The Boffa Miskell (2006) records and the occurrences of yellow mistletoe noted during the audit site visit indicate that yellow mistletoe is more common along the route than the MP report suggests.

4.3 Fauna (Section 5)

4.3.1 Birds (Section 5.1)

The presence/absence of bird species along the proposed monorail route has been determined during field surveys (mainly March 1995 and May 2009), and from species' general distributions evident in Robertson *et al.* (2007). In addition, some quantitative information about species was recorded during the May 2009 survey by the five-minute bird count methodology (5MBCs).

4.3.1.1 May 2009 bird survey

As indicated earlier (Section 4.1.1.2), the information present in Table 6 of the Mitchell Partnerships (2009) report is only the threatened species recorded by Lee and Elliott (1995), and Table 7 details just those species recorded during the May 2009 survey plus a list of other species recorded in the general area from Robertson *et al*. (2007). Thus, three species (white-faced heron (*Ardea novaehollandiae*), mallard (*Anas platyrhynchos*), redpoll (*Carduelis flammea*)) listed in Lee and Elliott (1995) are not mentioned. Also, the threat ranking of four species in Table 7 has not been included: New Zealand pipit (*Anthus novaeseelandiae*) (At Risk-Declining), New Zealand pied oystercatcher (*Haematopus ostralegus*) (At Risk-Declining), pied stilt (*Himantopus himantopus*) (At Risk-Declining), and little shag (*Phalacrocorax melanoleucos*) (At Risk-Naturally Uncommon) (Miskelly *et al*. 2008). The list of bird species present and likely to be present along the monorail route seems comprehensive, with two other species, based on their distributions (Robertson *et al*. 2007), perhaps turning up as vagrants (kea, *Nestor notabilis*)) and/or in suitable wetlands (South Island fernbird, *Bowdleria punctata*).

As might be expected, 5MBCs indicated that the rifleman (*Acanthisitta chloris*), grey warbler (*Gerygone igata*), bellbird (*Anthornis melanura*), yellow-breasted tit (*Petroica m. macrocephala*) (not pied tit as indicated in the Mitchell Partnerships (2009) report), brown creeper (*Mohoua novaeseelandiae*), South Island robin (*Petroica australis*) and silvereye (*Zosterops lateralis*) were the species most frequently encountered in May. Results from 5MBCs during other seasons, especially spring and summer, are required to have confidence that these species are the most common along the route. That six other forest-dwelling species (yellow-crowned

parakeet (*Cyanoramphus auriceps*), New Zealand pigeon (*Hemiphaga novaeseelandiae*), yellowhead (*Mohoua ochrocephala*), kaka (*Nestor meridionalis*), tui (*Prosthemadera novaeseelandiae*) and falcon (*Falco novaeseelandiae*)) were infrequently recorded during 5MBCs and at other times during the May survey is in accord with their sparse to very sparse distribution through the region (Robertson *et al.* 2007).

It would have been useful if the GPS location of each 5MBC station had been provided in an appendix, and a figure of their locations provided in the report. An analysis of the May and November 2009 data in relation to vegetation type would have been useful to determine whether a particular bird species was encountered more often in particular vegetation type, for example the tall red beech forest.

No braided riverbed specialists (black-billed gull (*Larus bulleri*), black-fronted tern (*Sterna albostriata*), banded dotterel (*Charadrius bicinctus*) (not New Zealand dotterel (*Charadrius obscurus*) as suggested in the Mitchell Partnerships (2009) report), and New Zealand pied oystercatchers) were seen during the May survey. This is to be expected because most individuals desert the braided river environment at the end of the breeding season (by March, Heather & Robertson 2005), moving to coastal habitats. Further surveys during the breeding season (September-February) would be required to assess their use of braided riverbeds at crossing points of the proposed monorail.

4.3.1.2 Lizards (Section 5.2)

No lizards were seen during the two surveys in April 1995 and May 2009. Lee and Elliott (1995) mention eight species, four skinks and four geckos, which may be present along the proposed monorail route, while five species, three skinks and two geckos, are mentioned in the Mitchell Partnerships (2009) report. We suspect a fourth skink species has been omitted from Table 8, *Oligosoma maccanni*. The lack of lizard sightings can probably be put down to the lack of a herpetologist in the teams, that the surveys were carried out in autumn when temperatures may have been marginal for diurnal lizard activity, and the short duration (2 days) of the April 1995 survey. For these reasons lizard searches along the proposed monorail route in summer by a herpetologist is warranted.

4.3.1.3 Bats (Section 5.3)

See Section 5.1.3 for results of a bat survey undertaken during November 2009 along the route.

4.3.1.4 Invertebrates (Section 5.4)

No survey for invertebrates has been carried out along the route, and nor is one planned by RHL.

4.3.1.5 Introduced pests (Section 5.5)

A variety of introduced mammalian pest species or their sign were seen during the surveys, such as feral cat (*Felis catus*), red deer (*Cervus elaphus*), feral pig (*Sus*

scrofa), brushtail possum (*Trichosurus vulpecula*), hare (*Lepus europaeus*), rabbit (*Oryctolagus cuniculus*) and house mouse (*Mus musculus*). Other species not observed but considered likely to be present based on known species distributions include stoat (*Mustela erminea*), ferret (*Mustela furo*), weasel (*Mustela nivalis*), hedgehog (*Erinaceus europaeus*), ship rat (*Rattus rattus*) and Norway rat (*Rattus norvegicus*). We consider it unlikely that any other introduced mammalian pest species is present in the area.

4.4 Ecological values (Section 6)

4.4.1 Assessment of significance (Section 6.1)

The MP report states that the Southland District Plan does not identify criteria for the assessment of ecological significance, but this is incorrect. The Southland District Plan includes a rule (HER3) governing clearance of indigenous vegetation which does not meet permitted activity standards. HER3(5) describes the ecological matters that the Council will have regard to when considering discretionary consents for clearance of indigenous vegetation:

- (a) The significance of the affected indigenous vegetation or habitat of indigenous fauna in terms of ecological, intrinsic, cultural or amenity values, and the effects of the proposed activity on these values.

- (b) The representativeness of the affected indigenous vegetation or habitat of indigenous fauna and its relationship with other habitats or area of vegetation.

- (e) Whether the habitat and/or vegetation are important to indigenous species which are regionally rare or nationally threatened, and the effects of the proposed activity on these values.

- (f) Whether the area has been identified in Schedule 6.14 of this Plan or by the Protected Natural Areas Programme administered by the Department of Conservation.

The MP report then describes ecological significance criteria from the Southland Regional Policy Statement (RPS; which is currently being reviewed) and Norton and Roper-Lindsay (2004). The RPS criteria are very broad and do not contain sufficient definitions or thresholds to easily determine levels of ecological significance, while the Norton and Roper-Lindsay (2004) criteria, while used by some ecologists, have been discredited by others as having inappropriate qualifiers and overly high thresholds for significance (Denyer *et al.* 2005; Walker *et al.* 2008). A plan change incorporating criteria based on those of Norton and Roper-Lindsay (2004) was recently rejected in Buller District. Public conservation land is often defined as significant in Regional and District Plans, purely on the basis of its protected status.

4.4.2 Ecological values along the 29.5 km route (Section 6.2)

This section of the MP report includes a lengthy discussion of representativeness that does not meaningfully address this criterion. The MP report cites Norton and Roper-

Lindsay (2004), who defined representativeness in terms of extent, but this is not supported. The representativeness criterion aims to identify (and protect) sites that have good quality examples of typical vegetation types. In our view, most of the forest vegetation along the monorail route can be regarded as having high value for representativeness, with a lower representativeness value for forest margin areas affected by stock grazing. Wetlands surrounded by indigenous forest would also have a high value for representativeness. Valley floor shrubland, grassland and wetland systems have been more modified than the forest vegetation, but clearly have higher representativeness values than those of nearby valley floors such as in the Eglinton Valley, which have been more heavily modified by stock.

The MP report states that the Land Environments of New Zealand (LENZ) database is useful in assessing representativeness of land environments and the degree to which each type is protected. This illustrates a fundamental lack of understanding of LENZ, which is a one-off model based on climate, soil, and topography, and contains no vegetation or ecosystem type information. Table 10 of the MP report describes the extent to which indigenous cover remains and is protected on LENZ environments, but this information from the Threatened Environment Classification (TEC; Walker *et al.* 2007) does not address representativeness, as it contains no measure of the quality of vegetation types, only the extent and legal protection of broad land cover classes. This information does provide useful context however, and the MP report identifies that the monorail route crosses land environment L1.1c, which is classed as 'Chronically Threatened', with less than 20% indigenous cover remaining, and less than 10% of indigenous cover protected. The MP report does not identify that the monorail route also crosses the 'Underprotected' land environment Q4.1c, which has less than 20% of its indigenous cover protected.

The MP report states that, with respect to land environments Q1.1d and M2.3b, 'The extent of these environments did not change between 1996 and 2001'. This again indicates a poor understanding of LENZ. The extent of land environments is dictated by an algorithm involving climate, soil, and landform. There can be no change to the extent of these land environments unless the algorithm itself is changed. It seems likely that the MP report authors are referring to the coarse assessment of land cover changes between 1997 and 2002, which was undertaken as part of the Threatened Environment Classification (Walker *et al.* 2007).

The MP report describes and illustrates an assessment of land cover along the monorail route, from the Land Cover Database Version 2 (LCDB2). The level of detail provided by this analysis is considerably less than that provided in the earlier vegetation descriptions, and its inclusion here has little merit.

The MP report describes distinctiveness as supporting indigenous species or an association of indigenous species which is unusual or rare in the ecological district, or endemic, or at the natural limits of its distribution. Other attributes, such as unusual landforms, habitats, and ecosystems, are also generally considered to be distinctive. The recently-developed classification of 'historically rare' ecosystems (Williams *et al.* 2007) documents distinctive ecosystem types on a national basis. The Norton and Roper-Lindsay (2004) criteria combine rarity with distinctiveness, but this is not normally done. The MP report describes the red tussock grasslands in the Kiwi Burn and Mararoa River as distinctive on the grounds of now being rare in the region, but

this muddles rarity with distinctiveness. Red tussock grasslands would have been a typical feature in disturbed riparian sites and on poorly-drained valley floors within the ecological districts through which the monorail passes, and as such are more properly addressed under representativeness. Distinctive ecosystems in the vicinity of the monorail corridor include bog pine (*Halocarpus bidwillii*)-mountain toatoa (*Phyllocladus alpinus*) shrublands, limestone land forms such as Limestone Hill, and possibly some wetland types. Historically rare ecosystems in the area include braided riverbeds, strongly leached terraces and plains, lake margins, tarns, and seepages and flushes.

The assessment of distinctiveness mostly concerns rarity, and has not addressed local endemics or unusual species within ecological districts, or species at their distribution limits. It is unlikely that there are any plant species that are endemic to the Livingstone and Upukerora EDs, but it is probable that there are unusual species, and possible that distribution limits occur.

Ecological context is defined appropriately. The site is regarded as mostly intact, and supporting important habitats of indigenous fauna. The site is assessed as being sustainable (an arguable criterion), which implies that ecological functions are operating at a relatively intact level. We would assess the site as having very high value for ecological context on the basis of these factors.

4.4.3 Significant habitats along the 29.5 km route (Section 6.3)

The MP report describes six important habitat types identified by Boffa Miskell (2006), and three additional types: low elevation wetlands, old growth matagouri shrubland, and bog pine shrublands. The assessment of these important habitat types is supported.

4.4.4 Ecological values and habitat quality at Te Anau Downs (Section 6.4)

The MP report describes the ecological values of the forest and lakeshore vegetation as being high, which is supported. No assessment is made of indigenous turf vegetation in the mown grassland areas, previously described in Section 4.7 of the MP report.

4.5 Construction and operation of the monorail: activities and effects (Section 7)

4.5.1 Consideration of construction constraints (Section 7.1)

Information from the engineering report (Appendix E) is addressed in this section of the audit report, in addition to information from the terrestrial ecology report.

Two construction approaches were considered, one with a single corridor for the monorail and construction track, and the other keeping these two facilities separate, with occasional connecting spur roads. The MP report considers that separation of monorail and construction track is the preferred option, as it minimises the width of vegetation clearance in any one location, and allows reinstatement of the ground on either side of the monorail to provide a natural appearance for monorail passengers.

In addition, the 3 m wide construction track can be located more flexibly if it is not constrained to the 4-6 m wide monorail corridor. It is anticipated that spur roads would be required every 200-300 m. Some will be retained after construction, for emergency access to the monorail corridor.

The preferred option is associated with a greater area of clearance of ground and understorey vegetation, but on flat or gently-sloping terrain is likely reduce canopy gap size and duration. On side slopes, there is potential for the construction track, spur roads, and monorail to have cumulative effects on the forest canopy, because the construction track will be closer to the monorail (20-30 m), there will be less flexibility as to track and monorail routes, and there will be greater potential for instability of cleared areas. As a detailed monorail route plan has not been prepared, and detailed geotechnical investigations have not been undertaken, the effects of this are uncertain.

The monorail track will be a concrete beam approximately 1 m deep, which will be placed on piers of varying height according to topography. The monorail will straddle the beam, and be from 2.4-3.7 m tall. Maximum pier height will be 5 m on side slopes, but the monorail beam will be close to the ground in some places. The monorail corridor will require clearance of all vegetation within and overhanging the route, to a minimum height of 12 m above ground level. Minimum cleared areas in forest will be 4-5 m wide between piers, and 6 m wide at piers, but additional vegetation will need to be removed if there is an appreciable risk of branches falling on the rail, including 'at risk' trees beyond the minimum clearance corridor.

4.5.2 Activities (Section 7.2)

Laydown areas, fuel storage, stockpiles, maintenance facilities, vehicle wash-down areas, and staff facilities will be located on private land and, as such, are beyond the scope of this report.

Activities on conservation land include:

- Clearance of vegetation within the monorail corridor and along the construction track and spur roads.
- Removal and stockpiling of soil and possibly leaf litter.
- Removal of woody debris and felled trees from the cleared areas.
- Excavation of holes for pier foundations every 20 m.
- Placement of the monorail beam on the piers.
- Reinstatement of the ground contour around each pier after construction.
- Rehabilitation of cleared areas along the monorail route using stockpiled soil, litter, and planting.
- Visual disguising of spur roads using leaf litter, branches, and planting.
- Construction of terminals at each end of the monorail route.
- Construction of piers and bridges across streams and rivers.
- Ongoing vegetation trimming and clearance.

Almost half (14.3 km) of the monorail route will be constructed on side slopes, predominantly in forest, with 3.3 km on swampy ground. In total, 22.9 km of the route passes through forest, and 6.7 km through open grassland, wetland, or riverbed.

4.5.3 Vegetation clearance along the monorail and construction track routes (Section 7.3.1)

The MP report indicates that just over 26 ha of vegetation will be cleared if the dual track construction option is chosen, comprising 22 ha of forest and 4 ha of grassland. This is based on 3 m widths for the construction track and spur roads but these widths do not appear to incorporate drainage channels and batters. Similarly, the monorail is said to have a 3 m width in grassland, but this does not appear to include drainage and batter requirements. No allowance has been made for greater areas of clearance at intersections between the spur roads and the construction track or monorail, although this seems inevitable. The monorail is, however, given a 6 m width through forest, which may over-estimate the area cleared, because the engineering report indicates a 4-5 m clearance width between piers.

No allowance has been made for modification of areas outside the minimum clearance areas. This assumes that all felled trees will be felled without causing any damage outside the monorail route, and that no excavated soil along the monorail route will be placed outside it. Neither of these scenarios seem practicable, and they have not been sufficiently assessed in either the terrestrial ecology or engineering reports.

The number and diameter of trees that would need to be removed is based on the vegetation plot data, which as described in Section 4.2.3 of this report, should be interpreted very cautiously. The figures for tree removal given include reference to 76 very large trees (>1 m diameter) that may need to be removed if they cannot be avoided. There is uncertainty as to how many trees will need to be removed, due to poor reliability of vegetation plot data, the lack of a detailed design for the monorail, no mapping of significant trees along the route, and potential for tree removal and damage to trees outside the 'minimum' cleared areas.

The MP report considers that the tree removal figures given over-estimate the actual number of trees that will need to be removed, and that a worst case scenario would involve just under 20,000 trees being removed. This conclusion is not supported due to the uncertainties described above. This uncertainty also applies to the calculations of wood volumes.

Chainsaws will be used to fell trees and excavators used to move felled trees. The MP report states that most trees will be moved a short distance into the surrounding forest and left to decompose. It is proposed to manage this process carefully, to avoid damage to the surrounding forest other than what would be incurred laying down the felled material. The MP report notes that collateral damage to standing trees outside the minimum clearance area may occur, and that if it occurs, the damaged trees may be removed or trimmed. Similarly, trees may be removed where monorail or road construction damages the roots of adjacent trees. In our opinion, it is highly likely that tree felling and removal will cause significant damage outside the minimum clearance areas. Tree crowns will often be of greater width than the minimum clearance area, it will be difficult to constrain all tree fall within it, and construction

activities will affect the roots of trees adjacent to the minimum clearance area. Additional damage would be caused by moving felled trees into the surrounding forest. The potential for additional damage from tree-felling operations has been significantly under-estimated in the MP report.

The MP report anticipates that removal of trees along the monorail route will open up a patchily linear canopy gap, but that a continuous canopy gap is unlikely to be formed along the construction and spur tracks. On this basis, the MP report considers canopy gap creation only in respect of the monorail route. This premise may be appropriate in flat and gently-sloping forest where the construction track will be approximately 80 m distant from the monorail. However cumulative effects of the construction track, spur tracks, and monorail are likely to occur on the forest canopy on side slopes where the construction track is relatively close to the monorail, and where junctions of the spur track and construction track and monorail are present. In these locations, canopy gaps from road and monorail construction may coincide, or be separated by narrow ribbons of standing forest that are exposed to wind and susceptible to tree fall, and thus open a larger gap in future. The MP report does not consider the effects of the passing bays that will be incorporated into junctions with the spur tracks. The effects of removal of adjacent trees due to collateral damage is not assessed, but would also increase canopy gap size. We consider that the MP report significantly under-estimates the potential for creation of large canopy gaps along the route.

The MP report notes that the width of canopy opened along the route can be expected to vary, and that the risk of further tree fall may be greater in some areas than others. Felling of large trees with few neighbours will create large canopy gaps compared to felling small trees with many neighbours. The MP report does not attempt to quantify the extent of canopy opening except for a 'patchily linear canopy gap' being opened along the monorail corridor. The MP report recognises that canopy gaps are likely to fill in over time, due to the extension of adjacent tree crowns, and this is supported on stable terrain where canopy gaps are not too large, but it may not occur on sideslopes and where large canopy gaps are formed.

The MP report notes that clearance widths have not appreciably increased over time where the Te Anau-Milford road passes through beech forest. Recent observations of this road corridor suggest this is correct, and that the growth of adjacent tree crowns has largely filled in the canopy, at least where the road passes through flat or gently-sloping terrain. Where the road crosses side slopes in steep terrain however, land above the road has generally been cleared of trees, opening a larger gap. Recent tree falls on to the road have occurred and been cleared away in many places, but most of these instances did not involve trees on the road margins, but those occurring further back. These tree falls have occurred despite the annual inspection and removal of unsafe trees and limbs.

The MP report notes that fallen trees were seen in several locations but that these were generally restricted to unstable ground (wet soil or steep stream banks) and to exposed forest edges. During the audit site visit, treefalls were noted in many other locations, particularly on moderately-steep side slopes. The engineering report notes a large amount of recent treefall at the site, caused by wet ground, snow, and wind.

We consider that there is potential for canopy gaps to be greater in red beech forest, due to the large tree sizes, and on sideslopes, where the construction track, spur tracks, and monorail will be closer together. These factors will coincide where red beech occurs on sideslopes, such as on the western side of the saddle between the Kiwi Burn and Whitestone Valley.

The assessment of vegetation clearance and canopy gap creation is hampered by the lack of detailed monorail route planning and geotechnical investigations, and low resolution of topographical information used. Mapping of significant trees along the route, particularly in red beech forest and on side slopes, would be required to assess the potential effects of monorail construction on ecologically important large trees and the forest canopy. An assessment could then be made as to whether such effects can be avoided by altering monorail, construction track, and spur track locations while remaining within constraints posed by topography and geotechnical issues. The route between the 6-9 km points from the Kiwi Burn flats to the Whitestone flats should be the primary focus for such detailed investigations, followed by the section from the 26-29 km points. Ecologically important red beech forest is a dominant vegetation type in both of these sectors, with the former occurring on sideslopes and the latter on relatively flat topography.

Microclimatic effects are expected along the route wherever a canopy gap is opened, and the MP report recognises this. The MP report's assessment that browse-resistant shrubs, herbs, and ferns are likely be the long term cover beneath this gap is supported. Cohorts of regenerating beech trees are also likely to occupy these gaps, but these would not be compatible with monorail operation and would be periodically cleared. Weed invasion is also likely and this is discussed later in this report.

Approximately 4.2 km of tussock grassland along the route will be affected by the monorail, and additional areas at the Kiwi Burn terminus, but the overall area affected is not defined. It is suggested that stripped tussock grassland will be salvaged and stockpiled for reuse in rehabilitation, but stock pile locations and storage conditions are not defined. The MP report states that stripped tussock grassland vegetation will also be used to provide a buffer along the construction track, to minimise damage to the adjacent grassland, but it is uncertain how this would provide buffering. We consider that disturbance to tussock grassland will inevitably promote the invasion and dominance of exotic grasses and herbs, and it is unlikely that stripped tussock grassland vegetation will provide much benefit for rehabilitation. Adverse effects on tussock grassland vegetation will probably be permanent and irreversible.

Marginal 'edge effects' such as weed invasion and changes in species composition are likely in both grassland and in forest. Edge effects such as weed invasion and increased wind and light intensity penetrate to varying levels when a new edge is opened, but this is to some extent dependent on the context of the edge (for example sheltered or exposed, natural or weedy). The permanently cleared monorail corridor will effectively make a linear tunnel through the forest, which is likely to act as a conduit for wind. Wind tends to reduce humidity, and the reduction in humidity would be greater where canopy opening allowed entry of more sunlight. Reduced humidity could potentially affect the habitats of ferns, bryophytes, and epiphytes, which are often sensitive to humidity changes. The significance of edge effects reduces with increasing distance from the edge. Conservatively, 10 m of significant

edge effects along each margin of the 29.5 km monorail corridor would result in an additional ca. 30 ha of vegetation modification. This does not include collateral damage to trees, which is not strictly an edge effect.

At the Te Anau Downs terminus site, the MP report suggests that construction of the terminus and monorail track would have minimal effects on ecological values, however there is potential for adverse effects on the indigenous turf species growing in mown areas at this site. These have not been evaluated. It is suggested that landscaping could include creation of patches of indigenous vegetation, including reintroduction of species that were formerly present, but these species are not defined, and the ecological value of the created patches is uncertain.

4.5.4 Vegetation debris and its removal (Section 7.3.2)

Two strategies (or a combination of both) are suggested for forest debris. It could either be left in the forest to decompose, or removed from the forest using the monorail or construction track. The main factor behind the applicant's desire to remove the material is so that it does not cause an unsightly view for monorail passengers or mountain biking users of the construction track. Removal of woody debris would also reduce the potential for outbreaks of pathogens such as the pinhole beetle, but this is not considered a significant risk. On ecological grounds, it would be better to leave debris within the forest, where it would provide ecological benefits such as provision of microhabitats and regeneration sites, and through decomposition providing a source of nutrients to natural forest food webs.

4.5.5 Potential increases in weed abundance (Section 7.3.3)

The MP report notes that construction disturbance will provide ideal sites for weed establishment, and that weed seeds can invade these from many sources. As described above, construction in tussock grassland vegetation will inevitably increase the invasion and abundance of weeds, and this will be irreversible. In forest areas, there is potential for establishment of exotic grasses and herbs in canopy gaps, and also for exotic woody species such as Scotch broom (*Cytisus scoparius*), gorse (*Ulex europaeus*), and blackberry (*Rubus fruticosus* agg.) which are commonly dispersed on construction machinery and in gravel. The MP report recommends preparation of a weed management protocol and rigorous weed hygiene. Development and implementation of these types of strategies is supported, but they are only likely to be effective with respect to woody weeds.

4.5.6 Machinery use (Section 7.3.4)

A range of heavy machinery will be required to construct the monorail and this will entail considerable movement of vehicles along the construction track, spur tracks, and monorail route. The MP report notes that this has the potential to compact soils and damage tree roots, and that damaged trees may have to be removed for safety reasons. It is proposed to rehabilitate the ground surface along the monorail route, and this is supported. Compaction of soil can provide a barrier to the movement of water, which can then cause changes to hydrological flows and result in ponding. Hydrological changes have the potential to cause marked changes to vegetation composition. The MP report notes that a gravel base can help to reduce compaction,

however the effects of mechanical compaction along the route are difficult to quantify and are likely to be revealed only as monorail construction proceeds.

The MP report notes that refueling of construction vehicles is likely to take place on conservation land, and carries the risk of fuel spills. Spills can also result from the operation of machinery, particularly machinery using hydraulic equipment. Spills are likely to affect only localised areas of terrestrial vegetation and habitat, but can have strong effects in those sites. Spills escaping to streams are of greater concern, but these are beyond the scope of this audit report. Accidental spills of fuel and oil will be almost inevitable for such a large and extensive construction project.

Increased fire risk is also identified as a potential effect of construction. This risk can be mitigated by adopting and implementing a fire risk management plan containing appropriate fire avoidance objectives.

4.5.7 Movement patterns of plants and animals (Section 7.3.5)

The MP report states that, in grassland vegetation, direct transfer of soil and vegetation sods will recreate the pre-existing vegetation around the monorail piers and beneath it, but this conclusion is not supported for tussock grassland, where exotic grasses and herbs will inevitably dominate disturbed areas.

4.5.8 Increased use (Section 7.3.6)

The MP report notes that increased use will result in increased construction waste, human waste, and rubbish.

4.5.9 Effects of operating the monorail (Section 7.4)

Annual or six-monthly inspections will take place to assess the risk of tree or branch fall on to the monorail. While the MP report notes that tree felling should be undertaken on a case-by-case basis and approved by the Department of Conservation, the effects of tree and branch fall on monorail operation would only be revealed after operation commences, and there remains a risk that commercial or safety considerations might require widening of the monorail corridor. This risk has not been evaluated.

Ongoing trimming and clearance of vegetation within the monorail corridor will be required where the monorail passes through forest. As the MP report notes, a browse-resistant shrub layer is the most likely vegetation to develop in the long term, although disturbance will mean that exotic grasses and herbs are likely to become important components of the monorail corridor vegetation in the short to medium term. Microclimatic effects generated by the monorail, if warmed, are discussed and it is accepted that any such effects would be of low ecological importance.

4.5.10 Overall effects of the project on significant vegetation and habitats (Section 7.5)

The MP report identifies that some sites and landforms will be prone to cumulative and ongoing effects during construction and maintenance of the monorail route.

These include track junctions, steep slopes, and swampy areas. The route sections from 6-9 km and 18-22 km are identified as posing particular constraints, because of steep and possibly unstable topography. The MP report does not identify the consequences of greater effects at such sites, but as described above, we consider that these will include more extensive clearance and modification of vegetation, and larger canopy gaps where these sites occur in forest. The MP report considers that most of these effects will be restricted to the period of construction, but this may not be true, for example there may be ongoing stabilisation work required at unstable sites, or ongoing clearance of trees from unstable slopes above the monorail.

The MP report identifies that the monorail route lies within an ecologically-significant area and passes through ecologically important habitats, and that management aims to protect the ecological integrity of these habitats. Key components of ecological integrity are indigenous dominance, species occupancy, and environmental representativeness.

The MP report suggests that mountain beech, silver beech, and red beech forests are not rare and are surrounded by large areas of similar habitat. This may be correct for mountain beech and silver beech forest, but is less so for red beech forest, which is restricted to warmer, relatively fertile habitats in the Te Anau region, and is not widespread in Fiordland. Red beech forest is a keystone ecosystem that occurs on ecologically productive sites and has long-lived trees that provide abundant cavities for use of indigenous fauna. Old-growth red beech trees may be many centuries old and cannot be readily replaced. Text references to the distribution of tall red beech forest along the monorail route do not correspond to the kilometre points mapped on sheet 30 of the engineering report.

The MP report considers that removal of grassland vegetation will be remedied by replacing it soon after construction, and therefore only the pier sites will involve permanent loss of grassland vegetation. This is not supported, because exotic grasses and herbs will quickly invade disturbed sites in grassland vegetation. While red tussock and short tussock grasslands have already been modified, indigenous dominance and species occupancy will be further reduced by monorail construction, and these effects are likely to be irreversible.

The MP report's assessment that good site management and mitigation to protect threatened species will ensure that there is no change to the ecological status of the site is not supported.

It is concluded that, provided weed and pest species are prevented from invading the site, that species composition will remain similar, and indigenous dominance will be maintained along the route. This is not supported for indigenous grassland vegetation, and will not be the case along the monorail corridor in forest, where indigenous dominance is unlikely in the short term, and species composition will be markedly changed so long as the monorail operates. Similar effects will be generated by the construction road. Steep slopes created or affected by monorail and road construction may also suffer from loss of soil and result in long term changes to the composition of indigenous vegetation on these sites.

The MP report notes that roost trees of long-tailed bats are difficult to detect because of intermittent use. Loss of such trees would result in a long term reduction in the availability of roost trees at the site and the loss of only a few key roost trees would have a significant impact on a relatively large number of bats (Lee & Elliott 1995).

It is suggested, in the MP report, that mountain beech forest is nationally important, and that tussock grassland habitats are internationally important and thus it is critically important to maintain the integrity of these habitats. It is puzzling that red beech forest is not given similar nationally important status. As described above, monorail construction and operation will result in permanent adverse effects on the ecological integrity of tussock grassland habitats, and the representative value of this vegetation will be permanently reduced. The representative value of the forests traversed by the monorail will also be reduced, because the affected areas will no longer be good quality examples of their type.

It is suggested, in the MP report, that ecological context and functioning will be minimally affected. The MP report puts the removal of 22 ha of red beech forest in context by stating that this represents 0.05% of the natural vegetation found within the Snowdon Forest Conservation Area. This trivialises an important issue and is a misleading comparison, given that the Snowdon Forest Conservation Area is dominated by vegetation other than red beech forest. It is suggested that loss of habitat is unlikely to be important at the population level for affected species, but the removal of large trees will result in long term reductions in habitat quality at the site, which may well affect indigenous fauna populations.

It is concluded, in the MP report, that despite deer browsing and the presence of some weeds, natural processes dominate throughout the site, but that monorail construction and operation will not greatly affect ecological functioning. It is also intimated, in the MP report, that the construction road will not have any effects greater than the current walking track. The walking track is a narrow feature, which avoids a considerable part of tussock grassland that would be traversed by the monorail route, does not generate any canopy gaps, would not have involved the removal of any large trees during construction, and has very limited or non-existent edge effects. It is untenable to suggest that the effects of monorail and construction road construction and operation will be similar to the effects of construction and operation of the walking track.

The MP report suggests that monitoring and adaptive management can ensure that values at the site are protected over the long term, but loss of some values, such as tussock grassland and old growth red beech trees, cannot be resolved by adaptive management.

4.6 Ecological criteria for selecting the final route (Section 8)

The ecological criteria outlined for selecting the final route within the 200 m corridor applied for are generally sound, but are not prioritised into the most important and least important considerations, and this may be necessary given that some of the criteria conflict. For example, a criterion in the MP report is that land environment L1.1c should be avoided wherever possible, which conflicts with a construction road

criterion that the road should stay out of the forest, and on grassland, where the grassland is of predominantly exotic character.

One consideration not identified is that the monorail should preferably be located away from forest margins so as to avoid effects on ecotones, including those that have suffered from modification by ungulate browsers, particularly since these modified ecotones remain an important habitat for yellow mistletoe.

4.7 Mitigation and site restoration (Section 9)

4.7.1 Introduction (Section 9.1)

The MP report states that mitigation of adverse effects can be achieved by minimizing the project footprint, and rehabilitating areas as quickly as possible after completion, but these are avoidance and remediation measures. Mitigation is required to deal with residual adverse effects once avoidance and remediation strategies have been implemented. A high priority needs to be given to avoidance of adverse effects on significant vegetation and habitats along the route.

4.7.2 Minimising the effects of vegetation clearance (Section 9.2.1)

It is considered, in the MP report, that the design of the route has, to a large extent, avoided sensitive and important habitats. However it is not possible to be confident of this, given that significant and sensitive habitats occur within the 200 m corridor applied for, and the route currently-shown has been drawn on the basis of coarse topographical information and no detailed geotechnical work. The current route also passes through significant stands of red beech forest and it is estimated in the MP report (though on uncertain grounds) that only 76 very large trees will be felled to establish the route.

This section of the MP report mostly concerns the potential for an outbreak of forest pathogens stemming from a build up of dead wood following route construction, but this was earlier assessed as a low risk. No evidence of such an outbreak is cited in relation to other roads that pass through beech forest vegetation in the region.

The envelope approach does not provide enough certainty that avoidance of important habitats will occur, and it is possible that the 200 m corridor applied for may even constrain the monorail development to a route that is not fully effective at minimising adverse ecological effects. In this context, we suggest that resources could be more effectively devoted to mapping the large trees that occur along the proposed route, prioritizing this mapping to parts of the route where there are known topographical or geotechnical constraints, and known stands of large trees. If combined with more resolved topographical information achieved through LIDAR (as advocated in the engineering report), this would allow better optimisation of the monorail and construction track routes, and better assessment of the residual effects that would need to be mitigated. Unfortunately, the approach of estimating stand density and structure through vegetation plots has not provided any spatial information that could be used to refine the monorail route so as to minimize adverse effects.

4.7.3 Minimising invasion by weeds (Section 9.2.2)

As described earlier in this report, we consider that exotic grass and herb weeds, which are already present in tussock grassland, will be impossible to prevent from invading and becoming dominant in areas disturbed by construction activity. As there are no practical methods for controlling exotic grasses and herbs in indigenous grassland vegetation, these effects will be irreversible.

For woody weeds, the biosecurity protocols described in this section are appropriate.

4.7.4 Minimising the effects on native fauna (Section 9.2.3)

Much of this section relates to reducing the abundance of exotic fauna, including deer, possums, rodents, and mustelids. There would certainly be value in reducing densities of these pest animals at the site to levels that allow recovery of palatable forest plants, and this would enhance natural colonisation of cleared areas, and screening of debris from monorail passengers and mountain bike riders (which is not an ecological concern but is mentioned for the benefit of the applicant). It should be noted that attempts to control deer to low levels may be resisted by the local hunting community, which clearly values recreational hunting in the area.

4.7.5 Other ways to minimise the proposed footprint (Section 9.2.4)

Implementing the strategies outlined in this section of the MP report would help to reduce adverse effects. The MP report notes that it is impossible to predict the number of visitors that might use the area after the monorail is constructed, and that cyclists in particular could have significant effects on the vegetation and fauna of the area. If this is the case, then consideration should be given to avoiding these effects by abandoning plans to create a mountain bike track on the construction road (It does seem unlikely, however, that cyclists would generate such adverse effects.)

4.7.6 Prompt rehabilitation of the route (Section 9.3)

Proposals in this section of the MP report for planting and seeding are untested and poorly developed, and we consider that the effectiveness of these strategies is unproven and uncertain. The MP report describes reinstatement of natural vegetation on areas disturbed by construction activities, but glosses over the considerable difficulties in achieving a standard of this level. For example, there is little prospect that any forest understorey shrubs or trees can be quickly reinstated in this way, and no methodology is described as to how forest vegetation will be stripped, stored, and reinstated. Species that could be used for replanting are not named, and the sources of these plants are not given. In our opinion, the best that could be hoped for is natural regeneration of indigenous forest plants if soil and debris are replaced on the post-construction landforms. This regeneration is likely to be constrained in the short term by invasion of exotic grasses and herbs where larger canopy gaps are created. The MP report concludes that a prompt return to vegetation cover can be achieved, but no timeframes are given for this, and we consider it may take several years to a decade or more.

As described above, we consider that reinstatement of tussock grassland vegetation is impractical. The MP report describes dense planting with native species, but none are named. Weed control is specified but the way in which exotic grasses and herbs are to be controlled is not described.

The MP report describes remediation of storage depots, but earlier in the report these were described as being located outside of public conservation land, and it is not clear whether the report is referring to these, or to previously undescribed storage areas on conservation land. If the latter, these sites will need to be defined.

In general, this section of the MP report glosses over the considerable practical difficulties of achieving prompt rehabilitation of indigenous vegetation, and we very much doubt that it will be achieved to the optimistic levels expressed in the MP report.

4.7.7 Mitigation of effects on the South West New Zealand World Heritage Area (Section 9.4)

Three options for mitigation of effects on loss of habitat, ecological continuity, and ecosystem integrity are outlined in the MP report. These are:

- Control of possums, stoats, and rats along the monorail corridor;
- Pest animal control in a red beech stand near Dunton Swamp;
- An extension of pest animal control undertaken at the 'Operation Ark' site in the Eglinton Valley.

The MP report states that pest control along the monorail route is not preferred because of the presence and operation of the monorail track, and human use of the construction track. However no explanation is given as to why the presence of the monorail and people discounts pest control in this area. The construction track would certainly provide a good transport route for pest control operations, and the presence of facilities and people has not prevented effective pest control in places such as the Clinton, Arthur, and Cleddau Valleys, which have considerable development of facilities and a very large number of visitors. Pest control along the monorail corridor could also benefit the same indigenous fauna populations that are potentially affected by the monorail, and help to ensure their persistence in the area. It would also help to maintain ecological continuity between the Eglinton catchment, the Eyre Mountains, and the Takitimu Mountains via the Burwood Conservation Area. If deer were included in the management regime, it would potentially help to address loss of forest habitat, by enhancing the growth of palatable forest trees and ground cover plants. In our view, pest control (deer, possum, rodents, mustelids, lagomorphs and feral cats) along the monorail corridor has the greatest potential to mitigate loss of habitat, ecological continuity, and ecosystem integrity, and benefit the local indigenous fauna populations. Indigenous fauna populations would be enhanced in an area where existing and future recreational activity is likely, allowing people to enjoy the benefits of enhanced forest health and encounters with wildlife. Pest control along the monorail corridor would provide the best 'on site, in kind' offset for the effects of the project. The area treated would have to be at least 500 ha in size, preferably larger (e.g. 1,000 ha) to maintain sufficiently low pest densities in the core of the area, given few constraints to pest reinvasion from the margins.

The Dunton Swamp red beech pest control option was chosen on the basis of Lee and Elliott (1995) who, according to the MP report, considered it likely to support high numbers of bat and kaka roosts. Lee and Elliott (1995) actually describe the Dunton Swamp red beech stand as an important habitat for yellowhead and kakariki, whereas they describe the Whitestone and Upukerora Valleys as containing forests that provide important habitat for these species in addition to kaka and long-tailed bat. The presence of long-tailed bat and kaka populations along the monorail route has been confirmed by the more recent spring survey (Mitchell Partnerships 2010). On the basis of the spring survey results, and the conclusions of Lee and Elliott (1995), the Dunton Swamp red beech stand would not appear to be as high a priority as the red beech stands along the monorail route.

Providing resources to carry out pest animal control over an additional 200 ha adjacent to the Operation Ark site in the Eglinton Valley is the mitigation preferred in the MP report. This would provide *c.*20% extension to the 950 ha treated under Operation Ark, and thus provide additional benefits for the mohua, bat, kaka, and kakariki populations in the Eglinton Valley. This could help to sustain populations of these species in the Eglinton Valley, and would build on existing programmes and thus provide economies of scale. It is not clear whether similar benefits could be obtained from pest control operations in one or more red beech stands along the monorail route, but this should be evaluated.

The mitigation proposals outlined above are designed to benefit populations of indigenous fauna which might be affected by habitat loss, but do not mitigate direct or indirect adverse effects on indigenous vegetation, or threatened plant species such as yellow mistletoe. The adverse effects of monorail development on tussock grassland vegetation and habitats would not be mitigated by any of the above options, nor would loss of indigenous forest vegetation, including the intrinsic values of old-growth red beech trees.

There is insufficient information in the MP report to properly assess the above mitigation options. They need to be fleshed out in much greater detail before their value can be assessed. In all cases, pest control would need to be substantive and ongoing if it is to provide the anticipated benefits. Calculating the value of these mitigation options in a biodiversity offsets framework would help to assess their sufficiency, but this will not be possible until the residual adverse effects of the monorail development are properly quantified. It would be useful to develop contingency mitigation options in the event of adverse effects being greater than anticipated after monorail construction. These contingency mitigation options should be prepared wherever there are uncertainties as to the magnitude of effects generated by the monorail development.

4.8 Monitoring (Section 10)

Regular monitoring of the vegetation and fauna populations along the route is recommended (in the MP report) after construction, to determine if the monorail development is having any adverse effects on terrestrial ecology. We suggest that more detailed work on the monorail route would be more useful so as to quantify

adverse effects prior to monorail construction. The MP report recommends that monitoring should be undertaken on existing habitats, and on rehabilitated habitats.

4.8.1 Monitoring existing habitats during and after construction (Section 10.2.1)

Inspections of working areas and the completed monorail corridor are suggested in the MP report, to identify and remove common weeds, with a decreasing frequency of inspections over time. It is assumed that these inspections will be visual, but the methodology is not described. Visual inspections would need to be undertaken on foot if they are to be of any value for detecting weeds. It is not clear what 'common weeds' refers to. Visual inspections on foot would be useful for identifying any woody weeds that establish along the monorail corridor.

It is proposed to map the locations of all weeds, but this will be impractical for exotic grasses and herbs, which are widely dispersed in open habitats traversed by the monorail route. The locations of woody weeds is worth mapping, both because they are infrequent at the site and are also often associated with persistent seed banks from which future regeneration can occur.

The MP report suggests manual removal or herbicide treatment of weeds along the route. Again, while this is feasible for woody weeds, it is not a practical option for grasses and herbaceous weeds, particularly in indigenous grassland vegetation.

It is proposed to monitor weeds using vegetation plots, but this will be inefficient and will under-estimate the occurrence of weeds, because it will be impractical to establish a sufficient number of monitoring plots to cover more than a tiny proportion of the area affected by the monorail.

The MP report suggests that weeds in wetlands and tussock grasslands can be removed by hand if detected, but this will be impractical for graminoid and herbaceous weeds, particularly since by the time they are detected, they are likely to have produced seeds. Replanting is recommended, in the MP report, to avoid bare ground, but replanting is a form of disturbance which will promote weed invasion.

The MP report states that the route will be monitored every six months to identify any trees that pose a risk to the monorail or wildlife if they fall. It is difficult to see how wildlife would be affected by falling trees, given they are a natural occurrence in forested ecosystems. These monitoring inspections relate to monorail operational safety requirements which are not an ecological issue, although they have implications for adverse effects on terrestrial ecology, as described in Sections 4.5.3 and 4.5.9 above.

4.8.2 Monitoring rehabilitated habitats during and after construction (Section 10.2.2)

Monitoring is proposed for rehabilitated sites along the construction road and monorail route, mainly to check on the survival of plants used in rehabilitation. No species have been named for planting, and there is no detail on how survival will be monitored. Rehabilitation targets are 90% vegetation cover in grassland, and a

limited cover with no exotic weed species in forest. The grassland target does not address the composition of vegetation (exotic or indigenous), which is the main issue of concern in indigenous grassland vegetation. As discussed earlier in this report, indigenous dominance will be difficult to sustain on rehabilitated landforms in open habitats, and the MP report provides insufficient detail to show how this would be achieved. In forest ecosystems, the monitoring appears to have no purpose except to assess whether weeds are present, and thus should be covered during the weed surveys described above.

4.8.3 Pest mammal monitoring (Section 10.3)

4.8.3.1 Purpose of monitoring (Section 10.3.1)

As indicated, the purpose of monitoring mammalian pests along the monorail route would be to determine whether the development resulted in greater numbers of any pest species than at control sites in adjacent habitat. RHL indicate that monitoring would be carried out before, during and after construction, but there are no details about how soon before construction and for how long after construction this would occur. RHL proposes to monitor for and control, if necessary, just rat and possum populations along the route. Such pest control would be insufficient to enhance the natural colonisation of cleared and planted areas or to mitigate for impacts on indigenous fauna, such as will occur with the removal of large old trees.

4.8.3.2 Monitoring rats (Section 10.3.2)

The Norway rat, which largely occurs in association with human habitation, rarely inhabits forested environments, and then most often in wetland habitats, such as along stable streams (King 2005). Likewise, the kiore has a very restricted distribution on the mainland, now apparently confined to parts of Fiordland, Southland and south Westland (King 2005). Thus the common rat species in New Zealand forest habitats, including beech forest, is the ship rat. The procedure for monitoring forest-dwelling ship rat populations, as set out in Section 10.3.2 of the MP report (2009), is in line with the standard Department of Conservation (DOC) procedure. At least eight tracking-tunnel lines would need to be established along the monorail route and another set of lines, as controls, in similar habitat some distance away. The proposal to monitor rat abundance twice, three months apart, during the forest-bird breeding season (Sep-Jan) is appropriate. Details are needed about how the ship rat population would be reduced if monitoring showed it was necessary, and what level of rat tracking frequency would trigger control.

4.8.3.3 Monitoring possums (Section 10.3.3)

The MP (2009) report indicates that the possum population along the route would be monitored using the standard RTC procedure, "probably annually", and re-measured soon after any control operation. The trigger point for control is given as 10% RTC, and that control would be expected to reduce the population to ≤ 3% RTC. These thresholds are appropriate. Details of how the possum population would be reduced are required.

4.8.3.4 Monitoring mustelids

No monitoring or control of mustelid populations along the monorail route is proposed because "no standard protocol …. exists" and "it is not possible to tell apart the footprints of the three species present in New Zealand." However, there is a standard DOC protocol for monitoring mustelids through the use of tracking tunnel lines set as for rodents, but with every second tunnel baited with meat and left 'set' for three nights. The stoat is the most widespread and common species of mustelid in forests. Weasels (*Mustela nivalis*) prefer thick ground cover (King 2005), and so the presence of weasels along the monorail route would probably be rare and restricted to wetland habitats. Ferrets commonly occur in grassland, tussockland, shrubland, about the margins of wetlands, and along road edges and grassy tracks (King 2005). Given this latter habit, it seems likely that the establishment of the monorail and cycle routes would provide dispersing ferrets with ready access to suitable habitat between forested areas. Thus, it would be prudent to monitor for mustelids immediately after rat monitoring using the same tracking tunnel lines with tunnels sufficiently large to accommodate ferrets. Mustelid control could be triggered if tracking rates were significantly higher (a threshold would need to be defined) than in the control site.

4.8.3.5 Monitoring deer, rabbits, and hares

The MP report's dismissal of monitoring the deer population seems a bit confused even though a standard protocol (faecal pellet index) procedure is mentioned. The MP report goes on to indicate that the intensity of browsing on planted species at revegetation sites could be monitored to determine whether deer numbers change or not. Such monitoring would only indicate whether deer are willing to feed on such plants or not. Even so the MP report concludes that no deer monitoring or control is proposed. Thus, we can only conclude that if deer impede the revegetation of disturbed and/or planted sites, which seems inevitable, that RHL will not take responsibility for controlling deer numbers to ensure the success of the re-establishment of the native plant cover along the monorail route. Similarly, there is no mention of monitoring or managing rabbit and hare populations, both species being well known to browse regenerating seedlings and plants planted at managed sites to the point that in the end only unpalatable species survive.

4.8.4 Wildlife monitoring (Section 10.4)

4.8.4.1 Monitoring bird abundance (Section 10.4.2)

The monitoring of bird abundance using the 5MBC method with the addition of estimated distance of each bird detected from the point or station is appropriate. More details are required about the number of points at which 5MBCs will be carried out, and whether they will be stratified for habitat. A minimum of 30 counts per habitat would be required. Given the greater conspicuousness of forest species in November 2009 than May 2009 (Mitchell Partnerships 2009; 2010), it would be best to carry out the counts during October-December rather than in autumn. To determine the impact of the monorail development on bird numbers along the route, the counts would need to be done annually, not at five year intervals, in order to account for annual variation in populations as a result of weather, predator numbers, masting of beech, etc.

4.8.4.2 Monitoring lizards (Section 10.4.3)

No field survey for lizards along the proposed monorail route is planned. While forest-dwelling species can be very difficult to detect, species inhabiting grassland, tussockland and shrubland habitats, especially those associated with stony areas along river and stream margins, can be quite numerous and visible during sunny weather. Also, given the likely high productivity of tall red beech forest and wetlands, these habitats should be searched for lizards. There are techniques available to search and monitor for lizards, such as pit-fall traps, artificial cover objects, searching at night for eye-shines, and captures per hour of searching. There are techniques available to monitor for lizards, such as pit-fall traps, artificial cover objects and captures per hour of searching. It would be prudent to carry out a lizard survey of the proposed route during summer, especially to check for "scarce or unique areas of lizard habitat" (Mitchell Partnerships 2009), and because much of it probably has not been previously surveyed by herpetologists.

4.8.4.3 Monitoring bats (Section 10.4.4)

Given that long-tailed bats were found distributed along much of the proposed monorail route in November 2009, especially along forest edges at about wetlands, much baseline data are now available (Mitchell Partnerships 2010), such as locations and habitats with pass rates per hour. Given the threat ranking of the long-tailed bat (nationally endangered) and the potential for monorail construction and operation to detrimentally impact the population (noise, felling of roost trees), monitoring the impact of the development on the population along the route is warranted. Although the DOC protocol recommends that 50 transects be surveyed for statistical comparisons, which RHL regards as prohibitive, it would be worth investigating whether a repeat of the November 2009 protocol on an annual basis would be useful to detect any major changes in the population's numbers or distribution.

4.8.4.4 Survey for invertebrates

No invertebrate survey is proposed along the monorail route because RHL considers that the narrow linear strip of vegetation to be removed during the development would be from widely distributed vegetation types, and that the invertebrate species impacted are expected to be widely distributed (Mitchell Partnerships 2009). While this may be correct, no information is provided to give confidence that this is the case. That the taxonomy of many New Zealand invertebrate species is uncertain, and that there is a lack of knowledge about invertebrates in the area (Mitchell Partnerships 2009) are important reasons why an invertebrate survey along the proposed route is warranted. If the recommendation that searches be carried out in key productive habitats (tall red beech, grass- and shrub-covered river terraces, wetland margins, etc) for lizards is acted upon, then it would be useful to take the opportunity to search these sites for invertebrates at the same time.

4.9 Appendices

The species list contains species that are very unlikely to be present, including taupata (*Coprosma repens*), *Hoheria glabrata*, *Pseudopanax linearis*, and tanekaha (*Phyllocladus trichomanoides*). None of these species were recorded by either Lee

and Elliot (1995) or Boffa Miskell (2006), and their natural habitats are either in climatic zones or parts of New Zealand that differ from those of the monorail site. The lists contain duplicate entries for some species, including *Acrothamnus colensoi* = *Leucopogon colensoi*, *Nertera* sp. aff. *dichondraefolia* = *Nertera villosa*, and also duplicates spelling mistakes from Lee and Elliot (e.g. *Nertera* aff. *dichondraefolia* as *N.* aff. *dichondrifolia*). Small errors are often present in plant species lists, and individually, these mistakes might be put down to a lack of care when compiling the list, but in total, they indicate poor familiarity with the local flora.

5. AUDIT OF SPRING SURVEY REPORT

Surveys were undertaken in November 2009 to fill information gaps primarily relating to seasonally present plant species and fauna, and the presence and abundance of bats, as this information was not available from previous surveys undertaken in the autumn. In addition, 20 × 20 m forest vegetation plots were surveyed to provide additional information on forest structure.

5.1 Assessment methods (2.3)

5.1.1 Vegetation (2.3.1)

Nine additional 20 × 20 m plots were measured in forest. These plots were established at various points along the monorail corridor, but no information is provided about their locations, or why they were located in particular sites. It is unlikely that the plots were located in an unbiased manner because no description of unbiased methodology is provided, which would normally be the case if this aspect was considered important.

5.1.2 Avifauna (Section 2.3.2)

General observations of birds and their sign were made along the proposed route during 23 November to 2 December 2009 (Mitchell Partnerships 2010a). In addition, 85 5MBCs were carried out at 300 m intervals along the route, 75 in forest and 10 in grassland. Surveys at night for kiwi were carried out at a central location, during a walking transect at Kiwi Burn, and informally at five campsites. These methods are appropriate.

5.1.3 Bats (Section 2.3.3)

Electronic bat detectors were used to determine whether bats, both long-tailed and short-tailed, were present along the route. Detectors were placed at about 60 locations at regular intervals along much of the proposed monorail route. Detectors were apparently left in place for 2-3 nights, although given that they were operational for a total of 113 nights (Mitchell Partnerships 2010a) some sites were probably only surveyed for one night each. A variety of habitat types likely to be used by bats for foraging and roosting were surveyed, such as mature forest, forest edges and near streams and ponds.

5.2 Vegetation (Section 3)

5.2.1 Additional plant records (Section 3.1)

Twenty-seven additional plant species were recorded during the spring survey, but these are not identified separately in the combined species list. These additional plant species include two - *Kirkianella novae-zelandiae* and *Libertia peregrinans* - that have a threat classification of 'Threatened-Nationally Vulnerable' (de Lange *et al.* 2009). *Kirkianella novae-zelandiae* was recorded from turf in the mown lawn of Fiordland National Park Lodge at Te Anau Downs. The occurrence of *Kirkianella novae-zelandiae* at Te Anau Downs has not been verified by this audit. A form of this species is known from turf habitats, but it is distinguished from *Microseris scapigera* only by fruit characters which may not have been evident during the spring survey (c.f. de Lange *et al.* 2010). A species of *Libertia* which may have been *L. peregrinans* was observed near the Mararoa River, but the authors of the MP report were not confident that this was not the related and unthreatened *L. ixioides* as the plant was not flowering at the time. It seems unlikely that this was in fact *L. peregrinans* because it is mostly a species of dune slacks in coastal areas. *Libertia peregrinans* can be readily distinguished from *L. ixioides* on the basis of vegetative characters (de Lange *et al.* 2010), and it is puzzling that the authors of the spring survey report were unable to confidently determine the identity of the Mararoa River plants.

5.2.2 Results of the tree diameter and height surveys (Section 3.2)

As described in Section 4.2.3 of this report, we do not accept that differences in plot sizes necessarily bias mean values of basal area and other forest structure variables. A bias toward higher values from smaller plots would only occur if the way that trees were defined as being included in plots was if a tree touched the plot, rather than if its centre occurred within the plot. Consequently, the assertion that the 10 × 10 m plots used in May 2009 were too small to produce reliable results is not accepted.

The nine 20 × 20 m plots sum to an area of 0.36 ha, which is exactly the same area as covered by the 36 10 × 10 m plots. Quite different basal area and density figures were obtained from sampling areas of the same size. The differences could relate to sampling error or observer bias when locating plots. Rather than using the results of from the larger plots and rejecting those of the smaller plots, a more accurate figure would be obtained by combining and averaging the data. That would still however cover only 0.12% of the monorail development envelope, which is a very small sample to extrapolate from. Basal area, tree density and size distribution, and wood volume calculations must therefore still be regarded as of dubious accuracy, although the combined data indicate that the figures would be higher than figures obtained from the 20 × 20 m plots alone.

5.2.3 Threatened plant species (Section 3.3)

The spring survey report records a total of two specimens of yellow mistletoe along the monorail and mountain bike routes. As described in Section 4.2.4 of this report, this considerably under-estimates the size of the yellow mistletoe population along the route.

5.3 Fauna (Section 4)

5.3.1 Avifauna (Section 4.1)

Thirty-nine species were detected along the route during the November 2009 survey (Mitchell Partnerships 2010a), compared with 29 during the May 2009 survey (Mitchell Partnerships 2009), and 25 during the April 1995 survey (Lee & Elliott 1995). The combined results from the three surveys were not provided (Mitchell Partnerships 2010a). Combining the results from the three surveys, 45 species have been recorded along the proposed monorail route, 14 introduced species and 31 native species. Twelve species have a national threat ranking based on Miskelly *et al.* (2008): Nationally Critical - grey duck; Nationally Endangered - black-fronted tern, black-billed gull and South Island kaka; Nationally Vulnerable - New Zealand falcon and yellowhead; At Risk-Declining - South Island rifleman, New Zealand pipit, New Zealand pied oystercatcher, pied stilt; At Risk-Naturally Uncommon - long-tailed cuckoo and black shag. It is of note that while yellowheads were recorded during the two autumn surveys, none were detected during the November survey (breeding season) when males would be expected to have been frequently giving distinctive territorial song (Heather & Robertson 2005). Of the threatened 12 species, grey duck, South Island kaka, New Zealand falcon, yellowhead, South Island rifleman, and New Zealand pipit are probably the most vulnerable to the development because they are likely to be resident along the route year-round and to nest along or near it. With regard to the braided river inhabiting species (black-fronted tern and black-billed gull), there is unlikely to be sufficient width or complexity of the braided riverbeds adjacent to the monorail route to attract these species for nesting. Therefore it is the forest-dwellers (kaka, falcon, yellowhead and rifleman) and the open grassland/ riverbed inhabitants (pipit) that are most likely to be at risk from the development.

Table 1: Results for five-minute bird counts showing the most frequently recorded species during the May 2009 and November 2009 surveys.

Species	May 2009	November 2009
Rifleman	58.7%	57.6%
Grey warbler	45.3%	64.7%
Yellow-breasted tit	33.3%	48.2%
Bellbird	33.3%	No data
South Island robin	29.3%	27.1%
Brown creeper	29.3%	No data
Silvereye	25.3%	No data
Yellow-crowned parakeet	No data	23.5%

The 5MBC results from the two surveys are roughly similar, except that yellow-crowned parakeets were infrequently recorded in May. It would have been useful to have provided the 5MBC data for all species encountered, and to have stratified and analysed the counts on the basis of major habitat differences (e.g. mountain beech vs red beech forest).

No kiwi were heard during listening periods at night in November (Mitchell Partnerships 2010a). Likewise, no kiwi records for the region about the proposed monorail route were submitted for the 1999-2004 bird distribution atlas (Robertson *et al.* 2007). On the basis of this information it is unlikely that kiwi are present.

5.3.2 Bats (Section 4.2)

Even though no short-tailed bat passes were detected during the November 2009 survey, there is a moderate likelihood of the species occurring along the monorail route, since the species occurs in the nearby Eglinton Valley (King 2005).

Long-tailed bats were detected throughout the survey area, particularly at forest edges near streams and other wetlands (Mitchell Partnerships 2010a). Long-tailed bats roost mainly in cavities in the trunks and limbs of large (>80 cm dbh) old (>100 years old) trees (King 2005). Along the proposed monorail route such trees are mainly red beech because they are the largest and have numerous cavities.

The South Island form of the long-tailed bat has a threat ranking of Nationally Endangered (Hitchmough *et al.* 2007). The main threats to its long-term conservation are disturbance of roost sites, habitat loss, and predation by introduced mammalian predators (King 2005). Thus, if the monorail development was to proceed much care would be needed to ensure long-tailed bat roosts (large old trees with many cavities) and foraging habitats (forest edges, wetlands) remain undisturbed. Given that 76 very large trees are predicted to need felling during monorail construction (Mitchell Partnerships 2009), there is potential for considerable negative impact on bat roosts, bats themselves and other fauna occupying cavities. As a consequence, the removal of any very large old beech trees should be undertaken as a last resort as there is no way of mitigating their loss.

6. AUDIT OF CYCLE LINK ROUTE REPORT

The mountain bike track diverges from the monorail route near the 29.5 km mark, and mostly follows parcels of conservation land in the Henry Creek catchment before crossing to Te Anau Downs near Lake Mistletoe. A walk-through survey was undertaken in November 2009 to identify vegetation and habitat associations, assess bird abundances, and identify any threatened species found along the proposed route (Mitchell Partnerships 2010b).

6.1 Habitat associations (Section 3.1)

Four broad habitat associations are mapped as linear features, but this level of mapping provides little information that can be used to refine the mountain bike route. In addition, shrubland dominated by bog pine is not mapped separately from shrubland dominated by manuka, which is a significant deficiency given that bog pine shrublands have been identified as an ecologically-significant vegetation type.

A very large number (277) of indigenous plant species was recorded from the route, but the species list contains a number of significant identification errors (see Section 6.4 below), and it seems likely that this is an over-estimate of the actual number of indigenous plant species present. The threatened sedge *Uncinia strictissima* was recorded from a wetland near the route, as was the uncommon shrub *Coprosma wallii*, but given the significant identification errors described above, it is possible that these identifications are mistakes. One specimen of yellow mistletoe was also recorded.

The mountain bike route passes through the Dome Mire, which the MP report notes is regarded as the best mire of its type in New Zealand, in addition to other wetlands. Other important values crossed by or close to the route include red beech forests, kahikatea swamp forest, bog pine shrubland, and red tussock grassland.

6.2 Activities and effects (Section 6)

The proposed mountain bike track is to be 2 m wide but has few limitations of grade and direction and thus it is considered that there will be a high degree of flexibility as to its final location. This flexibility may be of less value where the route is constrained to conservation land supporting vulnerable ecosystems such as wetlands.

The MP report recommends placing the mountain bike track on existing 4WD tracks and bulldozed lines along property boundaries, and this is supported. Boardwalks are proposed where the track would cross wetland areas, but it is not known if these are feasible for mire wetlands, which may be associated with deep peat deposits. We consider that it would be best if the mountain bike track avoided wetland habitats.

Mountain bike track construction would require a gravelled track, with gravel having the potential to introduce woody weeds. Scotch broom is already abundant along parts of the route. The MP report suggests removing broom from the immediate vicinity of the track and replacing it with native species. This statement betrays a poor understanding of the difficulties inherent in achieving such an outcome, given that Scotch broom is highly invasive, associated with persistent seed banks, and will readily colonise disturbed areas and gravel. No detail is given on the native species that would be used to replace Scotch broom, or the feasibility of establishing and maintaining these native species along sections of the route. The MP report describes the standard of weed control required to maintain the route as similar to other walking tracks constructed on Crown land elsewhere in the country, but no examples are given for tracks where significant infestations of broom are present.

The MP report states that use of the track by cyclists will have effects on the local ecology, but no such effects are listed or defined.

On the whole, the assessment of effects is minimal and lacks sufficient detail to adequately assess the effects of the mountain bike track construction and operation. In addition to the deficiencies described above, there is no description of the methods and machinery that would be used to construct the track. We consider that there is potential for adverse effects to be high, and for maintenance of the mountain bike track to require a greater input of resources than envisaged by the MP report authors.

6.3 Mitigation (Section 6)

As in the main ecology report, many of the actions identified as mitigation are in fact avoidance, remediation, and monitoring activities. The residual adverse effects of mountain bike track construction and operation have not been quantified. The only actual mitigation described is protection of populations of threatened species via predator control programme in forest. There are no further details on this proposal, and it will do nothing to mitigate any adverse effects on the important vegetation and

habitat values identified along the mountain bike route. Mitigation options will need to be reconsidered following a more comprehensive assessment of effects.

6.4 Appendix 1 - Plant species list

Table 1 lists selected issues with the Appendix 1 plant species list. Supposed identification of species that are well outside their natural distribution limits indicates serious problems with species identification. Listing of species names that are no longer in use indicates lack of familiarity with taxonomic changes. The listing of names that do not refer to any known plant species is careless. Together, these deficiencies represent a lack of adherence to professional standards.

Table 1: Issues with the species list in Appendix 1 of the cycle link route report.

Listed Species	Issue
Hebe propinqua	Possibly present, but currently known western limit is the Mavora Valley.
Hebe parviflora	Distribution is North Island and coastal Marlborough.
Coprosma intertexta	Distribution is eastern South Island from Marlborough to Central Otago.
Pterostylis oliveri	Occurs from Arthurs Pass to Nelson.
Lepidothamnus australis	No such species.
Leucopogon suaveolens	A synonym for *Acrothamnus colensoi*.
Podocarpus cunninghamii	A synonym for *Podocarpus hallii*.
Ranunculus lappaceus	Invalid name for *Ranunculus multiscapus*.
Herpolirion redolens	No such species, mistaken for *Hierochloe redolens*.

7. SUMMARY

While the description of the environment and the assessment of ecological values are deficient in some respects (Table 2), in general the most important indigenous values are identified. The MP reports are more deficient with respect to identification of the likely effects of the monorail development, and we conclude that these have been under-estimated. The MP reports tend to minimise monorail development effects, rather than giving a worst case, or even a likely scenario. Considerable effort has been put into obtaining vegetation plot information, which samples a very small proportion of the affected area, and cannot be relied on to adequately represent forest structure. More effort on detailed monorail and construction road design and incorporation of better topographical information and spatial information on the location of significant trees is needed to provide a more accurate assessment of the potential effects of the proposal. The envelope approach used by the applicant does not allow these effects to be quantified. A summary of effects is presented in Table 3.

The importance of large red beech trees needs to be emphasised. These are likely to be several hundred years old, occur in restricted sites, provide important fauna habitat, and cannot be readily replaced. Avoiding adverse effects on such trees is of critical importance. The removal of canopy trees in general has the potential for significant cumulative effects. Minimising the number and size of trees cleared from the road and monorail corridors is important with respect to not only loss of indigenous vegetation and habitat, but to collateral damage on surrounding trees, creation of large

unstable canopy gaps, edge effects, weed establishment, and issues relating to the disposal of unsightly debris.

Edge effects are not specifically addressed, but are likely to occur at least over the short to medium term, and persist in sites with a permanent canopy gap.

Effects on indigenous alluvial tussock grassland are also important, given the extent to which these habitat types are already modified throughout the South Island, and their susceptibility to irreversible effects after disturbance.

Mitigation is proposed for adverse effects on indigenous fauna populations, but these proposals are not sufficiently detailed to assess their value. Loss of large red beech trees and tussock grassland cannot be remedied, and if unable to be avoided, will need to be mitigated, for example by protecting and/or enhancing similar unprotected ecosystems. Statements on rehabilitation lack detail and are unsubstantiated by supporting evidence. Rehabilitation will pose significant practical difficulties in open habitats. Indigenous grassland rehabilitation will be practically impossible to implement, and exotic dominance of disturbed sites in these grasslands is virtually guaranteed. Overall, the residual adverse effects of the monorail cannot be determined at this stage, and until these are determined, the sufficiency of mitigation cannot be fully assessed.

The ecological assessment of the mountain bike track route, where it departs from the monorail route, does not contain sufficient information with which to accurately assess the potential effects of mountain bike track construction and operation.

Table 2: Issues and further information requirements identified from evaluation of ecological components of RHL's reports on terrestrial ecological values. Section numbers refer to the sections of the MP reports.

Matter	Section	Issue	Further Requirement or Comment
Appendix I, Terrestrial Ecology Report			
Method			
Vegetation plots	3.3.1	Sampling design not related to distribution of forest types.	Plot results may not be representative of the distribution of forest types along the route.
Avifauna	3.3.2	No analysis of 5MBCs relative to habitat type. No combined listing of species from all surveys.	Useful to have analysis for major habitats, such as red beech, mountain beech, grassland, etc. List has omitted some species seen during 1995 survey.
Lizards	3.3.3	No field survey of this group is proposed.	This species group would be worthy of surveying by a herpetologist in summer.
Description of Environment			
Route description	4.2	Route revised at bluff above Upukerora River since survey was undertaken.	No description in this or subsequent reports.
Plant species	4.3; Appendix 3	Several inaccuracies in text descriptions. List inflated by species not likely to be present along route.	Relatively minor issues, not likely to affect conclusions but indicates insufficient care in compiling lists and descriptions.
Yellow mistletoe	4.3; 4.5.3	Only one yellow mistletoe plant detected in 2009 survey, but described as frequent in previous surveys, and seen during the field visit undertaken during the audit.	Lack of familiarity with yellow mistletoe recognition and habitat. This species is more common along the route than suggested.
Text/map mismatch	4.3; Fig 7.	Vegetation descriptions along the route often do not correlate with the distribution of forest types in Figure 7. The text tends to describe features as being present 1 km eastward along the route compared to where they are represented on Fig 7 and on sheet 30 of the Engineering report.	Potential for confusion over the location of ecological features, needs to be rectified.
Five-minute bird counts	4.3	No appendix or map showing locations of where 5MBCs were carried out, or analyses in relation to vegetation type.	Having the locations of the 5MBCs would help to identify any gaps in distribution, and analyses may help to show which vegetation types are important for particular species.
Basal area calculations	4.4	Highly variable results, and high overall mean, indicate sampling error.	Results should not be relied on. More plots required to accurately estimate the true mean basal area value.
Lizard survey	4.8	No field survey proposed.	Important to carry out a survey for lizards in summer in likely occupied (e.g. stony sparsely-vegetated river/stream terraces) and productive habitats (e.g. tall red beech forest, margins of wetlands).

Matter	Section	Issue	Further Requirement or Comment
Invertebrate survey	4.8	No field survey proposed.	Useful to carry out a combined lizard and invertebrate survey during summer in likely rare and productive habitats.
Significance assessment	6.1	Analysis of Southland District Plan does not refer to Rule HER3, which governs non-permitted indigenous vegetation clearance and describes the matters that the Council will have regard to when considering consents.	Assessing the ecological values along the monorail route against these matters would assist the assessment of significance.
Representativeness analysis	6.2	Flawed assessment of representativeness.	Much of the indigenous vegetation along the monorail route would have a high value for representativeness.
LENZ	6.2	Poor understanding of use of LENZ	Much of the discussion on LENZ does not make sense
TEC	6.2	Underprotected land environment Q4.1c not identified.	This land environment is present along the toeslopes of most of the streams and rivers traversed by the monorail route.
LCDB2	6.2	LCDB2 analysis does not add value to the report.	Would have been better to leave this analysis out.
Distinctiveness	6.2	Assessment mainly addresses rarity.	Distinctive ecosystems and vegetation types are present in the vicinity, and there may unusual species and species distribution limits.
Te Anau Downs	6.4	Ecological value of indigenous turf vegetation not assessed.	Requires assessment.
Assessment of Effects on Terrestrial Ecology			
Route options	7.1	Potential for separate construction track and monorail to have cumulative effects on canopy opening on side slopes.	Requires detailed assessment.
Vegetation clearance	7.3.1	Minimum widths are given for the construction track and spur roads, but no allowance for drainage and batter slopes appears to have been made. Calculations assume no clearance or modification of vegetation outside the minimum cleared areas, but this seems unlikely.	Requires reassessment.
Tree removal	7.3.1	Uncertainty over the number of trees that will be removed, and how many very large trees will need to be removed.	Requires more detailed assessment based on detailed monorail route planning incorporating mapping of significant trees within the corridor.
Edge effects	7.3.1	The potential for edge effects along the monorail corridor has not been sufficiently addressed.	Requires more assessment.
Tree removal	7.3.1	Effects of tree felling and movement of felled material under-estimated.	Significant damage is likely to occur outside the minimum clearance areas.
Canopy removal	7.3.1	The potential for creation of canopy gaps is under-estimated. The effects of passing bays, close proximity	There is potential for larger canopy gaps on side slopes and where forest comprises large trees, and where these factors

Matter	Section	Issue	Further Requirement or Comment
		of construction track and monorail, and removal of adjacent trees for safety reasons, have not been sufficiently evaluated.	coincide. A more detailed assessment is required.
Tussock grassland	7.3.1; 7.5	Affected area not defined, proposals to use stripped tussock grassland for rehabilitation are optimistic. An increase in the invasion and dominance of exotic grasses and weeds is inevitable in areas of tussock grassland disturbed by monorail construction.	There will be permanent irreversible adverse effects on tussock grassland vegetation and these will need to be mitigated.
Te Anau terminus	7.3.1	Effects of construction on indigenous turf vegetation are not recognised.	Further assessment required.
Soil storage areas	7.3.1	It is proposed to reuse excavated soil to rehabilitate the ground surface under the monorail, but soil storage areas have not been defined, or their effects assessed.	Further information and assessment required.
Forest debris	7.3.2	Applicant would prefer to remove cleared and felled forest debris from the forest.	Ecologically, it would be beneficial to retain forest debris within the forest.
Sites where effects will be greater	7.5	Sites where adverse effects are likely to be greater are identified, but the consequences of those effects for indigenous habitats, vegetation, and species are not identified.	Effects are likely to include more extensive clearance and modification of vegetation, and larger canopy gaps.
Rarity of forest types	7.5	The extent of red beech forest in the region is overstated.	Red beech forest is restricted to warm, fertile sites and is not nearly so widespread as mountain beech and silver beech forest.
Indigenous dominance and species composition	7.5	It is suggested that indigenous dominance and species composition will remain similar throughout the route.	This will not be the case in indigenous grassland, and there will be permanent effects on indigenous dominance and species composition along the monorail and road corridors.
Long tailed bats	7.5	Loss of a few key roost trees could significantly impact the long-tailed bat population.	More certainty is required that this will not occur.
Monitoring and adaptive management	7.5	It is suggested that monitoring and adaptive management will ensure that values are protected.	This is very unlikely for some values, such as tussock grassland and old growth red beech trees.
Mitigation	9.1	Confusion over avoidance, remediation, and mitigation.	Mitigation is required for residual effects after avoidance and remediation have been implemented.
Envelope approach	9.2.1	The 200 m construction corridor means that effects cannot be accurately assessed.	Mapping large trees near the route and a LIDAR topographic survey would help to refine the route and gauge effects.
Weeds in grassland	9.2.2	The report considers that weeds can be successfully controlled in tussock grassland.	There are no practical methods for controlling grass and herb weeds in indigenous grassland vegetation.

Matter	Section	Issue	Further Requirement or Comment
Mountain biker effects	9.2.4	Report states that mountain bikers could have significant effects on vegetation and fauna.	This statement is not backed by supporting evidence, but if it is true, then creation of the mountain biking route should be reviewed.
Rehabilitation	9.3	Proposals for prompt rehabilitation of disturbed areas are very optimistic and lack methodological detail.	Considerable practical difficulties are glossed over, and we do not share this optimism.
Mitigation of Effects on Terrestrial Ecology			
Pest control	9.4	Pest control mitigation options are not sufficiently detailed.	More detail needed before their value can be assessed.
Mitigation	9.4	Adverse effects on indigenous vegetation are not mitigated.	Mitigation needs to be developed for unavoidable adverse effects on indigenous vegetation.
Monitoring			
Monitoring	10.2.1	Monitoring proposals generally lack detail, and some are of uncertain merit.	Other than visual monitoring of woody weeds, the vegetation and weed monitoring proposed is poorly conceived.
Monitoring	10.2.2	Monitoring targets are of uncertain merit or redundant.	Vegetation composition is not assessed in grassland, and forest monitoring relates only to weeds.
Monitoring	10.3.1	Monitor only for rats and possums. No details of how soon monitoring would begin before construction, or how long it would last once the monorail became operational.	Control is only specified for rats and possums, which would be insufficient to enhance natural revegetation or survival of planted plants in disturbed areas.
Monitoring rats	10.3.2	No details about location of control site (distance from development) or how rat population would be reduced if monitoring indicated it was necessary.	Details required for location of control site, the rat density threshold that would trigger control, and how the rat population would be controlled.
Monitoring possums	10.3.3	No details about location of control site (distance from development) or how possum population would be reduced if monitoring indicated it was necessary.	Details required for location of control site, and how the possum population would be controlled.
Monitoring mustelids		No monitoring of mustelid populations proposed even though a protocol is available.	Monitoring is warranted given that the development may aid dispersal of ferrets to grassland and tussocklands areas via routes.
Monitoring deer, rabbits and hares		No monitoring or control of these pest populations is proposed.	Control likely to be necessary as these species will impede re-establishment of some native plant species over disturbed areas.
Monitoring bird abundance	10.4.2	Lacking detail of procedure. Carrying out monitoring at 5-yearly intervals would not be useful due to annual variation.	Specify how many counts will be carried out in each habitat type. Best carried during Oct-Dec. Needs to be done annually in order to determine trend.
Monitoring lizards	10.4.3	No field survey proposed even though several species will be present and detection techniques are available.	Prudent to have a survey carried out by a herpetologist in summer.

Matter	Section	Issue	Further Requirement or Comment
Monitoring bats	10.4.4	RHL regards protocols for bat monitoring as prohibitive.	Need to determine whether a repeat of the Nov 09 protocol (use of bat detectors) annually would be appropriate to detect any major population changes as a result of development.
Appendices			
Plant list	Appendix	Errors in plant species list	Indicates poor familiarity with local flora
Spring Survey Report			
Vegetation plots	2.3.1	Unlikely that plots were located in an unbiased manner.	Interpretations generated from plot information need to be viewed with caution
Rare plant species	3.1	*Libertia* sp. unlikely to be *L. peregrinans*.	The *Libertia* plants should have been confidently identifiable based on vegetative characters.
Vegetation plots	3.2	Large differences in data from small versus large plots.	Most likely caused by sampling error or observer bias.
Vegetation plots	3.2	Small area sampled.	Results may not be representative of forest types across the site, but mean values of combined data likely to be more accurate.
Avifauna	4.1	No list of species detected during Nov 09 compared with previous surveys.	A complete list of species detected during all 3 surveys would be useful, along with threat status, and habitats found in.
Cycle Link Route Report			
Vegetation map	3.1	Vegetation mapped as linear features in four broad classes.	Ecologically significant bog pine shrublands are not identified on the map.
Indigenous plant species	3.1	A large number listed, but list includes significant identification errors.	Many fewer indigenous plant species likely to be present.
Wetland effects	6	Boardwalks are suggested to avoid effects on wetlands.	Boardwalks may not be feasible in peat-based wetlands. It would be preferable for the track to avoid wetlands.
Effects assessment	6	The assessment is minimal and contains substantial information gaps.	A comprehensive and accurate assessment of effects is required.
Mitigation	7	Mitigation proposals are poorly conceived.	Only one mitigation action is defined, and there is no information on which to assess its value. No mitigation is proposed for adverse effects on important ecosystems.

Table 3: Summary of monorail and mountain bike construction and operational effects and their scale.

Type of Effect	Activity
No effect	
Minimal effect	Monorail beam shading and heating effects.
Temporary effect	Noise of passing monorail
Minor effect	Small scale spills of hydraulic oil.
Potential significant adverse effect	Clearance, modification, and disturbance of mountain beech and mixed beech forest, including edge effects. Effects of construction on indigenous turf vegetation and *Kirkianella* habitat at Te Anau Downs. Woody weed invasion.
Unmitigated potentially significant adverse effect	Loss of old-growth beech trees and physical disturbance of indigenous grassland vegetation.
Insufficiently assessed effect	Loss of trees, habitats of cavity-nesting or -roosting indigenous fauna and creation of canopy gaps, especially on side slopes and in red beech forest Effects of the cycle link route construction/ operation. Construction and operation of the monorail is likely to generate larger ecological effects than assessed in the MP reports.
Positive effect	Pest animal control proposed as mitigation.

8. CONCLUSIONS

The Department of Conservation asked Wildland Consultants Ltd to consider:

- **Whether RHL and/or its consultants have used accepted processes, methodology, and industry standards in the application, EIA, and additional reports.**

  Although there is insufficient information to be entirely sure, plots set up to measure forest structure do not appear to have used objective methodology and are likely to be subject to bias. A greater number of plots would also be required, stratified according to forest type, to accurately represent forest structure along the monorail route.

  The assessment of the cycle link route does not meet industry standards except as a scoping report.

- **Whether the contents of the application, EIA, and additional reports are factually correct.**

  There are factual errors in the plant species lists, which cast doubt on other botanical findings.

- **Whether there are any information gaps or omissions in respect of the activities proposed on public conservation land.**

  The envelope approach used by the applicant means there is insufficient information on the magnitude of potential effects generated by the monorail development.

  Survey and monitoring proposals for indigenous fauna and pest animals are of insufficient coverage, and mostly lack thresholds that would trigger control. Methods of control have not been determined in the event of thresholds being exceeded.

- **Whether the applicant has identified all potential effects of the activities proposed on public conservation land, and whether measures proposed to avoid/remedy or mitigate adverse effects are appropriate.**

  The potential effects of the monorail and construction track on ecological values are under-estimated and have not been sufficiently quantified, so that the residual adverse effects cannot be determined, and it is not possible to fully assess mitigation requirements. Current mitigation proposals address only some types of effect.

  The information in the cycle link report does not allow proper assessment of potential effects, and there is no mitigation for some effects along this part of the route.

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