MILL ROAD CORRIDOR NOTICE OF REQUIREMENT

Assessment of Ecological Effects

Prepared for Auckland Transport

6 October 2014

Boffa Miskell

Document Quality Assurance

This report has been prepared in accordance with Boffa Miskell quality assurance procedures, and has been reviewed and approved for release as set out below.

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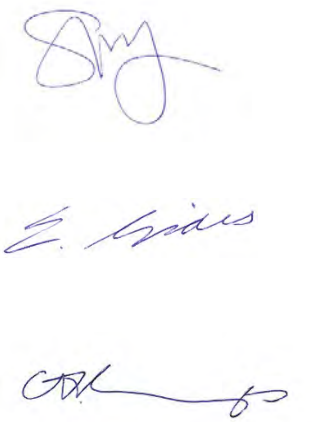
Prepared by:	Sarah Flynn Associate Principal (Ecology) Boffa Miskell Ltd Eddie Sides Principal (Ecology) Boffa Miskell Ltd Georgia Cummings Ecologist Boffa Miskell Ltd	
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Executive Summary

The Mill Road Corridor project involves the widening of the existing Redoubt Road – Mill Road carriageway between Manukau and Alfriston, together with a new eastern deviation to the immediate east of Totara Park. It also involves the widening of Murphy's Road together with a new intersection with Redoubt Road, and upgrades to the intersections at Mill Road – Ranfurly Road and Mill Road – Alfriston Road. This report assesses the ecological effects of these works. In doing so this report recognises the existence of the current busy two lane arterial route along Redoubt Road and Mill Road, and the fact that in general any road-related ecological effects are (by and large) already manifest as a result.

Previous studies had evaluated several options, with Opus investigating ten options for the Redoubt Road/ Mill Road Corridor and four options for the Murphy's Road Corridor. Kessells & Associates (2008) assisted in this process by evaluating the ecological effects associated with the final selected five options, referred to as Options C, D and J (for the Redoubt Road / Mill Road Corridor) and Options I and K for the Murphy's Road Corridor. These five options were then further fine-tuned and allocated new names, being Eastern 1-3 and Northern 1 and 5. The ecological effects of these final five options were then assessed by Wildlands (2012). Following this evaluation process a final preferred option was selected and a Notice of Requirement (NoR) has been served. This present report focuses on the ecological effects of the road alignment that is the subject of that NoR.

The majority of the landscape along the Redoubt Road portion of the corridor is urban residential, while that along the Mill Road and Murphy's Road sections is predominantly rural. Two areas of native forest are crossed by way of elevated bridges, with these being at 146 Mill Road and within the Watercare property at 38 Mill Road. The latter includes an area of native-exotic scrub that is also spanned by that same bridge.

While the footprint of these two bridges spans over 3,100m^2 of forest and 2,900m^2 of mixed quality scrub the main impacts are restricted to canopy trees, which will need to be felled. Other canopy trees may also die back as a result of the ensuing reduction in light levels, although both bridges are elevated with highpoints of 17m and 23m respectively and so not all canopy trees within the footprints will be affected. Additionally, for the most part the existing understorey within these bush areas is likely to remain intact, since the bridge structures will simply replace the dense canopy foliage that already keeps light levels subdued in the understorey. There will be some loss of understorey beneath the Watercare bridge to accommodate a haul road and several piers that will support the bridge. This adverse effect cannot be avoided but can be mitigated. There will be no direct disturbance to the understorey of the bush at 146 Mill Road.

In addition to the above some outlying trees and shrubs on the edge of Murphy's Bush may need to be cleared to extend the existing road culvert here by several metres. However, at this stage of design it is unclear in which direction this culvert will need to be extended, and if this extension is solely on the eastern side of the existing road no native trees should be affected.

No At Risk or Threatened species of flora or fauna were observed to be present over the course of the field surveys. No native skinks were observed to be present although the introduced rainbow skink was found, and a solitary native gecko was seen in Totara Park. No bats were detected by the ABM's, and the local birdlife was found to be unremarkable and dominated by introduced species. The likelihood and magnitude of both direct and indirect effects (such as noise and light) on native fauna were assessed, and all in all the anticipated effects on native wildlife are likely to be minor or less.

The project includes crossing over six permanent streams, a few intermittent streams and several ephemeral reaches. However, since the design includes two bridges the actual loss of stream habitat is restricted to a total length of 80 linear metres. Using the SEV criteria, in areas of native forest most of the streams were of either of Excellent or Good quality. Conversely those streams flowing through farmland were of either Moderate or Low quality. Given that the streams within bush are being bridged, and further given that the extension to the culvert at Murphy's Road is modest (involving several metres), the anticipated adverse effects on streams are not high and can be mitigated. The exact form and extent of mitigation will be resolved during the subsequent resource consent stage of the project.

While overall the adverse ecological effects associated with the project are not considered to be high there are nevertheless going to be some residual such effects. While the significance of these is variable, it is considered that all can be appropriately mitigated. The mitigation works recommended in this present report are described in detail in section 7.0.

1.0 Introduction

1.1 Project Description Overview

The Mill Road Corridor Project involves the upgrading (in part) and construction (in part) of an 8.9km arterial route between Redoubt Road in Manukau and Mill Road in Alfriston. Currently the existing corridor has a poor crash record and provides a poor quality arterial connection east of SH1. Population growth and future development in the area of Flat Bush, Papakura and Takanini areas will place increased pressure on this existing route which necessitates the need to upgrade the corridor. The planned road upgrade and new construction will feature four lanes, cycle lanes and improved pedestrian and bus facilities to ease the impact of the future growth. A preferred route has been selected based on multiple criteria analyses (Figure 1). There are 3 separate Notices of Requirement associated with the upgrade, as shown in Figure 1.

This report assesses the ecological effects of that preferred alignment. In doing so this report recognises the existence of the current busy two lane arterial route along Redoubt Road and Mill Road, and the fact that in general (and subject to site specific effects arising from construction) any road-related ecological effects are already by and large manifest.

1.2 Previous Ecological Reporting

An iterative approach has been taken to date in relation to assessing an initial wide number of possible options. In relation to ecology, Kessels & Associates (2008) assessed the effects of 12 route options, and then went on to describe in further detail the effects of the subsequently selected five preferred options. It is noted that those investigations were "high level" and involved a restricted amount of actual field studies, relying instead on existing databases (such as the Freshwater Fisheries Data Base (FFDB) and records from the Ornithological Society of New Zealand (OSNZ)) and previous reports (Survey Report for the Protected Natural Areas Programme – Hunua Ecological District; ARC annual water quality reports for the Puhinui and Papakura Streams). No lizard surveys or bat surveys were undertaken, and only "*a brief inspection of the macroinvertebrate populations was undertaken in July 2008*". Notwithstanding this, vegetation and birds were surveyed more thoroughly over the course of three surveys and the report contains detailed information on these two ecological aspects.

Wildlands (2012) built upon that earlier study by investigating a fine tuned set of those same five options. Their field investigations were also "high level" and involved reliance on the FFDB (for fish data) and DOC's Bioweb Herpetofauna Database (for lizard data). No avifauna, bat or aquatic macroinvertebrate surveys were undertaken, with reliance instead on the records from data bases and the earlier Kessels & Associates (2008) report. However, the vegetation surveys appear to have been relatively comprehensive.

Neither the Kessels & Associates (2008) nor the Wildlands (2012) reports recommended an overall preferred option, but rather clearly identified the adverse effects associated with each of the options that were under consideration. However, Wildlands subsequently did attend a Multi Criteria Analysis workshop with the project team in 2013, and considered all options poorer than the Do Nothing option with the exception of Northern A which was neutral. Simply in terms of vegetation (habitat) loss alone this is an appropriate conclusion. As a result of that workshop a final preferred option was selected and a Notice of Requirement (NoR) has since been prepared and lodged. This preferred option is that referred to in the earlier reports as Eastern 3, and forms the focus of this assessment.

In recognition of the "high level" nature of the previous investigations Boffa Miskell undertook additional field studies in 2014. These were more intensive and comprehensive than the previous studies, and included surveys for bats, avifauna, skinks, geckos, vegetation and freshwater communities.

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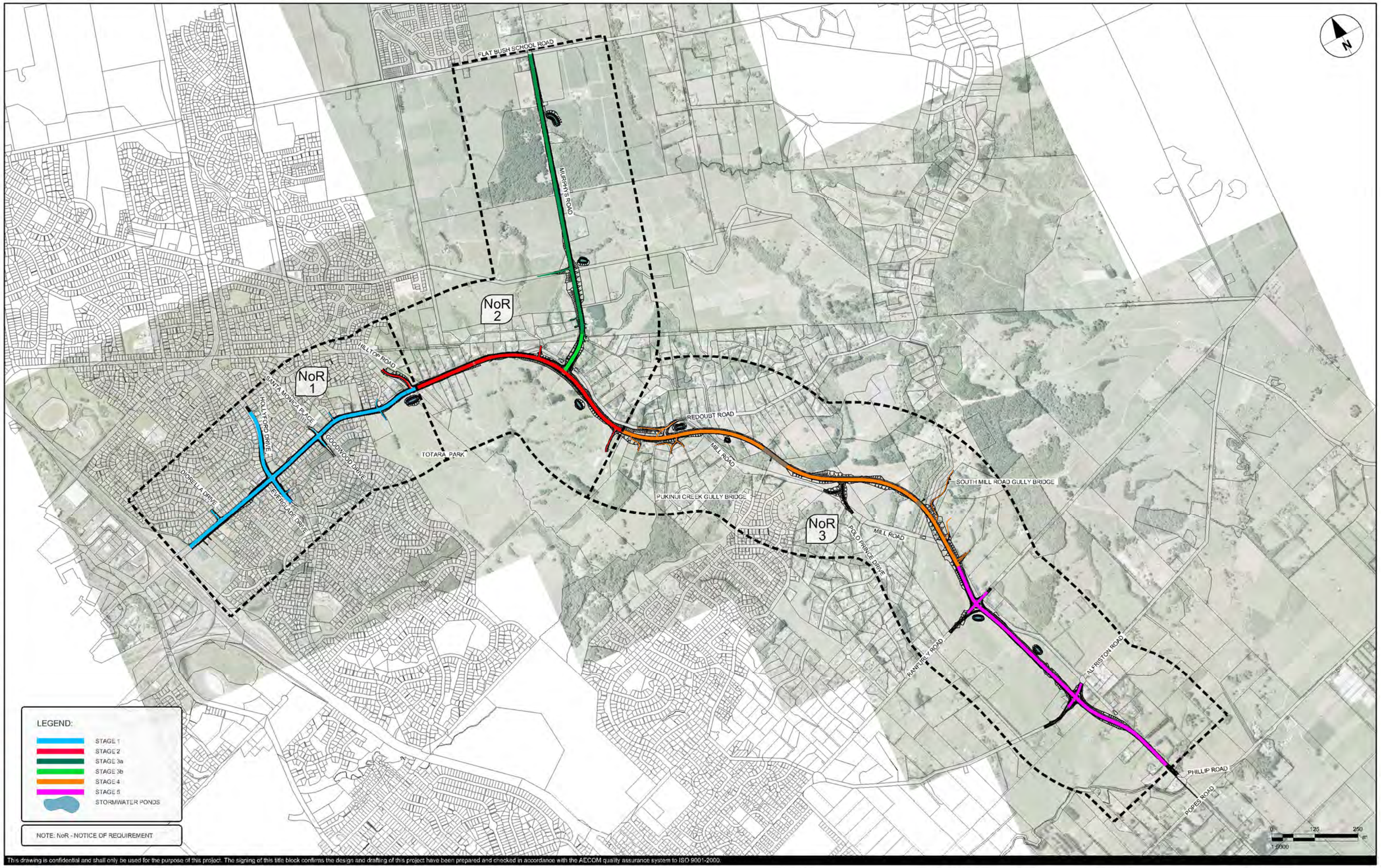

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REGISTRATION

PROJECT MANAGEMENT INITIALS

DESIGNER	CHECKED	APPROVED

FOR INFORMATION ONLY

ISSUE/REVISION

I/R	DATE	DESCRIPTION
B	09.09.14	General updates
A	03.09.14	For Information Only

PROJECT NUMBER
60317081

SHEET TITLE
Staging of Prefered Option

SHEET NUMBER
60317081-SHT-30-0000-CD-0012

Figure 1: Preferred Alignment NoR's

2.0 Ecological Context

2.1 Manukau Ecological District

The preferred alignment lies within the Manukau Ecological District, in the Auckland Ecological Region. Wildlands (2012) provides a succinct summary of the district as follows.

"Manukau Ecological District covers approximately 62,100 hectares and comprises low altitude hills and flats between the Manukau Harbour in the north and the Waikato River in the south. Underlying geology is predominantly Pliocene- Quaternary basalts, with smaller areas of Pliocene sediments adjoining the harbour, and Holocene river sediments near the Waikato River. Most of the district has fertile, well-drained soils derived from weathered volcanic ash. The fertile soils and reliable rainfall is well suited for agriculture and horticulture, and most of the district has been highly modified.

Former forest cover, most often dominated by puriri (*Vitex lucens*), taraire (*Beilschmiedia tarairi*), or kahikatea (*Dacrycarpus dacrydioides*), has been severely reduced in extent (Auckland Regional Council 2004). Only 908 hectares of the original 42,462 hectares (2%) of podocarp/broadleaved and kauri (*Agathis australis*) forest remains, and of the 908 hectares, only 103 hectares (2%) is protected. The loss of freshwater wetlands has been even greater with 105 hectares (0.4%) remaining, of which only two hectares are protected".

Murphy's Bush, through which the proposed road corridor (and existing Murphy's Road) passes, is one of the largest remnants of indigenous forest remaining in the northern part of Manukau Ecological District. This forest, which regenerated following logging in the 1880s, is regarded as the best remaining example of dense kahikatea forest in Auckland (Clapperton 2004), and the flora has been well documented for vascular plants (Clapperton 2004), liverworts (Renner 2004), lichens (Blanchon et al. 2004), and fungi (Shirley 2004).

This forest remnant was not included in the description of natural areas for the Manukau Ecological District by Auckland Regional Council (2004) as, at this time, the Ecological District boundaries placed Murphy's Bush in Tamaki Ecological District. However, with only 1% of podocarp-broadleaved forest remaining in the Tamaki Ecological District, and only 2% in the Manukau Ecological District, Murphy's Bush is highly significant regardless of the Ecological District to which it belongs. Indeed, it has been described in a 2008 review of the Auckland Regional Policy Statement as being one of the finest examples of regenerating kahikatea forest in Auckland, one of the few stands of native forest remaining on the lowlands of the former Manukau District and the largest and only podocarp forest in the Ecological District.

3.0 Methodology

3.1 Vegetation

Vegetation was initially assessed by way of visual survey along the 6km stretch of Mill Road within the construction footprint of the preferred alignment. Areas of indigenous vegetation were subsequently identified for more detailed investigations.

Field surveys were specifically undertaken by expert botanists within native bush at Murphy's Bush, Totara Park, 134 Mill Road and the Watercare property at 38 Mill Road. These field surveys involved a number of transects within the bush patches (the routes being selected to include all obvious ecological gradients), noting species and habitat characteristics such as understorey integrity, weed impact, canopy intactness and general ecological attributes. These surveys were undertaken in April 2014. Species were recorded and general notes taken in terms of vegetation quality and other ecological attributes.

3.2 Avifauna (Birds)

Avifauna habitats were identified over the course of a site reconnaissance survey in early April 2014, with the assessment being based on factors including food availability, presence of suitable nest sites, habitat linkages and vegetation condition. Three dawn and dusk five minute bird counts were then undertaken by an expert ornithologist at sites deemed to be representative bird habitat (Figure 2), and incidental observations of birds were recorded during all other ecological field surveys.

The surveys were conducted at dawn and dusk on April 8th, 9th and 14th 2014. The listening stations were located at five locations, being Murphy's Bush, the Puhinui Stream bush at 38 Mill Road (the Watercare property), and opposite 242 Redoubt Road, 134-146 Mill Road and 232 Mill Road. The same observer was used for all sampling runs, eliminating observer bias.

New Zealand Bird Atlas data (OSNZ 2007, derived from surveys undertaken in 1999-2004) and records from previous avifauna surveys of pastoral land in Manukau ED (Boffa Miskell 2010) were also compiled and compared with site observations.

3.3 Bats

Bats were surveyed using eight Automated Bat Monitors (ABM's) deployed over a two week period in April 2014 (Figure 2). While this period was not optimum for bat investigations (given that in the colder months native bats enter a torpid state with decreased activity, including flight and feeding) the nocturnal temperatures nevertheless remained above 13^0C and conditions were considered to be acceptable for ABM surveys.

ABM's passively record both long-tailed bat (40 kHz) and lesser short-tailed bat (28 kHz) echolocation calls on two concurrently operating frequency channels. They operate remotely by recording and storing each echolocation call (bat pass), along with the date and time of occurrence. The ABMs were set to record from half an hour before sunset until half an hour after sunrise. Eight ABMs were deployed for a two week period in April 2014 (Figure 2). They were deployed along the obvious local potential flyways around the preferred alignment, at both ends, and in proximity to mature (potential roost) trees.

In addition Auckland Council provided records from its regional bat monitoring programme.

3.4 Herpetofauna (Lizards)

The lizard investigations were undertaken by Ecogecko Ltd. Their full report is included as Appendix 1.

3.4.1 Literature Review

The Department of Conservation's (DOC) Bioweb Herpetofaunal Database was searched for all records of terrestrial herpetofauna previously observed within the local Ecological District, and an assessment made (based upon expert opinion and experience) of the likelihood of their occurrence within the footprint of the preferred alignment.

Lizard taxa known to occur in the Manukau ED are copper skinks, moko skinks, ornate skinks, shore skinks, the introduced rainbow skink, as well as forest geckos, elegant geckos and Pacific geckos. The significance of occurrence of each species in the proposed development footprint is listed in Table 1.

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Data Sources: Auckland Council (2010-2011 Aerials), EcoGecko, Aecom, Boffa Miskell

Legend

- 5 Minute Bird Counts
- Lizard Survey Locations
- Pitfall Transects
- Spotlighting
- VES
- Bat Box Locations
- SEV Locations
- Stream Surveys
- Pond Locations
- Preferred Route

MILL RD UPGRADE

Figure 2a: Preferred Option Route

Date: 22 August 2014 | Revision: 0

Plan Prepared by Boffa Miskell Limited

Drawn: sandeep.gangar@boffamiskell.co.nz | *Checked: DSI*

File Ref: A14034_20_Figure2_Prefered_Option_Route_revA.mxd

Boffa Miskell
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1:8,500 @ A3

Data Sources: Auckland Council (2010-2011 Aerials), EcoGecko, Aecom, Boffa Miskell

Legend

- 5 Minute Bird Counts
- Lizard Survey Locations
- Pitfall Transects
- Spotlighting
- VES
- Bat Box Locations
- SEV Locations
- Stream Surveys
- Pond Locations
- Preferred Route

MILL RD UPGRADE

Figure 2b: Preferred Option Route

Date: 22 August 2014 | Revision: 0

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0 100 200 Meters
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Data Sources: Auckland Council (2010-2011 Aerials), EcoGecko, Aecom, Boffa Miskell

Legend
- 5 Minute Bird Counts
- Lizard Survey Locations
- Pitfall Transects
- Spotlighting
- VES
- Bat Box Locations
- SEV Locations
- Stream Surveys
- Pond Locations
- Preferred Route

MILL RD UPGRADE

Figure 2c: Preferred Option Route

Date: 22 August 2014 | Revision: 0

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File Ref: A14034_20_Figure2_Prefered_Option_Route_revA.mxd

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0 100 200 Meters
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Data Sources: Auckland Council (2010-2011 Aerials), EcoGecko, Aecom, Boffa Miskell

Legend

- 5 Minute Bird Counts
- Lizard Survey Locations
- Pitfall Transects
- Spotlighting
- VES
- Bat Box Locations
- SEV Locations
- Stream Surveys
- Pond Locations
- Preferred Route

MILL RD UPGRADE

Figure 2d: Preferred Option Route

Date: 22 August 2014 | Revision: 0

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Table 1: Threat status, likelihood of occurrence and significance of occurrence of lizards in the Manukau ED

Common name	Scientific name	Threat status	Likelihood of occurrence	Significance of occurrence
Copper skink	*Oligosoma aeneum*	Not Threatened	Moderate	Low
Moko skink	*Oligosoma moco*	At Risk – Relict	Moderate	High
Ornate skink	*Oligosoma ornatum*	At Risk – Declining	Moderate	High
Rainbow skink	*Lampropholis delicata*	Introduced	High	Low
Shore skink	*Oligosoma smithi*	Not Threatened	Low	Moderate
Elegant gecko	*Naultinus elegans*	At Risk - Declining	Moderate	High
Forest gecko	*Mokopirirakau granulatus*	At Risk – Declining	Moderate	High
Pacific gecko	*Dactylocnemis pacificus*	At Risk – Relict	Moderate	High

3.4.2 Habitat Assessment and Site Reconnaissance

Possible locations for undertaking visual encounter surveys and night spotlighting for herpetofauna were determined prior to visiting the site. A rapid site reconnaissance was used to ground-truth chosen areas, with survey areas being adjusted or confirmed based on habitat suitability and access. Table 2 explains the survey methods used to detect different lizard species. Because no search method is appropriate for all species and sites, the use of more than one technique during lizard inventorying improves the detection of lizard species.

Table 2: Survey methods and target species.

Common name	Scientific name	Day searches	Pitfall traps	Spotlighting
Copper skink	*Oligosoma aeneum*	✓	✓	
Moko skink	*Oligosoma moco*	✓	✓	
Ornate skink	*Oligosoma ornatum*	✓	✓	
Rainbow skink	*Lampropholis delicata*	✓	✓	
Shore skink	*Oligosoma smithi*	✓	✓	
Forest gecko	*Mokopirirakau granulatus*	✓		✓
Pacific gecko	*Dactylocnemis pacificus*	✓		✓
Elegant gecko	*Naultinus elegans*	✓		✓
Total Survey Effort		**6 person hours**	**230 'trap days'**	**5.5 person hours**

3.4.3 Visual Encounter Surveys

Visual Encounter Surveys (VES) were undertaken during the day between the 15th and 19th of April 2014 (using the same two herpetologists each day). Search effort was based on a consideration of habitat quality (i.e. targeting habitat types known to support lizards). VES were undertaken in a number of places and habitat types (Figure 2). VES effort involved scanning vegetation for active or basking lizards, lifting ground cover objects and searching crevices in dead wood or debris piles.

Night searches for arboreal geckos using powerful torches (*LED Lenser*® P7.2) and spotlighting binoculars were completed during mild and still weather conditions on the evening of the 18th May. All surveys were undertaken by one very experienced herpetologist and an ecologist with good lizard survey experience.

3.4.4 Pitfall Trapping

Pitfall traps were used to assist in surveying for, capturing and identifying any skink species present in the preferred alignment footprint. A total of six transects (A-F) consisting of 10 pitfall traps each (baited with canned pear) were deployed (Figure 2), in suitable habitat likely to be occupied by skinks across the site (total 60 pitfall traps, separated by 5-10 m intervals along each transect).

The trap transects were located within that part of Totara Park opposite the Watercare property (two transects), within the bush on that same property (two transects) and in areas of rank pasture within that same property (two transects). Traps were deployed for four days and checked once daily (total trapping effort = 240 trap days).

Pitfall trapping is a common method used for surveys or monitoring of terrestrial herpetofauna (e.g. Fisher et al. 2008). These traps are most useful for capture of terrestrial skinks and the traps can capture any of the skinks known to be resident in the Manukau ED. The pitfall traps used for the Mill Road corridor survey consisted of a 250 mL plastic container dug into the ground with a plywood cover placed on top, approximately 2 cm off the ground, in order to allow skinks to enter the trap.

3.4.5 Habitat Surveyed and Restrictions

Lizard habitat within the footprint of the preferred alignment consists of rank grass areas along fence lines and bordering bush or scrub, mixed exotic/native scrub, areas of mature broadleaf-conifer forest and gullies with existing and planted native vegetation. Bush edges provide areas of kikuyu and other rank grasses and often gorse. All of these habitat types can support both terrestrial skinks and arboreal geckos. Areas adjacent to the current road that are regularly grazed and mowed, as well as pine plantations, are of lower habitat quality for lizards.

VES and spotlighting areas were chosen to maximise the detection of possible lizard taxa present. Areas with potentially suitable lizard habitat included native bush, patches of kanuka/manuka, rank grass, scrub edges and wooden debris/logs.

Substantial amounts of Totara Park consist of managed farmland with mountain biking paths for the public. Grassy areas are typically grazed or mowed but gullies with existing native vegetation have been re-planted and are fenced off. These areas, although isolated and small (the largest being approximately 0.9 ha) can provide habitat for arboreal geckos and terrestrial skinks.

Large areas of apparently suitable lizard habitat within the preferred alignment footprint could not be surveyed as a result of access issues. Therefore, the searchable habitat along the proposed corridor was restricted, but attempts were made to cover as much accessible habitat as possible that was likely to support lizard populations. It is a reasonable assumption that lizard species found in proximity to the footprint should also be within similar habitats inside the footprint.

3.5 Freshwater

3.5.1 Assessment Approach

The assessment of freshwater ecological values included the following:

- Literature and database review;
- Reconnaissance of the route and stream catchments;
- Permanent and Intermittent Stream classification at all stream crossings;
- Stream Ecological Valuation surveys of selected Permanent Stream reaches;
- Analysis of macroinvertebrate and fish survey results and SEV data.

3.5.2 Stream Classification

Streams were classified and assessed using the stream flow criteria in the Auckland Council Regional Plan: Air, Land and Water (ALWP), as set out in Table 3. They were also classified under the Proposed Auckland Unitary Plan (PAUP) definitions. Under the ALWP, stream works within Intermittent Streams are a Permitted Activity while works within Permanent Streams require a resource consent. Under the PAUP, stream works in either Intermittent or Permanent Streams are Non Complying Activities. The PAUP identifies *Permanent River or Stream* as "the continually flowing reaches of any river or stream", *Intermittent Streams as* "stream reaches

that cease to flow for some periods of the year – including reaches with stable natural pools having a depth at their deepest point of not less than 150mm and a total pool surface that is 10m² or more per 100m of river or stream bed length; and reaches without stable natural pools" and then further notes it excludes *Ephemeral Reaches,* which in turn are defined as "stream reaches with a bed above the water table at all times, with water only flowing during and shortly after rain events."

Table 3: Definition of Permanent and Intermittent Streams, ALW Plan

Permanent River or Stream

Downstream of the uppermost reach of a river or stream which meets either of the following criteria:

- has continual flow; or
- has natural pools having a depth at their deepest point of not less than 150 millimetres and a total pool surface area that is 10m² or more per 100 metres of river or stream bed length;

Intermittent Stream

Any stream or part of a stream that is not a Permanent stream.

Notes: This definition does not include any artificial watercourse (including an irrigation canal, water supply race, canal for the supply for electricity power generation, farm drainage canal and roadside drain and water-table except where the roadside drain or water-table is a modified element of a natural drainage system).

Watercourses were identified using aerial photography, topographical hill shade, contours, Auckland Councils GIS Streams and Hydrology layer and field surveys. As the definition states that all streams that are not Permanent or artificial are Intermittent, an inclusive approach was taken to ensure that streams were comprehensively surveyed.

The waterways and streams within and immediately adjacent to the preferred alignment were walked or viewed from the roadside (i.e. from within the road reserve) to determine their status under the Auckland Regional Council definitions (Figure 2).

The following guidelines were followed when making assessments using the criteria:

Artificial watercourses – excavated drains in areas where the contour indicated that no natural watercourse existed were excluded. Modified natural streams were included.

Natural pools – pools created by artificial or man-made structures were excluded. Pools at culvert inlets and outlets were therefore excluded. Pools created by erosion processes, including those formed at informal livestock crossings, were included. Where cattle pugging occurred in a pool, maximum depth was not measured in hoof prints.

Continual flow – reaches with flowing water, and also with still water that was continuously connected to flowing reaches (i.e. without dry sections delineating pools) were included. In these areas surface water was present throughout the year, although it may be less than 150mm in depth. Saturated mud, where the water table is at or below the ground surface, does not constitute surface water. Intermittent surface water, for example in a wetland with an uneven surface, does not constitute continual flow.

3.5.3 Aquatic Macroinvertebrate Communities

Macroinvertebrate samples were collected at nine sites (Figure 2) following the Ministry for the Environment's '*Protocols for Sampling Macroinvertebrates in Wadeable Streams*' (Stark *et al.* 2001). 'Protocol C2: Soft Bottomed Semi-Quantitative' was used at all sites except for 125 Murphy's Road, which used 'Protocol C1: Hard Bottomed, Semi-Quantitative'. For each sample, benthic macroinvertebrate community health was assessed using the following indices or metrics:

Total Abundance: This is the total number of invertebrates recorded in the samples.

Taxonomic Richness: The total number of taxa (usually species or genus) recorded in a sample. This reflects the general health of the community through a measurement of the variety of the taxa present. Taxonomic richness generally increases with increasing habitat diversity.

EPT Richness: The total number of taxa belonging to the orders Ephemeroptera, Plecoptera and Trichoptera (mayflies, stoneflies and caddisflies, repesctively). These insect groups are generally dominated by pollution-sensitive taxa. Two caddisfly taxa are excluded as they are not indicators of good water quality, these being *Oxyethira* and *Paroxyethira*. The EPT index usually increases with improved water quality and increased habitat diversity, with six or more taxa indicating good conditions.

Macroinvertebrate Community Index (MCI) (Stark and Maxted, 2007): The MCI derives a stream health score from pollution-sensitivity scores assigned to each macroinvertebrate taxon. Taxon scores are between 1 and 10, with 1 representing species highly tolerant of organic pollution (e.g. worms and some dipteran species) and 10 representing species highly sensitive to organic pollution (e.g. some mayflies and stoneflies). A site score is obtained by summing the scores of individual taxa and dividing this total by the number of taxa present at the site. Guidelines for interpretation of scores are provided in Table 4. For example, a low site score (e.g. 40) represents 'probable severe pollution' and a high score (e.g. 140) represents very 'clean' conditions.

Quantitative Macroinvertebrate Community Index (QMCI) (Stark and Maxted, 2007): The QMCI uses a similar approach as the MCI but weights each taxa score based on how abundant the taxa is within the community. As for MCI, QMCI scores can be interpreted as indicated in Table 4. QMCI scores are calculated for samples collected quantitatively and processed according to Protocol 'P3 : Full Count with Sub-sampling Option'.

Table 4 Interpretation of Macroinvertebrate Community Index values from Stark and Maxted (2007).

Quality Class	***Description***	***MCI***	***QMCI***
Excellent	*Clean water*	*> 119*	*> 5.99*
Good	*Doubtful quality*	*100 – 119*	*5.00 – 5.99*
Fair	*Probable moderate pollution*	*80 – 99*	*4.00 – 4.99*
Poor	*Probable severe pollution*	*< 80*	*< 4.00*

Taxonomic Distinctness (Clarke & Warwick, 1998): Taxonomic distinctness is an index combining measures of diversity and relatedness of individuals within a sample based on phylogenetic ranks. The taxonomic distinctness of the macroinvertebrate communities between sampling sites was calculated using the statistical programme PAST 3.02a (Hammer, Harper, & Ryan, 2001). The taxonomic distinctiveness is expressed as an index relative to the commonality of taxa calculated from 200 random replicates drawn from the pooled data set (i.e., from the nine macroinvertebrate samples; one sample from each sample site) and expressed as 95% confidence limits. It is worth noting that the index has been calculated using only the data available from the nine sites sampled for the purposes of this AEE, and is not intended to represent the pool of macroinvertebrates of the broader region.

3.5.4 Fish Communities

The fish communities were sampled at nine sites (Figure 2) using an electric fishing back pack unit (EFM 300). All fish caught were identified, counted and measured before release back to the stream. Fish community taxonomic richness, fish abundance, and conservation and pest status were assessed. The Fish Index of Biotic Integrity (Fish IBI; Joy and Henderson, 2004) was also used to assess ecological values. This index is a measure of intactness of stream communities and indicates the quality of habitats and accessibility to migrating fish.

3.5.5 Stream Ecological Values

Stream Ecological Valuations (SEV) were undertaken at the same sampling sites used for fish and macroinvertebrate communities (Figure 2). The SEV is a comprehensive method for quantifying the value of aquatic ecosystems (Storey *et al*., 2011) and is the method recommended by Auckland Council for assessing the ecological value of streams in the Auckland Region.

The SEV uses a set of fourteen qualitative and quantitative variables to assess the integrity of stream ecological functions. Field work consists of a comprehensive assessment of the in-stream and riparian environment. This includes a fish survey, aquatic macroinvertebrate sampling and cross-sections of the stream to measure width, depth and substrate, as well as using qualitative parameters for reach-scale attributes.

Table 5: Summary of the 14 ecological functions used to calculate the SEV score

Hydraulic functions:	**Biogeochemical functions:**
Processes associated with water storage, movement and transport. • Natural flow regime • Floodplain effectiveness • Connectivity for species migrations • Natural connectivity to groundwater	Relates to the processing of minerals, particulates and water chemistry. • Water temperature control • Dissolved oxygen levels maintained • Organic matter input • In-stream particle retention • Decontamination of pollutants
Habitat provision:	**Biotic functions:**
The types, amount and quality of habitats that the stream reach provides for flora and fauna. • Fish spawning habitat • Habitat for aquatic fauna	The occurrences of diverse populations of native plants and animals that would normally be associated with the stream reach. • Fish fauna intact • Invertebrate fauna intact • Riparian vegetation intact

This data is analysed using a series of formulae in order to produce an SEV score of between 0 (a stream with no ecological value) and 1 (a pristine stream with maximum ecological value). Interpretation of SEV scores is given in Table 6 below.

Table 6: Interpretation of SEV scores (adopted from Golder Associates, 2009)

Score	Category
0 - 0.40	Poor
0.41 – 0.60	Moderate
0.61 – 0.80	Good
0.81+	Excellent

Aquatic communities were surveyed and SEV scores calculated by taking macroinvertebrate samples at nine locations within potential receiving waterways. The sites were as follows:

- Site 1 Headwater tributary of Otara Creek at Murphy's Bush;
- Site 2 Tributary of Puhinui Stream at Totara Park;
- Site 3 Tributary of Puhinui Stream at Watercare property (38 Mill Road);
- Site 4 Headwater tributary of Papakura Stream (within road reserve opposite 146 Mill Road);
- Site 5 Headwater tributary of Papakura Stream (between Alfriston and Ranfurly Roads);
- Site 6 Tributary of Papakura Stream, upstream of Alfriston Road (2 Wastney Road);
- Site 7 Tributary of Papakura Stream, downstream of Ranfurly Road (2 Wastney Road);
- Site 8 Tributary of Papakura Stream between Mill Road and Alfriston Road (2 Wastney Road);
- Site 9 Tributary of Otara Creek at 125 Murphy's Road.

3.6 Ecological Values and Significance Assessment

The ecological values and significance of the indigenous habitats within the Mill Road corridor were assessed using the relevant statutory planning criteria as set out in the Auckland Regional Policy Statement. Case law dictates that such criteria (i.e. those that have legal standing by virtue of their inclusion in statutory documents) must be used in cases where they are available.

3.7 Significance of Effects

A three stage process is used in the effects assessment provided in section 4 of this report utilising matrices, as shown in Tables 7-9 below (modified from Regini (2002) and IEEM, 2002)[1]:

Table 7: Ecological Values.

Value	Explanation
Very High	A reference quality feature in condition close to its pre-human condition with the expected assemblages of flora and fauna and no contributions of contaminants for human induced activities. Negligible degradation.
High	A feature with high ecological or conservation value but which has been modified to the extent it is no longer reference quality. Slight to moderate degradation.
Medium	A feature which contains fragments of its former values but has a high proportion of tolerant fauna and obvious habitat quality issues. Moderate to high degradation.
Low	A highly modified feature with poor diversity and abundance of flora or fauna and significant habitat issues. Very high degradation.

Table 8: Magnitude of Effects

Magnitude	Description
Very High	Total loss or very major alteration to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether.
High	Major loss or major alteration to key elements/ features of the baseline (pre-development) conditions such that post development character/ composition/ attributes will be fundamentally changed.
Moderate	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of baseline will be partially changed.
Low	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre-development circumstances/patterns.
Negligible	Very slight change from baseline condition. Change barely distinguishable, approximating to the "no change" situation.

Table 9: Significance of Ecological Effects

SIGNIFICANCE		**Ecological &/or Conservation Value**			
		Very High	**High**	**Medium**	**Low**
Magnitude	**Very High**	Very High	Very High	High	Medium
	High	Very High	Very High	Medium	Low
	Moderate	Very High	High	Low	Very Low
	Low	Medium	Medium	Low	Very low
	Negligible	Low	Low	Very Low	Very Low

[1] See Appendix 3 for an explanation underlying Boffa Miskell's use of these matrices.

4.0 Results

4.1 Vegetation

The vegetation currently within the footprint of the preferred alignment includes types associated with homestead gardens and amenity trees. These include trees (many large) such as macrocarpa, poplar, willow, *Casuarina,* gums and pines (particularly along Redoubt Road), along with a variety of native amenity trees in some locations. The preferred alignment also traverses two stream gullies containing mature native bush, as well as revegetation plantings in Totara Park. The forested areas involved include part of the bush at 146 Mill Road and the Watercare bush and scrub (a gully at 38 Mill Road on property owned by Watercare). All of these stands contain mature taraire and puriri forest with kahikatea dominating the wet gully floors, with all being markedly homogeneous. The revegetation plantings affected are all in the upper ephemeral reaches of the Puhinui Stream in Totara Park.

In addition the preferred alignment will require localised vegetation clearance on the margin of Murphy's Bush as a result of widening Murphy's Road (and culvert). The vegetation concerned comprises mature deciduous exotic trees on the eastern side and native broadleaved trees and shrubs on the western side. The majority of the works (potentially all) appear to involve the eastern side.

Vegetation associations investigated during the site surveys are described in detail below with a specific focus on the mature indigenous bush remnants that could be affected. The vegetation communities described are mapped in Figure 3 and the potential extent of effects depicted in Figure 8.

4.1.1 Watercare Bush and Scrub

Stream gully vegetation at 38 Mill Road comprises a stand of broadleaved-conifer forest and an adjacent area of tree fern-dominated scrub (hereafter termed Watercare bush' and 'Watercare scrub' respectively). Both of these vegetation types will be crossed by way of a bridge. Within the designation the Watercare bush comprises a stand of mature kahikatea (approximately 18 m or more tall) on the stream terrace and the adjacent hillslopes. The stand is interspersed with rewarewa and a single mature rimu and matai. Cabbage trees, nikau and kanuka are also present. The wider site includes broadleaved forest dominated by taraire and puriri, but this forest type is outside of the designation. The trees affected are all on the outer edges of the forest, and number a few dozen or so individuals. Edge effects are obvious here and the understorey is relatively open, being dominated by a sparse tier of common shrubs and saplings including mahoe, pate, ponga, karamu, nikau, putaputaweta, hangehange and the occasional young taraire, pigeonwood and mingimingi. The forest floor here is carpeted with a mix of slender panic grass, hook sedge and thread fern. Epiphytes, lianes and climbers are all relatively common. Approximately 1,100m^2 (11%) of the Watercare bush as described above is within the bridge footprint. All in all the botanical conservation values of the affected forest area (i.e. within the bridge footprint) were High.

The majority of the Watercare scrub vegetation is very weedy, with a low canopy characterised by mamaku and ponga tree ferns that are surrounded by and interspersed with sizeable infestations of woolly nightshade and gorse, together with multiple patches of young Chinese privet and tree privet. Additional weeds present include Himalayan honeysuckle, pampas, *Tradescantia*, blackberry, Japanese honeysuckle, montbretia, creeping buttercup, lotus and other herbaceous weeds. Shrubs and small trees of common native species are also scattered throughout, including mahoe, kawakawa, hangehange, kanono and saplings of nikau and mapou. *Carex geminata* is present in local swards around the watercourse, and a variety of native ground ferns (gully fern, *Lastreopsis glabella,* kiokio, *Blechnum chambersii*) are also present. Some 1,700m^2 (3%) of this degraded scrub vegetation is located within the bridge footprint.

In addition 1,200m^2 (37%) of better quality scrub is also within the bridge footprint, located adjacent to the kahikatea forest. This scrub is dominated by a 3-5m high canopy of ponga. The understorey is not dense, and includes scattered mahoe, rangiora, hangehange, kanono, turepo, kahikatea saplings mapou and pigeonwood. Ferns and ground tier sedges and grasses are common, as are epiphytes and climbers.

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0 100 m
1:4,000 @ A3

Data Sources: Auckland Council (2010-2011 Aerials), Auckland Council PAUP, Aecom, Boffa Miskell

Legend

Vegetation Types
- Exotic pine
- Mature broadleaf-podocarp
- Mixed scrub
- Taraire treeland

- Significant Ecological Areas
- Preferred Route

MILL RD UPGRADE

Figure 3: Vegetation Types - Preferred Option Route

Date: 14 August 2014 | Revision: 0

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All in all the botanical conservation values of this scrub (both the degraded and better quality portions) are not high, although both bestow benefits to the headwater tributary of the Puhinui Stream that flows through this vegetation.

4.1.2 146 Mill Road Bush

The extent of survey work within the bush at 146 Mill Road was restricted due to access issues, but that portion of it within the property at 134 Mill Road was able to be visited. Views of its canopy were also obtained from neighbouring vantage points.

The bush is an example of old growth podocarp-broadleaved forest with a canopy height of 18-20m. The gully system is dominated by taraire and puriri, interspersed with rimu, rewarewa, karaka, pigeonwood, tawa tanekaha and occasional matai. Kahikatea, nikau, cabbage tree and scattered pukatea occupy the gully floor, while kanuka is locally dominant on steep, drier slopes above the watercourse, with associated canopy species including totara, lancewood and titoki. Mapou, mahoe, ponga, wheki and mamaku are common throughout the subcanopy.

Climbers and epiphytes include NZ passionfruit, small white rata, pink rata vine, hound's tongue fern, fragrant fern, hanging spleenwort, sickle spleenwort, filmy fern, fork fern and leather-leaf fern and kahakaha (*Collospermum hastatum)*. The understorey includes mapou, hangehange, lancewood, karamu, kanono, putaputaweta and occasional flax. *Coprosma spathulata* and mingimingi grow higher up the slopes.

Lacebark, kauri, *Pittosporum*, corokia and five-finger species have been planted along the upper margins of the bush. Ferns (predominantly thread fern, sweet fern, *Lastreopsis microsora* and gully fern) make up most of the groundcover, in addition to seedlings of canopy species and a variety of pasture herbs and grasses.

While this bush will be bridged, approximately 1,500m^2 of it will be directly lost as a result of the bridge abutments, and the bridge itself will span across 500m^2 of bush canopy.

4.1.3 Murphy's Bush

Murphy's Bush is one of the largest remnants of indigenous forest remaining in the northern part of Manukau ED. It is regarded as the best remaining example of dense kahikatea forest in Auckland (Clapperton 2004). Murphy's Bush has been described, in a 2008 review of the Auckland Regional Policy Statement, as comprising:

> *"two stands of kahikatea forest with rimu, totara and matai and broadleaved trees including pukatea, taraire, puriri, titoki and karaka. The forest has a healthy understorey and has been described as one of Auckland's finest examples of regenerating kahikatea forest. The nationally declining (but regionally common) tree Mida salicifolia is present in the understory. The reserve is one of the few stands of native forest on the lowlands in the former Manukau City and is the largest and only podocarp forest in the ecological district. A full range of bird species exist in this rare forest type (kahikatea- podocarp- broadleaved forest)."*

Our own surveys confirmed the above, although it is noted that the area of Murphy's Bush potentially affected by the road widening is very small (numbering a dozen or so trees and shrubs) and characterised by a few karaka, puriri, tawa, titoki and mahoe together with native shrubs. The vegetation on the other side of the road is characterised by two large poplar trees, together with willows, woolly nightshade, a single puriri and a few scattered karaka.

4.2 Birds

The Wildlife Act (1953) provides legislative protection for all wild bird species in New Zealand. Prioritisation for the conservation of bird species in New Zealand is itemised in the Conservation status of New Zealand birds, 2012 (Robertson et al., 2012). Species listed as 'threatened' or 'at risk' in that document are considered to be especially vulnerable and hence worthy of particular consideration in any development proposal.

A total of 15 5-minute bird counts were completed during the survey, with each of five count stations replicated three times over three days (April 8-9th and 14th, 2014) during daylight hours. Count locations are shown in Figure 2. Counts identified a total of 15 bird species (see Table 10). One additional species (yellowhammer, an 'introduced and naturalised' species) was seen while transiting between sites, while Australasian harriers were observed in the course of vegetation surveys.

The most common species recorded were silvereyes, starlings, mynas and tui (Figure 4). New Zealand pigeons were recorded at sites MR01 and MR03, with over 6 birds per count recorded at the latter. All species recorded were either 'not threatened' or 'introduced and naturalised.'

Table 10: Bird species recorded during 5-minute bird counts, April 2014.

Species Name	Threat Classification	Mean number of birds recorded per site				
		MR01	MR02	MR03	MR04	MR05
Blackbird	Introduced & Naturalised	1.0	2.0	1.0	0.3	0.0
Chaffinch	Introduced & Naturalised	0.7	0.7	0.7	0.0	0.3
Dove, spotted	Introduced & Naturalised	0.3	0.0	0.0	0.0	0.0
Fantail, NZ	Not Threatened	1.7	1.0	3.0	2.0	1.3
Magpie, Australian	Introduced & Naturalised	0.0	0.3	0.3	0.0	0.3
Myna	Introduced & Naturalised	5.0	3.0	1.3	6.7	4.0
Kereru	Not Threatened	1.0	0.0	6.3	0.0	0.0
Plover, spur-winged	Not Threatened	2.7	2.0	0.0	0.0	0.7
Pukeko	Not Threatened	0.3	0.0	0.0	0.0	0.3
Rosella, Eastern	Introduced & Naturalised	0.0	0.3	0.0	0.0	0.0
Silvereye	Not Threatened	5.3	8.7	19.0	12.0	21.3
Skylark	Introduced & Naturalised	0.0	0.0	0.0	0.0	0.3
Sparrow, house	Introduced & Naturalised	0.0	0.0	0.0	0.3	0.0
Starling	Introduced & Naturalised	0.0	2.3	16.3	4.7	17.0
Tui	Not Threatened	1.0	0.3	8.0	0.7	0.3

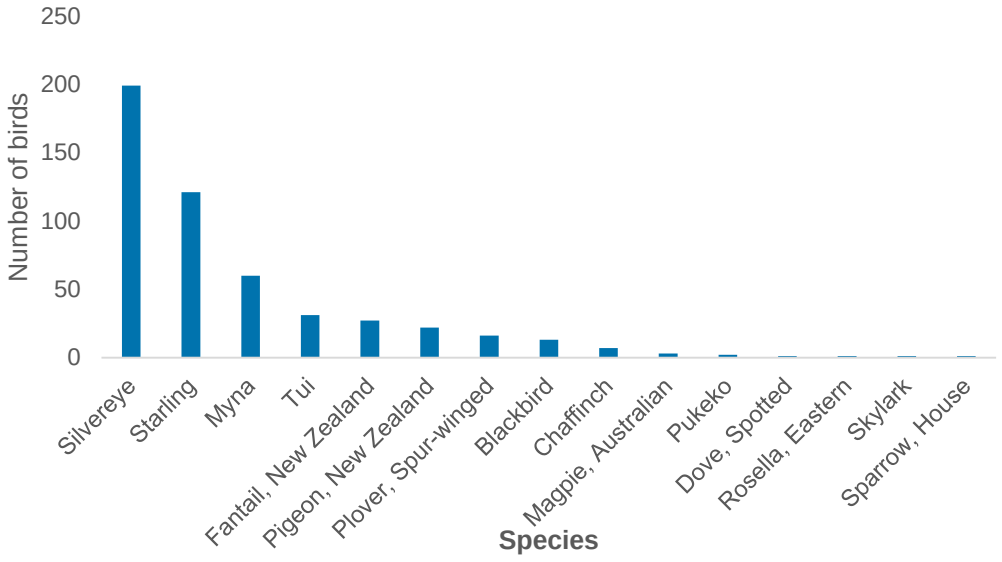

Figure 4: Total number of birds recorded for all sites over the course of field surveys.

Records from the Ornithological Society of New Zealand (OSNZ) were obtained to supplement survey data from the current study. Members of the OSNZ surveyed a 10km^2 area that included the preferred alignment 18 times between1999-2004 as part of the bird distribution atlas scheme (see Robertson et al., 2007). A total of 52 bird species were recorded within the 10km^2 OSNZ survey area (see Appendix 2), including all of the species recorded during the current survey.

Those OSNZ surveys identify a variety of additional species likely to be common in the immediate area, approximately half of which are common exotic species of rural and/or urban environments. Most other species observed during OSNZ surveys but not in the current survey comprise native gulls, shags, waterfowl, and species characteristic of pastoral environments. Additional native species of bush habitats recorded during OSNZ surveys (but not recorded during the Boffa Miskell 5 minute counts) include grey warbler, kingfisher, shining cuckoo and morepork.

OSNZ surveys recorded three 'at risk' species (black shag, little shag, and pied stilt) and five 'threatened' species (dabchick, grey duck, red-billed gull, black-billed gull, and pied shag; see Table 11). All of these are primarily coastal and wetland species. Five species, including black-billed gulls, pied shags, little black shags, dabchicks and grey ducks, were recorded by the OSNZ in wetland habitat only. Black shags and red-billed gulls were recorded in farmland, residential and wetland habitats, and stilts were recorded in wetland and farmland.

Table 11: 'Threatened' and 'at risk' bird species recorded by the OSNZ within 10km^2 of the preferred option.

Species Name	Threat Classification
Duck, Grey	Threatened (Nationally Critical)
Gull, Black-billed	Threatened (Nationally Critical)
Dabchick, New Zealand	Threatened (Nationally Vulnerable)
Gull, Red-billed	Threatened (Nationally Vulnerable)
Shag, Pied	Threatened (Nationally Vulnerable)
Stilt, Australasian Pied	At Risk (Declining)
Shag, Black	At Risk (Naturally Uncommon)
Shag, Little Black	At Risk (Naturally Uncommon)

Given the absence of wetlands along the preferred alignment, wetland-inhabiting species are unlikely to be significantly affected, although shag species may use some of the established trees as occasional roost sites. Species such as stilts and gulls may sometimes feed on inundated pastures in the area during wet weather.

Kessels & Associates (2008) noted that North Island kaka are present in the wider area. Although there are no records of kaka in the vicinity of the preferred alignment, the area may be occasionally frequented by kaka as a seasonal feeding site.

Although the New Zealand pigeon (kereru) is considered 'not threatened' and increasing, it is also classified as 'conservation dependent,' meaning that its survival relies on ongoing efforts to conserve it (Robertson et al., 2012). It is also a valued cultural species and an important seed disperser for many valued large-fruited trees. Much of the mature forested habitat along the preferred alignment is well-suited to its feeding and nesting requirements. This was borne out in the high numbers of kereru seen at site MR03 (see Table 10). This was probably accentuated by heavy fruiting of kahikatea during the survey period which is an important seasonal food source for pigeons (Baker, 2001).

4.3 Bats

There are two extant species of native bat in New Zealand, the long-tailed bat and the lesser short-tailed bat. Both are classed as threated species (O'Donnell et al., 2013). The northern subspecies of the lesser short-tailed bat and long-tailed bat are listed as nationally endangered and nationally vulnerable respectively.

Lesser short-tailed bats are dependent on large tracts of old growth native forest and there are no known populations on the mainland in the Auckland region (Department of Conservation, 1995). Conversely, long-tail bats are edge habitat specialists that utilise various habitats (Department of Conservation, 1995) and populations have been able to persist in a few areas of rural-suburban Auckland[2].

[2] http://naturewatch.org.nz/projects/auckland-bats

The closest known populations of long-tailed bats are both located approximately 10 km away in the Clevedon Reserve to the East. Long-tail bats have large home ranges (upwards of 100 km^2; O'Donnell 2001). Given the mobility of long-tailed bats coupled with the relatively good vegetation connectivity between the site and the Clevedon Reserve, there is potential for bats to be using the area.

No echolocation pulses were recorded on any of the ABM's. Furthermore, Auckland Council has reported that the regional bat survey sites have similarly not recorded any echolocation pulses from the Mill Road area, and they further report that community bat detectors have recorded no bat activity in the Redoubt Road area to date.

4.4 Lizards

Two lizard species were confirmed as present in the areas searched between the 15th and 19th of April 2014, being the introduced rainbow skink and a native unidentified gecko. The gecko could not be identified to species level due to difficulty in capturing the animal, but was most likely a forest gecko. All of the native lizards are endemic to New Zealand and constitute a significant component of our extant fauna. All lizards, except for the introduced rainbow skink, are legally protected under the Wildlife Act 1953, and areas of significant habitat are protected via the Resource Management Act 1991 (Anderson et al. 2012).

No native skinks were found despite suitable habitat being present. However, surveys were conducted in April, when this faunal group tends to become less active as the colder months approach. Further, due to unpredictable weather during Cyclone Ita, detection probability of skinks in the surveys may have been affected. However, unlike skinks native geckos can remain active and detectable during winter months. Jewelled geckos (*Naultinus gemmeus*), for example, can be detected during mild and sunny conditions right throughout winter (Carey Knox, EcoGecko Consultants, *pers. comm*.). Active forest geckos and elegant geckos have also been observed in Auckland during May (Sabine Meltzer, EcoGecko Consultants, *pers. comm*.).

4.5 Freshwater

4.5.1 Stream Classification

Figure 5 presents the Permanent and Intermittent Stream classification of streams potentially affected by the proposed works. Outside of Totara Park almost all of the waterways potentially affected are Permanent Streams, while those in the upper catchment of Totara Park are intermittent or ephemeral reaches.

4.5.2 Freshwater Ecology (Macroinvertebrate and Fish Communities)

The results of the macroinvertebrate investigations are summarised in Table 12, with the results of the taxonomic distinctiveness biometric analysis shown in Figure 6. The results of the Stream Ecological Valuations are given in Table 13.

Table 12: Macroinvertebrate Community Metrics and Fish IBI Scores

	Site 1 Murphys	Site 2 Totara Park	Site 3 Watercare	Site 4 146 Mill Rd	Site 5 Lower Mill Rd
1 Total abundance	92	228	96	147	387
2 Number of taxa	13	10	8	8	16
3 Number of EPT taxa*	4	2	5	5	0
4 MCI score	63	82	116	122	64
5 QMCI score	3.8	2.8	2.8	3.6	2.2
6 Taxonomic Distinctness Indices	4.6	4.9	4.6	4.8	4.6
7 Fish IBI	26	22	26	32	0

File Ref: A14034_41_Amended_Preferred_Option_Figure5_Stream.mxd

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0 100 200 Meters

1:8,500 @ A3

Data Sources: Auckland Council (2010-2011 Aerials), EcoGecko, Aecom, Boffa Miskell

Legend

Stream Classification
- Permanent
- Intermittent

SEV Locations
- Stormwater Wetland
- Preferred Route

MILL RD UPGRADE

Figure 5a: Stream Classification Preferred Route Option

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0 100 200 Meters

1:8,500 @ A3

Data Sources: Auckland Council (2010-2011 Aerials), EcoGecko, Aecom, Boffa Miskell

Legend

Stream Classification
- Permanent
- Intermittent

- SEV Locations
- Stormwater Wetland
- Preferred Route

MILL RD UPGRADE

Figure 5b: Stream Classification Preferred Route Option

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0 100 200 Meters
1:8,500 @ A3

Data Sources: Auckland Council (2010-2011 Aerials), EcoGecko, Aecom, Boffa Miskell

Legend

Stream Classification
- Permanent
- Intermittent

SEV Locations
Stormwater Wetland
Preferred Route

MILL RD UPGRADE

Figure 5c: Stream Classification Preferred Route Option

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0 100 200 Meters
1:8,500 @ A3

Data Sources: Auckland Council (2010-2011 Aerials), EcoGecko, Aecom, Boffa Miskell

Legend

Stream Classification
- Permanent
- Intermittent

SEV Locations
Stormwater Wetland
Preferred Route

MILL RD UPGRADE

Figure 5d: Stream Classification Preferred Route Option

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	Site 6 Ranfurly	Site 7 Alfriston	Site 8 Mill Rd (south)	Site 9 125 Murphy's Rd
1 Total abundance	1501	445	1837	198
2 Number of taxa	15	12	17	25
3 Number of EPT taxa*	1	1	2	6
4 MCI score	71	57	69	90
5 QMCI score	2.4	2.4	2.5	3.3
6 Taxonomic Distinctness Indices	4.0	3.7	4.3	3.9
7 Fish IBI	24	14	14	32

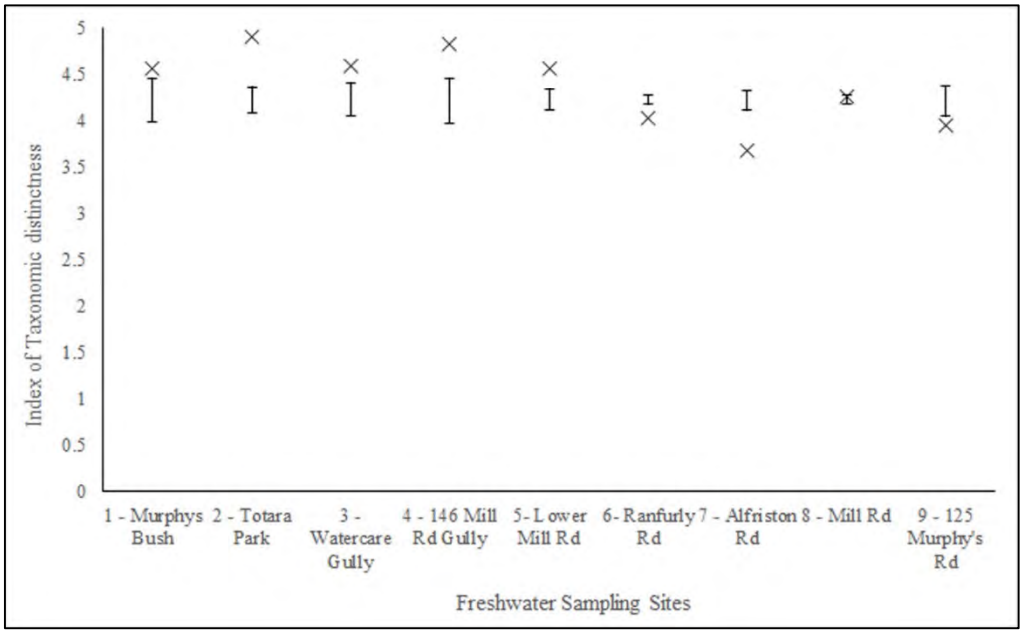
***** excluding *Oxyethira* and *Paroxyethira*

Table 13: Summary of SEV scores, mean scores for function classes and overall mean score

	Site 1 Murphys	Site 2 Totara Park	Site 3 Watercare	Site 4 146 Mill Rd	Site 5 Lower Mill Rd
Hydraulic function	0.92	0.96	0.96	0.67	0.87
Biogeochemical function	0.91	0.78	0.91	0.56	0.43
Habitat provision function	0.67	0.74	0.82	0.40	0.46
Biodiversity function	0.45	0.48	0.54	0.44	0.23
Overall mean SEV score	**0.78**	**0.76**	**0.83**	**0.54**	**0.52**
SEV Range	**Good**	**Good**	**Excellent**	**Moderate**	**Moderate**

	Site 6 Ranfurly	Site 7 Alfriston	Site 8 Mill Rd (south)	Site 9 125 Murphys Rd
Hydraulic function	0.75	0.65	0.64	0.68
Biogeochemical function	0.34	0.28	0.29	0.67
Habitat provision function	0.23	0.23	0.24	0.42
Biodiversity function	0.31	0.21	0.23	0.42
Overall mean SEV score	**0.43**	**0.36**	**0.37**	**0.58**
SEV Range	**Moderate**	**Low**	**Low**	**Moderate**

Figure 6: Indices of taxonomic distinctness (as defined by Clarke & Warwick 1998) of the macroinvertebrate communities sampled at the nine freshwater survey locations along the Mill Road Preferred Alignment.



Site 1 – Murphy's Bush

This site was located on a headwater branch of the Otara Creek, which discharges into the Tamaki Estuary (Appendix 5). The stream on the west of the culvert is located in a native forest reserve, being Murphy's Bush. The upstream catchment is predominantly pasture but vegetation has been retained along much of the stream length, including the headwaters near Redoubt Road.

The stream at this site has high-quality native riparian vegetation and low channel modification, and appears to have good water quality.

Fishes recorded here were shortfin and longfin eel, bully (not identified) and koura (freshwater crayfish), which were very abundant. The Fish Index of Biotic Integrity (IBI) assessment was Poor (score of 26, less than the 50th percentile for Auckland sites), indicating severely impaired fish communities.

Macroinvertebrate communities here had a relatively low abundance but moderate richness, and supported four sensitive EPT taxa (i.e. mayflies, caddisflies and stoneflies) these being *Deleatidium, Aoteapsyche, Triplectides* and *Pycnocentrodes*. Other taxa included snails, worms and amphipods. The MCI-sb score was only 63 and the QMCI-sb 3.8, both in the Poor category, potentially indicating polluted conditions. These low scores were not consistent with the relatively high proportion of EPT taxa, and overall the macroinvertebrate communities indicate better water quality than suggested by the MCI-sb and QMCI-sb (Table 12).

The MCI sample had a relatively high estimate of taxonomic distinctness of 4.6. This index is outside the range of the 95% confidence interval (4.0, 4.5) indicating the distinctness of the macroinvertebrate community, relative to the other sample sites, is higher than would be expected by chance alone.

The overall SEV score was 0.78, in the Good value range. Habitat provision and biodiversity functions were sub-optimal, the latter due to relatively low diversity of fish and macroinvertebrates (Table 13 & Appendix 4).

Site 2 – Totara Park

This site was located on the northern branch of the Puhinui Stream within Totara Park, the catchment for which extends towards Redoubt Road (Appendix 5) (the main stream continues west and passes under Mill Road, and was sampled at Site 3). The Puhinui Stream ultimately discharges into the Puhinui Inlet in the south-east Manukau Harbour. The stream catchment is predominantly pasture with riparian planting along some of its upstream tributaries.

Fish communities consisted of shortfin eel and common bully. The Fish IBI score was 22, indicating poor ecological integrity.

Macroinvertebrate communities had a moderate abundance and richness. The only EPT taxa were *Deleatidium* and *Triplectides*; other taxa included snails, amphipods and midges. The MCI-sb score was 82 and QMCI-sb 2.8, indicating Fair to Poor conditions (Table 12). Macroinvertebrate communities at Site 2 scored the highest in taxonomic distinctness with an index of 4.9. This was well above the 95% confidence interval for the site (4.1, 4.4) indicating the distinctness of the community was higher than expected.

The overall SEV score was 0.76, in the Good quality range. Biodiversity scores were relatively low, but overall integrity was relatively high compared to other sites.

Site 3 – Watercare Gully

This site was located on a branch of the Puhinui Stream on the eastern side of Mill Road (Appendix 5). Upstream habitats were largely unmodified and had an extensive corridor of riparian forest.

Macroinvertebrate communities had a relatively low abundance and richness, but a high proportion of EPT taxa. The five EPT taxa recorded here were *Deleatidium, Neozephlebia* and *Zephlebia, Triplectides* and *Pycnocentrodes*. Other taxa included snails and beetle larvae. The MCI-sb score of 116 indicated good conditions, while the QMCI-sb of 2.8 indicated poor conditions due to sensitive taxa being present but relatively rare (Table 12). The taxonomic distinctness score of 4.6 (CI: 4.0, 4.4) shows a relatively high level of distinctness that is greater than would be expected by chance alone.

Fish recorded here were eels (not identified) and common bully, while koura were very abundant (around 80 koura were recorded). The Fish IBI score was 26, indicating Poor integrity and a high level of impacts.

The overall SEV score was 0.83, in the excellent quality range. Biodiversity functions were sub-optimal, but overall functional integrity was high (Table 13).

Site 4 –146 Mill Road Gully

The stream within 146 Mill Road is a headwater tributary of the Papakura Stream, which discharges into the Pahurehure Inlet in the south-east Manukau Harbour. The stream was sampled in the road reserve below the bush on 146 Mill Road (Appendix 5). Only about 20m of stream length was available for surveying at this location. The upstream catchment land cover is predominantly native forest.

The macroinvertebrate community had a moderate abundance and low richness, but a high proportion of EPT taxa (Table 13). The EPT taxa here were *Deleatidium, Zephlebia, Polyplectropus, Pycnocentrodes* and *Triplectides*. Other taxa included snails, beetles and dobsonflies. The MCI-sb score of 122 indicated excellent conditions but the QMCI-sb of 3.6 indicated poor conditions (due to the low abundance of sensitive taxa). The taxonomic distinctness score of 4.8 (CI: 4.0, 4.5) was the highest score after Site 2 Totara Park. This shows a high level of distinctness that is appreciably higher than the 95% confidence limits for the index.

The fish community recorded here comprised shortfin eels and one banded kokopu. The Fish IBI score was 32, indicating Fair integrity, above average for the Auckland Region but still significantly impaired.

The overall SEV score was 0.54, in the Moderate range. This was due to the level of disturbance in the road reserve. Scores for all functional classes were low to moderate, ranging from 0.40 to 0.67.

Site 5 – Lower Mill Road

This site is located on a tributary of the Papakura Stream, near the Alfriston Road roundabout (Appendix 5). The upstream headwaters include two main branches, comprised of one with extensive forest cover and one with primarily pasture land cover. The stream was sampled in the road reserve. Riparian vegetation was primarily willow trees, which produced root mats and contributed leaves and woody matter. There was a high abundance of orange iron bacteria, probably indicating anaerobic groundwater inflows.

Macroinvertebrate communities had a relatively high abundance and moderate richness, but EPT taxa were absent. Taxa here included worms, snails and mosquito larvae. The MCI-sb score of 64 and QMCI-sb score of 2.2, both indicating poor water quality conditions. The taxonomic distinctness score of 4.6 (CI: 4.1, 4.3) shows a relatively high level of distinctness that is higher than would be expected by chance alone.

No fish were recorded here, indicating very poor conditions and/or accessibility to migrating fish. The Fish IBI score was 0.

The overall SEV score was 0.52, in the Moderate range. Hydraulic functions were relatively intact (mean score of 0.87), Biogeochemical functions were moderate (0.43), Habitat Provision functions were also moderate (0.46), and Biodiversity functions were very low (0.23). This site was disturbed but has upstream catchment vegetation that would be benefiting some functions, and exotic tree cover in the sampling reach also provides some water quality and habitat benefits.

Site 6 – Ranfurly Road

This site is located on a tributary of the Papakura Stream, west of the Ranfurly and Mill road intersection (Appendix 5). Upstream habitat is grazed pasture, with rural sections and no riparian vegetation or shade.

Macroinvertebrate communities showed a high abundance with a moderate level of taxa richness, including two EPT taxa, the caddisflies *Oxyethria* and a single high scoring *Psilochorema*. The MCI-sb was scored as 71 and the QMCI a 2.4. This classifies the stream as poor, with probable severe pollution due to the absence of abundance of higher scoring Taxa and the low abundance of the EPT taxa found within. This could either mean stream pollution or the lack of available habitat for species richness or both.

The taxonomic distinctness score of 4.0 (CI: 4.2, 4.3) shows a relatively low level of distinctness compared to sites 1 to 5. It is interesting to note that although the macroinvertebrate communities at this site are not greatly dissimilar in terms of the other MCI metrics compared to the previous sites, this is the first site where there was very little riparian cover. Figure 6 shows an interesting drop in distinctness scores in the open sites compared to the sites under vegetative cover (see Appendix 5 for indicative photos of stream cover).

The fish community surveyed here consisted of a single banded kokopu found living in a tyre. The Fish IBI was scored as 24, indicating poor integrity and a high level of impact.

The overall SEV score was 0.43 in the Moderate range. Hydraulic functions were relatively intact and scored well (0.75). However biogeochemical functions scored low with a 0.34 due to the lack of shade and riparian vegetation, neither of which was present. Habitat Provision functions scored low due to the same reasons. Biodiversity functions also scored low (0.31) due to the lack of fish found, and poor MCI scores. This site was a typical farm gully stream with cattle access.

Site 7 – Alfriston Road

This site is located in farm land on a tributary of the Papakura Stream, west of the Alfriston road and Mill road intersection (Appendix 5). Upstream habitat is largely grazed pasture, with rural sections. Riparian vegetation is present in the form of willow weed, starwort, watercress and *Glyceria spp.*

Macroinvertebrate communities showed a moderate species abundance with a moderate taxa richness. Two EPT taxa were identified, the stonefly *Acroperla* and the caddisfly *Oxyethira*. Despite this the MCI-sb score was 57 and the QMCI-sb was 2.4. Both scored as low and indicated probable severe pollution due to the absence of abundance of both EPT taxa and other non-EPT taxa. Despite riparian vegetation there is almost no shading. It is probable that there is farm run off entering the stream as well as a lack of available habitats.

The taxonomic distinctness score of 3.7 (CI: 4.1, 4.3) indicates that the macroinvertebrate communities at this site have the lowest distinctiveness relative to the other survey sites (Figure 6). This score at site 7 also falls below the 95% confidence interval for the index.

Three shortfin eels where recorded with a fish IBI score of 14, a scoring of very poor, indicating a very poor integrity and a high level of impact.

The overall SEV score was 0.36, in the Low range. Hydraulic functions scored well with 0.65, indicating a relativity intact and physically functional water system. Biogeochemical, Habitat Provision and Biodiversity function scored 0.28, 0.23, and 0.21 respectively. Lack of shade, low MCI's and lack of fish presence contribute to these low scores.

Site 8 – Mill Road (south)

This site is on a tributary of the Papakura Stream, north of the Mill road and Alfriston junction (Appendix 5). Upstream is comprised of large patches of bush and some farmed pasture and rural housing. Riparian vegetation is present in the form of starwort, watercress, *Apium* and willow weed.

Macroinvertebrate communities showed a high abundance with a moderate level of taxa richness. Two EPT taxa were found, including a large number of stone flies and a single Psilochorema. Despite their presence, MCI-sb and QMCI-sb scores were low (69 and 2.5 respectively), indicating probable severe pollution. This site was wide and spread out, with no shade, with low water depth. These factors could provide insight into habitat issues for higher scoring MCI taxa. The large abundance of ostracods and Orthocladiinae is also an indication of water quality issues. The taxonomic distinctness score of 4.3 (CI: 4.2, 4.3) shows a moderate level of community distinctness compared to the other survey sites. This was also the only site where the estimate of taxonomic distinctness was within the 95% confidence interval.

Seven shortfin eels were observed, bringing the fish IBI score to 14 or very poor, indicating a very poor integrity and a high level of impact, most likely caused to sedimentation issues and water flow.

The overall SEV score was 0.37, in the Low range. Hydraulic functions scored well with 0.64, indicating a relativity intact and physically functional water system, despite low water depth. Biogeochemical, Habitat Provision and Biodiversity function scored 0.29, 0.24, and 0.23 respectively. Lack of shade, low MCI's and lack of fish presence contribute to these low scores. Despite the bush patches found across the road and upstream, the steam located in the paddock was of low quality, with no shading and no significant riparian vegetation structure.

Site 9 – 125 Murphy's Road

This site is a tributary of the Otara creek catchment. It is located just north of the junction of Thomas road and Murphy's road. Upstream of the catchment is a mix of farmed pasture and bush, including Murphy's reserve. Stock have direct access to the stream. The stream here was predominantly bedrock with stony riffles and a number of small waterfalls up to 1.5 metres in height.

Macroinvertebrate communities (sampled and assessed using hard-bottomed methods) had a relatively low abundance but a high level of taxaonomic richness. Six EPT taxa were found, the majority being caddisflies, such as Triplectides and Psilochorema. Despite their presence, the MCI-hb score was only Fair and QCMI-hb scored Low, due to the lack of abundance, indicating probable to moderate pollution. These low scores were not consistent with the relatively high proportion of EPT taxa, and overall the macroinvertebrate communities indicate better water quality than suggested by the MCI-hb and QMCI-hb. The taxonomic distinctness score of 4.0 (CI: 4.1, 4.4) is again low relative to the majority of the other survey sites. This score is also falls outside of the 95% confidence interval indicating the distinctness of the macroinvertebrate community is lower than expected.

Three shortfin eels, a single banded kokopu and a single koura were recorded, giving the fish IBI score of 32, indicating Fair integrity, above average for the Auckland Region but still significantly impaired.

The overall SEV score was 0.58, in the Moderate range. Hydraulic function and Biogeochemical scores were 0.68 and 0.67 respectively. However, both habitat provision and biodiversity scored 0.42, due to low score of the MCI and Fish IBI.

5.0 Assessment of Ecological Significance

5.1 Threatened Environments

The key natural features were assessed against the "The Threatened Environment Classification" GIS map as described by Walker *et al.* (2007). The Threatened Environment Classification uses indigenous vegetation as a surrogate for indigenous biodiversity which includes ecosystems, habitats and communities. Walker *et al.* (2007) state that the Threatened Environment Classification "*is most appropriately applied to help identify places that are priorities for formal protection against clearance and/or incompatible land uses, and for ecological restoration to restore lost species, linkages and buffers*". The classification identifies six threat categories as follows:

Category	Criteria	Category Name
1	< 10 % indigenous vegetation left	Acutely Threatened
2	10-20 % indigenous vegetation left	Chronically Threatened
3	20-30 % indigenous vegetation left	At Risk
4	>30 % left & 10 % protected	Critically Under-protected
5	>30 % left & 10-20 % protected	Under-protected
6	>30 % left & > 20 % protected	Less Reduced & Better Protected

Virtually all remaining natural areas in the Manukau ED are considered to be important features because of their scarcity. Less than 2% of the Manukau ED total land area remains under native vegetation cover. Forest types with taraire dominant canopy now only cover 0.8% of the land in the Manukau ED.

The area included within the project footprint spans two Threatened Land Environments, being Category 3 - At Risk and Category 1 - Acutely Threatened (Figure 7). However, all of the key natural features within that footprint (i.e. areas of native scrub or indigenous forest) are located within the former category (i.e. At Risk) - there are no indigenous forest or scrub habitats within the project footprint that are located inside the Acutely Threatened Land Environment of this particular area.

5.1 Proposed Auckland Unitary Plan (PAUP)

The PAUP includes a policy in Volume 1 Chapter B Section 4.3.4 (Regional Policy Statement – Biodiversity) that sets out the criteria to be used in identifying Significant Ecological Areas (SEAs), as follows:

1. *Identify and protect areas of significant indigenous vegetation and the significant habitats of indigenous fauna in terrestrial, freshwater and coastal environments as SEAs using one or more of the following criteria:*

   (a) Representativeness: The area is important for the indigenous habitats and/or ecosystems it supports because they are ecologically representative of the mature and successional stages of the vegetation of each ecological district in Auckland and provide cumulatively for at least 10% of the natural extent of each ecosystem type.

   (b) Stepping Stones, Buffers and Migration Pathways: The area is significant because of its context with other habitats and ecosystems. This includes groups of smaller sites that together form an important vegetation component in the landscape, cumulatively provide critical habitat for a native species, provide buffers to other significant ecological areas or act as stepping stones or ecological corridors providing for the movement of species across the landscape.

   (c) Threat Status and Rarity: The area supports genes, species, habitats and/or ecosystems that have been classified as threatened with extinction or are naturally rare in Auckland or New Zealand.

   (d) Uniqueness or Distinctiveness: The area supports genes, species, communities, habitats and/or ecosystems that are endemic, or near endemic, and only naturally occur in Auckland.

   (e) Diversity: The area supports indigenous vegetation that is ecologically diverse, close to the typical species or ecosystem diversity for that habitat or supports indigenous vegetation that extends across at least one environmental gradient.

Using these criteria the PAUP classified Murphy's Bush and the Watercare Bush as being SEAs (SEA_T_5282 and SEA_T_4570 respectively). Murphy's Bush has been identified by Auckland Council as meeting two of the criteria, including *Representativeness* (part of an indigenous ecosystem that makes up part of at least 10% of the original extent [kahikatea forest]) and *Threat Status* and *Rarity* (threatened ecosystem [kahikatea forest]; less than 20% remains in LENZ Category IV; habitat supports locally rare and naturally uncommon or range restricted species [kaikomako, kawaka, *Collospermum microspermum*]).

The Watercare Bush was identified as meeting two criteria, including *Diversity* (indigenous vegetation that extends across more than one gradient and supports more than one ecosystem, habitat or community [taraire, tawa, podocarp forest - kanuka scrub/forest]) and *Stepping Stones, Migration Pathways and Buffers* (part of a network of sites which cumulatively provide important habitat or ecosystem presence).

Auckland Council did not identify the bush at 146 Mill Road as a SEA in the PAUP, though the reasons for this omission are not clear. Despite its small size it meets the *Representative* criterion (old growth forest) and also the *Stepping Stones, Migration Pathways and Buffers* criterion.

5.2 Operative Auckland Regional Policy Statement

Section 6.4.7 of the Auckland Regional Policy Statement (RPS) gives some guidance to the criteria used to evaluate the significance of natural areas. Appendix 6 presents an assessment of the three bush remnants affected by the preferred alignment in accordance with RPS criteria. Under these criteria of the operative RPS all three bush areas are ecologically significant, with Murphy's Bush considered to be of regional significance.

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Data Sources: Auckland Council (2010-2011 Aerials), Auckland Council PAUP, Aecom, Boffa Miskell

Legend

Vegetation Types
- Exotic pine
- Mature broadleaf-podocarp
- Mixed scrub
- Taraire treeland

- Significant Ecological Areas
- Preferred Route

MILL RD UPGRADE

Figure 3: Vegetation Types - Preferred Option Route

Date: 14 August 2014 | Revision: 0

Plan Prepared by Boffa Miskell Limited

Drawn: david.maxwell@boffamiskell.co.nz | *Checked: DSI*

5.3 IEEM Ecological Values

Using the ecological evaluation system of IEEM (2002) in Table 7 (Section 2 of this report), Murphy's Bush has been assessed as being of Very High ecological value and both the Watercare Bush and the bush at 146 Mill Road as being of High ecological value. The Watercare scrub has been assessed as being of Medium ecological value.

6.0 Assessment of Effects on Ecological Values

6.1 Clearance of Vegetation

When assessing the magnitude of adverse effects associated with bush clearance, there are two important factors to consider, being firstly the quality of vegetation to be cleared; and secondly the extent of the clearance. In relation to the preferred alignment, the majority of the vegetation that will be affected is presently farmed pasture, together with rural residential and residential properties. Additional woody vegetation that will be cleared is predominantly exotic, and includes hedgerows, shelterbelts and screen plantings, together with garden ornamentals. This vegetation is primarily associated with the Nor 1 and Nor 2 areas, together with the western and southern portions of the NoR 3 area. The loss of this vegetation does not constitute a significant adverse botanical effect.

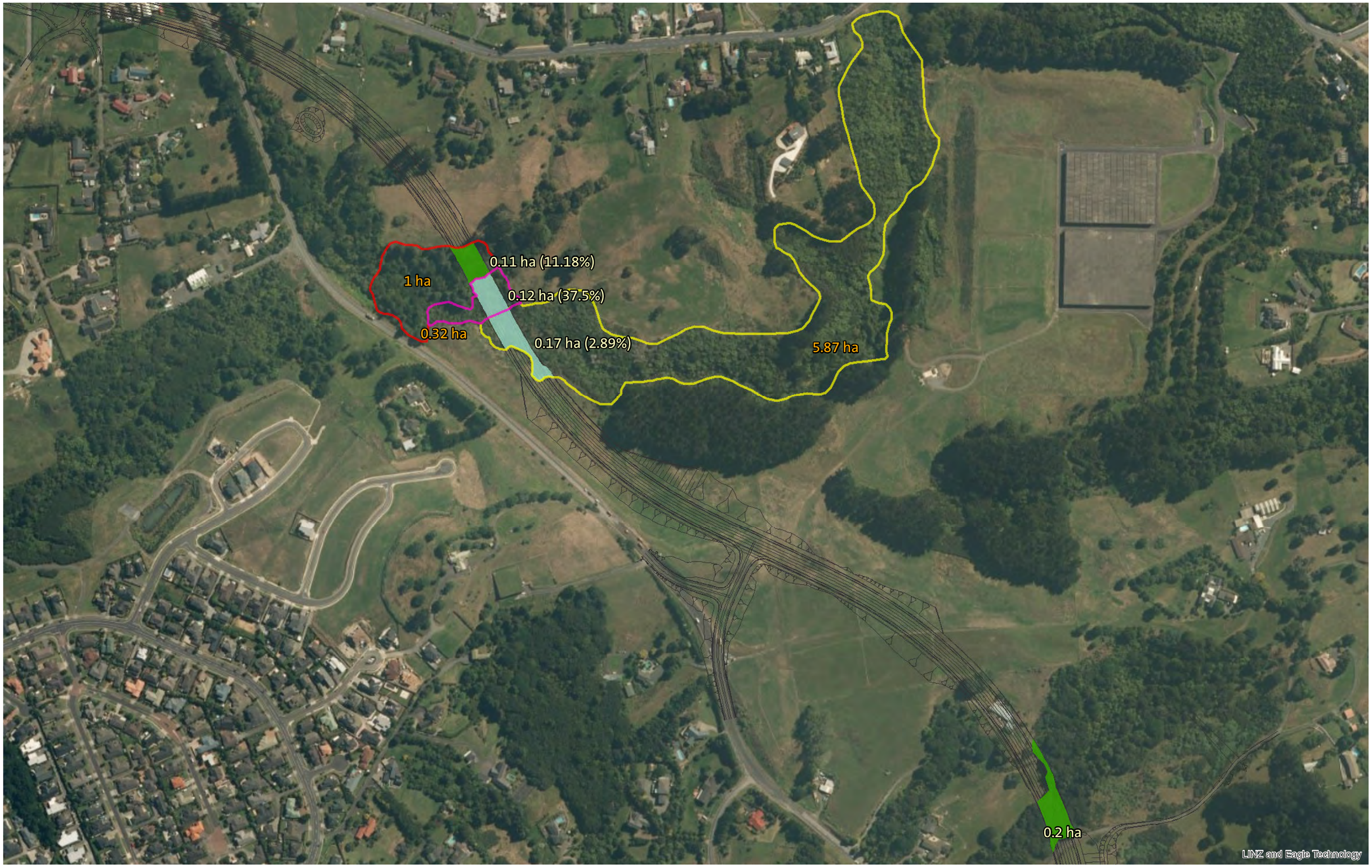
In addition to the above, three stands of native bush and an area of mixed scrub will be impacted upon to varying degrees (Figure 8), with all three being in the NoR 3 area. Firstly, 1,500m^2 of old growth forest will be cleared and a bridge will span over 500m^2 of that same forest in the southern portion of the bush located at 146 Mill Road. Secondly, a bridge will span over a 1,100m^2 stand of similar old growth forest together with 2,900m^2 of mixed scrub located on the Watercare land at 38 Mill Road. Thirdly, a handful of native trees on the outer margins of Murphy's Bush may be potentially affected when extensions to the existing stream culvert are undertaken here. These sites are discussed below.

6.1.1 Bush at 146 Mill Road

The use of a bridge to cross this bush gully substantially reduces the extent of vegetation loss compared to works required to construct a reinforced earth fill. The bridge will be 30m long and 30m wide, and does not require any supporting central piers (and hence no haul road or crane platform is needed within the bush it traverses). It will launch and land on fill abutments of 8m elevation (eastern side) and 15m elevation (western side), with the retaining walls supporting these abutments necessitating the loss of 1,500m^2 of bush (all tiers). In addition to this the bridge will span over some 500m^2 of bush, with consequent topping (probably loss) of some additional canopy trees. However, with its high point at 17m elevation, smaller canopy trees should survive intact. In addition, much of the underlying vegetation (i.e. the understorey) is likely to be retained - these lower tiers have all grown in the shade beneath the dense forest canopy and are all shade-tolerant species, so replacing the canopy with a bridge does not represent a substantial change in terms of the existing sunlight regime.

It is likely that immediately beneath the eastern bridge abutments there will also be rain-shadow effects, where precipitation will be unable to drift underneath the bridge and water the underlying soil. However, this effect diminishes with increasing bridge elevation, and given the steep nature of the stream gully here together with the bridge elevation it is anticipated that rain-shadow effects are only likely to only manifest in a very small portion of the bridge footprint.

With reference to the IEEM approach, the bush is rated as being of High ecological value, while the magnitude of effects is assessed as Low. This Low assessment is a consequence of the relatively small portion of the bush located within the works footprint (i.e. 1,500m^2,or 3.6% of the entire feature), coupled with the fact that the feature is going to be bridged and as a result much of sub-canopy and understorey vegetation will remain intact (as has been described above). The overall significance of effects is assessed as Low.



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Data Sources: LINZ & Eagle Tech NZ Imagery, Aecom, Boffa Miskell

Legend

- Mature Broadleaf-Podocarp Vegetation
- Mixed Scrub Vegetation
- Preferred Route
- Kahikatea Forest
- Poor Quality Scrub
- Good Quality Scrub

MILL RD UPGRADE

Figure 8: Native Vegetation Bridged - Preferred Option Route

Date: 19 September 2014 | Revision: 0

Plan Prepared by Boffa Miskell Limited

Drawn: sandeep.gangar@boffamiskell.co.nz | *Checked: DSI*

6.1.2 Watercare Bush and Scrub

The Watercare bush and scrub have been identified in the PAUP as a SEA (SEA-T-4570). In total this SEA occupies 8.6ha of largely indigenous vegetation, although the scrub component has a heavy weed infestation. The preferred alignment proposes to bridge the Watercare bush and scrub, overtopping 1,100m^2 of bush and 2,900m^2 of mixed scrub (1,200m^2 good quality and 1,700m^2 poor quality) (Figure 8).

The use of a bridge to cross the Watercare gully substantially reduces the extent of vegetation loss compared to works utilising placement of fill material. The bridge will be 100m long and 30m wide. It will launch and land on fill abutments of 12m elevation (eastern side) and 11m elevation (western side). At its highest point it will be 23m, and much of it is 13m or more above ground level. While the bridge will result in removal of the mature emergent trees within its footprint much of the underlying vegetation will remain undisturbed, with the exception of that within the path of a haul road needed to construct the 5 supporting piers and 2 abutments.

With that exception, the lower vegetation tiers beneath the bridge structure should continue to survive given that the plants have all grown in the shade beneath the dense forest canopy and are all shade-tolerant species. Replacing the existing canopy with a bridge does not represent a substantial change in terms of sunlight except possibly in the areas closest to the two abutments where bridge elevation will be lowest.

It is likely that immediately beneath the bridge abutments there will also be rain-shadow effects, where precipitation will be unable to drift underneath the bridge and water the underlying soil. However, these effects diminish with increasing bridge elevation, and given the steep nature of the stream gully here together the bridge elevation it is anticipated that rain-shadow effects are likely to only manifest in a very small portion of the bridge footprint.

In relation to the issue of haul roads, once pier construction has been completed the accessways will be rehabilitated by way of removing all road-metal material, ripping the compacted earth, laying topsoil and revegetating these areas with appropriate hardy native forest shrub and small tree species. This would eventually replace the understorey removed during the bridge construction period.

Using the IEEM (2002) approach, the ecological values of the affected Watercare bush are classified as High, while the magnitude of effects (Table 8) is assessed as Moderate (i.e. loss of 1,100m^2 of canopy trees at the impacted area but with the remaining bush staying intact, and temporary (but potentially lingering) restrictions on corridor function and increases in edge effects during bridge construction). Therefore the significance of the effects is assessed as Medium.

In addition to the Watercare bush discussed above, the preferred alignment also bridges over an area of mixed native and exotic scrub that is contiguous with the bush. This vegetation is early successional and in a regenerating stage. It is compromised by the presence of much woolly nightshade, gorse and privet. While it does bestow riparian vegetation benefits on the Puhinui Creek as well as providing a vegetated corridor within the local landscape, its botanical conservation values at present are negligible.

The impact of bridge construction on this scrub will be similar to those associated with the forest with the exception of the loss of any mature trees (which are not present). The ecological value of the scrub affected by the bridge is Medium (primarily due to its provision of riparian benefits to the headwaters of the Puhinui Stream rather than anything pertaining to terrestrial ecology), while the magnitude of effects is Moderate (i.e. impacts restricted to a small area only), and therefore the significance of the effects is assessed as Low.

6.1.3 Murphy's Bush

In the absence of detailed design the actual extent of vegetation clearance at Murphy's Bush is not entirely clear, but ranges from nil to a few outlying trees. At worst it would be restricted to a few dozen trees and shrubs. The majority (possibly all) of the vegetation that will be cleared appears to be located on the opposite side of the road where the culvert will be extended several metres. This will involve predominantly exotic trees and woody weeds, in particular two mature poplar trees and several woolly nightshade shrubs. While the ecological values of Murphy's Bush were assessed as Very High the magnitude of effects was assessed to be Negligible (i.e. loss of a few common native trees, and excluding any kahikatea), and therefore the significance of the effects was evaluated as being Low.

6.1.4 Other Vegetation

Along the northern side of Redoubt Road there are numerous street and garden trees, with the majority of these being exotic species. While of some amenity value these trees have very little in the way of botanical conservation values.

6.2 Loss of Significant Flora

No 'threatened' or 'at risk' species of flora were observed to be present over the course of the field investigations, and furthermore there was no mention of such in the literature reviewed. In addition, while certainly in the mature stage of their life cycle, none of the larger trees (either native or exotic) are especially notable specimens in terms of their form and/or dimensions.

6.3 Habitat Fragmentation and Loss of Ecological Corridors

Roads can create barriers to wildlife movement through mortality of fauna attempting to cross them, and via behavioural avoidance of roads. Vehicle related mortality of wildlife has been widely documented in North America and Europe but is a less apparent impact to native wildlife in New Zealand (see Forman *et al*., 2003 p. 114 - 120 for review). A long term study conducted by Brockie *et al*. (2009) found that the only native fauna impacted by vehicle collisions in significant numbers are pukeko and Australasian harriers, both of which are classified as "Not Threatened" in the latest NZ Threat Classification Series (Robertson *et al*., 2013). Avoidance of areas with higher road densities has been documented in many species internationally (see: Trombulak & Frissell, 2000) and smaller fauna groups such as reptiles and ground dwelling invertebrates often avoid crossing roads altogether.

Barriers caused by roads limit habitat availability, reduce gene flow and can isolate populations (Forman *et al*., 2003; Shepard *et al*., 2008). Isolation of populations leads to inbreeding depression which reduces the resistance of populations to stochastic events, increasing the chance of local extinction (Forman *et al*., 2003; Shepard *et al*., 2008). These population-level impacts also have the potential to alter species composition and richness within isolated habitat patches, consequently impacting on ecosystem processes in the area (Laurance, 2008).

However, the barrier impacts of roads differ between species and there are records of species preferentially using road edges as corridors and core habitat (see: Forman *et al*., 2003). A New Zealand example is the long-tailed bat (*Chalinolobus tuberculata*) that has been recorded using forest roads preferentially to all other habitats sampled (O'Donnell, 2000). Moreover, the effects of road barriers and habitat fragmentation differ depending on the characteristics of different species, for example: mobility, road-avoidance behaviour, habitat specialisation and population numbers. Species that are especially sensitive to fragmentation are unlikely to occur in the already highly modified landscape surrounding Mill Road. It is important to acknowledge the busy existing road when considering this issue – to the extent that a road could give rise to fragmentation effects this effect is already present.

Further to the above, the local landscape is already highly fragmented, consisting of a patchwork of small to medium sized indigenous bush habitats which act as stepping stones for native fauna (in particular birds and bats) for movements in all directions. The local landscape is very rich in these stepping stone habitats, and the effects of the preferred alignment on habitat fragmentation over and above existing levels will be very limited, due to the fact that it impacts upon very few such features (either directly or indirectly) and that there will remain a multitude of alternative such habitat patches. For example, while the stand of trees at 242 Redoubt Road (affected by the preferred alignment) may be part of the local network of habitat patches that facilitate bird movement through the wider landscape (even though it is predominantly exotic in composition), the key word here is "*part of*" that local network - alternative patches providing the same corridor services (and additional ones, such as food) will remain unaffected by the preferred alignment (e.g. in this example, the immediately adjacent [and larger] patch at 246 - 250 Redoubt Road and 17 Murphy's Road, unaffected by the preferred alignment). All in all it is considered that no single small habitat patch located within the local landscape stands out as being of any more importance to ecological corridors than any of the others, and the loss of any such features as a result of the project does not constitute a significant adverse ecological effect.

The only potential intact corridor crossed by the preferred alignment is that within the Watercare property (i.e. the Watercare bush and scrub). However, this is being crossed by way of a bridge, and the native vegetation forming the understorey beneath the forest canopy will be largely unaffected, allowing connectivity within this habitat to be maintained. Notwithstanding this, there will be temporary fragmentation here since some clearance is necessary to construct haul road(s) necessary to build the bridge piers. These will need to be wide enough to accommodate the transportation of cranes to and from the pier construction areas, as well as concrete trucks and other heavy vehicles, and as a result they may be quite wide. However, vegetation within the haul road routes will be reinstated following construction and the habitats on either side re-connected.

The temporary fragmentation noted above can also be ameliorated by way of approaching the pier construction sites from both sides of the creek, thereby retaining a habitat linkage beneath the bridge that connects the bush on either side while the pier construction is underway. Once pier construction has been completed the haul roads can be rehabilitated by way of removing all road-metal material, ripping the compacted earth, laying topsoil and revegetating these areas with appropriate hardy native forest shrub and small tree species. This would eventually lead to a complete reconnection of the bush on both sides of the bridge.

In relation to Murphy's Bush, the preferred alignment will have negligible effects on existing corridors.

6.4 Increase in the Extent of Edge Effects

As well as physical habitat removal, road construction creates extended linear edges through the habitats they traverse. Habitat edges alter the microclimate of the surrounding area via increased exposure to light and wind (Saunders, Hobbs, & Margules, 1991). Changes in microclimate create shifts in flora and fauna communities, thus altering associated ecosystem processes such as leaf litter composition and nutrient recycling (Coffin, 2007; Saunders *et al*., 1991). These microclimate alterations are highly site specific, depending on are variety interacting mechanisms including: the type of habitat effected, the surrounding land use matrix and landscape topography (Donovan, Jones, Annand, & Thompson, 1997; Murcia, 1995; Saunders *et al*., 1991). Additionally, habitat fragmentation and edge effects often expose habitat interiors to increased predation, weed invasions and direct human impacts (Donovan *et al*., 1997; Matlack, 1993).

Creation of new edges also suddenly exposes previously 'stand interior' trees to more severe wind conditions without the opportunity to adapt their growth to these conditions (as with trees growing along natural edges), this increases the susceptibility of forest fragments to windthrow (Martin & Ogden, 2006). Windthrow can cause further habitat loss associated with fragmentation by killing the trees affected and also damaging vegetation in the path of the uprooted tree. Yet there is evidence that increased susceptibility occurs only in short-term and that peripheral trees can adapt a resistance (Martin & Ogden, 2006). In addition, it is recognised that windthrow maintains heterogeneity in soil development and is an important mechanism for regeneration in New Zealand forests (Adams & Norton, 1991).

Modifications to existing edges may be important when edge effects reduce the extent of habitat-interior conditions, but is not such a significant issue where the areas to be affected are already characterised by edge processes. In this regard it is known from scientific studies that edge effects can penetrate up to 50m into Northland forest habitats, on all sides (Young & Mitchell, 1994; Davies-Colley *et al*., 2000). Hence, habitats that are less than 100m in width are generally influenced by edge effects and processes, and contain only limited habitat "interior" conditions, though site topography and exposure is also a factor.

In light of the above, Boffa Miskell undertook an analysis of the extent of existing forest edges, based on the findings of Young and Mitchell (1994). This analysis showed that the preferred alignment only crosses areas of forest habitat that are already classed as edge (i.e. within 50 m of a forest margin). Therefore no interior forest habitat will be directly removed as a result of the project, and correspondingly there will be no obvious increases in the extent of edge effects.

6.5 Air Quality

The construction of new roads generally facilitates higher traffic volumes, which in turn produces increasing levels of vehicle emissions. Vehicle emissions that have the potential to impact on the ecology of the surrounding area include: Nitrogen Oxides (NO_x), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), metals and particulate matter (PM) (Bignal, Ashmore, Headley, Stewart, & Weigert, 2007). Relative to the extensive literature focussing on the impacts of air pollution on human health, little research has directly investigated the ecological impacts of these emissions (Coffin, 2007). Notwithstanding this, it is understood many atmospheric chemicals enter and persist in the environment where they interact with biota (Coffin, 2007).

Potentially the most far reaching ecological impact of atmospheric pollutants are indirect soil mediated effects. Nitrogen oxides and other nitrogen-based compounds (for example ammonia (NH_3) and nitrous acid (HNO_2)), lead to elevated soil fertility and corresponding shifts in roadside vegetation communities (Bernhardt-Römermann, Kirchner, Kudernatsch, Jakobi, & Fischer, 2006; Bignal *et al*., 2007; Lee & Power, 2013). This is also hypothesised to be the case for particulate matter, where compounds comprising PM enter soils and interact with soil microbes and effect the nutrient cycling of plants (Grantz *et al*., 2003).

Grantz *et al*. (2003) also found that PM can impact upon vegetation through direct contact with plant surfaces, with highly acidic or alkaline compounds harming vegetative tissues and thick coatings of particulate matter on leaves decreasing photosynthetic efficiency. Bignal *et al*. (2007) also recorded reduced tree health (e.g. defoliation; fungal and insect damage) with decreased distance from major motorways. The authors attribute these health impacts to the known trends of increased atmospheric pollutants, specifically NO_x, in close proximity to motorways.

Notwithstanding the above, it should be noted that PM is a highly variable class of atmospheric pollutants and different chemical constituents can react in different ways. Further to this, Grantz *et al*.'s (2003) study was not specific to vehicle emitted PM, and changes in emission levels, chemical constituents and meteorological conditions will alter the impacts of PM (and other traffic-related pollutants) in any given system.

In relation to the preferred alignment, although increased traffic on roads is known to increase the emissions of harmful atmospheric gases, commuter traffic along Mill Road and Redoubt Road is forecasted to increase irrespective of the road upgrade (Aecom, *pers. comm*.). Moreover, the road upgrade could actually mitigate emissions increases by reducing traffic build-up and by providing improved infrastructure for cyclists, pedestrians and public transport.

Further to this, detailed modelling of the potential emissions outputs of the Mill Road upgrade have been conducted (Aecom, 2013). This modelling found that under worst-case scenarios, forecasted concentrations for all modelled pollutants will not exceed National Environmental Standards for Ambient Air Quality and that overall the effects of the Mill Road upgrade on ambient air quality will be less than minor. It should be noted that the modelled $PM_{2.5}$ exceeded the 24-hour mean Auckland Regional Target, yet this was due to background levels in the model already exceeding this target.

6.6 Avifauna (Bird) Effects

Disturbance to avifauna, by way of both direct impacts (eg. loss or degradation of habitat) and indirect impacts (eg. effective loss of habitat as a result of increased noise) is a potential effect of the proposed works. The more rare (or threatened) the species that are affected by disturbance activities then the greater are the likely adverse impacts. The magnitude of the adverse effects associated with disturbance activities are also proportional to the extent of habitat affected compared to that which remains unaffected. Where habitat loss as a result of disturbance is comparatively minimal then the adverse effects are reduced. The magnitude of disturbance effects is also reduced considerably where existing disturbances are already present, such as is the case with Mill Road which is already a busy arterial route.

Overall, the preferred alignment poses little direct risk to 'threatened' and 'at risk' bird species. Nevertheless, any removal of indigenous woody vegetation compounds the general loss of forest and scrub habitat for birds in the region. Additionally, birds may be affected if vegetation clearance occurs in their nesting season. In general the nesting season for most native birds is generally September to February, and clearance of native forest vegetation should commence outside this period if practicable. Alternatively, if such is not practicable, then ensure no nesting birds are present in any tree prior to felling.

Loss of forest vegetation could be mitigated by way of legal protection of existing stands of old growth forest, which would protect in perpetuity important feeding, roosting and nesting habitat for native birds. However, this opportunity would depend on the existence of such forest within lands AT has acquired for designation purposes (the opportunity being to covenant any old growth forest growing there-upon prior to land disposal). Compensatory planting of native vegetation in the local area is another mitigation option, but as this would not compensate for the loss of existing of vegetative resources (e.g. large established trees, fruit-bearing plants) such planting would need to aim to increase the current extent of existing forested area over time.

The creation of any new wetland habitat, which is scarce in the area, would be a direct benefit to local birdlife. Indeed, as noted above, all 'threatened' and 'at risk' bird species recorded by the OSNZ in the immediate area would benefit from wetland creation. The establishment of seven stormwater treatment wetlands in association with the project would provide such benefits.

6.7 Chiropterofauna (Bat) Effects

The close proximity of the preferred alignment to a known bat population (Clevedon Scenic Reserve) coupled with the relatively high vegetative connectivity between these locations indicate that even though no bats were detected during the survey, they may potentially use the area periodically. Therefore, it is recommended that bat behaviour and ecology is considered during the design and construction of the road. Steps that could be taken include:

- Minimising vegetation clearance.
- Monitoring mature trees for bat habitation before felling.
- The breeding season for long-tailed bats is generally between November and late January. Vegetation clearance would ideally avoid this period.
- Minimise road lighting, where lights are necessary use downward facing low pressure sodium lamps with hoods to limit spillage (Bat Conservation Trust, 2009).

6.8 Herpetofauna (Lizard) Effects

The only skink species detected during the surveys was rainbow skink. This is an introduced pest species that is not legally protected, and no management or mitigation for it is required. In relation to native skinks, none were observed to be present in the footprint of the preferred alignment. However, due to the restrictions experienced in accessing private land within the footprint, coupled with the variable weather conditions during the survey, it cannot be concluded that native skinks are absent.

A single gecko (most likely a forest gecko) was observed in Totara Park (outside of the works footprint). While no geckos were observed within the preferred alignment footprint, given that the same restrictions experienced for native skinks (described above) apply equally to native geckos, it cannot be concluded that they are actually absent.

This conjecture is supported by the presence of several different habitat types within the preferred alignment footprint (identified during the field surveys) that could potentially support lizards, as follows:

(a) regenerating bush with a scrub edge,

(b) mature broadleaf forest,

(c) rank grass bordering pasture and bush, and

(d) wooden debris/logs across all habitat types.

Habitat types (a) and (b) may support populations of arboreal geckos, while habitat types (a)-(d) may support terrestrial skinks. Arboreal geckos typically occur in manuka, kanuka and broadleaf forest, and usually require moderately large tracts of such habitat for viable populations to persist in the presence of introduced predatory mammals. Day searches of the suitable habitat coupled with nocturnal spotlighting did not detect forest geckos or elegant geckos in either of the habitat types (a) and (b), but it remains possible that either or both of these species is present (but seemingly at very low densities).

Kikuyu and gorse (habitat type (c)) is present along the preferred option footprint and this habitat can support native terrestrial skinks. Given the presence of this suitable habitat within the preferred footprint, it is certainly possible that populations of copper and possibly also ornate skinks persist in these areas.

Habitat on private property that could not be searched includes mature broadleaf-podocarp bush containing puriri, taraire and rimu (e.g. at 146 Mill Road), as well as groupings of mature exotic trees such as eucalypt. These comprise habitat type (b) and potentially support both skink and gecko populations.

Given the above, it is considered that potential adverse effects on native lizards are a possibility, and given this any such effects need to be mitigated. This is best achieved by preparation of a Lizard Management Plan prior to construction commencing. This plan should include the following:

- A rescue and relocation programme for both native geckos and skinks, including specific recommendations for salvage techniques and actions that are suitable for different lizard species, and determining appropriate release/receptor sites for translocated lizards. Capture techniques should include pre-clearance trapping for several weeks in likely skink habitat, and also involve herpetologists following behind tractor-mounted mowers (set a few centimetres above ground level) to capture disturbed individuals. Other effective techniques include leaving felled trees in situ for a few days prior to disposal to allow arboreal geckos time to escape.
- In the event that native lizards are found in substantial numbers (i.e. dozens of individuals), habitat enhancement and pest control should be undertaken around release sites for a minimum of five years to ensure the habitat is able to support the increased population.

6.9 Noise and Light Effects

Road-related noise disturbance has generally been shown to have either a negative or neutral effect on most species that have been studied (see: Forman *et al*., 2003, p 274 - 276). In addition, impacts of noise disturbance appear to be especially pronounced for fauna where vocal communication is an important part of their life histories, a prominent example being avifauna (Reijnen, Foppen, & Veenbaas, 1997). Rheindt (2003) found birds that call at significantly higher sound frequencies than that of traffic noise occur in greater abundances in proximity to roads compared to species whose calls are lower. This finding indicates that acoustic masking is a primary mechanism of noise disturbance for birds occurring around roads. Use of smooth road surfaces and soil berms are relatively simple and effective ways of reducing traffic noise (Forman *et al*., 2003). The former is proposed for the Mill Road project insofar that a low noise road surface will be used.

Light cycles are imperative to the physiological and behavioural processes of nearly all life forms, including dictating circadian rhythms, influencing behaviour and regulating phenological events (Gaston, Davies, Bennie, & Hopkins, 2012). Thus it comes as no surprise that there is a growing body of evidence that night-time light pollution impacts numerous organisms in a variety of different ways. Impacts range from changes in foraging activity of bats, invertebrates and lizards to shifts in reproductive timing and behaviour in birds (see: Gaston *et al*., 2012; Longcore & Rich, 2004 for full reviews). Night-time light pollution comes from a multitude of sources, yet the extent of road networks means that street lighting can have substantial impacts if not managed properly. Notwithstanding this, changes in light regimes are not necessarily negative for all fauna. Sodium lamps sometimes used in street lights can increase the foraging efficiency of long-tailed bats who feed on the flying insects that are attracted to them (G. Cummings, *pers. obs*. 2014).

In relation to the Mill Road upgrade project, there is already a very substantial degree of street lighting in the Redoubt Road residential area. Furthermore the main intersections are well lit. This situation will increase with the upgrade, with lighting proposed throughout the corridor at 40-60m intervals. While this does represent additional light sources the type of lights in the vicinity of the bush areas can use bulbs and designs which limit the amount of light spill, such as downward facing low pressure sodium lamps with hoods. As a consequence of the above, adverse ecological effects as a result of street lighting are likely to be less than minor.

6.10 Freshwater Effects

6.10.1 Hydrological Effects

The surface area of a road and its spatial arrangement relative to surrounding stream networks and topography will dictate a road's influence on the hydrology of the surrounding landscape (Jones, Swanson, Wemple, & Snyder, 2000). In a natural stream network, movement of water follows gravitational flow paths down hillslopes into channels and along these channels into the stream network. Roads often disrupt this gravitational sequence by modifying the magnitude and direction of water movements (Jones *et al*., 2000).

The hydrological changes described above have secondary impacts on aquatic biota. Changes in run-off patterns and the resulting increases in velocity of water flowing into stream networks can reduce the ability of the surrounding landscape to filter out sediment and contaminants carried in the runoff (Trombulak & Frissell, 2000). This potentially increases levels of sediment, nutrients and toxins entering aquatic environments (Trombulak & Frissell, 2000). Increased sedimentation in waterways can smoother or reduce habitat availability for aquatic flora, benthic invertebrates and spawning sites (Henley, Patterson, Neves, & Lemly, 2000). In addition, suspended sediment can alter light penetration and water temperatures as well as decreasing the respiration abilities of fish and other aquatic biota (Henley *et al*., 2000). Increased nutrient inputs can change the vegetative species composition of waterways and result in reduced levels of dissolved oxygen as plants decompose (NIWA, 2013). Finally, toxins entering waterways can negatively impact sensitive plants, changing the plant species composition, as well as building up in the tissues of fish, reducing their reproductive capacity and ultimately increasing mortality (Trombulak & Frissell, 2000).

Road culverts can also alter stream hydrology by constricting water flow through the culvert relative to the natural stream channel and surrounding floodplain (Hotchkiss & Frei, 2007; Stevenson & Baker, 2009). As the cross-sectional width of a flow path is reduced, water velocities increase, inducing streambed scour and channelisation downstream of the culvert. These hydrological changes can impede fish passage in a variety of ways, such as streambed scour at a culvert outlet creating a perched culvert that surpasses the climbing or jumping abilities of native fish, or increased velocity through the culvert exceeding the swimming abilities of fish. A contrasting hydrological barrier occurs in low flow conditions when a culvert does not hold enough water to facilitate fish passage (Hotchkiss & Frei, 2007; Stevenson & Baker, 2009). The ecological impacts of barriers to fish passage include reduced habitat availability and isolation of populations.

Bridges may also potentially contribute to hydrological changes via the creation of rain shadows and by disruption of water flows around associated in-stream structures (where relevant). However, in comparison to piping or infilling, bridging roads over waterways generally has a considerably smaller impact on the aquatic environment (Hotchkiss & Frei, 2007). The bridging of the Watercare bush and the bush at 146 Mill Road will not include any pier or other structures within stream beds, and this greatly reduces the potential impacts on the streams flowing through these partially forested catchments.

The preferred alignment includes sizeable areas of cut and fill which will undoubtedly disrupt and redirect existing flow paths. In addition, the road upgrade will create larger areas of impervious surfaces, which in turn will generate increased runoff at higher velocities. Areas of fresh cut and fill, coupled with increased surface runoff has the propensity to generate high levels of sediment-laden runoff which have the potential to generate serious ecological impacts. However, the hydrological effects associated with the Mill Road upgrade will be small relative to the creation of an entirely new road, and erosion and sediment controls during earthworks will be managed according to methods and procedures described in Auckland Council Technical Publication No.90, Guidelines for Land Disturbing Activities. These factors should keep adverse freshwater effects to minor (or less) levels.

In terms of managing the operational phase potential effects on freshwater, stormwater runoff from the road will be treated and attenuated in a total of seven treatment wetlands, which will be designed to meet the treatment criteria recommended by Auckland Council in TP10. This will provide removal of 75% of suspended solids and associated contaminants. From these ponds treated discharges will be directed to headwater tributaries of the Puhinui Stream in the Watercare gully and in Totara Park, the Otara Creek at Murphy's Bush and the Papakura Stream in the south of the project area. The stormwater discharges to these streams will be additionally buffered by dilution, and as a result any related adverse effects should be minor.

The gully at 146 Mill Road will be bridged and no stormwater discharges are directed into the stream here, and as a result this waterway will remain wholly unaffected. While the Watercare bush and scrub will be bridged a stormwater treatment wetland is proposed for this area, and as a consequence during storm events there will be discharges of treated stormwater to the stream.

On the Murphy's Road section, the culvert near Thomas Road will need to be extended by approximately 10m or so (mainly [possibly entirely] on the eastern side). The western side of this stream is within Murphy's Bush, while the reaches on the eastern side emanate in grazed farmland. In the southern Mill Road section, an entirely new culvert will be required, with a length of approximately 70m. The watercourse here is located in open pasture and is in a degraded condition. Both of these culverts are almost flat and are unlikely to present issues for fish passage. Table 16 summarises the stream crossings associated with the preferred alignment.

Table 16: Stream Crossings

	WaterCare gully	146 Mill Rd gully	Murphy's Bush	Mill Road South	Total culvert length
Preferred Option	bridge	bridge	10m	70m	80m

6.10.2 Ecological Effects

Under the preferred alignment aquatic habitat will be lost in the north (Murphy's Bush) and south (Alfriston), and possibly also in north-west (Totara Park). The SEV scores for the Watercare stream were in the "excellent habitat" range; the streams in Murphy's Bush, at 146 Mill Road, at Ranfurly and at 125 Murphy's Road were in the "moderate habitat" range, and the streams at the Alfriston and Mill Road South sites were in the "low habitat" range.

An interesting pattern in the taxonomic distinctness across the nine sample sites has emerged where the forested sites (Site 1 – Site 5) display higher than expected distinctness compared to the open sites with less vegetation cover (Site 6 – Site 9, see Figure 6 and Appendix 5). This pattern may be a result of the latter sites possessing considerably higher abundances of tolerant taxa such as Chironomus, Orthocladiinae, Ostracoda and Oligochaeta.

The extent of instream and stream bed habitat loss at the Murphy's Bush site is in the order of 10m, due to the extension of an existing culvert. While not an excessive amount, this stream is permanent and it is in the "excellent habitat" range, and consequently this loss constitutes a more than minor adverse ecological effect, but one that can be sufficiently mitigated. With regard to the loss of 70m of instream and stream bed habitat at Mill Road South due to the construction of a new culvert, while the stream is permanent it is in the "low habitat" quality range. Consequently the effects are not significant but nevertheless do require mitigation. Mitigation for stream habitat loss is addressed in section 6.10.3 below.

All other permanent steams will either be bridged (i.e. in the Watercare property and at 146 Mill Road) or otherwise existing culverts not extended (such as at the existing culverts beneath Ranfurly Road and Alfriston Road). Where the preferred alignment traverses through Totara Park the majority of waterways affected are ephemeral reaches (flowing only immediately after rain as overland flow) or the uppermost reaches of intermittent streams.

Under the Auckland Regional Council Air, Land and Water Plan the infilling of such streams is a Permitted Activity, while under the PAUP it is a Non-Complying activity. Notwithstanding that the freshwater provisions of the PAUP are currently under appeal, the ecological values of these uppermost reaches of intermittent streams in Totara Park are not high, and the second requirement of the RMA s.104(d) tests (i.e. adverse effects are minor) is considered to be met.

In relation to the potential adverse freshwater effects described above, it needs to be emphasised that the Mill Road upgrade is occurring in an already mixed suburban-rural landscape with an extensive road network and zoning for future urban development under the Proposed Auckland Unitary Plan. The hydrological and ecological changes generated by the upgrade are likely to be minimal relative to the extent of change that has already taken place in the area.

In conclusion, the adverse freshwater effects associated with the preferred alignment are expected to be either minor or negligible. Regardless of ecological value however, all aquatic habitat that is to be lost as a result of new culverts will need to be mitigated or compensated for. This is discussed below.

6.10.3 Environmental Compensation

Where loss of intermittent or permanent stream reaches cannot be avoided then such an effect needs to be mitigated or compensated for. The extent of such mitigation is normally calculated using the Environmental Compensation Ratio (ECR) as per the methodology presented in Auckland Council Technical Report TR2011/009. This compensation usually takes the form of riparian restoration of a nearby stream, in recognition that such vegetation plays an important role in regulating the environmental variables that directly influence stream health (e.g. providing shade, preventing stream bank erosion and providing both woody debris and leaf/insect inputs to feed aquatic communities). The length of any such restoration is determined using a formula which compares the gain in functions at the mitigation site with the loss at the impact site. This formula typically generates an ECR between 2 and 5, so that for each square metre of stream bed lost, between two and five square meters is improved through restoration measures. In cases where the mitigation stream is wider than the impact stream, the length of stream restoration cannot be less than the length of the stream impacted (i.e. a minimum ratio of 1:1 is required).

At this stage of the process (i.e. a NOR) there is an insufficient level of detailed design to work out the final ECR, but it is probable that (given the culvert lengths as presently proposed and the habitat quality of the affected reaches) the result would be the need for the restoration of between approximately 160 – 400m^2 of aquatic habitat in a nearby stream.

7.0 Recommended Mitigation Measures

A hierarchy has been used in the design of the preferred option with regard to ecological effects, with avoidance being the first priority. To a large degree this has been achieved by virtue of avoiding the old growth forest remnant at 134 Mill Road and at Murphy's Bush, and by bridging over (rather than traversing through) the two other areas of old growth indigenous forest at 146 Mill Road and on the Watercare property. In addition amendments to the alignment of the bridge over the Watercare bush in mid-2014 resulted in the retention of several mature kahikatea trees.

Notwithstanding this, there will still be some residual adverse ecological effects associated with the project, and it is appropriate that these be mitigated. A number of recommendations have been made in the assessment of effects section of this report in relation to the mitigation of adverse effects associated with the project. These are summarised below.

7.1 Vegetation

Remedy the loss of native trees by legally protecting native bush located within properties that will remain within the Mill Road designation. The obvious candidate for this form of remedial action would be the Watercare forest. While presently identified as a SEA in the PAUP the final suite of applicable rules relating to vegetation clearance within SEA's is uncertain at this stage, since those that are presently proposed in the PAUP are under submission. Notwithstanding this, under the proposed rules as they currently stand, vegetation clearance within a SEA is either a Controlled or Discretionary activity (depending on circumstances), which means there is no guaranteed protection into the future for this significant bush area. Providing guaranteed protection of this old growth forest will deliver excellent remedial outcomes in exchange for (limited) adverse ecological effects on 1,100m^2 of old growth forest at this same location.

Mitigation for loss of native trees could also be achieved by undertaking compensatory planting of native vegetation in the local area. Unfortunately there is no widely accepted formula for determining an appropriate 'replacement planting for lost bush' ratio. However, given that mature bush would provide significantly greater ecosystem services than would an area of recent revegetation plantings it is clear that any compensatory area of plantings needs to be well in excess of the area of mature forest lost.

Mitigation planting could be undertaken either within or potentially away from the designation (with the latter being contemplated if the results of doing such would deliver a better ecological outcome than planting within the corridor). Potential candidate sites for revegetation within the designation include some of the severance lands where such land adjoins existing native bush. Examples could include the severance land located south east of the new road at 158-166 Mill Road, the severance land to the north of the new road at 134 Mill Road (where it adjoins the bush on 146 Mill Road), and the severance lands located south of the new road at 375, 361, 355 and 353 Redoubt Road.

7.2 Habitat Fragmentation

Temporary fragmentation during construction of the Watercare bush bridge can be ameliorated by way of approaching the pier construction sites from both sides of the creek, thereby retaining a habitat linkage beneath the bridge that connects the bush on either side while the pier construction is underway.

Once pier construction has been completed for the Watercare bush bridge, the haul road(s) can be rehabilitated by way of removing all road-metal material, ripping the compacted earth, laying topsoil and revegetating these areas with appropriate hardy native forest shrub and small tree species.

7.3 Avifauna (Birds)

The nesting season for most native forest and grassland birds is generally September to February. Vegetation clearance would ideally avoid this period. Otherwise an ecologist will need to confirm that no 'At Risk' or 'Threatened' native avifauna are nesting in the areas to be cleared.

7.4 Chiropterofauna (Bats)

Bat behaviour and ecology should be considered during the design and construction of the road. Steps that could be taken include:

- Minimising vegetation clearance.
- Monitoring mature trees for bat habitation before felling.
- Minimise road lighting, where lights are necessary use downward facing low pressure sodium lamps with hoods to limit spillage (Bat Conservation Trust, 2009).

7.5 Herpetofauna (Lizards)

A Lizard Management Plan should be completed prior to construction, which should include the following:

- A rescue and relocation programme for both native geckos and skinks, including specific recommendations for salvage techniques and actions that are suitable for different lizard species, and determining appropriate release/receptor sites for translocated lizards. Capture techniques should include pre-clearance trapping for several weeks in likely skink habitat, and also involve herpetologists following behind tractor-mounted mowers (set a few centimetres above ground level) to capture disturbed individuals. Other effective techniques include leaving felled trees in situ for a few days prior to disposal to allow arboreal geckos time to escape.
- In the event that native lizards are found in substantial numbers (i.e. dozens of individuals), habitat enhancement (refuges and food supplementation) and pest control should be undertaken around release sites for a minimum of five years to ensure the habitat is able to support the increased population.

7.6 Freshwater Communities

The effects of culverts on stream habitats by providing for fish passage and undertaking stream rehabilitation to off-set the effects of habitat loss of Permanent and Intermittent Streams, with the extent of this restoration

to be determined using the Environmental Compensation Ratio method (Storey *et al*, 2011) at the resource consents stage of the project.

8.0 Conclusions

The adverse ecological effects of NoR 1 are negligible, and those associated with NoR 2 are less than minor. However, those associated with NoR 3, if left unmitigated, would be greater than minor – in this NoR the preferred alignment will result in the loss of 1,500m^2 of old growth forest and the overtopping (via two bridges) of a further 1,970m^2 of similar forest and 2,900m^2 of mixed quality scrub. Additionally, 80 linear metres of stream habitat will be lost as a result of new and extended culverts. Effects on native fauna will also occur as a result of this loss of habitat. However, these adverse effects can be sufficiently minimised or mitigated, as described in section 7.0 above. All in all, it is concluded that provided the majority of the mitigation recommendations described above are implemented the residual effects of the project would be no greater than minor.

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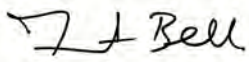
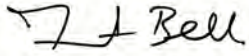
Appendix 1: Herpetofauna Report (Ecogecko Ltd, 2014)

LIZARD SURVEY REPORT FOR THE PROPOSED UPGRADE OF THE REDOUBT ROAD-MILL ROAD CORRIDOR

Dr Sabine Melzer
EcoGecko Consultants Limited
May 2014

Quality Assurance Statement

Author	SIGNED	DATE
Sabine Melzer		**13/5/2014**
REVIEWER	**SIGNED**	**DATE**
Trent Bell		**19/5/2014**
REVIEWER	**SIGNED**	**DATE**
Sarah Herbert		**13/5/2014**
APPROVAL FOR RELEASE	**SIGNED**	**DATE**
Trent Bell		**21/5/2014**

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Cover photograph: Rainbow skink, Mill Road
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Executive summary

To support the resource consent application for the construction associated with the proposed upgrade of the Redoubt Road-Mill Road corridor, Boffa Miskell commissioned EcoGecko Consultants Ltd to undertake an assessment of the lizard values within the development footprint.

- Historically, five lizard species have been recorded as occurring within a 10 km radius of the development corridor (the non-native rainbow skink, native copper and shore skinks, as well as native forest and Pacific geckos).
- We conducted surveys for the presence of lizards between the 15th and 19th April 2014. Survey efforts consisted of a total of 6 person hours of day searching, 5.5 person hours of night spotlighting, and 230 pitfall trap checks.
- One unidentified gecko (most likely a forest gecko, *Mokopirirakau granulatus*) was detected by eye shine amongst the old fronds of a large tree fern during night spotlighting. The gecko could not be captured for species identification.
- Eight non-native rainbow skinks (*Lampropholis delicata*) were captured in or on a pitfall trap (2), or seen during visual encounter searches (6).
- **Potential adverse effects of vegetation clearance and construction of the new road on lizards is considered more than minor,** given that the extent of suitable habitat along the proposed development corridor for both native skinks and geckos.
- Many areas where apparently suitable lizard habitat existed could not be surveyed. This was because some landowners refused to give permission to access privately-owned land.
- We recommend a Lizard Management Plan that outlines measures to avoid, remedy and/or mitigate adverse effects on native lizards. This should be written and implemented by an experienced herpetologist.

Introduction

There are currently 100 recognized species of lizards in New Zealand, of which only half are formally described (Hitchmough et al. 2013, Nielsen et al. 2011). All lizards, with the exception of the introduced rainbow skink, are endemic to New Zealand. With lizard species richness being approximately equivalent to that of terrestrial birds, skinks and geckos represent a significant component of our living fauna. All native lizards are legally protected under an amendment to the Wildlife Act 1953, and significant native lizard habitats by the Resource Management Act 1991 (Anderson et al. 2012). A significant component of our lizard fauna (around 80-85%) are recognised as 'Threatened' or 'At Risk' in the latest DOC Threat Ranking Lists (Hitchmough et al. 2013). Due to the strict legal protection of native herpetofauna under the Wildlife Act, and the wide variety of habitats used by lizards, lizard surveys are obligatory for many projects requiring consent from local authorities.

Overview of project

EcoGecko Consultants Limited was commissioned by Boffa Miskell to survey for the presence of lizards within the developmental corridor of the proposed Redoubt Road-Mill Road upgrade. Auckland Transport is planning this upgrade to accommodate an expected two fold increase in traffic over the next 20 years. Significant population growth is expected in this area, with up to 55,000 new houses to be constructed by 2041. The planned road upgrade will feature four lanes, cycle lanes and improved pedestrian and bus facilities to ease the impact of these new demands. The entire new corridor spans from Redoubt Road in the Manukau/Flat Bush area to Papakura and State Highway 1 (SH1) at Drury. In this report, the area surveyed for herpetofaunal values was an approximately 9 km long section between Redoubt Road at the Manukau motorway interchange and Popes Road in Alfriston. Here, I report the results of these surveys conducted between the 15th and 19th of April 2014.

Materials and Methods

Desktop assessment

A desktop assessment was undertaken to assess the potential lizard values of the proposed Redoubt Road-Mill Road corridor. This includes a consideration of each species of lizard potentially present, along with their threat status, abundance and significance (if found in the development footprint, or similar adjacent habitat that is highly connected to the habitat values within the footprint). This assessment was conducted using a search in the Department of Conservation's BioWeb *Herpetofauna*

database and existing literature, along with our expert knowledge of lizard species distribution patterns. This desktop assessment, which is no substitute for a thorough survey effort, attempts to predict species occurrence based on historical records within the vicinity, along with our expert knowledge of habitat requirements relative to the habitat types available within the proposed development area (Table 1).

The proposed development site is within both the Tamaki (09.03) and Manukau (09.07) Ecological Districts. Extant lizard taxa known to occur in the area are copper skinks (*Oligosoma aeneum*), moko skinks (*Oligosoma moko*), ornate skinks (*Oligosoma ornatum*), shore skinks (*Oligosoma smithi*), the introduced rainbow skink (*Lampropholis delicata*), as well as forest geckos (*Mokopirirakau granulatus*), elegant geckos (*Naultinus elegans*) and Pacific geckos (*Dactylocnemis pacificus*). We rated the significance of occurrence of each species in the proposed development site. This represents an arbitrary indicator of the potential and relative significance of populations of each species locally (Table 1). These rankings are based on our knowledge of the species' currently known range and extent of ranges, local and regional abundances, threat categories, and are subject to revision as new information becomes available, particularly from field survey work.

Table 1: *Threat status, likelihood of occurrence and significance of occurrence of lizards in the Tamaki and Manukau Ecological Districts. Species recorded in surrounding Ecological Districts are also listed if habitat requirements were considered highly similar at the road corridor. Threat status and taxonomy from Hitchmough et al. (2013).*

Common name	Scientific name	Threat status	Likelihood of occurrence	Significance of occurrence
Copper skink	*Oligosoma aeneum*	Not Threatened	Moderate	Low
Moko skink	*Oligosoma moco*	At Risk – Relict	Moderate	High
Ornate skink	*Oligosoma ornatum*	At Risk – Declining	Moderate	High
Rainbow skink	*Lampropholis delicata*	Introduced	High	Low
Shore skink	*Oligosoma smithi*	Not Threatened	Low	Moderate
Elegant gecko[1]	*Naultinus elegans*	At Risk - Declining	Moderate	High
Forest gecko	*Mokopirirakau granulatus*	At Risk – Declining	Moderate	High
Pacific gecko	*Dactylocnemis pacificus*	At Risk – Relict	Moderate	High

Remote habitat assessment and rapid site reconnaissance

Prior to field surveys, a lizard habitat assessment was conducted remotely using Google Earth and an aerial map supplied by Boffa Miskell to identify habitat types utilized by different lizard species.

[1] After consultation with New Zealand herpetologists, the Department of Conservation has recently accepted that the standardized common name for the Auckland green gecko is the elegant gecko.

Possible locations for undertaking visual encounter surveys and night spotlighting for herpetofauna were determined prior to visiting the site. A rapid site reconnaissance on the first day was used to ground-truth chosen areas. Adjustments were made based on habitat suitability and access. Table 2 explains the survey methods utilized to detect different lizard species. Because no search method is appropriate for all species and sites, the utilization of more than one technique during lizard inventorying improves the detection of lizard species.

Table 2: *Lizard species potentially present within the proposed development area; along with recommended survey methods following Department of Conservation guidelines. A 'tick' (✓) indicates that this method has usually detected the species in question in past lizard surveys either carried out by ourselves or by other herpetologists at other study sites. Day refuge searches (visual scanning in vegetation, turning over ground cover objects, looking in crevices) detects the widest range of lizard species but successful detection of the full suite of species is highly dependant on weather and experience of personnel due to the cryptic nature of lizards.*

Common name	Scientific name	Day refuge searches	Pitfall traps	Spotlighting
Copper skink	*Oligosoma aeneum*	✓	✓	
Moko skink	*Oligosoma moco*	✓	✓	
Ornate skink	*Oligosoma ornatum*	✓	✓	
Rainbow skink	*Lampropholis delicata*	✓	✓	
Shore skink	*Oligosoma smithi*	✓	✓	
Forest gecko	*Mokopirirakau granulatus*	✓		✓
Pacific gecko	*Dactylocnemis pacificus*	✓		✓
Elegant gecko	*Naultinus elegans*	✓		✓
Survey Effort		**6 person hours**	**230 'trap days'**	**5.5 person hours**

Visual Encounter Surveys

Visual Encounter Surveys (VES) were undertaken during the day between the 15th and 19th of April 2014 to determine the presence of lizards. Search effort was divided across the development corridor, based on a consideration of land area and habitat quality (habitat types known to support lizards). Night searches for arboreal geckos using powerful torches (*LED Lenser*® P7.2) and spotlighting binoculars were completed during mild and still weather conditions on the evening of the 18th May. All surveys were undertaken by one experienced herpetologist (see Appendix A) and an ecologist with some lizard survey experience. VES effort involved scanning vegetation for active or basking lizards, lifting ground cover objects and searching crevices in dead wood or debris piles.

Pitfall trapping: justification of use for skink species inventory instead of Onduline ACOs

We used pitfall trapping to assist in surveying for, capturing and identifying any skink species present in the development footprint. We placed 6 transects (A-F) of 10 pitfall traps each, baited with canned pear, in suitable habitat likely to be occupied by skinks across the site (total 60 pitfall traps, separated by 5-10 m intervals). Traps were open for four days (= 240 trap days) and checked once daily. Pitfall trapping is a common method used for surveys or monitoring of terrestrial herpetofauna (e.g. Fisher et al. 2008). These traps are most useful for capture of terrestrial skinks and the traps can capture any of the skinks known to be resident in the Tamaki and Manukau Ecological Districts. Copper and ornate skinks have been consistently captured using pitfall traps in combination with Onduline ACOs at Shakespear Regional Park, as part of the Auckland Council lizard monitoring programme there (M. Maitland, pers. comm.). The pitfall traps used for the Redoubt Road-Mill Road corridor survey consisted of a 250 mL plastic container dug into the ground with a plywood cover placed on top, approximately 2 cm off the ground, in order to allow skinks to enter the trap.

Given that survey results were needed prior to the next available field season (i.e. spring and summer of 2014-2015), Onduline Artifical Cover Objects (Onduline ACOs) were not an appropriate survey method in this instance. ACOs need time in the environment in order for lizards to find and occupy them (Anderson et al. 2012). The optimum time for this is still unclear but it is known that the number of southern grass skinks (*Oligosoma* aff. *polychroma* Clade 5) found under ACOs increases with time, peaking at 6 months (Hoare et al. 2009, O'Donnell & Hoare 2012). Therefore, we used pitfall traps and day refuge searches to detect skinks and night spotlighting to detect arboreal geckos. These methods are effective in surveys that are required immediately, if weather conditions remain suitable for lizard activity.

Habitat surveyed and restrictions

Lizard habitat along the proposed upgraded Redoubt Road-Mill Road corridor consisted of rank grass areas along fencelines and bordering bush or scrub, mixed exotic/native scrub, areas of mature broadleaf forest and gullies with existing and planted native vegetation. Bush edges provided areas of kikuyu (*Pennisetum clandestinum*) and other rank grasses and often gorse (*Ulex europaeus*). All of these habitat types can support both terrestrial skinks and arboreal geckos. Areas adjacent to the current road that are regularly grazed and mowed, as well as stands of pine plantation are of lower habitat quality for lizards.

***Fig. 1**. Lizard habitat searched on the proposed development footprint along Redoubt and Mill Road. Native bush with ground vegetation (A, B), rank/kikuyu grass along bush, road edges (C) and fencelines (D) are habitat for lizards.*

VES and spotlighting areas were chosen to maximise the detection of possible lizard taxa present. Areas with potentially suitable lizard habitat included native bush, patches of kanuka/manuka, rank grass, scrub edges and wooden debris/logs.

Substantial amounts of Totara Park consist of managed farmland with mountain biking paths for the public. Grassy areas are typically grazed or mowed but gullies with existing native vegetation have

been re-planted and are fenced off (Fig. 2). These areas, although isolated and small (the largest being approximately 0.92 ha) can provide habitat for arboreal geckos and terrestrial skinks.

Large areas of apparently suitable lizard habitat within the development footprint could not be surveyed because private land owners refused access to the properties,due to opposition against the development project. Therefore, the searchable habitat along the proposed development corridor was restricted but attempts were made to cover as much accessible habitat as possible likely to support lizard populations. It is a reasonable assumption that lizard species found immediately adjacent to the envelope should also be within similar habitats inside the envelope.

Several properties along the Redoubt/Mill Road corridor have excellent lizard habitat, such as mature broadleaf forest containing puriri (*Vitex lucens*), taraire (*Beilschmiedia tarairi*) and rimu (*Dacrydium cupressinum*).

Fig. 2*. Lizard habitat searched in Totara Park. Suitable habitat consisted of predominantly revegetated gullies with some existing mature trees that were fenced off from stock. Manuka/kanuka* (Leptospermum scoparium / Kunzea ericoides) *and undergrowth of red mapou* Myrsine australis *and rank grass can provide habitat for both arboreal geckos and terrestrial skinks.*

Results

The Department of Conservation's BioWeb *Herpetofauna* records database currently holds no records for lizards from within the proposed development footprint. However, five lizard species have been recorded within a 10 km radius in the BioWeb *Herpetofauna* database. These include the native shore and copper skinks and forest and Pacific geckos (based on a single sighting in 1934), as well as the non-native rainbow skink.

Survey activities were undertaken during variable weather conditions in April, with maximum daily temperatures ranging between 22 and 24.1 °C (Table 3). Adverse weather conditions during the second check of pitfalls caused by Cyclone Ita (strong winds and over 40 mm of rain) negatively affected the survey results. The spotlighting was conducted between 7:00 pm and 11:00 pm in ideal conditions for surveying, with temperatures ranging between 15 and 16 °C and light winds. One arboreal gecko was seen during night spotlighting, detected by the reflective eye shine, located in native bush within Totara Park in reasonably close proximity to the Mill Road corridor (see map). Due to the position of the gecko in the skirt of old fronds in a tall tree fern (> 15m tall, in a gully surrounded by thick vegetation), it was not possible to catch the gecko to identify it. However, it is suspected that this gecko is most likely a forest gecko, although Pacific geckos cannot be discounted as they can use microhabitats that forest geckos also use.

Table 3: *Summary of weather conditions over the pitfall trapping period. Weather information was obtained by accessing the NIWA national climate database and shows combined daily data at midnight (local) taken at the closest station to the site at Auckland Airport.*

Weather data	Check 1	Check 2	Check 3	Check 4
Speed of max gust over 24 hrs (m/s)	15.4	23.7	12.4	12.9
Rain over 24 hrs (mm)	1.8	43.4	0	2.8
Max temp. over 24 hrs (°C)	22	24	24.1	22.9
Min. temp over 24 hrs (°C)	17.2	17	17.5	15
Min. grass temp. over 24 hrs (°C)	16	16.4	15.6	13

A total of 230 pitfall trap days, 6 person hours of day search effort and of 5.5 person hours of night spotlighting were allocated across the area (Table 2). The expected 240 trap days resulting from 60 pitfall traps checked over four consecutive days was reduced due to some pitfall traps being dug out or bait being removed by animals, likely to be possums or rabbits. Dug out traps were reinstalled and not counted for trap days, while those with bait removed were counted as half trap days to account for disturbance.

Lizards were located during visual encounter searches (7 rainbow skinks) and pitfall trapping (1 rainbow skink). One gecko was detected by eye shine during spotlighting, most likely a forest gecko. In addition, three juvenile frogs were seen during surveys (*Litoria aurea,* non-native).
Survey effort and lizard locations are shown on map A in the appendix (to be supplied by Boffa Miskell)

Discussion

Lizard populations and their ecological values

The New Zealand native lizard fauna currently comprises 100 recognised species, of which around half are formally described (Hitchmough et al. 2013, Nielsen et al. 2011). All of our native lizards are endemic to New Zealand and constitute a significant component of our extant fauna. All lizards, except for the introduced rainbow skink (*Lampropholis delicata*), are legally protected under the Wildlife Act 1953, and areas of significant habitat are protected via the Resource Management Act 1991 (Anderson et al. 2012). A significant component of our lizard fauna (around 80-85%) are recognised as 'Threatened' or 'At Risk' in the latest Threat Ranking Lists (Hitchmough et al. 2013).

Lizard values

Two lizard species were confirmed as present in the areas searched between the 15th and 19th of April 2014: the introduced rainbow skink and a native unidentified gecko. The gecko could not be identified to species level due to difficulty in capturing the animal, given its position amongst dead fronds on a large tree fern in a gully. However the gecko is most likely a forest gecko. Arboreal geckos are extremely cryptic and can be difficult to detect, particularly where they occur at low densities.

Surprisingly, no native skinks were found despite suitable habitat being present. Surveys were conducted in April, when lizards tend to become less active. Further, due to unpredictable weather during Cyclone Ita, detection probability of lizards in our surveys may have beenimpaired.

However, geckos can remain active and detectable during winter months. Jewelled geckos (*Naultinus gemmeus*), for example, can be detected on the South Island during mild and sunny conditions right throughout winter (Carey Knox, EcoGecko Consultants, pers. comm.). Forest geckos have been successfully studied on Waiheke Island during May in a recent EcoGecko Consultants-DOC-Auckland Council joint research project, and elegant geckos were also detected during this study.

Due to the restrictions experienced in accessing private land within the development footprint, and the variable weather conditions during our survey, we cannot conclude that native skinks are absent. Copper skinks occupy the same habitat as rainbow skinks and these skinks have also been recorded nearby, so it is likely that copper skinks are present. While there are no records of ornate skinks within 10 km of the site in the BioWeb *Herpetofauna* database, there is suitable habitat for this species within the development corridor and it is possible that ornate skinks may be present in low numbers. Unfortunately, survey records for lizards are often not submitted to the BioWeb *Herpetofauna* database and the seeming absence of a species in an area must therefore be viewed with caution, particularly when the site is within the natural range of the species and suitable habitat is present.

The rainbow skink is not legally protected, and no management or mitigation is required for this species. Forest geckos are legally protected and adverse effects must be mitigated for these species in this project. If any other native lizard species are subsequently recorded as present (such as the copper and ornate skink) and thus affected, adverse effects must also be mitigated for these species.

Habitat values

Several different habitat types potentially containing lizards within the proposed development area were identified during the survey. Identified habitat were as follows:

(a) regenerating bush with a scrub edge,
(b) mature broadleaf forest,
(c) rank grass bordering pasture and bush, and
(d) wooden debris/logs across all habitat types.

Habitat types (a) and (b) may support populations of arboreal geckos, while habitat types (a-d) may support terrestrial skinks. Arboreal geckos typically occur in manuka, kanuka and broadleaf forest, and usually require moderately large tracts of such habitat for viable populations to persist in the presence of introduced predatory mammals. Day searches of the suitable habitat and spotlighting did not detect elegant geckos but it remains possible that this species is present at very low densities.

Habitat on private property that could not be searched includes mature broadleaf forest containing puriri, taraire and rimu. Further, Murphy's Bush (along Murphy's Road) consists of kahikatea-dominated (*Dacrycarpus dacrydioides*) lowland forest.This site considered to be of high habitat value for copper and ornate skinks, and also arboreal geckos.

Kikuyu and gorse is present along the development footprint and this habitat can support native terrestrial skinks, as well as non-native rainbow skinks. Given the presence of suitable habitat within the development footprint, it is likely that populations of copper and possibly also ornate skinks persist in these areas.

Sensitivity to potential effects and potential mitigation measures

Project construction will require vegetation clearance and earthworks, disturbing the surrounding vegetation and landscape. Based on the lizard habitats and the species present, it is likely that lizards will be affected by the proposed road. The remaining mature broadleaf forest habitat is of high value for lizards.

Forest gecko populations are declining and their threat status is 'At Risk-Declining' (Hitchmough et al. 2013). The presence of Pacific geckos could not be ruled out, although they were not detected in this survey. The threat status of Pacific geckos is 'At Risk - Relict' and the presence of this species would be significant. While copper skinks were not detected, they share much of the same habitat as rainbow skinks and may be present. Given the presence of suitable habitat within the development footprint, ornate skinks may also be present. The conservation status of copper skinks is 'Not Threatened', while ornate skinks are 'At Risk- Declining' (Hitchmough et al. 2013).

The mature native bush is being bridged in the two places where it is impacted and the vast majority of the earthworks will occur in farmland. Given this, while potentially some mortalities of native lizards may occur, it is nevertheless likely that the actual numbers involved will be low given the low detection rates in the areas surveyed. However, it is recommended that a lizard salvage operation be undertaken immediately prior to construction – this is discussed further in the following Recommendations section. Any such salvage operation should include any land supporting lizard habitat, including properties for which access was denied in this present survey – this will be possible once land purchase has been completed

Recommendations

I recommend the preparation and implementation of a Lizard Management Plan by an experienced herpetologist to provide detailed information on management actions to avoid, remedy and/or mitigate adverse effects on protected native lizards. Although not confirmed, copper skinks and ornate skinks should be assumed potentially present based on suitable habitat. Management actions should include:

- A rescue and relocation programme is required for both native geckos and skinks including specific recommendations for salvage techniques and actions that are suitable for different lizard species.
- Habitat restoration, enhancement and management should be undertaken to mitigate the effects of the road, especially for the remaining vegetation along the Redoubt Road-Mill Road

route. This requirement also includes habitat enhancement at identified release/ receptor sites for translocated lizards.

- Post-release monitoring of lizards within release sites and revegetated areas for at least five years.
- Design and implementation of a pest control programme.
- Any other conditions as required by an Wildlife Act permit for the salvage and relocation of native lizards.

ARDS Cards

ARDS cards have been submitted to the Department of Conservation by EcoGecko Consultants Limited for the lizards found during the survey activity.

Acknowledgements

This assessment was conducted under a Wildlife Act Authority (National Permit 37787-FAU) from the Department of Conservation. Alistair McCullough and Georgia Cummings (Boffa Miskell) participated in the field work.

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Appendix A: Herpetological experience of Dr Sabine Melzer, EcoGecko Consultants

Sabine completed her PhD at the University of Otago on New Zealand's unique *Leiopelma* frogs and has authored 18 peer-reviewed scientific publications and consultancy reports. Her experience includes both fieldwork and the coordination of field assistants in urban environments and remote field sites in New Zealand, Europe, USA and in the Caribbean. NZ field experience includes gecko and skink mark-recapture and site occupancy studies, amphibian and reptile inventory surveys and Assessments of Environmental Impact on herpetofauna across New Zealand. She has experience in maintenance of endangered NZ native frogs, introduced frogs and reptiles (tuatara, skinks and geckos) in captivity. Laboratory experience includes culturing amphibian chytrid fungus, and collecting skin peptides. Sabine is a member of the Society for Research on Amphibians and Reptiles in NZ (SRARNZ), and four major herpetological societies internationally. She has 13 years of experience working with amphibians and reptiles (8 years in New Zealand).

Department of Conservation
Te Papa Atawbai

Wildlife Act Authority for wildlife located on public conservation land *and* non public conservation land

Authorisation Number: 37787-FAU

THIS AUTHORITY is made this 12th day of December 2013

PARTIES:

The Director General of Conservation and where required the Minister of Conservation (the Grantor)

AND

EcoGecko Consultants Limited (the Authority Holder)

BACKGROUND:

A. The Director General of Conservation is empowered to issue authorisations under the Wildlife Act 1953.

B. Where the authorisation applies to wildlife located on public conservation land a further authorisation is required, depending upon the legislation applying to the public conservation land, from either the Director General of Conservation or the Minister of Conservation.

C. The Authority Holder wishes to exercise the authorisation issued under the Wildlife Act 1953 and where applicable the authorisation issued under the Conservation legislation applying to the public conservation land subject to the terms and conditions of this authority.

OPERATIVE PARTS:

In exercise of the Grantor's powers under the Conservation legislation the Grantor **AUTHORISES** the Authority Holder under Section 53 of the Wildlife Act 1953, subject to the terms and conditions contained in this Authority and its Schedules.

_____

SIGNED on behalf of the Grantor by
Markerita POUTASI,
Director, Conservation Partnerships, Auckland
acting under delegated authority dated 29 August 2013
in the presence of:

Witness Signature:_____
Witness Name: _____
Witness Occupation:_____
Witness Address: _____

A copy of the Instrument of Delegation may be inspected at the Director-General's office at 18-22 Manners Street, Wellington

SCHEDULE 1

1.	**Authorised activity (including any approved quantities of wildlife and collection methods).** (clause 2)	Catch and handle native skinks and geckos where encountered during herpetological surveys. Includes species in the following genera: *Dactylocnemis* spp., *Hoplodactylus* sp., *Mokopirirakau* spp., *Naultinus* spp., *Tukutuku* sp., *Toropuku* sp., *Woodworthia* spp., and *Oligosoma* spp.
2.	**The Location** (clause 2)	Areas which are covered by the: - Warkworth District Office; and - Auckland District Office
3.	**Personnel authorised to undertake the Authorised Activity** (clause 3)	- Trent Bell; - Sarah Herbert; - Carey Knox; and - Sabine Melzer
4.	**Term** (clause 4)	Commencing on and including 1 December 2013 and ending on and including 30 June 2016
5.	**Authority Holder's address for notices** (clause 8)	The Authority Holder's address in New Zealand is: EcoGecko Consultants Limited 1-40 Fulford Street New Plymouth 4310 New Zealand Phone: 06 7588771 Email: carey@ecogecko.co.nz
6.	**Grantor's address for notices**	The Grantor's address for all correspondence is: Department of Conservation Hamilton Shared Service Centre Level 4 73 Rostrevor Street Hamilton 3204 Email: permissionshamilton@doc.govt.nz

SCHEDULE 2

STANDARD TERMS AND CONDITIONS OF THE AUTHORITY

1. Interpretation

1.1 The Authority Holder is responsible for the acts and omissions of its employees, contractors or, agents. The Authority Holder is liable under this Authority for any breach of the terms of the Authority by its employees, contractors or agents as if the breach had been committed by the Authority Holder.

1.2 Where obligations bind more than one person, those obligations bind those persons jointly and separately.

2. What is being authorised?

2.1 The Authority Holder is only allowed to carry out the Authorised Activity on the Land described in Schedule 1, Item **2.**

2.2 The Authority Holder must contact the Department of Conservation's local Partnership Manager(s) prior to carrying out the Authorised Activity in the Area.

2.3 The Authority Holder and Authorised Personnel must carry a copy of this Authority with them at all times while carrying out the Authorised Activity.

2.4 Unless expressly authorised by the Grantor in writing, the Authority Holder must not donate, sell or otherwise transfer to any third party any material, including any genetic material, or any material propagated or cloned from such material, collected under this Authority. Notwithstanding the preceding constraint, the Authority Holder may publish authorised research results.

2.5 The Authority Holder must lodge holotype specimens and a voucher specimen with a recognised national collection any taxon, which is new to science. The Authority Holder must immediately notify the Grantor of any such finds.

3. Who is authorised?

3.1 Only the Authority Holder and the Authorised Personnel described in Schedule 1, Item 3 may be involved in carrying out the Authorised Activity, unless otherwise agreed in writing by the Grantor.

4. How long is the Authority for - the Term?

4.1 This Authority commences and ends on the dates set out in Schedule 1, Item 4.

5. What are the obligations to protect the environment?

5.1 The Authority Holder must not cut down or damage any vegetation; or damage any natural feature or historic resource on any public conservation land being part of the Land; or light any fire on such public conservation land; or erect any structure such public conservation land without the prior consent of the Grantor.

5.2 The Authority Holder must ensure that it adheres to the international "Leave No Trace" Principles at all times (**www.leavenotrace.org.nz**).

5.3 The Authority Holder must not bury:

(a) any toilet waste within 50 metres of a water source on any public conservation land being part of the Land; or

(b) any animal or fish or any part thereof within 50 metres of any water body, water source or public road or track.

6. What are the liabilities?

6.1 The Authority Holder agrees to exercise the Authority at the Authority Holder's own risk and releases to the full extent permitted by law the Grantor and the Grantor's employees and agents from all claims and demands of any kind and from all liability which may arise in respect of any accident, damage or injury occurring to any person or property arising from the Authority Holder's exercise of the Authorised Activity.

6.2 The Authority Holder must indemnify the Grantor against all claims, actions, losses and expenses of any nature which the Grantor may suffer or incur or for which the Grantor may become liable arising from the Authority Holder's exercise of the Authorised Activity.

6.3 This indemnity is to continue after the expiry or termination of this Authority in respect of any acts or omissions occurring or arising before its expiry or termination.

7. What about compliance with legislation and Grantor's notices and directions?

7.1 The Authority Holder must comply with all statutes, bylaws and regulations, and all notices and requisitions of any competent authority relating to the conduct of the Authorised Activity. Without limitation, this includes the Conservation Act and the Acts listed in the First Schedule of that Act and the Health and Safety in Employment Act.

7.2 The Authority Holder must comply with all reasonable notices and directions of the Grantor relating to the conduct of the Authorised Activity.

8. Are there limitations on public access and closure?

8.1 The Authority Holder acknowledges that the public conservation land being part of the Land is open to the public for access and that the Grantor may close public access to that public conservation land during periods of high fire hazard or for reasons of public safety or emergency.

9. When can the Authority be terminated?

9.1 The Grantor may terminate this Authority at any time in respect of the whole or any part of the Land if:

(a) The Authority Holder breaches any of the conditions of this Authority; or

(b) in the Grantor's opinion, the carrying out of the Authorised Activity causes or is likely to cause any unforeseen or unacceptable effects

9.2 If the Grantor intends to terminate this Authority, the Grantor must give the Authority Holder either:

(a) one calendar month's notice in writing; or

(b) such other time period which in the sole opinion of the Grantor appears reasonable and necessary

10. How are notices sent and when are they received?

10.1 Any notice to be given under this Authority by the Grantor is to be in writing and made by personal delivery, fax, by pre paid post or email to the Authority Holder at the address, fax number or email address specified in Schedule 1, Item 5. Any such notice is to be deemed to have been received:

(a) in the case of personal delivery, on the date of delivery;

(b) in the case of fax, on the date of dispatch;

(c) in the case of post, on the 3rd working day after posting;

(d) in the case of email, on the date receipt of the email is acknowledged by the addressee by return email or otherwise in writing.

10.2 If the Authorised Holder's details specified in Schedule 1, Item 5 change then the Authorised Holder must notify the Grantor within 5 working days of such change.

11. What about the payment of costs?

11.1 The Authorised Holder must pay the standard Department of Conservation charge-out rates for any staff time and mileage required to monitor compliance with this Authority and to investigate any alleged breaches of the terms and conditions of it

12. Are there any Special Conditions?

12.1 Special conditions are specified in Schedule 3. If there is a conflict between this Schedule 2 and the Special Conditions in Schedule 3, the Special Conditions shall prevail.

SCHEDULE 3

SPECIAL CONDITIONS.

Collection / Removal of material

1. No material is to be collected or removed from the survey sites.

Variations

2. The Authority Holder may apply for variations to the Authority; this must be done by contacting the Permissions team where the original authorisation was processed.

Private land

3. This Authority does not confer any right of access over any private land; or public conservation land leased by the Grantor (unless specified in the Authorised Activity). Any arrangements necessary for access over private land or leased land are the responsibility of the Authority Holder. In granting this Authority the Grantor does not warrant that such access can be obtained.

Nature Reserves & Burgess Island

4. If the Authority Holder intends to undertake the activity in any nature reserve within the Location, or on Burgess Island, it must first contact the respective Conservation Services Manager at the Auckland District Office or Warkworth District Office and provide a plan of proposed work. Any activity proposed to be undertaken in a nature reserve or on Burgess Island is subject to the Conservation Services Manager's approval.

Entry Permits

5. Entry permits are to be obtained by the relevant District Office prior to entering Public Conservation Land where such permits are required.

Death of wildlife associated with activities covered by the authority

6. All wildlife handled during the Authorised Activity must be handled using accepted best practice and as carefully as possible, but if any Threatened, At Risk or Data Deficient species (see NZ Threat Classification System and Lists: http://intranet/our-work/biodiversity-and-natural-heritage/threatened-species/nz-threat-classification-system/) should die, the body must be sent to Massey University Wildlife Post Mortem Service for necropsy along with details of the animal's history.

7. The Authority Holder shall:
    - Ensure that the body is to be chilled if it can be delivered within 24 hours, or frozen if longer than 24 hours to delivery.
    - Ensure appropriate measures are taken to minimise further deaths.
    - Inform the Grantor and discuss whether it is necessary to halt all further handling until full investigations of death(s) occur.
    - Pay for any costs incurred in investigation of the death of any lizards.

Track markers

8. The Authority Holder shall remove all track markers, flagging tape or other material used at the catching and/or release areas for the purposes of the Authorised Activity within one (1) month of the Authorised Activity being completed.

Expectations of the public

9. The Authority Holder must use best endeavours to ensure that the Authorised Activity is not undertaken within sight of the public.

10. While undertaking the Authorised Activity the Authority Holder must not exclude or impede the public from accessing any sites, tracks or facilities.

11. If approached by members of the public while carrying out the Authorised Activity, the Authority Holder shall provide an explanation of why the Authorised Activity is taking place.

Stakeholders

12. The Authority Holder must inform the respective District Office's Conservation Services Manager at least one (1) week prior to commencing the Authorised Activity.

13. The Authority Holder must identify the relevant tanagata whenua groups and undertake consultation with iwi at least 10 days prior to commencing the activity in the Location and provide information about the activity proposed and where it is to be carried out. The Authority Holder must contact the respective District Office for iwi contact details.

Reporting requirements

14. Upon completion of a survey, the Authority Holder shall forward a copy of the survey findings to the local Conservation Services Manager within one month. This report shall include any implications to conservation management.

    The Authority Holder shall acknowledge that the local Conservation Service Manager may provide copies of the report to tangata whenua.

The survey report shall include the following information:

- Survey area/location (include map)
- Size of area surveyed
- Dates and times of survey
- Location of transects, trap sites, survey tracks
- Total time spent on the survey
- Personnel involved (the number of people involved and names of personnel)
- Species and numbers of lizards found, and the GPS coordinates of each of these
- Weather conditions during the survey
- Completed Amphibian and Reptile Distribution System (ARDS) cards (http://www.doc.govt./conservation/native-animals/reptiles-and-frogs/species-information/herpetofauna-data-collection/ards-card/) to Herpetofauna, Department of Conservation, National Office, PO Box 10420, Wellington 6143, or herpetofauna@doc.govt.nz for all herpetofauna sightings and captures.

All monitoring and trapping records shall be made available for inspection at reasonable times by officers of the Grantor.

Biosecurity General

15. The Authority Holder must take all precautions to ensure weeds and non-target species are not introduced to the Land; this includes ensuring that all tyres, footwear, gaiters, packs and equipment used by the Authority Holder, its staff and clients are cleaned and checked for pests before entering the Land.

Didymo

16. The Authority Holder must comply with the Ministry for Primary Industry (MPI)'s "Check, Clean, Dry" cleaning methods to prevent the spread of didymo (*Didymosphenia geminata)* and other freshwater pests when moving between waterways. "Check, Clean, Dry" cleaning methods can be found at - http://www.biosecurity.govt.nz/cleaning. The Authority Holder must regularly check this website and update their precautions accordingly.

Kauri dieback

17. The Authority Holder must comply and ensure its field assistants strictly adhere to the following Kauri dieback *Phytophthora taxon Agathis* (PTA) hygiene procedures, attached as Schedule 4 to prevent the spread of weeds, diseases or pathogens including Kauri PTA and chytrid fungus. http://www.biosecurity.govt.nz/pests/kauri-dieback

Searching, Catching & Handling

18. Traps are to be checked as soon as possible after sunrise within 8 hours of daylight.

19. The Authority Holder shall only use methods to search for lizards that preserve habitat quality.

20. Lizard capture and handling shall be undertaken at a suitable time of year (September – May) when lizards are active, as advised by a suitably experienced herpetologist.

21. The Authority Holder shall ensure that during capture and handling of lizards, only techniques that minimise the risk of infection or injury to the animal are used, and handling and disturbance of lizards is restricted only to when necessary to determine taxa or to photographically record characteristics when taxon is in doubt.

22. Lizards shall only be handled by people who are appropriately trained and experienced in lizard capture and handling, or under direct supervision of someone who is. Only non-destructive search methods shall be used.

23. If traps are used the Authority Holder shall ensure that they are covered to protect lizards from exposure and stress. Damp leaf litter or other material shall be provided to reduce desiccation risk and to provide hiding places. If using pit-fall traps, the bottom shall be perforated to allow drainage of water. Traps shall be placed on a secure surface to avoid disturbance from predators. Traps may be baited.

24. No manipulation, removal from habitat or holding for longer than one hour is permitted without prior consultation with the Grantor.

25. The Authority Holder shall ensure that any lizard held temporarily will be held in a suitable container (such as a breathable cloth bag), and held out of direct sunlight in order to minimise the risk of over heating, stress and death.

Dead specimens

26. The Authority Holder must notify the relevant District Office should it find dead rare specimens.

Department of Conservation
Te Papa Atawbai

Permission Number: 37787-FAU

Variation to a Wildlife Act Authority under the Wildlife Act 1953

THIS VARIATION OF AUTHORITY is made this 5th day of May 2014

PARTIES:

The Director General of Conservation (the Grantor)

EcoGecko Consultants Limited (the Authority Holder)

BACKGROUND

A. The Director General of Conservation on [*insert date*] issued the Authority Holder an authority under the Wildlife Act 1953 (called the Authority).

B. The Authority Holder wishes to vary that Authority.

OPERATIVE PARTS

1. In exercise of the Grantor's powers under the Wildlife Act the Grantor varies the Authority as follows:

(i) Schedule One (clause 2) has been updated to include:
To move authorised species of lizards up to a distance of 500 meters, and temporarily hold lizards for a period of 24hours.

2. Confirmation of other Authority Covenants

Except to the extent to which they are amended by this Variation the provisions expressed and implied in the Authority continue to apply.

3. Costs

The Authority Holder must pay the costs of and incidental to the preparation and completion of this Variation.

SIGNED on behalf of the Grantor

by Pieter Tuinder

Conservation Partnerships Manager

Auckland Office

acting under delegated authority
in the presence of:

Witness Signature: _____
Witness Name: Rebecca Rush
Witness Occupation: Partnerships Ranger
Witness Address: 64 St Georges Rd,
Avondale, Auckland

A copy of the Instrument of Delegation may be inspected at the Director-General's office at 18-22 Manners Street, Wellington

Appendix 2: Bird species recorded by the Ornithological Society of New Zealand (OSNZ) within a 10km² area that includes the designation, 1999-2004. Green shading indicates habitat and seasons recorded.

Species Name	Current Survey	% of OSNZ Surveys Recorded	Habitat					Season			
			Native forest	Exotic Plantation	Farmland	Residential	Wetland	Autumn	Spring	Summer	Winter
Sparrow, House	✓	100			■	■	■	■	■	■	■
Starling	✓	100	■		■	■		■	■	■	■
Myna	✓	94	■		■	■	■	■	■	■	■
Blackbird	✓	89	■		■	■		■	■	■	■
Harrier, Australasian		83	■		■	■	■	■	■	■	■
Mallard		83			■	■	■	■	■	■	■
Fantail, New Zealand	✓	78	■		■	■	■	■	■	■	■
Swallow, Welcome		78	■	■	■	■	■	■	■	■	■
Plover, Spur-winged	✓	72			■	■	■	■	■	■	■
Pukeko	✓	72			■	■	■	■	■	■	■
Thrush, Song		72	■		■	■		■	■	■	■
Goldfinch		67			■	■		■	■	■	■
Silvereye	✓	67	■	■	■	■	■	■	■	■	■
Warbler, Grey		67	■	■	■	■		■	■	■	■
Chaffinch	✓	61	■	■	■	■		■	■	■	■
Gull, Black-backed		61			■	■	■	■	■	■	■
Magpie, Australian	✓	61	■	■	■	■		■	■	■	■
Rosella, Eastern	✓	61	■		■	■		■	■	■	■
Dove, Spotted	✓	56			■	■		■	■	■	■
Greenfinch		56	■		■	■		■	■	■	■
Heron, White-faced		56			■	■	■	■	■	■	■
Kingfisher, New Zealand		56			■	■	■	■	■	■	■
Skylark	✓	56			■			■	■	■	■
Tui	✓	56	■		■	■		■	■	■	■
Yellowhammer		56			■	■		■	■	■	■
Quail, California		50			■	■		■	■	■	■
Shelduck, Paradise		50			■		■	■	■	■	■
Pigeon, Rock		39			■	■		■	■	■	■
Gull, Red-billed		33			■	■	■	■		■	■
Shag, Black		33			■	■	■	■	■	■	■
Pheasant, Ring-necked		28			■	■		■	■	■	■
Pigeon, New Zealand	✓	28	■		■	■		■	■	■	■
Turkey, Feral		22			■	■		■	■		
Goose, Feral		17			■		■	■			■
Sparrow, Hedge		17			■	■		■	■		■
Cuckoo, Shining		11	■		■	■			■	■	
Dabchick, New Zealand		11					■			■	■
Duck, Grey		11					■	■			■
Morepork		11				■		■	■		
Peafowl		11			■	■			■	■	
Shag, Little		11			■		■		■	■	
Shag, Little Black		11					■			■	■

Shag, Pied		11									
Stilt, Australasian Pied		11									
Cockatoo, Sulphur-crested		6									
Dove, Barbary		6									
Duck, Mandarin		6									
Fowl, Feral Domestic		6									
Guineafowl, Tufted		6									
Gull, Black-billed		6									
Shoveler, New Zealand		6									
Swan, Black		6									

APPENDIX 3:

Matrices for Guidance in Determining Significance of Adverse Ecological Effects

Introduction

There is currently no agreed process in New Zealand for determination of the magnitude and significance of adverse ecological effects, whether for an individual species or an ecological system. Typically, assessments of ecological effects rely on "expert opinion" with each expert having a different approach to reaching that opinion, some more subjective, others more objective, and with a focus on legal/RMA thresholds 'less than minor, 'no more than minor', 'minor', which themselves are poorly defined with regard to species or ecological systems.

This lack is perhaps less of an issue with small projects that don't proceed beyond a council hearing or when adverse effects are able to be delineated and described with a high degree of accuracy, and where effects are of a modest nature allowing for an easier consensus of expert opinion. However, on larger and more complex projects, this lack of guidance has resulted in an equivalent lack of certainty for applicants, council planners, judges, commissioners and the public alike.[3]

Europe, the UK and North America are significantly more advanced in their effects assessment methodologies than NZ, with early versions dating back to the 1990's and with considerable activity in the early 2000's.

In 2004 BML ecologists began investigating this international guidance, turning in the first instance to the Institute of Ecology and Environmental Management (IEEM) which was the professional body for many ecological and environmental management professionals in the UK, Ireland and abroad. This organisation was in the process of developing ecological impact assessment guidance at that time[4]. This guidance was a development of an earlier paper by Karen Regini[5].

The IEEM draft guidance drew together a range of impact assessment methodologies from around the UK to compile a comprehensive assessment process relevant and focused on Ecological Impact Assessment (EcIA). This assessment process allowed the identification of Valued Ecosystem Components (VEC's) and the determination of ecological significance of the VEC. It then applied those values to a series of assessment matrices. These matrices aided in the determination firstly of magnitude of effect (temporal and spatial), and provided a determination of the significance of that effect, both positive and negative.

The IEEM guidance evolved considerably between 2002 and 2006 when it was finalised. In addition over that period several UK consultancies began applying the draft IEEM guidance to actual ecological effects assessments. These assessments and some of the other guidance tools described by Regini were also influential in developing our approach. We finalised our method prior to finalisation of the IEEM guidance[6] taking those bits from it that we believed would best support a NZ approach and modifying them where necessary, as discussed below.

We would note that the final 2006 version of the IEEM guidance ended up as a much more generic document and it eliminated the matrices. The following are IEEM (2002) and Regini (2002) derived tables used for BML assessments.

Firstly, tables used by UK practitioners for describing '**Sensitivity**" of fauna and habitats (as above) don't have equivalents in New Zealand and in their place we developed separate tables for species of conservation concern, terrestrial vegetation and habitats, freshwater-marine habitats and species.

[3] Note that this issue is quite separate from discussions regarding mitigation or offsetting of an effect which is a completely separate aspect of the EcIA process and which requires its own tools.

[4] Guidelines For Ecological Impact Assessment: Amended Pilot November, 2002

[5] Rigini 2000.

[6] Note we did not use the definitions or tables in the first draft of the IEEM guidance 2002.

Sensitivity	Determining **Factor**
Very High	Species that form the cited interest of SPAs and other statutorily protected nature conservation areas. Cited means mentioned in the citation text for the site as a species for which the site is designated.
High	Species that contribute to the integrity of an SPA but which are not cited as species for which the site is designated. Ecologically sensitive species including the following: Divers, common scoter, hen harrier, golden eagle, rednecked phalarope, roseate tern and chough. Species present in nationally important numbers (>1% Irish population)
Medium	Species on Annex 1 of the EC Birds Directive Species present in regionally important numbers (>1% regional (county) population) Other species on BirdWatch Ireland's red list of Birds of Conservation Concern
Low	Any other species of conservation interest, including species on BirdWatch Ireland's amber list of Birds of Conservation Concern not covered above.

This table for describing "**Magnitude**" was used largely unchanged, however we excluded the guide to loss which was felt to be an unhelpful and potentially inflammatory section.

Magnitude	Description
Very High	Total loss or very major alteration to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether. *Guide: < 20% of population / habitat remains*
High	Major loss or major alteration to key elements/ features of the baseline (pre-development) conditions such that post development character/ composition/ attributes will be fundamentally changed. *Guide: 20-80% of population/ habitat lost*
Medium	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of baseline will be partially changed. *Guide: 5-20% of population/ habitat lost*
Low	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre-development circumstances/patterns. *Guide: 1-5% of population/ habitat lost*
Negligible	Very slight change from baseline condition. Change barely distinguishable, approximating to the "no change" situation. *Guide: < 1% population/ habitat lost*

This final table which described "**Significance**" was used without modification. We accept that there are many ways this table could be structured (should medium & medium equal a low?). We have tested it on a number of projects and the results generally seem to make sense. Where they don't they should be explored further.

SIGNIFICANCE		**Sensitivity**			
		Very High	**High**	**Medium**	**Low**
Magnitude	Very High	Very High	Very High	High	Medium
	High	Very High	Very High	Medium	Low
	Medium	Very High	High	Low	Very Low
	Low	Medium	Low	Low	Very low
	Negligible	Low	Very Low	Very Low	Very Low

Also discussed in the IEEM guidance and adopted in our descriptions of effects were definitions for direct and indirect effects and for effect duration as below[7]:

PERMANENT	• Impacts continuing indefinitely beyond the span of one human generation (taken as approximately 25 years), except where there is likely to be substantial improvement after this period (e.g. the replacement of mature trees by young trees which need > 25 year to reach maturity, or restoration of ground after removal of a development). Such exceptions can be termed long term impacts.
TEMPORARY	• Long term (15-25 years or longer – see above) • Medium term (5-15 years) • Short term (up to 5 years)

Major Projects

Variations of this tool were initially used on a number of minor projects. The first major project that this was used on was Transmission Gully, a project that commenced in 2009. Since then it has also been applied to MacKays to Peka Peka and more recently to the Ruakura Plan Change.

For these tyhree major projects our method was presented and discussed with Regional and Territorial Councils, the Department of Conservation, and a number of independent reviewers for these agencies. Neither the matrix tool nor the over-riding approach to carrying out the assessment were challenged in any of these discussions nor in submissions to the BOI, in expert caucusing, or during the hearings. The key discussions in these forum related to mitigation of the effects that had been described.

Caution

Ultimately a tool is just a tool. In this case the tool is intended to 'assist' in reaching an informed and robust assessment, meaning that the results cannot simply be taken on face value, they must be grounded in good data and the outputs must be interrogated and justified.

The words which result from each table – very high, high, medium and low, are merely short hand for the implications, which should be discussed and justified within the body of the assessment. Similarly there is a level of risk or uncertainty associated with every assessment that must be acknowledged appropriately. It is also likely that, on occasion we will need to make a simple significant / not significant decision and explain how the decision was reached in the light of the above.

Fundamentally, this tool is not a substitute for sound professional judgement and good science.

Prepared by

Stephen Fuller

Technical Director Science and Technology

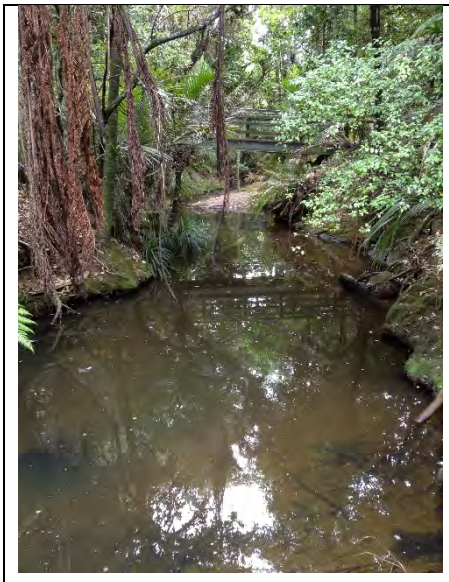
Boffa Miskell Limited

[7] There has been some discussion on duration, noting that in some environments (low fertility) or with some species (slow growth rates, long lived, low fecundity) 25 years may be an underestimate. Also the relationship between this time and Resource Consent duration could be considered.

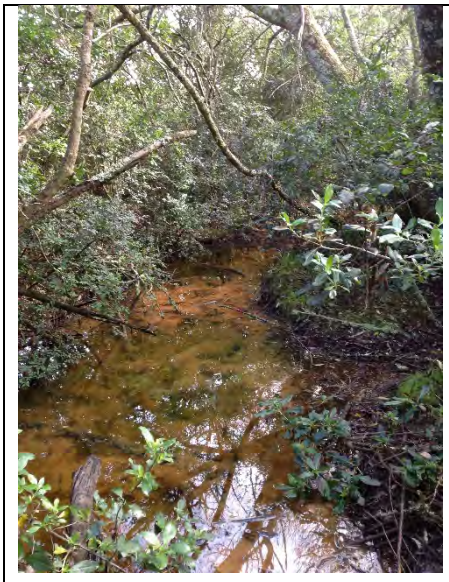
Appendix 4: SEV Data

Variable (code)	1 Murphys	2 Totara	3 Watercare	4 Cheesmans	5 Lower Mill Rd	6 Ranfurly	7 Alfriston Rd	8 Mill Road	9 125 Murphy's Rd
Vchann	1.00	0.99	1.00	0.91	1.00	1.00	0.48	0.40	0.65
Vlining	1.00	1.00	1.00	0.80	1.00	0.80	0.80	0.80	0.84
Vpipe	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NFR	**1.00**	**0.99**	**1.00**	**0.87**	**1.00**	**0.93**	**0.59**	**0.53**	**0.71**
Vbank	0.68	0.84	0.84	0.70	0.70	1.00	1.00	1.00	0.36
Vrough	1.00	1.00	1.00	0.90	0.66	0.20	0.20	0.20	0.57
FLE	**0.68**	**0.84**	**0.84**	**0.63**	**0.46**	**0.20**	**0.20**	**0.20**	**0.21**
Vbarr	1.00	1.00	1.00	0.30	1.00	1.00	1.00	1.00	1.00
CSM	**1.00**	**1.00**	**1.00**	**0.30**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
Vchanshape	1.00	1.00	1.00	0.99	1.00	1.00	0.80	0.90	0.72
Vlining	1.00	1.00	1.00	0.80	1.00	0.80	0.80	0.80	0.84
CGW	**1.00**	**1.00**	**1.00**	**0.86**	**1.00**	**0.87**	**0.80**	**0.83**	**0.80**
Hydraulic function mean score	**0.92**	**0.96**	**0.96**	**0.67**	**0.87**	**0.75**	**0.65**	**0.64**	**0.68**
Vshade	1.00	0.98	1.00	0.80	0.36	0.00	0.06	0.00	0.56
WTC	**1.00**	**0.98**	**1.00**	**0.80**	**0.36**	**0.00**	**0.06**	**0.00**	**0.56**
Vdod	1.00	0.50	1.00	0.50	0.17	0.68	0.45	0.68	1.00
DOM	**1.00**	**0.50**	**1.00**	**0.50**	**0.17**	**0.68**	**0.45**	**0.68**	**1.00**
Vripar	1.00	0.85	1.00	0.30	0.25	0.00	0.00	0.00	0.50
Vdecid	1.00	1.00	1.00	1.00	0.26	1.00	0.87	1.00	1.00
OMI	**1.00**	**0.85**	**1.00**	**0.30**	**0.16**	**0.00**	**0.00**	**0.00**	**0.50**
Vmacro	1.00	1.00	1.00	1.00	1.00	0.72	0.53	0.58	1.00
Vretain	1.00	0.99	1.00	0.92	1.00	1.00	0.28	0.20	0.86
IPR	**1.00**	**0.99**	**1.00**	**0.92**	**1.00**	**0.72**	**0.28**	**0.20**	**0.86**
Vsurf	0.38	0.36	0.32	0.27	0.32	0.18	0.82	0.65	0.48
Vripfilt	0.72	0.80	0.78	0.30	0.60	0.40	0.40	0.50	0.40
DOP	**0.55**	**0.58**	**0.55**	**0.28**	**0.46**	**0.29**	**0.61**	**0.58**	**0.44**
Biogeochemical function mean score	**0.91**	**0.78**	**0.91**	**0.56**	**0.43**	**0.34**	**0.28**	**0.29**	**0.67**
Vgalspwn	1.00	0.55	0.85	0.81	1.00	1.00	1.00	1.00	0.40
Vgalqual	0.75	0.75	0.75	0.25	0.25	0.25	0.25	0.25	0.25
Vgobspwn	0.20	1.00	0.80	0.20	0.80	0.10	0.10	0.10	0.20
FSH	**0.48**	**0.71**	**0.72**	**0.20**	**0.53**	**0.18**	**0.18**	**0.18**	**0.15**
Vphyshab	1.00	1.00	0.98	0.61	0.42	0.21	0.21	0.16	0.78
Vwatqual	0.75	0.37	1.00	0.45	0.07	0.03	0.04	0.17	0.53
Vimperv	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
HAF	**0.86**	**0.77**	**0.91**	**0.59**	**0.40**	**0.29**	**0.29**	**0.30**	**0.70**
Habitat provision function mean score	**0.67**	**0.74**	**0.82**	**0.40**	**0.46**	**0.23**	**0.23**	**0.24**	**0.42**
Vfish	0.43	0.37	0.60	0.43	0.00	0.40	0.23	0.23	0.53
FFI	**0.43**	**0.37**	**0.60**	**0.43**	**0.00**	**0.40**	**0.23**	**0.23**	**0.53**
Vmci	0.24	0.46	0.83	0.90	0.26	0.52	0.33	0.43	0.55
Vept	0.67	0.33	0.83	0.83	0.00	0.33	0.33	0.33	0.33
Vinvert	0.35	0.35	0.35	0.47	0.23	0.35	0.12	0.23	0.38
IFI	**0.42**	**0.38**	**0.67**	**0.73**	**0.16**	**0.40**	**0.26**	**0.33**	**0.42**
Vripcond	1.00	1.00	0.90	0.80	0.54	0.13	0.13	0.11	0.30
Vripconn	0.50	0.70	0.40	0.20	1.00	1.00	1.00	1.00	1.00
RVI	**0.50**	**0.70**	**0.36**	**0.16**	**0.54**	**0.13**	**0.13**	**0.11**	**0.30**
Biodiversity function mean score	**0.45**	**0.48**	**0.54**	**0.44**	**0.23**	**0.31**	**0.21**	**0.23**	**0.42**
Overall mean SEV score (maximum value 1)	**0.78**	**0.76**	**0.83**	**0.54**	**0.52**	**0.43**	**0.36**	**0.37**	**0.58**

Appendix 5. Stream Assessment Site Photos

	1 Murphy's Bush
	2 Totara park

	3 Watercare Gully
	4 146 Mill Road Gully

	5 Lower Mill Road
	6 Ranfurly Road
	7 Alfriston Road

	8 Mill Road
	9 125 Murphy's Rd

Appendix 6.

Ecological Significance Assessment of the Three Native Forest Areas (excluding the Watercare scrub) Using the ARC RPS Criteria

ARC Criteria	Murphy's Bush	Watercare Bush	Bush at 146 Mill
The significance of natural heritage resources in the Region, and the identification of the qualities and values which give rise to their significance, shall be determined using criteria including the following:			
1. the extent to which an area is representative or characteristic of the natural diversity in an ecological district or contains outstanding or rare indigenous community types	yes	yes	yes
2. the presence of a threatened species or uncommon, special or distinctive features	yes	possibly	no
3. the extent to which a natural area can maintain its ecological viability over time	yes	yes	yes
4. the extent to which an area is of sufficient size and shape to maintain its intrinsic values	yes	probably	yes
5. the relationship a natural feature has with its surrounding landscape, including its role as an ecological corridor or riparian margin, and the extent of buffering or protection from external adverse effects	yes	yes	yes
6. the natural diversity of species of flora and fauna, biological communities and ecosystems, geological or edaphic features such as landforms and land processes, parent material, and records of past processes	yes	yes	yes
7. the diversity of ecological pattern, such as the change in species composition or communities along environmental gradients	no	no	no
8. the extent to which an area is still reflective of its original natural character and quality	yes	yes	yes
9. the extent to which an area provides an important habitat for species at different stages of their life cycle, e.g., breeding, spawning, roosting, feeding, and haul-out areas for the New Zealand fur seal;	yes	yes	yes
10. the importance of an area to Tangata Whenua	unknown	unknown	unknown

In assessing natural heritage resources, their contribution to the viability of the Region's ecosystems will be considered significant if they exhibit the following characteristics			
1. the area provides a characteristic example of the ecology of the local area; and	yes	yes	yes
2. the area is of good quality (e.g. for natural areas it has an intact understorey and is characterised by a low level of invasion from pest species); and	yes	yes	yes
3. the area contributes to the ecological viability of surrounding areas and biological communities; or	yes	yes	yes
4. the area contains a Regionally threatened species or a unique or special feature;	yes	possibly	no
5. the area contains an unprotected ecosystem type, or an ecosystem type under-represented within the protected area network of an ecological district; or	yes	yes	yes
6. the area is a component of, adjoins or provides a buffer to, a significant natural resource, or a watercourse or coastal margin	Yes (permanent stream)	Yes (permanent stream)	Yes (permanent stream)
7. the area has habitat values, or provides or contributes to a habitat corridor; or	yes	yes	yes
8. the area is in a landscape which is depleted of indigenous vegetation; or	yes	yes	yes
9. the protection of the area adds significantly to the spatial characteristics of the protected area network (e.g. by improving connectivity or reducing distance to the next protected area); or	yes	yes	yes
10. the area is significant to Tangata Whenua; or	unknown	unknown	unknown
11. there is a community association with, or public appreciation of, the aesthetic values of the landform or feature	yes	possibly	possibly

Appendix 7. Author's CV and Previous Roading Experience

DAVE SLAVEN

DIRECTOR, ECOLOGIST

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Dave is knowledgeable in a wide variety of scientific fields, including forest, freshwater and marine ecology. Over the past two decades he has worked as a professional ecologist undertaking much fieldwork and developing an extensive experience with the disciplines of significance evaluation, ecological impact assessment, mitigation programmes, site restoration and conservation planning.

Dave has undertaken a variety of ecological surveys in differing types of ecosystems and habitats, including wetland, forest, scrub and freshwater. These surveys have involved indigenous flora and fauna (including birds, herpetofauna and freshwater fish species) as well as an assessment of the ecological and conservation values of the site(s) in question. Dave's work experience ranges in scale from individual lots to District wide surveys.

He has the ability to assess environments not only from an ecological point of view but also from a more holistic 'effects and opportunities' perspective. He immediately recognises ecological issues related to a development proposal and has a reputation for identifying highly innovative yet practical approaches to their successful resolution. He is a very experienced expert witness at council and Planning Tribunal hearings.

EDUCATION

Masters of Science, Environmental Science and Conservation Planning (Hons, 1st), University of Auckland

Masters of Art, Physical Geography(Hons), University of Auckland

PROFESSIONAL AFFILIATIONS

Adviser, NZ Amphibian Recovery Group

Chairperson, Shore Bird Technical Working Group

AREAS OF EXPERTISE

Assessment of Effects on the Environment

Ecological Evaluation

Ecological Advice

Conservation Planning

Environmental Monitoring

Land Rehabilitation

Roading Projects Experience

Glenvar Ridge Road, 2014-on-going: Provided ecological investigations and Assessment of Ecological Effects report to support securing the designations required for the new road into the Long Bay development area.

Western Ring Route Waterview Connection, 2000 - 2013: Originally responsible for managing the ecological investigations and assisting in the selection of the preferred route for SH20 Waterview, together with preparing the Assessment of Ecological Effects report. With the combining of SH20 Waterview with the upgrade of the SH16 causeway, Dave assumed overall responsibility for all ecological aspects of this project, including those culminating in the EPA and Board of Inquiry (BOI) process (2010-2011). Presently running the ecology team within the successful Alliance awarded the Waterview Connection construction contract.

Glenvar Road Upgrade, 2012: Provided ecological investigations and Assessment of Ecological Effects report to support securing the designations required for the upgrading of the existing Glenvar Road.

Medallion Drive NOR, 2012: Povided ecological investigations and Assessment of Ecological Effects report to support securing the designations required for the upgrading of the existing Glenvar Road.

Northern Busway Extension, 2011 - 2012: Provided ecological investigations and Assessment of Ecological Effects report to support securing the designations required for the extension to the Northern Busway.

State Highway 1 (ALPURT) Sector B2 (Northern Gateway Toll Road – NGTR), 2003 - 2012: Preparation of Assessment of Ecological Effects of the ALPURT B2 project, which includes many ecologically sensitive habitats (terrestrial, freshwater and intertidal / marine). Preparation of strategies for avoiding, remedying and mitigating the potential adverse ecological effects associated with the project. Ecology Team Leader for the Northern Gateway Alliance that delivered the project, including responsibility for lizard translocations, fish relocations, and minimising habitat loss. Presently managing the post-construction monitoring programme.

Additional Waitemata Harbour Crossing Study - Route Selection, 2008 - 2009: Provided detailed ecological input to the selection of a preferred route and configuration for the third Auckland Harbour crossing, with particular attention on marine ecology, contaminated sediments, saline vegetation and shore birds. Prepared Assessment of Ecological Effects report on all crossing options**.**

Additional Waitemata Harbour Crossing Study - Preparation of Designation and Plan Change, 2009 - 2010: Provided ecological investigations and Assessment of Ecological Effects report to support securing the route of the Additional Waitemata Harbour Crossing by way of designations and a Plan Change in relation to the Auckland Regional Coastal Plan.

Eastern Corridor Strategy Study, 2002: Provided ecological investigations and Assessment of Ecological Effects report on options supporting a strategy for a new eastern road corridor in Auckland.

Esmonde Road Interchange, 2001: Provided ecological advice and management of all ecological investigations in relation to a proposed new interchange at Esmonde Road.

Road Effects on Hochstetter's Frog, 2000: Undertook a field study into the effects of road wasg stormwater on populations of the Threatened Hochstetter's frog.

Northern Busway, 1997 – 2002: Assessment of the potential adverse effects of the Busway on ecologically significant features, including Smith's Bush, breeding grounds in Shoal Bay for nationally threatened bird species (NZ dotterel in particular), streams and the inter-tidal area. Preparation of a Shore Bird Mitigation, Contingency and Monitoring plan for effectively mitigating the effects of the Busway on the rare shore birds at Shoal Bay.

Northern Busway, 1997 - 2013: Implementation of scheduled monitoring to judge the success and effectiveness of the mitigation measures that were put in place. Chairperson of the Shore Bird Technical Working Group, a working party established by consent conditions to manage the effects of the Busway on the rare shore birds.

State Highway 20 (Mt Roskill), 2000 – 2002: Assessment of the potential adverse ecological effects of the new motorway extension through Mt Roskill. Particular emphasis was placed on the Oakley Creek and its tributaries, together with developing ecological mitigation strategies.

State Highway 20 (Mt Roskill) Monitoring, 2002 - 2010: Preparation of the EMG (Environmental Monitoring Guidelines) for the project, and implementation of the scheduled monitoring programme to assess the actual effects of the construction and operational phases of the new motorway.

State Highway 20 – State Highway 1 Link), 1999 – 2001: Assessment of the potential adverse ecological effects of the new motorway link for SH 20-SH1 Link at Manukau City. Particular emphasis was placed on developing effective mitigation strategies for the Puhinui Creek.

State Highway 25 Upgrading and Seal Extension, 1997 – 2001: Assessed the ecological effects associated with the upgrading and seal extension of SH 25 between Coromandel township and Whangapaoua. This included assessments of the impacts on rare native wildlife, including kiwi and Hochstetter's frog.

State Highway 1 (ALPURT) Sectors A and B1, 1997 – 1999: Assessed the potential adverse ecological effects of the ALPURT project (including terrestrial, freshwater and intertidal/marine effects). Preparation of the ecological sections for the project management plan; site specific ecological requirements; environmental monitoring programme and ecology AEE.

State Highway 18 Realignment, 1996: Assessed the ecological impacts of three alternative highway alignments being considered for SH 18 (Upper harbour Drive). The investigations included terrestrial, freshwater and intertidal / marine habitats.

Addendum 1

Redoubt Road – Mill Road Corridor Study

Assessment of Ecological Effects of Short-Listed Options Prepared for Auckland Transport

20 October 2014

REDOUBT ROAD - MILL ROAD CORRIDOR STUDY

Assessment of Ecological Effects of Short-Listed Options
Prepared for Auckland Transport

20 October 2014

Document Quality Assurance

This report has been prepared in accordance with Boffa Miskell quality assurance procedures, and has been reviewed and approved for release as set out below.

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Prepared by:	Sarah Flynn Associate Principal, Ecologist Boffa Miskell Limited	
Reviewed by:	Dave Slaven Director, Ecologist Boffa Miskell Limited	
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CONTENTS

1.0 Introduction

A project description overview of the Mill Road project is provided in the Assessment of Ecological Effects (AEcE) report accompanying the NoR. This present report focuses on the final short-listed alignment options identified for more detailed study (Appendix 1). They are generally very similar to each other with two exceptions, being firstly the intersection of Redoubt Road and Murphy's Road, and secondly between 146 Mill Road and 38 Mill Road.

2.0 Previous Ecological Reporting

Kessels & Associates (2008) assessed the effects of 12 route options, and then went on to describe in further detail the effects of the subsequently selected five preferred options. It is noted that those investigations were "high level" and involved a restricted amount of actual field studies, relying instead on existing databases (such as the Freshwater Fisheries Data Base (FFDB) and records from the Ornithological Society of New Zealand (OSNZ)) and previous reports (Survey Report for the Protected Natural Areas Programme – Hunua Ecological District; and ARC annual water quality reports for the Puhinui and Papakura Streams). No lizard surveys or bat surveys were undertaken, and only *"a brief inspection of the macroinvertebrate populations was undertaken in July 2008"*. Notwithstanding this, vegetation and birds were surveyed in some detail over the course of three surveys and the report contains detailed information on these two ecological aspects.

Wildlands (2012) built upon that earlier study by investigating a fine tuned set of those same five options. Their field investigations were also "high level" and involved reliance on the FFDB (for fish data) and DOC's Bioweb Herpetofauna Database (for lizard data). No avifauna, bat or aquatic macroinvertebrate surveys were undertaken, with reliance instead on the records from data bases and the earlier Kessels & Associates (2008) report. However, the vegetation surveys appear to have been relatively comprehensive.

Neither the Kessels & Associates (2008) nor the Wildlands (2012) reports recommended an overall preferred option, but rather clearly identified the adverse effects associated with each of the options that were under consideration. However, Wildlands subsequently did attend a Multi Criteria Analysis workshop with the project team in 2013, and considered all options poorer than the Do Nothing option with the exception of Northern A which was neutral, on the basis that some clearance of woody vegetation (and associated potential fauna habitat) would be required under all scenarios other than the Northern A option. This is an appropriate conclusion, though we emphasise that the grading system used simply identified whether options were better or worse than the "Do Nothing" scenario, hence a ranking of "poor" for a given option does not necessarily mean that ecological outcomes envisaged for that option would be significantly adverse.

In recognition of the "high level" nature of the previous investigations Boffa Miskell undertook additional field studies into the ecological effects of each of the short-listed options in 2014. These were more intensive and comprehensive than the previous studies, and included surveys for bats, avifauna, skinks, geckos, vegetation and freshwater communities.

3.0 Results

3.1 Vegetation

The vegetation currently occurring throughout the majority of the project footprint is associated with homestead gardens and amenity trees. These include trees such as macrocarpa hedges, poplar, willow, *Casuarina* and pines, along with a variety of native amenity trees in some locations. However, all short-listed options intersect one or more stream gullies containing mature native bush.

The areas affected include a portion of the old growth bush at 146 Mill Road (all options), a portion the old growth bush at 134 Mill Road (Eastern B option), a portion of old growth bush on property administered by Watercare at 38 Mill Road (Eastern B and Eastern C options), and a portion of weedy scrub on the Watercare property at 38 Mill Road (all options). All of these stands of old growth bush contain mature taraire and puriri forest with kahikatea dominating the wet gully floors.

All proposed alignment options will require localised vegetation clearance on the margin of Murphy's Bush as a result of widening Murphy's Road (and culvert). The vegetation concerned comprises mature deciduous exotic trees on the eastern side and native broadleaved trees and shrubs on the western side. The Northern B and Northern C options also involve the loss of a stand of predominantly exotic trees at the intersection of Redoubt Road and Murphy's Road.

3.2 Birds

A total of 15 5-minute bird counts were completed during the survey, with each of five count stations replicated three times over three days (April 8-9th and 14th, 2014) during daylight hours. Counts identified a total of 15 bird species (see Table 1).

Table 1: *Bird species recorded during 5-minute bird counts, April 2014.*

Species Name	Threat Classification	Mean number of birds recorded per site				
		MR01	MR02	MR03	MR04	MR05
Blackbird	Introduced & Naturalised	1.0	2.0	1.0	0.3	0.0
Chaffinch	Introduced & Naturalised	0.7	0.7	0.7	0.0	0.3
Dove, spotted	Introduced & Naturalised	0.3	0.0	0.0	0.0	0.0
Fantail, NZ	Not Threatened	1.7	1.0	3.0	2.0	1.3
Magpie, Australian	Introduced & Naturalised	0.0	0.3	0.3	0.0	0.3
Myna	Introduced & Naturalised	5.0	3.0	1.3	6.7	4.0
Kereru	Not Threatened	1.0	0.0	6.3	0.0	0.0
Plover, spur-winged	Not Threatened	2.7	2.0	0.0	0.0	0.7
Pukeko	Not Threatened	0.3	0.0	0.0	0.0	0.3
Rosella, Eastern	Introduced & Naturalised	0.0	0.3	0.0	0.0	0.0
Silvereye	Not Threatened	5.3	8.7	19.0	12.0	21.3
Skylark	Introduced & Naturalised	0.0	0.0	0.0	0.0	0.3
Sparrow, house	Introduced & Naturalised	0.0	0.0	0.0	0.3	0.0
Starling	Introduced & Naturalised	0.0	2.3	16.3	4.7	17.0
Tui	Not Threatened	1.0	0.3	8.0	0.7	0.3

One additional species (yellowhammer, an 'introduced and naturalised' species) was seen while transitioning between sites, while Australasian harriers were observed in the course of vegetation surveys. The most common species recorded were silvereyes, starlings, mynas and tui. Kereru were recorded at Murphy's Bush and 38 Mill Road, with over 6 individuals per count recorded at the latter. All species recorded were either 'not threatened' or 'introduced and naturalised.'

Field data was supplemented by reference to information records from the Ornithological Society of New Zealand (OSNZ). Over 1999-2004, OSNZ surveyed a 10km2 area that includes the project area as part of their Bird Distribution Atlas scheme (see Robertson *et al*., 2007). Over that period, the area was surveyed 18 times. They recorded a total of 52 bird species, including all of the species recorded during this survey. Their surveys indicate that there are many additional species that are likely to be common in the immediate area. Notably, they recorded three 'at risk' species (black shag, little shag, and pied stilt) and five 'threatened' species (dabchick, grey duck, red-billed gull, black-billed gull, and pied shag) (see Table 2).

All of these are primarily coastal and wetland species. Five species - black-billed gulls, pied shags, little black shags, dabchicks and grey ducks - were recorded by the OSNZ in wetland habitat only. Black shags and re-billed gulls were recorded in farmland, residential and wetland habitats, and stilts were recorded in wetland and farmland. Given the absence of suitable wetlands in the alternative footprints, wetland-inhabiting species are unlikely, although shag species may use some of the established trees as occasional roost sites. Species such as stilts and gulls may sometimes feed on inundated pastures in the area during wet weather.

Table 2: *'Threatened' and 'at risk' bird species within 10km2 of the project area (OSNZ).*

Species Name	Threat Classification
Duck, Grey	Threatened (Nationally Critical)
Gull, Black-billed	Threatened (Nationally Critical)
Dabchick, New Zealand	Threatened (Nationally Vulnerable)
Gull, Red-billed	Threatened (Nationally Vulnerable)
Shag, Pied	Threatened (Nationally Vulnerable)
Stilt, Australasian Pied	At Risk (Declining)
Shag, Black	At Risk (Naturally Uncommon)
Shag, Little Black	At Risk (Naturally Uncommon)

3.3 Bats

No echolocation pulses were recorded on any of the ABM's. Furthermore, Auckland Council has reported that the regional bat survey sites have similarly not recorded any echolocation pulses from the Mill Road area, and they further report that community bat detectors have recorded no bat activity in the Redoubt Road area to date.

3.4 Lizards

No native lizards were observed to be present within any of the options footprints. However, two lizard species were confirmed as present in the wider area, being the introduced rainbow skink and a native unidentified gecko (most likely a forest gecko). Surveys were conducted in April, when lizards tend to become less active. Further, due to unpredictable weather during Cyclone Ita, detection probability of lizards in our surveys may have been affected.

3.5 Freshwater

The criteria of the Auckland Regional Plan - Air, Land and Water were used in determining whether or not the streams within the project footprints were permanently flowing or instead only flowing intermittently. Outside of Totara Park almost all of the waterways potentially affected are permanent streams, while those in the upper catchment of Totara Park are intermittent.

All three options cross the same streams, and in many places have the same crossing point. Table 3 summarises the Stream Ecological Valuation (SEV) results of the nine permanent waterways that are crossed or that receive treated stormwater discharges.

Table 3: *Summary of SEV scores, mean scores for function classes and overall mean score*

	Site 1 Murphys Bush	Site 2 Totara Park	Site 3 Watercare gully	Site 4 146 Mill Rd gully	Site 5 Lower Mill Road
Hydraulic function	0.92	0.96	0.96	0.67	0.87
Biogeochemical function	0.91	0.78	0.91	0.56	0.43
Habitat provision function	0.67	0.74	0.82	0.40	0.46
Biodiversity function	0.45	0.48	0.54	0.44	0.23
Overall mean SEV score (maximum value 1)	**0.78**	**0.76**	**0.83**	**0.54**	**0.52**

	Site 6 Ranfurly	Site 7 Alfriston	Site 8 Mill Rd (south)	Site 9 125 Murphy's Rd
Hydraulic function	0.75	0.65	0.64	0.68
Biogeochemical function	0.34	0.28	0.29	0.67
Habitat provision function	0.23	0.23	0.24	0.42
Biodiversity function	0.31	0.21	0.23	0.42
Overall mean SEV score (maximum value 1)	**0.43**	**0.36**	**0.37**	**0.58**

Table 4: *Interpretation of SEV scores (adopted from Golder Associates, 2009)*

Score	Category
0 - 0.40	Poor
0.41 – 0.60	Moderate
0.61 – 0.80	Good
0.81+	Excellent

4.0 Assessment of Ecological Significance

4.1 Threatened Environments

The key natural features were assessed against the "The Threatened Environment Classification" GIS map as described by Walker *et al*. (2007). This classification uses indigenous vegetation as a surrogate for indigenous biodiversity, which includes indigenous ecosystems, habitats and communities. According to the Threatened Environments classification (Walker *et al.* 2007) the majority of the corridor (and short-listed options) is situated within Category 3 – At Risk *("20-30% of indigenous vegetation remaining"*). While the southern end of the corridor area is classified as Category 1 – Acutely Threatened *("<10% of native vegetation remaining"*), no native bush is affected by any of the short-listed options in this Land Environment.

4.2 Proposed Auckland Unitary Plan (PAUP)

The PAUP includes a policy in Volume 1 Chapter B Section 4.3.4 (Regional Policy Statement – Biodiversity) that sets out the criteria to be used in identifying Significant Ecological Areas (SEA's). Using these criteria the PAUP classified Murphy's Bush and the bush and scrub at 38 Mill Road as being SEAs (SEA_T_5282 and SEA_T_4570 respectively).

Auckland Council did not identify either the bush at 134 and 146 Mill Road as SEAs in the PAUP, though the reasons for this omission are not clear. Both these remnants would appear to meet the criteria for Representativeness, and Stepping Stones, Migration Pathways and Buffers.

4.3 Operative Auckland Regional Policy Statement

Section 6.4.7 of the Auckland Regional Policy Statement (RPS) gives some guidance to the criteria used to evaluate the significance of natural areas. Under these criteria the three old growth forest areas (i.e. 146, 134 and 38 Mill Road) all qualify as being ecologically significant, and the scrub at 38 Mill Road may also qualify as providing a buffer to the headwater tributary of the Puhinui Stream.

4.4 IEEM Ecological Values

The Institute of Ecologists and Environmental Managers (IEEM - a European professional environmental practitioners organisation) published guidelines for ecological impact assessment in 2002 (Regini (ed), 2002). Boffa Miskell has adapted these for use in New Zealand as its best practice guide. It utilises a three stage process, beginning with an assessment of the ecological values of a given site, followed by an assessment of the magnitude of the effects of a project on those values, and then by way of combining these deriving the significance of those effects. These tables are attached in Appendix 2.

Using the ecological evaluation system of IEEM (2002), Murphy's Bush has been assessed as being Very High (*"A reference quality feature close to its pre-human condition with the expected assemblages of flora and fauna and no contributions of contaminants for human induced*

activities. Negligible degradation"), and the Watercare Bush and the forest remnants at 134 and 146 Mill Road as being High (*A feature with high ecological or conservation value but which has been modified to the extent it is no longer of reference quality. Slight to moderate degradation*). The Watercare scrub has been assessed as being of Medium ecological value (*"A feature which contains fragments of its former values but has a high proportion of tolerant fauna and obvious habitat quality issues. Moderate to high degradation"*). Roadside vegetation, including mature amenity trees (native and exotic), hedgerows and patches of weedy scrub, is assessed as of Low ecological value (*"A highly modified feature with poor diversity and abundance of flora or fauna and significant habitat issues. Very high degradation"*).

5.0 Assessment of Effects on Ecological Values

5.1 Clearance of Vegetation

For the most part the affected areas are the same for all options, since they only differ in the area between 146 Mill Road and the Watercare property (38 Mill Road), and the intersection of Redoubt Road and Murphy's Road. The three options in the Mill Road area are referred to in this report as the Eastern A, Eastern B and Eastern C. The Eastern A option is the eastern-most of the three, while Eastern B is the western-most, with Eastern C being central between these at the point of options deviation but quickly returning to follow Eastern B. At the intersection of Redoubt Road and Murphy's Road the Northern B and Northern C options are similar while the Northern A is located to the west of the present intersection.

The majority of the vegetation that will be affected is presently farmed pasture together with rural residential subdivision. Additional woody vegetation that will be cleared is predominantly exotic, and includes hedgerows, shelterbelts and screen plantings, together with garden ornamentals. In addition four areas of native bush will be impacted to varying degrees under one or more of the alignment options, with these being of Very High (Murphy's Bush) or High ecological value (the bush at 134 and 146 Mill Road, and the Watercare bush).

All Eastern options use an elevated bridge crossing over the bush at 146 Mill Road (with no need for supporting piers), and the Eastern B and C options cross the Watercare bush by elevated bridge also (with this one needing several supporting piers). Hence, vegetation loss will be minimised at these two sites. Due to the slightly differing alignments of the three options at 146 Mill Road the area beneath the bridge varies according to each, with the greatest area being associated with the Eastern B Route (0.22ha), the smallest area associated with the Eastern C route (0.16ha) and with the Eastern A route being 0.20ha.

The bush at 134 Mill Road is only affected by the Eastern B route, with half of it (0.58ha) being lost, leaving only a very small modified remnant.

The Watercare bush and scrub have been identified in the PAUP as a SEA (SEA-T-4570). Both the Eastern B and Eastern C routes propose to bridge the Watercare bush and scrub. Both options are very similar, with the Eastern B bridge overtopping 0.26ha of vegetation and the Eastern C overtopping 0.3ha. However, the Eastern B route would involve a greater number of the emergent kahikatea trees than would the Eastern C route. The Eastern A option avoids the mature forest of the Watercare Bush entirely, intersecting only with 1.03ha of the weedy Watercare scrub vegetation which will be filled under this proposal.

Murphy's Road will be widened under all three Northern options. The actual extent of vegetation clearance at Murphy's Bush is uncertain at this stage, but at worst may require the removal of a small number of semi-mature trees and shrubs should the culvert extension happen on the west side of Murphy's Road. If the culvert extension is located on the east side, affected vegetation it would instead comprise predominantly exotic trees and woody weeds, in particular two mature poplar trees and several woolly nightshade shrubs. The Northern B and C routes will impact upon a stand of predominantly exotic trees at the intersection of Redoubt Road and Murphy's Road, while the Northern A route avoids any woody vegetation.

In summary, the Eastern A option has the lowest extent of bush loss but highest extent of scrub loss, and the Eastern B has the highest extent of bush loss. Hence, from a strictly vegetation loss perspective, given that the bush habitats have greater ecological value than the scrub habitat, the Eastern A option would have the least associated adverse effects.

5.2 Loss of Significant ('Threatened' and 'At Risk') Species of Flora

In relation to the Project Area, no 'threatened' or 'at risk' species of flora were observed to be present over the course of the field investigations, and furthermore there was no mention of such in the literature reviewed. All options are equal in this regard.

5.3 Habitat Fragmentation and Loss of Ecological Corridors

Permanent habitat fragmentation over and above existing levels will be very limited as a result of the project. The bush remnants at 134 and 146 Mill Road are already highly fragmented, with both being relatively isolated (although still providing "stepping stone" habitat across the local landscape). The only potentially affected corridor is the Watercare bush and scrub (i.e. SEA-T-4570). Under the Eastern 2 and Eastern 3 options the Watercare bush is being crossed by way of a bridge as opposed to a large area of fill. The native vegetation forming the understorey beneath the forest canopy will be largely retained allowing connectivity of this habitat to be maintained.

The fill crossing proposed to traverse the Watercare scrub as part of the Eastern 1 option will likely result in additional fragmentation of this corridor. This is one of several vegetated corridors that link the native bush in Totara Park in the west to other large forested habitats in the east. However, these corridors are all somewhat fragmented by the presence of existing roads fragmentation effects would already be at elevated levels here. Given the above, there is a difference between the Eastern 1 option and the Eastern 2 and Eastern 3 options with regard to fragmentation effects, with the latter two being preferred over the former.

In relation to Murphy's Bush and the intersection of Redoubt Road and Murphy's Road, all three options will have negligible effects on existing corridors.

Removal of a stand of mature, predominantly exotic trees at the intersection of Redoubt Road and Murphys Road, as required for the Northern B and Northern C options, represents an incremental loss of large-stature woody vegetation that is likely to be of some value as roosting and nesting habitat for birds, and in maintaining connectivity between larger habitat remnants. However, the value of these these trees is limited to 'incidental' rather than core habitat, and similar copses of tall trees are well represented in the surrounding landscape (and notably the immediately adjacent Totara Park), so that the loss of these particular trees would not substantively degrade avifauna habitat or ecosystem connectivity.

5.4 Increase in the Extent of Edge Effects

The Watercare bush (SEA-T-4570) is already largely influenced by edge effects, with little in the way of an interior microclimate with the possible exception of the deepest parts of the gully in close vicinity to the creek. Under the Eastern B and Eastern C options this gully will be bridged, and as a result no new edges will be created in the long-term (while acknowledging that construction of the piers will necessitate haul roads which in the short term will create a new edge).

Edge effects are of little importance in relation to the Watercare scrub as this is a regenerating vegetation community primarily comprising early successional species that are particularly tolerant of edge conditions.

The bush remnant at 134 Mill Road is small, being approximately 80m across at its widest point and it is likely that the vegetation throughout this block is already subject to edge effects, at least to some extent. Nevertheless, the large reduction in size that would result from the construction of the Eastern B option would tend to increase the severity of these effects.

The bush remnant at 146 Mill Road is also a relatively small forest remnant but areas in the middle of the gully are likely to support habitat interior conditions. The bridge crossing traversing this remnant is unlikely to increase the extent of edge conditions here given that no works are planned within that bush in the construction of the bridge. Given this, all three options will have the same (low) levels of effect in this regard.

In relation to Murphy's Bush, the very minor loss of existing edge trees and shrubs at the culvert extension site will result in negligible changes to the existing edge conditions and processes in play at this location.

5.5 Avifauna Effects

Overall, the realignment poses little direct risk to 'threatened' and 'at risk' bird species. Nevertheless, the nesting season for most native birds is generally September to February, and clearance of native forest vegetation should commence outside this period.

5.6 Chiropterofauna (Bat) Effects

The close proximity of the site to a known bat population coupled with the relatively high vegetative connectivity between these locations indicate that even though no bats were detected during the survey, they may still use the area periodically. Therefore, it is recommended that bat behaviour and ecology is considered during the design and construction of the road, regardless of which option is selected.

5.7 Herpetofauna Effects

While no native skinks were observed to be present in the project footprint, it cannot be concluded that native skinks are actually absent. Copper skinks occupy the same habitat as rainbow skinks, and since that species has been recorded nearby it is certainly possible that copper skinks are present. Given the above, regardless of which option is selected it is recommended that potential adverse effects on native lizards be mitigated by preparation of a Lizard Management Plan prior to construction commencing.

5.8 Freshwater Effects

Potential construction effects include effects during culvert construction, and discharge of sediment during earthworks. Potential operational effects include permanent loss of stream length by culverting, and effects resulting from the discharge of stormwater from permanent treatment devices.

The extent of new and extended culverts associated with the Eastern options are described in Table 5 below. The extent of new and extended culverts is the same for all three Northern options.

Table 5: *Route Options – summary of Eastern options stream crossings and ranking*

	WaterCare gully crossing	134 Mill Road gully crossing	146 Mill Road gully crossing	Other culverts[2]	Total culvert length	Option Rank[3]
Eastern C	bridge	Avoids gully	bridge	80m	80m	1
Eastern B	bridge	50m culvert[1]	bridge	80m	130m	2
Eastern A	170m culvert	Avoids gully	bridge	80m	250m	3

1 – approximate length of intermittent stream habitat which will be lost as a result of the Eastern B option.
2 - other project culverts which are common to all options.
3 - lowest effect (1) to highest effect (3).

The project will increase impervious surface area and traffic flows in the catchment, and will result in an increase in stormwater contaminants and flow volumes. Operational phase stormwater runoff will be treated and attenuated in a total of seven treatment wetlands, which will be designed to meet the treatment criteria recommended by Auckland Council in Technical Publication No.10. This will provide removal of 75% of suspended solids and associated contaminants. The stormwater discharges to these streams will be treated and would be additionally buffered by dilution, and as a result any related adverse effects should be minor. Overall effects of operational stormwater on the downstream receiving environments are anticipated to be minor or negligible regardless of which option is selected.

In addition, at present there is limited treatment of road runoff, mainly via berms and swales in un-kerbed areas. The proposed treatment wetlands will therefore provide a significant amount of stormwater treatment for existing road surfaces. This will be a positive environmental outcome for the project.

Regardless of which option is selected, erosion and sediment control during earthworks will be managed according to methods and procedures described in Auckland Council Technical Publication No.90, Guidelines for Land Disturbing Activities.

6.0 Assessment of Magnitude of Ecological Effects

Using the IEEM approach (Appendix 2) the magnitude of the ecological effects on terrestrial ecological features was assessed as follows:

Table 6: *Magnitude of Ecological Effects for Eastern Options*

Vegetation Block	Magnitude of Effects for the Short-Listed Options		
	Eastern A	Eastern B	Eastern C
Watercare Bush	-	Low	Low
Watercare Scrub	Moderate	Low	Low
Bush at 134 Mill Road	-	High	-
Bush at 146 Mill Road	Low	Low	Low

Table 7: Magnitude of Ecological Effects for Northern Options

Vegetation Block	Magnitude of Effects for the Short-Listed Options		
	Northern A	Northern B	Northern C
Murphy's Bush	Negligible	Negligible	Negligible
Murphy's Road Intersection	Negligible	High	High

7.0 Comparison of Proposed Routes

Ecological effects associated with the route options are essentially identical along the Redoubt Road section, Murphy's Road section and the southern end of Mill Road. They only differ substantively in the central section between the bush remnant located at 146 Mill Road and the Watercare bush. Differences in the magnitude of ecological effects here are due to variations in the route locations as well as methods for crossing bush remnants and watercourses. In addition, removal of a number of large, mature exotic trees from Murphy's Road intersection will be required in two out of three Northern routes.

Using the IEEM approach (Appendix 2) the significance of the ecological effects was assessed as follows:

Table 8: *Significance of Ecological Effects for Eastern Options*

Vegetation Block	Significance of Effects for the Short-Listed Options		
	Eastern A	Eastern B	Eastern C
Watercare Bush	-	Medium	Medium
Watercare Scrub	Medium1	Low	Low
Bush at 134 Mill Road	-	Very High	-
Bush at 146 Mill Road	Medium	Medium	Medium

1 – Low for terrestrial effects but Medium for freshwater effects

Table 9: *Significance of Ecological Effects for Northern Options*

Vegetation Block	Significance of Effects for the Short-Listed Options		
	Northern A	Northern B	Northern C
Murphy's Bush	Low	Low	Low
Murphy's Road Intersection	Very Low	Low	Low

In terms of freshwater ecological effects, in the Watercare property the two bridges associated with the Eastern B and C options have the lowest impacts, whereas the Eastern A option culverts 170m of permanent stream habitat. This is an adverse effect, given the good ecological health of this stream, and from a freshwater perspective the Eastern A option is the least favoured. Similarly, the Eastern B option will include the loss of approximately 50m of intermittent stream habitat at 134 Mill Road, and as a result from a freshwater perspective Eastern C is clearly the preferred option.

In terms of terrestrial ecological effects, all three Eastern options are more or less similar with regard to matters such as impacts on fauna, edge effects and fragmentation. With respect to vegetation loss, the Eastern B option is the only one that affects the old growth forest remnant at 134 Mill Road, and as a result is the least favoured option.

Eastern A completely avoids the old growth forest at the Watercare site whereas the Eastern C crosses over it, hence from a vegetation loss perspective the Eastern A option is preferred. However, the most severe freshwater effects are associated with Eastern A by a large degree, while the proposal for the Eastern C route includes bridging the forested gully which will retain the forest understorey and internal connectivity within the remnant, though removal of a few dozen old growth trees will be required. Given that the effects of bush clearance proposed for Option C can be somewhat moderated by bridging, overall the preferred option is Eastern C.

Table 10 compares the ecological effects of those parameters that vary to any notable degree between the short-listed Eastern options, and demonstrates that Eastern C has the least combined ecological effects.

At Murphy's Bush and Alfriston, the ecological effects are essentially identical for all three Northern options, though the Northern A Option is marginally preferred as removal of mature exotic woody vegetation at Murphy's Road intersection would not be necessary under this scenario.

Table 10: *Effects Comparison Summary*

Effect	Eastern A	Eastern B	Eastern C
Forest Loss	1	3	2
Scrub Loss	3	1	2
Stream Habitat Loss	3	2	1
Overall	**7**	**6**	**5**

1 = Lowest Effects; 3 = Highest Effects

8.0 Conclusions

In conclusion, the Eastern B option has the highest terrestrial ecological effects, while Eastern A has the lowest terrestrial ecological effects. However, the Eastern A option has the highest freshwater effects, while the Eastern C has the lowest. With all things considered (extent of the loss of bush, scrub and stream habitat), of the options under deliberation the Eastern C is the preferred one from an ecological perspective. There are virtually no ecological differences between the three Northern options, though the Northern A Option is marginally preferred as it avoids the stand of mature exotic trees at Murphy's Road intersection.

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Appendix 1: Short-Listed Options Routes

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FLAT BUSH SCHOOL ROAD
MURPHYS ROAD
MILL TOP ROAD
SANTA MONICA PLACE
HOLLYFORD DRIVE
GOODWOOD DRIVE
DIORELLA DRIVE
EVERGLADE DRIVE
TOTARA PARK
REDOUBT ROAD
MILL ROAD
POLO PRINCE DRIVE
RANFURLY ROAD
ALFRISTON ROAD
PHILLIP ROAD
POPES ROAD
Bridge
Bridge
Bridge
Bridge
Bridge

N

LEGEND:

- EASTERN A
- EASTERN B
- EASTERN C
- NORTHERN A
- NORTHERN B
- NORTHERN C
- STORMWATER POND

SAFETY IN DESIGN

All reasonably practicable steps have been taken to ensure safety in design has been considered within AECOM's scope of work in this design in accordance with IPENZ Practice note 07 'Design for safety in buildings and other structures' (July 2006).
It remains the responsibility of the owner and/or operator to ensure appropriate practices are in place to protect the safety of workers and the public in the operation of the facility.

NOT FOR CONSTRUCTION

CAD Ref: K:\Projects\Local Authority\60250009 ATTH ACT Mill Rd Corridor\5 CAD\05 3 Working\DRG\Preliminary design\ 60250009-PD-C-0013.dwg

REVISIONS

No.	BY	DATE	DESCRIPTION	APPD
A	KC		Issued for information	IF

THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE AECOM QUALITY ASSURANCE SYSTEM TO ISO 9001:2000

DESIGNED	DG	CHECKED	DM
DRAWN	KC	CHECKED	DM
APPROVED		DATE	

SCALES:
SCALE V 0 100 200 300 400 500m
1 : 20000 (A3) 1 : 10000 (A1)

AECOM New Zealand Limited

CLIENT: Auckland Transport

Redoubt Road – Mill Road Corridor Study

Overall View - All Options

Sheet 1 of 1

A1 | STATUS: Preliminary Design | DRAWING NO: 60250009-PD-C-0013 | REV: A

Appendix 2: IEEM Approach

Table 1: *Ecological Values.*

Value	Explanation
Very High	A reference quality feature in condition close to its pre-human condition with the expected assemblages of flora and fauna and no contributions of contaminants for human induced activities. Negligible degradation.
High	A feature with high ecological or conservation value but which has been modified to the extent it is no longer reference quality. Slight to moderate degradation.
Medium	A feature which contains fragments of its former values but has a high proportion of tolerant fauna and obvious habitat quality issues. Moderate to high degradation.
Low	A highly modified feature with poor diversity and abundance of flora or fauna and significant habitat issues. Very high degradation.

Table 2: *Magnitude of Effects*

Magnitude	Description
Very High	Total loss or very major alteration to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether.
High	Major loss or major alteration to key elements/ features of the baseline (pre-development) conditions such that post development character/ composition/ attributes will be fundamentally changed.
Moderate	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of baseline will be partially changed.
Low	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre-development circumstances/patterns.
Negligible	Very slight change from baseline condition. Change barely distinguishable, approximating to the "no change" situation.

Table 3: *Significance of Ecological Effects*

SIGNIFICANCE		Ecological &/or Conservation Value			
		Very High	**High**	**Medium**	**Low**
Magnitude	**Very High**	Very High	Very High	High	Medium
	High	Very High	Very High	Medium	Low
	Moderate	Very High	High	Low	Very Low
	Low	Medium	Medium	Low	Very low
	Negligible	Low	Low	Very Low	Very Low

Addendum 2

Redoubt Road – Mill Road Corridor Study

Assessment of Ecological Effects of Alternative Options Prepared for Auckland Transport

20 October 2014

REDOUBT ROAD - MILL ROAD CORRIDOR STUDY

Assessment of Ecological Effects of Alternative Options
Prepared for Auckland Transport

20 October 2014

Boffa Miskell

Document Quality Assurance

This report has been prepared in accordance with Boffa Miskell quality assurance procedures, and has been reviewed and approved for release as set out below.

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CONTENTS

1.0 Introduction

A project description overview of the Mill Road project is provided in the Assessment of Ecological Effects (AEcE) report prepared by Boffa Miskell (2014) accompanying the NoR. In addition commentary regarding previous ecological reporting and the wider ecological context of the project is provided in that same AEcE. This present report documents the findings of an investigation into the merits of two potential adjustments to the Preferred Option requested by the Auckland Transport Board post the Scheme Assessment Report. These adjustments focus on a small section of the wider Mill Road corridor, generally extending between 174 – 38 Mill Road (to the immediate south of the existing carriageway).

There are two options being considered for this alternative alignment (see Appendix 1), with the only difference of any magnitude being an associated realignment of Polo Prince Drive associated with Option 2. Option 1 retains the existing alignment of this road and its existing intersection with Mill Road whereas Option 2 provides a realignment of part of Polo Prince Drive and an entirely new intersection with Mill Road. This present report provides an assessment of the ecological effects associated with these alternative options, and compares them to the preferred alignment in this same area. In doing so it does not concern itself with the wider corridor of the Preferred Option.You can easily change the formatting of selected text in the document text by choosing a look for the selected text from the Quick Styles gallery on the Home tab. You can also format text directly by using the other controls on the Home tab. Most controls offer a choice of using the look from the current theme or using a format that you specify directly.

2.0 Results

2.1 Vegetation

The vegetation associated with the Alternative Options is mostly grazed farmland and homestead gardens with amenity trees. These include trees such as macrocarpa hedges, poplar, casuarina and pines. In addition a variety of native small cultivar trees are present in some locations.

Both Alternative Options will result in the loss of an area of indigenous bush comprising a small copse of several taraire trees at 9 Polo Prince Drive. This copse of bush is approximately 0.18ha in area.

The preferred alignment in this same area does not impact upon the bush at 9 Polo Prince Drive, but does traverse across old growth native forest located at 146 Mill Road. The extent of survey work within the bush at 146 Mill Road was restricted due to access issues, but that portion of it within the property at 134 Mill Road was able to be visited. Additional views over its canopy were also obtained from neighbouring vantage points. While this bush will be bridged approximately 1,500m2 of it will be directly lost as a result of the bridge abutments, along with likely topping of canopy trees.

The bush is an example of old growth podocarp-broadleaved forest with a canopy height of 18-20m. The gully system is dominated by taraire and puriri, interspersed with rimu, rewarewa, karaka, pigeonwood, tawa tanekaha and occasional matai. Kahikatea, nikau, cabbage tree and scattered pukatea occupy the gully floor, while kanuka is locally dominant on steep, drier slopes above the watercourse, with associated canopy species including totara, lancewood and titoki. Mapou, mahoe, ponga, wheki and mamaku are common throughout the subcanopy.

Climbers and epiphytes include NZ passionfruit, small white rata, pink rata vine, hound's tongue fern, fragrant fern, hanging spleenwort, sickle spleenwort, filmy fern, fork fern and leather-leaf fern and kahakaha (Collospermum hastatum). The understorey includes mapou, hangehange, lancewood, karamu, kanono, putaputaweta, Coprosma spathulata and mingimingi.

Lacebark, kauri, Pittosporum, korokia and five-finger species have been planted along the upper margins of the bush. Ferns (predominantly thread fern, sweet fern, Lastreopsis microsora and gully fern) make up most of the groundcover, in addition to seedlings of canopy species and a variety of pasture herbs and grasses.

2.2 Avifauna

A total of 15 five-minute bird counts were completed, with the count station (located adjacent to the bush at 146 Mill Road) being replicated three times over three days (April 8-9th and 14th, 2014). Counts identified a total of 7 bird species (see Table 1).

Table 1: *Bird species recorded during 5-minute bird counts, April 2014*

Species	Threat Classification	Mean no. birds
Blackbird	Introduced and Naturalised	0.3
Fantail, New Zealand	Not Threatened	2.0
Myna	Introduced and Naturalised	6.7
Silvereye	Not Threatened	12.0
Sparrow, House	Introduced and Naturalised	0.3
Starling	Introduced and Naturalised	4.7
Tui	Not Threatened	0.7

Species shaded grey in Table 1 are introduced passerines. The most common species recorded were silvereyes, starlings, mynas and fantail. New Zealand pigeons were not recorded but given the forest type at 9 Polo Prince Drive it is considered likely that they would frequent when the trees are in fruit. All species recorded were either 'not threatened' or 'introduced and naturalised.'

Field data was supplemented by reference to information records from the Ornithological Society of New Zealand (OSNZ). Over 1999-2004, OSNZ surveyed a 10km2 area that includes the project area as part of their Bird Distribution Atlas scheme (see Robertson et al., 2007). Over that period, the area was surveyed 18 times. They recorded a total of 52 bird species, including all of the species recorded during this survey. Their surveys indicate that there are many additional species that are likely to be common in the wider area. Notably, they recorded three 'at risk' species and five 'threatened' species (see Table 2).

Table 2: *'Threatened' and 'at risk' bird species within 10km2 of the project area (OSNZ).*

Species Name	Threat Classification
Duck, Grey	Threatened (Nationally Critical)
Gull, Black-billed	Threatened (Nationally Critical)
Dabchick, New Zealand	Threatened (Nationally Vulnerable)
Gull, Red-billed	Threatened (Nationally Vulnerable)
Shag, Pied	Threatened (Nationally Vulnerable)
Stilt, Australasian Pied	At Risk (Declining)
Shag, Black	At Risk (Naturally Uncommon)
Shag, Little Black	At Risk (Naturally Uncommon)

All of these are primarily coastal and wetland species. Five species - black-billed gulls, pied shags, little black shags, dabchicks and grey ducks - were recorded by the OSNZ in wetland habitat only. Black shags and re-billed gulls were recorded in farmland, residential and wetland habitats, and stilts were recorded in wetland and farmland. Given the absence of suitable wetlands in the alternative footprints, wetland-inhabiting species are unlikely. Species such as stilts and gulls may feed on inundated pastures during wet weather.

2.3 Bats

Automated Bat Monitors (ABMs) were deployed in the wider area including in the vicinity of the Alternative Options in areas of potential flyways. No echolocation pulses were recorded on any of the ABM's.

Furthermore, Auckland Council has reported that the regional bat survey sites have similarly not recorded any echolocation pulses from the Mill Road area, and they further report that community bat detectors have recorded no bat activity in the Redoubt Road area to date.community bat detectors have recorded no bat activity in the Redoubt Road area to date.

2.4 Lizards

No native skinks or geckos were found despite suitable habitat being present. Two lizard species were confirmed as present in the wider area, being the introduced rainbow skink and a native unidentified gecko (most likely a forest gecko). Surveys were conducted in April, when lizards tend to become less active. Further, due to unpredictable weather during Cyclone Ita, detection probability of lizards in our surveys may have been affected.

2.5 Freshwater

2.5.1 Stream Status

Reference to Auckland Council's GIS database suggests there are no permanent streams within the Alternative Options footprint, but there are some intermittent streams and several ephemeral reaches. This was verified by way of field survey, using the criteria of the Auckland Regional Plan - Air, Land and Water (ALWP), as well as the definitions in the Proposed Auckland Unitary Plan (PAUP).

2.5.2 Freshwater Ecology (Macroinvertebrate and Fish Communities)

A representative site was sampled for aquatic biota and ecological values. Upstream habitat is grazed pasture, with rural sections. Riparian vegetation is present in the form of willow weed, starwort, watercress and Glyceria spp. The results are given in Table 3.

Table 3: *Macroinvertebrate Community Metrics and Fish IBI scores*

Metric	Sampling Site
1 Total abundance	445
2 Number of taxa	12
3 Number of EPT taxa*	1
4 MCI score	57
5 QMCI score	2.4
6 Taxonomic Distinctness	3.7
7 Fish IBI	14

Macroinvertebrate communities showed a moderate species abundance with a moderate taxa richness. Two EPT taxa were identified, the stonefly Acroperla and the caddisfly Oxyethira. Despite this the MCI-sb score was 57 and the QMCI-sb was 2.4. Both scored low and this indicates probable severe pollution due to the low abundance of both EPT taxa and other non-EPT taxa. Despite riparian vegetation there is almost no shading, and is part of farm gully stream. It is probable that there is farm run off entering the stream as well as a lack of available habitats.

The taxonomic distinctness score of 3.7 (CI: 4.1, 4.3) indicates that the macroinvertebrate communities at this site have low distinctiveness.

Fish fauna detected included three shortfin eels, while the fish IBI score of 14 (very poor) indicates a very poor integrity and a high level of impact.

The overall SEV score was 0.36, in the Low range. Hydraulic functions scored well with 0.65, indicating a relativity intact and physically functional water system. Biogeochemical, Habitat Provision and Biodiversity function all scored low (0.28, 0.23, and 0.21 respectively). Lack of shade, low MCI's and lack of fish presence contribute to these low scores.

Table 4: *Summary of SEV scores, mean scores for function classes and overall mean score*

SEV Function	Scores
Hydraulic function	0.65
Biogeochemical function	0.28
Habitat provision function	0.23
Biodiversity function	0.21
Overall mean SEV score*	**0.36**
SEV Range	**Low**

*** (maximum value = 1)**

3.0 ASSESSMENT OF ECOLOGICAL SIGNIFICANCE

3.1 Threatened Environments

The key natural features were assessed against the "The Threatened Environment Classification" GIS map as described by Walker et al. (2007). The Threatened Environment Classification uses indigenous vegetation as a surrogate for indigenous biodiversity, which includes indigenous ecosystems, habitats and communities. It utilises a 6 tier classification system, whereby Category 1 Land Environments are described as "Acutely Threatened with <10% of their indigenous vegetation remaining" up to Category 6 Land Environments which are described as "Less Reduced and Better Protected with >30% of their indigenous vegetation remaining and with >20% of this protected".

According to the Threatened Environments classification (Walker et al. 2007) the Alternative Options (including the Polio Prince Drive copse) and the preferred alignment in the area of interest (including the bush at 146 Mill Road) are both within a Category 3 – At Risk Land Environment, with 20-30% of indigenous vegetation remaining.

3.2 Proposed Auckland Unitary Plan (PAUP)

The PAUP includes a policy in Volume 1 Chapter B Section 4.3.4 (Regional Policy Statement – Biodiversity) that sets out the criteria to be used in identifying Significant Ecological Areas (SEAs). Under these criteria the Polo Prince Drive copse of taraire trees is not considered to reach the threshold of ecological significance as it is a small, relatively isolated stand containing low species and habitat diversity due to its size. The bush at 146 Mill Road is considered to meet most of the criteria, and as such is considered to be of ecological significance. Notwithstanding this, it is noted that the PAUP does not map the bush at 146 Mill Road as being an SEA – the reasons for this are not obvious but may be related to size or otherwise could possibly simply be an oversight since it clearly meets most of the relevant criteria.

3.3 Operative Auckland Regional Policy Statement

Section 6.4.7 of the Auckland Regional Policy Statement (RPS) gives some guidance to the criteria used to evaluate the significance of natural areas. Under these criteria the Polo Prince Drive copse is not ecologically significant, whereas under those same criteria the bush at 146 Mill Road is of ecological significance.

3.4 IEEM Approach to Assessing Ecological Values

The Institute of Ecologists and Environmental Managers (IEEM - a European professional environmental practitioners organisation) published guidelines for ecological impact assessment in 2002 (Regini (ed), 2002). Boffa Miskell has adapted these for use in New Zealand as its best practice guide. It utilises a three stage process, beginning with an assessment of the ecological values of a given site, followed by an assessment of the magnitude of the effects of a project on

those values, and then by way of combining these deriving the significance of those effects. These tables are attached in Appendix 2.

Using the ecological evaluation system of IEEM (2002) above, the bush at 146 Mill Road has been assessed as being of High ecological value *(A feature with high ecological or conservation value but which has been modified to the extent it is no longer of reference quality. Slight to moderate degradation)*. The Polo Prince Drive copse was assessed as being of Low ecological value *(A highly modified feature with poor diversity and abundance of flora or fauna and significant habitat issues. Very high degradation)*.

4.0 ASSESSMENT OF EFFECTS ON ECOLOGICAL VALUES

4.1 Clearance of Vegetation

When assessing the severity of adverse effects associated with bush clearance, there are two important factors to consider, being firstly the quality of vegetation to be cleared; and secondly the extent of the clearance.

In relation to the preferred alignment in the area of interest, the majority of the vegetation that will be affected is presently farmed pasture, together with rural residential properties. Additional woody vegetation that will be cleared is predominantly exotic, and includes hedgerows, shelterbelts and screen plantings, together with garden ornamentals. However, it does include the bridging of the bush at 146 Mill Road.

The use of a bridge to cross this gully substantially reduces the extent of vegetation loss compared to works required to place fill. The bridge will be 30m long and 30m wide, and does not require any supporting central piers. It will launch and land on fill abutments of 8m elevation (eastern side) and 15m elevation (western side), with the retaining walls supporting these abutments necessitating the loss of 1,500m2 of bush (all tiers). In addition to this the bridge will span over some 500m2 of bush, which is likely to require topping (or possible loss) of some additional canopy trees.

It is likely that immediately beneath the eastern bridge abutments there will also be rain-shadow effects, where precipitation will be unable to drift underneath the bridge and water the underlying soil. However, this effect diminishes with increasing bridge elevation, and given the steep nature of the stream gully here together with the bridge elevation it is anticipated that rain-shadow effects are likely to only manifest in a very small portion of the bridge footprint.

With reference to the IEEM approach (refer Appendix 2), the bush at 146 Mill Road is rated as being of High ecological value, while the magnitude of effects is assessed as Low. The Low assessment is on the basis that a relatively small portion of the bush is located within the footprint, and assumes construction of a bridge will retain much of sub-canopy and understorey vegetation (as has been described in above). Additionally no haul roads or crane platforms are required to be located within the bush itself. The overall significance of effects is assessed as Medium. Nevertheless, there is a degree of uncertainty as to the extent of pruning or topping on canopy trees under the bridge span, and the impact on these trees. In the event that

substantial removal of the forest canopy is required from beneath the 500m2 bridge span, the magnitude of effect would increase to 'Moderate', and the consequent significance of effect would be High.

In relation to the Alternative Options, the majority of the vegetation that will be affected is presently farmed pasture together with rural residential subdivision. Additional woody vegetation that will be cleared is predominantly exotic, and includes hedgerows, shelterbelts and screen plantings, together with garden ornamentals.

The copse of native trees at Polo Prince Drive is small in size (0.18ha) and comprises mature taraire. There is little in the way of buffering vegetation and the entire site is very exposed to edge effects, with its ecological integrity consequently being compromised. This entire copse of trees will be lost as a result of either of the Alternative Options. The ecological values of this site, assessed against the IEEM (2002) matrix are a classified as Low. The magnitude of effects is Very High (total loss), and therefore the significance of the effects is assessed as Medium. Therefore the loss of this small stand of mature taraire trees is an adverse effect of sufficient magnitude to require mitigation.

4.2 Habitat Fragmentation and Loss of Ecological Corridors

The local landscape is a patchwork of indigenous bush habitats which act as stepping stones for native fauna (in particular birds and possibly bats also) stretching all the way eastwards to the Hunua Ranges. There will be no permanent habitat fragmentation over and above existing levels as a result of either of the Alternative Options, although the existing barrier of Mill Road will become wider. However, the complete loss of this copse of trees will remove a potential "stepping stone" flight stop-over point for birds moving through the landscape. With regard to the bush at 146 Mill Road, while a bridge will cross over 500m2 of this forest there will be clear flyways both above and under that bridge. Additionally, the great majority of the bush here (<95%) will remain wholly unaffected and retain any role it plays as a local stepping stone for birds.

4.3 Increase in the Extent of Edge Effects

The Polo Prince Drive copse is entirely dominated by existing edge processes and conditions, and this bush patch will be lost entirely. There will be no increases in edge effects elsewhere over and above the present situation within the Alternative Options footprint. Likewise, the bridge crossing over the bush at 146 Mill Road is at its most-narrow point where edge effects already dominate. While the bridge abutments do necessitate the removal of 1,500m2 of bush here this vegetation (and that which will remain beneath the bridge) is already under the influence of edge effects, and no additional such effects are anticipated.

4.4 Effects on Bats

Lesser short-tailed bats are dependent on large tracts of old growth native forest and there are no known populations on the mainland in the Auckland region (Department of Conservation, 1995). Conversely, long-tail bats are edge habitat specialists that utilise various habitats and populations have been able to persist in a few areas of rural-suburban Auckland (Department of Conservation, 1995). The closest known population of long-tailed bats is located approximately 10 km to the east of the site in the Clevedon Scenic Reserve. Given the very large home ranges of long-tailed bats (upwards of 100 km2; O'Donnell 2001), they may forage around the

site and use mature trees in the area as temporary roosts. However, no bats have been recorded within the local area and effects of removing the Polo Prince Drive copse or the 2,000m2 at 146 Mill Road are not expected to result in any negative effects on them.

4.5 Effects on Avifauna

The extent of indigenous habitat for native avifauna that will be impacted upon is minor, being restricted to the Polo Prince Drive copse of taraire trees, 2,000m2 of taraire forest at 146 Mill Road and a score or more amenity garden trees. The bird community of the local area is unremarkable, and the Alternative Options and the Preferred Alignment pose little direct risk to any bird species. Furthermore, while taraire berries are a food resource for NZ pigeon there is an abundance of this species in the local and wider area.

4.6 Effects on Herpetofauna

While no native lizards were observed to be present in the entire project footprint, due to the restrictions experienced in accessing private land and the variable weather conditions during the survey, it cannot be concluded that native lizards are absent (particularly when the site is within the natural range of the species and suitable habitat is present). Notwithstanding this, potential adverse effects on native lizards can be effectively managed by way of a capture and relocation programme.

4.7 Freshwater Effects

All in all the ecological values of the affected streams was assessed as being Low.

Both Alternative Options affect local streams, but no streams are affected under the Preferred alignment. Table 5 summarises the culvert lengths associated with each option on both streams.

Table 5: *Alternative Route – summary of stream crossings*

	116 Ranfurly Road Stream 1	116 Ranfurly Road Stream 2	Total stream bed habitat loss
Alternative Option 1	20m	50m	70m
Alternative Option 2	50m	50m	100m
Preferred Alignment	-	-	-

The extent of stream culverting associated with both options is similar in relation to Stream 2. However, option 2 requires more extensive stream culverting in Stream 1, as a result of the alterations to the alignment of Polo Prince Drive. Notwithstanding the poor habitat quality and low ecological values of these streams, Alternative Option 1 is preferred over Option 2.

5.0 SUMMARY AND CONCLUSION

The significance of ecological effects is a product of both Ecological Value and Magnitude of Effects scores. As previously set out in Section 4.1, the significance of adverse effects associated with both the Alternative Options and the Preferred Option is assessed as Medium. Both Alternative Options affect a site of relatively low ecological value (Polo Prince Drive remnant) but have very high impact (total loss), while the bush at 146 Mill Road has High ecological value but a relatively low level of effects.

While the IEEM analysis concludes that there is minimal difference between the options in terms of the scale and severity of overall adverse effects, the ecological values of the bush at 146 Mill Road are such that the avoidance of all effects at that location would be the best outcome. Vegetation clearance required under Alternative Options 1 and 2 is roughly equivalent in area to the Preferred Option, but the bush remnant at Polo Prince Drive is fragmented and isolated, too small to be sustainable into the future, suffers from edge effects and habitat degradation, and is not part of an obvious corridor. The bush at 146 Mill Road is larger, more intact, and of better quality. Furthermore, there is a degree of uncertainty as to the extent of impact on canopy trees under the bridge span, and if substantial removal of the forest canopy beneath is required, the consequent significance of adverse effects would be High for the Preferred Option. Hence, either of the Alternative Options are recommended ahead of the Preferred Option on the basis of requirements for vegetation clearance.

Since both Alternative Options will have the same effect on the Polo Prince Drive remnant, the only differentiating factor is stream works, though effects on freshwater ecosystems are of relatively low significance in either case due to the degraded condition of the streams. In this regard, due to the lesser extent of stream bed habitat permanently lost as a result of additional culverting, Option 1 of the Alternative Options is preferred over Option 2.

In summary, Option 1 is recommended as the alternative alignment with the lowest net adverse ecological effects.

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Appendix 1: Alternative Options

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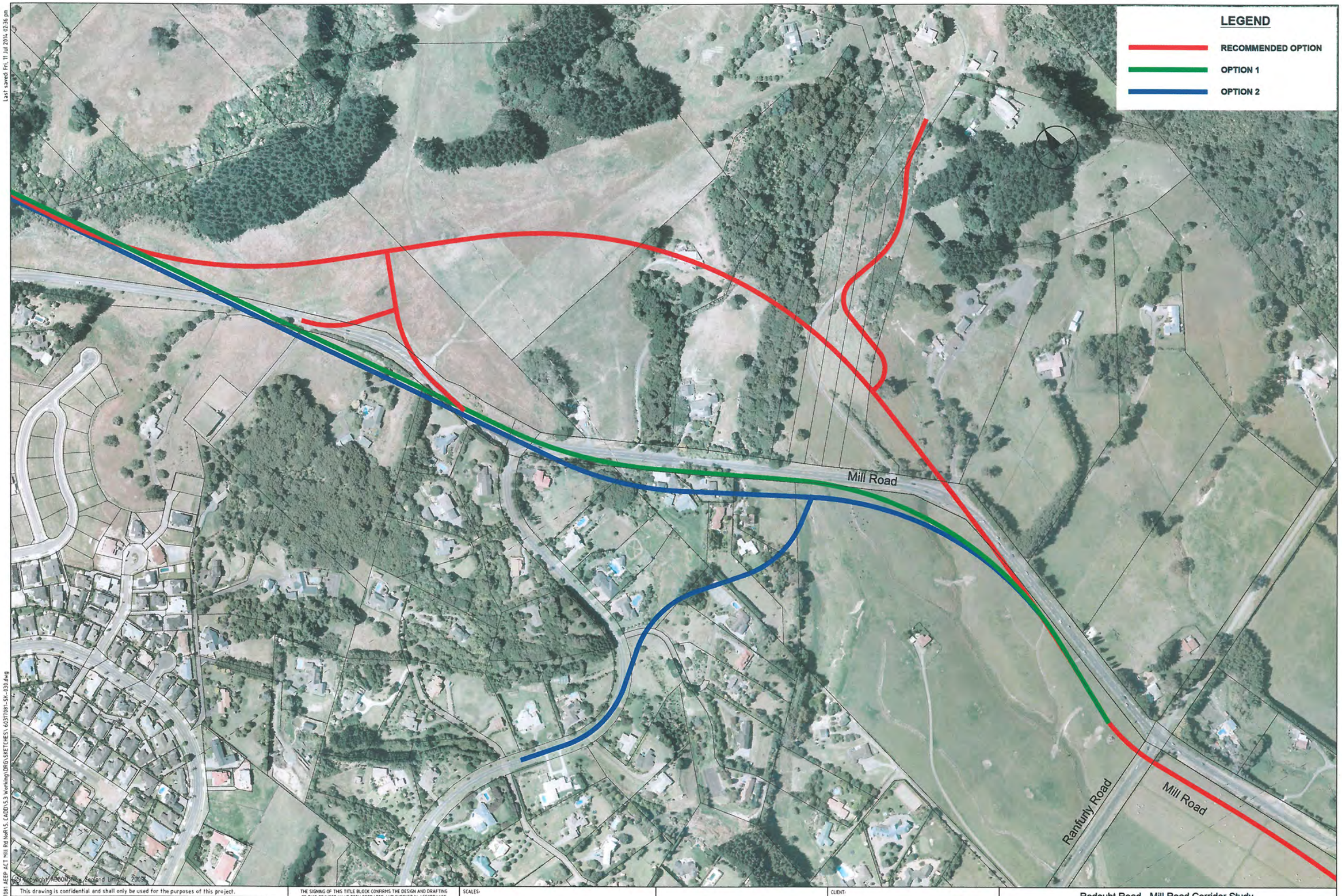

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STAGE 4 OVERALL SCHEME OPTIONS

Sheet 1 of 1

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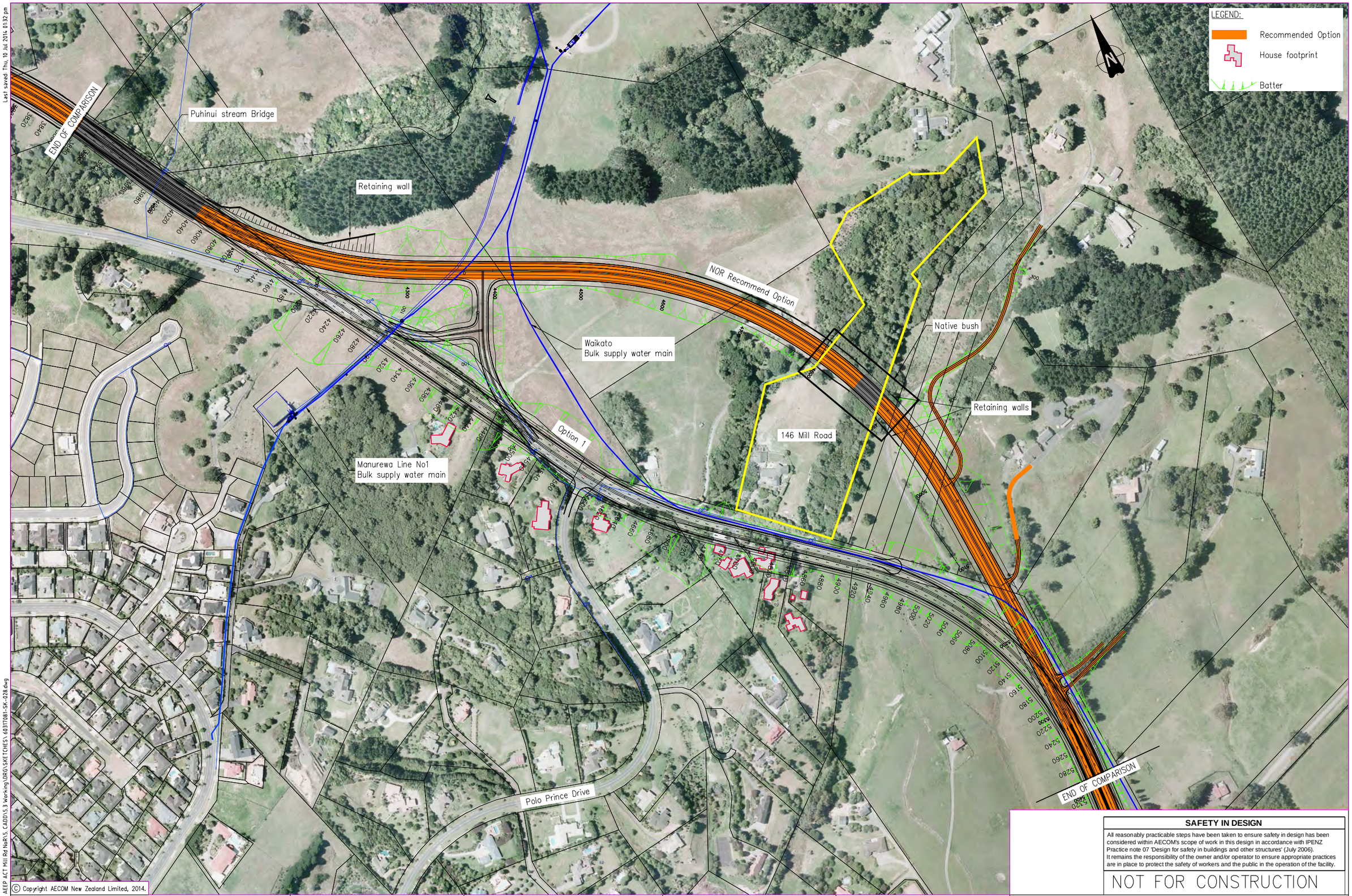

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Redoubt Road – Mill Road Corridor Study

STAGE 4
ALTERNATIVE ALIGNMENT
OPTION 1

Sheet 1 of 1

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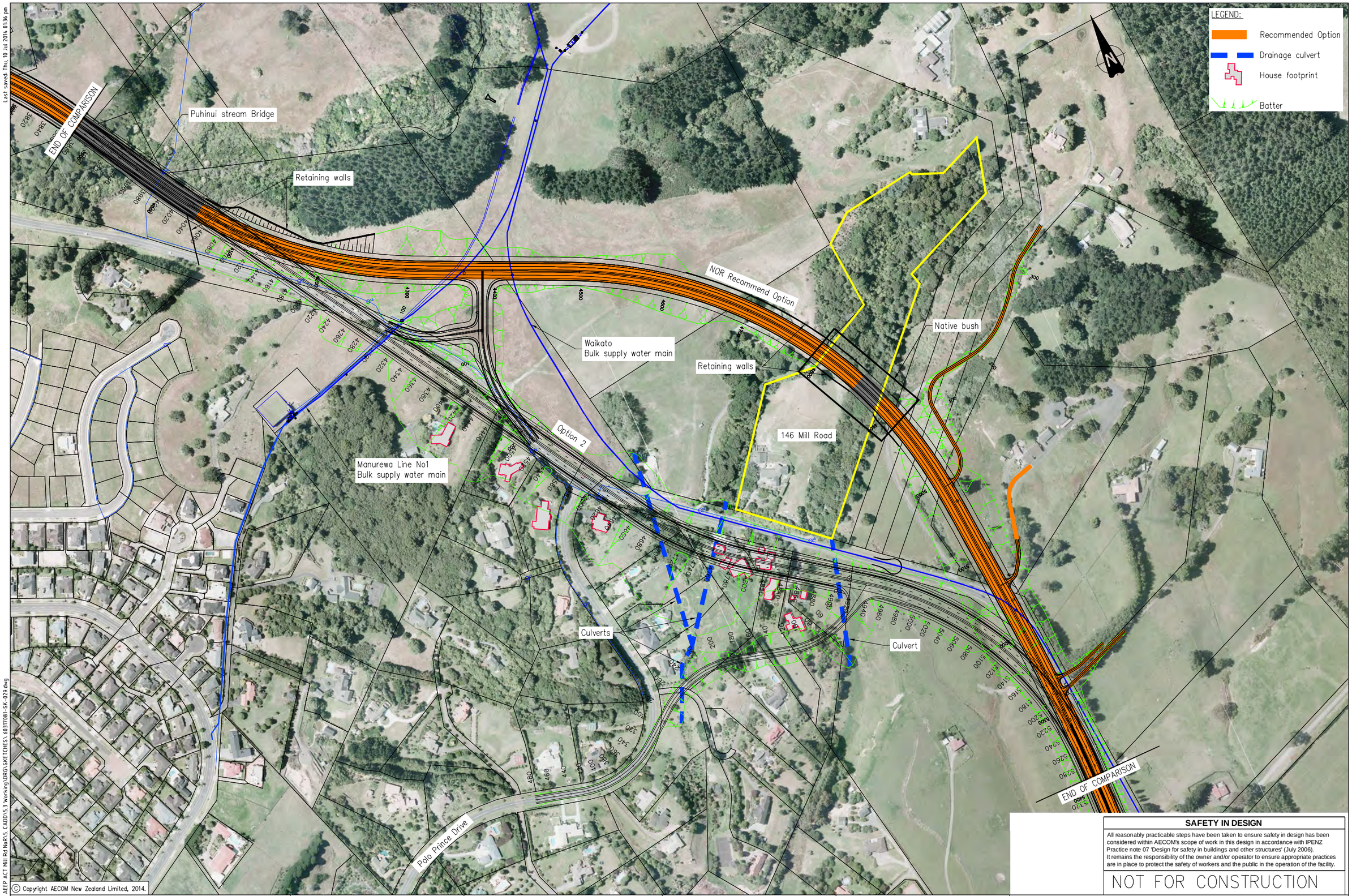

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Redoubt Road – Mill Road Corridor Study

STAGE 4
ALTERNATIVE ALIGNMENT
OPTION 2

Sheet 1 of 1

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Appendix 2: IEEM Matrices

Table 1: *Ecological Values*

Value	Explanation
Very High	A reference quality feature in condition close to its pre-human condition with the expected assemblages of flora and fauna and no contributions of contaminants for human induced activities. Negligible degradation.
High	A feature with high ecological or conservation value but which has been modified to the extent it is no longer reference quality. Slight to moderate degradation.
Medium	A feature which contains fragments of its former values but has a high proportion of tolerant fauna and obvious habitat quality issues. Moderate to high degradation.
Low	A highly modified feature with poor diversity and abundance of flora or fauna and significant habitat issues. Very high degradation.

Table 2: *Magnitude of Effects*

Magnitude	Description
Very High	Total loss or very major alteration to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether.
High	Major loss or major alteration to key elements/ features of the baseline (pre-development) conditions such that post development character/ composition/ attributes will be fundamentally changed.
Moderate	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of baseline will be partially changed.
Low	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre-development circumstances/patterns.
Negligible	Very slight change from baseline condition. Change barely distinguishable, approximating to the "no change" situation.

Table 3: *Significance of Ecological Effects*

SIGNIFICANCE		Ecological &/or Conservation Value			
		Very High	**High**	**Medium**	**Low**
Magnitude	Very High	Very High	Very High	High	Medium
	High	Very High	Very High	Medium	Low
	Moderate	Very High	High	Low	Very Low
	Low	Medium	Medium	Low	Very low
	Negligible	Low	Low	Very Low	Very Low