REPORT

WAIMEA WATER AUGMENTATION COMMITTEE

Lee Dam Feasibility Study: Enhancement Opportunities Scoping Plan

Report prepared for:

WAIMEA WATER AUGMENTATION COMMITTEE

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1 Introduction

1.1 Background

In 2007 Tonkin & Taylor Ltd and its sub-consultants completed a Phase 1 pre-feasibility evaluation of a number of options to provide water storage for long-term irrigation and community supplies in the Waimea Basin, Tasman District. The evaluation was undertaken on behalf of the Waimea Water Augmentation Committee (WWAC). The overall principle of the study was to identify and develop a water augmentation scheme to capture excess water for storage and release that water back into the Waimea River system during periods of high water demand and/or low natural water flows to augment those supplies, either directly or via recharging of the groundwater system.

The outcome of that Phase 1 study was to focus feasibility investigations on a water storage dam and reservoir site located in the upper Lee River catchment, a tributary of the Waimea River.

In 2007 WWAC initiated Phase 2 of the study, to take the Lee investigation programme to a feasibility level.

This report presents the results of an assessment of environmental enhancement and mitigation investigations completed as part of the Phase 2 feasibility study. It is based on a potential dam on the Lee River in Tasman District, at a site approximately 300 metres upstream of the confluence of Anslow Creek and the Lee River. The required storage capacity of the reservoir has been determined to be approximately 13 million m^3, with a normal top water level to RL 197m. The reservoir would extend approximately 4km upstream from the dam, and cover an area of approximately 65 hectares (based on normal top water level).

Figure 1 shows the location of the proposed dam, and the indicative reservoir extent.

1.2 Scope

The primary objective of this study has been to identify potential or actual environmental effects (both positive and negative) based on specialist studies, identify enhancement options and outline management considerations for recommended initiatives in order to provide adequate mitigation to compensate for any potential or actual adverse environmental effects of the proposed Lee River water augmentation project. The report describes a proposed management framework, restoration principles, and key ecological design issues to consider. It also recommends timeframes for putting these in place.

The information has been derived from the technical reports regarding the potential effects of the proposed development on ecological, recreational and cultural values. A workshop was also held with members of WWAC, and staff of the Department of Conservation and Fish and Game to identify constraints and opportunities that can be applied for this enhancement plan. Discussions were also had with technical specialists from the Department of Conservation and independent experts regarding biodiversity management options for providing compensation of values removed from the proposed development site.

Information from these discussions that has assisted with developing mitigation opportunities presented in this report includes:

1. Land tenure and the ease of land purchase in strategic areas surrounding the proposed Lee River dam;
2. Best practice mitigation including keeping mitigation local and replacing like-for-like environments;
3. The relative merits of site-orientated enhancement now compared to development of a financial fund of equivalent value which will direct expenditure of mitigation in the future;
4. Biological and management constraints and opportunities for vegetation community and species- orientated management; and
5. Calculation tools for estimating the financial value of sites based on relative ecological value.

This report considers mitigation and offset compensation. The distinction between the two follows definitions from international literature as follows:

- **Mitigation –** minimisation of adverse effects of a proposed development by the adoption of practices or processes within the development area to reduce the overall adverse effect.
- **Offset compensation** - also widely called 'mitigation compensation' in New Zealand. Offsets are defined as 'Conservation actions intended to compensate for the residual, unavoidable harm to biodiversity caused by development projects, so as to ensure a no net loss of biodiversity'.

The plan presented here provides an indicative framework and programme for mitigation and offsets for the scheme design described in the technical reports in Section 1.3. This plan is neither final nor is it formally agreed by the various stakeholders who have contributed information and technical advice, rather it has been developed to agree a general approach and to enable an indicative cost to be identified that can be incorporated in the financial modelling for the overall project. The details of the Plan are expected to be confirmed and agreed at later stages of the project. The discussions undertaken to date are without prejudice on the part of all parties (WWAC, DOC and F& G).

1.3 Sources of information and consultation

The following environmental assessment reports have been prepared for the current water augmentation proposal and form the basis for this enhancement opportunities scoping plan.

- Terrestrial ecology (T&T, *Lee dam feasibility study: terrestrial ecology effects assessment*, dated December 2009; T&T ref 24727.400/401)
- Aquatic ecology and water quality (Cawthron Institute: *Aquatic ecology - Mitigation and management options associated with water storage in the proposed Lee Reservoir*, dated December 2009)
- Cultural Assessment report (Tiakina te Taiao: *A management plan for Lee Valley: a tangata whenua perspective*, dated November 2009)
- Recreational Assessment (Rob Greenaway & Associates, *Upper Lee River Waimea water augmentation: recreational assessment of effects*, dated December 2009)

2 Statutory considerations

2.1 Introduction

The footprint of the proposed Lee River dam and reservoir includes private land and public conservation land administered by DOC **(Figure 1**). Environmental effects on private land are considered under the Resource Management Act 1991. Effects on public conservation land, in this case the Mt Richmond Forest Park, are considered under the Conservation Act 1987. Statutory constraints mean that mitigation must be considered separately for private land compared to public conservation land, as outlined below.

2.2 Resource Management Act 1991

The management of natural resources is governed by objectives, policies, methods and rules developed by local authorities, all within the context of the Resource Management Act 1991 (RMA). In addition there are over-riding principles set out in the RMA itself. The purpose of the RMA (s5) is to manage the use of natural and physical resources to provide for the current and future needs of people, while safeguarding the environment's life-supporting capacity and avoiding, remedying or mitigating adverse effects on the environment.

Section 6c of the RMA directs assessments of significance of resources to named levels of ecological complexity; ecosystems, habitats (vegetation communities) and species. This approach is also reflected in the way in which DOC assesses the significance of ecological values on sites. It makes inherent sense therefore that opportunities for mitigation be directed at similar levels of ecological complexity.

Within the context of this overarching statute, any development that results in adverse effects on the environment (or named components of the environment) that are considered 'more than minor' is required to avoid, remedy or mitigate those effects so that effects will be 'no more than minor'.

For the purposes of this enhancement opportunities scoping plan, ecological values of significance which relate to vegetation communities and species have been considered in terms of the likely level of effect and the means of minimising, avoiding or mitigating those effects for each specific component of ecological value (e.g. shovel mint, alluvial forest) identified in the technical assessment reports.

2.3 Conservation Act

The Conservation Act relates to publicly owned conservation land including the section of Mt Richmond Forest Park at the most southern extent of the proposed reservoir. Within this area, approximately 4.2 ha of riparian vegetation (comprising 20% gorge turf communities and 80% riparian forest) and 3.2 ha of stream bed (comprising 2 km of stream length) will be inundated by the proposed reservoir.

DOC has indicated that a concession is the most feasible statutory mechanism under which the Lee River reservoir could operate within the public conservation land. Without prejudice to the outcome of any formal application to DOC, under the terms of the concession it is likely that DOC will require that ecological effects generated on the public conservation land will be required to be compensated for by actions on public conservation land, preferably within Mt Richmond Forest Park.

Whereas the RMA requires the consideration of only those effects on the environment that are considered to be more than minor, discussions with DOC indicate that the Conservation Act requires the consideration of the loss of all ecological resources, irrespective of their level of significance. That is, the loss of even common species, their habitat and ecosystems must also be compensated for within the public conservation land that is proposed to be inundated by the reservoir.

In this regard, effects on the riparian vegetation are considered within Section 4 and those relating to loss of flowing river habitat are considered as part of the overall mitigation assessment in Section 4.3.

3 Summary of potential or actual adverse environmental effects

3.1 Terrestrial ecology

The following sections summarise the potential environmental effects and opportunities for mitigation presented in T&T's Terrestrial Ecology Effects Assessment Report.

3.1.1 Vegetation

The likely extent of vegetation clearance comprises approximately 27 ha of indigenous vegetation and approximately 42 ha of exotic plantation forestry. Of this, approximately 4.2 ha of indigenous vegetation is within public conservation land. The indigenous vegetation areas have all been degraded through the actions of exotic weeds and animal pests; however they still retain moderate to high botanical value, primarily due to high plant species diversity and the rarity of vegetation community types on a local, regional or national basis.

Vegetation communities within the proposed project footprint include: alluvial forest (high significance[1]); gorge flood-zone turf communities (moderate significance); river-bed island forest (moderate significance); riparian forest (high significance); and hill-slope beech forest (moderate-low significance). Radiata pine and Douglas fir plantation areas are not included in considerations of mitigation compensation for botanical values as they have been planted for the purpose of future felling under forestry regulations and support largely exotic plant species with common native plants forming a lower tier.

Species of significance within the development area include four threatened plant species. NZ shovel mint (*Scutellaria novae-zelandiae*) is endemic to the Nelson/Marlborough region and is listed as a Nationally Critically threatened plant species. The extent of shovel mint discovered during surveys associated with the proposed Lee River dam means that this area may support the largest area, and hence most nationally significant site, for shovel mint. The proposed dam and reservoir footprint will remove approximately half of the areas described during these surveys. Populations of shovel mint below the dam are not regarded as being under threat from the dam construction and reservoir operation and therefore offer one means of compensating for the loss of populations within the footprint.

Sand coprosma (*Coprosma acerosa*) is listed as a Nationally At Risk (Declining) threatened species. For the purposes of this assessment we have followed the most up-to-date taxonomy for this species (de Lange *et al.* 2009). It is therefore considered that the population found within the footprint of the proposed reservoir is part of the *Coprosma acerosa* complex, a nationally distributed species found in coastal areas and inland river bedrock and levees. The sand coprosma population within the project footprint is regarded as being of moderate conservation significance given its distribution elsewhere, including known populations elsewhere in Mt Richmond Forest Park. Compensation measures for the loss of this population should include propagation and cultivation of all specimens proposed for inundation and the establishment of new populations in areas of suitable habitat on the Lee River or adjacent catchments.

[1] As assessed by against the draft Tasman Significance Criteria Framework

Euchiton polylepis is associated with gorge turf communities and is listed as a nationally At Risk species which is naturally uncommon. Its distribution is not well understood through the Mt Richmond Forest Park and it is suspected that populations may exist elsewhere (S. Courtney, DOC, pers. comm.). This species was not recorded within the dam or reservoir footprint during surveys undertaken for this project. However DOC staff have sighted this species in the vicinity of the proposed dam (S. Courtney, DOC, pers. comm.). Given the uncertainty over its distribution within the proposed footprint and the likelihood that it is present elsewhere in the Lee and other nearby catchments, the significance of this species at the Lee site is considered to be low with a corresponding low level of proposed offset compensation relative to that proposed for shovel mint and sand coprosma. It is anticipated that mitigation proposed for protecting, restoring or creating vegetation communities will also have benefits for this species.

Scented broom (*Carmichaelia odorata)* is found throughout the riparian areas of the project footprint. Although it is found in the southern North Island and the northern and western areas of the South Island, this species is locally rare, and the size of the population found in the surveyed part of the Lee Catchment makes this site of regional significance. While several parts of the Lee population will be inundated by the proposed reservoir, there are good populations below the proposed dam that will remain and these offer opportunities for permanent protection and restoration. Populations of this species are recorded from the adjoining Wairoa Catchment. Given the presence of this species elsewhere in the Lee and adjoining catchments, and its distribution outside of the Nelson area, the level of offset compensation proposed, while species-specific, is the least proposed for the four plant species considered. It is anticipated that mitigation proposed for protecting, restoring or creating riparian vegetation communities will also have benefits for this species.

3.1.2 Birds

The diversity of birds within the development footprint is a typical representation of species which inhabit developed landscapes. Most are either exotic species of no particular conservation importance or are native species which are common in forested and farmland environments.

The most significant species identified in the project footprint is the NZ bush falcon. However the small size of the area proposed for vegetation clearance compared to the availability of adjoining exotic and native forest in this and other catchments suggests that any loss of foraging or nesting environment is likely to be minor in itself.

The proposed development will result in a permanent loss of food resources and nesting habitats, with native forest areas most likely providing a disproportionately higher benefit to local birdlife by virtue of nectar, fruits and diverse invertebrate food sources. The removal of this vegetation for the dam and reservoir will contribute to ongoing fragmentation of indigenous forest along the Lee River, by removing connections between the Mt Richmond Forest Park and lowland areas.

Measures to compensate for the loss of vegetation communities adopted for this project focus on improving the overall health of native forest areas or providing funding to enable forest health improvement elsewhere. The key mechanism for achieving such improvements is through weed control and the control of introduced mammals that degrade forest or prey on birds and other wildlife. Long-term compensation for the loss of forest areas will be provided by the planting or creation of indigenous forest.

Blue duck (whio) were not recorded during the survey or during a survey conducted by DOC several years ago (Barker in Gaze 2006). However, recent records of blue duck in the Wairoa and Lee catchments indicate that sufficient habitat exists although conditions are not favorable for the establishment of a self-supporting population, most likely due to the lack of sustained predator control. The sighting of a family of blue duck in the Lee around 2005 (email observation from Ross Holloway to Peter Gaze, DOC Nelson dated 2007) clearly indicates that habitat is present and that mitigation should be considered for the loss of potential blue duck habitat within the footprint of the dam and reservoir.

3.1.3 Lizards

No sightings were made of lizards or their sign during the site survey. However, it is considered likely that lizards would be present, albeit in very low densities. Given the scale of the development and the lack of sign of lizard presence, mitigation would best be provided through improvement of nearby lizard habitat rather than a rescue and relocation programme within the project footprint. The principal means of achieving this is as a secondary benefit from the improvement of forest health through weed and animal pest control, and through the creation of new indigenous forest areas as part of compensating for the loss of vegetation communities.

3.1.4 Bats

Recent survey information from other studies in nearby catchments indicates that long-tailed bats may be present in the Lee Catchment in the vicinity of the dam and reservoir footprints.

A survey for bats within the project footprint has recently been commissioned by WWAC and the results will be used in future as a basis for determining the need and level of mitigation required, should bats be present.

3.2 Aquatic ecology and water quality

The following sub-sections summarise the potential environmental effects and mitigation options presented in Cawthron Institute's Aquatic Ecology Mitigation and Management Options Report.

3.2.1 Reservoir stratification and water quality

Stratification can occur in deep lakes during summer with a warmer surface layer floating above a higher density cooler layer, with little mixing between the two. This can result in reduced dissolved oxygen concentrations at the bottom of the lake and anoxic conditions that cannot be tolerated by most higher organisms. Anoxia can also lead to further water quality problems. These problems are likely to be most apparent over the first 5 years after the reservoir is filled while inundated vegetation and soils decompose.

Cawthron predicts that for the Lee reservoir, the level at which the reservoir water outlet is placed will have a large influence on where the stratification layer will form in the reservoir. The design of the water off-take structure is therefore proposed to have two outlet levels: a primary outlet situated approximately 10 m below the reservoir surface to be used under most conditions, with a second outlet near the base of the reservoir to achieve a fully mixed water column during dry periods. Furthermore, removal of vegetation and topsoil from the development footprint prior to reservoir filling may further reduce effects of anoxia.

3.2.2 Instream habitat

Habitat flow modelling was undertaken using trout as the focal species. Trout are high-flow demanding, and therefore providing for the flow needs of trout is assumed to provide for the flow needs of other species as other species will be able to utilise slower or shallower habitat along the river margins, or in riffles or pools.

The following are the main findings:

- The natural Mean Annual 7-day Low Flow (MALF) should be the environmental benchmark minimum flow for the Lee River immediately below the dam to maintain food supply (macroinvertebrates) and feeding habitat for brown trout.
- A minimum flow of 1100 l/sec is to be retained in the Waimea River at Appleby Bridge (after all abstractions have been accounted for).
- Flow variability is important to maintain channel and riparian structure, control periphyton, and sustain invertebrate productivity and fish feeding opportunities.
- Prolonged low flows due to abstraction can lead to the proliferation of periphyton to nuisance levels. This may be mitigated by flushing flows.
- Flows in the Lee River below the dam are projected to be above the minimum flow much of the time, and will approach the minimum during periods when the reservoir is refilling (i.e. not spilling). However, it is important that flows are not maintained close to the minimum in the long-term, as it is considered that flat-lining of flows will have a negative effect on invertebrate and fish populations.

3.2.3 Flushing flows

Modelling was undertaken to predict the flows required to flush fine sediment and periphyton from the riverbed downstream of the dam. Under the proposed operating regime, flows with strong flushing potential will continue to occur. However, at times when the reservoir has been drawn down the flow below the dam may be at a relatively stable low level for some time, which may allow periphyton to develop to nuisance levels. It is recommended that having the ability to release flushing flows in the order of 5 m^3/s from the base of the dam would provide potential mitigation for this issue.

3.2.4 Fish populations

Fish species records indicate that 7 species of fish and a freshwater crayfish are likely to be present near the vicinity of the proposed storage reservoir. Of these, six species (long-fin and short-fin eel, koaro, torrentfish, redfin and bluegill bullies) have life cycle requirements that require access to and from the sea. While the current threat classification system lists only longfin eel as being nationally threatened, a revision of the threat status of fish currently being undertaken by DOC indicates that most of the fish species that may be affected by the proposed reservoir and dam will be attributed a threat ranking (M. Rutledge, DOC, pers. comm.). Therefore, mitigation measures are considered appropriate for all fish species in order to address species-level effects that may be regarded as significant in the future under the Conservation and Resource Management Acts.

Given the height of the proposed dam (approximately 52m to dam crest) and the relatively low status of the trout fishery on the Lee River, it is considered that mitigation of fish passage issues associated with the dam is only necessary and practical for the strongest of migrants such as elvers (young eels) and young koaro. The dam design

incorporates provision for a nature-like fish passage channel. It is more difficult to deal with the downstream migration of adult eels, and trapping and transfer of them over the dam wall may be required during peak migration periods.

If the scheme incorporates provision to generate electricity, there is potential for fish to enter the intakes to the turbines. Avoidance of this is proposed by incorporation of fish screens on the intakes, with a mesh size of 20mm.

Inundation of a reach of the Lee River by the reservoir will result in a loss of river flowing habitat for a range of fish species. Compensation for much of this habitat loss is proposed from the planned increase in baseline flows below the dam. This is discussed in more depth in Section 4.4.2.

3.2.5 Reservoir management

3.2.5.1 Lake fishery

A self sustaining trout fishery in the reservoir will be reliant on adequate spawning and rearing habitat in the reservoir tributaries, and the size of the fishery supported will depend on the productivity of the reservoir. Macrophyte (aquatic plant) beds in the littoral zone around the lake margins are also important, as these can provide both cover and food for juvenile brown trout. Given the relatively low frequency of very low drawdown of the reservoir, it is likely that macrophyte beds will be able to develop. Overall, it is estimated that about 32% of the lake surface area will be able to support aquatic plants. The reservoir is therefore likely to be able to support a relatively productive fishery, provided that sufficient spawning habitat exists in the upper catchment.

The availability of potential spawning areas for trout will be assessed by the Fish and Game Council. Depending on the predicted availability of natural spawning habitats within the reservoir, additional habitats may be created or alternatives considered to improve the likelihood that the reservoir can support a population of trout.

3.2.5.2 Nuisance macrophyte and periphyton growth

Excessive macrophyte growth can clog water intakes and impair recreational values of reservoirs. An assessment of the proposed reservoir suggests that there is a low risk of macrophytes clogging the outlet, and this can be managed by a mitigation plan if necessary.

Another issue is the potential impact of the invasive alga didymo, which can also cause clogging issues. However didymo does not generally proliferate in lakes, and given the relatively unmodified nature of the upper Lee Catchment and low nutrient concentrations in the upper Lee River, algal proliferation in the reservoir is unlikely.

3.3 Cultural values

The cultural assessment undertaken by Tiakina te Taiao (A Management Plan for Lee Valley) is based on results of their taonga survey, and the potential for the project to enable the protection, enhancement or harvest of these taonga as a method of avoiding or mitigating adverse cultural effects. Iwi members described the area as being dead or sterile, and there are few native birds present and no lizards were observed during a survey.

The cultural assessment report identifies the following adverse cultural effects that could potentially be generated by the project:

- Further degradation of the mauri (life supporting capacity) and wairua (spiritual essence) of the Waimea River system through the artificial blocking of flow. Intensification and agriculture industrialisation within the catchment could contribute to this degradation.
- Disruption to the passage of fish, eels and waterfowl past the dam.
- Removal of indigenous forest and associated effects on ecological function and potential cultural use.
- Loss of public access rights to the area.

In order to mitigate the above potential adverse effects, the following measures are suggested by Tiakina te Taiao:

- Enable the harvest of taonga, including ngahere (trees), seedlings and pakohe (argillite):
- Ngahere (native trees): approximately 15 ha of merchantable native timber will be inundated by the project and could be available for harvest for cultural or community purposes.
- Pakohe (argillite boulders): ancient pakohe workings are located in the general area and pakohe are common in the reservoir area. Although most of the pakohe is heavily fractured and therefore of low value, high value boulders that could be harvested are concentrated below the confluence of the Lee River and Anslow Creek (ie below the project footprint).
- Native plant seedlings: native regeneration is currently limited; however, there is the potential for relocation and propagation of target species for use in restoration.
- Restoration or enhancement of at least the same area of indigenous forest as would be lost. This would be best concentrated immediately around the reservoir and below the dam site, and should focus on replacing current ecological functions such as bird pathways. The programme should include rare or endangered plant communities (such as black and white maire) and establish plants with the potential for community use (such as wetland and podocarp communities). Wetland development could also be included if appropriate.
- Ongoing pest control with a focus on a keystone species.
- Enable long-term harvest of some taonga species, to maintain a cultural connection and restore the role of tangata whenua as kaitiaki and the practice of kaitiakitanga.
- Investigate the potential for funding mechanisms to support ongoing maintenance, such as through a levy on water use.
- Use best practice design to facilitate the passage of fish and possibly water fowl past the dam.
- Maintain public access rights to Mt Richmond Forest Park, and provide for a public access strip around the edge of the reservoir and dam.
- Establish scientific and cultural monitoring sites and programmes.

3.4 Recreational values

Rob Greenaway & Associates' Recreational Assessment of Effects report identifies the main recreational use of the study area as swimming and associated terrestrial recreation

(such as picnicking) in the lower Lee River and the Wairoa and Waimea Rivers. Other smaller scale recreational activities include trout fishing (in the Wairoa and Waimea Rivers), whitebaiting (in the lower Waimea River), and whitewater kayaking (in the Wairoa River). Tramping and hunting also occur in the upper Lee Valley; however as there are no maintained tracks and access is difficult, the level of these activities is low.

Following construction of the dam, during infrequent dry years the lower Lee River will experience higher flow velocities when very low flows are augmented. However, the projected change in base flows resulting from the proposal will be within normal ranges for wet and normal years, resulting in minor or negligible effects on recreation values.

Without mitigation the proposal is likely to have a net positive effect on recreation by increasing trout numbers in the lower Waimea River. Short term adverse effects on water clarity and periphyton levels are possible in the three to four years after construction, and an appropriate flushing regime has been incorporated into the dam design.

The development has the potential to create new recreation opportunities as enhancements, albeit at a small scale, by providing access to the reservoir. These opportunities could include canoe and kayak use, boating and recreation fishing. A public access strip around the edge of the reservoir and dam would facilitate this.

The net effect of the project on recreation is likely to be slight, but potentially positive.

4 Mitigation opportunities

4.1 Mitigation and offset approaches

The proposed mitigation and offset opportunities incorporate the following best practice principles:

- Design, management and methodologies should be investigated that avoid, minimise and mitigate potential adverse effects on-site before considering the need for offset compensation outside of the immediate project footprint. For this project, design considerations for the dam and operating regime of the reservoir provide the means to minimise or mitigate many of the potential adverse effects on aquatic systems. Other mitigation proposed includes salvage of plants, merchantable timber and argillite as cultural materials for iwi,
- Where offset compensation is required, offsets should be undertaken locally where possible. Offsetting at remote sites should only be considered if no feasible opportunities exist within the general project area,
- Mitigation and offsets should use methods that have been tried and tested elsewhere with a high probability of success (i.e. low risk of failure). For this project, techniques include baseline flows, fish pass construction, pest plant and animal control, plant relocation and propagation, and forest establishment through tree planting. All of these techniques have been used elsewhere in New Zealand, often over many years, with established track records of success,
- The new values created by offsets should be similar to the values removed i.e. offsetting should replace like with like values, and
- Offsetting, where required, should be based on a transparent and robust framework that provides quantification of adverse effects and values achieved through compensation.

The timeline for this project is likely to follow that typical of most projects in New Zealand, where offset mitigation is implemented following the construction process. This means that opportunities to provide offset compensation ahead of the removal of ecological values are limited. As a result, the time gap that will likely result between the loss of existing values and the maturation of offsets (e.g. planted trees) and their ability to provide replacement values to those removed needs to be recognised in the offset calculation methodology. The following method for calculating the scope and indicative magnitude of offsets required for the Lee scheme incorporates both the removal of existing values and offsets required to bridge the resource gap until the principal offsets mature. Together, the use of principal and bridging offsets, especially for the removal of vegetation, assists with achieving a no-net adverse ecological effect for the project.

For each of the offset mitigation areas and types of opportunity identified in the following sections, there are potentially many different outcomes that will each satisfy the need for a required level of compensation. The opportunities presented in this report represent the results of discussions with WWAC and stakeholders (as previously discussed) which have narrowed the range of options to those which best satisfy the needs for local and like-for-like compensation and which take into consideration additional issues such as land tenure, access, economic cost-benefit and social and cultural considerations. WWAC have indicated that the creation of a compensation fund may be warranted, where offset compensation cannot feasibly be achieved within the project area, based on the proposed scale of offsets required. The fund would be used to achieve offset compensation in

keeping with the intention of the offset principles in areas of identified conservation priority outside of the project area.

4.2 Framework and timelines

The proposed framework for structuring the development of mitigation and offset compensation initiatives (**Figure 2**) follows the way in which statutory considerations of environmental effects are considered under the RMA.

The primary tier for the framework considers disciplines separately – aquatic ecology, terrestrial ecology, recreation values and cultural values.

The secondary tier of the framework considers on-site mitigation initiatives separately from site and off-site offset compensation initiatives. This follows the hierarchy of effect assessment within the RMA which prioritises initiatives to avoid, minimise and mitigate potential adverse effects ahead of initiatives to provide offset compensation for residual, unavoidable adverse effects. The validity of applying offset compensation initiatives has become more common in recent years and has been considered in several decisions in the Environment Court (e.g. JF Investments Ltd vs (C48/2006)) which defined environmental compensation as a means of addressing unavoided or unmitigated effects.

The tertiary tier of the framework follows best-practice in restoration management with the prioritisation of offsets local to the development site where possible, and the identification of specific sites, management needs and management plans as part of developing an overall offset compensation package.

Lastly, where habitat and species specific offsets are not able to be identified prior to the project proceeding, a conservative estimate of the cost involved or site specifications required to implement the offsets is provided with a robust funding mechanism to ensure that offsets are implemented at a later date (e.g. through the formation of a Compensation Fund managed by the consenting agency).

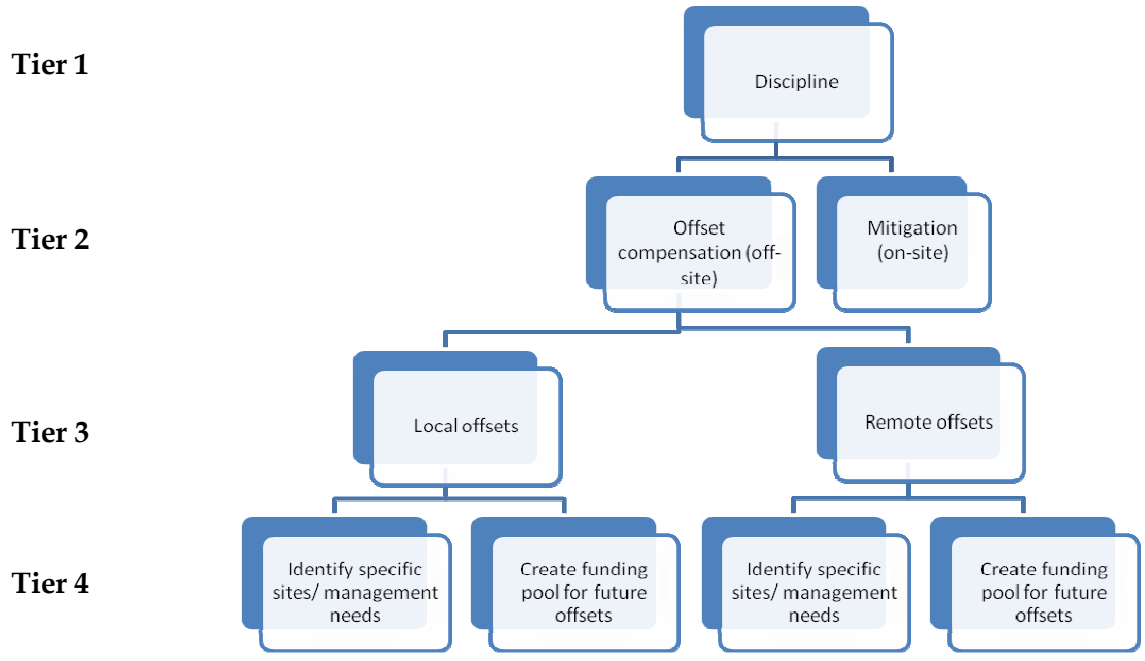

Figure 2. Framework for assessing mitigation and offset compensation needs.

Approximate timelines for the implementation of the enhancement opportunities are provided in **Table 1**, relative to the start of the project works. The timelines highlight the need for detailed planning of mitigation and offset initiatives prior to the start of planned works. Indeed, it is often a requirement of resource consent that developers prepared management plans for approval by regulators for each of the proposed mitigation and offset initiatives to ensure that sufficient lead time and post-construction management is undertaken to ensure success.

Table 1. Indicative timeline for implementation of major actions required to implement mitigation and offset initiatives at the Lee dam site.

Initiative/ Planning requirement	Timeline considerations
Develop preliminary ecological enhancement plans	At least 1 year prior to vegetation clearance to identify key actions, costs and responsibility for pre-construction tasks.
Develop preliminary planting plans and planting schedules, including species, numbers and grades required	At least 1 ½ years prior to the start of the revegetation programme to enable a plant provider to be engaged and to provide planting stock of the diversity, quantity and quality required for the project.
Develop structure and operating processes for Compensation Fund that will implement offsets not able to be achieved at the site	At least 6 months prior to the start of works to ensure that a functional Fund is operating by the time the project capital works are complete.
Consult with iwi regarding timber (ngahere) and argillite (pakohe) extraction	At least 6 months prior to the start of works to enable identification of the scale of the resource and the means by which it will be removed (may require engagement of sub-contractor).
Collect seed, cuttings and seedlings of significant plant species for nursery cultivation	At least 1 year prior to vegetation clearance to allow for fruiting cycles of trees and determination of successful establishment of nursery stock.
Develop detailed planting plans and restoration management plans	At least 3 months prior to the start of works, a basis for tender documents for contract planting services and for achieving approvals of regulators (where required).
Install animal pest control measures	At least 3 months prior to the start of vegetation clearance in order to provide replacement resources for those removed during vegetation clearance.
Undertake species relocation works for fish and wildlife (where needed)	1-2 months prior to the start of planned works. Planning for these aspects will be covered under the development of detailed planting plans and restoration management plans.

4.3 Aquatic mitigation and offsets

The majority of aquatic ecology effects of the proposed development have been able to be addressed and incorporated as mitigation measures within the design of the proposed dam and reservoir management regime.

4.3.1 Mitigation measures within the project footprint

Mitigation measures that are included as part of the dam and reservoir design, and which provide mitigation within the footprint or compensation due to flow-on benefits elsewhere are as set out in Table 2.

Table 2. Proposed aquatic mitigation measures within the footprint of the development.

Adverse effect	Description	Proposed mitigation
Loss of flowing river habitat for instream fauna including fish and invertebrates	Effects on threatened fish and river ecology.	Augmentation of flow downstream. Analysis of change in habitat quality by Cawthron (see **Section 4.3.2**) indicates that all species apart from redfin bully will see a net benefit in habitat.
Loss of logs and macro-particles to stream system	Dam will impede natural flow of sediments and large materials downstream.	Manually transfer logs, stones, sediment during large flow events. Quantities and frequency to be determined. Onsite storage may be required in preparation for future use.
Poor water quality in reservoir	Caused by thermal separation, breakdown of organic materials within footprint and macrophytes.	Thermal separation – two variable height outlets are included in the scheme design. Soils and vegetation – strip in readily accessible areas – e.g. alluvial flats. Extent of stripping to be determined at a later date based on topography and depth of soils. Macrophytes – manual removal/ preparation of a Reservoir Management Plan. Opportunities for establishing native macrophytes and wetland vegetation should be investigated as part of more detailed revegetation plan proposals during resource consent applications.
Poor water quality downstream	Caused by temperature and oxygen saturation effects of released reservoir water. Low flow effects on downstream habitats.	Two variable height outlets to source water at different levels included in scheme design. Plunge pool included in dam design will provide opportunity for re-oxygenation. Minimum flow to be retained downstream. Provision made for flushing flows. Proposed mitigation measures will be included within a Reservoir Management Plan prepared as part of resource consent applications.

Barrier to fish migration	Loss of access by fish migrating upstream and downstream. If hydro power is included, prevention of damage to fish species by exclusion from turbines.	Construction of a fish pass to allow access by eels and koaro is included in dam design. Fish passage should include continuous flow and rat control around uncovered pass. Investigation of need to provide downstream access for migrating eels (particularly longfin eels).Most feasible method may be a 'trap and transfer' programme to ensure safe passage of migrating longfin eels to downstream areas. Hydro power – include screens to prevent longfin elver mortality. This is included in the dam design.
Loss of upstream fish populations	Habitat loss for migratory species unable to use to the fish pass – bluegill bully and redfin bully.	Improvement of downstream habitat through minimum downstream flows. Analysis of change in habitat quality by Cawthron (see **Section 4.3.2**) indicates that bluegill bully will benefit, however redfin bully will not.
Loss of trout spawning habitat	The reservoir will flood most known trout spawning habitat	Fish and Game Council will survey to assess likely spawning areas in Upper Lee River. If no other natural spawning habitats exist, consider construction of spawning areas, or stocking.
Construction water quality	Potential effects from earthworks and stream diversions during the period of constructing the dam and associated structures	Construction effects should be temporary. Potential effects and ways of mitigating and managing these will be covered in a Construction Management Plan prepared as part of resource consent applications. Consider fish salvage within affected areas and/or 'trap and transfer' operation during construction phase.
Hydro power effects-fluctuating water levels (if hydro is considered as part of this development)	Effects of peaking and ramping flows on downstream habitats and wildlife	If hydropower is included within the dam design, and if the station is able to be operated as a peaking station, an assessment of the potential additional adverse effects on downstream river and water quality values will need to be undertaken and measures included within the Reservoir Management Plan

4.3.2 Weighing up the costs and benefits of the scheme on instream habitat

This sub-section summarises the analysis undertaken by Cawthron regarding the costs and benefits of the proposed dam and reservoir footprint on the availability of habitat and anticipated effects on fish species.

The creation of the reservoir, restriction of fish passage and changes in the flow regime downstream of the proposed dam potentially have positive and negative effects on instream habitat availability and aquatic life. The increased minimum flows downstream

of the reservoir are predicted to result in a 25% increase in the number of adult trout in the lower Waimea River.

To assess the net effect associated with the proposed water storage scheme Cawthron predicted habitat availability (WUA) for the range of species present in different reaches of the catchment and multiplied this by the length of river affected. For this analysis the river was divided into five sections:

- Wairoa/Waimea River from Irvines recorder (exit of the Wairoa Gorge) to the sea,
- the Lee River from the Roding River confluence to Irvines Recorder,
- the Lee River from the dam to the Roding confluence,
- the reach of the Lee River within the dam and reservoir footprint, and
- the Lee River upstream of the reservoir footprint.

Habitat availability for the Wairoa/Waimea River from Irvines Recorder to the sea, the Lee River from the Dam to the Roding confluence, and the reach of the Lee River within the dam footprint and upstream was estimated from the IFIM surveys that have been conducted in or near these reaches. No information on habitat change with flow is available for the reach of the Lee River between the Roding confluence and Irvines Recorder so it was assumed that there would be no change in habitat availability in this reach as a result of the scheme. This is likely to be a conservative approach for most species, since flow will generally be increased in this reach with a consequent increase in habitat availability. For the reach of the Lee Catchment above the reservoir footprint Cawthron only accounted for habitat availability in streams of 3rd order or greater.

Cawthron used the change in median flow resulting from the scheme to infer changes in macroinvertebrate habitat availability, and changes in 7-day MALF resulting from the scheme to infer changes in habitat for fish. The rationale for this difference is that macroinvertebrates have relatively short life cycles and therefore their abundance is likely to be controlled by the amount of habitat available most of the time (as indicated by median flow). However, for fish Cawthron have assumed that the minimum flow experienced every couple of years (MALF) is the bottleneck through which fish populations must pass. In other words, fish are unable to capitalise on short-term increases in habitat availability in the same way that invertebrates can.

Based on this rationale Cawthron added up the positive and negative effects of the scheme throughout the catchment. This included taking account of habitat losses upstream of the dam for species that are unlikely to pass the dam, but assuming that habitat created in the reservoir compensates for loss of riverine habitat within the reservoir footprint for those species that are likely to be present above the dam. Approximately 80,000 m^2 of riverine habitat will be inundated by the reservoir (5.4 km of river channel x 14.7 m average width), compared with approximately 650,000 m^2 of lake habitat created within the reservoir.

For migratory (diadromous) fish species Cawthron also weighted the habitat value in each reach by the predicted fish density for each river section based on their elevation, given the typical reduction in abundance of these species with distance from the coast.

The results of this analysis are shown in **Table 3**. Overall Cawthron predict a positive net effect for adult trout, small trout, eels, torrentfish, koaro, upland bully, and food producing habitat, but a net negative effect for yearling trout and redfin bullies. Bluegill bullies are expected to be affected negatively based on the raw numbers and affected

positively based on the fish density weighted numbers; i.e. improvements in habitat availability near the coast are more influential than loss of habitat further inland.

In summary, most species are predicted to benefit from the storage scheme. The main exception is redfin bullies, which tend to like slow shallow water and thus will not benefit from enhanced minimum flows in the lower reaches of the river. Redfin bullies will also be unlikely to negotiate the fish pass and occupy habitat above the dam.

Table 3: Predicted changes in net instream habitat availability (WUA) for a range of species and life stages throughout the Waimea Catchment that are associated with the proposed water storage scheme.

Species/Life Stage	Net WUA change	Net WUA change weighted by fish density
Brown trout adult (Hayes & Jowett 1994)	12.1	60.4
Brown trout yearling (Roussel et al 1999)	2.1	10.5
Brown trout 15-25cm (Raleigh et al. 1986)	8.3	41.6
Longfin eels <300 mm (Jellyman et al.)	7.4	231.5
Longfin eels >300 mm (Jellyman et al.)	5.9	185.5
Shortfin eel < 300mm (Jowett & Richardson 2008)	5.9	195.5
Torrentfish (Jowett & Richardson 2008)	8.0	603.9
Koaro (Jowett & Richardson 2008)	1.3	20.7
Bluegill bully (Jowett & Richardson 2008)	-4.7	353.0
Redfin bully (Jowett & Richardson 2008)	**-85.3**	**-316.3**
Upland bully (Jowett & Richardson 2008)	1.2	6.1
Food producing (Waters 1976)	0.5	N/A

4.3.3 Mitigation measures outside footprint

Much of the downstream mitigation for fish and habitat is provided by the engineering and operational management measures included within the dam and reservoir design (see previous sections).

Redfin bullies are not expected to benefit either from the construction of the dam and reservoir or from its operating regime (**Table 3**). Given that this species is likely to be classified as a threatened species in the near future under DOC's review of the status of freshwater fish in New Zealand, targeted offset compensation may be required to demonstrate a net benefit in habitat and/or population health for this species.

Research by NIWA on the restoration of small streams by fencing and planting may provide guidance for designing offset mitigation for redfin bullies for this project. NIWA's project showed an increase of up to 50% in the number of redfin bullies over 8 years following the fencing (to exclude stock) and planting (with native plants) of two grazed, pasture-lined streams.

Offset mitigation for redfin bullies could comprise funding to assist communities and Council to improve the health of small streams likely to be used by redfin bullies.

Restoration activities may include stock exclusion fencing, planting, weed control and removal of impediments to fish migration.

The length of stream proposed for restoration, or costed for inclusion in a Fund to achieve this purpose, should be equivalent to the quality of habitat removed under the dam and reservoir. The length of river removed as part of this project is 5.4 km. Following the approach for estimating the offset quantum for threatened plants (see Appendix B), the offset will be dependent on the threat classification ranking attributed to the species and the area of habitat removed. As the ranking for this species is not currently known, the offset proposed for redfin bully should be agreed with DOC at a future date.

***Recommendation:** That the mitigation initiatives outlined in Table 2 are adopted and that further consideration is given to restoration of potential habitats for redfin bully away from the Lee catchment site.*

4.4 Terrestrial mitigation and offsets

4.4.1 Approach

The majority of terrestrial ecology effects of the proposed development are addressed as offset compensation measures as the construction and operation of the dam and reservoir offer few benefits for terrestrial ecology within the development footprint.

Under the Conservation Act, adverse effects on wildlife on the public conservation land must be compensated for by improvements on public conservation land in the nearby area. The opportunities for planting on public conservation land to replace forest removed and pest control to improve forest health are limited for reasons of availability and access respectively. Rather than seek opportunities elsewhere, DOC has indicated that offset compensation within the Lee River catchment is its currently preferred option. The most pragmatic, and beneficial solution for conservation management is to identify areas of land currently in private or non-DOC management that could be added to the Forest Park as public conservation land.

Offset approaches for the removal of indigenous vegetation communities are:

- Compensation should focus on a like-for-like basis so that adverse effects on particular plants can be offset by benefits elsewhere. Where offsets cannot be identified as specific sites, restoration of a quantum of appropriate habitat will be a condition of the compensation fund with appropriate funding or alternative mechanisms for achieving this to be decided by a fund manager.
- Offsets for the loss of ecological values from the public conservation land shall be identified separately to those on private land.
- The magnitude of offsets should relate to the area of vegetation removed, the ecological significance of that area, and the assumed gain in ecological values that can be achieved at a potential offset management site. An evaluation tool has been applied to assess site significance and the benefits of undertaking management initiatives. The tool gave guidance as to whether the level of offset compensation required could feasibly be met within the vicinity of the scheme location, or whether additional or alternative offsets were required outside the Lee Catchment. Details of the application of this method can be found in **Appendix A**.

4.4.2 Offsets for loss of wildlife habitat

The removal of indigenous vegetation will result in the loss of habitat and resources for wildlife in the local area. This loss will be most acute during the period between when vegetation is cleared and the time at which planted forest matures – which may be up to 15 years for some species of slow-growing canopy tree. Control of plant browsers such as goats, pigs and feral deer and the control of bird predators such as possums are known to have marked benefits for the health of ecosystems.

The key goal of the weed and animal pest control programme is to assist with the establishment of replacement habitat – both in the medium-term by improving the health of existing forest, and in the long-term by ensuring that planted trees have the best chance of survival and growth to reach maturity. As such, the first 3 years of the offset programme will be important for reducing pest plants and animals to low levels. Thereafter, maintenance control, with targeted control around, for example threatened plant sites, should be sufficient to maintain restoration gains made in the early years of the programme.

Mitigation measures:

1. Undertake vegetation clearance outside of the peak bird breeding and nesting season (Oct – Feb).
2. Obtain cuttings, seed and, where appropriate, wild seedlings for propagation and raising in a nursery for future planting into offset compensation planting sites around the proposed dam and reservoir.

Offset compensation measures

Priorities for the control of weed and animal pests are (**Figure 4**):

1. Removal as far as possible of ecological weeds and pest animals (including possums, feral deer, goats and pigs) over a land area of 110 ha surrounding the proposed reservoir, dam site and downstream to Lucy Creek. Control of weeds may only need to be targeted within this area. Control of pest animals may be required over a broader geographic area, due to the wide-ranging behaviour of these species, to maintain ecological benefits within the proposed 110 ha.

***Recommendation:** That Priority 1 be adopted as the complete package to compensate for the removal of wildlife habitat.*

4.4.3 Offsets for loss of vegetation communities

Alluvial Forest (LENZ environment B1.1a)

This vegetation community covers approximately 3.1 ha of the footprint (**Figure 3**) and comprises mostly Site 3 (as represented in the botanical report) and part of Site 4 (**Figure 3**).

Priorities for offsets (**Figure 4**) to compensate for the removal of this vegetation type are as follows (assuming agreement can be reached with the respective landowners):

- Priority 1: Enhance the quality of the existing alluvial forest at Site 1 below the dam.

- Priority 2: Restore the alluvial flat upstream of Site 1 currently planted in Douglas fir to alluvial forest.
- Priority 3: Enhance the quality of the alluvial flat upstream from Lucy's Creek.
- Priority 4: Plant new alluvial forest at suitable sites downstream from the dam, such as on the Wairoa River and Waimea lowlands.
- Priority 5: Assist with the restoration of alluvial forest on private and public land.

Recommendation: That Priorities 1 – 5 be adopted as the complete package to compensate for the removal of alluvial forest.

River-bed Island Forest (LENZ environment F5.1b)

This vegetation community covers approximately 0.3 ha of the footprint (**Figure 3**) and comprises part of Site 4 of the botanical report (**Figure 3**).

There are no potential sites within the vicinity of the development for offset mitigation. The best opportunity for offset mitigation is off-site as part of river restoration projects elsewhere in the region.

Priorities for offsets to compensate for the removal of this vegetation type are:

- Priority 1: Plant new river-bed island forest at suitable sites elsewhere on the Lee or in suitable areas elsewhere in the region.

Recommendation: That Priority 1 be adopted as the complete package to compensate for the removal of river-bed island forest.

Riparian Forest (LENZ environment E 1.1b)

This vegetation community covers approximately 15.1 ha of the footprint (**Figure 3**) and comprises part of Site 2, 3 and part of Site 4 of the botanical report (**Figure 3**).

Priorities for offsets (**Figure 4**) to compensate for the removal of this vegetation type are (assuming agreement can be reached with the respective landowners):

- Priority 1: Enhance the quality of the riparian margin from the proposed dam downstream to Lucy Creek, including the regenerating indigenous forest at the confluence of the Lee River and Lucy Creek and including a buffer zone around the patch of pine plantation reverted to indigenous forest.
- Priority 2: For the area of riparian margin described in Priority 1 above, to encourage a change in land tenure to public conservation land and add this area to Mt Richmond Forest Park.
- Priority 3: Plant and restore the buffer area of land around the proposed reservoir to indigenous riparian forest.

Recommendation: That Priorities 1 - 3 be adopted as the complete package to compensate for the removal of riparian forest.

Hill Slope Forest (LENZ environment E 1.1b)

This vegetation community covers approximately 8.9 ha (9.7 ha minus 20% of the 4.2 ha within the DOC estate which is regarded as being gorge turf community) of the footprint (**Figure 3**) and comprises areas along the length of the proposed project scheme (**Figure 3**).

Priorities for offsets (**Figure 4**) to compensate for the removal of this vegetation type are (assuming agreement can be reached with the respective landowners):

- Priority 1: For the removal of 3.4 ha of public conservation land within the Forest Park, offset compensation is proposed as the purchase and addition to the Forest Park of approximately 10 ha of remnant matai forest and plantation forest comprising part of Site 4 and the area of private land between Site 4 and the proposed reservoir. Plant hill-slope beech forest within the areas of plantation forestry following their removal. Undertake weed and pest animal control through the area for 15 years to assist with the establishment of planted indigenous forest.
- Priority 2: For the removal of 6.5 ha on private land, part of the offset compensation is proposed as the planting of hill-slope indigenous forest over the approximately 5 ha of cleared pine forest used for construction and borrow areas associated with the construction of the dam.

***Recommendation:* That Priorities 1 and 2 be adopted as the complete package to compensate for the removal of hill-slope forest.**

Gorge Flood-Zone Turf communities

This vegetation community covers approximately 0.84 ha of the flood zone within the gorge on public conservation land and the scattered areas of bedrock below the gorge within the project footprint. It is also includes areas of known flood-zone turf below the proposed dam site which are recommended for monitoring following dam construction to assess the potential adverse effects of the change in river flow rate on this plant community.

This plant community appears to be suited to these high energy flood environments of the Lee River gorge where bedrock is exposed during scouring flood events. The encrusting turf community appears not to be able to maintain itself where low flood energy fails to remove larger colonising shrubs and trees, which grow to shade out the turf community.

The proposed reservoir may offer opportunities for the establishment of turf communities; however these have not been included in the offset calculations due to the uncertainty about being able to successfully establish these through active intervention. Observations of established reservoirs elsewhere in the region show that wind-generated waves in water storage reservoirs can generate sufficient wave energy to maintain edge fringes free of shrubs and trees. If the same conditions exist for the future Lee reservoir, there may be opportunities for self-supporting turf communities to establish on the reservoir fringes.

Priorities for offsets (**Figure 4**) to compensate for the removal of this vegetation type are:

- Priority 1: Monitor the potential adverse effects of the dam on the persistence of flood-zone turf communities downstream from the dam.

- Priority 2: For the removal of 0.84 ha on public conservation land, restore riparian margin forest downstream of Lucy Creek and (assuming agreement can be reached with the respective landowners) change the ownership of this land to public conservation land and add it to the Mt Richmond Forest Park.

***Recommendation:* That Priority 1 and 2 be adopted as the complete package to compensate for the removal of gorge turf communities.**

4.4.4 Offsets for loss of threatened plant species

Offset approaches for threatened plants have been discussed with DOC and the following approach agreed upon:

- Compensation should be directed on a like-for-like basis so that adverse effects on particular plants can be offset by benefits elsewhere.
- While propagation and planting techniques are low risk for some species, for others where knowledge of restoration success is limited or does not exist, the type and level of compensation should be sufficient to allow learning opportunities towards gaining knowledge to achieve success.
- For most species, sites for restoration cannot be identified at present, and therefore the creation of a dedicated fund to resource future restoration actions is the preferred approach.
- Area of habitat removed and recognition of the threat status of the species are the two key determinants in calculating a reasonable level of offset mitigation. Multipliers that relate compensation to status used for the following offset calculations are based on DOC's Threatened Plant Classification System. The offset evaluation tool for threatened species was applied to the site to roughly determine the need for on-site or off-site compensation requirements. Details of this method can be found in **Appendix B**.

Shovel mint

This species is of greatest conservation significance within the proposed development area, with a significant portion of the known population in the Lee Catchment proposed to be removed by the dam and reservoir. The Lee River population around the proposed development site likely represents the greatest area of shovel mint known to exist (anywhere) and therefore even its partial loss is of great significance.

Opportunities for improvement of habitat exist downstream between the dam and Lucy Creek, where this species is sparse and has been severely impacted by pigs. Opportunities elsewhere in the Lee Catchment are limited by the lack of alluvial habitat and open-canopy mature riparian forest with which it is usually associated. Off-site, the best opportunities exist for conservation of this species within the few known sites on private land, propagation and establishment of trial plots in suitable locations and management of known and newly created habitats that can support the species. Area of habitat removed and recognition of the threat status of the species relative to the condition of the population are the key determinants in calculating a reasonable level of offset mitigation. Multipliers that relate compensation to status used for the following offset calculations are

based on DOC's Threatened Plant Classification System. Details of the application of this method can be found in **Appendix B**.

Priorities for offsets to compensate for the removal of shovel mint populations are:

- Priority 1: Within the 2.5 km riparian margin and alluvial flat areas from the dam to Lucy Creek (assuming agreement can be reached with the respective landowners), improve shovel mint habitat by removing weeds and controlling pigs, goats and deer to low levels.
- Priority 2: Trial planting of new populations in the Priority 1 site using stock rescued from inundation areas.
- Priority 3: Secure genetic stock from the inundation areas, propagate and undertake trial plantings in areas of suitable habitat that are created or managed as recipients of the monies used to create the off-site compensation fund.

Recommendation: That Priorities 1 - 3 be adopted as the complete package to compensate for the removal of shovel mint populations.

Sand coprosma

This species is of moderate conservation significance although populations exist elsewhere in the Nelson region and elsewhere in New Zealand. The area of sand coprosma that is proposed for removal represents all of the known individuals in the Lee Catchment found during studies associated with this project.

Priorities for offsets to compensate for the removal of the sand coprosma population are:

- Priority 1: Secure genetic stock (seeds, cuttings) from all known individuals within the inundation area. This may require several visits to the site if propagules initially collected fail to establish in cultivation.
- Priority 2: Trial plantings of cultivated stock within the restoration area from the dam to Lucy Creek (assuming agreement can be reached with the respective landowners). Monitor the results of the trials.
- Priority 3. Survey adjoining catchments (e.g. Roding and Wairoa) for suitable habitat in which sand coprosma could be planted without obvious commitments to ongoing management of weeds. Monitor the results of the plantings.
- Priority 4. Identify potentially suitable planting sites in adjoining catchments which may require site preparation (e.g. weed removal) and ongoing weed control to establish populations of sand coprosma.

Recommendation: That Priorities 1 - 3 be adopted as a complete package to compensate for the removal of sand coprosma, with implementation of Priority 4 if efforts to establish this community in adjoining catchments do not succeed.

Euchiton polylepis

Little is known of the distribution of this At Risk species, although it is likely that the proposed development will remove populations along part of the Lee River. The lack of

accurate information regarding the distribution of this species within the Mt Richmond Forest Park makes assessments of the significance of population removal (such as for this development) difficult to assess although the level of significance of the Lee population within the footprint of the proposed scheme is assumed to be low based on current information.

It is likely that initiatives outlined elsewhere in this offset mitigation package will benefit *Euchiton polylepis* and it is hoped that weed and pest control of the wider area around the dam and reservoir will also provide benefits. In lieu of targeted restoration actions, funding could be provided to survey adjoining parts of the Forest Park to determine the distribution of the species in this area.

Priorities for offsets to compensate for the potential removal of *Euchiton polylepis* populations are:

- **Priority 1**: Survey for *Euchiton polylepis* in other areas of the Mt Richmond Forest Park.

<u>Recommendation:</u> That Priority 1 is adopted as the complete package to compensate for the removal of Euchiton polylepis populations.

Scented broom

The population of this species in the vicinity of the Lee dam and reservoir is regarded as being of regional significance. While a part of this population will be removed under the proposed development, a large portion will not be removed. Scented broom is recorded as being common along the riparian areas from the dam to Lucy Creek and in large numbers at Site 2, just below the proposed dam. Both areas will not be removed as part of the development; however both suffer severe weed and pig damage. The lack of possum control undoubtedly also impacts on scented broom.

Offset mitigation proposed is mainly through ongoing animal and weed pest control around the reservoir and between the dam and Lucy Creek as part of the programme to improve the overall health of the forest in these areas.

Priorities for offsets to compensate for the potential removal of scented broom populations are:

- **Priority 1**: Collect seed and cuttings from scented broom within the proposed development area and include as part of the plant-raising programme.

<u>Recommendation:</u> That Priority 1 is adopted as the complete package to compensate for the removal of scented broom populations.

4.4.5 Offsets for loss of threatened animal species

There are currently no threatened animal species within the development footprint that will be directly affected.

Falcon:

Indirect effects are anticipated for NZ bush falcon which presumably use the area for hunting and possibly nesting. Surveys for bats are being undertaken in late 2009 and are not expected to detect high levels of use.

Priorities for offsets to compensate for the removal of foraging and potential nesting habitat for NZ bush falcon are:

- **Priority 1**: Plant replacement indigenous forest as future nesting habitat and control possums to low levels over the project area to improve potential food supplies for falcon.

<u>Recommendation:</u> That Priority 1 is adopted as the complete package to compensate for the removal of nesting and foraging resources for NZ bush falcon.

Blue duck:

Blue ducks (whio) have been record occasionally in the Lee catchment and more frequently in adjacent areas, especially the Wairoa. Records over several years have included lone birds as well as a family in one part of the Lee River (specific location not known). Surveys during 2005 (DOC) and 2008 (this project) recorded no sign of blue duck within the project area. Together these records indicate that although suitable habitat is present within the proposed development area, there is currently not a breeding population within the site. Under the 'business as usual' test for impact assessments, it is not possible to consider the potential of the habitat to support blue duck, only the likely effects on individuals or a population that currently exists on site. Under the current management regime for the site it is not likely that blue duck will establish. Furthermore, it is unlikely that the Lee River area within the proposed development contributes to an important part of the wider blue duck population in the region, or nationally.

Therefore, while suitable habitat exists for blue duck at the site, the probable level of impact on blue duck of this development will be minor (for lone individuals passing through the area) or none if blue duck are currently not able to use this habitat due to human, animal predator of other pressures.

Efforts to undertake pest control in the Lee Catchment as an outcome of this development may assist with better protecting ducks as they move through the area. However, even if they establish a breeding site in the Lee, substantial effort would be required to foster and maintain a viable population. Given the scale of the effort required to achieve any gains for blue duck in the Lee Catchment, and the uncertainty of whether such habitat improvement would actually benefit blue duck, efforts directed at blue duck conservation from this project are considered disproportionate to the actual or likely effects of the development.

DOC's efforts for the conservation of blue duck recognize the need to maintain large populations over large areas and that intensive pest control is required to achieve this. In this regard, strong-hold populations of blue duck in the Wangapeka/ Fyfe Catchments are given priority by DOC for management of blue duck.

Given the historic presence of blue duck on the site and the uncertainty of whether blue duck are using this stretch of river, it is regarded as appropriate to propose a low level of offset mitigation for blue duck with the aim of improving the status of one or more

breeding populations. The value of the offset mitigation require discussion with DOC, however as guidance we recommend that it comprise a contribution towards an established predator trapping and blue duck population management programme at a

<u>Recommendation:</u> That a contribution be made towards maintaining and improving the status of blue duck populations at a site where blue duck are currently managed.

Bats:

Should bats be found within the proposed development footprint, the following measures could be considered as mitigation and offset compensation.

- Survey large trees within the footprint to establish the presence or absence of bats prior to vegetation clearance; and
- Clear vegetation outside of the bat breeding season, and confirm the likely absence of bats from sites prior to clearance; and
- Undertake possum and rat control over the area encompassing the reservoir and dam surrounds, and the downstream corridor to Lucy Creek in order to improve the habitat quality, food supply and opportunities for successful breeding by bats.

4.5 Recreation values

No significant adverse effects are predicted for the recreation values of the Lee River from the project. Rather, a net (albeit slight) benefit is predicted for users of the Waimea and lower Lee Rivers through the improvement in downstream flow rates.

No offset mitigation is proposed, although enhancements for recreation access to and beyond the reservoir have potential to increase the net benefit of the proposal beyond that required for mitigation.

<u>Recommendation:</u> That no specific mitigation or offset compensation is required to improve recreational values.

4.6 Cultural values

The ecologically-based concerns over cultural effects are addressed by the preceding mitigation initiatives for aquatic systems and offset compensation measures for terrestrial ecology.

The remaining outstanding issues of access and cultural harvest of argillite and merchantable trees are addressed as follows:

- <u>Mitigation initiative 1</u>: To retain the potential for public access to the upper Lee catchment, create a buffer strip of vegetation along the perimeter of the proposed reservoir. There is an intention to provide this as part of the ecological buffer to the proposed reservoir.
- <u>Mitigation initiative 2</u>: Iwi have indicated that they may wish to salvage up to 20-30 tonnes (equivalent to 2 truckloads) of argillite, mostly from the area around the

proposed dam, prior to the start of construction works. Access for iwi to salvage argillite blocks from the footprint of the project should be facilitated.

- Mitigation initiative 3: Iwi have indicated that they wish to harvest up to 2,000 m^3 of merchantable timber from the project footprint prior to the start of vegetation clearance. The salvage of this timber should be facilitated within the footprint below the gorge prior to the start of vegetation clearance works. For the proposed inundation area above the gorge, merchantable timber may be easier and less expensive to salvage once the reservoir is filling by using a barge or floating it to a vehicle access point further down the reservoir.

Recommendation: ***That Mitigation initiatives 1 -3 are adopted as the complete package to compensate for the removal of culturally significant resources within the proposed scheme footprint.***

5 Summary and Recommendations

The proposed Lee River dam is likely to cause a range of unavoidable adverse effects on the local environment. Potential effects include those to aquatic and terrestrial ecology, recreational use and cultural considerations by iwi.

This Enhancement Opportunities Plan has sought to address each identified potential effect and explore means of mitigating and offsetting these to result in a no-net loss of values from the construction and operation of the proposed scheme.

Mitigation and offset compensation opportunities for the identified effect of the proposed development are as follows.

5.1 Aquatic

Recommendation: ***That the mitigation initiatives outlined in Table 4 (see below) are adopted and that further consideration is given to restoration of potential habitats for redfin bully away from the Lee catchment site.***

Table 4.

Adverse effect	Proposed mitigation
Loss of flowing river habitat for instream fauna	Augmentation of flow downstream. All species apart from redfin bully will see a net benefit in habitat.
Loss of logs and macro-particles to stream system	Manually transfer logs, stones, sediment during large flow events.
Poor water quality in reservoir	Thermal separation – two variable height outlets are included in the scheme design. Soils and vegetation – strip in readily accessible areas – e.g. alluvial flats. Macrophytes – manual removal/ preparation of a Reservoir Management Plan.
Poor water quality downstream	Two variable height outlets to source water at different levels included in scheme design. Plunge pool included in dam design will provide opportunity for re-oxygenation. Minimum flow to be retained downstream. Provision made for flushing flows. Proposed mitigation measures will be included within a Reservoir Management Plan prepared as part of resource consent applications.
Barrier to fish migration	Construction of a fish pass to allow access by eels and koaro is included in dam design. A 'trap and transfer' programme to ensure safe passage of migrating adult longfin eels to downstream areas may be required. Hydro power – include screens to prevent longfin elver mortality. This is included in the dam design.

Loss of upstream fish populations	Improvement of downstream habitat through minimum downstream flows.
Loss of trout spawning habitat	Fish and Game Council will survey to assess likely alternative spawning areas.
Construction water quality	Construction effects should be temporary. Potential effects and ways of mitigating and managing these will be covered in a Construction Management Plan
Hydro power effects- fluctuating water levels (if hydro is considered as part of this development)	If hydropower is included within the dam design, and if the station is able to be operated as a peaking station, an assessment of the potential additional adverse effects on downstream river and water quality values will need to be undertaken and measures included within the Reservoir Management Plan
Effects on nesting indigenous birds	Undertaken vegetation clearance outside of the typical bird breeding season (Oct – Jan)
Loss of plant population genetic diversity	Collect seed or cuttings and seedlings if practicable of rare plants or species of interest for the purposes of including these in future planting programmes around the site.
Recreational effects	There are no significant adverse recreational effects identified. The proposed scheme will likely have net positive benefits for downstream river users.
Cultural effect – loss of access	Investigate use of the planned buffer zone around the reservoir as an accessway to maintain informal public access along the Lee River
Cultural effect – loss of timber resources	Enable salvage of up to 2,000 m^3 of merchantable timber from within the proposed footprint prior to the start of works. Timber trees in the gorge area may need to be floated out following filling of the reservoir.
Cultural effect – loss of argillite resources	Enable salvage of up to 100 kg of argillite from within the proposed footprint prior to the start of works.

5.2 Terrestrial

5.2.1 For the loss of wildlife habitat and resources from the clearance of indigenous forest:

<u>Recommendation:</u> That the mitigation initiatives outlined in Table 5 (see below) are adopted.

Table 5.

Effects on nesting indigenous birds	Undertaken vegetation clearance outside of the typical bird breeding season (Oct – Jan)
Loss of plant population genetic diversity	Collect seed or cuttings and seedlings if practicable of rare plants or species of interest for the purposes of including these in future planting programmes around the site.

Recreational effects	There are no significant adverse recreational effects identified. The proposed scheme will likely have net positive benefits for downstream river users.
Cultural effect – loss of access	Investigate use of the planned buffer zone around the reservoir as an accessway to maintain informal public access along the Lee River
Cultural effect – loss of timber resources	Enable salvage of up to 2,000 m^3 of merchantable timber from within the proposed footprint prior to the start of works. Timber trees in the gorge area may need to be floated out following filling of the reservoir.
Cultural effect – loss of argillite resources	Enable salvage of up to 100 kg of argillite from within the proposed footprint prior to the start of works.

***Recommendation:* That Priority 1 be adopted as the complete package to compensate for the removal of wildlife habitat.**

- *Priority 1. Removal as far as possible of ecological weeds and pest animals (including possums, feral deer, goats and pigs) over a land area of 110 ha surrounding the proposed reservoir, dam site and downstream to Lucy Creek. Control of weeds may only need to be targeted within this area. Control of pest animals may be required over a broader geographic area, due to the wide-ranging behaviour of these species, to maintain ecological benefits within the proposed 110 ha.*

5.2.2 For the loss of vegetation communities

5.2.2.1 Alluvial Forest

***Recommendation:* That Priorities 1 - 5 be adopted as the complete package to compensate for the removal of alluvial forest (assuming agreement can be reached with respective landowners).**

- *Priority 1: Enhance the quality of the existing alluvial forest at Site 1 below the dam.*
- *Priority 2: Restore the alluvial flat upstream of Site 1 currently planted in Douglas fir to alluvial forest.*
- *Priority 3: Enhance the quality of the alluvial flat upstream from Lucy's Creek.*
- *Priority 4: Plant new alluvial forest at suitable sites downstream from the dam, such as on the Wairoa River and Waimea lowlands.*
- *Priority 5: Assist with the restoration of alluvial forest on private and public land.*

5.2.2.2 River-bed island Forest

***Recommendation:* That Priority 1 be adopted as the complete package to compensate for the removal of river-bed island forest (assuming agreement can be reached with respective landowners).**

- *Priority 1: Plant new river-bed island forest at suitable sites elsewhere on the Lee or in suitable areas elsewhere in the region.*

5.2.2.3 Riparian Forest

<u>Recommendation:</u> That Priorities 1 – 3 be adopted as the complete package to compensate for the removal of riparian forest (assuming agreement can be reached with respective landowners).

- *<u>Priority 1</u>: Enhance the quality of the riparian margin from the proposed dam to Lucy Creek, including the regenerating indigenous forest at the confluence of the Lee River and Lucy Creek and including a buffer zone around the patch of pine plantation reverted to indigenous forest.*
- *<u>Priority 2</u>: For the area of riparian margin described in Priority 1 above, change the land tenure to public conservation land and add this area to Mt Richmond Forest Park.*
- *<u>Priority 3:</u> Plant and restore the buffer area of land around the proposed reservoir to indigenous riparian forest.*

5.2.2.4 Hill-slope Forest

<u>Recommendation:</u> That Priorities 1 and 2 be adopted as the complete package to compensate for the removal of hill-slope forest (assuming agreement can be reached with respective landowners).

- *<u>Priority 1</u>: For the removal of 3.4 ha of public conservation land within the Forest Park, offset compensation is proposed as the purchase and addition to the Forest Park of approximately 10 ha of remnant matai forest, pine forest and eucalyptus plantation comprising part of Site 4 and the area of private land between Site 4 and the proposed reservoir. Plant hill-slope beech forest within the areas of plantation forestry following their removal. Undertake weed and pest animal control through the area for 15 years to assist with the establishment of planted indigenous forest.*
- *<u>Priority 2</u>: For the removal of 6.5 ha on private land, part of the offset compensation is proposed as the planting of hill-slope indigenous forest over the approximately 5 ha of cleared pine forest used for construction and borrow areas associated with the construction of the dam.*

5.2.2.5 Gorge turf communities

<u>Recommendation:</u> That Priority 1 and 2 be adopted as the complete package to compensate for the removal of gorge turf communities.

- *<u>Priority 1</u>: Monitor the potential adverse effects of the dam on the persistence of flood-zone turf communities downstream from the dam.*
- *<u>Priority 2</u>: For the removal of 0.84 ha on public conservation land, restore riparian margin forest downstream of Lucy Creek and change the ownership of this land to public conservation land and add it to the Mt Richmond Forest Park (assuming agreement can be reached with respective landowners).*

5.2.3 For the loss of threatened plant populations:

5.2.3.1 Shovel mint

***Recommendation:* That Priorities 1 - 3 be adopted as the complete package to compensate for the removal of shovel mint populations.**

- *Priority 1: Within the 2.5 km riparian margin and alluvial flat areas from the dam to Lucy Creek, improve shovel mint habitat by removing weeds and controlling pigs, goats and deer to low levels.*
- *Priority 2: Trial planting of new populations in the Priority 1 site using stock rescued from inundation areas.*
- *Priority 3: Secure genetic stock from the inundation areas, propagate and undertake trial plantings in areas of suitable habitat that are created or managed as recipients of the monies used to create the off-site compensation fund.*

5.2.3.2 Sand coprosma

***Recommendation:* That Priorities 1 - 3 be adopted as a complete package to compensate for the removal of sand coprosma, with implementation of Priority 4 if efforts to establish this community in adjoining catchments do not succeed.**

- *Priority 1: Secure genetic stock (seeds, cuttings) from all known individuals within the inundation area. This may require several visits to the site if propagules initially collected fail to establish in cultivation.*
- *Priority 2: Trial plantings of cultivated stock within the restoration area from the dam to Lucy Creek. Monitor the results of the trials.*
- *Priority 3. Survey adjoining catchments (e.g. Roding and Wairoa) for suitable habitat in which sand coprosma could be planted without obvious commitments to ongoing management of weeds. Monitor the results of the plantings.*
- *Priority 4. Identify potentially suitable planting sites in adjoining catchments which may require site preparation (e.g. weed removal) and ongoing weed control to establish populations of sand coprosma.*

5.2.3.3 Euchiton polylepis

***Recommendation:* That Priority 1 is adopted as the complete package to compensate for the removal of Euchiton polylepis populations.**

- ***Priority 1**: Survey for Euchiton polylepis in other areas of the Mt Richmond Forest Park.*

5.2.3.4 Scented broom

***Recommendation:* That Priority 1 is adopted as the complete package to compensate for the removal of scented broom populations.**

- **Priority 1**: Collect seed and cuttings from scented broom within the proposed development area and include as part of the plant-raising programme.

5.2.4 For the loss of threatened animal populations:

5.2.4.1 Falcon

***Recommendation:** That Priority 1 is adopted as the complete package to compensate for the removal of nesting and foraging resources for NZ bush falcon.*

- **Priority 1**: Plant replacement indigenous forest as future nesting habitat and control possums to low levels over the project area to improve potential food supplies for falcon.

5.2.4.2 Blue duck

***Recommendation:** That a contribution be made towards maintaining and improving the status of blue duck populations at a site where blue duck are currently managed.*

5.3 Recreational

***Recommendation:** That no specific mitigation or offset compensation is required to improve recreational values beyond those which accrue to trout angling as a direct result of the scheme operation.*

5.4 Cultural

***Recommendation:** That Mitigation initiatives 1 -3 are adopted as the complete package to compensate for the removal of culturally significant resources within the proposed scheme footprint.*

- *Mitigation initiative 1: To retain the potential for public access to the upper Lee catchment, create a buffer strip of vegetation along the perimeter of the proposed reservoir. There is an intention to provide this as part of the ecological buffer to the proposed reservoir.*
- *Mitigation initiative 2: Iwi have indicated that they may wish to salvage up to 20-30 tonnes (equivalent to 2 truckloads) of argillite, mostly from the area around the proposed dam, prior to the start of construction works. Access for iwi to salvage argillite blocks from the footprint of the project should be facilitated.*
- *Mitigation initiative 3: Iwi have indicated that they wish to harvest up to 2,000 m^3 of merchantable timber from the project footprint prior to the start of vegetation clearance. The salvage of this timber should be facilitated within the footprint below the gorge prior to the start of vegetation clearance works. For the proposed inundation area above the gorge, merchantable timber may be easier and less expensive to salvage once the reservoir is filling by using a barge or floating it to a vehicle access point further down the reservoir.*

6 Applicability

This report has been prepared for the benefit of the Waimea Water Augmentation Committee (WWAC) with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

TONKIN & TAYLOR LTD

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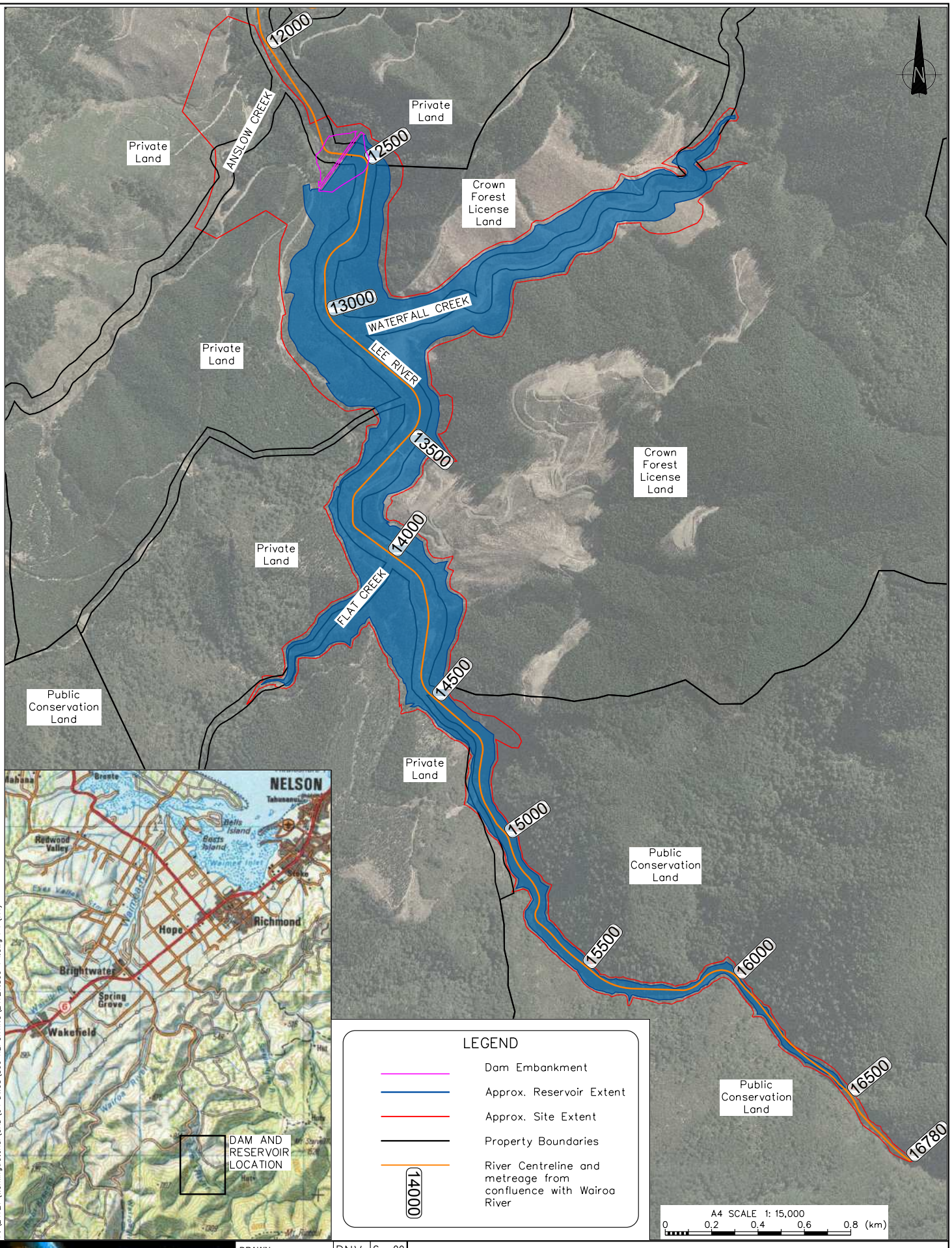

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WAIMEA WATER AUGMENTATION COMMITTEE

WAIMEA WATER AUGMENTATION – PHASE 2

SITE LOCATION PLAN

FIG. No. FIGURE 1

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LUCY CREEK

Remnant indigenous forest comprising rimu and black beech, swamp forest and kahikatea as well as southern rata and white maire

N

Site 1
Riparian forest and small patches of alluvial forest. Severely degraded by weeds, goats, deer and pigs. Supports shovel mint, scented broom and abundant dwarf mistletoe.

Site 2
Riparian forest and hill-slope forest. Riparian forest includes tanekaha, abundant shovel mint and scented broom.

WATERFALL CREEK

ANSLOW CREEK

Site 3
Alluvial forest comprising mature kahikatea forest (true left) and regenerating kanuka and black beech (true right). Shovel mint locally abundant.

One falcon observed on 14 March 2008

Two falcons observed on 15 March 2008

Site 4
Hill-slope forest dominated by regenerating forest with a stand of almost pure mature matai forest.

Site 4
River bed island forest dominated by kanuka and cold montane wetland groundcover species.

Site 5
Hill-slope forest dominated by regenerating and mature beech. Gorge flood-resistant turf communities along marginal edge.

FLAT CREEK

Coprosma acerosa

LEGEND

- Features of ecological interest
- Proposed Dam and Spillways
- Site extents
- Approx. Reservoir Extent

LENZ Threatened Environments within Site Extents

- B1.1a Alluvial Forest (27,200 sq.m)
- E1.1b Riparian Forest (133,100 sq.m)
- F5.1b River-bed Forest (3,300 sq.m)
- P6.2a Hill-slope beech/matai Forest (97,600 sq.m)
- Remainder Exotic plantation forest (610,800 sq.m)

Notes:

A3 SCALE 1:15,000

0 0.2 0.4 0.6 0.8 1 (km)

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WAIMEA WATER AUGMENTATION COMMITTEE
WAIMEA WATER AUGMENTATION PHASE 2

FEATURES OF ECOLOGICAL INTEREST

FIGURE No. 24727.408-F3 Rev. 0

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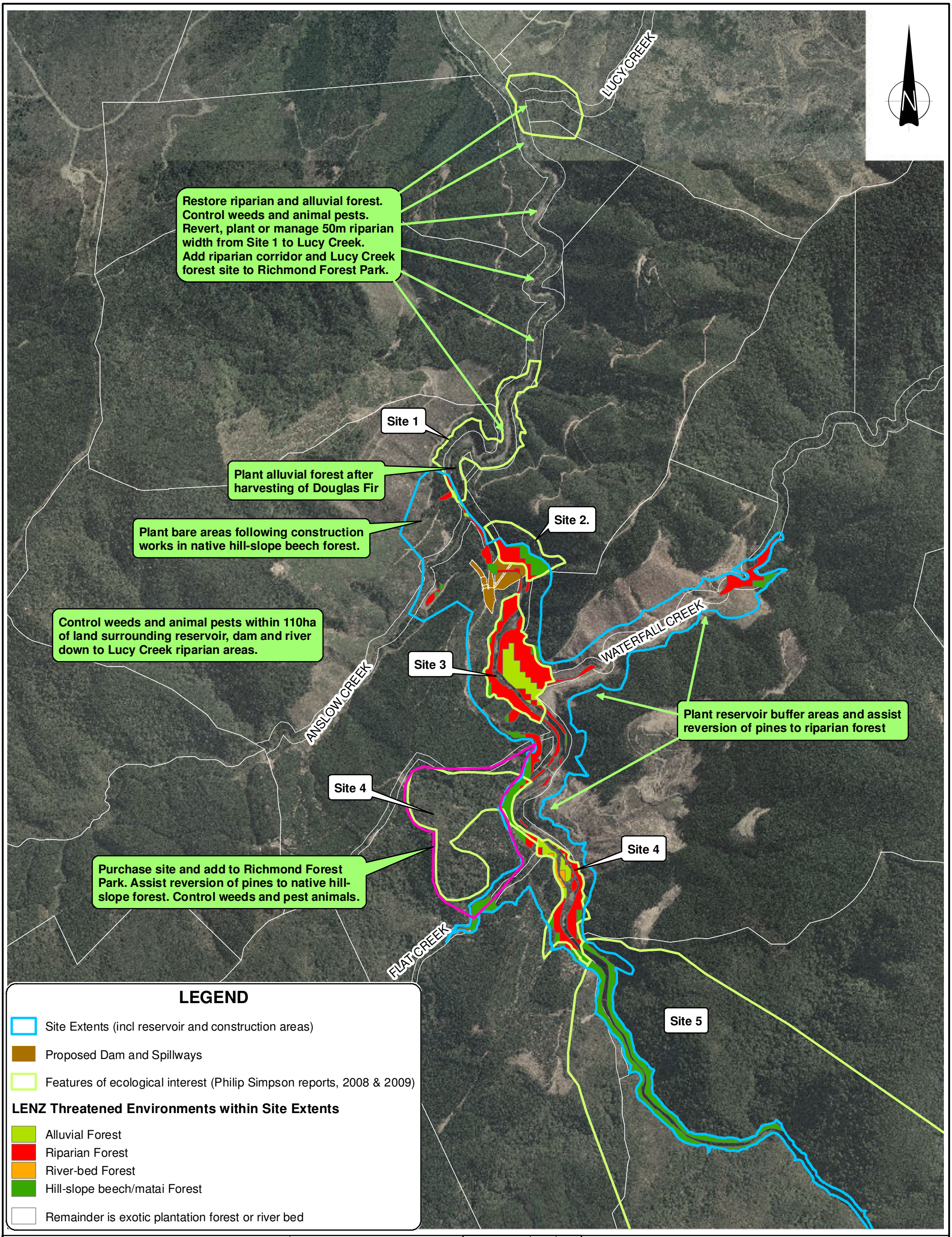

Notes:

A3 SCALE 1:15,000

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WAIMEA WATER AUGMENTATION COMMITTEE
WAIMEA WATER AUGMENTATION PHASE 2

PROPOSED KEY OFFSET COMPENSATION INITIATIVES

FIGURE No. 24727.408-F4 Rev. 0

Appendix A Method for calculating indigenous vegetation offsets

The offset calculation approach for the removal of indigenous vegetation communities used in this report is as follows:

- **1. Assessment of pre-development value**

The pre-development ecological value is a product of the **area** occupied by the vegetation type multiplied by an index of ecological **significance** relative to the ecological **condition** of the site and is expressed in 'habitat hectares'.

Area of each vegetation type is determined by using field survey to delineate vegetation boundaries, with confirmation by using the Land Environments of New Zealand's (LENZ) predicted historic vegetation cover to identify the types of vegetation communities likely to have existed across the entire site. LENZ does not map gorge turf communities. For the purpose of this mitigation opportunities scoping analysis we have estimated that gorge turf communities comprise approximately 20% of the gorge vegetation on public conservation land (4.2 ha). Turf communities can be patchy, however this allows for the infrequent turf patches recorded on river margins just below the gorge area; i.e. it is a conservative estimate of gorge vegetation area. Vegetation on public conservation land is 4.2 ha of which 0.84 ha (20%) covering 2 km of river margin is estimated to be gorge turf community.

Significance of the vegetation type was derived using the Tasman Significance Criteria Framework to assess the relative ecological significance of the vegetation within the scheme footprint. The Tasman criteria were allocated numerical scores based on the ranking system as follows:

- High 5
- Medium-High 4
- Medium 3
- Low-Medium 2
- Low 1

The five Criteria were grouped to provide three ranking scores for Primary Criteria (representativeness, rarity/distinctiveness and diversity/pattern) and one for Secondary Criteria (average of scores for ecological context, size/shape and Other criteria). The total score is the sum of the three Primary Criterion scores plus the

average of the Secondary Criterion Scores (i.e. the Primary Scores were weighted as 75% of the value of the overall score) to give an overall proportion out of 20.

The ecological significance score is represented as the inverse of (1- the proportional significance score) which is applied as a multiplier to the area of the vegetation type in question proposed for removal.

Condition of the site is based on scores of the state of health and presence of weed and animal pest threats of the vegetation type using a semi-quantitative scoring system covering 12 aspects of threat and health of the site. The score for the site is expressed as a proportion of the total achievable score and applied as a multiplier in the calculations.

For this project the quantum of offset required is equal to the pre-development ecological score as the vegetation areas within the development footprint will be completely removed (i.e. the loss of values is the existing value).

• 2. Assessment of offset required

The quantum of offset required depends upon the type and level of management proposed for the potential offset compensation sites(s).

Whether the site supports degraded habitat of a similar type with potential for managing threats and improving condition or a site where no indigenous vegetation exists and where creation of habitat through planting is feasible, the process for assessing the offset gains is the same as for assessing the loss of values within the development footprint.

For each offset area, calculate the current ecological value and the predicted ecological value. The difference between the two (should be a gain in value) counts as a portion of the offset against the loss of values removed from the development footprint.

Where an offset site has not yet been surveyed, take a conservative approach to estimating the likely starting value and net gain using the Tasman criteria and the condition criteria.

Appendix B Method for calculating threatened species offsets

The offset calculation approach for threatened species used in this report is as follows:

- **1. Assessment of existing value**

The ecological value is a product of the **area** occupied by the species multiplied by a multiplier that recognises the **threat** status of the species and is expressed in 'species hectares'. Condition of the population is not taken into account i.e. equal value is given to the presence of a population of the species no matter what the prospects are for its persistence under a 'business as usual' scenario.

The area of habitat currently occupied by the species is estimated based on the results of field surveys.

The threat status multiplier is based on DOC's Threatened Plant Classification System where multipliers are applied as follows:

- Nationally Critical x 5
- National Endangered x 4
- Nationally Vulnerable x 3
- At Risk: Declining x 2
- At Risk: Recovering, Relict, Naturally Uncommon x 1

This method assumes a linear relationship between the threat status of a species and the multiplier that is applied with x 1 multiplier applied to the category of least threat status and x 5 applied to the category of greatest threat status.

- **2. Assessment of offset required**

The offset quantum of habitat area is the species hectares removed by the proposed development.

For example, shovel mint is a Nationally Critical species which is found over approximately 3 ha of alluvial habitat and patches of riparian habitat within the proposed scheme footprint.

The ecological value of the area removed is 3 ha x 5 threat status = 15 species hectares.

The quantum of offset mitigation for the complete removal of this species is 15 ha of appropriate alluvial or riparian habitat required for the establishment of shovel mint or the restoration of existing degraded populations.