

BEFORE THE CANTERBURY REGIONAL COUNCIL

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER resource consent applications by
Southdown Holdings Limited, Five Rivers
Limited and Killermont Station Limited to
take and use water in the Upper Waitaki
Catchment.

1. INTRODUCTION

- 1.1 My full name is Ruth Miriam Bartlett. I hold the degrees of Bachelor of Science and Master of Science (First Class Honours), both from the University of Auckland, and a Doctorate of Philosophy in Botany from the University of Guelph, Canada. I am a partner of Mitchell Partnerships, an environmental consulting practice based in Auckland, where I have worked since 1998. Prior to that I was a Director of Kingett Mitchell and Associates Ltd, Auckland, where I worked from 1990 to 1997.
- 1.2 I have undertaken a large number of ecological investigations and assessments of the effects of developments on the ecology of coastal, forest, wetland and subalpine areas throughout New Zealand since 1990.
- 1.3 I have undertaken ecological investigations, managed resource consents projects and prepared assessments of environmental effects for numerous projects over the past 17 years. I have been involved in a variety of large development projects in New Zealand, including energy projects. I have carried out assessments of the effects of such schemes on ecology and have developed and implemented mitigation works including riparian and terrestrial restoration projects. I also work as a resource consents manager for large development projects, in which I have been responsible for the preparation of Assessment of Environmental Effects ("AEE") documentation among other matters. A list of relevant projects is attached as **Appendix 1**.
- 1.4 I have read the Environment Court's Code of Conduct for expert witnesses contained in the Environment Court Consolidated Practice Note 2006 and agree to comply with it. I confirm that I have considered all the material facts that I am aware of that might alter or detract from the opinions I express, and that this evidence is within my area of expertise.

Involvement at Glen Eyrie Downs, Ohau Downs, WHL Killermont and Killermont Run Station

- 1.5 I have visited Glen Eyrie Downs, Ohau Downs and WHL Killermont on three occasions, 6 November 2008, 9 - 10 June 2009 and 25 June 2009 and visited Killermont Station on 10 June 2009. The four stations are shown in Figure 1.

During these visits, I carried out field assessments by vehicle and on foot, which included visiting each station and viewing the areas proposed for irrigation, the intake sites at Maori Bay and near the Ohau River on Lake Ohau, the intake sites at Manuka Creek and on the Ahuriri River, parts of the Queen Elizabeth II ("QEII") covenant land, Six Mile Creek, Wairepo Creek, Serpentine Creek, Maori Creek, the Wairepo Kettlehole Reserve area and other sites thought to be potentially affected by the irrigation proposals. Figures 2 and 3 show the routes I took on my site visits.

- 1.6 I have prepared reports detailing the terrestrial ecological values, potential effects of irrigation and intensification of farming on the properties and provided advice as to which areas, if any, of high ecological values should be avoided and the level of mitigation or remediation necessary for any effects that cannot be avoided.

Scope of Evidence

- 1.7 In my evidence I will describe the environmental setting and proposed ecological mitigation on the four stations. This will include details on proposed planting and fencing of significant waterways and effects associated with the intensification of farming.

- 1.8 My evidence provides the following:

- A brief description of the environmental setting, and history of the Omarama Ecological District.
- For each of the four properties:
 - A description of the property.
 - A description of the existing vegetation including any areas considered to have high ecological value.
 - A description of the works proposed, including mitigation works.
 - Effects of the proposal.
- Consideration of the Officer's Report and submissions made.

Summary of Key Findings

- 1.9 The four stations are shown on Figure 1. Individual farms are shown on Figures 4 (Glen Eyrie Downs), 5 (Ohau Downs) and 6 (WHL Killermont and Killermont Station). Like other farms in the district all four stations have been extensively modified by historic and current land use including vegetation clearance by fire and farming activities. This modification has left large areas (mainly the flat land) with little or no ecological value. These are the areas proposed for irrigation.
- 1.10 The areas that are proposed for irrigation have the lowest ecological value with the least indigenous vegetative cover. The irrigation layout has avoided, as much as practicable, the areas that are considered to have the greatest ecological value on each property.
- 1.11 The features which retain the most ecological value within the irrigation command areas are the watercourses, however the watercourses are not currently fenced and have been subject to grazing and in some areas to a degree of pasture improvement. It is proposed that these areas be fenced, retired from grazing and planted with indigenous species. I consider this to be a benefit of the farm proposals as the riparian buffer areas will provide corridors of indigenous vegetation across these very large properties and improve water quality within the streams.

2. ENVIRONMENTAL AND ECOLOGICAL CONTEXT

- 2.1 Glen Eyrie Downs and Ohau Downs stations are located near Lake Ohau in the Mackenzie Basin, on the plains of the eastern South Island high country, while the WHL Killermont Station and Killermont Station are further south, on the true right bank of the Ahuriri River. This area includes some of the driest, most drought-prone and seasonal climates in New Zealand. The near-continental climate in an otherwise oceanic, moist archipelago has resulted in speciation of unusual plants and animals adapted to its extremes and distinctive communities found nowhere else. One consequence of the dry climate has been an

elevated susceptibility to fire and, as a result, less unmodified vegetation exists in the high country than anywhere else in New Zealand (McGlone 2004).

- 2.2 Scanty fossil evidence suggests that small-leaved shrublands provided the main vegetation cover in the dry central and south-eastern districts of the Mackenzie Basin and Central Otago prior to human settlement, with kowhai (*Sophora sp.*) and kanuka (*Kunzea ericoides*) along the river courses and on deeper soils, and grassland or mat herbs and shrubs on the driest soils (McGlone 2004).
- 2.3 The arrival of Maori increased the frequency of fire and the repeated, deliberate burning they initiated cleared approximately 75% of the forest and tall scrub cover of the eastern South Island. Grasses and some shrubby species such as matagouri (*Discaria toumatou*), kanuka, manuka (*Leptospermum scoparium* agg.) and kowhai had life history traits or morphology that enabled them to increase in abundance and range as a result of this increased fire pressure.
- 2.4 Farms managed according to “exploitative pastoralism” (O’Connor 1982) did not significantly alter the broad pattern of forest and grassland established by Maori colonists some 500 years previously (McGlone 2004).
- 2.5 Collectively the impact of grazing, burning, weeds and pests transformed the nature of high country grasslands. Palatable shrubs, herbs and grasses rapidly declined under the browsing impact of millions of sheep, rabbits, goats, hares and pigs. Frequent burning used to stimulate fresh palatable foliage from the poor quality tussock and native grass fodder resulted in a decline in the stature, vigour and cover of the main tussock species that survived. The accidental or intentional release of aggressive weeds such as gorse (*Ulex europaeus*), broom (*Cytisus scoparius*), briar (*Rosa rubiginosa*), willows (*Salix* spp.), pines (*Pinus* spp.) and hawkweeds (*Hieracium* spp.) resulted in the exclusion of indigenous species and the formation of new scrub and grassland communities in the high country (McGlone 2004).
- 2.6 By 1950 soil fertility was nearly exhausted and palatable native species had been nearly eliminated as dominants. Many shrublands were reduced to non-regenerating remnants. After 1950 farmers adopted fertiliser application,

oversowing, fencing, improved cultivar selection, rotational grazing and other stock management practices which were beneficial to the ground cover and production but were just as damaging to native vegetation (McGlone 2004).

- 2.7 In 1994 more than 30% of the Mackenzie Basin was bare ground (Cuff 1994). Basher (1996) found widespread evidence of erosion in the Mackenzie Basin with bare sites losing an average of 25 mm of soil over a 40 year period. From fully vegetated sites there was no loss. Soil erosion, particularly due to wind, has long been recognised as an important high country issue (Martin *et al.* 1994). It is now generally accepted that any land management practice that increases vegetation cover and reduces the amount of bare ground will reduce the soil erosion risk in the Mackenzie Basin (Brown & Harris 2005). Irrigation may enhance vegetation cover in this regard.
- 2.8 Towards the end of the 20th century pressure for the conservation of non-forested lands grew. Simply stopping grazing and burning will not necessarily result in improved ecological values because exotic weeds and wilding pines may benefit to a greater degree than the remnants of indigenous vegetation. Native species richness is declining across non-forest vegetation and exotic weeds continue to increase. Active management is likely to be required to improve the ecological values in the area. (Meurk *et al.* 2002, Walker *et al.* 2003, McGlone 2004, Mark and McLennan 2005).

Omarama Ecological District

- 2.9 The properties for which irrigation is proposed are located in the Omarama Ecological District of the Mackenzie Basin Ecological Region. A large part of this district is occupied by a dry outwash plain located below 900 m above sea level ("m asl") between the Diadem and Benmore Ranges near Omarama (McEwen 1987). The Manuka Creek intake is located near the border between the Omarama, Ahuriri and St Bathans Ecological Districts.
- 2.10 The geology of the Omarama Ecological District is mainly Pleistocene tills and fluvioglacial outwash deposits from the Otira glaciation which overlie Pliocene conglomerate with some alluvial gravels dating from the Holocene and some Mesozoic Torlesse Supergroup greywacke and argillite. The overlying soils are

shallow to moderately deep, sandy and silty soils from variable thicknesses of loess. The climate is semi-arid to humid inland with cold winters and warm summers (McEwen 1987).

- 2.11 Recent environmental analyses indicate that the environments present would have supported tussock grassland with narrow-leaved snow tussock (*Chionochloa rigida*), red tussock (*Chionochloa rubra*), silver tussock (*Poa cita*), fescue tussock (*Festuca novae-zelandiae*), spear grass (*Aciphylla spp.*) and matagouri shrubland with red tussock, *Schoenus* and *Carex* species dominating in wet depressions (Leathwick *et al.* 2002, 2003). Currently, the vegetation throughout the district consists mainly of degraded tussock grasslands with adventive weeds, converted pasture and wetland vegetation associated with tarns and swamps including stands of bog pine (*Halocarpus bidwillii*) and toatoa (*Phyllocladus alpinus*), manuka and *Ozothamnus leptophyllus* (tauhinu or cottonwood). Matagouri, *Coprosma propinqua* and *Olearia* species are also common.
- 2.12 Examination of the Land Cover Database (“LCDB2”) (Terralink 2004), which is a spatial dataset based on satellite images, shows that recent (2002) land use on the outwash plains included improved pasture under irrigation, degraded tussock grassland and exotic forest (Figure 7).
- 2.13 The land which is the subject of this irrigation proposal is almost entirely covered by pasture and exotic weeds and only very small areas of natural vegetation remain. Because most of the indigenous vegetation has been removed or degraded any remaining area of natural vegetation can be regarded as having ecological importance. O’Connor (1976) considered that the depletion of short tussock grasslands in the South Island high country was most serious in the Omarama district.
- 2.14 The small areas of ecological value that remain were recognised in the Protected Natural Areas Programme report (“PNAP report”) for the Mackenzie Ecological Region (Espie *et al.* 1984). These authors identified 14 sites covering 3,390 ha as priorities for protection (recommended areas for protection, or “RAPs”), with those in the vicinity of the proposed irrigation areas shown on Figure 8.

- 2.15 Parts of two of these areas, covering around 46% of the land area identified as retaining ecological value, are formally protected: 400 ha as a Department of Conservation reserve, the Wairepo Kettleholes Conservation Area, on Glen Eyrie Downs (shown as Department of Conservation land on Figure 3), and 1,186 ha by a Queen Elizabeth II Open Space Covenant (“the QEII covenant”) on Ohau Downs (shown on Figure 8).
- 2.16 Wetland habitats and stream channels that meander across this landscape are often dry, reflecting the low rainfall of the area, but are also important habitats. Because of the lack of indigenous forest in the ecological district, forest birds are rare, but the braided riverbed of the Ahuriri River and other wetlands provide valuable breeding habitat for wetland birds, including the endangered endemic black stilt (*Himantopus novaezelandiae*). The upper Waitaki Basin may now provide half of all remaining suitable braided river habitat in New Zealand (Maloney *et al.* 1997).
- 2.17 A Water Conservation Order applies to the Ahuriri River. This is to provide for the outstanding wildlife habitats, fisheries and angling features of the river. The Water Conservation Order requires that these outstanding features, the natural water level and quantity in all lakes, ponds, tarns, lagoons and streams (other than the Omarama Stream) forming part of the protected waters be retained in their natural state. Because of its rare, unmodified braided river habitat the Ahuriri River is regarded as nationally significant, providing seasonal habitat for a large number of bird species, including threatened species. Some birds, for example black stilt or black fronted terns (*Chlidonias albostratus*), are restricted to this habitat for breeding.
- 2.18 To summarise, the vegetation of the Mackenzie Basin area is thought to have undergone one of the most dramatic transformations seen in New Zealand due to human influence and the pervasive effects of exotic species. Any remaining areas of indigenous vegetation and the braided river habitat are recognised as nationally significant because of their rarity and the usually degraded nature of these habitats where they remain.

3. ASSESSMENT OF SIGNIFICANCE

3.1 In the following sections I describe the vegetation of the subject properties and consider their ecological values and significance against the criteria set out in the partly operative Waitaki District Plan (2004) (the “Partly Operative Plan”). These criteria assess whether an area supports significant indigenous vegetation or significant habitats of indigenous fauna (Policy 16.9.3.3):

- i. Representativeness – the area supports an example of a particular vegetation type, habitat or ecological process that is typical of the ecological district relative to the pre-European baseline and contributes to maintaining the appropriate proportional representation of that feature; or
- ii. Rarity and Distinctiveness – the area supports an indigenous species, habitat or community which is rare and vulnerable within the ecological district or threatened nationally; or the area contains unusual features such as: playing an important role in the life-cycle of protected or threatened indigenous fauna; the presence of species at their distribution limit; containing an intact sequence, or a substantial part of an intact sequence, of unusual ecological features or gradients; or
- iii. Diversity and Pattern – The area exhibits a high degree of biological diversity in terms of: species (vegetation and fauna), habitat types (i.e., “Seral” or “Climax” types), or ecological processes; or
- iv. Ecological Context, Size and Shape – The area maintains connectivity between other significant areas or maintains the opportunity for better connectivity between existing significant sites; provides a buffer for areas that are of significant value; is of sufficient size to be viable and edge effects are not an important limitation; is important feeding/breeding areas for indigenous fauna.

3.2 The Partly Operative plan also recognises (Policy 16.9.3.4) that communities and fauna that are not significant in themselves may have nature conservation

values by maintaining connectivity or providing habitat. These criteria are applied here to determine the ecological significance of the sites.

4. GLEN EYRIE DOWNS

- 4.1 Glen Eyrie Downs is a 2,135 ha property located south of Lake Ohau between Quailburn and Lake Ohau Roads (Figure 4). It borders Ohau Downs on its northern edge. Southdown Holdings Limited has applied to the Canterbury Regional Council for consent to take water from Lake Ohau at a rate of 1.2m³/s (1,200 L/s) to irrigate 2,068 ha of land at Glen Eyrie Downs. Application to irrigate a further 400 ha of land on an adjoining station, being either Ohau Downs or Shelton Downs, was made but has been put on hold and these areas have not been considered further.
- 4.2 Water will be abstracted from the lake via an infiltration gallery buried beneath the Lake Ohau shoreline located in Maori Bay as shown on Figure 1. A buried pipeline located along the boundary on the Shelton Downs property will carry the water from Lake Ohau to Glen Eyrie Downs where it will be applied over the land using centre-pivot travelling irrigators and K-Line sprinklers. A total of 20 centre-pivot irrigators is proposed (16 full circles and 10 half circles) with diameters ranging from 230 m to 650 m (shown on Figure 9). Gaps between centre-pivot irrigators will be irrigated by K-line irrigators.
- 4.3 A pump station will be built on the shore of Lake Ohau near the intake and will be buried below ground level. The pipeline between the farm and Lake Ohau will be buried to a minimum depth of 600 mm and will run along the boundary with Shelton Downs for approximately 3.2 km. The pipeline will cross Lake Ohau Road at or about New Zealand Infomap Series (“**NZMS**”) 260 map reference H39:615 511, Maori Creek at or about NZMS 260 H38:617 512 and the creek from Red Lagoon (Aqualinc 2009a). The pipeline will be buried beneath the beds of the two streams and beneath the road.
- 4.4 Three streams run through the Glen Eyrie property: Wairepo Creek which runs in an easterly direction, towards Lake Ruataniwha, Serpentine Creek which

runs south to the Ahuriri River and tributaries of Six Mile Creek which cross the northern-most corner of the property.

- 4.5 The irrigator layout has been designed to avoid Serpentine Creek and Wairepo Creek, and will avoid the northernmost of the two tributaries of Six Mile Creek, which has a defined stream channel.
- 4.6 The proposed land use at Glen Eyrie Downs is the cultivation of crops within the irrigation command area, to support diary livestock in a series of barns, termed “cubicle stables”. The cattle will not be given access to the pasture for grazing for eight months of the year. During the remaining four months they will be allowed a maximum of 12 hours grazing per day. The effluent produced, including that from housing the animals, will be separated into liquid and solid components. The liquid portion will be diluted with water and returned to the land via spray irrigation using irrigators or trucks. Some of the dry portion will also be applied to the land and some of the dry effluent is likely to be exported from the site.

Description of Vegetation

- 4.7 Glen Eyrie Downs is currently being managed as an arable cropping unit, supplying a biodiesel initiative. Until 2006 the property was almost completely covered in wilding pine (Plate 1). The vast majority of these pines have been removed and the land has been ripped, raked and seeded to allow crop production. The areas visited during the site visit had very limited indigenous species presence, but in some areas scattered fescue tussock, small native grasses such *Deyeuxia avenacea*, and small herbs and subshrubs such as *Gonocarpus micranthus*, *Geranium sessiliflorum* and *Leucopogon fraseri* survive.
- 4.8 The pine infestation, its removal and the development of the land for cropping, means that the vast majority of the property has very limited ecological value (Plate 2).

Wairepo Kettleholes Conservation Area and Wairepo Creek

- 4.9 In the centre of the property is the 400 ha Wairepo Kettleholes Conservation Area, (administered by the Department of Conservation), which was established in 2004 when Glen Eyrie Downs station completed their tenure review process. This area was recognised by Espie *et al.* (1984) in the PNAP report as a priority natural area for conservation. The reserve is also proposed as an Outstanding Landscape by the Waitaki District Council. This reserve comprises tussock grassland and shrubland around some large ephemeral tarns or “kettleholes” and a large area of red tussock grassland bordering Wairepo Creek along its northern boundaries (Plate 3). Much of the reserve is located on undulating low hills.
- 4.10 A small portion of Wairepo Creek on Glen Eyrie Downs to the northwest of the reserve supports remnant patches of red tussock along the margins of a drainage channel on the property boundary. This area was part of the RAP, the values of which are represented within the Wairepo Kettleholes Conservation Area, but this area has been recently cultivated which has reduced its ecological values (Plate 4).
- 4.11 East of the Wairepo Kettleholes Reserve the Wairepo Creek crosses arable land to the boundary with Ohau Downs. The stream margins support scattered fescue tussock and scattered matagouri amongst exotic grasses, primarily brown top (*Agrostis capillaris*) and sweet vernal (*Anthoxanthum odoratum*) with sheep’s sorrel (*Acetosa acetosella*) and hawkweed.

Serpentine Creek

- 4.12 Serpentine Creek meanders through the lowest-lying part of a valley at the north western end of the property (Plate 5). As Plate 1 shows, pines grew along the wetland margins and were scattered within it. During the removal of the pines debris piles were scraped together and some of these remain within the wetland area (Plates 5 and 6). This area was identified as a “recommended area for protection” by Espie *et al.* (1984). It is RAP number 7 on Figure 8.

- 4.13 Browntop and other exotic grasses dominate the low-lying areas near the stream but the ephemeral wetlands along the stream and the riparian margins support scattered red tussock, fescue tussock, swards of *Carex coriacea*, Chewings fescue (*Festuca rubra*) and occasional toetoe along with herbs such as the exotic *Stellaria graminea*, and native *Gonocarpus micranthus*, and scattered rushes. Approximately half of the valley floor is dry and parts of it have been cultivated. Downstream, the creek meanders through cultivated land as shown on Plate 7, until it enters a formed channel which carries it through the remainder of the property.

Six Mile Creek Tributaries

- 4.14 The northern most of the two tributaries lies on the edge of the land that was cleared of pines (Plate 8). It has a defined channel with a vegetation cover of red tussock, *Carex coriacea*, exotic grasses including Yorkshire fog, cocksfoot and browntop, and *Juncus* species along with pines, golden Spaniard (*Aciphylla aurea*) and small herbaceous species including *Ranunculus amphitrichus*, *Oreomyrrhis ramosa* and *Pratia angulata*.
- 4.15 The southern of the two tributaries on the property does not have a formed channel but is within the cultivated area and does not support indigenous vegetation. When I visited the property following heavy rainfall (June 10 2009) the southern tributary was flowing close to the fence line on the neighbouring property (Plate 9) but was present only as small ponds on the Glen Eyrie side of the fence (Plate 10). My understanding is that this area will be irrigated.

Intake and Pipeline at Maori Bay

- 4.16 The proposed intake structure would be located at Maori Bay within Lake Ohau. The shoreline vegetation there consists of a band of shrubland behind a cobble – boulder beach (Plate 11). The shrubland comprises matagouri, briar rose, *Coprosma propinqua*, *Melicytus alpinus*, small kowhai trees and occasional saplings, and scattered *Coprosma crassifolius*. Uphill of this shrub band this vegetation continues as patchy shrubland and tussock grassland, extending back over this hummocky hillside to Lake Ohau Road.

- 4.17 On the cobble beach are scattered *Coprosma*, *Melicytus alpinus*, *Muehlenbeckia axillaris* and grazed sedges, rushes and grasses along with herbs such as *Gonocarpus micranthus*, *Viola sp*, *Pratia angustifolia* and *Geranium sessiliflorum*.
- 4.18 Similar vegetation extends around the shoreline to the east onto the QEII covenant land as shown on Plate 12.
- 4.19 The pipeline and pump station will be located underground. This means that vegetation can be re-established in these areas after construction is complete.

Ecological Values

- 4.20 Most of the Glen Eyrie Downs irrigation command area cannot be considered significant under the criteria outlined in paragraph 3.1. It is almost entirely under cultivation and this large scale modification has resulted in very limited indigenous vegetation cover. Exceptions to this are described below.
- 4.21 The Wairepo Creek margins provide a corridor of vegetation that contains natural elements, across the northern part of Glen Eyrie Downs to Ohau Downs and can be considered to rate positively under criterion iv above, because it connects upper reaches of Wairepo Creek on the neighbouring property with the now protected Wairepo Kettleholes Reserve and with grazed but uncultivated land on the Ohau Downs property. This latter area will not be irrigated or intensively grazed. Any such stream channels and riparian vegetation in this heavily modified landscape can be considered to be of high ecological value since they preserve elements of indigenous species and processes that are now of limited distribution in the Ecological District. The buffering proposed provides a positive outcome of the project in this regard. The values of this creek along the boundary on the western edge of the property have been diminished by the earthworks previously carried out and mitigation for those effects is described later in my evidence.
- 4.22 The upper part of the Serpentine Creek nearest the western boundary area can be considered to rate positively at least under criteria i and iv, despite the modifications to it that have taken place, because the Serpentine Creek

wetland area represents one of the few remaining riparian wetlands in this part of the Mackenzie Basin. Its values were recognised in the 1984 PNAP report (it is RAP 7). The creek's margins provide linkages from the subtending wetlands in its headwaters through to the mainstem of Serpentine Creek and thence to the Ahuriri River. The irrigation layout proposed allows a five metre fenced buffer along the Serpentine Creek tributaries. Paragraphs 4.28 and 4.29 below describe how this buffer will be managed. The provision of this buffer, which will not be grazed or otherwise developed, will improve the quality of the riparian margins through the length of the stream on this property. Water quality within the stream can also be expected to improve.

- 4.23 Vegetation at the proposed intake location on Maori Bay and along the route of the pipeline on Shelton Downs is part of a swathe of lakeshore vegetation that extends around the shoreline in both directions. The area is grazed by stock and also subject to heavy rabbit pressure. The construction of the intake would require limited clearance of vegetation because the structure will be in the bed of the lake. Construction of a pump house and excavation to bury the pipeline would require the removal of vegetation along the route. This vegetation is part of a matrix of oversown tussock grassland and shrubland. It does not possess any values that would elevate it in importance above the large area of surrounding similar vegetation. The extent of the activities proposed is very limited and the effects of the activities will be ameliorated by rehabilitation after the construction is complete.

Proposed Works

Wairepo Creek

- 4.24 The Environment Canterbury guide to managing waterways on Canterbury farms recommends a stream buffer of two to three metres on flat land, increasing with increasing slope. Discussion with Ms Robson about nutrient removal indicates that a five metre wide buffer with zoned vegetation provides the best opportunity to remove nutrients from water that passes across or through the buffer to the stream. Low growing grasses, tussocks and sedges would be planted nearest the stream edge, and mixed tussocks, shrubs and trees along the outer half of the buffer zone for this purpose. The species to be

planted would be selected from those present in the ecological district that can be expected to provide habitat as well as contributing the nutrient stripping qualities required. Species are likely to include red tussock, tussock sedge, toetoe (*Cortaderia richardii*) and flax (*Phormium tenax*) closest to the stream and *Coprosma propinqua*, manuka, *Olearia bullata*, cabbage tree (*Cordyline australis*) and kowhai (*Sophora microphylla*) nearest the fence. The planting will supplement the native vegetation already present. Revegetation on the scale proposed (along several kilometres of stream margin) provides an opportunity to reintroduce species that are now rare in the area including *Carex tenuiculmis*, *Coprosma intertexta*, and *Hebe cupressoides*. Environment Canterbury provides a useful guide to the planting of riparian vegetation along inland basin streams and a variety of other species would be included as suggested in the species list they provide.

- 4.25 As I described in paragraph 4.10 above In the northwestern portion of Wairepo Stream along the boundary a channel has been formed along the boundary fence and the ground cultivated, removing an area of red tussock wetland that was previously present. This is in an area that was designated as a “recommended area for protection” by Espie *et al.* (1984). It is RAP number six in Figure 8. To remedy the effects of these previous earthworks on the stream channel and red tussock wetland it is proposed to reinstate the wetland near the boundary beyond where the road diverges from the boundary fence. The existing road follows this fenceline for some distance to the north and this will be used as a farm race. There is very little distance between the road edge and the stream. It is not considered practical to move the road.
- 4.26 A cattle lane will be formed (either using the existing road or the ground on the eastern side of the road) such that it can be fenced off from the creek and runoff from the road drains to the east instead of into the creek. The margin of the creek comprises a very narrow band at the bottom of the road batter. This margin will be planted with red tussock and associated shrubs such as flax (*Phormium tenax*), mingimingi (*Leucopogon fasciculatus*), toetoe and matagouri. These will grow and shade the creek and will assist in providing aquatic habitat and filtering runoff.

4.27 Where the road diverges from the creek and boundary fence:

- A series of wide shallow depressions will be excavated and the stream directed to them. These depressions will form a meandering pattern and flood in times of heavy rainfall to interrupt and slow the stream flow through this area.
- The stream will be fenced five metres from the edge of the nearest meander.
- Most of the area will be planted with red tussock (with associated *Carex* and *Juncus* species around any particularly deep or wet areas) but shrub and tree species will be planted nearest the fence to assist with nutrient removal as described in paragraph 4.24 of this evidence.
- The planted area will be oversown with browntop to allow it to establish a rapid vegetation cover, minimising sediment generation and weed establishment (particularly *Hieracium*).

Serpentine Creek

4.28 It is proposed to retire a five metre buffer along the length of Serpentine Creek. The meandering nature of the creek means that it is probably impractical to follow the line of the creek. A fencing layout such as that shown in Figure 10 would be required. As I described in paragraph 4.7 the clearing of pine trees has left debris piles along the stream and disturbed the vegetation present. It is proposed to reinstate the surface and replant the area as part of the works.

4.29 Works in the Serpentine Creek area would therefore include:

- Removal of the remaining pine debris.
- Limited re-contouring of the areas where the debris is removed (i.e., using the excavator shovel to roughly smooth the ground).

- Replanting with red tussock (preferably greater than 10 cm diameter at the base, to minimise loss from snow damage) and with sedges such as *Carex geminata* and *Carex secta* in disturbed ground on the wet edge of the creek).
- Oversowing the bare areas with browntop so that the vegetation cover mimics what is present in the surrounding riparian zone. This will also minimise the opportunity for weed invasion.
- Planting with other species similar to those described above for Wairepo Creek.

Six Mile Creek Tributaries

- 4.30 It is proposed to retire a five metre buffer along the northernmost of the Six Mile Creek tributaries and to plant it in a similar manner to that described above for Wairepo and Serpentine Creeks. During the removal of pines the ground along the southern edge of this tributary was disturbed by machinery and this will be recontoured prior to planting.

Effects of the Proposal

- 4.31 Overall, the removal of pines from Glen Eyrie Downs has provided a significant benefit by removing a large source of wilding pine seed from the area. Some remaining piles of pine debris left over from the felling operations will be removed. The irrigation layout proposed avoids the riparian margins along Serpentine Creek, Wairepo Creek and the northern tributary of Six Mile Creek. The provision of a fenced five metre buffer will assist in retaining remnant ecological values along these streams and provide improved connectivity downstream as they regenerate.
- 4.32 Within the command area, irrigation of the property can be expected to result in the loss of the remnant indigenous species that may have survived cultivation, and will result in the further development of an exotic grassland cover. The return of vegetation to this land will have the benefit of providing a more intact cover that will help bind soil and prevent it's loss. In areas where irrigators will

come close to watercourses, such as Serpentine Creek, there may be limited seepage or through flow that may assist in the regeneration towards a riparian cover dominated by indigenous species. This would be an improvement from the continued degradation of the area that has occurred in the past.

- 4.33 Some runoff of irrigation water into the QEII covenant area may occur from the irrigation of the most northern corner of the property. I understand there may also be runoff into the Wairepo Kettleholes Conservation Area from a small area to be irrigated along the southern boundary of the reserve. My understanding is that this will be monitored by the farm manager (once irrigation begins), and if runoff is seen to be occurring, then appropriate steps will be taken to stop it. This could include altering the flow rate or the type of irrigator used to reduce the amount of water applied.
- 4.34 Wairepo Creek, Serpentine Creek and the northern tributary of Six Mile Creek will be fenced to exclude livestock with at least five metres protected. This will result in approximately 34 ha being retired from grazing. This buffer area will be replanted with indigenous species. This riparian protection from grazing livestock is also an improvement on the current situation. The proposed irrigation scheme will limit the erosion across the property by providing an overall increase in vegetative cover as well as fencing and retiring from grazing the banks of several streams contained within the command areas proposed. This will improve water quality by removing nutrients and restricting runoff and it will also minimise the erosion of stream banks.

Monitoring

- 4.35 For the buffer areas along the Serpentine and Wairepo Creeks and the northern tributary of Six Mile Creek, the vegetation planted should be monitored to ensure that mortality is less than 10% over the first year. If necessary remedial planting can be undertaken to achieve the desired nutrient removal. Monitoring for woody weeds like pines, gorse and broom would also be carried out.

4.36 Monitoring would include:

- A check on the vegetation planted after three months to ensure there had not been wholesale mortality for any reason.
- Six monthly checks along the length of the creek for woody weed species (gorse, broom and pines) and removal of these as necessary. Any woody weeds found would be cut and painted with weed killer, or hand pulled. After a full vegetation cover has established, or it is clear that woody weeds are not being found in significant numbers, such monitoring could be carried out less frequently (annually or biannually).
- Regular checks to ensure the fence remains stock proof.

Conclusion

4.37 Native vegetation at Glen Eyrie Downs is restricted to the riparian margins of Wairepo and Serpentine Creeks and ephemeral wetlands upstream of where the Serpentine Creek has been channelized. Vegetation in these areas includes red tussock, fescue tussock, chewings fescue and small native grasses, herbs and subshrubs. These stream margins provide a corridor of native vegetation between the Wairepo Kettleholes Conservation Area and the grazed but uncultivated land on the Ohau Downs property. These areas will be protected from irrigation. The ecological value of the irrigation command area is low and the provision of a five metre riparian buffer along with replanting and weed control is expected to improve the ecological values of the site and protect native species and habitat and improve the quality of the corridor for wildlife. The return of vegetation cover to the irrigated areas is expected to reduce soil erosion from the property. The increased cropping and grazing pressure will result in the loss of the small remaining indigenous component of the vegetation on the irrigated area. In the absence of irrigation and the continuation of current management this is likely to occur in any event.

4.38 A portion of the Wairepo Creek north of the Wairepo Kettleholes Reserve will be within the command area and will receive irrigation water. The potential also exists for runoff of irrigation water into either the Department of Conservation

Reserve or the QEII covenant area. My understanding is if this occurs the irrigation method will be adapted to reduce the flow rate and minimise any effect.

5. OHAU DOWNS

- 5.1 Ohau Downs comprises 5,120 ha located both north and south of Lake Ohau Road as shown on Figure 5. Approximately 1,186 ha of the property is protected within a QEII covenant. Five Rivers Limited has applied to the Canterbury Regional Council for consent to take water from Lake Ohau to irrigate 1,493 ha of land at Ohau Downs. The take from Lake Ohau will not exceed 950 L/s and the area of land protected by covenant will not be irrigated (Aqualinc 2009b).
- 5.2 Water will be abstracted from the lake via an infiltration gallery buried beneath the Lake Ohau shoreline near the outlet to the Ohau River (as shown on Figure 5). From the intake point water will be conducted to the boundary of Ohau Downs via a buried pipeline. The water will be applied over the land using centre point irrigators and K-Line sprinklers. Twelve centre-pivot travelling irrigators are proposed with diameters ranging from 268 m to 650 m (Figure 11). Gaps between centre-pivot irrigators will be irrigated by K-line irrigators.

Description of Vegetation

- 5.3 Ohau Downs is mostly in pasture, some of which has been cultivated, and some of which has been oversown but remains in a relatively natural condition. Most of the flat plains on the property would be irrigated and this large area has already been cultivated and used either for grazing or cropping in the past (Plate 13). On the terraces and gentle slopes surrounding the plains the vegetation is a mix of exotic and native species, similar to that on the adjacent QEII covenant area.
- 5.4 Exotic grasses and herbs most commonly present on the hummocky ground away from the command area include browntop, sweet vernal, sheep's sorrel, mouse-ear chickweed (*Cerastium vulgatum*), bird's foot trefoil (*Lotus*

pedunculatus) and hawkweed. The exotic briar rose (*Rubus rubiginosa*) is commonly present. Native species include fescue tussock, *Coprosma petrei*, *Leucopogon fraseri*, *Raoulia subsericea*, tauhinu, matagouri, the native broom *Carmichaelia petrei*, tiny *Pimelia aff. oreophila* and *P. prostrata* subsp. *prostrata*, *Gaultheria macrostigma*, and tufts of the grass *Deyeuxia avenoides* are present (Plate 14).

- 5.5 Continued grazing in these areas means that the ecological values found there are unlikely to improve and the patchy vegetation cover means that soil loss from these areas will continue.
- 5.6 The QEII covenant was applied to 1,186 ha in August 2000 as shown on Figure 5. This includes hummocky land around and inland of Lake Ohau surrounding two ephemeral ponds (Swan Lagoon and Raupo Lagoon). Part of this covenanted area was recognised as a priority natural area for conservation by Espie *et al.* (1984) on the basis that its protection would protect the representative fauna of the region. Plate 15 shows typical tussock grassland within the QEII area. The investigation of the QEII covenant area and adjacent grazed tussock grassland on the Ohau Downs property indicates that the Ohau Downs grassland is in a similar state to that in the QEII area, and this extends across a very large area between the proposed irrigation area and the QEII covenant band around the lake shore.

Six Mile Creek

- 5.7 Six Mile Creek crosses Ohau Downs from west to east on the southern side of Lake Ohau Road (Plate 16). The low-lying land on either side of the creek supports a cover of scattered fescue tussock, matagouri, and *Melicytus alpinus* amongst browntop, sweet vernal, *Deyeuxia avenoides* and white clover (*Trifolium repens*). Further upstream *Schoenus pauciflorus*, *Juncus articulatus*, *Gaultheria macrostigma* and *Oreomyrrhis ramosa* were present amongst taller tussocks (Plate 17). The irrigation layout avoids this area.

Water Take and Pipe Location at Lake Ohau

- 5.8 Ohau Downs would source water from the Lake Ohau shoreline near the mouth of the Ohau River at the location shown on Figure 5. An intake structure would be buried beneath the lake bed adjacent to the shoreline and a pipe would take water up and across the terrace at the lake margin. Plate 18 shows the vegetation in the vicinity of the proposed pipeline and underground pump house which would be located on Ohau Downs on the left side of the fence shown on Plate 18. The vegetation near the fenceline is a mix of exotic and indigenous tussock grassland and shrubland comprising briar, matagouri, native broom, *Coprosma propinqua*, manuka, *Melicytus alpinus*, cocksfoot grass (*Dactylis glomerata*) sweet vernal, bird's foot trefoil, fescue tussock, woolly mullein (*Verbascum thapsus*) and occasional bracken (*Pteridium esculentum*).
- 5.9 A steep gravelly bank leads down to the foreshore and scattered matagouri dominates the vegetation on this bank. A dense band of divaricating shrubs lines the lake shore, and includes occasional kowhai (*Sophora microphylla*) and *Coprosma crassifolia* amongst matagouri, manuka, briar and *Coprosma propinqua*. *Rubus schmidelioides* (white leaved bush lawyer) is a common component of this vegetation.
- 5.10 On the lake shore *Coprosma rugosa* and *C. cheesemannii* are present amongst cobbles and boulders with a scattered grass cover, with manuka, *Coprosma propinqua* and matagouri behind (Plate 19). Plate 20 shows the vegetation in the vicinity of the pipeline location, leading uphill from the lake.
- 5.11 The vegetation at the proposed intake site is continuous with a band of shrubland that covers the slopes and terraces above Lake Ohau around to and beyond the Glen Eyrie Downs intake point at Maori Bay (Plate 21). The vegetation closest to the shoreline around this coast is within the QEII covenant area but similar vegetation extends uphill onto the Ohau Downs property.

Ecological Values

- 5.12 The irrigation command areas on Ohau Downs are under cultivation or have been developed as pasture and retain extremely limited ecological value. The

tussock grassland areas that are not to be irrigated, but will continue to be grazed, have similar values to those within the QEII covenant area and these values will not be affected by the proposed irrigation activity.

- 5.13 The proposed irrigation layout has been designed to avoid irrigating onto Six Mile Creek. The low-lying land adjacent to the creek is often dry but forms the floodplain for the creek (which itself is often dry). The creek's riparian margins and surrounds support a limited number of indigenous species mixed with exotic pasture grasses and herbaceous species. In an environment such as this, where almost all of the indigenous vegetation has been lost, this wetland and riparian margin can be considered to be of moderate value, providing connectivity between the wetland areas in the upper tributaries of the stream (the Raupo and Red Lagoon areas) and the environment further downstream which joins Wairepo Creek.

Proposed Works

- 5.14 Construction of the underground pump house and pipeline from the Lake Ohau shoreline up the hill and into the irrigation area will require the removal of vegetation that is of similar quality to that described above, comprising grazed tussock grassland and shrubland of similar value to that in the QEII covenant area. The vegetation here was considered of high ecological value by Espie *et al.* (1984), and these values are protected within the adjacent QEII covenant. This vegetation extends within the covenant and outside it around the slopes above Lake Ohau where the underground pump house would be built. The activities required to construct the pump house and pipeline will create limited and localised disturbance. The pump house area is expected to measure some 5 m x 5 m and the adjacent staging area is likely to require the removal of additional vegetation to allow machinery access to the site. Pipeline construction is likely to require removal of vegetation in a band approximately three metres wide. Once the construction of the pump house is complete and the pipeline has been buried the surface will be revegetated with a grassland mix similar to that applied to the rest of the property.
- 5.15 An underground pumping station will be required near the take point at Lake Ohau and it is intended that this be located on Ohau Downs property. From

there the buried pipeline will skirt around the QEII covenant area to Ohau Downs. The pipeline will be buried at least 600 mm deep and will not cross any roads or streams. There are no surface streams on the Ohau Downs property north of Lake Ohau Road. Six Mile Creek crosses the property from west to east south of Lake Ohau Road.

- 5.16 The irrigator layout has been designed to avoid Six Mile Creek as shown on Figure 11, and a five metre wide fenced buffer will be left between the creek and the cultivated area. The buffer will not be grazed. A system of stock-watering channels that take water from Six Mile Creek across the property, shown in blue on Figure 5, will be filled in and closed.
- 5.17 The proposed land use at Ohau Downs is similar to Glen Eyrie Downs, that is production of pasture and crops within the irrigation command area to support dairy livestock in cubicle stables. Young stock will be grazed off the farm, but once milking, the cows will remain on the farm year round. Stock will be wintered on the farm using the cubicle barns. Manure collected from the barns and dairy shed will be returned to the land via centre pivot spray irrigators and some of the dry effluent is likely to be exported from the site.
- 5.18 An alternative farming proposal includes intensive beef farming and dairy support but with a similar management strategy. From an ecological point of view there is little difference in terms of the likely effects on terrestrial values.

Proposed Mitigation

- 5.19 A fenced buffer five metres wide is proposed along Six Mile Creek, and this will be planted with a variety of tussock, sedge, shrub and tree species as described in paragraph 4.24 of my evidence. This will retire approximately 15.5 ha from grazing on this property.

Effects of the Proposal

- 5.20 The imposition of a five metre buffer along Six Mile Creek is a positive development. The buffer will not be grazed and this will allow gradual regeneration back to taller tussock vegetation over time. It is possible that

irrigation of the cultivated land adjacent to this area will allow the seepage of some water into the riparian margin. This may encourage the development of lush vegetation than might develop under the natural conditions but this is unlikely to be a disadvantage. Irrigation water is applied at a calculated rate to prevent runoff or excessive leaching and my understanding is that if through flow or seepage towards the stream margin does occur it is unlikely to be excessive.

- 5.21 Given the present status of the stream margins, which are currently grazed, the effects of this project will be beneficial.
- 5.22 The application of water and nutrients to the irrigated area will result in an improved vegetation cover. Given the rate at which soil is lost from the plains area in the absence of a vegetation cover this is a positive ecological outcome. The alternative to irrigation is to leave the land as it is and continue to graze or crop it in the absence of additional water. The current status of the land is unproductive. The effects of the irrigation proposed do provide benefits to indigenous vegetation as they will result in the development of buffered watercourses which will be able to regenerate to a more-or-less natural condition. The vegetation has already been cleared and attempts made to utilise the resulting unproductive pasture. The proposed irrigation is not stimulating further clearance of vegetation on this property.
- 5.23 The proposed irrigation will assist in preventing erosion from Ohau Downs by ensuring that a vegetative cover is present over much of the land area. This will have a net environmental benefit compared to the current grazing practices being undertaken.

Conclusion

- 5.24 The flat land that would be irrigated at Ohau Downs is mostly in pasture. More native species, including herbs, tussocks, and shrubs are found on the hummocky ground away from the command area including the part of the property which is protected by a QEII covenant. These areas will continue to be grazed and their values will not be affected by the proposed irrigation. The proposed irrigation layout has also been designed to avoid Six Mile Creek,

which passes through the property. Riparian fencing and planting along Six Mile Creek will exclude farm animals and protect this habitat. The application of water and nutrients to the command area will result in an improved vegetation cover and this will improve soil conservation on the property. The expected ecological effects are negligible on this property.

6. WHL KILLERMONT

- 6.1 WHL Killermont extends over two distinct terraces located south of the Omarama – Lindis Pass Road (State Highway 8) and is approximately 1,200 ha in size. Southdown Holdings Limited has applied to the Canterbury Regional Council for consent to take water from the Ahuriri River to irrigate 1,100 ha of land. The take from the river will not exceed 750 L/s (Aqualinc 2009c).
- 6.2 To irrigate WHL Killermont, water will be abstracted from the river. A traditional gravity intake is proposed which would divert part of the river's flow through the existing stop bank to a holding pond via a 750 – 900 mm diameter pipe. From the holding pond excess water would be diverted to a bypass while water required for irrigation would go to a storage tank. The diversion race and bypass would be protected from erosion by rip-rap and energy dissipating materials. An alternative to a gravity intake is to draw water via an infiltration gallery buried beneath the river bed. The exact location of the take in the Ahuriri River is yet to be determined and two options are proposed. The first is to install an intake and underground pumping station approximately 250 m north of the northwest corner of the property as shown on Figure 6. The second is to install an intake approximately 5 km upstream of the northwest corner of the property in order to allow water to be gravity fed down a pipeline to the property (Figure 6). Under the second option up to 950 L/s would be abstracted, however only 750 L/s is required so the remainder would be discharged back into the river at the intake location. From the intake point, water would be conducted to the boundary of WHL Killermont via a buried pipeline. The water will be applied over the land using centre point irrigators and K-Line sprinklers. Nine centre-pivot travelling irrigators are proposed (eight full circles and one half circle) with diameters ranging from 375 m to 614 m

(Figure 12). Gaps between centre-pivot irrigators will be irrigated by K-line irrigators (Aqualinc 2009c).

- 6.3 The proposed land use of WHL Killermont is the production of crops to support dairy livestock in cubicle stables, similar to those described for Glen Eyrie Downs.

Vegetation Description

- 6.4 The area that is proposed for irrigation on WHL Killermont is a vast flat plain with a sparse vegetation cover almost entirely composed of hawkweed, sheep's sorrel and scattered exotic grasses as shown on Plate 22. Fescue tussock is very occasionally present, along with briar rose. Plate 23 shows the sparse nature of the ground cover.
- 6.5 Wilding pines are establishing near the western property boundary with a large pine shelterbelt providing a seed source.
- 6.6 Manuka Creek crosses the south western corner of the property over a short distance and appears to have been channelized in this area. The vegetation along the margins is almost entirely composed of exotic grasses with briar rose and occasional pine seedlings present (Plate 24).

Water Intake Points

- 6.7 Two possible intake points are under consideration for WHL Killermont. The Option 1 intake is in the vicinity of Plate 25. This area had been inundated and covered in new sand and gravel following a large flood 10 days prior to the site visit. Scattered grasses, small willows, bird's foot trefoil, *Juncus articulatus*, briar and scotch thistle (*Cirsium vulgare*) provide a patchy remnant vegetation cover on this disturbed substrate. The buried pipeline would cross the depauperate sparse pasture on the plain above the river shown in Plate 26.
- 6.8 The option 2 intake location is just upstream of the area shown on Plate 27 where the river swings close to a steep bank. The vegetation on the river bank is almost entirely composed of exotic herbs and grasses with woolly mullein,

hawkweed, and browntop. Briar is also scattered amongst this vegetation. The vegetation above the bank is grazed pasture. The pipeline would be buried along a route above the bank and would cross the road onto WHL Killermont, following the fenceline and then climbing to the command area as shown on Figure 6.

- 6.9 Plate 28 was taken from the edge of a terrace that marks the roadward edge of the command area. No irrigation is planned for the lower terrace adjacent to the road at this end of the property. The vegetation in the vicinity of the road is similar to that described for the rest of WHL Killermont with a greater proportion of briar rose present than on the plain above the terrace.
- 6.10 The pipeline would cross the flat land shown on Plate 28 and then traverse up the terrace. The vegetation on the terrace is grazed and has a larger proportion of briar rose shrubland, but also supports scattered *Melicytus alpinus*, scattered *Coprosma propinqua*, tufts of *Deyeuxia avenacea* and fescue tussock, along with hawkweed, sheep's sorrel, bird's foot trefoil and bryophytes that have established where the shrubs provide shade and trap moisture.

Ecological Values

- 6.11 The areas that would be irrigated on WHL Killermont or would be affected by the development of the pipeline or the development of a diversion race and holding pond have low ecological values because almost all of the indigenous vegetation cover has been removed. Soil loss can be expected to be ongoing in this depauperate pasture. Irrigation on the flat land would have a positive effect by creating a vegetative cover, preventing further soil loss. The very small proportion of indigenous vegetation present is likely to be lost but in the absence of irrigation under the current management regime, this can be expected to occur in any event.
- 6.12 The vegetation cover in the Ahuriri River at the time of the site visit did not support any particular ecological values, having been recently flooded and the vegetation scoured out. The Ahuriri River and its floodplain are of ecological significance since they provide habitat for a variety of birds and connect the habitats across the plains. The values of parts of this area were recognised by

Espie *et al.* (1984), and recommended for protection as RAP 14 (Figure 8). The option 1 intake location on the Ahuriri River is at the far upstream end of this RAP, while the option 2 intake location is well upstream of the RAP. At the locations proposed for the construction of the intakes (to be buried below the surface) little vegetation is present. The degree of vegetation cover is likely to depend on the time since the Ahuriri last flooded. At the time of the site visit the course of the river had recently changed as a result of a flood and sand and silt had been deposited in areas that appeared likely to have supported a vegetation cover before the flood.

Proposed Works

- 6.13 A traditional gravity intake will require construction of the diversion, holding pond and bypass race as well as a tank and mainline irrigation pipe to reach the property. The diversion pond and bypass race would require additional vegetation clearance and earthworks to create them, including works in the bed of the Ahuriri River.
- 6.14 The location of the WHL Killermont underground pumping station depends on the final choice of intake site but the pipeline will be required to cross State Highway 8, either near NZMS 260 H39:598 284 or H39:553 278. For the downstream intake option (Option 1) two pipelines each buried to a depth of 400 mm are proposed, whilst for the upstream intake options (Option 2) one pipeline buried to a minimum depth of 500 mm is proposed. Bridges and/or culverts will be installed where the irrigators are required to cross the Tara Hills water race. Land three metres either side of the Tara Hills water race will not be irrigated and will be fenced to exclude stock.
- 6.15 Manuka Creek crosses the south western corner of the WHL Killermont over a short distance adjacent to Shortcut Road. The irrigators would be set to avoid Manuka Creek, leaving a five metre buffer. Riparian vegetation would be re-established there similar to that described in paragraph 4.24 of this evidence. Irrigation will not occur on the south side of Manuka Creek.
- 6.16 The construction of the pipeline route would create a ribbon of disturbance along the road edge, across the flats and up the terrace. The surface would be

reinstated following the construction of the pipeline and the area sown in similar grasses to those already present.

Effects of the Proposal

- 6.17 Construction within the river bed and on the banks where the pipeline would cross would need to be undertaken with careful management to minimise the footprint of the activities and ensure the surface is reinstated and rehabilitated to a high standard. Provided this is done the effects of the construction activities can be expected to be minor, as they are limited in nature and any effects will be localised.
- 6.18 The construction of a holding pond and diversion race to hold water for irrigation is not expected to have any effects on the vegetation of the site beyond clearance of the area required. The pond may provide a small amount of alternative habitat for waterfowl, but given its small size and location near the Ahuriri River this is of limited benefit.
- 6.19 It is recommended that as the time of construction approaches the sites be surveyed for threatened birds that may be using the area. If threatened birds are found within the riverbed then methods will need to be developed to minimise the effects of the construction on them. This may include disturbing them so as to encourage them to nest elsewhere. As described in Section 2, this area is known to provide high quality habitat for threatened species.

Conclusion

- 6.20 The area proposed for irrigation on WHL Killermont is a vast flat plain with sparse vegetation which is almost entirely exotic. Soil loss can be expected to be ongoing on this depauperate pasture. Both Manuka Creek and the Tara Hills water race will be fenced to exclude livestock. Irrigation on this flat land would have a positive effect by creating a vegetative cover preventing further soil loss.
- 6.21 The Ahuriri River and its floodplain are of ecological significance since they provide habitat for a wide variety of birds and connect the habitats across the

plains. The vegetation at the time of the site visit did not support any particular values and the proposed intake sites are upstream of the area recommended for protection as wildlife habitat. If birds begin to use the riverbed at the intake sites then methods will need to be developed to minimise the effects of the construction on them.

7. KILLERMONT STATION

- 7.1 Killermont Station is split into two distinct parts, one to the north of WHL Killermont, between the Omarama – Lindis Pass Road and the Ahuriri River consisting of flat land (the “pebbly block” which is shown in purple in Figures 1 and 6) and the second to the west extending from Manuka Creek through to the Omarama – Lindis Pass Road consisting of similar terrain (also shown in purple in Figures 1 and 6). Killermont Station Ltd has applied to the Canterbury Regional Council for consent to take water from the Ahuriri River, Frosty Gully Dam and Manuka Creek to irrigate 619 ha of land, with each intake velocity and volume being adjusted to the source (Aqualinc 2009d). Of the 619 ha applied for 28 ha is already irrigated with water abstracted from Frosty Gully dam. An additional 41 ha is already irrigated on the property under an existing consent using water from Manuka Creek.
- 7.2 Killermont Station has proposed the use of four intakes to irrigate 619 ha of land. Two of the proposed intakes are existing structures, these being the Frosty Gully dam and the Tara Hills Race. The use of the Tara Hills Race will be controlled by a Memorandum of Understanding between Tara Hills Station, Omarama Station and Killermont Station (currently being drawn up). The other two intakes are located on the Ahuriri River and Manuka Creek both of which will employ an intake gallery in the bed of the river / creek. Manuka Creek will utilise a gravity fed system whereas the Woolshed intake from the Ahuriri River will require a pumping station. The pebbly block and an area to be supplied by Frosty Gully dam will be irrigated using K–line irrigators only, while the remaining areas will be irrigated using centre pivots, K–lines and a linear irrigator. The proposed layout for the centre pivots is shown in Figure 13.

- 7.3 The proposed land use is sheep and beef farming and cropping. On the pebbly block no livestock would be grazed and crops would be harvested and fed to livestock.

Proposed Works

- 7.4 Four intake points are considered for Killermont Station, two of these are existing structures (a dam and intake at Frosty Gully and the existing Tara Race) and will utilise the water resource without further land use changes. The other two intakes will be buried galleries in the beds of Manuka Creek and the Ahuriri River. The Ahuriri River intake is referred to as the Ahuriri Woolshed intake. The Woolshed intake is well upstream of RAP 14 (Figure 8).
- 7.5 Frosty Gully dam is located on the slopes above the valley and is shown on Plate 29. Above the dam is an area of forest identified as RAP 13 in the neighbouring Ahuriri Ecological District by Espie *et al.* (1984) shown in Plate 30. As noted earlier, no further construction is required in this area.
- 7.6 The pipeline from the Ahuriri Woolshed intake will cross State Highway 8 at or about NZMS 260 H39 558 276 and will consist of a single pipe buried to a minimum of 400mm.

Vegetation Description

- 7.7 The centre pivot irrigation area occupies flat land east of a long pine shelterbelt. The land is under cultivation, producing barley and oats as shown on Plate 31, and retains little natural value. The land west of the shelterbelt and farm road is also in cultivation and is currently grazed. Plate 32 shows the vicinity of the irrigation command area, with the K-line irrigation area on the flats in the foreground (in front of the pine tree shelter belt) and the centre pivot land beyond.
- 7.8 The “pebbly block” which lies between the state highway and the Ahuriri River has a sparse cover of mainly exotic grasses, with *Hieracium*, bird’s foot trefoil, stonewort, woolly mullein and occasional fescue tussock present (Plate 33). Along the edge of Tara Hills water race, which traverses this area, scattered

Chionochloa rigida and *Shoenus* sp. were present, along with exotic species and fescue tussock.

Water Intake Points

- 7.9 The Manuka Creek intake would be constructed within the bed of the existing creek channel, shown on Plate 34. The area is surrounded by rough pasture and shrubland, including mingmingi, native broom, *Coprosma crassifolia*, matagouri, mountain wineberry (*Aristotelia fruticosa*), briar rose and prickly shield fern (*Polystichum vestitum*).
- 7.10 The Manuka Creek pipeline will travel parallel to Manuka Creek and be a single pipe buried to a minimum depth of 400mm. The pipe travels through similar rough pasture and patches of shrubland. The surface contour will be restored and the area grassed following construction. I have not walked all the pipeline route, but given that the topography and grazing management are the same across the entire property I expect that it will be covered by similar vegetation to that occurring elsewhere in Manuka Creek which is described here.
- 7.11 The Manuka Creek intake location and pipeline route are near a large area of shrubland comprised of divaricating plant species such as those noted above, that covers the slopes on both sides of Manuka Creek. This forest and shrubland was not identified as a priority for protection and lies to the south of the remnant Hall's totara and mountain toatoa forest that was described as RAP 13 in the PNAP report for the Ahuriri Ecological District (Espie *et al.* 1984). Similarly the vegetation in Manuka Creek was not regarded as valuable enough to be included in the conservation reserve created as part of the tenure review process for Killermont Station. The majority of the shrubland is on the southern (true right) side of the creek, and the proposed pipeline route runs along the northern side of the stream. The construction of the pipeline will avoid passing through most of the shrubland, crossing rough pasture instead.
- 7.12 The Ahuriri River Woolshed intake is close to the state highway, and down a step bank (Plate 35). At the time of the site visit flood waters had recently modified the channel. The vegetation on the gravel banks adjacent to the site have a sparse cover of Russell lupin (*Lupinus polyphyllus*), sheep's sorrel, wild

carrot (*Daucus carota*), bird's foot trefoil, woolly mullein and exotic grasses such as browntop, There are scattered crack willow (*Salix fragilis*), matagouri, cotoneaster (*Cotoneaster glaucophyllus*) and hawthorn (*Craetagus monogyna*) present. The gallery would be constructed on the gravelly flats of the river bed. Again, this intake point is upstream of the area considered to be of highest conservation value for birds.

7.13 The road edge vegetation is generally a mixture of exotic grasses and herbaceous species with scattered briar and matagouri.

7.14 The irrigation command area avoids watercourses and hence there is no need for fencing of buffer zones along any streams.

Ecological Values

7.15 The ecological values of these areas are extremely limited. The poor vegetation cover of the pebbly block in particular is likely to result in ongoing soil loss year round. This may be ameliorated by the seasonal crop cover on the main part of Killermont Run.

7.16 The ecological values and effects of the Killermont Station areas are similar to those for WHL Killermont. The cultivated crop and grazing land has already lost almost all of its indigenous vegetation and the grazed "pebbly block" supports a very sparse vegetation cover also almost completely dominated by exotic species.

Effects of the Proposal

7.17 Construction of the Manuka Creek pipeline may require the removal of a small area of shrubland. The intake is located on the north eastern (downstream) margin of this shrubland, which extends upstream of the proposed intake for more than a kilometre. The removal of a small amount of habitat on the margin of this shrubland will have a negligible effect on the ecological functioning of the shrubland as a whole.

7.18 The construction of the Ahuriri woolshed intake will require some disturbance to the banks of the river to allow machinery access to the proposed gallery area

on the river bed, and there will be disturbance along the road edge to the point where the pipeline crosses onto Killermont Run. The vegetation cover here is of low value and no adverse effects of the construction activities appear likely.

- 7.19 The proposed irrigation will assist in preventing erosion from Killermont Station by ensuring that a vegetative cover is present over much of the land area. This will have more of a net environmental benefit than the current grazing practices being undertaken.
- 7.20 The cultivated crop and grazing land has already lost almost all of its indigenous vegetation and the grazed “pebbly block” supports a very sparse vegetation cover also almost completely dominated by exotic species. Irrigation would have the beneficial effect of assisting development of a ground cover that may minimise continued soil loss from the area.

Conclusion

- 7.21 Some of the land proposed for irrigation on Killermont Station is already used for cropping and retains little natural value. The “pebbly block,” which is not cropped, has a sparse cover of mainly exotic species. The poor vegetation cover is likely to result in soil loss year round. The proposed Manuka Creek intake is located within an area of rough pasture and shrubland. Given the current poor ecological values of the irrigation command areas and the pipeline and intake sites I do not expect more than minor adverse effects.

8. MITIGATION AND MONITORING

Fencing and revegetation along streams and creeks

- 8.1 Currently, stock have access to all of the streams and creeks on the properties. This generates sediment, increases erosion on the stream banks and increases the nutrient load of the water in the streams.
- 8.2 All of the streams on the Glen Eyrie Downs, Ohau Downs and WHL Killermont properties, shown on Figures 4-6 will be fenced to provide a five metre buffer

zone between irrigated and/or and grazed areas and the stream margins except a small section of Wairepo Creek. There are two ephemeral streams affected by the proposed irrigation on the Killermont Station property which will not be fenced. These streams only flow during 10-15 year floods and this situation is unlikely to change. Elsewhere stream buffers will be planted and/or oversown in order to provide a vegetative cover and left to regenerate. The riparian zone will remove nutrients as runoff and through-flow percolates across these riparian margins. Fencing and planting the buffers will create a ribbon of vegetation dominated by indigenous species that would have previously been found in the area. Through-flow and surface flows from irrigation may create a damper environment than would naturally occur. The vegetation cover can be expected to benefit from this and a lush growth than would naturally be expected may develop along these stream margins. The provision of a ribbon of fenced, well-watered, vegetation will not replicate the indigenous pattern of vegetation in this area but can be expected to provide habitat for invertebrates, birds and possibly lizards and will improve linkages to areas of more natural vegetation nearby, including the Wairepo Kettleholes Conservation Area on Glen Eyrie Downs, the QEII conservation area on Ohau Downs and (to a lesser degree) to the Manuka Creek shrublands upstream of WHL Killermont.

8.3 The planted areas will require monitoring and maintenance as follows:

- Check for mortality three monthly for the first year then six monthly and fill any gaps that occur over the first two years.
- Check for and remove visible woody weeds (gorse, broom, pines) from the riparian buffer zone. This should be carried out six monthly until a full cover has developed and then annually.
- Ensure fences are maintained and adequate to keep stock out of the buffer. This should be carried out six monthly (or whenever any breach is noted).

9. CONSIDERATION OF SUBMISSIONS

- 9.1 The submissions about effects on the terrestrial ecology at the sites where irrigation is proposed were concerned with the protection of habitat from ecological damage, protection against soil erosion and protection of indigenous biodiversity.
- 9.2 These submissions need to be considered in the light of the severe modification that these habitats have already been subjected to since human arrival. The sites have been substantially altered and native species richness, diversity and distribution across the irrigation sites is very limited. Generally the indigenous species are limited to riparian areas and the few limited areas that have not been previously cultivated. As outlined in Section 2.8 of my evidence, the cessation of grazing and burning is unlikely to restore native species because of the widespread presence of weeds such as hawkweed and wilding pines which respond very quickly when grazing animals are removed and will out-compete native species. This is what occurred on the Glen Eyrie property in the past. Active management would be necessary to improve the presence and diversity of native species at such sites and the fencing and planting as proposed combined with effective weed control will be an improvement over the current situation in that regard. Removal of stock will protect the indigenous species within the riparian area and the enhancement of this habitat will increase the connectivity of habitats across the plains via the watercourses that will be fenced.
- 9.3 An increase in vegetative ground cover is expected to result from the proposed irrigation and this will reduce soil erosion across the properties concerned.

10. OFFICER'S REPORT

- 10.1 The Officer's Report considers that the effects of the proposed irrigation include the loss of indigenous biota, the effects on terrestrial wetland ecosystems and the cumulative effects on the terrestrial ecology of the properties. These matters have already been addressed in my evidence and are summarised here.

- 10.2 The Omarama Ecological District is characterised by prolonged and severe modification. Limited indigenous ecological values remain outside of formally protected areas and those that do remain are subject to continued grazing and other habitat modifications such as cultivation and exotic forestry. Loss of soil, particularly due to wind erosion, is a significant problem and the persistence of native species and habitats in this setting is unlikely over the medium to long term without active management. The irrigation proposed by the applicant will restore a vegetation cover, albeit an exotic one, and bind the soil, preventing further soil loss. The retirement of riparian areas from grazing combined with planting of native species and removal of weeds will protect stream edge plant communities, prevent eutrophication of waterways, provide habitat and increase connectivity between formally protected areas of more natural habitat. This will also provide the opportunity to restore locally rare species such as *Hebe cupressoides* and *Carex tenuiculmis* to the area. I consider that these effects are positive for the indigenous biota of the district.
- 10.3 The terrestrial wetland ecosystems, including the streams and ephemeral wetlands will not be irrigated and will be buffered from the irrigation activity by fencing and planting.
- 10.4 Whilst the flat land on these properties has been extensively modified by pastoralism, some native species do remain and any increase in cropping and grazing pressure will result in their removal. This is likely to be the outcome if the area is not irrigated in any event.
- 10.5 The Officer's Report recommends that 50 m buffer zones be required to protect all streams, with a 100 m buffer for the Ahuriri River and 300 m buffer for roads. These figures appear to be derived from a landscape point of view rather than an ecological one and there does not appear to be any ecological reason for providing such a wide buffer, particularly with respect to roads. The Environment Canterbury guidelines indicate two or three metre buffers are adequate to protect aquatic ecosystems from the effects of intensive farming. Five metre buffers with zoned planting (to increase nutrient stripping) are proposed.

- 10.6 The cumulative effects of human occupation in the Mackenzie Basin have adversely affected the terrestrial ecology of the area since human arrival. Natural plant communities are rare in the Omarama District and active management is required to prevent soil erosion and colonisation, particularly by hawkweed and wilding pines. The areas that do support native plant communities are not within the irrigation footprint, and those that remain along riparian margins will not be irrigated. The exotic vegetation cover will help protect soils, while regular monitoring and removal of weeds from riparian buffers will ensure a predominantly native community develops. Without irrigation and with continued grazing further loss of native species and soils can be expected to continue.

11. CONCLUSION

- 11.1 Areas of significant ecological value are found on three of the four properties proposed for irrigation, but the irrigation command areas have been designed to avoid these areas.
- 11.2 The proposed irrigation command areas cannot be considered significant using criteria under the Partly Operative Plan since they have been extensively modified by a history of pastoral improvement, oversowing, burning, grazing and invasion of exotic species.
- 11.3 The potential exists for runoff of irrigation water into the ecologically valuable QEII covenant area and Wairepo Kettleholes Conservation Area from Glen Eyrie Downs. The station manager will monitor these areas once irrigation begins, and if runoff is seen to be occurring, the irrigation will be modified to prevent it. Provided such monitoring is carried out frequently and any modification made promptly this approach is appropriate to prevent adverse effects on these sites.
- 11.4 Irrigation is expected to result in an increase in exotic vegetation growth which will increase ground cover, reduce the amount of bare ground and reduce soil erosion. Increased grazing and cropping pressure is likely to result in the loss of the very limited remaining indigenous component of the vegetation on the

irrigated areas, however the ecological values of these areas are already very low. In the absence of irrigation and with the continuation of existing land use practices it is unlikely that there would be any improvement in the indigenous component of the vegetation and soil loss would continue.

- 11.5 The features within the command areas that retain ecological value on Ohau Downs and Glen Eyrie Downs are the watercourses. The provision of a fenced, planted and un-irrigated five metre buffer along the watercourses (with the exception of a part of Wairepo Stream, as described) and the cessation of grazing in these areas will encourage regeneration toward an indigenous cover in the long term. Trees and shrubs along the outer margins of the buffer zone are expected to improve water quality by removing phosphorus from runoff while the use of grasses, sedges and tussocks closer to the streams will improve denitrification. This will result in a positive improvement in the ecological values and water quality of these areas
- 11.6 Creating the intake, pumping and pipeline infrastructure across the land between the Lake Ohau intake points at Maori Bay and near the Ohau River will require the removal of some shrubland and tussock grassland vegetation. The area that will be cleared to enable this construction is small. Provided the surface is reinstated and a vegetation cover consistent with the surrounding vegetation is encouraged, the effects on the ecological values and functioning of the ecosystems there will be minor.
- 11.7 The Ahuriri River locations proposed as options 1 and 2 for the WHL Killermont intake and the Ahuriri Woolshed intake are upstream of an area recommended for protection under the PNA programme because of its particular importance as habitat for breeding river birds. The bed of the Ahuriri changes reasonably frequently, therefore it is recommended that the intake locations be surveyed for threatened birds at the beginning of the nesting season, prior to commencing works. Methods to discourage nesting birds may need to be implemented in the intake area.
- 11.8 The construction of the Manuka Creek pipeline may remove a small amount of shrubland habitat and areas of rough pasture. Their removal will have limited

effects on the ecological integrity of the shrubland in this vicinity and the effect will be minor.

- 11.9 It is my opinion that the proposed irrigation will have a less than minor effect on the terrestrial ecology of the properties concerned. The proposal will not irrigate areas of ecological value where native species are common and will restore vegetation cover to areas of depauperate and degraded pasture. Active management of the riparian buffers will protect native species at the expense of invasive weeds and restore habitat connectivity with other areas of natural habitat nearby.

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PLATES

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APPENDIX 1

Relevant current and previous projects

Some relevant current and previous projects that I have undertaken include:

- Mahinerangi Windfarm (terrestrial ecology evidence).
- Project Hayes Windfarm (terrestrial ecology evidence)
- Mokihinui Hydro Scheme (terrestrial ecology evidence).
- Wairau River Hydro Scheme (terrestrial ecology peer review and evidence).
- Hillend Station (ecological advice).
- Queenstown Airport Runway Extension (ecological report).
- Shotover River Gravel Extraction (ecological evidence).
- Matahina Hydro Scheme (ecological report).
- Huntly Power Station (terrestrial ecology reports, evidence and management of riparian enhancement project).
- Tongariro Power Development (preparation of AEE documentation).
- Cypress Mine Project (terrestrial ecology reports, management of other technical inputs, AEE preparation and provision of evidence).
- Patea River Hydro Scheme (terrestrial ecology reports).
- Stockton Mine management of water-related resource consent acquisition; surveys of existing and potential habitat for *Powelliphanta* “Augustus”; ongoing advice on rehabilitation.
- Arnold River Hydro Scheme (terrestrial ecology peer review and evidence.
- Mountain Landing subdivision (terrestrial ecology evidence, ongoing ecological restoration advice).