Before Queenstown Lakes District Council

In the matter of	The Resource Management Act 1991
And	The Queenstown Lakes District proposed District Plan Topic 08 Resort Zones

STATEMENT OF EVIDENCE OF JOHN DARBY FOR

Jacks Point Residential No.2 Ltd, Jacks Point Village Holdings Ltd, Jacks Point Developments Limited, Jacks Point Land Limited, Jacks Point Land No. 2 Limited, Jacks Point Management Limited, Henley Downs Land Holdings Limited, Henley Downs Farm Holdings Limited, Coneburn Preserve Holdings Limited, Willow Pond Farm Limited (#762, #856 and #1275)

Jacks Point Residents and Owners Association (#765, and #1277)

Dated 3rd February 2017

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QUALIFICATIONS AND EXPERIENCE

1 My full name is John Gerard Darby

2 I am the Director of the Jack's Point companies as noted, further referred to as the Jack's Point Group (JPG) and I am authorised to give evidence on their behalf.

3 I am also a Director of the planning and design consulting firm Darby Partners. I have a Bachelor of Horticulture and a Postgraduate Diploma in Landscape Architecture from Lincoln University and am a Fellow, of the New Zealand Institute of Landscape Architects.

4 For the past 40 years I have practiced as a Landscape Architect, master planner and golf course architect both in New Zealand and overseas, as well as undertaking specialist post graduate studies in community planning and golf resort design at the Harvard University Graduate School of Design Cambridge USA.

5 I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note. This evidence has been prepared in accordance with it and I agree to comply with it. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

6 Darby Partners have been retained by the JPG to provide master planning, development management and design services for the JPG properties, that cover approximately 560ha of the Zones total 1200ha, and includes the existing golf course, open space, the village precinct and the wider Hanley Farm as well as parts of its undeveloped residential precincts, as illustrated on the attached plan showing land ownership within the Jack's Point Zone.

7 I have been closely involved in the planning and development of Jack's Point since its inception. I first walked over the property in 1987 when it was part of Remarkables Station and I was scouting for suitable sites for the development of a golf course resort. Later that year I settled on and developed another property. Like Jack's Point, Millbrook from its onset, was conceived and planned as an integrated resort living community that provided for the needs of both visitors and locals alike. Visitor and residential activities were carefully sited within areas of mandated open space incorporating a golf course, trail network and shared sportsground with neighbouring Arrowtown. The master planning, design controls and administration of what was one of New Zealand's first private mixed use communities required careful consideration with Millbrook being the first of the Special Zone open space properties in the then new District Plan.

8 My evidence provides a brief history and overview of the Jack's Point Zone and under the District Plan Review, how the Zone can better address changing circumstances of land ownership, growth demands of the District and new opportunities for achieving a vibrant, well-integrated self-sustaining community for both residents and visitors alike.

THE HISTORY AND RATIONALE OF THE JACK'S POINT ZONE

9 In 1993, the Queenstown Lakes District Council commissioned the preparation of a settlement strategy to assist in decision making related to urban growth issues. The settlement strategy identified the Coneburn area as having 'considerable potential' for future residential development. The Proposed Queenstown Lakes District Plan, notified in 1995, further identified this area as suitable for 'new town' development by introducing a 'New Residential Development Zone' (NRDZ). In 1998 the decisions on the Proposed District Plan submissions were released. The NRDZ was subsequently deleted from the plan at the conclusion of a submission process due to debate around the legality of deferred zones, and replaced with a policy identifying the Jack's Point area's potential to accommodate Queenstown's future growth and a range of matters that would be addressed by way of a later variation to the District Plan.

10 In 2002 the Council initiated a variation for a special Jack's Point Zone over an area of approximately 420ha that largely now coincides with the current developed area of the zone. The Structure Plan for this original area of the Zone was based on very detailed site studies by a team of resource planning specialists and included detailed computer mapping and analysis of the landscape, and factors such as geology, topography, soils, ecology, hydrology, land use and its visibility from adjacent public viewpoints. The combination of these factors enabled the identification of the area's suitability to absorb change and direct the form and scale of development to appropriate parts within the site.

11 In submissions, the owners of neighbouring properties sought to extend the Zone to the north over Hanley Downs and to the south over Homestead Bay, an area of approximately 780ha and a total zone area of approximately 1200ha.

12 The Council requested that the detailed site resource study that was undertaken for the original Jack's Point Zone area be extended over the wider Coneburn area to better assist the Council in evaluating submissions and to ensure development is restricted to appropriate areas within the Coneburn sub-district.

13 The absence of detailed contours over the Hanley Downs farm area limited the accuracy of some of the computer modelled visibility, slope and aspect mapping which are important factors used to identify areas capable of absorbing varying levels of building development. Nonetheless, the study was progressed at a

high level and the specialist team involved erred on the cautious side when identifying suitable areas of the development due to the lack of detailed site information. That study, referred to as the Coneburn Area Resource Study (CARS 2002) became the foundation document and formed the basis of the Structure Plan for the wider Jack's Point Zone.

14 Another anomaly, that arose when agreeing the final expanded Structure Plan between the owners, was the addition of a second Village activity area of 13.8ha located on the neighbouring Hanley Downs property. This was based on the "logic" that the original Jack's Point Zone had 72ha of residential activity area and 15.2ha (correctly 18ha as per the approved ODP) of village activity area. Hanley Downs activity areas added another 45ha of residential activity area and therefore "required" another 15.2ha of Village activity area.

15 The landowners also agreed to various other arrangements such as community administration, capital contributions and cost sharing in respect to maintenance of infrastructure (roading, waste treatment, potable water, power and telecoms) and open space areas and trails to be administered by one overall Resident and Owners Association. The ODP required that between 10-12 residential dwellings per hectare (gross) of residential activity area be developed resulting in a maximum of 540 dwellings on Hanley Downs and 864 dwellings within the original Jack's Point Zone area. This along with Homestead Bay's activity area's proposed 152 dwellings and 6.22ha commercial precinct formed the basis of fair pro rata cost share formula between the land owners (and their successors in title) based on dwelling equivalents.

16 In 2007 a listed Australian residential developer, Residential Communities Limited (RCL), acquired the undeveloped Hanley Downs residential and village precincts. A long period of inactivity followed due to RCL's financial restructuring and the adverse prevailing economic conditions through to about 2013.

UPDATING THE JACK'S POINT MASTER PLAN

17 Jack's Point Group acquired 563ha of the original Hanley Downs property in 2011. Based on more detailed topographical mapping, ecology, landscape and visibility mapping was undertaken to better refine the Land Use and Landscape Management Plan for the Hanley Downs wider area and the updated Coneburn Area Resource Study 2015 (CARS 2015); a copy of which is appended to my evidence.

18 The Jack's Point Zone Structure Plan as notified in the Proposed District Plan was based on the updated CARS 2015. Mr Duane Te Paa's evidence will cover the proposed refinement to the Structure Plan arising from caucusing between Council's Landscape Architect, Dr. Read and Jack's Point Group's

Landscape Architect, Yvonne Pfluger. The refined Structure Plan and related amendments to the provisions for the Jack's Point Zone, are fully consistent with the CARS 2015 and its anticipated landscape management outcomes.

19 The CARS 2015 also supports expansion of the Residential (R) activity areas in Hanley Downs valley floor area. The measured areas of the expanded R activity areas is approximately 146ha. The extent of linked open space and maximum number of permitted dwellings however is difficult to predict due to the density of dwellings in R(HD)activity areas being expressed in varying ranges and on a dwellings per net hectare basis (i.e. after deduction of anywhere between 20-40% for roads and open space) as opposed to on a gross hectare basis (before deduction of roads and open space) as used for the Jack's Point Residential and Village activity areas. This has led to considerable confusion on overall residential yield in R(HD) activity areas and concerns from existing residents on infrastructure capacity and possible adverse effects from stormwater run-off into Lake Tewa or the neighbouring wetland known as Willow Pond.

20 I support the provisions in the Jack's Point Zone providing for a range of residential options from the higher density living within what is now one central pedestrian focused Village precinct, radiating out to increasingly lower density options on the peripheral areas. It is important that adequate areas of green open space, linked pedestrian, cycleway networks, and parking be provided for as residential density increases. Accessing permitted residential density on a dwellings per net hectare basis leaves the developer to determine the extent of open space beyond the minimum required to create functional access and meet minimum parking requirements (assuming that is controlled by subdivision). Therefore to create open space, the developer is having to forego what is otherwise potential residential yield: a decision that I don't believe should be left solely in the hands of a developer.

21 For several reasons, I believe residential density in greenfield developments should be set on an activity gross area basis (before deduction of areas for roads and open space) or have specific open space performance standards that increase with density. I concur with Council's urban design expert that the minimum permitted residential lot size should be 380m². To develop housing on lots below 350-400m² requires a comprehensive development approach and in my experience, increases development costs significantly and therefore doesn't improve home affordability at all. Typically, the 10-12 residential dwellings per hectare in R(JP) activity areas equates on gross basis equates to 12.5-15 dwellings on net basis if 20% is lost to roads only as large open space areas are already provided for in between R(JP)activity areas. Applying a minimum lot size of 380m² typically equates to 21 dwellings per hectare on net basis if 30% is lost to roads and open space. Therefore, it is improbable that single family homes in R(HD) activity areas could ever exceed 20-24 dwellings

per hectare when measured on a net density basis. The upper permitted density in the R(HD)E activity area at 45 dwellings per hectare is more than double the density arising from the minimum lot size and accordingly has created considerable confusion and concern as to the living quality of those neighbourhoods and their effect on surrounding areas.

22 Another reason that residential density should be set on an activity gross area basis is the ability to more accurately forecast residential yield, which is a critical outcome for planning and funding infrastructure in any large greenfield development. It is also critical for the Resident and Owners Association or Council charged with maintaining said infrastructure or having to later upgrade capacity to meet the permitted entitlement.

23 In summary, I believe the Jack's Point Zone can and should provide for a balanced mix of housing types within a permitted net density of up to 24 dwellings per net hectare or 18.5 dwellings per gross hectare. Development beyond such densities is not conducive to creating quality neighbourhoods for family living. Such developments are better located in the Village activity area which is subject to a Comprehensive Development Plan that addresses the many issues typically arising from higher density development. Mr Brett Thomson, a Landscape Architect and master planner that worked on the original Jack's Point Village Master Plan, will address this point in greater detail in his evidence.

COMPLETION OF THE ORIGINAL VISION FOR JACK'S POINT

24 JPG controls 563ha being approximately 50 percent of the Zone's area. Of the 563ha approximately 500ha is to be managed in perpetuity as either golf course or protected natural open space managed primarily for low intensity recreation, conservation and appropriate low intensity grazing.

25 An important final component is the development of Jack's Point Village to create a single vibrant and sustainable community hub centrally located to service the surrounding residential neighbourhoods, and meet the needs of the growing numbers of residents and visitors to the Queenstown district. To create a successful village environment, it is essential that commercial activities such as hotels, visitor accommodation and mixed use buildings (those incorporating a mix of retail, restaurants, offices and residential living), should be restricted to the village precinct and not otherwise enabled in the surrounding residential activity areas. This restriction has always been in place in the Jack's Point residential activities area and the same restriction should also apply to the Henley Downs residential activity areas. This eliminates the risk of medium density housing defaulting into hotel use and its adverse effects on the quality of residential neighbourhoods. Visitor accommodation is better located in the

central village precinct with its pedestrian character and its easy linkages to both public transport, open space networks and recreational amenities.

26 Two key drivers of the first stage of the village are therefore the delivery of a higher density local living product from affordable entry level town houses or apartments through to retirement living options and visitor accommodations, all located within a cohesive pedestrian focused environment. Brett Thomson's evidence will expand upon several critical matters that have been raised in the context of the District Plan review that are essential to the delivery of a vibrant and sustainable community hub.

27 Duane Te Paa's evidence will address matters concerning the finalisation of the last phase of the Preserve Homesite programme. Finalising this last element will enable a significant area of natural open space to be permanently held for open space protection and managed solely for its recreational, landscape, and conservation values.

28 Confirmation of the final 22 Preserve Homesites; a consolidated one village activity area of approximately 26ha, and provision of 12ha of residential in place of the EIC activity area; remain consistent with the original vision for the Jack's Point Zone and are important economic outcomes that allow a significant area of approximately 400ha to be dedicated as protected natural open space; a key component for completion of the Jack's Point Master Plan.

Dated this 3rd day of February 2017

John Darby

762/856/1275, 765/1277

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APPENDIX 1 – JACK'S POINT ZONE OWNERSHIP PLAN

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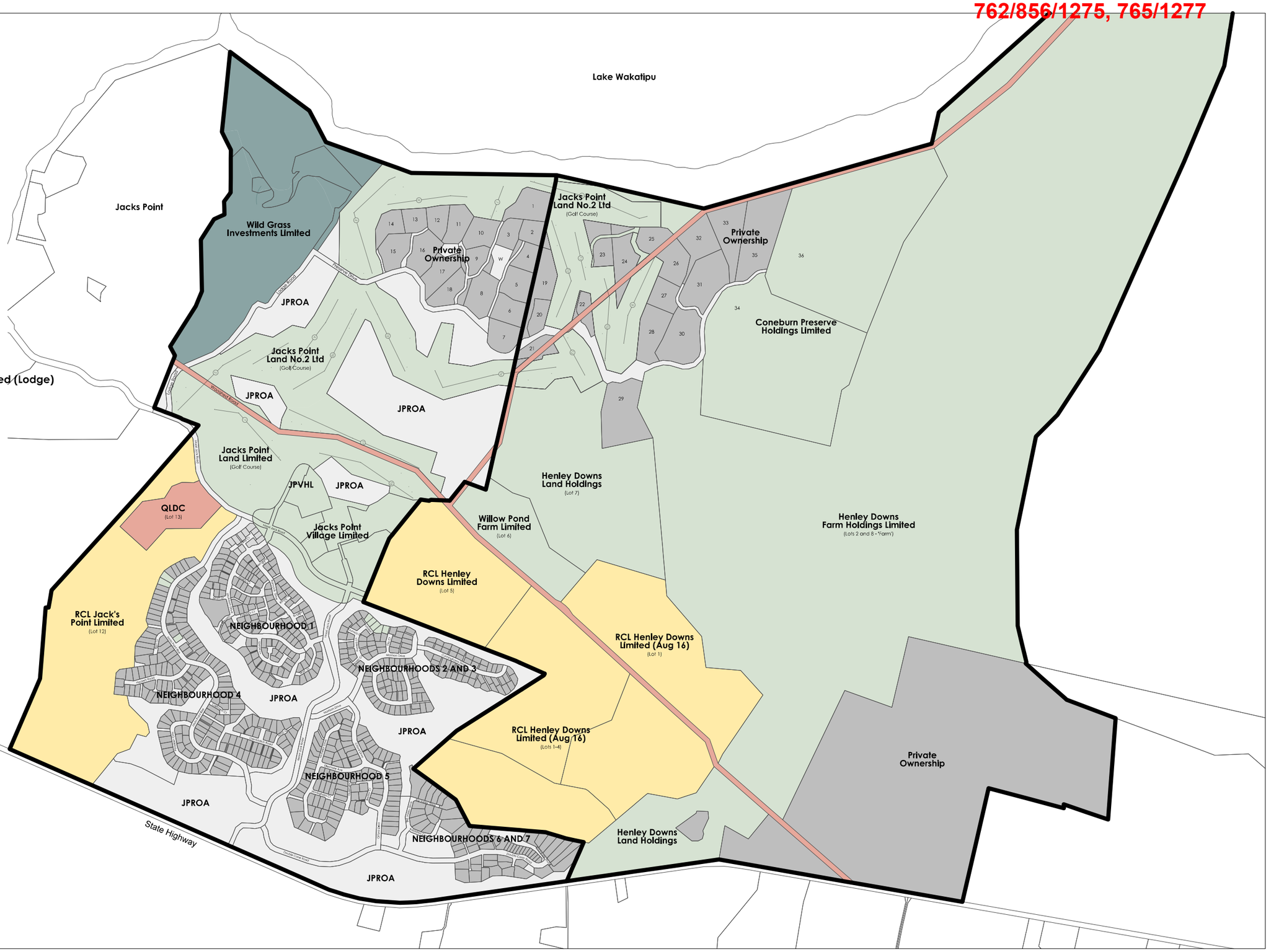
KEY:

563Ha	**Jacks Point Group Entities** 50% of Total Land Area
210Ha	**Private Ownership** 19% of Total Land Area
148Ha	**RCL Entities** 12% of Total Land Area
143Ha	**JPROA** 12% of Total Land Area
42Ha	**Wild Grass Investments Limited (Lodge)** 4% of Total Land Area
20Ha	**QLDC/Crown** 2% of Total Land Area



V:\JP_Jack's Point\29_District Plan Review\2_Consents\CAD\JD Evidence_Land Ownership).dgn

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SCALE: 1:7,500 (A1); 1:15,000 (A3)

0 50 100 250 500m

CONSULTANTS:

NOTES:

Disclaimer:

Every precaution has been taken to establish the accuracy of the information set out here. Prospective purchasers should not confine themselves to the property information set out here and should make their own independent enquiries to satisfy themselves on all respects prior to entering into an agreement to buy. Jacks Point Management Limited, Darby Partners Limited nor any related company will accept any responsibility in respect of any errors, inaccuracies or misstatements contained herein, should any details prove to be incomplete or incorrect.

REVISION:

NO	DESCRIPTION	DATE	DRAWN	REVIEWED	APPROVED
-	For Evidence	03.02.17	ZC	TG	JD

JACK'S POINT & HENLEY DOWNS

LAND OWNERSHIP

APPENDIX

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APPENDIX 2 - CONEBURN RESOURCE STUDY 2015

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762/856/1275, 765/1277

Coneburn Area Resource Study

October 2002

Revised June 2015

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REVISION - JUNE 2015

Coneburn Area Resource Study

RESOURCE STUDY CO-ORDINATION BY DARBY PARTNERS LIMITED

OTHER CONSULTANTS:

Ecology	Boffa Miskell Limited
Geologist	Royden Thompson
Infrastructure Services	Ken Gousmett
Landscape Architects	Darby Partners Limited
Resource Management	John Edmonds and Associates

NOTE:

Document Reviewed by Carl Lucca (Principal Planner) and Liz Kidson (Principal Landscape Architect)

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0.0 Coneburn Resource Study

2015 Update

Introduction

The Coneburn Area Resource Study was commissioned by the Queenstown Lakes District Council in October 2002 with specialist input from ecologists, geologists, landscape architects, hydrologists and planners. The study informed the then variation to the District Plan relating to Jacks Point over a wider catchment. The forthcoming review of the Queenstown Lakes District Plan and private plan change 44 have been the catalyst for a re-examination of the outcomes of the Coneburn study to ensure that it remains relevant to present and future needs.

The purpose of this document is to record what elements of the environment (natural and physical) have been modified since the original study, how that has impacted on the findings and analysis of the Coneburn study and to present updated plans so that the study continues to provide the type of high level guidance relating to the management of change within this area.

This update reviews the Coneburn Study and is presented in a format that summarises the most significant changes that have occurred or that are proposed to occur within this environment. This update will support the evidence and changes to the Jacks Point area through Plan Change 44.

The original Coneburn Study outlined a detailed methodology for its formulation, involving the mapping of natural and cultural elements in the landscape, visibility, vegetation and the identification of landscape character areas and their ability to absorb change.

Since this study was formulated, the zoning of the area has been confirmed through the operative district plan and over a decade of residential development has occurred. That development has resulted in the construction of approximately 170 houses, together with the Jacks Point golf course, club house, reserves, open space and the installation of private infrastructure and roading access throughout the Jacks Point area. For the most part, development has generally followed the outcomes anticipated through the Coneburn study. The two parts of the Jacks Point area included within the original Coneburn study that have yet to undergo any significant development are the areas of Homestead Bay and Hanley Downs.

This update to the Coneburn study is presented in three parts, as follows:

- Change within the Coneburn area
- Resource Analysis
- Updated Plans

Landscape Change and Existing Development within the Coneburn Area

In the decade since the development of the original Coneburn study, Jacks Point and the Queenstown Lakes District have undergone significant change in terms of population growth, the distribution of development and associated infrastructure.

In physical terms, Jacks Point has transformed from a working rural landscape to a significant community containing approximately 170 houses (constructed), an 18 hole championship golf course, club house and other recreation amenities and open space. Development has modified the physical environment through the addition of road corridors and land modification to accommodate housing. This has included subtle changes to enhance natural landforms to reduce the visibility of development within Jacks Point, particularly when viewed from the State Highway.

Within the development significant areas of new native planting have been implemented which helps to establish screening vegetation (State Highway) as well as enhancing areas throughout the settlement where planting builds on natural patterns such as streams, gullies and terrace escarpments.

In addition, Jacks Point has created a manmade lake (Lake Tewa) at the centre of the settlement that provides the setting for waterfront development within a backdrop of surrounding open space and recreation activities.

The planning provisions for Jacks Point in this time have also changed to provide a focus on the containment of growth to within identified urban areas. The Council has driven the formulation of studies for Queenstown which has included Tomorrow's Queenstown 2002 and the Growth Management Strategy 2007. These have resulted in a move towards policies of containment of urban growth through changes and updates to the District Plan. Jacks Point now fits within the broader Queenstown urban area and is subject to the policies which seek to manage change within that area.

Many aspects of the physical environment have not changed and the following plans are unchanged through this update:

- Figure 5 – Hydrology and Overland Flow Paths

  Lake Tewa is not shown but is a new manmade feature that contributes towards the management of stormwater and overland water flows.
- Figure 6 – Geology
- Figure 7 – Soils Map
- Figure 9 – Slope Analysis

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New and Updated Plans

- **Figure 3** – Cadastral, Tenure and existing land use **REV A, JAN 2015**
- **Figure 4** – District Plan Zoning **REV A, JAN 2015**
- **Figure 8** – Ecology/Vegetation **REV A, JAN 2015**
- **Figure 10** – Visibility Analysis **REV A, JUNE 2015**
- **Figure 10.1** – State Highway Mitigation **REV, JAN 2015**
- **Figure 11** – Landscape Character **REV A, JAN 2015**
- **Figure 12** – Potential to Absorb Change **REV D, JUNE 2015**
- **Figure 14** – Landuse Landscape and Management Strategy **REV D, JUNE 2015**

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View of the Coneburn Area from Deer Park Heights

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1.0 Introduction

This report presents the results of an area wide resource study of the Coneburn District. The study has been commissioned by the QLDC and prepared by a specialist team of resource consultants coordinated by Darby Partners Limited. The purpose of the study is to provide the QLDC, community and landowners in the Coneburn District with objective resource information for the area, a review of existing and potential land uses, an analysis of current planning policies, and guidelines for the ongoing management and development of the Coneburn area with particular regard to landscape and ecological values, public access and recreation, services and infrastructure.

The information contained within this document provides greater depth to the previous Section 32 Analysis undertaken for the Jacks Point Variation, by extending the study beyond the Jacks Point area to the greater visual and physical catchments of the Coneburn Area.

The study provides a resource based context for a number of current unresolved planning issues and concludes with guidelines for formulating a land use and landscape management strategy for this important area.

2.0 Methodology

The study approach is based on a traditional landscape planning methodology. Natural and cultural factors such as landform, vegetation and land use are computer mapped and overlaid in order to break the study area down into discrete landscape units or character types. The study area's visibility from public viewpoints is also computer mapped and analysed. Visibility combined with the landscape character provides a useful planning tool to identify the types of landscapes within the study area and their ability to absorb change. This information combined with other resource data enables site specific guidelines to be developed and a land use for a landscape management strategy for the Coneburn area.

The study can be broken down into four distinct phases leading to the conclusion of a strategy, (refer 2.1 Methodology Flow Chart).

Stage 1 **Resource Studies & Information Gathering**

Individual resource studies such as geological and ecological surveys were undertaken by appropriate specialists. Ten resource studies were undertaken for this study area. The layers of information compiled provide a good general understanding of the study area, its physical and visual make-up.

Stage 2 **Resource Analysis**

The above information is then analysed, looking for patterns in the landscape, which help to categorise it into discrete landscape units that possess similar characteristics (refer Figure 11). These units are not hard edged and the boundaries exist as blurred transitions, as one landscape type merges with another.

Other source data relating to both district planning and infrastructure, public access and recreation are also gathered to complete the Resource Analysis.

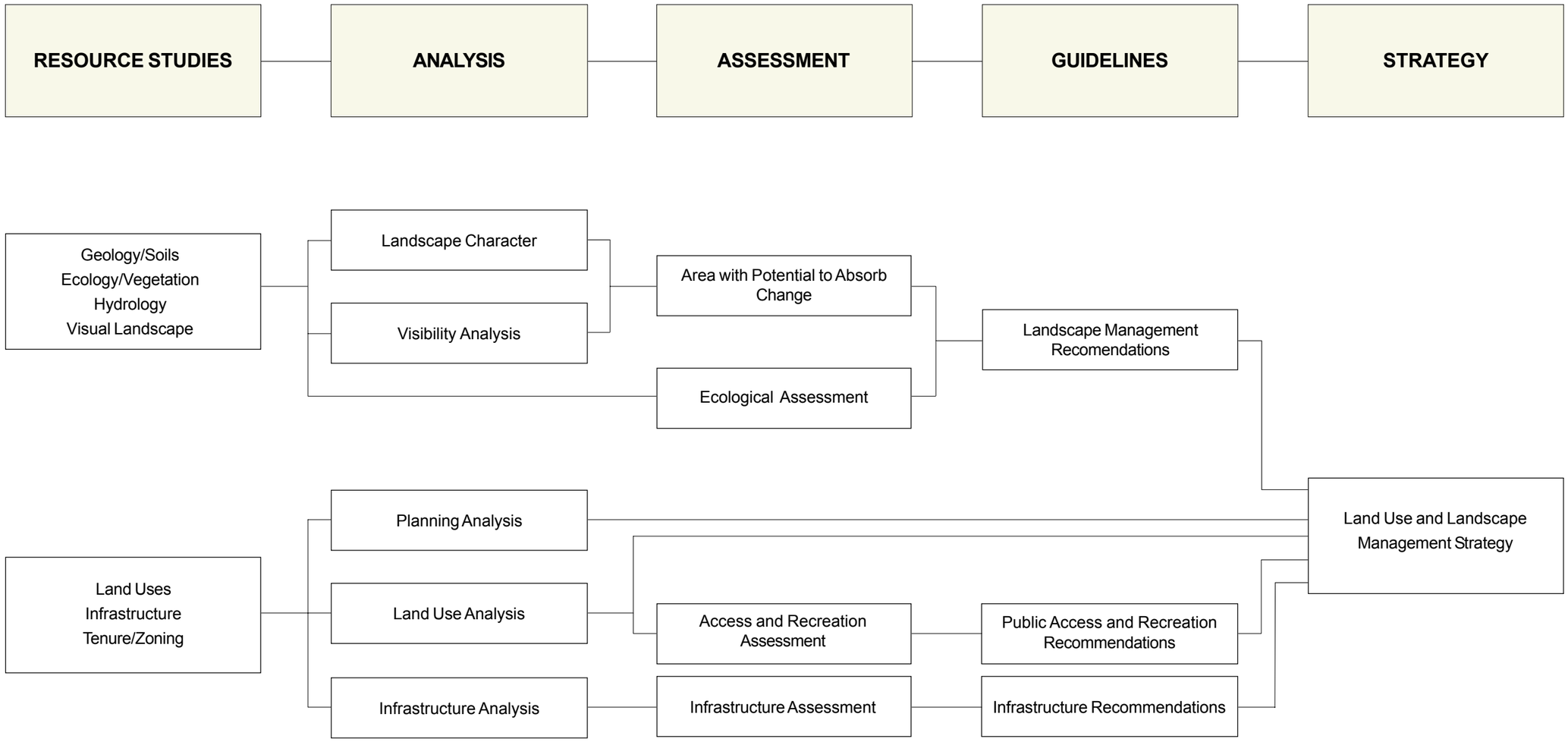
Stage 3 **Resource Assessment**

The study area is then assessed and categorised in terms of its 'Ability to Absorb Change' together with an assessment of the areas ecological heritage, access and recreation potential. The area's infrastructure to support development is also assessed.

Stage 4 **Resource Summary & Recommendations**

Tabulation of Stages 1 through 3, with recommendations in respect of Landscape Management, Infrastructure, Public Access and Recreation.

2.1 Methodology Flow Chart



3.0 Coneburn Study Area

The study area (refer Figure 1) is located 10 minutes drive south of Frankton Village, approximately 10 minutes drive from Queenstown airport and comprises approximately 5000ha (12,500 acres). The study area is clearly defined by topographical and physical boundaries, which the aerial photograph clearly illustrates (refer Figure 2).

The boundaries for the study are defined as follows:

- To the east is the Remarkables
- To the west is Lake Wakatipu
- To the south is Wye Creek
- To the north, is the back of Deer Park Heights

The study area has a varied and complex topography, comprising a lake escarpment along the entire western edge, rising up to an elevated schist ridge extending from Jacks Point in the south to Deer Park Heights in the north. This ridge then descends to the east into a central valley that is flat to slightly undulating. From here the terrain rises again giving way to a hummocky, channeled topography adjacent to the Highway. Outwash fans dominate the base of the Remarkables. To the south, the Remarkables descend down to the edge of Lake Wakatipu.

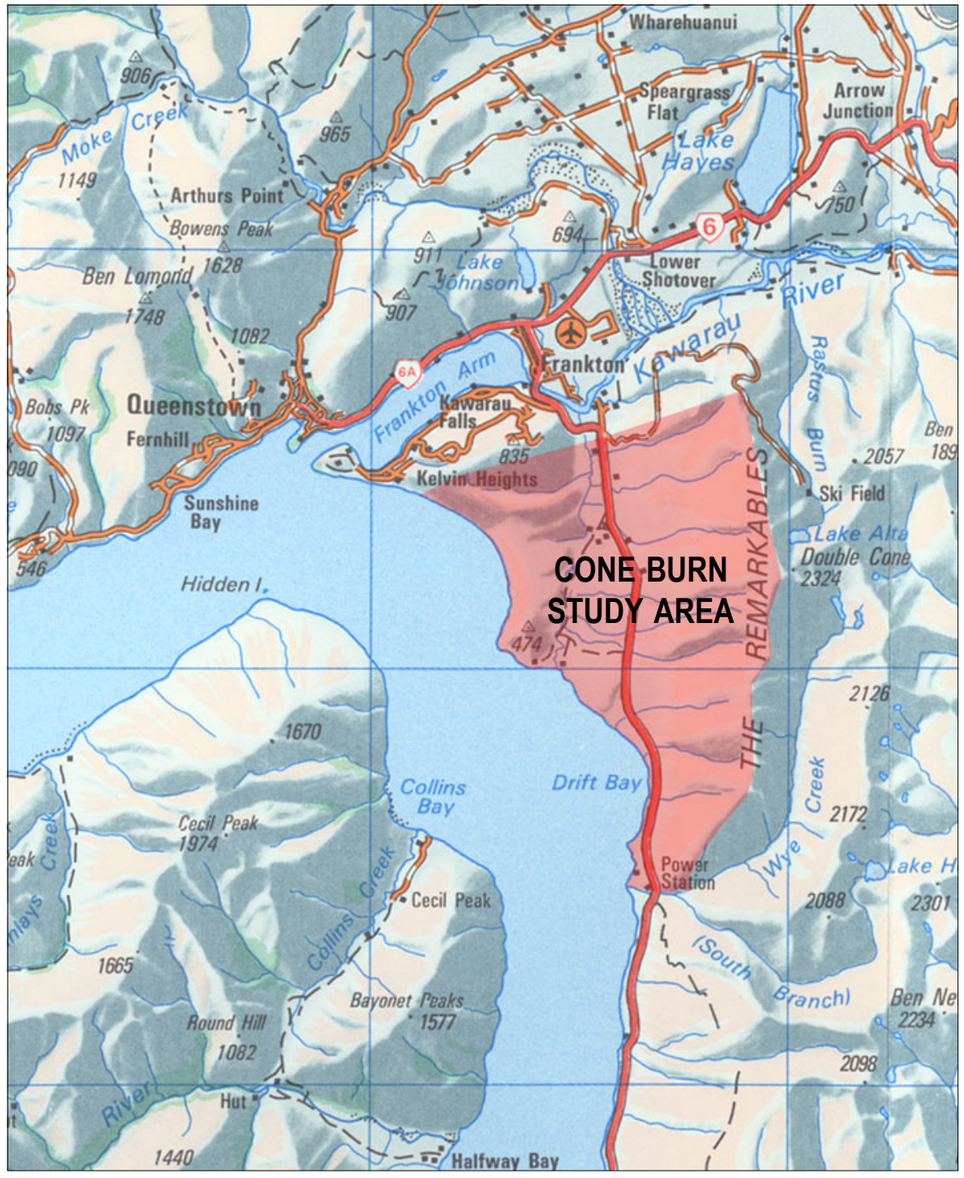


Figure 1 - Location Plan

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NORTH

KEY

Study Area Boundary

Cadastral Boundaries

GRAPHIC SCALE

0 0.5 1 1.5km

FIGURE 2
AERIAL PHOTOGRAPH

coneburn area resource study

scale 1:30,000 july 2002

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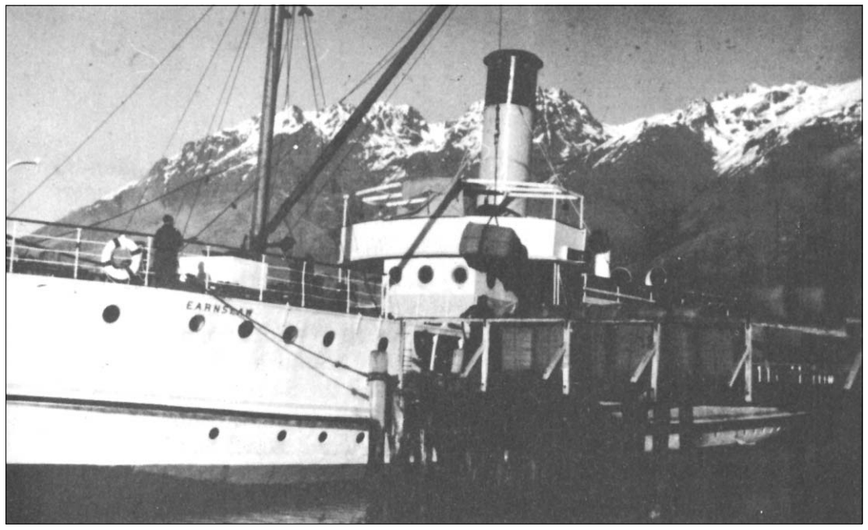
4.0 Resource Studies

4.1 Historical/Cultural/Heritage



The Earnslaw taking on a load of wool at the Woolshed

4.1.1 Pre European Period

Prehistoric use of the interior is well known from archaeological, historical and traditional sources. Routes to the interior from the coast often followed river courses, and while inland journeys would be made on foot, the return to the coast would often be made by raft back down the river. The "Natural Bridge" over the Kawarau River near the Roaring Meg was the crossing point on one of the inland routes, and continued in use into the historic period.

These inland journeys were made for a variety of reasons. Most commonly they were for resource-gathering. Prior to the extinction of the Moa, hunting expeditions were made in pursuit of these birds, and numerous moa-hunting sites are known in Central Otago. Lithic resources were also very important, with nephrite (pounamu) now being the best known, but other materials such as silcrete was also sought. Movements into the interior during periods of warfare also occurred. Historically, eeling trips were documented by a number of early European observers, as were the remains of a number of village and campsites.

However, it is unlikely that the area under study was ever intensively used by Maori. Communication along the lake would have been by canoe, particularly as the eastern shore is very rugged. A good landing is to be found to the south, by the Remarkables Station homestead, but the shoreline of the study area itself is steep and rocky. There are no recorded archaeological sites in the area, and the landowner of Remarkables Station has found no evidence of prehistoric activity.

4.1.2 European History

Historically, the first European to venture into the interior was Nathanial Chalmers in September 1853. He was guided by the chief Reko from Southland, up the Mataura River, crossed the Natural Bridge over the Kawarau, and reached as far as the Clutha at Lake Hawea before he became too ill to travel. Reko constructed a mokihi (flax raft) in which they travelled down river to the coast. By the end of the decade the pastoralists had begun to move into the area, taking up depasturing licences over large areas of land. This settlement was rapidly followed by the Otago goldrushes of the early 1860s, which brought vast numbers of miners to the interior, closely followed by merchants, hoteliers, packers etc. Canvas towns quickly grew up and died as rushes occurred and died away, although some of these towns survived to become regional service centres. Queenstown grew up on the site of W G Rees station buildings and is now the main local centre.

4.1.3 Brief History of the Remarkables Station – Coneburn

Towards the end of January, 1860 a party set out from Dunedin to penetrate the relatively unexplored central region of Otago in search of suitable pastoral lands. They made their way inland via the Waitaki river and the Lindis Pass. After making an extremely hazardous and costly crossing of the Clutha river and many disappointments in their search, only two of the party decided to continue – W G Rees and N P B von Tunzelman. About February 12 they surmounted the Crown Range and the great Wakatipu Basin lay before them.

They spent several days investigating the area and decided to apply for grazing rights, Rees on the eastern side of the Lake and von Tunzelman on the west.

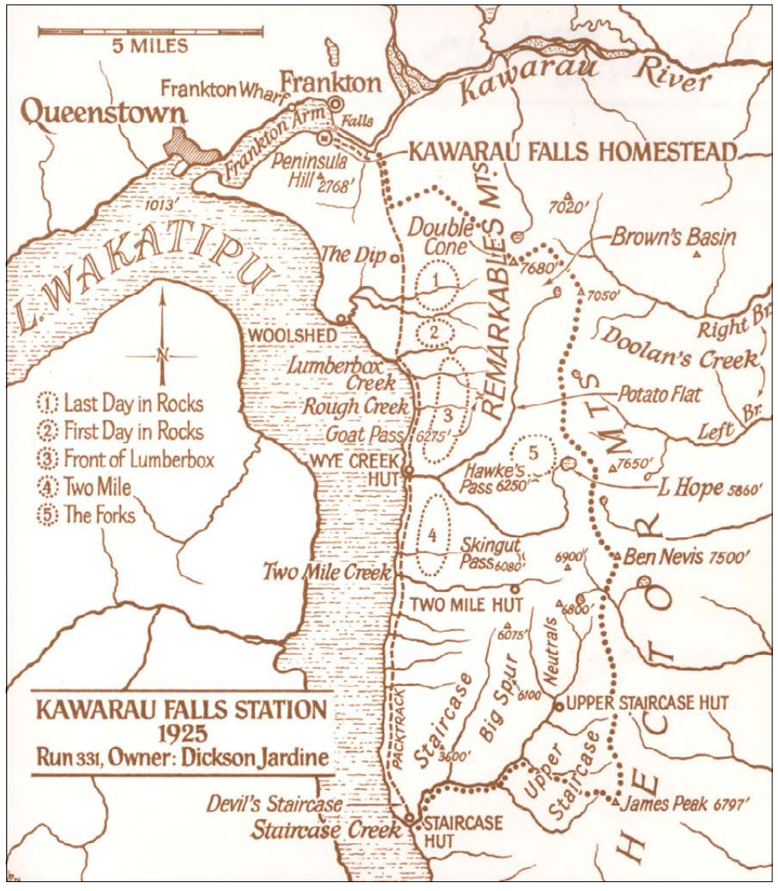
By January 1861 Rees, on behalf of the partnership of Grant, Gammie and Rees, had stocked Run 356 which he named Shotover and begun stocking Run 346, named the Bucklerburn. He then obtained Run 331 from A A Macdonald and J McIntosh, which became known as Staircase Run. This Run included all the country on the east side of the south arm of the Lake. By September 30, 1862 he had taken over Run 345 from Shenans. This Run, known as the Peninsula Run, encompassed all the land to the south of the Kawarau river from Doolan's Creek to the Lake.

What promised to be a huge pastoral empire soon encountered insurmountable difficulties when, in 1862 gold was discovered in the Shotover and Arrow rivers. Run 356 was formally declared a Goldfield by the Provincial Government on January 6, 1863. Rees, anticipating the inevitable, moved his pastoral activities to his southern Runs and commenced building a homestead near the outlet of the Lake in the latter part of 1862, completing it early in 1863. Runs 331 and 345 were now, for all practical purposes, combined and named Kawarau Falls by Rees.

The partnership of Grant, Gammie and Rees was dissolved "by effluxion of time" on the 27th July, 1865 and Kawarau Falls Station was sold to Charles Crofton Boyes and Frank Campbell Boyes on 7 December 1866.

In the years that were to follow the Station, through boundary adjustments and sales, gradually became reduced in size to 46,600 acres and, having passed through a succession of ownerships, was purchased on the 14th September 1922

by Dickson Jardine, who owned the 60,747 acre Glencoe Station near Arrowtown. On 11th April 1923 Dickson moved his family from Glencoe to the Kawarau Falls homestead where, at that time, the only means of access was by boat. On the 5th July 1928 Dickson sold Glencoe to a Dr Aitken and concentrated on Kawarau Falls. On the 24th January, 1924 the Kawarau Gold Mining Co. was granted a licence to construct a dam and bridge across the Falls. It was completed and opened on the 23rd August 1926.



On 27th April 1927 the Public Works Department commenced building a road to Kingston with unemployed labour. The road, little more than an access track, reached the Staircase bluffs from both ends in 1929. Work then ceased until August 1934 and the road was officially opened on 4th April 1936. This road was more of a curse than a benefit to the Station.

In October 1929 Dickson took up the lease of the McAdam Brothers Soldier's Settlement farm which he subsequently freeholded.

On the 19th September 1941 Dickson took his two sons, Grieve T and Dickson G, into partnership, management being undertaken by DG. Because of depressed wool prices the decision was taken to dispose of the fine wool flock meantime and move into fat lamb production. The sale of the fine wool sheep was held on the property on the 20th March 1944.

In 1947 Dickson subdivided the property between his sons, the necessary documents being signed at the Homestead 17th February, 1948. In the subdivision GT took over the freehold Homestead Block and name of Kawarau Falls and DG the leasehold hill country and part freehold which he named Remarkables Station.

In 1955 the quarters built by Rees at the woolshed were burnt down. Two rouseabouts, the only members of the shearing gang present apart from the cook, had left candles burning while they had tea and by the time the fire was noticed it was beyond control. All they could do was to drag out the swags of the 10 other members of the gang who had not yet arrived. DG was in Queenstown for shearing items when he received word, by the time he and the fire brigade reached the Woolshed the quarters were completely destroyed. Shearing was put off for a day until a large marquee and tents could be set up to accommodate the gang. New quarters were built in 1956. In 1960 GT sold Kawarau Falls to F Mee and the Homestead block to the Methodist Church.

In 1966 DG purchased the farm known as McAdam's. The small adjoining Run known as Loch Linnhe came up for sale and was purchased by DG for the older son DS. The Land Board approved the sale subject to a substantial portion of the Station leasehold being amalgamated with the smaller property. The decision was taken in 1974 to dispose of the Loch Linnhe property and further develop the remainder.

In 1973 DG took his two sons Dickson S and Andrew G into partnership in Remarkables Station and in process the property was subdivided between them, Dickson S taking the leasehold hill country and part of the freehold, including McAdam's Farm and Remarkables Homestead, retaining the name of Remarkables Station. Andrew G took the balance of the Freehold, which included the original Remarkables Homestead, naming his property Henley Downs.

4.1.4 Cultural Landscape Today

The cultural landscape and land use pattern we see today, is strongly influenced by farming practices both past and current: For example:

- Farm buildings located on foreshore next to wharf access.
- Dwellings located in close proximity to roading and services.
- Fencelines demarcate both cadastral boundary and farm management units.
- Shelterbelts reinforce the above delineation and provide the functional requirement of shelter for stock.

This culturally modified landscape extending back from the lake edge, contrasts with the untamed landscape of the Remarkables, as the cultural landscape makes a rapid transition into the natural.

4.1.5 Architectural Heritage

Many historic buildings have been lost over the years for one reason or another. Only one structure has been included in the inventory of Protected Features, that being Ref. No. 78

Stone Cottage (Rees) near Kawarau Falls SH6, at the base of Deer Park Heights. It is a white washed cottage which sits adjacent to the road.

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4.2 Land Tenure (Figure 3)

Landownership with the Coneburn area has changed considerably with the transformation of improved pasture and arable farmland converted into an urban area. The has resulted in a corresponding increase to residential and commercial land uses as well as the introduction of new areas of recreation (golf) activity. Land tenure outside of the new urban areas have changed little.

Within the period from 2001 to 2013, the usually resident population of the Queenstown Lakes District has growth from 17,043 to 28,224[1]. Over the same period Jacks Point has growth from 57 people to 297, experiencing a 54.7% rate of growth. That rate of growth is predicted to continue as available land capacity is taken up.

4.3 District Plan Zoning (Figure 4)

The operative Queenstown Lakes District Plan identifies the area of the Jacks Point Resort Zone over most of the Coneburn area, west of State Highway 6, with all of the surrounding rural land remaining a part of the rural general zone. For the purposes of this study, the location of individual structure plan areas have been excluded.

4.4 Geological Survey (Refer Figure 6)

Mr Royden Thomson was commissioned to provide a geological survey of the Coneburn area and to identify areas of potential natural hazard (refer Appendix 4).

Key points of his report are:

a. The terrain generally west of The Remarkables, and between the Kawarau River and Wye Creek, varies from flat to precipitous and there is a relative relief difference between Lake Wakatipu and the mountain crest in excess of 2000m.

b. Most slopes are west facing in the area studied.

c. No faults have been located in the study area but some structural control is likely as inferred from the lineal nature of the valley at and west of SH6. An active fault daylighting further east in the Nevis Valley dips west beneath The Remarkables and Lake Wakatipu. There is ongoing seismic activity associated with this feature.

d. Repeated glacial erosion during Quaternary times has sculptured the area and routinely removed surficial deposits. The last glacial incursion was 18,000 years ago. When the ice melted a proto Lake Wakatipu formed at higher levels then dropped to its present dimension after capture by the Kawarau River. The changing lake margin is evident through the study area.

e. Surficial deposits of various ages and types are present throughout much of the moderate to low relief terrain. These include glacial till, glacially related fluvial sediments, lake deposits and fans. In many localities there is a sequence of lithologies, the lower of which are imprecisely understood.

f. Landslides and rockslides are present on many steep slope elements in schist. No catastrophic failures have been identified.

g. Obvious hazards are posed by rockfall, floods and debris flows. However, these are relatively minor and should be able to be avoided or mitigated should developments occur in the future in the study area. Seismotectonic effects need to be addressed in line with standard practice for the Queenstown area.

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4.5 Soils (Refer Figure 7)

Soils information from the Landcare Soil Survey has been transposed over the site. The survey did not cover the entire study area, but gives a good general overview for the type and distribution of the soils over the majority of the site. The table in Appendix 6 summarises some of their major attributes and assesses their versatility and land use options. The most commons soils are those of the Wanaka and Blackstone soil series.

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4.6 Ecology and Vegetation (Figure 8)

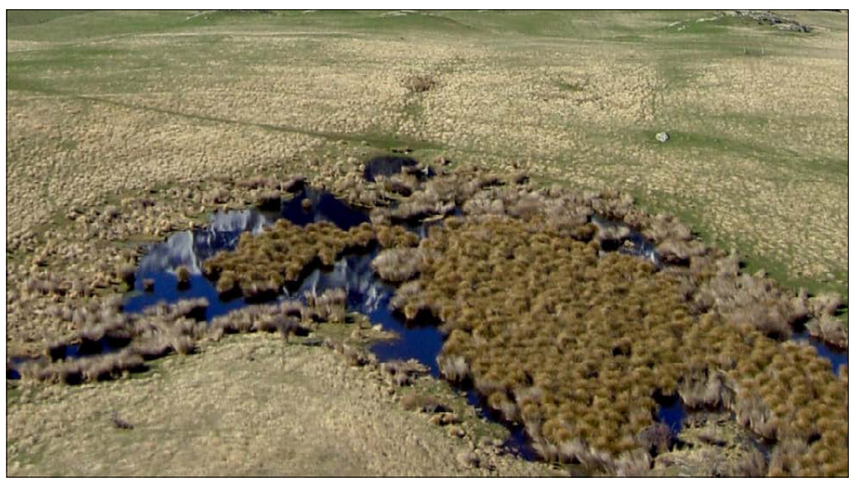
The ecology and vegetation within parts of the Jacks Point settlement has been affected through the addition of large areas of native planting along the interface with the State Highway 6 corridor to assist screening of development as well as through the current main vehicle access into the Zone at Maori Jack Road and with the areas of open space throughout the zone.

Based on our examination of this change, we have considered it necessary to update the following base plans describing the natural and physical resources within the Coneburn Area:

HABITAT TYPE	COMMENTS
1. Snow Tussockland on Steep Mountain Slopes	• Control exotic weeds • Exclude grazing
2. Remanant Beech Forest	• Control linkages • Lowland revegetation
3. High Energy Ephemeral Streams	• Control linkages • Weed control
4. Bracken Fernland *i. on mid altitude mountain slopes* *ii. on moraine and fluvial outwash fans and terraces*	• Reduce disturbance
5. Grey Shrubland *i. on mid altitude mountain slopes* *ii. on moraine and fluvial outwash fans and terraces* *iii. on roches moutonee*	• Create more shrub diversity • Weed control
6. Schist Rock Tors and Scarps *i. on mid altitude mountain slopes* *ii. on roches moutonee*	• Control skink predators • Introduce skink food plants • Link to other habitats • Add threatened plants
7. Wetlands	• Enhance wetlands • Link wetlands
8. Broadleaf Forest on Lakeshore Escarpments	• Introduce rata • Control weeds and pests • Create link to other habitats
9. Developed Farmland i. low indigenous ecological value	• Improved pasture • Exotic shelter belts
10. Residential Planting (mixed habitat type)	• Pockets native scrub & trees • Specimen trees

Remanant Beech Forest on the Remarkables

Lakeshore Native Revegetation



Wetlands

4.7 Slope Analysis (Refer Figure 9)

Slopes in excess of 25% gradient are largely unsuited to any form of development other than revegetation. These are mapped in Figure 9.

4.8 Visibility Mapping (Refer Figure 10)

Part of the resource mapping involves assessment of the visibility of certain parts of the study area as viewed from prominent public viewpoints. These were deemed to be the following:

- SH6 road corridor
- Lake Wakatipu

Visibility of the study area has been mapped at 2 levels of accuracy, which was dependent upon the quality of contour information available. Of the 11km of SH6 running through the middle of the study area, contour information ranging from 0.5m to 2.5m contour interval existed for approximately 6km. This encompassed Henley Downs, Jacks Point and Homestead Bay of Remarkables Station. Of the remaining 5km, of which 3km lay to the south, the area has been mapped using 20m contours supplied by Terralink, combined with ground survey.

From here the visibility analysis tool of the specialist computer graphics software, GEOPAK is employed. A 3-dimensional model of the study area is created and all areas visible from specified viewpoints are mapped with a radiating line of sight at 1 degree intervals from each point. The 150m interval between viewpoints along SH6 represents approximately 5 seconds of travel based on a vehicle travelling at 100km/hr and 16 seconds for a 500m interval.

For the analysis the viewers eye level was set at 3.00m above existing ground (road level) to best replicate the view from a tour bus being the highest likely road user viewer level. No existing vegetation has been taken into consideration in this mapping.

The GEOPAK software identifies the extent of the site visible from the nominated viewer position and height. Each viewpoint is individually mapped and a composite plan showing the visibility from all viewpoints is generated. The intensity and overlap of mapped colours gives an immediate graphic indication as to the extent of visibility of various parts of the study area from specified viewpoints along SH6.

This same procedure was repeated for specified viewpoints on Lake Wakatipu. To account for the more random location of viewpoints on the lake a series of representative viewpoints were selected at 500m, 1.00km, 1.50km and 2.00km intervals from the shoreline. The viewer's eye level was set at 4.00m above the lake level, to represent the viewer level from the TSS Earnslaw (presently the highest on Lake Wakatipu – although it does not usually travel down this arm of Lake Wakatipu).

The extent of the study area visible from various viewpoints is illustrated on Figure 10.

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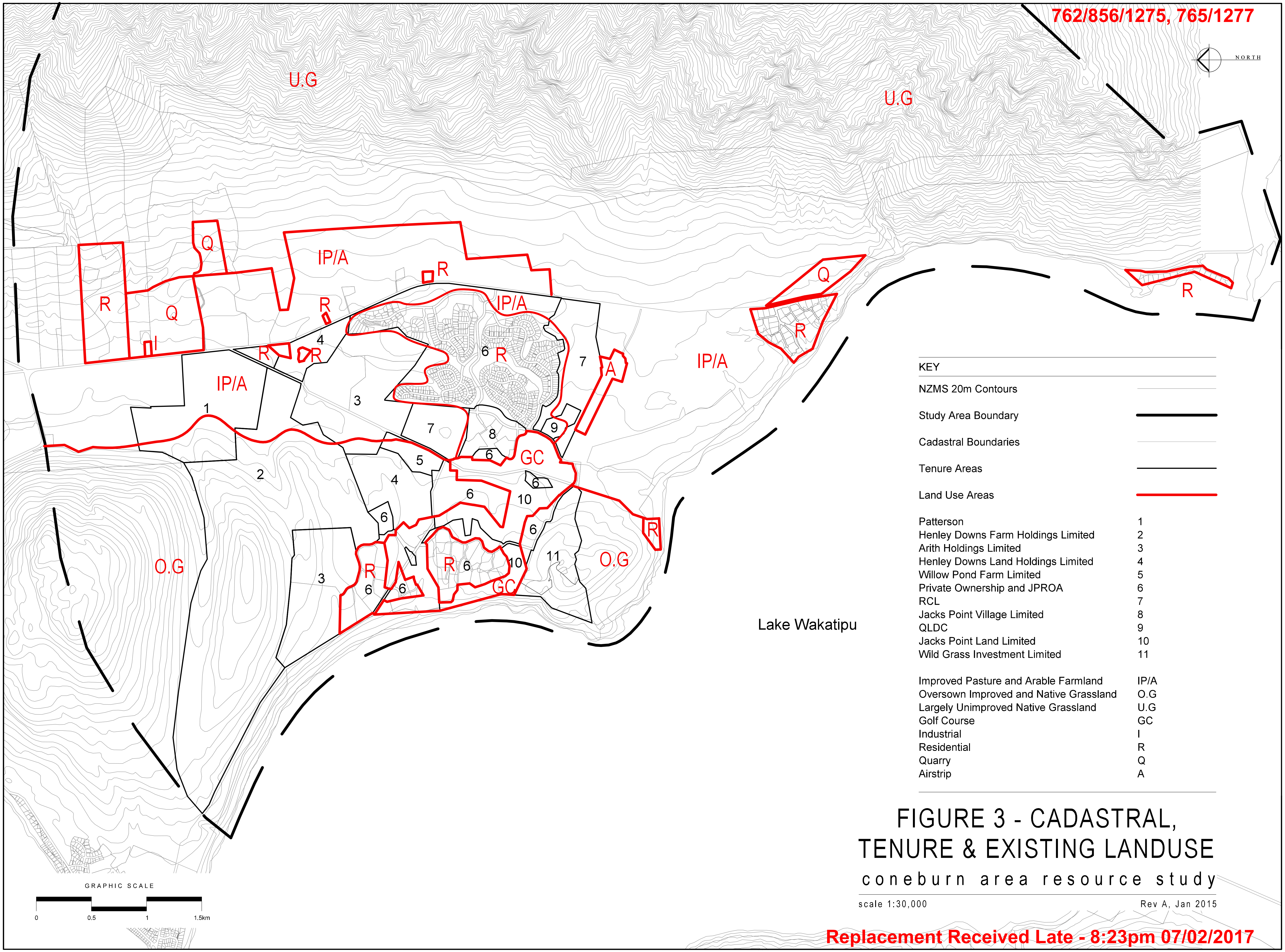

KEY

NZMS 20m Contours	
Study Area Boundary	
Cadastral Boundaries	
Tenure Areas	
Land Use Areas	

Patterson	1
Henley Downs Farm Holdings Limited	2
Arith Holdings Limited	3
Henley Downs Land Holdings Limited	4
Willow Pond Farm Limited	5
Private Ownership and JPROA	6
RCL	7
Jacks Point Village Limited	8
QLDC	9
Jacks Point Land Limited	10
Wild Grass Investment Limited	11

Improved Pasture and Arable Farmland	IP/A
Oversown Improved and Native Grassland	O.G
Largely Unimproved Native Grassland	U.G
Golf Course	GC
Industrial	I
Residential	R
Quarry	Q
Airstrip	A

FIGURE 3 - CADASTRAL, TENURE & EXISTING LANDUSE

coneburn area resource study

scale 1:30,000

Rev A, Jan 2015

V:\HD_Henley Downs\14_2015 Plan Change\1_Preplanning\CAD\HD_14_1_RS-004 Tenure and Existing Landuse.dgn

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762/856/1275, 765/1277

REVISION - JUNE 2015

NORTH

Rural General

Rural General

Rural Residential

Rural General

Jacks Point Resort Zone

Rural General

Low Density Residential

Lake Wakatipu

KEY

NZMS 20m Contours

Study Area Boundary

GRAPHIC SCALE

0 0.5 1 1.5km

QUEENSTOWN LAKES DISTRICT COUNCIL DISTRICT PLAN MAPS

FIGURE 4 - DISTRICT PLAN ZONING

coneburn area resource study

scale 1:30,000 rev A Jan 2015

Replacement Received Late - 8:23pm 07/02/2017

V:\HD_Henley Downs\14_2015 Plan Change\1_Preplanning\CAD\HD_14_1_RS-006 District Plan Zoning.dgn

762/856/1275, 765/1277

REVISION - JUNE 2015

Remarkables Station Catchment

Henley Downs Catchment

Lake Catchment

NORTH

KEY

Study Area Boundary

Cadastral Boundaries

Ephemeral Streams

Catchment Boundaries

GRAPHIC SCALE

0 0.5 1 1.5km

FIGURE 5 - HYDROLOGY AND OVERLAND FLOW PATHS

coneburn area resource study

scale 1:30,000

july 2002

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762/856/1275, 765/1277

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NORTH

KEY

- Schist
- Glacial till. Multiple glacial events; different ages.
- Glacially associated river alluvium (kame terraces, fluvioglacial sediments) with till capping in part
- Post-glacial alluvium - larger stream.
- Fan and fan/delta - smaller stream. Loess capping common.
- Beach deposits on lake margin.
- Lake sediments.
- Landslide/rockslide.
- Colluvium (slope debris)

GRAPHIC SCALE

0 0.5 1 1.5km

FIGURE 6 - GEOLOGY

coneburn area resource study

scale 1:30,000 july 2002

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REVISION - JUNE 2015

NORTH

KEY

SOIL TYPE

Wanaka Soils	1
Blackstone Soils	2
Moke Soils	3
Pigburn Soils	4
Puerua Soils	5
Frankton Soils	6
Shotover Soils	7
Maungawera Soils	8

Caution: the soil units distinguished are based on reconnaissance soil surveys. Further field checks may be required to determine the precise soil distribution on individual properties.

Soil Map from - Soil map of the Arrow-Frankton-Gibbston Basins by Landcare Research Lincoln, Canterbury, N.Z. and soil survey undertaken by AE Hewitt, Landcare Research

GRAPHIC SCALE

0 0.5 1 1.5km

FIGURE 7 - SOILS MAP

cone burn area resource study

scale 1:30,000 july 2002

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762/856/1275, 765/1277

REVISION - JUNE 2015

NORTH

Sweat brier shrubland

Sycamore & brier

(with sycamore, elder, pine and barberry

(with brier)

With elder, sycamore and pine

Elder Woodland

Riparian kowhai forest

(with emergent brier)

(with emergent brier)

(with emergent brier)

Crack willow, buddleja, brier, kohuhu, broadleaf

Low diversity with hawthorne.

Mainly low diversity with pockets of good grey shrubland. Cattle grazing

Low diversity with cattle grazing.

Lake Wakatipu

GRAPHIC SCALE

0 0.5 1 1.5km

HABITAT TYPE

1. Snow Tussockland on Steep Mountain Slopes

2. Remnant Beech Forest

3. High Energy Ephemeral Streams

4. Bracken Fernland
   - i. on mid altitude mountain slopes
   - ii. on moraine and fluvial outwash fans and terraces

5. Grey Shrubland
   - i. on mid altitude mountain slopes
   - ii. on moraine and fluvial outwash fans and terraces
   - iii. on roches mountonees

6. Schist Rock Tors and Scarps
   - i. on mid altitude mountain slopes
   - ii. on roches mountonees

7. Wetlands

8. Broadleaf Forest on Lakeshore Escarpments

9. Developed Farm Land
   - i. low indigenous ecological value

10. Residential Planting (mixed habitat type)

FIGURE 8 - ECOLOGY / VEGETATION

coneburn area resource study

scale 1:30,000 Rev A, Jan 2015

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Replacement Received Late - 8:23pm 07/02/2017

5.0 Resource Analysis

5.1 Landscape Character (Figure 11)

TEXT REVISION - JUNE 2015

Based on the nature of the changes to the natural and physical environment within the Coneburn Area described above, aspects of the resource analysis have also been affected. The landscape character areas described within Figure 11 remain as a relevant part of the historic record of the landscape prior to development, but with the development and growth of Jacks Point, large areas of the landscape are now urbanised.

The landscape character in Figure 11 identifies the Hummocks/Township as a distinct area.

CHARACTER TYPE	DESCRIPTION
Remarkables	An iconic landscape feature of the Wakatipu Basin, characterised by precipitous schist terrain and a dominant ridge line. Remnant and regenerating beech forest are to be found in the deep sheltered gullies.
Fans & Lower Slopes	This landscape unit stretches from Lakeside Estates in the south to past the Remarkables Ski Area access road to the north. It is a gently rolling landscape, cut by ephemeral streams. The landscape to the south has been modified for farming and characterised by fencelines, amenity planting, farm dwellings, shelterbelts and wilding tree species on the higher slopes. To the north, the landscape has undergone a greater degree of domestication with small farmlet blocks and commercial uses becoming obvious. The Remarkables Ski Area access road is the clearest example of the change in land use at this end of the study area.
Hummocks	Elevated, undulating plateau intercepted by strongly channelled ephemeral streams, gentle contour in improved pastures with shelterbelts and fencing, rougher areas characterised by grey shrubland.
Central Valley	Broad open valley floor running north south contained either side by gentle slopes. Contained views and sense of enclosure.
Tablelands	Elevated broad schist ridge and plateau, gentle contour with localised hummocky terrain, tarns and largely unimproved pasture and matagouri stands contrasting with small localised spaces defined by schist rock outcrops and ridges.
Jacks Point Knob	Very elevated, steeper contour rising to a dominant outcrop with small rock enclosed spaces and localised tarns. Predominate vegetation unimproved pasture, short tussock and matagouri stands.
Lake Escarpment	Lake margins and rocky bluffs with native shrubland dominate the character of this lake edge landscape.
Lake Terraces	Occurs in two locations along the Lake edge: from Homestead Bay to Lakeside Estate and further south at Wye Creek. Terraces set back 200m-400m from lake edge. Landscape mostly modified by farming and subdivision and characterized by improved pasture, shelterbelts, fencelines, water tanks and amenity planting. Lakeside Estates and Wye Creek are the two small subdivisions totaling 38 and 15 lots respectively.
Hummocks / Township	Residential neighbourhoods nestled amongst a framework of indigenous scrub, trees and openspace.

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Lake Escarpment

Fans, Fan Delats and Lower Slopes

Hummocks / Township

Lake Terraces

Central Valley

Jacks Point

Hummocks

Remarkables

Tablelands

Replacement Received Late - 8:23pm 07/02/2017

5.2 Visibility (Figure 10)

TEXT REVISION - JUNE 2015

The visibility analysis shown within Figure 10 was originally formulated on the basis of landform only (i.e. without planting) and identifies categories of visibility. For the purposes of this plan, visibility was mapped form the State Highway 6 corridor and Lake Wakatipu.

The outcomes of this analysis remain relevant to this study because it provides an unaltered assessment of visibility prior to development and mitigation and is based solely on the landform. The addition of mitigation has, however, altered visibility of development and the ability of the landscape to absorb change.

CLASSIFICATION	CRITERIA
HV - Highly Visible	• Readily visible from a specified viewpoint/viewpoints eg SH6 • Viewing distance less than 1.00km • Visible for greater than 5 seconds from road corridor (i.e. distance of greater than 150m assuming a vehicle travelling at 80-100km/hr).
MV - Moderately Visible	• Visible or intermittently readily visible from a specified viewpoint / viewpoints • If readily visible, then visible from road for less than 5 seconds or 150m of the road corridor. • Viewing distance greater than 1km
LV - Low Visibility	• Intermittently visible or not readily visible from a specified viewpoint / viewpoints. • Viewing distance greater than 2km.
NV - Not Visible	• Cannot be seen from specified viewpoint / viewpoints.

Figure 10 provides a map of the study area broken down into different levels of visibleness as defined by the above criteria.

5.3 Land Use Analysis (Refer Figure 2)

Semi-extensive pastoral farming is the dominant existing land use of the Coneburn study area, however the following land uses also play a significant role in creating the land use fabric that makes up the Coneburn catchment.

5.3.1 Rural and Residential Living

This is presently limited to less than 120 dwellings and is situated in two areas, the northern area adjacent to the Remarkables Ski Area Road and the southern end in the Lakeside Estates and Wye Creek developments.

5.3.2 Quarrying

Two quarries are located in the area. One is adjacent to the Remarkables ski area road, the other is east of Lakeside Estates.

LANDOWNERS	EXISTING USES	FUTURE POTENTIAL LAND USES
Jacks Point Limited	• Semi-extensive pastoral farming	• Integrated residential and visitor community • Open space network with golf course and recreation • Village
DS & JF Jardine	• Semi-extensive pastoral farming ie. deer, cattle and sheep • Temporary film set location • Airfield and parachute operations	• Continued farming • Integrated community village and visitor community • Farm buildings and craft activity area • Horticulture on appropriate soils • Open Space network with public access to walkways and lake edge • Native Revegetation of foreshore and gully areas • Wharf, Boating Facility and complementary activities area
Henley Downs Limited	• Semi-extensive pastoral farming	• Integrated community • Open Space network with outdoor recreational activities • Village • Defined neighbourhood precincts with design controls • Native Revegetation • Semi-extensive pastoral farming • Film Studio
Lakeside Estates Limited	• Medium density rural residential estate with extensive exotic tree planting and landscaping	• Medium density rural residential
Various Landowners North of SH6 (near Remarakables Ski Field access road)	• Rural lifestyle 50 acre residential area • Farm forestry • Quarrying • Earth moving depot	• Continued rural living

Farm Forestry

Quarry Operations

Farming Remarkables Station

Lakeside Estates

Film Set

5.3.3 Farm Forestry

A pine forest has been planted adjacent to the highway at the foot of the Remarkables. The plantation is probably half way through its cycle.

5.3.4 Temporary Film Set

An area on the Henley Downs property was used as a temporary film set for the filming of the movie called the Vertical Limit. Part of this has been dismantled, the other portion remains, with its current use unknown.

5.3.5 Airfield & Sky Diving Operation

A skydive operation is set up on the Jardines Airfield which is an extremely popular attraction. The valley itself is all the site for low level flying practice by the aero club (call Richard Hanson to confirm)

5.3.6 Trucking / Construction Yard

One of the local construction firm uses an area off the highway, close to the ski field road at the northern end of the valley, as a storage/maintenance depot for its equipment and materials.

5.4 Infrastructure Analysis

5.4.1 Roading

The primary access to all properties in the study area is from SH6, which is a proposed limited access road. SH6 traverses through the study area on a north/south alignment. This is a high capacity highway with a 100km/hr speed limit. Any access, driveway or road intersection will need the approval of Transit New Zealand. The only other formed legal road is Woolshed Bay Road which intersects with SH6 and heads in a more westerly direction, only the first kilometre or so of which is formed.

5.4.2 Wastewater

There is no existing wastewater system within the study area. The nearest community scheme is the Queenstown-Frankton Sewerage System operated by the Queenstown Lakes District Council. The nearest point of connection to the reticulation is at the Kawarau Falls Bridge on SH6. The treatment facility is on the true right bank of the Shotover River just downstream of SH6. The treated effluent discharges to the Shotover River.

In considering options for disposal of wastewater the strong cultural requirement and the growing community preference for disposal to land rather than to water should be respected.

5.4.3 Water Supply:

There is no existing water supply scheme in the study area other than scattered private bores. The nearest community scheme is the Queenstown-Kelvin Heights Water Supply operated by the Queenstown Lakes District Council. The nearest point of connection to the reticulation is at the Kawarau Falls Bridge on SH6 where a large diameter trunk main (approximately 300mm diameter) crosses the bridge. The source of water is Frankton Arm, Lake Wakatipu and there is a 1000 cubic metre storage reservoir above Peninsula Road.

5.4.4 Stormwater

There are a series of streams and watercourses that drain the western flanks of The Remarkables and then cross SH6 in a generally east to west direction. These streams and watercourses have high capacity for flood flows and the increase in runoff from development would be a relatively small additional flow. However these discharges will require the consent of the Otago Regional Council.

It is necessary to recognise that there is some potential risk of flood flows from these streams and watercourses due to the short and very steep catchments, which makes them vulnerable in the event of high intensity short duration rainstorms. Any necessary flood plain or channel containment works need to be identified as part of the land use planning.

5.4.5 Power Supply

There is an existing 11kv overhead power line setback from the east side of SH6 that serves the existing users as far south as Wye Creek. Currently there is no ring feed available for this supply.

5.4.6 Telecommunications:

Telecom NZ Ltd advise that there is an existing fibre optic cable that extends to the Lakeside Estates Development and that this has very high capacity to serve future development. Telecom does not expect that there would be any restriction on the expansion of its system to serve development in this area. (Contact is Innes Forbes, Telecom NZ Ltd Invercargill).

5.5 Existing Public Access within the Study Area

The State Highway is the main conveyor of public access through the study area. An unformed legal road cuts through both Henley Downs and Remarkables Station and terminates at Woolshed Bay. This road is currently unformed except for the first kilometre.

Access to the Remarkables is made available via the Ski Area road, located to the north of the study area. This provides good access for many recreational activities: skiing, mountain biking, hiking and also as a hang gliding launch location.

Public access to the lake edge is currently made available at the discretion of the landowners via the main entry to Remarkables Station. This is used primarily by the Queenstown Windsurfing club who have an arrangement with the landowners, the Jardine family. An existing 'paper' road provides legal access to the lake, but this remains unformed.

The Jardines also allow public access to two well known climbing areas at the foot of the Remarkables. Once again this is an informal arrangement and at the discretion of the landowners.

The airstrip is currently used by a commercial sky diving operation.

5/1277

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The Remarkables

SH6

NORTH

Lake Wakatipu

KEY

NZMS 20m Contours

Study Area Boundary

Cadastral Boundaries

25-100% Slope

Note - Areas shown in red determine areas of 25%-100% slope (>1 in 4) and therefore unsuitable for development

GRAPHIC SCALE

0 0.5 1 1.5km

FIGURE 9 - SLOPE ANALYSIS

coneburn area resource study

scale 1:30,000 july 2002

762/856/1275, 765/1277

REVISION - JUNE 2015

NORTH

HV-Lake HV-SH6
NV-Lake LV-SH6
NV-Lake HV-SH6
LV-Lake LV-SH6
NV-Lake NV-SH6
NV-Lake MV-SH6
MV-Lake NV-SH6
HV-Lake LV-SH6

Lakeside Estates

GRAPHIC SCALE

0 0.5 1 1.5km

CLASSIFICATION	CRITERIA
HV - Highly Visible	-Readily visible from a specified viewpoint / viewpoints eg. SH6 -Viewing distance less than 1km -Visible for greater than 5 seconds from the road corridor (ie. distance of greater than 150m assuming a vehicle travelling at 80-100km/hr)
MV - Moderately Visible	-Visible or intermittently readily visible from a specified viewpoint / viewpoints eg. SH6 -If readily visible, then visible from the road for less than 5 seconds or 150m of the road corridor -Viewing distance greater than 2km
LV - Low Visibility	-Intermittently visible or not readily visible from a specified viewpoint / viewpoints -Viewing distance greater than 2km
LV - No Visibility	-Cannot be seen from specified viewpoint / viewpoints

KEY

Cadastral Boundaries

Study Area Boundary

Visibility Analysis Areas

Visibility from Lake Wakatipu mapped from viewpoints 0.5km, 1.0km, 1.5km and 2.0km from the lake edge at a height of 4m (radiating line of sight from points at 1 degree intervals).

Visibility from State Highway 6 mapped from viewpoints 3m high along the state highway corridor. Points north of Lakeside Estates mapped at 300m intervals and south at 500m intervals.

Visibility has been mapped with as-built mitigation mounding and vegetation and proposed Hanely Downs mitigation mounding and vegetation.

FIGURE 10 - VISIBILITY ANALYSIS

coneburn area resource study

scale 1:30,000 Rev A, June 2015

V:\HD_Henley Downs\14_2015 Plan Change\1_Preplanning\CAD\HD_14_1_RS-007 Visibility Analysis.dgn

Replacement Received Late - 8:23pm 07/02/2017

762/856/1275, 765/1277

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NORTH

Lake Wakatipu

KEY

- Study Area Boundary
- NZMS 20m Contours
- Cadastral Boundaries
- Existing State Highway Mitigation Mounding / Planting
- Proposed State Highway Mitigation Mounding / Planting
- Existing Planting Retained / Replaced with Mitigation Mounding / Planting

GRAPHIC SCALE

0 0.5 1 1.5km

FIGURE 10.1 - STATE HIGHWAY MITIGATION

coneburn area resource study

scale 1:30,000 Jan 2015

V:\HD_Henley Downs\14_2015 Plan Change\1_Preplanning\CAD\HD_14_1_RS-008 State Highway Mitigation.dgn

Replacement Received Late - 8:23pm 07/02/2017

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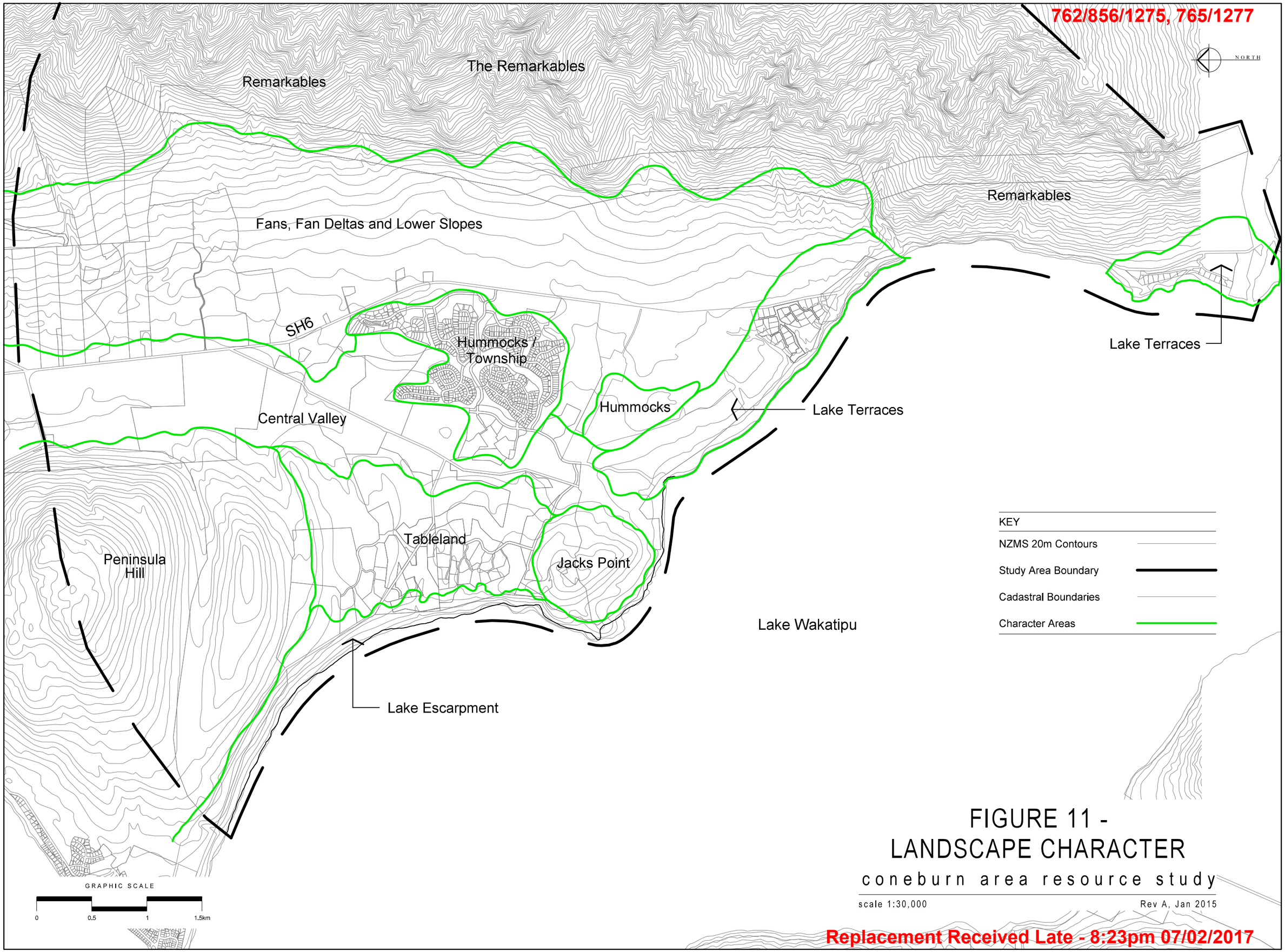
REVISION - JUNE 2015



KEY

- NZMS 20m Contours
- Study Area Boundary
- Cadastral Boundaries
- Character Areas

FIGURE 11 - LANDSCAPE CHARACTER

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scale 1:30,000 Rev A, Jan 2015

Replacement Received Late - 8:23pm 07/02/2017

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6.0 Planning Analysis

This section of the report assesses the relevant policy documents that have affected the Coneburn area for over the past 20 years.

6.1 Chronology of Policy Development

1982 Transitional District Plan
This plan was prepared under the Town and Country Planning Act 1977, which had a different philosophy to the current statute. This Act sought to direct and control development through specific lists of activities.

1993 Settlement Strategy
The Settlement Strategy was commissioned by the Council as part of its preparation of the 1995 District Plan. This strategy sought to identify the methods of accommodating future anticipated growth.

1995 Strategic Plan
This plan was adopted by the Council in 1995, and continues to be an operative Council policy document.

The plan was intended to "set the overall vision of what we would like to see the district achieve in 20 years' time".

The Strategic Plan is the high level plan – with implementation achieved through the District and Annual Plans.

Regional Policy Statement for Otago
The Otago Regional Council notified the RPS in 1993 and made it operative in 1998.

The RPS sets the policy framework for the region (including air, water, and land), and district plans cannot be inconsistent with it.

Plan Change 99 (to the Transitional District Plan)
In response to a large number of rural-lifestyle subdivisions and criticism from the Environment Court as to the permissive nature of the 1982 District Plan, the Council promoted Plan Change 99. Upon issue of the decisions on Plan change 99 a number of references were lodged with the Environment Court.

1995 District Plan
The Council decisions on Plan Change 99 were incorporated into the Proposed District Plan, which was notified for submissions in October 1995. It attracted approximately 4,500 submissions (20,000 points of submission) of which approximately 80% related to the rural area.

This was the first district plan to articulate the value of the landscape to the social and economic well-being of the District. It incorporated a Rural Uplands and Downlands zoning, and 'Areas of Landscape Importance' – with corresponding higher restrictions on use and development.

This plan also included a section on urban growth, with associated issues and objectives – as well as tackling the issue of growth management. Specific 'New Development areas' were identified by zoning and by text description.

After notification of the Proposed Plan, the Council withdrew Plan Change 99.

1998 Decisions on District Plan (submissions)
The Council then began a two year process of hearing from the various submitters, and as a result it amended the District Plan. The District Plan was re-released in 1998, containing the Council's decisions on the submissions received.

The Council amended the plan in response to the weight of submissions. This plan removed Areas of Landscape Importance, combined the two rural zonings, introduced a new 'Rural-Lifestyle' zoning, increased the number of 'rural-Residential' areas and softened the landscape policies. This Plan also removed references to growth management, although the balance of the 'urban growth' section was retained. The 'New Development Areas' were deleted from the Plan.

References
The amended District Plan was then appealed (by reference) to the Environment Court, with approximately 50 of the 201 references relating to the rural area.

Two of these references by the Jardines and Henley Downs sought rezoning of parts of their land from rural to 'Residential New Development' zone.

The Environmental Society lodged several references seeking, in general, a return to the provisions of the Plan as notified

Environment Court decisions - amending District Plan
Landscape has been the most significant issue before the Court. Intermingled within this broad issue have been various sub-issues such as methodology for controlling effects (ie. zoning), density of rural living, locations of rural sub-zones, subdivision rules, the introduction of 'tiers of landscape', restrictions on land-use, and the format for assessing development proposals.

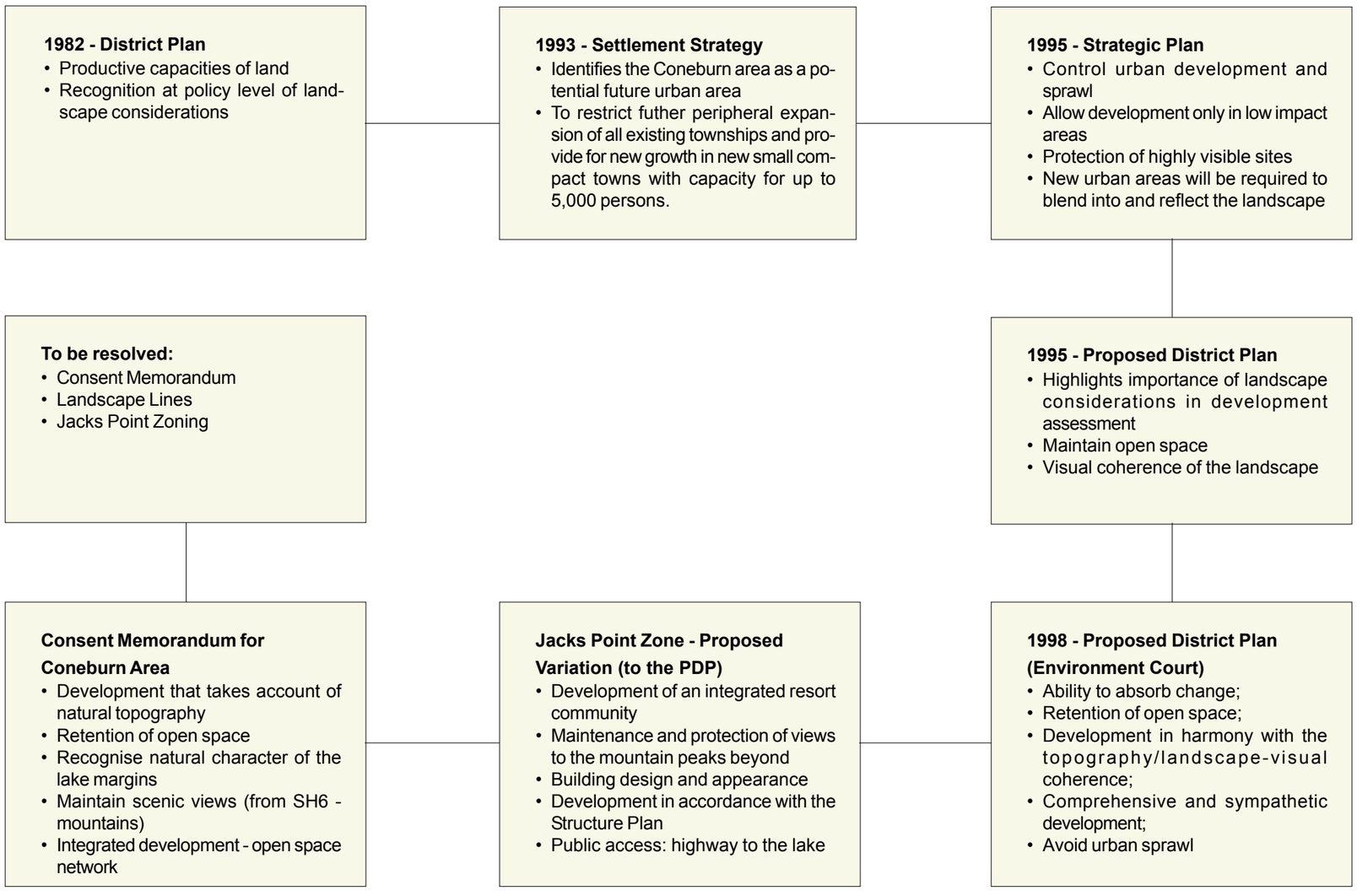
Consent Memorandum
The Jardines and Henley Downs references were resolved through a consent memorandum in 2002. This resulted in all parties (including the Council) agreeing that new policy provisions would be included in the District Plan; generally identifying the Coneburn area as being suitable for future urban development.

Jacks Point Zone Variation
The Council notified the Jacks Point zone variation in October 2001. This affected 410 hectares of rural land, providing for an integrated resort and residential community of up to 2 golf courses, 400 dwellings/ visitor units and ancillary recreation and central facilities.

A number of submissions were received, including one from each of the neighbours seeking an extension of this zoning to the north and the south (Henley Downs and the Jardines respectively).

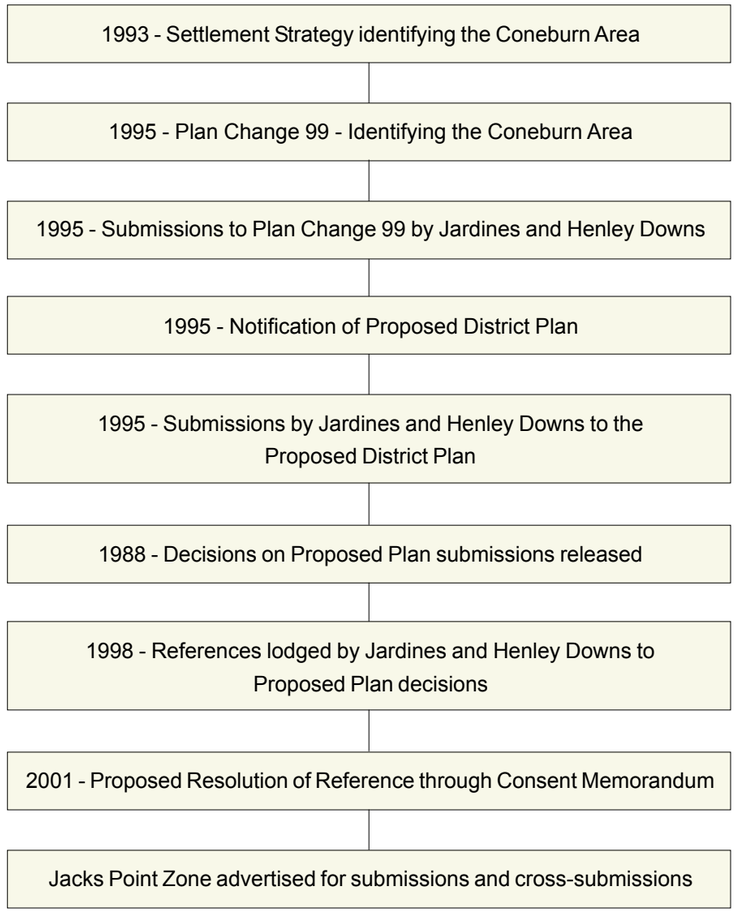
The hearing for this zoning will occur in the latter part of 2002.

6.2 Flow Chart: Chronology of Policy Development



6.3 Chronology of Policy Development Affecting the Coneburn Area

6.4 Flow Chart: Chronology of Policy Development Specifically Affecting the Coneburn Area



6.5 Identification of Key Policies (from each document)

1982 Transitional District Plan

The rural policy focus of this plan was to ensure protection of land for active farming purposes, while also ensuring that areas of interest to visitors would be protected. The term 'landscape' is not mentioned in the District-wide objectives and policies.

Key Policy Points:

- Maintenance of the existing land use categories and their respective boundaries
- Support for the tourism industry
- Retention of farming land for such purposes

1993 - Settlement Strategy

The preliminary landscape assessment recognised the Coneburn area as one

of two locations suitable for residential development (the other being Gibbston terrace).

Six potential settlement options were identified, and four included as recommendations (x):

- Higher density development within existing settlements x
- Incremental growth
- Infilling and planned extension to existing settlements x
- New towns x
- Hamlets x
- Rural subdivision

Key Policy Points:

To restrict further peripheral expansion of all existing townships and provide for new growth in new small compact towns with capacity for up to 5,000 persons. One of the four recommended options was to provide for new towns of between 2500 and 5000 residents. Two of the six possible township locations were within the Coneburn area; Woolshed/ Homestead Bay and an area straddling the boundary of Henley Downs and Jacks Point.

1995 Strategic Plan

The plan canvassed 25 topics, including management of growth, urban form and housing and established the 'vision' for 2015.

Key Policy Points:

- Control urban development and sprawl
- Allow development only in low impact areas
- Protection of highly visible sites
- Limit size of urban areas
- Create areas of comprehensively planned higher density housing
- Development of new urban areas in appropriate locations will be supported
- New urban areas will be required to blend into and reflect the landscape
- Growth in existing urban areas will be restricted to roughly the existing urban boundaries

Regional Policy Statement for Otago

Like the Strategic Plan, this document provides an overview or policy framework, without touching on any specific area.

Key Policy Points:

- Promotion of sustainable land management practices
- Protect Otago's outstanding natural features and landscapes
- Ensure public access opportunities exist
- Avoid, remedy, or mitigate degradation of Otago's natural and physical resources
- Safeguard the life supporting capacity of Otago's water resources
- Maintain and enhance the ecological, intrinsic, amenity and cultural values of Otago's water resources

Plan Change 99 (to the Transitional District Plan)

Key Policy Points:

- Areas of Landscape Importance
- Indicative 'new town' locations
- A minimum allotment size of 150 hectares
- Introduction of landscape matters as principal development consideration

Five possible new settlement areas were shown, the two settlements areas for the Coneburn area were rationalised to a single area within the Central Valley and Hummocks

Council received over opposing 900 submissions to the change, including one from the Ministry of the Environment opposed to indicating locations of 'new towns'.

The Jardines and Henley Downs both lodged submissions to this plan change. The Jardine submission notes that the 'new settlement area' should be approved.

In it's decisions the Council:

- Retained the Areas of Landscape Importance
- Deleted the 'new town' locations
- Decreased the minimum lot size to 20 hectares

1995 District Plan

This plan was the culmination of a number of studies, including the Settlement Strategy and Plan Change 99.

Key Policy Points:

- Identified 'Areas of Landscape Importance'
- Avoid adverse effects on landscape values
- Preserve visual coherence of the landscape
- Identification of 'Residential New Development Areas' at 7 locations, including one at "Frankton, south of the airport"
- New urban development:
- to maintain open character/ minimise modification of the landscape
- to avoid urban sprawl

Environment Court decisions - amending District Plan

The Court's decisions on landscape have resulted in the following:

Introduction of a three-tier approach to categorising the landscape:

- Outstanding Natural Landscapes ('ONL') and Outstanding Natural Features ('ONF')
- Visual Amenity Landscapes ('VAL')
- Third tier other rural landscape ('ORL')

Inclusion of more specific policies in Part 4 (District–Wide Matters) of the Plan, that encourage development to occur within landscapes that have the ability to absorb change.

Inclusion of Assessment Matters into the rules that establish a methodology for assessing development proposals.

Inclusion of policies and assessment matters that ensure the impact of a development upon the landscape is a primary consideration.

Retention of the 'Urban Development' polices (4.2.5 (6), page 4/9) only slightly modified since the 1995 plan.

Key Policy Points:

In the rural areas, the Proposed Plan generally discourages development unless:

- it occurs in areas that have the ability to absorb change;
- it achieves the retention of open space;
- the development is in harmony with the topography/ landscape ~visual coherence;
- it comprises comprehensive and sympathetic development;
- it avoids urban sprawl

Consent Memorandum

The various parties to the Jardines and Henley Downs references, including the Council, finalised and agreed a Consent Memorandum in 2002.

Key Policy Points:

- Overriding acknowledgement that future development is generally appropriate in this
- area, subject to detailed plans being presented.
- Development that takes account of natural topography
- Retention of open space
- Recognise natural character of lake margins
- Maintain scenic views (from SH6 - mountains)
- Integrated development – open space network

Jacks Point Zone – Variation

Key Policy Points:

- Development of an integrated resort community
- Maintenance and protection of views
- Protection of views across the site (from the State Highway) to the mountains beyond
- Building design and appearance controls
- Open space performance standards
- Development in accordance with the Structure Plan
- Public access from highway to the lake

6.6 Bibliography

Critical extracts from the following documents, referred to in this section of the report, are contained in Appendix 7.

1	1982	(Transitional) District Plan
2	1993	Queenstown-Lakes Settlement Strategy
3	1995	Strategic Plan
4	1993 – 1998	Regional Policy Statement for Otago
5	1995	Plan Change 99 - to the 1982 Transitional District Plan
6	1995	Decisions on submissions - to Plan Change 99
7	1995	Proposed District Plan
8	1995	Submissions to the Proposed District Plan
9	1998	References to the 1998 District Plan (Jardine and Henley Downs)
10	1998	Proposed District Plan (as amended by Environment Court decisions 2001)
11	2001	Consent Memorandum to resolve (Jardine and Henley Down) 1998 Proposed Plan references
12	2001	Jacks Point Zone
13	Jacks Point Zone – neighbour submissions	

7.0 Resource Assessment

7.1 Landscape's Ability to Absorb Change (Figure 12)

In the rural areas such as Coneburn the Proposed Plan generally discourages development unless:

- it occurs in areas that have the ability to absorb change
- it ensures retention of open space
- the development is in harmony with the topography/landscape
- it achieves visual coherence
- it comprises comprehensive and sympathetic development
- it avoids urban sprawl

In assessing the Coneburn area's suitability for development it is necessary to identify areas that "have the ability to absorb change". By overlaying the area's visibility analysis with its landscape character, an assessment can be made of the various landscape's ability to absorb change on a scale of 1 (high potential) through to 5 (low potential):

CATEGORY	POTENTIAL TO ABSORB CHANGE
1	High Potential
2	Medium to High Potential
3	Medium Potential
4	Low to Medium Potential
5	Low Potential

Landscapes can be distinguished by their visibility from surrounding public areas, and landscape characteristics such as vegetation or landform, that assist successful integration of changes into the landscape. These characteristics enable the landscapes of the Coneburn area to be graded from low to high potential to absorb change. Figure 12 provides a broadscale categorisation within the various catagories mapped. There maybe smaller pockets of different category land but due to their small area they are not considered relevant at this broadscale level.

REVISION - JUNE 2015

TEXT REVISION - JUNE 2015

The Landscape Ability to Absorb Change (Figure 12)

The Coneburn Study identified areas of the landscape with ability to absorb change. This plan (Figure 12) was prepared on an analysis of the visibility combined with landscape character sensitivity.

The two key changes to Figure 12 relate to the areas of the Central Valley at the new entrance to the zone alongside Woolshed Road and in the two pockets located within the Peninsula Hill landforms.

These changes can be summarised as follows:

State Highway Mitigation

Because of the role that mitigation provides on absorption of development in the landscape, this update to the Coneburn Study seeks to identify further the factors that can assist in the successful integration of change into the landscape, including:

i. The extent of landscape planting which has occurred through development to date (Figure 8);

ii. The nature of the State Highway mitigation developed through implementation of the Jacks Point Residential Areas ODP; and

iii. The addition of further landscape mitigation towards the northern edge of the zone alongside the Woolshed Road and the State Highway that would be implemented through PC44.

The State Highway mitigation is now shown on a new **Figure 10.1**.

The State Highway mitigation that has been incorporated into the outline development plans approved in relation to the residential activity areas are a key element of mitigation protected through resource consent conditions. The spatial planning for PC 44 also seeks to implement State Highway mitigation through the structure plan and related provisions seeking to implement those outcomes. On this basis, the State Highway mitigation described

7.2 Ecological Assessment

7.2.1 Ecological Heritage

Considerable potential exists for protection and enhancement of the ecological heritage of the Coneburn area. Planning for new land uses and open space presents an opportunity to create linked corridors of native habitat. High energy ephemeral streams draining the steep scarps of the Remarkables down through the fans, downlands and terraces to the lake provides obvious corridor opportunities.

Reinstatement of the stream margins with native vegetation creates valuable linked habitat and reinforces natural landscape patterns. Similarly the lake margins with already a strong cover of native shrubland presents opportunities for habitat enhancement and extension along the lakeshore within the study area.

Extensive use of locally characteristic native species such as matagouri, silver tussock, red tussocks and mountain beech (where suitable) in future landscape plantings will also enhance the ecological heritage of the Coneburn area.

7.2.2 Species lists for revegetation and enhancement planting for the Coneburn Study Area

Species suitable for enhancement and creation of habitat types identified in this document are appended (Refer Appendix 3). These species list have been compiled from Meurk (1997) and Simpson (2001).

Additional comments on the suitability of species for particular locations or roles within the habitats are given. Such comments include the ability of the species to act as a colonising plant, ameliorating the habitat for the planting, or natural regeneration, of other native species. One species, bracken (Pteridium esculentum) that performs this role in the high-energy stream and lake forest habitats in the study area is not noted. It is capable of self-introducing and thus it does not need to be actively planted. In many instances, allowing bracken to develop prior to planting in areas that are desired to become forest habitats will benefit regeneration and revegetation.

7.2.3 Beech forest regeneration

The development of beech forest, a habitat type that is now poorly represented in the study area, can be slow. To ensure good growth of beech forest the inclusion of appropriate mycorrhizal microbes in the potting mix is essential. Initial shelter from companion plantings of kohuhu (Pittosporum tenuifolium) and mingimingi (Coprosma propinqua) will provide necessary shelter. However beech does grow naturally in open locations so deep shade, or planting in copses of shrubs, would not appear to be beneficial. Growth rates in excess of 0.2 - 1m per year have been reported by Meurk (1997), who further notes that beech has a ‘fast’ growth rate. He further comments that poor growth in plant species, such as that noted from some beech revegetation plantings in the study area (pers. obs.), are not an indication of poor potential. This poor growth may be the result of missing ingredient (mycorrhizal infections), a pathogen (Meurk 1997) or planting in an inappropriate location. To date, detailed research on revegetation requirements of beech, and other species (that Meurk (1997) notes need study), have not been completed.

In general, of the soil types that Meurk (1997) note as being suitable to sustain mountain and red beech forest, there are only small amounts in the study area. These Dunstan and Blackstone soils are sparingly distributed on the lakeshore terrace, and Jacks Point and Peninsula Hill rouches moutonées. Consideration of the appropriateness of beech revegetation in regard to the soils may increase the success of beech revegetation.

7.3 Infrastructural Assessment

7.3.1 Roading

Transit New Zealand will require access to new development to be from an existing local road or approved new local road. Transit will also limit the number of new road intersections and will require adequate sight distances (330m at 1.5m height) and adequate separation of road intersections. The few existing local roads and approved intersections together with new intersections that meet the criteria of Transit NZ will have to provide access to a number of adjoining properties. However it is expected that it will be possible to gain approval for a sufficient number of new intersections to provide an adequate local roading network to any proposed development within the study area.

7.3.2 Wastewater

There are two primary alternatives for the disposal of wastewater.

(a) On Site Disposal to Land

There are several alternatives for this method of disposal from individual septic tanks for isolated dwellings or large lots (say 4000m2 plus), collection and treatment (see below) or a single community treatment and disposal scheme serving the area of development.

(b) Connection to Council's Treatment Facility

The future of this facility is currently under review as required by the resource consent to discharge treated effluent to the Shotover River. The report is due for release shortly but at this stage it is not certain what the future capacity of this scheme will be or the implications of a large additional area being added to the system. One of the review outcomes is understood to be a shift from disposal of treated effluent to natural water to disposal to land. The distance of some 9km from Remarkables Lodge to the Shotover River may make this option prohibitively expensive except for land closest to Frankton. It is also unlikely that the existing system, from the Kawarau Falls Bridge to the Frankton Beach pump station, will have sufficient capacity to cope with the additional load from the study area as this was not considered at the time of design.

The recommended option is decentralised wastewater management serving clusters of housing with disposal of the treated effluent to land. This option is explained in some detail in the attached report prepared by Professor Ian Gunn for Darby Partners Ltd (Appendix 2). Each separate disposal of treated effluent will require consent from the Otago Regional Council. The size of each housing cluster will be dependent on the layout and the topography but this method of wastewater management allows for considerable flexibility and is particularly suitable for the relatively low overall density proposed. This method also meets the cultural requirement and growing community preference for land disposal.

It will be necessary to ensure that on site disposal of treated wastewater cannot contaminate any existing or proposed water supply.

7.3.3 Water Supply

There are three primary alternative water sources available for the proposed area of development – Lake Wakatipu, a secure bore, or connection to Council's water supply at the Kawarau Bridge. It may be that all of these options are utilised based on proximity to the source.

Lake Wakatipu – this is already Queenstown's only source of drinking water and is pumped from the lake at two locations – west of Two Mile and Frankton Arm. The amount of water needed is extremely small compared to the quantity stored in the lake and compared to the amount of outflow even in low flow conditions. Consents would be needed from the Otago Regional Council (right to take water, right to disturb the lake bed), LINZ acting for the Crown as owner of the lakebed, Civic Corp land use consent and Doc for crossing the foreshore reserve. This is a very good source of drinking water although treatment would still be necessary.

Bores – it is likely that the central valley between SH6 and the high ground close to the lake will be a suitable site for a bore water supply. Preliminary drilling within the Jacks Point property gave promising results for a water bore in the central valley at the northern end of the property. This has yet to be proven by the installation of a permanent bore and pump testing.

Queenstown Water Supply – there is a large diameter trunk main crossing the Kawarau Falls Bridge supplied from the reservoir above Peninsula Road. Lake water is pumped from the lake to the reservoir where it is treated. The existing pump station, reservoir and mains have been sized to cope with growth within the existing zone boundaries. No allowance has been made in the asset planning for new growth in entirely new areas such as Coneburn. Therefore it is reasonable to expect that the existing system would need substantial upgrade to cope with the additional demand from the Coneburn area. However, it may be suitable to supply water to some of the stuudy area from this source.

Storage – all of the options, for water source will require storage above the highest level of development (30m desirable, 25m minimum after friction losses) in the vicinity of the development. There is a suitable site in a deep hollow near the top of Jacks Point and there is high ground under the Remarkables. The visibility of both sites would require the structures to be partially buried and to be completely screened. The storage capacity would have sufficient volume to provide for fire flows (expected to be Class D – 50 litres/second for 2 hours or 360m3) plus sufficient operating storage to cover power outages and mechanical failure. The source would either be from a bore in the central valley as described above or Lake Wakatipu at Woolshed Bay where there is good access. For the latter there would be a lake intake at Woolshed Bay (309m at low level), an in-
ground pump station, a pumping main to a reservoir near the top of Jacks Point at 455m where the water will be treated and then reticulated by gravity mains to the proposed development.

There are a number of options one or several of which can be utilised to serve any proposed development. There does not appear to be any constraints that would inhibit development.

7.3.4 Stormwater

It is expected that stormwater will be directed to natural watercourses and streams, all of which discharge into either Lake Wakatipu or the Kawarau River (at the northern end). Water quality is an issue and it would be necessary to install pollution interceptors in carparks to intercept runoff from the first flush rainfalls.

These watercourses, although dry for most of the year, are fed by reasonably large catchments and the small additional flows from the proposed development will have little impact. Furthermore it is expected that the stormwater design will incorporate features such as grassed watertables and landscape retention ponds that will assist in recharging the water table and to filter any runoff as well as reducing the peak flows.

7.3.5 Power Supply

Delta Utility Services has advised that there is sufficient capacity in the grid exit point (GXP) operated by Transpower from 110kv lines to cope with the expected load increase of up to 1000 lots. (Refer to the attached email from Delta Utility Services Ltd dated 26 March 2002. (Appendix 1)). However the 11kv feeder lines into the area are at 50% capacity. Therefore, an upgrade of the capacity into the area will be required at some time during the development period.

Long term power supply planning has identified the need to construct a zone substation in the Commonage to provide greater security of supply to the Queenstown CBD. One option is to link an 11kv feeder cable to the western end of Kelvin Heights to provide greater capacity and a back feed potential to the CBD. This cable could be extended along the eastern lakeshore by Deer Park Heights, into the Coneburn area and back into the existing 11kv overhead lines to supply the capacity required. There are other options and the planning has not advanced sufficiently to determine which option will best suit the growth of the whole area.

7.4 Potential Public Access (Refer Figure 15)

7.4.1 Potential Public Access

Roading

Potential access roads off the highway corridor have been identified on Figure 14 utilising the existing legal road access off the state highway through Henley Downs. A loop road could then reconnect this back to the State Highway.

Walking

Walking/biking trails could be formed as part of a potential Open Space Network within the study area. A walkway connection linking Lakeside Estates with Kelvin Heights has long been discussed but is difficult to achieve due to the current tenure and incompatibility with existing farming operations. This connection along with the Open Space Network is proposed as part of the Jacks Point Variation. Incentives could be provided to extend this network and public access into neighbouring lands which have lake frontage.

Recreation

Incentives for the landowners could be provided to formalise access to the rock climbing areas, thus ensuring accessibility for future users.

The water sports potential of Woolshed Bay could be further developed to add to the recreational amenity of the area: e.g. windsurfing, recreational boating and fishing.

A potential water taxi/ferry connection from Woolshed Bay to the Queenstown CBD could be developed, thus providing direct public access to Coneburn and its recreational potential. This has the distinct advantage of potentially minimizing road usage to access this area.

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The Remarkables

NORTH

SH6

Lakeside Estates

Wye Creek Subdivision

Lake Wakatipu

KEY - Landscape Potential to Absorb Change

1	High Potential to Absorb Change
2	High-Medium Potential to Absorb Change
3	Medium Potential to Absorb Change
4	Medium-Low Potential to Absorb Change
5	Low Potential to Absorb Change

GRAPHIC SCALE

0 0.5 1 1.5km

FIGURE 12 - POTENTIAL TO ABSORB CHANGE

coneburn area resource study

scale 1:30,000 Rev D, June 2015

Replacement Received Late - 8:23pm 07/02/2017

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NORTH

To Lakeside Estates

Unformed Legal Road

Woolshed Bay

Jacks Point

To Queenstown

KEY

- State Highway 6
- Potential Road Access
- Potential Walking Tracks
- Potential Water Taxi Connection to Queenstown
- Water Sports Activity Area
- Existing Airstrip
- Existing Rock Climbing/Bouldering Area
- Existing Access Road to Ski Area, Hiking Hand Gliding Launch Area and Mountain Biking
- Existing Public Access to Windsurfing Launch Area (at discretion of landowner)

GRAPHIC SCALE

0 0.5 1 1.5km

FIGURE 13
PUBLIC ACCESS/RECREATION

coneburn area resource study

scale 1:30,000 july 2002

Replacement Received Late - 8:23pm 07/02/2017

8.0 Resource Summary and Guidelines

8.1 Resource Tables

The following tables provide a summary for each landscape type within the Coneburn area in terms of resources, land uses and its inherent ability to absorb change.

Guidelines have also been developed in accordance with key policy points of the proposed district plan relating to:

- mitigation of adverse effects on landscape values
- retention of open space
- achieving development that is in harmony with the topography/landscape – visual coherence
- achieving comprehensive development and avoidance of urban sprawl

Guidelines have been provided under the following 3 headings: Landscape Management, infrastructure and Public Access, and Recreation. These provide a resource basis for assessing land use suitability and evolving a planning and land use strategy for the Coneburn area.

8.1.1 Remarkables

RESOURCE SUMMARY	REMARKABLES
Geology	• Steep Schist scarps and tors • Glacial till and incidential rock slips
Ecology	• Snow Tussockland • Remnant beech forest on lower slopes
Visibility	• Highly visible from the Lake (HV) • Highly visible from SH6 (HV)
Existing Land Uses	• Conservation/ wildlife habitat • Admin by Doc, non interventionist management
Potential Land Uses	• Maintain existing regime • Visual amenity / Open space
GUIDELINES	
Potential to Absorb Change	• Low potential to absorb change (5)
Landscape Management	• Continuation of conservation and allow regeneration to occur • Minimise spread of exotic wildings on lower slopes • Encourage regeneration of ecological heritage, particularly mountain beech
Infrastructure	• N/A
Public Access and Recreation	• Access to this part of Remarkables is limited by topography • There is existing access to the mountain basins via the ski area road

8.1.2 Fans, Fan Deltas and Lower Slopes

RESOURCE SUMMARY	FANS, FAN DELTAS AND LOWER SLOPES
Geology	• Post glacial fans have been constructed by streams draining off the Remarkables • Fans moderately cut by emphemeral streams
Ecology	• Predominantly improved and unimproved pasture • Small remnant pockets of Grey Shrubland
Visibility	• Highly visible from the Lake (HV) • Highly visible from SH6 (HV) • Pockets of lower visibility
Existing Land Uses	• Pastoral farming, farm buildings, structures and dwellings
Potential Land Uses	• Farming and related buildings • Visual amenity / Open space • Native regeneration in ephemeral streams and on the upper fan slopes of the Remarkables
GUIDELINES	
Potential to Absorb Change	• Low potential to absorb change (4/5) with small pockets with moderate ability to absorb change (3) (suitable for siting farm buildings.)
Landscape Management	• Grazing of freehold land to minimise spread of exotic wildings • Landscape management of highway corridor to maintain the open rural character and views to distant mountains • Control type and scale of planting to preserve distant views • Minimise spread of exotic wildings on lower slopes • Encourage regeneration of ecological heritage, around existing stands of mountain beech, grey shrubland and along stream margins
Infrastructure	• Limited development able to be serviced by existing overhead power supply and farm track network
Public Access and Recreation	• Access to this part of Remarkables is limited by topography • There is existing access via the ski area road • Possible formalisation of access for climbers

8.1.3 Hummocks

RESOURCE SUMMARY	HUMMOCKS
Geology	• Complex geomorphology • Fans, comprising glacial till, have been deeply incised by distributary channels/ephemeral streams
Ecology	• Predominantly improved and unimproved pasture • Small remnant pockets of Grey Shrubland • Soils of high versatility found in the gullies
Visibility	• Predominantly not visible from SH6 and lake
Existing Land Uses	• Pastoral farming
Potential Land Uses	• Community/Residential development • Open Space/Recreation • Native regeneration • Continued farming
GUIDELINES	
Potential to Absorb Change	• High Potential to absorb change (1) • Medium to High Potential to absorb change (2) where partly visible in distant view from lake
Landscape Management	• Landscape management of highway corridor to maintain the open rural character and views to distant mountains • Control type and scale of planting to preserve distant views • Provide for significant areas of Open Space and Open Space corridors • Revegetation of ephemeral streams with native species to create wildlife corridors connecting to the Remarkables and lake margin • Instigate appropriate design controls on both architecture and landscape • Provide incentives for the regeneration of Grey Shrubland
Infrastructure	• Roading to avoid steeper terrain and extensive earthworks • Services reticulation to be located underground • Wastewater: preferred methods are cluster or communal collection followed by land application of treated wastewater • Where possible, stormwater transport and retention systems should adopt natural engineering principles, using swales and wetlands
Public Access and Recreation	• Incentivise landowners to encourage public access to Lake Wakatipu for hiking and water sport activities

8.1.4 Central Valley (Lake Wakatipu, Middle Valley and SH6)

RESOURCE SUMMARY	CENTRAL VALLEY
Geology	• A combination of fan deltas and beach deposits along the old lake margin
Ecology	• Improved and unimproved pasture • No significant areas of ecological value
Visibility	**Lake Wakatipu End** • Low visibility from SH6 • Moderate visibility from the Lake due to intervening landform of Jacks Point **Middle Valley** • Not visible from the lake • Not visible from SH6 **Northern Valley End by Ski Access Road** • Not visible from the lake • Highly visible from SH6
Existing Land Uses	• Pastoral farming, farm buildings and dwellings • Airstrip
Potential Land Uses	• Integrated residential/village development with emphasis on Open Space • Reinstatement of wetland areas and appropriate native planting in low-lying part of site • Intensive farming and in certain areas with versatile soils • Establishment of ecological corridors • Continued farming
GUIDELINES	
Potential to Absorb Change	**Lake Wakatipu End** • The Wakatipu end of the valley has absorption range from low to medium potential (4) by the Lake edge, through to a medium to high potential (2) where it joins the middle valley. It extends to the upper lake terraces to middle valley and is rated as (2), with medium to high potential to absorb change. **Middle Valley** • The middle valley has a high potential (1) to absorb change **Northern Valley End** • The SH6 end has a low to medium potential due to its close proximity to SH6 and the open nature of the pastoral landscape
Landscape Management	• The areas with an absorption classification of (1) are well suited to higher density village and medium density residential development • Areas classified as (2), are suited to low density or carefully sited village/cluster residential/commercial development enclosed by landscape

RESOURCE SUMMARY	CENTRAL VALLEY
	• Incentives should be provided to encourage the revegetation along lake margin and in ephemeral streams using native species. • Establishment of appropriate architectural and landscape design controls to ensure the intergration of the built with the natural environment • Landscape controls to provide coordinated and unified planting themes to integrate developed areas into landscape.
Infrastructure Guidelines	• All services reticulation to be located underground • Disposal to ground is preferred wastewater treatment method. • Where possible, stormwater transport and retention systems should adopt natural engineering principles, using swales and wetlands. • Wastewater: preferred methods are cluster or communal collection followed by land application of treated wastewater
Public Access & Recreation Guidelines	• Provide incentives to formalise public access to the lake edge at Homestead Bay. Access currently exists, but at the discretion of the landowner. Access via the legal (paper) road through Henley Downs is currently not possible due to its alignment through a wetland area.

8.1.5 Tablelands

RESOURCE SUMMARY	TABLELANDS
Geology	• Glacial Till surrounding a bedrock of schist, located in the midpoint of the tablelands
Ecology	• Predominantly unimproved pasture with stands of Grey Shrubland and several wetland pockets
Visibility	• Not visible from the lake • Low visibility from SH6
Existing Land Uses	• Pastoral farming
Potential Land Uses	• Managed open space, conservation and recreation (golf) • Low density residential/visitor accommodation
GUIDELINES	
Potential to Absorb Change	• Medium (3) and medium to high potential (2) to absorb development.
Landscape Management	• Revegetation of Grey Shrubland and wetland • Guidelines on preferred planting for this area to encourage skink habitat • Low density development with a predominance of Open Space • Instigate appropriate design controls on both architecture and landscape (earthworks) • Strict planting controls (native species) on type and species to avoid domestication of rural landscape • Irrigation retention ponds to be integrated into the natural landscape • Integration of golf course with native shrubland margin
Infrastructure	• All services reticulation to be located underground • Wastewater: Options are density dependent and range from on-site septic tanks to cluster systems with land application of treated effluent • Where possible, stormwater transport and retention systems should adopt natural engineering principles, using swales and wetlands
Public Access and Recreation	• Encourage the landowners to establish open space/public access corridors connecting through to the lake escarpment and onto a public walkway connecting to Kelvin Heights

8.1.6 Jacks Point and Deer Park Heights

RESOURCE SUMMARY	JACKS POINT AND DEER PARK HEIGHTS
Geology	• Schist tors and scarps
Ecology	• Unimproved pasture • Grey Shrubland
Visibility	• Highly visible from the lake • Low visibility on the northern slopes from both the lake and SH6 • Medium visibility of the eastern side from SH6
Existing Land Uses	• Low intensity pastoral farming
Potential Land Uses	• Regeneration/ Revegetation of Grey Shrubland and short tussock grassland • Creation of ecological preserve • Lodge accommodation • Extensive pastoral grazing
GUIDELINES	
Potential to Absorb Change	• Medium/Low (4) to Low potential (5) to absorb change except on the Jacks Point Terrace where there is medium/ high potential (2) in an isolated pocket
Landscape Management	• Incentives to encourage regeneration and revegetation of • Grey Shrubland and minimise grazing • Architecture and landscape design on Jacks Point Terrace to have appropriate design control in respect of height, materials roofing and exterior lighting • Strict controls on type and species of planting to avoid domestication of rural landscape. Endemic native species to predominate.
Infrastructure	• All services reticulation to be located underground • Disposal to ground is preferred wastewater treatment method • Where possible, stormwater transport and retention systems should adopt natural engineering principles, utilizing swales and wetland retention areas
Public Access and Recreation	• Provision of public access walking track to the high point on Jacks Point as part of open space network connecting this to the overall Open Space network

8.1.7 Lake Escarpment

RESOURCE SUMMARY	LAKE ESCARPMENT
Geology	• Schist scarps with incidental rock slips
Ecology	• Pastoral farming occurs where the Tableland interfaces with the escarpment • As it steepens and grazing is less prevalent broadleaf forest species have colonized
Visibility	• Some areas highly visible from parts of the lake, other less so due to intervening landscape features eg: Jacks Point • Not visible from SH6 due to intervening landform
Existing Land Uses	• Grazing at the interface with the Tablelands • Natural regeneration occurring where grazing is excluded.
Potential Land Uses	• Regeneration/conservation • Walking tracks/ public access
GUIDELINES	
Potential to Absorb Change	• Low potential (5) to absorb change
Landscape Management	• Continued regeneration/revegetation of native vegetation along the lakeside escarpment up to the Lake Edge Landscape Protection Line • Restriction of pastoral farming • Predominance of Open Space
Infrastructure	• N/A
Public Access and Recreation	• Incentives to provide public access to lake escarpment and lake edge as part of Open Space network

8.1.8 Lake Terraces

RESOURCE SUMMARY	LAKE TERRACES
Geology	• Lake Sediments with areas of glacially associated river alluvium in the gullies
Ecology	• Mixture of improved and unimproved pasture • Native regeneration in the gullies and in some areas along the lake shore, with pockets of Grey Shrubland
Visibility	• Medium to Highly visible from the lake. Some parts less so due to being located in the visual shade of Jacks Point. • Southern terraces more visible than the northern ends • Nil visibility from SH6
Existing Land Uses	**Homestead Bay** • Pastoral farming • Farm homestead and associated farm structures • Natural regeneration in gullies at the southern end of foreshore • Extensive landscaping and tree planting **Lakeside Estate/Wye Creek Subdivision** • Residential subdivision predominates in two distinct locations • Native regeneration in gullies • Wye Creek has undertaken revegetation along lake margin

RESOURCE SUMMARY	LAKE TERRACES
Potential Land Uses	• Clustered lakeside village in native landscape, low density • Open Space network • Public access to waterfront • Horticulture, viticulture and associated buildings • Revegetation of streams margins, gullies and foreshore
GUIDELINES	
Potential to Absorb Change	• Area ranges from medium to high (2) potential on terraces to medium potential (3) from Homestead Bay to Wye Creek
Landscape Management	• Architecture and landscape design control in respect of height, colour and materials. • Draw on 'Farm Homestead' architectural themes to ensure continuity with existing farm structures • Strict planting controls on type and native species to avoid over domestication of rural landscape • Incentives to continued regeneration/revegetation of native vegetation along the lakeside escarpment • Predominance of Open Space
Infrastructure	• All services reticulation to be located underground. • Disposal to ground is preferred wastewater treatment method • Where possible, stormwater transport and retention systems should adopt natural engineering principles
Public Access and Recreation	• Public Access to lake escarpment and lake edge as part of open space network • Creation of watersports activity zone in Woolshed Bay • Potential water taxi/ferry connection from Woolshed Bay to Queenstown Bay

9.0 Landuse and Landscape Management Strategy

9.1 Area Wide

Figure 14 illustrates a recommended land use and landscape management strategy for the Coneburn area. The strategy has been devised in accordance with the resource studies and guidelines developed for the various landscape character types of the study area.

Key considerations in formulating the strategy have been:

- Protection of the open rural character of SH6 visual corridor and preservation of distant mountain views.
- Protection and enhancement of the natural character of the lake margin
- Restriction of building development and densities to areas with highest potential to absorb landscape change without significant adverse effects on the open rural landscape character of the Coneburn area and the visual quality of its backdrop, the Remarkables.
- Creation of a strong and dominant pattern of open space within any development area to avoid overdomestication of the landscape and ensure adequate area to accommodate land based effluent disposal
- Protection of ecological values and the incorporation of linked natural habitats into an open space network.
- Extension of public access to the lakeshore and areas of recreational opportunity

9.2 Area with Development Potential

Figure 14 illustrates the areas identified as having potential to absorb change (areas 1,2,3). The Jacks Point zone structure plan is based on a more detailed level of site analysis that has enabled a finer grain mapping of areas suitable for high, medium and low density residential and visitor accommodation development. Areas of steeper slopes (above 25%), southern aspect, overland drainage paths and native vegetation cover have been incorporated into the open space network along with areas suited for recreational use and land based effluent disposal.

The balance development areas have the potential to accommodate between 1,200 and 1,500 residential unit equivalents. At a district average of between 2.50 and 2.70 persons/ unit, Coneburn has the potential to ultimately accommodate an integrated residential and visitor population of between 3,000 and 4,000 persons.

Calculation of projected populations has been based on the following area measurement and yield analysis:

ABILITY TO ABSORB CHANGE	AREA	OPEN SPACE	AVERAGE DENSITY	No. of DWELLINGS
JACKS POINT ZONE STRUCTURE PLANS *(includes Homestead Bay and Henley Downs)*				
Area with high potential (1)	250 Ha	50%	High - Med (8 per Ha average)	1000
Area with medium to high (2) potential and medium (3) potential	400 Ha	80%	Low (2 per Ha)	160
RURAL ZONE				
Area with medium to high (2) potential	112 Ha	80%	Low (2 per Ha) High-Med (8 per Ha average)	45 -180
	762 Ha			**1205 - 1385**

The above forecast is an assessment only and assumes all landowners fully develop their respective properties at the densities proposed. This forecast should therefore only be considered a broad brush assessment of the Coneburn area's longterm potential residential carrying capacity having had full regard to infrastructure, open space, landscape and ecological considerations.

762/856/1275, 765/1277

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REVISION - JUNE 2015

NORTH

Lake Wakatipu

SH6

KEY

Study Area Boundary	
Cadastral Boundaries	
Potential for medium-high density development with open space for recreation, conservation and land disposal of effluent	1
Potential for clustered development within areas of open space for recreation, farming and conservation	2
Potential for low density development within areas of open space for recreation, farming and conservation	3
SH6 Visual Corridor - Area to be managed to preserve and enhance open rural character, continued pastoral farming and conservation land uses	4/5
Lakeshore Landscape Protection Area - Area to be managed to preserve and enhance natural character of the foreshore, limited extensive pastoral grazing, recreation and conservation land uses.	5
Peninsula Hill Landscape Protection Area - Area to be managed to preserve and enhance natural character of the roche moutonnee landform, limited extensive pastoral grazing, recreation and conservation land uses.	5
Remarkables	5
ONL - Wakatipu Basin (C90 / 2005)	

GRAPHIC SCALE

0 0.5 1 1.5km

FIGURE 14 - LANDUSE & LANDSCAPE MANAGEMENT STRATEGY

coneburn area resource study

scale 1:30,000 Rev D, June 2015

V:\HD_Henley Downs\14_2015 Plan Change\1_Preplanning\CAD\HD_14_1_RS-002C Landscape Management Strategy.dgn

Replacement Received Late - 8:23pm 07/02/2017

APPENDIX 1 - E-Mail from Delta Utility Services

From: Paul Johnson <paul.johnson~del.co.nz
Date: 2002/03/26 Tue PM 02:12:09 GMT+12:00
To: "'kengo~xtra.co.nz"' <kengo~xtra. co .nz>
CC: Niel Frear <nielf@del.co.nz

Ken,

Eased on DEL policy and some long term scenarios the following may be of use.

Assumptions:

- 1000 lots would be ~5MW diversified load.
- DEL policy is to provide alternative feeder capability for more than say 50 lots - so multiple feeders would be required
- capital contribution from DEL would be based on 15KVA/lot — '-$585,000
- cost share for feeders and zone substation upgrades would be negotiated
- easements, resource consents and all the other authorities required are obtained.
- 11Kv supplied is the preferred option - as opposed to a 33Kv zone substation

The grid exit point (GXP) operated by Transpower from 110Kv lines has the capacity to supply the expected load increase as have the DEL Zone substations at Frankton and Queenstown.

However the 11Kv feeder lines into the area are at about 50% (~1.5MW) capacity now, as such there is insufficient capacity in these circuits to supply the subdivision and upgrading to twin circuits or different construction would be difficult re easements, access and resource consents.

We have a security of supply problem in Kelvin Heights - this area is served by one 11Kv overhead line via Frankton resulting in a 'spur feeder' arrangement with no backfeed ability should the line fail for whatever reason.

Longer term engineering planning is to construct a zone substation in the Commonage area of Queenstown — to provide greater security of supply to the Queenstown CBD. We plan to take an 11Kv feeder cable from the Commonage directly to the western end of Kelvin Heights Peninsula to provide greater capacity and a backfeed capability.

Should the 1000 lot scenario become a reality, this feeder would be extended along the eastern shore of the lake, into the subdivision and back onto the exiting 11KV overhead lines.

This work is purely in the 'policy' stages — however should your development gather momentum then the planning would be brought forward.

I appreciate this is a rather technical response — however it should provide sufficient background information for you to discuss the project with Council — if I can help further please contact me.

Regards
Paul Johnson
Distribution Designer (Central)
DELTA Utility Services Ltd

762/856/1275, 765/1277

REVISION - JUNE 2015

Replacement Received Late - 8:23pm 07/02/2017

APPENDIX 2 - Wastewater Management Report by Iann Gunn

1.0 INTRODUCTION

1.1 Background

The proposed Jacks Point rural-residential and golf course resort village development is to occupy a 410 ha site located between SH 6 and Lake Wakatipu some 7 km south of Frankton. This report presents proposals for managing wastewater flows from residential lots together with communal facilities including accommodation units, restaurants, clubhouse and administration offices.

1.2 Site Information

Darby Partners have provided a preliminary structure plan for the overall development (Fig. 1) showing the general location of residential development (R), lodge accommodation units (L), village administration and clubhouse (V), and golfing and recreational areas (G). A site visit and briefing meeting was undertaken on 14 August during which access was provided to soils information based on bore logs associated with an earlier airfield proposal for part of the site.

2.0 ENVIRONMENTAL and CULTURAL OBJECTIVES

Given the location of the proposed development within the catchment of Lake Wakatipu and the high value placed on both lake water quality and the natural environment of the area, Darby Partners are seeking a wastewater management solution that will deliver the highest environmental performance consistent with best-available-technology. The proposed solution is also to be sensitive to cultural (Tangata Whenua) objectives. For these reasons the approach to wastewater management is to minimise the quantity of effluent residuals discharged into the environment by use of high performance pre-treatment units followed by land application of the resulting high quality effluent for further in-soil treatment and uptake by vegetation.

Indeed, the final effluent for land application will result in a “reclaimed” water source which following storage in dedicated ponding areas has value as irrigation water for controlled summer utilisation on the golf course and landscaping features of the resort area.

3.0 WASTEWATER FLOW QUANTITIES

The overall development is to be based on the following:

- 400 residential dwellings (single lot and cluster layout);
- 40 to 60 room accommodation lodge;
- restaurants;
- Clubhouse and administration offices.

Wastewater flow quantities are based on a communal water supply system sourced from lake water. A conservative allowance is thus made for flow volumes to be treated and then land applied. Given that the development will proceed in two stages, separate wastewater flow assessments are set out below. The Stage I portion of the development comprises the western area of the site (Fig. 1), with Stage II the eastern area.

STAGE 1	DESIGN CRITERIA	DESIGN FLOW
40 dwellings	4.5 persons/dwelling; 200 litres/person/day wastewater output; 900 litres/dwelling	36m^3/day
60 room lodge	a. 150 residents plus staff; 200 litres person/day b. Extra diners; 65 at 30 litres/person/day	36m^3/day
Village Service Area	a. 120 persons (staff, visitors) clubhouse and administration offices; 50 litres/person/day c. Public Toilets; 200 uses/day; 10 litres/use	6m^3/day 2m^3/day
	TOTAL FLOW STAGE 1	**82m^3/day**

STAGE 11	DESIGN CRITERIA	DESIGN FLOW
360 dwellings	4.5 persons/dwelling; 200 litres/person/day wastewater output; 900 litres/dwelling	324m^3/day
Village Service Area Expansion	a. 120 persons (staff, visitors) clubhouse and administration offices; 50 litres/person/day b. Restaurant(s); 400 diners/day; 30 litres/person/day c. Public Toilets; 200 uses/day; 10 litres/use	6m^3/day 12m^3/day 2m^3/day
	TOTAL FLOW STAGE 11	**344m^3/day**

The flow estimates set out above provide a basis for sizing the land application areas. Detailed design flows will be prepared in due course in support of resource consent applications for land application area discharge permits. The above flows are thus conservatively based to represent a potential maximum development scenario.

4.0 SITE and SOIL CONDITIONS

The site comprises two sections of rolling topography separated by a central plain area (Fig. 1). Its elevation is well above lake level, and generally slopes down from SH 6 towards an escarpment at the western edge of the development bordering the lake. Borehole investigation results are available along a north-south line approximately through the centre of Stage II. Borelog records indicate shallow topsoil layers (100 mm to 250 mm depth) overlying sandy gravels, with no water tables detected in the range of the investigation depths (6 to 10 metres). These soils are expected to be representative of the overall development area, and indicate permeability conditions, which will facilitate rapid infiltration of treated wastewater effluent when applied on or into the land.

However, the porous nature of such soils will result in very limited in-soil treatment capacity, thus necessitating high quality pre-treatment prior to land application. Such pre-treatment should achieve tertiary treatment quality.

5.0 WASTEWATER SERVICING PROPOSALS

5.1 Servicing Concept

The overall low density of residential development (some 400 units within 410 ha) together with the dispersed layout of accommodation lodge and service village results in extensive open space areas. Conventional wastewater centralised servicing to single treatment plant location and point discharge into the natural environment does not fit well with nor does it best serve the environmental objectives for the development. The alternative approach of DWM (decentralised wastewater management) involving a mix of individual on-site wastewater systems plus cluster development involving hybrid on-site/off-site (or full off-site) treatment together with communal land application, all under a centralised operational and management control, provides the best overall servicing solution. The DWM approach makes best use of on-lot and off-lot open space lands to assimilate effluent residuals into soils in a low intensity manner while utilising both carriage water and nutrients in the treated effluent to enhance landscape planting values. Centralised management of operation and maintenance procedures ensures a high quality and uniform service delivery across the whole development independent of the home owner involvement associated with traditional oversight of on-site wastewater systems. Body corporate structures can be readily set up to facilitate the overall implementation and administration of the DWM approach.

5.2 Wastewater Pre-treatment

Pre-treatment options, which fit within the servicing concept outlined above, include the following:

On-lot Option A

On-site enhanced performance septic tank (with effluent outlet filter) (EPST) plus intermittent dosed sand filter unit (ISF) plus UV (ultraviolet) disinfection unit. This system provides a tertiary effluent quality for individual on-lot land application and/or landscaping enhancement. It is suitable for both permanently or intermittently occupied dwellings.

On-lot Option B

On-site aerobic treatment plant (ATP) (household package unit) with UV disinfection. This system provides a tertiary effluent quality for individual on-lot land application and/or landscaping enhancement. It is primarily suitable for permanently occupied dwellings.

Cluster Option C

On-site EPST with 50 mm gravity MEDS (modified effluent drainage servicing) to communal RSF (recirculating sand filter) and UV disinfection unit serving groups of dwellings. It is suitable for both permanently or intermittently occupied premises. Where individual or a sub-groups of dwellings are located below the grade line of the MEDS system, individual on-site or communal off-site pumping units can feed into the gravity MEDS lines. This system is appropriate for either low or high density cluster layout of dwellings. It provides a tertiary effluent quality suitable for communal landscape enhancement within dedicated land application areas. Storage of reclaimed water can provide for seasonal use as irrigation water under controlled conditions.

Communal Option D

MCS (modified conventional sewer) of 100 mm diameter gravity lines to off–site communal EPST plus RSF and UV unit serving groups of dwellings, and/or accommodation lodge, and/or village service centre. In all other respects it replicates the servicing approach of Cluster Option C, but with no on-site pre-treatment. It provides the same servicing level to permanently or intermittently occupied premises, and produces a high quality effluent suitable for communal landscape enhancement and/or seasonal irrigation use.

Communal Option E

As for Option D above except that a communal ATP and UV unit replaces the EPST/RSF/UV treatment combination. More suited to higher levels of permanently occupied premises.

Final design of the development is likely to result in a mix of the above pre-treatment options being utilised to fit with the layout and density of dwellings and the associated land application options for final effluent management.

Note:

In wastewater treatment terminology there are three degrees of effluent treatment performance. “Primary treatment” refers to basic settling and solids retention such as achieved by a septic tank. “Secondary treatment” refers to the aerobic biological processes provided by sand filter and aerobic treatment plant units. “Tertiary treatment” relates to the use of disinfection processes to remove human intestinal micro-organisms following secondary treatment. UV is accepted as the most environmentally acceptable disinfection process.]

5.3 Land Application of Treated Effluent

(a) General

The high quality tertiary treated effluent proposed as a minimum pre-treatment standard for this development can be returned to the environment for subsoil infiltration and plant evapo-transpiration. Environmental impact is confined mainly to the soil within a metre or so depth below the distribution lines. Rainwater infiltration and dispersion at depth into the groundwater will extensively dilute any nutrient not taken up by plant growth. Given the substantial depth to groundwater below the site, and the large volume of such groundwater into which any infiltration quantity of treated effluent can be diluted, it is likely it will be very difficult to detect nutrient impacts. There will be no bacteriological impacts because of the level of pre-treatment, and the capacity of the natural soil at the proposed effluent loading rates to retain any undisinfected micro-organisms beyond their natural dieoff times.

These matters will be subject to review during the discharge consents application procedures to be considered in due course by the Otago Regional Council. At that time the results of detailed environmental assessment will be available to confirm the extent of discharge permit conditions. Following dedicated storage, which enables the effluent through dilution and biological processes to become mature pond water, the resulting reclaimed water has potential for use as an irrigation water source. This option for effluent land application to golf course areas would similarly be subject to discharge permit conditions.

(b) Land application alternatives

Site and soil conditions within the development area present two land application options which best fit the environmental objectives for the project. These are:

Infiltration Option F

The use of pump-dosed loaded shallow trenches to take tertiary quality effluent and disperse into the subsoil by direct infiltration. A conservative design loading rate of 50 mm/day (50 litres for every square metre of trench base area) would enable low impact dispersion of infiltrated flows into the soil and ultimately into the groundwater.

However, this system this will result in minimal opportunity for evapo-transpiration and nutrient uptake by plant growth, and is the least preferred option. In addition, trench installation requirements within the gravel subsoils lack the flexibility in construction technique provided by the alternative of shallow subsurface and covered surface drip irrigation systems (Option G below).

Irrigation Option G

Drip irrigation of tertiary treated effluent utilising pressure compensating drip emitters provides maximum flexibility in locating and installing land application areas. The use of a conservative design loading rate will ensure maximum opportunity for plant uptake of nutrient (to enhance plant growth) and liquid (for evapo-transpiring to the atmosphere), thus reducing infiltration to groundwater. The recommended loading rate of 3 mm/day (3 litres for every square metre of irrigation area) is 60% of the design loading rate considered acceptable for the porous soil conditions at this location. This low intensity drip irrigation approach is the preferred option for the development. It presents an opportunity for utilisation of tertiary treated effluent for both on-lot and communal landscaping enhancement, as drip lines can be located to fit irregular shaped distribution areas, as well as handle moderate variations in elevation under the inherent pressure compensating capabilities of the system.

(c) Land area requirements: The footprint areas for Options F and G above are set out in the following tables. The aggregate areas for the preferred Option G (drip irrigation) are shown on Fig. 1 to illustrate the irrigation area requirement relative to those site areas currently identified for development facilities. The use of drip irrigation layout provides ultimate flexibility in distributing the aggregate area within on-lot and communal areas throughout the development so that the resulting dedicated effluent management land application areas form part of the overall landscaping and planting plan.

Option F: (Infiltration Trenches)

Aggregate Area Requirement	On-lot Area Requirement
Stage I 82 m^3/day; 4,100 m of 400 mm wide trenches spaced at 2 m centres results in 8,200 m^2 of trench system (0.82 hectare)	**Stage I** 900 litres/day per dwelling; 45 m of 400 mm wide trench spaced at 2 m centres results in 90 m^2 of trench system per lot
Stage II 344 m^3/day; 17,200 m of 400 mm wide trenches spaced at 2 m centres results in 34,400 m^2 of trench system (3.44 hectare)	**Stage II** 900 litres/day per dwelling; 45 m of 400 mm wide trench spaced at 2 m centres results in 90 m^2 of trench system per lot

Option F: (Drip Irrigation)

Aggregate Area Requirement	On-lot Area Requirement
Stage I 82 m^3/day; 27,330 m of dripline spaced at 1 m results in 27,330 m^2 of irrigation system (2.73 hectare)	**Stage I** 900 litres/day per dwelling; 300 m of dripline spaced at 1 m centres results in 300 m^2 of irrigation system per lot
Stage II 344 m^3/day; 114,670 m of dripline spaced at 1 m results in 114,670 m^2 of irrigation system (11.5 hectare)	**Stage II** 900 litres/day per dwelling; 300 m of dripline spaced at 1 m centres results in 300 m^2 of irrigation system per lot

5.4 Design and Operational Factors

Two aspects of the preferred drip irrigation system operation require consideration relative to the winter versus summer climate conditions in the Wakatipu basin. They relate to the effect of freezing conditions on effluent irrigation driplines, and the year round influence of evapo-transpiration on effluent uptake within landscaped areas.

(a) Cold climate conditions

Dripline systems are installed either at shallow depth within topsoil (100 mm being common), or are laid on the ground surface and covered with protective mulch or compost. Plantings of grasses, shrubs or trees are located between the driplines, with dripline spacing adjusted to suit the planting regime and configuration. Root systems do not penetrate the dripline emitters where soil moisture deficit is not a constraint, and/or where driplines drain between dose applications. Experience has been obtained over several years in the rigorous cold winter freezing conditions in North America where periodic soil freezing at depths below the drip lines have been recorded (see “On-site NewZ” Special Report 01/1, April 2001 which summarises Wisconsin research into this issue). Where driplines are located within a vegetated area, and where full drain-back to the distribution chamber is provided after each dose, then natural heat of the effluent relative to external temperatures together with the insulating effects of vegetation (such as long grass, shrubs or trees) ensures trouble free operation.

For the proposed application at this location, with driplines laid within soil to a depth of 100 mm (topsoil enhancement to be provided where necessary), with planting cover established from commissioning of the effluent distribution system, and with the system designed and operated on a drainback basis, then adequate cold weather protection can be maintained.

(b) Evapo-transpiration assist

The utilisation of plant evapo-transpiration for nutrient uptake as well as carriage water transfer to the atmosphere is an important mechanism in treated effluent uptake and environmental effects management. The proposed dripline irrigation system maximises opportunity for evapo-transpiration (ET) assist. This ET assist is at a maximum during summer warm weather and high pan-evaporation conditions. However, ET assist is also important in winter even though pan-evaporation rates are at their lowest. This is due to the fact that effluent stimulated plant growth still draws moisture onto leaf surfaces where the “clothesline” effect of wind action passing over and through the plants draws that moisture into the atmosphere. This mechanism has been shown to enhance ET rates to 2 to 3 times that of pan-evaporation, and provide positive liquid transfer to atmosphere even during winter. Once again it is North American research (specifically Canada) that has provided leadership in investigating the mechanisms involved.

In the porous soil conditions prevalent throughout the site of this development, ample infiltration capacity exists to take all treated effluent applied to land without reliance on ET assist. However, plant uptake will be an important element in effluent management, as dripline systems will place that effluent within the rootzone of the landscape plantings. Where deciduous trees are used, or when low ET assist conditions prevail, then under winter conditions the effluent not taken up by plants will automatically drain away from the rootzone and infiltrate through the natural soil to groundwater at depth.

6.0 MANAGEMENT PROCEDURES

The management of all wastewater servicing facilities under central agency control administered by a Body corporate has already been referred to in 5.1 above.

Centralised operation and management oversight would have the following elements:

An operation and management plan dealing with all private and communal elements of wastewater servicing together with the environmental monitoring requirements related to resource consent conditions. (Where reclaimed water use via irrigation of recreation areas is involved, the management plan will detail the constraints associated with irrigation operations in meeting the consent conditions.)

- Body corporate ownership of all communal facilities (including pre-treatment and land application systems).
- Body corporate commissioning and supervision of operation and maintenance service contract(s). Unimpeded access for servicing agency staff to all privately owned pre-treatment and land application systems to undertake monitoring, repairs, and routine maintenance on a structured basis.
- A quick response system based on automatic alarm activation, and specialist service personnel callout to deal with faults.
- A centralised workshop/servicing base at which standby mechanical and electrical equipment is stored and maintained (such as replacement pump units, aerators, disinfection units, electrical control fittings, plus associated drainage system hardware).

Opportunity exists for the developer to engage an appropriate company on a design-build-operate (DBO) basis in accordance with an agreed concept plan. This would facilitate a unified approach to system design and hardware selection, and lead to long-term benefits in having standardised technical systems and operating procedures. The DBO approach can be centered on performance criteria that are aimed at securing the environmental objectives for the development. Remote sensing of equipment operation and treatment performance can deliver monitoring information to a centralised control centre (anywhere outside Queenstown if need be) so that specialist personnel can provide monitoring diagnosis and support of all system operations on a 24 hr basis.

7.0 SUMMARY

- Wastewater servicing proposals for the Jacks Point development are to deliver the highest environmental performance consistent with best-available-technology.
- Wastewater flow quantities for pre-treatment and land application have been adopted at 82 m^3/day for Stage I development, and 344 m^3/day for Stage II.
- Wastewater pre-treatment options include enhanced performance septic tank and sand filter systems with ultraviolet disinfection for on-site single property use. For communal cluster or service area use, either septic tank/sand filter/disinfection systems or aerobic treatment plant/disinfection systems are applicable.
- The preferred land application system is drip irrigation of tertiary treated effluent, with dripline system designed and operated to handle seasonal cold weather conditions.
- The aggregate area required for a conservative (low intensity) irrigation loading rate is 2.73 hectares for Stage I, plus 11.5 hectares for Stage II.
- However, the operational and installation flexibility offered by dripline land application enables the aggregate area to be split into a range of individual and communal irrigation areas for on-lot and dedicated open space landscaping enhancement.
- Tertiary treated effluent also offers a source of reclaimed water, which following maturing in storage pond(s) can be used for specific recreational area irrigation purposes.
- The decentralised wastewater management servicing of this development is to be subject to centralised management of operation, maintenance and monitoring procedures for both on-lot and communal facilities.

APPENDIX 3 - Revegetation Plant Schedule by Boffa Miskell Limited

1.0 Species Lists for Revegetation and Enhancement Planting at Coneburn

Species suitable for enhancement and creation of habitat types identified in this document are appended. These species list have been compiled from Meurk (1997) and Simpson (2001).

Additional comments on the suitability of species for particular locations or roles within the habitats are given. Such comments include the ability of the species to act as a colonising plant, ameliorating the habitat for the planting, or natural regeneration, of other native species. One species, bracken (*Pteridium esculentum*), that performs this role in the high-energy stream and lake forest habitats in the study area is not noted. It is capable of self-introducing and thus it does not need to be actively planted. In many instances, allowing bracken to develop prior to planting in areas that are desired to become forest habitats will benefit regeneration and revegetation.

Species mentioned here are those that will generally be available from nurseries. However, large quantities, and uncommon species, will need to be ordered in advance. There may be difficulties for nurseries in obtaining and growing some threatened species.

2.0 Beech Forest Regeneration

The development of beech forest, a habitat type that is now poorly represented in the study area, can be slow. To ensure good growth of beech forest the inclusion of appropriate mycorrhizal microbes in to the potting mix is essential. Initial shelter from companion plantings of kohuhu (*Pittosporum tenuifolium*) and mingimingi (*Coprosma propinqua*) will provide necessary shelter. However, beech does grow naturally in open locations so deep shade, or planting in copses of shrubs would not appear to be beneficial. Growth rates in excess of 0.2 - 1m per year have been reported by Meurk (1997), who further notes that beech has a ‘fast’ growth rate. He further comments that poor growth in plant species, such as that noted from some beech revegetation plantings in the study area (*pers. obs.*), are not an indication of poor potential. This poor growth may be the result of missing ingredient (mycorrhizal infections), a pathogen (Meurk 1997) or planting in an inappropriate location. To date, detailed research on revegetation requirements of beech, and other species (that Meurk (1997) notes need study), have not been completed.

In general, of the soil types that Meurk (1997) note as being suitable to sustain mountain and red beech forest, there are only small amounts in the study area. These Dunstan and Blackstone soils are sparingly distributed on the lakeshore terrace, and Jacks Point and Peninsula Hill rouches moutonées. Consideration of the appropriateness of beech revegetation in regard to the soils may increase the success of beech revegetation.

LAKESHORE FORESTS: species for revegetation planting in lakeshore forest locations

species	common name	large tree	small tree	tall shrub	small shrub	sedge, rush, tussock	comments
Nothofagus fusca	red beech	√					requires initial shelter
N.solandri var. *cliffortioides*	mountain beech	√					requires initial shelter and mycorrhizae
Prumnopitys taxifolius	matai	√					requires shelter, slow growing
Podocarpus hallii	Hall's totara	√					requires shelter, slow growing
Pseudopanax crassifolius	lancewood		√				requires initial shelter, slow growing
Pennantia corymbosa	kaikomako		√				requires shelter, lower (moist) lakeshore and wetland margin locations
Coprosma linariifolia			√				appropriate?, requires initial shelter, tolerance for a range of soils
Elaeocarpus hookerianus	pokaka		√				requires shelter, requires moist soils, lake margin locations
Griselinia littoralis	kapuka / broadleaf		√				requires initial shelter, tolerance for a range of soils and habitats
Hoheria lyallii	mountain ribbonwood		√				colonising species, tolerant & requiring moist soils in a range of habitats
Pittosporum tenuifolium	kohuhu		√				coloniser but requires initial shelter, tolerant of a range of soils & habitats
Aristotelia serrata	wineberry		√				requires shelter and moist soils, very palatable
Carpodetus serratus	putaputaweta/marbleleaf		√				requires shelter and moist soils
Cordyline australis	ti kouka / cabbage tree		√				colonising species, tolerance for a range of soils and habitats
Fuchsia excorticata	kotukutuku/tree fuchsia		√				requires shelter, palatable
Melicytus lanceolatus	mahoe wao		√				requires shelter, palatable
Melicytus ramiflorus	mahoe/whiteywood		√				requires shelter, palatable, good insect habitat
Metrosideros umbellata	southern rata		√				currently only present south of Cone Burn
Myrsine australis	red matipo		√				requires shelter
Pittosporum eugenioides	tarata/lemonwood		√				requires shelter
Sophora microphylla	kowhai		√				colonising species, tolerance for a range of soils and habitats, N fixer
Schefflera digitata	seven finger		√				requires shelter, palatable, requires moist soils
Pseudopanax colensoi var. *ternatus*	mountain three finger			√			requires initial shelter only
Olearia avicenniifolia				√			colonising species, tolerant of a range of soils and habitats
Olearia fragrantissima				√			requires initial shelter, tolerant of a range of soils & habitats, uncommon.
Coprosma lucida	shining leaf Coprosma			√			requires shelter, palatable, tolerance for a range of soils
Olearia arborescens				√			requires initial shelter, tolerance for a range of soils
Hebe rakaiensis					√		requires initial shelter, tolerance for a range of moist habitats
Dracophyllum longifolium	inaka				√		open sites, requires moist soils
Myrsine divaricata	weeping mapou				√		requires initial shelter, tolerant of a range of moist soils and habitats
Aristotelia fruticosa	mountain wineberry				√		requires intial shelter, palatable, tolerant of a range of dry soils & habitats
Astelia nervosa						√	requires shelter, ground cover
Carex maorica						√	appropriate?, open sites on open,wet lakeshore forest margins
Astelia fragrans	bush lily					√	requires shelter, ground cover

GREY SHRUBLAND: species for enhancement of, and revegetation in, grey shrublands

species	common name	small tree	tall shrub	small shrub	sedge, rush, tussock	comments
Coprosma linariifolia		√				appropriate?, requires initial shelter, tolerance for a range of soils
Podocarpus hallii	Hall's totara	√				requires shelter, slow growing
Olearia bullata			√			open sites, tolerance for a range of dry soils
Olearia fragrantissima			√			requires initial shelter, tolerant of a range of soils & habitats, uncommon
Olearia hectorii			√			requires initial shelter, uncommon
Leptospermum scoparium	manuka		√			appropriate?, colonising species, tolerance for a range of soils & habitats
Olearia lineata			√			open sites, tolerance for a range of soils & habitats
Discaria toumatou	matagouri		√			colonising species, tolerance for a range of dry soils & habitats, N fixer
Aristotelia fruticosa	mountain wineberry			√		appropriate?, requires intial shelter, palatable, tolerant of a range of dry soils & habitats
Coprosma propinqua	mingimingi			√		colonising species, tolerance for a range of soils & habitats
Coprosma crassifolius				√		open sites, tolerance for a range of soils
Cyathodes juniperina	mingimingi			√		requires initial shelter, good lizard habitat
Olearia nummularia				√		open sites
Olearia odorata				√		open sites, good invertebrate habitat
Melicytus alpinus	porcupine shrub			√		open sites, tolerant of dry soils, good lizard habitat and food
Corokia cotoneaster	korokia			√		open sites, palatable, tolerant of a range of dry soils & habitats
Carmichaelia petriei	NZ broom			√		open sites, hardy, tolerates a range of dry soils & habitats, N fixer
Ozothamnus sp.	cottonwood			√		colonising species
Hebe cupressoides				√		open sites, tolerates and requires dry soils
Dracophyllum uniflorum	turpentine shrub			√		open sites, requires moist soils, high altitude shrubland only
Dracophyllum longifolium	inaka			√		open sites, requires moist soils
Aciphylla aurea	golden speargrass				√	open sites, tolerates a range of dry soils, sharp
Chionochloa rigida	narrow-leaved snow tussock				√	colonising species, requires moist soils
Festuca novae zelandiae	hard tussock				√	open sites, tolerates a range of dry soils
Poa cita	silver tussock				√	colonising species, tolerates a range of dry soils

BEECH FOREST REMNANTS: species for enhancement, revegetation and planting of remnant beech forests

species	common name	large tree	small tree	tall shrub	small shrub	sedge, rush, tussock	comments
Nothofagus fusca	red beech	√					requires initial shelter
N. solandri var. *cliffortioides*	mountain beech	√					requires initial shelter and mycorrhizae
Pseudopanax crassifolius	lancewood		√				requires initial shelter, slow growing
Pennantia corymbosa	kaikomako		√				requires shelter, lower (moist) lakeshore and wetland margin locations
Coprosma linariifolia			√				requires initial shelter, tolerance for a range of soils
Elaeocarpus hookerianus	pokaka		√				requires shelter, lower (moist) lakeshore locations
Griselinia littoralis	kapuka, broadleaf		√				requires initial shelter, tolerance for a range of soils and habitats
Hoheria lyallii	mountain ribbonwood		√				colonising species, tolerant & requiring moist soils in a range of habitats
Pseudopanax colensoi var. *ternatus*	mountain three finger			√			requires initial shelter only
Olearia avicenniifolia				√			colonising species, tolerant of a range of soils and habitats
Olearia hectorii				√			requires initial shelter, uncommon species
Hebe rakaiensis					√		requires initial shelter, tolerance for a range of moist habitats
Dracophyllum longifolium	inaka				√		open sites, requires moist soils
Myrsine divaricata	weeping mapou				√		requires initial shelter, tolerant of a range of moist soils and habitats
Olearia cymbifolia					√		open sites on upper terrace locations
Coprosma propinqua	mingimingi				√		colonising species, tolerance for a range of soils and habitats
Coprosma crassifolius					√		open sites, tolerance for a range of soils
Cyathodes juniperina	mingimingi				√		requires initial shelter, good lizard habitat
Olearia nummularia					√		open sites
Hebe salicifolia	willow-leaved Hebe				√		requires initial shelter, tolerance for a range of moist soils & habitats
Hebe subalpina					√		open sites
Olearia odorata					√		open sites, good invertebrate habitat
Corokia cotoneaster	korokia				√		open sites, palatable, tolerant of a range of dry soils & habitats
Carmichaelia petriei	NZ broom				√		open sites, hardy, tolerates a range of dry soils & habitats, N fixer
Ozothamnus sp.	cottonwood				√		colonising species
Poa cita	silver tussock					√	colonising species, tolerates a range of dry soils
Astelia fragrans	bush lily					√	requires shelter, ground cover
Astelia nervosa						√	requires shelter, ground cover
Carex secta	pukio					√	colonising species, hardy and tolerant on moist margins
Chionochloa conspicua	bush tussock					√	open sites, requiring moist soils in a range of habitats
Cortaderia richardii	toi toi					√	colonising species, tolerant of moist soils in a range of habitats
Phormium tenax	harakeke/swamp flax					√	colonising species, tolerant of moist soils in a range of habitats
Phormium cookianum	mountain flax					√	colonising species, requires moist soils, tolerates a range of habitats

HIGH ENERGY STREAMS: species for enhancement of, and revegetation in, high energy streams

species	common name	small tree	tall shrub	small shrub	sedge, rush, tussock	comments
Griselinia littoralis	kapuka / broadleaf	√				requires initial shelter, tolerance for a range of soils & habitats
Hoheria lyallii	mountain ribbonwood	√				open sites, requires moist soils in a range of habitats
Pittosporum tenuifolium	kohuhu	√				coloniser, but can require initial shelter, tolerant of a range of soils & habitats
Carpodetus serratus	putaputaweta, marbleleaf	√				requires shelter and moist soils
Cordyline australis	ti kouka / cabbage tree	√				colonising species, tolerance for a range of soils & habitats
Fuchsia excorticata	kotukutuku/tree fuchsia	√				requires shelter, palatable
Melicytus ramiflorus	mahoe/whiteywood	√				requires shelter, palatable, good insect habitat
Pittosporum eugenioides	tarata/lemonwood	√				coloniser but requires shelter
Sophora microphylla	kowhai	√				colonising species, tolerance for a range of soils & habitats, N fixer
Pseudopanax colensoi var. *ternatus*	mountain three finger		√			requires initial shelter only
Olearia avicenniifolia			√			colonising species, tolerant of a range of soils & habitats
Olearia lineata			√			open sites, tolerance for a range of soils & habitats
Discaria toumatou	matagouri		√			colonising species, tolerance for a range of dry soils & habitats, N fixer
Hebe rakaiensis				√		requires initial shelter, tolerance for a range of moist habitats
Myrsine divaricata	weeping mapou			√		requires initial shelter, tolerant of a range of moist soils & habitats
Aristotelia fruticosa	mountain wineberry			√		requires initial shelter, palatable, tolerates a range of dry soils & habitats
Olearia cymbifolia				√		open sites on upper terrace locations
Coprosma propinqua	mingimingi			√		colonising species, tolerance for a range of soils & habitats
Coprosma crassifolius				√		open sites, tolerance for a range of soils
Cyathodes juniperina	mingimingi			√		requires initial shelter, good lizard habitat
Hebe odora				√		open sites, requires moist soils
Olearia nummularia				√		open sites
Hebe salicifolia	willow-leaved Hebe			√		requires initial shelter, tolerance for a range of moist soils & habitats
Hebe subalpina				√		open sites
Olearia odorata				√		open sites, good invertebrate habitat
Corokia cotoneaster	korokia			√		open sites, palatable, tolerant of a range of dry soils & habitats
Carmichaelia petriei	NZ broom			√		open sites, hardy, tolerates a range of dry soils & habitats, N fixer
Ozothamnus sp.	cottonwood			√		colonising species
Poa cita	silver tussock				√	colonising species, tolerates a range of dry soils
Astelia fragrans	bush lily				√	requires shelter, ground cover
Astelia nervosa					√	requires shelter, ground cover
Carex secta	pukio				√	colonising species, hardy and tolerant on moist margins
Chionochloa conspicua	bush tussock				√	open sites, requiring moist soils in a range of habitats
Cortaderia richardii	toi toi				√	colonising species, tolerant of moist soils in a range of habitats
Phormium tenax	harakeke/swamp flax				√	colonising species, tolerant of moist soils in a range of habitats
Phormium cookianum	mountain flax				√	colonising species, requires moist soils, tolerates a range of habitats

TUSSOCKLAND: species for enhancement of, and revegetation in, tussockland

species	common name	small shrub	sedge, rush, tussock	comments
Hebe odora		√		open sites, requires moist soils
Melicytus alpinus	porcupine shrub	√		open sites, tolerant of dry soils, good lizard habitat and food
Carmichaelia petriei	NZ broom	√		open sites, hardy, tolerates a range of dry soils & habitats, N fixer
Ozothamnus sp.	cottonwood	√		colonising species
Hebe cupressoides		√		open sites, tolerates and requires dry soils
Hebe subalpina		√		open sites, montane locations
Dracophyllum longifolium	inaka	√		open sites requires moist soils
Dracophyllum uniflorum	turpentine shrub	√		open sites, requires moist soils, high altitude shrubland only
Pimelia aridula	NZ daphne	√		colonising species on a range of dry soils
Carex coriacea	NZ swamp sedge		√	open sites, hardy and tolerant of a range of wet soils
Chionochloa conspicua	bush tussock		√	open sites, tolerant and requiring moist soils in a range of habitats
Cortaderia richardii	toi toi		√	colonising species, tolerant of moist soils in a range of habitats
Phormium tenax	harakeke/swamp flax		√	colonising species, tolerant of moist soils in a range of habitats
Phormium cookianum	mountain flax		√	colonising species , requires moist soils, tolerates a range of habitats
Aciphylla aurea	golden speargrass		√	open sites, tolerates a range of dry soils, sharp
Chionochloa rigida	narrow-leaved snow tussock		√	colonising species, requires moist soils
Festuca novae zelandiae	hard tussock		√	open sites, tolerates a range of dry soils
Poa cita	silver tussock		√	colonising species, tolerates a range of dry soils

WETLANDS: species for enhancement of, and revegetation in, wetland locations

species	common name	small tree	tall shrub	small shrub	sedge, rush, tussock	comments
Pennantia corymbosa	kaikomako	√				requires shelter, moist soils on wetland & lake margins
Pittosporum tenuifolium	kohuhu	√				requires initial shelter, tolerance for a range of soils & habitats
Pseudopanax crassifolius	lancewood	√				requires initial shelter, slow growing
Leptospermum scoparium	manuka		√			appropriate?, colonising species, tolerance for a range of soils & habitats
Olearia lineata			√			open sites, tolerance for a range of soils & habitats
Hebe rakaiensis				√		requires initial shelter, tolerance for a range of moist habitats
Hebe salicifolia	willow-leaved Hebe			√		requires initial shelter, tolerance for a range of moist soils & habitats
Olearia cymbifolia				√		open sites on upper terrace locations
Olearia nummularia				√		open sites
Carex maorica					√	appropriate?, open sites on open,wet lakeshore forest margins
Aciphylla glaucescens	blue speargrass				√	wetland margins and planted in moist areas with tussocks
Carex coriacea	NZ swamp sedge				√	colonising species, hardy and tolerant of a range of wet soils
Carex secta	pukio				√	colonising species, hardy and tolerant
Chionochloa conspicua	bush tussock				√	colonising species, tolerant & requiring moist soils in a range of habitats
Cortaderia richardii	toi toi				√	colonising species, tolerant of moist soils in a range of habitats
Juncus distegus	wiwi				√	open sites, requires moist soils
Juncus gregiflorus	NZ soft rush				√	colonising species, requires moist soils
Juncus sarophorus	wiwi				√	open sites, requires moist soils
Phormium cookianum	mountain flax				√	colonising species, requires moist soils, tolerates a range of habitats
Phormium tenax	harakeke / swamp flax				√	colonising species, tolerant of moist soils in a range of habitats
Typha orientalis	raupo / bullrush				√	colonising species, wastewater treatment, wetland bird habitat
Schoenus pauciflorus	bog rush				√	open sites, requires moist soils

species	common name	lake shore forest	remnant beech forest	wetland	grey shrubland	high energy streams	tussock land	large tree	small tree	tall shrub	small shrub	sedge, rush, tussock
Pseudopanax crassifolius	lancewood	√	√	√					√			
Pennantia corymbosa	kaikomako	√	√	√					√			
Hebe rakaiensis		√	√	√		√					√	
Coprosma linariifolia		√	√		?				√			
Dracophyllum longifolium	inaka	√	√		√		√				√	
Nothofagus fusca	red beech	√	√					√				
N. solandri var. *cliffortioides*	mountain beech	√	√					√				
Elaeocarpus hookerianus	pokaka	√	√						√			
Griselinia littoralis	kapuka / broadleaf	√	√			√			√			
Pseudopanax colensoi var. *ternatus*	mountain three finger	√	√			√				√		
Astelia nervosa		√	√			√						√
Hoheria lyallii	mountain ribbonwood	√	√			√			√			
Olearia avicenniifolia		√	√			√				√		
Myrsine divaricata	weeping mapou	√	√			√					√	
Carex maorica		√		?								√
Pittosporum tenuifolium	kohuhu	√		√		√			√			
Aristotelia fruticosa	mountain wineberry	√			?	√					√	
Podocarpus hallii	Hall's totara	√			√				√			
Olearia fragrantissima		√			√					√		
Prumnopitys taxifolius	matai	√						√				
Schelfflera digitata	seven finger	√										
Aristotelia serrata	wineberry	√							√			
Carpodetus serratus	putaputaweta / marbleleaf	√				√			√			
Cordyline australis	ti kouka / cabbage tree	√				√			√			
Fuchsia excorticata	kotukutuku / tree fuchsia	√				√			√			
Melicytus lanceolatus	mahoe wao	√							√			
Melicytus ramiflorus	mahoe / whiteywood	√				√			√			
Metrosideros umbellata	southern rata	√							√			
Myrsine australis	red matipo	√							√			
Pittosporum eugenioides	tarata / lemonwood	√				√			√			
Sophora microphylla	kowhai	√				√			√			
Coprosma lucida	shining leaf Coprosma	√								√		
Olearia arborescens		√								√		
Astelia fragrans	bush lily	√				√						√
Olearia cymbifolia			√	√		√					√	
Coprosma propinqua	mingimingi		√		√	√					√	
Coprosma crassifolius			√		√	√					√	
Olearia hectorii			√		√					√		
Cyathodes juniperina	mingimingi		√		√	√					√	
Hebe odora			√			√	√				√	
Coprosma rugosa			√								√	
Gaultheria antipoda	tall snowberry		√								√	
Leptospermum scoparium	manuka			√	√					√		
Olearia lineata				√	√	√				√		
Olearia nummularia				√	√	√					√	
Olearia bullata					√					√		
Hebe salicifolia	willow-leaved Hebe			√		√					√	
Aciphylla glaucescens	blue speargrass			√								√
Carex coriacea	NZ swamp sedge			√			√					√
Carex secta	pukio			√		√						√
Juncus distegus	wiwi			√								√
Juncus gregiflorus	NZ soft rush			√								√
Juncus sarophorus	wiwi			√								√
Schoenus pauciflorus	bog rush			√								√
Chionochloa conspicua	bush tussock			√		√	√					√
Cortaderia richardii	toi toi			√		√	√					√
Typha orientalis	raupo / bullrush			√								√
Phormium tenax	harakeke/swamp flax			√		√	√					√
Phormium cookianum	mountain flax			√		√	√					√
Olearia odorata					√	√					√	
Discaria toumatou	matagouri				√	√				√		
Melicytus alpinus	porcupine shrub				√		√				√	
Corokia cotoneaster	korokia				√	√					√	
Carmichaelia petriei	NZ broom				√	√	√				√	
Ozothamnus sp.	cottonwood				√	√	√				√	
Hebe cupressoides					√		√				√	
Aciphylla aurea	golden speargrass				√		√					√
Chionochloa rigida	narrow-leaved snow tussock				√		√					√
Festuca novae zelandiae	hard tussock				√		√					√

TUSSOCKLAND: species for enhancement of, and revegetation in, tussockland

species	common name	small shrub	sedge, rush, tussock	comments
Hebe odora		√		open sites, requires moist soils
Melicytus alpinus	porcupine shrub	√		open sites, tolerant of dry soils, good lizard habitat and food
Carmichaelia petriei	NZ broom	√		open sites, hardy, tolerates a range of dry soils & habitats, N fixer
Ozothamnus sp.	cottonwood	√		colonising species
Hebe cupressoides		√		open sites, tolerates and requires dry soils
Hebe subalpina		√		open sites, montane locations
Dracophyllum longifolium	inaka	√		open sites requires moist soils
Dracophyllum uniflorum	turpentine shrub	√		open sites, requires moist soils, high altitude shrubland only
Pimelia aridula	NZ daphne	√		colonising species on a range of dry soils
Carex coriacea	NZ swamp sedge		√	open sites, hardy and tolerant of a range of wet soils
Chionochloa conspicua	bush tussock		√	open sites, tolerant and requiring moist soils in a range of habitats
Cortaderia richardii	toi toi		√	colonising species, tolerant of moist soils in a range of habitats
Phormium tenax	harakeke/swamp flax		√	colonising species, tolerant of moist soils in a range of habitats
Phormium cookianum	mountain flax		√	colonising species , requires moist soils, tolerates a range of habitats
Aciphylla aurea	golden speargrass		√	open sites, tolerates a range of dry soils, sharp
Chionochloa rigida	narrow-leaved snow tussock		√	colonising species, requires moist soils
Festuca novae zelandiae	hard tussock		√	open sites, tolerates a range of dry soils
Poa cita	silver tussock		√	colonising species, tolerates a range of dry soils

WETLANDS: species for enhancement of, and revegetation in, wetland locations

species	common name	small tree	tall shrub	small shrub	sedge, rush, tussock	comments
Pennantia corymbosa	kaikomako	√				requires shelter, moist soils on wetland & lake margins
Pittosporum tenuifolium	kohuhu	√				requires initial shelter, tolerance for a range of soils & habitats
Pseudopanax crassifolius	lancewood	√				requires initial shelter, slow growing
Leptospermum scoparium	manuka		√			appropriate?, colonising species, tolerance for a range of soils & habitats
Olearia lineata			√			open sites, tolerance for a range of soils & habitats
Hebe rakaiensis				√		requires initial shelter, tolerance for a range of moist habitats
Hebe salicifolia	willow-leaved Hebe			√		requires initial shelter, tolerance for a range of moist soils & habitats
Olearia cymbifolia				√		open sites on upper terrace locations
Olearia nummularia				√		open sites
Carex maorica					√	appropriate?, open sites on open,wet lakeshore forest margins
Aciphylla glaucescens	blue speargrass				√	wetland margins and planted in moist areas with tussocks
Carex coriacea	NZ swamp sedge				√	colonising species, hardy and tolerant of a range of wet soils
Carex secta	pukio				√	colonising species, hardy and tolerant
Chionochloa conspicua	bush tussock				√	colonising species, tolerant & requiring moist soils in a range of habitats
Cortaderia richardii	toi toi				√	colonising species, tolerant of moist soils in a range of habitats
Juncus distegus	wiwi				√	open sites, requires moist soils
Juncus gregiflorus	NZ soft rush				√	colonising species, requires moist soils
Juncus sarophorus	wiwi				√	open sites, requires moist soils
Phormium cookianum	mountain flax				√	colonising species, requires moist soils, tolerates a range of habitats
Phormium tenax	harakeke / swamp flax				√	colonising species, tolerant of moist soils in a range of habitats
Typha orientalis	raupo / bullrush				√	colonising species, wastewater treatment, wetland bird habitat
Schoenus pauciflorus	bog rush				√	open sites, requires moist soils

species	common name	lake shore forest	remnant beech forest	wetland	grey shrubland	high energy streams	tussock land	large tree	small tree	tall shrub	small shrub	sedge, rush, tussock
Pseudopanax crassifolius	lancewood	√	√	√					√			
Pennantia corymbosa	kaikomako	√	√	√					√			
Hebe rakaiensis		√	√	√		√					√	
Coprosma linariifolia		√	√		?				√			
Dracophyllum longifolium	inaka	√	√		√		√				√	
Nothofagus fusca	red beech	√	√					√				
N. solandri var. *cliffortioides*	mountain beech	√	√					√				
Elaeocarpus hookerianus	pokaka	√	√						√			
Griselinia littoralis	kapuka / broadleaf	√	√			√			√			
Pseudopanax colensoi var. *ternatus*	mountain three finger	√	√			√				√		
Astelia nervosa		√	√			√						√
Hoheria lyallii	mountain ribbonwood	√	√			√			√			
Olearia avicenniifolia		√	√			√				√		
Myrsine divaricata	weeping mapou	√	√			√					√	
Carex maorica		√		?								√
Pittosporum tenuifolium	kohuhu	√		√		√			√			
Aristotelia fruticosa	mountain wineberry	√			?	√					√	
Podocarpus hallii	Hall's totara	√			√				√			
Olearia fragrantissima		√			√					√		
Prumnopitys taxifolius	matai	√						√				
Schelfflera digitata	seven finger	√										
Aristotelia serrata	wineberry	√							√			
Carpodetus serratus	putaputaweta / marbleleaf	√				√			√			
Cordyline australis	ti kouka / cabbage tree	√				√			√			
Fuchsia excorticata	kotukutuku / tree fuchsia	√				√			√			
Melicytus lanceolatus	mahoe wao	√							√			
Melicytus ramiflorus	mahoe / whiteywood	√				√			√			
Metrosideros umbellata	southern rata	√							√			
Myrsine australis	red matipo	√							√			
Pittosporum eugenioides	tarata / lemonwood	√				√			√			
Sophora microphylla	kowhai	√				√			√			
Coprosma lucida	shining leaf Coprosma	√								√		
Olearia arborescens		√								√		
Astelia fragrans	bush lily	√				√						√
Olearia cymbifolia			√	√		√					√	
Coprosma propinqua	mingimingi		√		√	√					√	
Coprosma crassifolius			√		√	√					√	
Olearia hectorii			√		√					√		
Cyathodes juniperina	mingimingi		√		√	√					√	
Hebe odora			√			√	√				√	
Coprosma rugosa			√								√	
Gaultheria antipoda	tall snowberry		√								√	
Leptospermum scoparium	manuka			√	√					√		
Olearia lineata				√	√	√				√		
Olearia nummularia				√	√	√					√	
Olearia bullata					√					√		
Hebe salicifolia	willow-leaved Hebe			√		√					√	
Aciphylla glaucescens	blue speargrass			√								√
Carex coriacea	NZ swamp sedge			√			√					√
Carex secta	pukio			√		√						√
Juncus distegus	wiwi			√								√
Juncus gregiflorus	NZ soft rush			√								√
Juncus sarophorus	wiwi			√								√
Schoenus pauciflorus	bog rush			√								√
Chionochloa conspicua	bush tussock			√		√	√					√
Cortaderia richardii	toi toi			√		√	√					√
Typha orientalis	raupo / bullrush			√								√
Phormium tenax	harakeke/swamp flax			√		√	√					√
Phormium cookianum	mountain flax			√		√	√					√
Olearia odorata					√	√					√	
Discaria toumatou	matagouri				√	√				√		
Melicytus alpinus	porcupine shrub				√		√				√	
Corokia cotoneaster	korokia				√	√					√	
Carmichaelia petriei	NZ broom				√	√	√				√	
Ozothamnus sp.	cottonwood				√	√	√				√	
Hebe cupressoides					√		√				√	
Aciphylla aurea	golden speargrass				√		√					√
Chionochloa rigida	narrow-leaved snow tussock				√		√					√
Festuca novae zelandiae	hard tussock				√		√					√

APPENDIX 4 - Geological Survey by Royden Thomson

Geological Evaluation of an Area Between The Remarkables and Lake Wakatipu and South of the Kawarau River - APRIL 2002

CONTENTS

SUMMARY

The area bounded by The Remarkables mountains, Lake Wakatipu, the Kawarau River and Wye Creek has a highly variable terrain that varies from precipitous to flat and a relative elevation difference in excess of 2000 m. Glacial sculpturing has progressively modified the area over time but the relief is in part due to active, tectonic uplift.

A variety of glacially and non-glacially-related sediments and deposits overlie the schist basement west of The Remarkables. These surficial materials locally form a layered sequence as a consequence of the advances and retreats of the various intrusive glaciers in the last million years approximately. This study did not attempt to resolve temporal and spatial issues associated with most of the lithologies that were mapped. On steeper slopes there are landslides and rockslides that only locally intrude into developed regions.

Rockfall, floods and debris flows pose small-scale hazards to part of the study area. Where necessary they should be avoided or mitigated. There is no evidence for active faulting but earthquake shaking effects, and liquefaction occurrences in lake sediments, should be considered in any development.

1. INTRODUCTION

This outline geological report has been prepared as a component of the strategy plan for the area generally lying east of Lake Wakatipu and extending south from the Kawarau River to Wye Creek, as outlined on Figure 1. It incorporates the more intensively mapped Jacks Point development area (Fig. 1), the geological report for which addresses many of the issues and features pertinent to the larger region.

In this study mapping has been achieved both by photogeological studies and field inspections in more accessible areas. The constructed geological map (Fig. 2) incorporates interpretations from both mapping types and, as a consequence, has varying degrees of reliability. It should also be noted that only the surface expressions of the various lithologies are presented on Figure 2; in many areas there will be a layered sequence of younger deposits some of which can only be inferred at depth or established as 'blind' formations where encountered in drill holes. No subsurface interpretations have been included as part of this study.

2. PHYSIOGRAPHY

The Remarkables range dominates both the local and more regional terrains. At an altitude of 2319 m the Double Cone peak is the highest mountain east of the main divide in Otago and there is a relative relief difference between it and Lake Wakatipu of more than 2000 m. Western slopes of the range, strongly affected by glacial erosion in the past, remain steep to precipitous and there are few embayments.

Peninsula Hill also has a marked visual impact when viewed from most perspectives. It is a roche moutoneé with a steep eastern flank but the smooth overall surface texture contrasts sharply with the craggy west face of The Remarkables.

From the toe of the latter to the lake most slopes are west-facing at moderate to low angles. Exceptions include a north-south elongated valley, with an almost flat floor, that extends from just east of Jacks Point to the Kawarau River, and an undulating spur extending south from Peninsula Hill to Jacks Point. Lake margins, and adjacent terrains, are irregularly gentle to precipitous and there are marked variations in slope element heights.

3. TECTONIC STRUCTURE

No faults have been identified in the area of interest during recent studies and there are no identified lineal features of local extent that could be interpreted as possible surface expressions of basement rupture.

However, the regional terrain is acknowledged as being structurally controlled and relief is in part a consequence of plate boundary deformation. The Remarkables are being relatively elevated on a west-dipping, NNE-SSW- trending fault that daylights in the Nevis Valley and the reverse movements on this regionally extensive feature generate shallow depth micro and macro-seismic events that have epicentral positions beneath The Remarkables and Hector Mountains, and to a lesser extent beneath Lake Wakatipu. It can be interpreted that a low angle thrust zone may underlie Lake Wakatipu near the study area at shallow depths but there is no indication it could bifurcate to intersect either the south arm of the lake or the valley axis between Jacks Point and the Kawarau River.

4. GLACIAL EFFECTS - GENERAL

The region has been repeatedly glaciated during the Quaternary period by large to small glaciers that have been sourced both in the main divide and in tributary Central Otago valleys. Evidence for glacial events is widespread and includes characteristic erosional and depositional landforms and deposits over a wide range of elevations. During the last million or so years there appears to have been a spatially diminishing sequence of glacial events that have left ‘footprints’ in the Wakatipu region identifying their presence.

The most significant glacier of interest is the proto Wakatipu Glacier. It split near Queenstown, with tongues extending into valleys both to the east and south, and had surface elevations of up to about 1500 at the north end of The Remarkables and along its west flank. The last advance occurred approximately 18.000 years ago, at which time the glacial tongues extended to Kingston in the south and Lake Hayes in the east. Within the study area the glacier surface is estimated to have been at about RL 440 m, thus all glacial deposits above this elevation are assumed to be related to earlier, larger advances.

Previous work has established a glacial chronology with altitudinal relationships for the Wakatipu Basin. Event differentiation has not been attempted for this study, however.

5. LAKE WAKATIPU EVOLUTIONARY CHANGES

With the melting of the 18,000 year BP glacier a lake formed in the depression with a surface much higher than that at present and an outlet within the terminal moraine at Kingston. Large deltas were constructed on the lake margin at the mouths of tributary rivers (e.g. Shotover River) and benches were constructed or eroded along the lake margin within intervening segments.

At some indeterminate time, but possibly only 5-6,000 years ago, the lake was captured by a Kawarau River tributary and a relatively rapid drop in surface level appeared to have occurred in the subsequent short time span. The lake dropped to lower than its present level but an indicated landslide blockage at the outlet raised it to the existing RL 308 m mean elevation. Various shoreline positions, commonly mantled by beach deposits, are visible both along the west margin and internally within the study area.

Tributary fans also record very clearly the rapid drop in lake level. Well-developed fan surfaces grade out to effective ‘space’ at many localities and these surface remnants have been strongly incised by the tributary streams that now grade to arcuate fan elements at much lower levels.

6. ROCK TYPES AND DISTRIBUTION

The following discussion largely involves the surficial deposits of mid to late Quaternary age that in part are present as layered sequences, as previously noted.

6.1 Schist

This is the basement lithology in the region. In the interest area it has an intermediate metamorphic rank (Textural Zone III) and an irregular outcrop distribution. Foliation dips are generally to the south-east at low to moderate angles.

The schist is essentially a competent rock mass although there are prominent, persistent joint sets and some of the landslides appear to be on foliation dip slopes; some local weakness along foliation can be inferred.

6.2 Glacial Till

In the central and western parts of the study area deposits of till can be defined or inferred on the basis of morphology and the presence of greywacke erratics. The majority of the visible exposures suggest a direct association with the equivalent glacier at the appropriate height (rock clasts in a commonly silty matrix; heterogeneous composition) but there are remnants with a fluvial composition indicating marginal or englacial streams were actively transporting debris at the time.

Till thicknesses will be highly variable; sometimes deceptively so. For example, in the deeply incised gully to the south of the initial zigzag in the ski field road, till is merely a mantle on a thick deposit of coarse debris interpreted as ‘fan’.

Small to intermediate sized areas of till are preserved within the cirques and tributary valleys east of the spine of The Remarkables. Most appear to be very young.

6.3 Pro-glacial River Alluvium

On both sides of SH 6, generally at and below RL 400 m, there are remnants of hummocky terrain that appear to be glacial moraine both on the aerial photos and from a distance in the field, but close inspection reveals a grading and bedding nature suggestive of a fluvial (river) origin.

The limited field mapping has defined three fundamentally different types:

(a) outwash alluvium (fluvioglacial), accumulating in front of the advancing glacier and being overtopped by it with local preservation; e.g. adjacent to the north fringe of Drift Bay.

(b) kame terrace, where ice marginal streams transported and deposited glacial and tributary sediment. Subsequent ice melting may disrupt sedimentary bedding. Combination of schist and greywacke clasts, plus silt lenses, suggestive of pro-glacial association. Examples in working borrow pits just south of the ski field road; also within Jacks Point development area.

Some till cappings suggest a pre 18,000 year age.

(c) river alluvium that is schistose in composition and clearly Shotover River sourced; on the basis of weathering and grading as well. Examples are present just south of the ski field road (high knob; previously quarried) and in the north-east corner of the Jacks Point development area.

This formation lies at higher levels than known 'kame terrace' sediment and is therefore likely to be the younger of the two There is no obvious glacial association and it may therefore be a product of a normal but constrained river system rather than that in an 'ice-contact' situation.

6.4 Post-glacial River Alluvium

Wye Creek is the only river in the area that is transporting coarse debris thus limiting the category to this catchment. The fan/delta complex at the mouth has a fan morphology and could overlap with subsection 6.5 below.

6.5 Fans, Fan/Delta Complexes

Numerous streams, mostly ephemeral, drain to the west off The Remarkables. These have constructed extensive debris fans over time that have partially or completely buried other lithologies of differing ages. There is evidence that early fans have also been overtopped by younger glacial tills so the relationships are complex.

Features of particular note include:

(a) Pertinent to younger fan deposits is the stepped sequence close to the margin of the high level, former position of Lake Wakatipu. Discussed above.

(b) Fans continue to aggrade onto the floor of the central elongate valley, although the rate of sediment accumulation is uncertain.

(c) Significant streams entering the lake in the Drift Bay vicinity do not appear to have created shoreline fans. Sediment transport is assumed to be small, therefore.

(d) Thick loess (to 3-4 m) mantles at least some fans in the distal (western) segments. This modifies fan surface morphologies in part and also suggests the sediment supply below SH 6 is generally small.

6.6 Beach Deposits

One or more benches are locally preserved along the band of erosion and accumulation formed along the former lake edge as the water level dropped. These benches are mantled with a varying thickness of poorly graded 'gravel' that is a distinctive, but surficial lithology.

Beach deposits are veneers on other formations.

6.7 Lake Sediments

At higher lake levels fine sediments accumulated offshore to form a laminated sequence of silt and sand that is visible in outcrop at both ends of the narrow, central valley south of the Kawarau River.

Much of the sediment would have been Shotover River sourced.

6.8 Landslides/Rockslides

Mass movement deposits irregularly mantle schist slopes on The Remarkables and Peninsula Hill. Some are obviously failures on foliation but a few of the slides on the steep west flank of The Remarkables are controlled by the persistent joint sets. Failures in surficial deposits are small, rare and probably confined to the lake margin.

No attempt has been made to classify the slides by activity. Some are clearly moving, either in part or as a whole, whereas others have an uncertain status. It is unlikely that large slides are dormant or inactive over a longer time interval.

6.9 Colluvium

Clastic and fine material, washed or rolled down steep slopes or formed by small ephemeral streams (transitioned to 'fans'), form local deposits on The Remarkables and along Wye Creek.

7. GEOLOGICAL HAZARDS

7.1 Seismotectonic Hazards

There is no evidence for active faulting within the study area although the elongate valley at and west of SH 6 may be structurally controlled. Quaternary movements cannot be disproved as the cover beds are all relatively young but the risk of direct displacement is considered to be very low in the next couple of hundred years.

Shaking effects due to earthquakes generated on faults in Central Otago, and the Alpine Fault in particular, need to be considered in the design of any buildings constructed in the area with a particular emphasis on the region underlain by lake sediments. There are

mapped depressions in this lithology, very likely resulting from earthquake-induced liquefaction, albeit at an unknown period of time and with uncertain relationships to the level of Lake Wakatipu.

7.2 Landslides/Rockslides

Most have formed on steep terrain away from prospective development areas. There are no evident occurrences of catastrophic failures since glaciers last intruded to the toes of the steeper slopes and major embayments on the flanks of The Remarkables are absent, suggesting an inherent slope stability.

First time failures in the future cannot be dismissed but the risk is considered to be very low on the basis of observed (lack of) incidences in a long time frame.

7.3 Rockfall

At several locations along the toes of the west-facing slopes of The Remarkables individual or clusters of large schist blocks lie on the fan surfaces. These have clearly originated as rockfall on the steep terrain.

Most are close to, or perhaps within 100 m of, the base of the steep slope but one boulder is approximately 300 m out and this distance should be kept in mind as a possible travel path. As the total slope morphology changes laterally along The Remarkables the prospective hazardous zone should be uniquely evaluated for particular circumstances.

7.4 Floods and Debris Flows

Tributary streams off The Remarkables obviously flood during rainstorm events and occasionally transport debris to varying distances down the fan. At this time most tributaries have defined channels within the peripheral fans but avulsion must occasionally occur with resulting redistribution of flood waters and debris.

All fans and fan elements have the potential to be affected by flooding. Debris flows are prospective on upper fan segments, particularly where slope gradients are relatively steep but the debris flow risk must diminish in more distal, flatter areas.

8. CONCLUSIONS

(a) The terrain generally west of The Remarkables, and between the Kawarau River and Wye Creek, varies from flat to precipitous and there is a relative relief difference between Lake Wakatipu and the mountain crest in excess of 2000 m.

Most slopes are west-facing in the area studied.

(b) No faults have been located in the study area but some structural control is likely as inferred from the lineal nature of the valley at and west of SH 6. An active fault daylighting further east in the Nevis Valley dips west beneath The Remarkables and Lake Wakatipu. There is ongoing seismic activity associated with this feature.

(c) Repeated glacial erosion during Quaternary times has sculptured the area and routinely removed surficial deposits. The last glacial incursion was 18,000 years ago. When the ice melted a proto Lake Wakatipu formed at higher levels then dropped to its present dimension after capture by the Kawarau River. The changing lake margin is evident through the study area.

(d) Surficial deposits of various ages and types are present throughout much of the moderate to low relief terrain. These include glacial till, glacially-related fluvial sediments, lake deposits and fans. In many localities there is a sequence of lithologies, the lower of which are imprecisely understood.

(e) Landslides and rockslides are present on many steep slope elements in schist. No catastrophic failures have been identified.

(f) Obvious hazards are posed by rockfall, floods and debris flows. However, these are relatively minor and should be able to be avoided or mitigated should developments occur in the future in the study area. Seismotectonic effects need to be addressed in line with standard practice for the Queenstown area.

APPENDIX 5 - Ecological Report by Boffa Miskell Limited

Ecological patterns and processes

A description of the ecological patterns and processes within and between habitat types in the Cone Burn area of The Remarkables near Queenstown.

1.0 Patterns – habitat types

Patterns or habitat types are described on a landscape scale, rather than at a detailed micro-habitat scale. They relate to the flora and fauna on landforms, and are described broadly by dominant and important features, not details. The habitats are described below and their extent and location(s) represented on an attached map.

2.0 Processes – interactions and ecological functions

Processes described here range from landscape wide interactions between habitat types, to processes occurring within habitats on a meso- or micro- scale. Only those observed or expected to be occurring from a reconnaissance survey, rather than in-depth studies are described.

Ecological information is presented here that can be used by developers, the local authority and landowners to develop their land-use strategies for one the most iconic landscapes of the Wakitipu Basin.

Such information can be used to identify:

- areas of particular ecological value
- areas with ecological sensitivity to particular land-uses
- areas where land-uses are compatible with ecological values
- areas with potential for ecological enhancement
- risks and threats to ecological values posed by land-uses or processes

3.0 Cone Burn Study Area – a description

The Cone Burn Study area encompasses all land between Lake Wakatipu and the ridge of The Remarkables. To the north and south respectively the bounds are Wye Creek, and a line between Peninsula Hill and Peak 1520 on The Remarkables ridge.

The study area is composed of schist rock that has been strongly influenced by glacial activity. Steep faces with rock tors and dissected by numerous streams stretch from approximately 600m to the peaks on the ridge at over 2000m (a.s.l). Below 600m colluvial toe slopes and fluvial fans meet a lakeshore terrace. To the south the lakeshore terrace is very small or non-existent, and the toe slopes drop directly into Lake Wakatipu (300m a.s.l.). To the north the lakeshore terrace merges with three roches moutonées (isolated mountains ground smooth and gradual-sloping by glacier bound rocks on the leading edge and plucked to steep cliffs on the trailing edge – e.g. Peninsula Hill). A generally steep escarpment from the lake to the lake terrace is between 20 and 100m high around the entire study area.

Habitat types with significant; indigenous components, or issues have been identified and mapped. Ecological values, processes and threats, and recommendations have been described for each of the habitats.

Developed land – pasture on the moraine and lake edge terraces, and outwash fans - have not been described. These, and the weed infested land identified, do not contain high indigenous ecological value. They are less ecologically sensitive, but the types of land-uses should first consider any effects. Plantation forestry would further exacerbate weed infestations, and nearby residential development would introduce additional predators. General pet and weed control provisions should apply here too. There may also be other constraints or limitations (landscape and social issues) to development in these areas.

Habitat Type and key to the map:	**Recommendations**
1. Snow Tussockland on Steep Mountain Slopes	- development impractical - control exotic weeds - exclude grazing
2. Remnant Beech Forest	- development impractical - create linkages - lowland revegetation
3. High Energy Ephemeral Streams	- development on lowland only - create linkages - weed control
4. Bracken Fernland *i on mid altitude mountain slopes* *ii. on moraine and fluvial outwash fans and terraces*	- sensitive development only - reduce disturbance
5. Grey Shrubland *i. on mid altitude mountain slopes* *ii. on moraine and fluvial outwash fans and terraces* *iii. on roches moutonées*	- sensitive development only - create more shrub diversity - control weeds
6. Schist Rock Tors and Scarps *i. on high and mid altitude mountain slopes* *ii. on roches moutonées*	- development nearby - control skink predators - introduce skink food plants - link to other habitats - add threatened plants
7. Wetlands	- sensitive development nearby - enhance wetlands - link wetlands
8. Broadleaf Forest on Lakeshore Escarpments	- sensitive development nearby - create links to other habitats - introduce rata - control weeds and pests

Notes:

This is an initial scoping document identifying potential for enhancement within and between habitat types. These ideas have not been developed in detail because enhancement in specific locations requires site-specific considerations.

3.1 Snow Tussockland on Steep Mountain Slopes

Description - Tall snow tussockland supports a range of fauna from birds such as pipit, breeding black-backed gulls and kea to a rich invertebrate fauna. These include local endemics and a mixture of Western and Central Otago species in moth, beetle, weevil (many associated with speargrass) and stonefly families. Skinks and geckos, potentially including two of New Zealands most uncommon (Grand and Otago skinks), utilise tussocklands in the study area.

Tussocklands are extensive and extend down to the lower colluvial slopes where they merge with bracken fernland or grey shrubland.

Recommendations - This habitat type is only suited for conservation, development is impractical due to steep terrain. Most of this habitat type here is retired from agricultural use and is administered by the Department of Conservation. The management of this habitat type is best left to natural, non-interventionist regenerative processes. Most is fenced for stock exclusion; fencing any remaining areas would further enhance the tussocklands.

Threats - Invasion of wilding pine and elder from plantings lower in the study area has occurred and further spread is likely. Control of existing infestations is possible, but if left will be more costly and tussockland quality will be reduced.

3.2 Remnant Beech Forest

Description - A few, small remnant mountain beech forest fragments lie in a number of gullies within the high altitude portions of the study area. All but the lowest and most accessible in Wye Creek are isolated from other woody vegetation, being surrounded by tussockland and scree.

At Wye Creek a broadleaved dominated forest in and above the creek bed merges with beech forest. It links with forest containing similar elements around the lakeshore (see; Broadleaf Forest on Lakeshore Escarpments) and is the only part of the study area where there is no intensive development between alpine areas and the lake. These linkages assist the movement of fauna, particularly birds like fantail, grey warbler and others between habitat types and altitudinal zones. This is potential kea breeding habitat, and bellbirds utilise the range of nectar resources in both the beech forest (honeydew) and the lower broadleaf forest (flax and yellow mistletoe).

Only Wye Creek and one other remnant appear to be expanding. Small remnants, slow regeneration rates of beech trees and their location in a montane area with unstable substrate are an impediment to them increasing in size.

Recommendations - This habitat type is only suited for conservation, development here being impractical due to the steep terrain and lack of access.

Beech spreads slowly and to re-introduce it to other areas, particularly on lowland parts of the study area in conjunction with development, requires revegetation. Beech revegetation projects are often slow to establish and faster results can often be achieved by using other species that ameliorate the environment so that beech can re-establish, or invade easier. Beech roots have a fungal association that assists them to gain nutrients, introducing this association in beech revegetation projects is important for success.

Threats - Senescence of the beech forest in existing fragments, and the lack of replacement individuals presents potential for these remnants to disappear. There is likely to be some regeneration, so that these remnants will persist in the medium-term. However, predation of seeds by rodents and the likelihood of mass movements of rock could destroy some or all of these remnants except Wye Creek; which is big enough to be resilient to such disturbances.

3.3 High Energy Ephemeral Streams

Description - Flowing off the steep high altitude faces of The Remarkables are a series of ephemeral streams, which flow swiftly after rain or during snow melt. The streambeds are un-vegetated boulders and rocks, but on their margins lower down is a mosaic of bracken with emergent and grey and broadleaved shrubs. At about the altitudinal zone where these streams flow onto fluvial fans and colluvial toe slopes exotic buddleja, elder and sycamore trees are common. In at least one of these streams is a small, riparian kowhai woodland.

Recommendations - Development of these streams is impractical. Adjacent to them in pastureland and grey scrub on easy country in the north of the study area it is acceptable if recommendations for developing grey shrubland are followed.

These streams have the ability to create ecological links between high altitude portions of the study area and the lowland portions in the same way as Wye Creek (see Remnant Beech Forest) does. Only the few streams south of Lumberbox Creek contain significant indigenous vegetation components directly to the lake edge. Others are infested with exotic trees and shrubs, which limit the potential for transit of some fauna and flora. The creation of indigenous dominated riparian strips from The Remarkables could significantly enhance these corridors for birds, reptiles and plants. To achieve this weed control and revegetation with locally sourced native species would be desirebable.

Threats - The exotic tree and shrub species mentioned above are a significant threat to these riparian strips and to other land in the study area. In places these trees form woodlands that further exacerbate their spread.

3.4 Bracken Fernland

Description - There are two main locations containing bracken fernland, mid altitude mountain slopes and on moraine and fluvial outwash fans and terraces. In these locations bracken has colonised previously forested areas disturbed by fire. Bracken provides quick and effective ground cover and acts as a nursery for the establishment of other species. On the mid-altitude slopes near Wye Creek native broadleaved species are regenerating through the dense bracken fernland. In other areas, particularly lower down on colluvial fans and terraces the exotic shrub sweet brier is the dominant emergent. In this latter situation it is uncertain whether sweet brier is invading the bracken fernland or bracken is invading sweet brier, evidence for both is present.

Recommendations - Development in some of these areas is acceptable if clearance of bracken and garden plantings are minimised. Any development will likely only occur on

easy land where sweet brier occurs. Control of this species is desirable in conjunction with development.

Whatever the nature of the process of regeneration among bracken it's ability to ameliorate the micro-environment to allow regeneration of native shrubs is a significant asset. To speed, up or increase this native shrubland regeneration process the retention of existing bracken is important. Areas near existing native shrubland or forest will regenerate into natives sooner than those further away.

Threats - The continual disturbance to bracken fernland will impede regeneration of native shrubland. If such processes are desired then a lack of disturbance (burning and vegetation clearance) to both the bracken fernland and nearby native shrubland and forest is important.

3.5 Grey Shrublands

Description - From a distance this habitat type is grey in colour, hence the name. It can range from open scrub to closed shrubland and is comprised of a number of small-leaved, often divaricating shrub species. The dominant ones are matagouri and mingimingi (*Coprosma propinqua*). They are found in three general locations; on mid altitude mountain slopes below and around rock tors, on moraine and fluvial outwash fans and terraces, and on roches moutonées.

Generally they are low in diversity with matagouri being the most common. However in some locations, particularly on roches moutonées there is more diversity with other Coprosma species (*Coprosma rugosa*, *C. crassifolia*) a tree daisy (*Olearia odorata*), porcupine scrub (*Melicytus alpinus*) and a native broom (*Carmichaelia petrei*) present.

Shrublands such as these are ecologically valuable, and not just for the plant species. There is a rich and diverse fauna of insects that live in association with many of them. One, *Olearia odorata*, hosts up to 27 species of moth, many specific to this shrub. Most of these shrubs produce small fruits, which native skinks utilise for food. The diversity of plant species producing fruit and hosting insects provides an important year-round supply of food for generally omnivorous skinks.

Recommendations - Sensitive residential development within grey shrubland is possible without impinging on the values contained here (see Schist Rock Tors and Scarps). Restrictions on clearing shrubland, garden size, species in gardens, prohibitions on cats and dogs are some of the recommended measures to introduce ecological sustainability into these developments.

Clearance of exotic vegetation, particularly in and around the more diverse grey shrubland areas provides an opportunity to enhance these areas. There are considerable areas of grey shrubland infested with sycamore, buddleja, elder, brier and barberry. In some areas these exotic species are dominant.

There is also considerable opportunity to add greater diversity to these shrublands through the planting of additional plant species. Some of the plantings could include some uncommon species including *Olearia hectorii*, *O. fragrantissima* and *Carmichaelia compacta* plus common ones that are not present here, like korokio.

Threats - Clearance of this vegetation, which is often not regarded as valuable is the greatest threat. The invasion of exotic species into these shrublands is also a threat. In the study area sweet brier, elder, sycamore, buddleja, barberry, crack willow, poplar, pine and other species planted in conjunction with landscape enhancements and plantations are already present. All of these species pose a serious threat to biodiversity values and already most have spread well beyond the sites of their initial plantings. Elder, sycamore and pine, due to their efficient dispersal mechanisms, have spread well up the mid-altitude slopes of The Remarkables.

3.6 Schist Rock Tors and Scarps

Description - The movement of glaciers across the landscape has left much of the schist bedrock shattered and exposed. Most noticeable are large, steep scarps on high and mid-altitude mountain slopes, but there are also many smaller ones on roches moutonées.

The steep and shattered faces less prone to grazing, predation and burning are a refuge for plant and animal species. These include blue tussock, a threatened cress *Ischnocarpus novaezelandiae*, uncommon *Gingidia montana*, rock fern, the small mat plant *Scleranthus uniflorus*, porcupine scrub, dwarf heath and crawling over rocks and plants is bush lawyer and two species of pohuehue (*Muehlenbeckia australis* and *M. complexa*).

The latter five plants all produce berries, which (see Grey Shrublands) are important food for skinks. In addition to providing food for skinks this habitat also offers sheltered and safe locations among rocks and under robust and intertwined branches of porcupine scrub. High rock scarps could provide nesting places for falcon – though they tend to occur where human occupation is lower.

Recommendations - Along with grey shrublands, rock tors and scarps are robust enough to withstand ecologically sensitive development in the flatter areas nearby. However, provisions such restrictions on cats and dogs, which predate on skinks, and on garden plants, which can escape to become weeds (see also Grey Shrublands) are necessary.

In most of the Cone Burn study area grey shrubland, and often bracken fernland occurs around rock tors and scarps. Interaction of components in both these habitat types is important, and there is opportunity to increase this by allowing regeneration of grey scrub around the rock tors. Grey shrubland linked with rock tors is especially important to provide invertebrate prey to skinks. Silver tussockland around rock tors, which is currently only infrequent and scattered, would provide additional habitat diversity and invertebrate prey for skinks.

Habitat could be provided for threatened and local plant species; *Ischnocarpus novaezealandiae*, *Gingidia montana* and the threatened brassica, *Lepidium kawarau* all of which live on shattered schist rock scarps in or near the Cone Burn area.

Threats - Intensive stock grazing and trampling around and on rock tors is a common feature because animals to 'camp' in these dry locations. While fencing exclusion to prevent this is impractical measure to prevent 'stock camps' in these locations could be investigated to improve the quality of these habitats.

There is also an opportunity to increase the quality of the habitat for skinks by controlling threatening predators such as cats and stoats and other mustelids, particularly on the lower altitude roches moutonées.

3.7 Wetlands

Description - All of the wetlands in the Cone Burn study area are located on the lakeshore terraces around, and on, roches moutonées. Most are ephemeral, and grazed. While some, particularly on the Henley Downs property are linked together, most of the wetlands are discrete and distinct entities fed mostly by rainwater.

Dominant species in the wetlands are purei / pukio and soft rush. Some wetlands contain only these species, but a few are more diverse containing other wetland and aquatic species. Aquatic species only occur in the moist, rarely dry wetlands rather than the strictly ephemeral ones. They provide seasonal habitat, or in the case of one permanent wetland, year-round habitat for waterfowl.

Purei / pukio is noted for having a diverse insect fauna associated with it. The distribution of this species in many of the wetlands adds to the botanical values.

Recommendations - Wetlands in lowland locations like these are among the most threatened habitat types nationally. They are often drained and developed for agricultural and residential land uses. However, development adjacent to wetlands can be compatible with ecological values if carried out sensitively.

Retention of the existing wetlands and creation of new wetlands in conjunction with development enhances wetland values. There is a large wetland on Henley Downs that appears to have been enhanced. It has a diversity of habitat, shallow margins and open water for waterfowl and dense reedland and sedgeland for wetland birds. Wetland enhancements can have direct practical benefits to adjacent developments, for example the retention and treatment of storm water can be achieved in wetlands.

Enhancing wetland habitat attracts waterfowl and wetland birds such as scaup, white-faced heron and pied stilts. Suitable habitat with appropriate plants and invertebrate communities, and safe from predators such as cats, dogs and mustelids increases the success of wetland enhancements. Threatened plant species such as *Carex tenuiculmis* and *Deschampsia cespitosa*, both rare in the Wakatipu Basin, can provide additional conservation benefits to wetland enhancements here.

Reducing the grazing regime in wetlands will increase the quality and diversity of vegetation. Linking them with other habitat types like grey shrublands and lakeshore escarpments will add further diversity and corridors for insect, plant, reptile and bird species.

Threats - Reduction in wetland area through intensive grazing and trampling, drainage and other developments is a threat. Here there is also the potential for exotic crack willow trees to spread from the currently small infestations in one wetland on Henley Downs and on the land east of the highway into other wetlands. Crack willow is a serious threat to biodiversity values in wetlands.

3.8 Broadleaf Forest on Lakeshore Escarpments

Description - Forest dominated by kohuhu and broadleaf occurs along the lakeshore escarpment. Except for one section the entire escarpment through the study area is forested. Botanically this is the highest diversity habitat; kowhai, lancewood, yellow mistletoe, koromiko and wineberry are found here.

Closer to the lakeshore are wetland plant species such as rushes, sedges and turfs on the frequently inundated lake margins. Within the lake itself are aquatic plants such as water milfoil and pondweed. This lake margin to forest area provides habitat for a large number of plants and insects that provide much of the food that is important for aquatic and terrestrial species like fish (eel, bully, koaro) and birdlife (scaup), and for processes in and around the lake.

Recommendations - Development in these areas is largely impractical due to the steep terrain. Sensitive development in adjacent areas can be undertaken with the following recommendations.

Creating ecological linkages between other habitats close to the lakeshore escarpment (wetlands, grey scrubland and high-energy streams) and the lake is useful. Only the high-energy streams in the south of the study area currently link to the lakeshore escarpment with quality indigenous riparian habitat. Excluding grazing from small areas between wetlands and the lakeshore escarpments can provide links. There is an existing example of a revegetation project associated with a residential subdivision that when mature will provide a stronger link between the upper Wye Creek beech and broadleaved forest area and the lakeshore escarpment.

The use of specific plants that strengthen and speed up ecological processes is recommended in any revegetation and enhancement projects here. For example nectar-producing plants like flax encourage bellbirds, which in turn pollinate and distribute yellow mistletoe and introduce seeds of other plants.

The re-introduction of rata to this section of the lakeshore escarpment is possible. It currently occurs on the lakeshore escarpment to the south of the study area.

Threats - Weeds such as Himalayan honeysuckle buddleja, gum trees and poplar that have spread from enhancement plantings are present here. The location of lifestyle subdivisions immediately above this habitat type exacerbates this problem unless species planted here are compatible (natives or non-invasive exotic species).

Domestic pets such as cats and dogs predate upon forest birds (bellbird, fantail and grey warbler). Their presence near this habitat will reduce bird numbers and diversity. Goats grazing in this area reduce native plant diversity.

Water discharges containing sediment and organic pollutants reduce the water quality in Lake Wakitipu. Measures to reduce these effects such as reduced land clearance, effective sewerage disposal, storm water treatment and reduced use of herbicides, pesticides and fertilisers are recommended.

4.0 References and further reading

Knight Frank 1997. Cone Peak pastoral lease - conservation resources report. Report prepared by the DoC for tenure review of Cone Peak Station.

Lucas,D., Head,J., Lynn,I., Simpson,N., Patrick,B., Loh,G. & Lucas,C. 1995. *Indigenous Systems an ecological plan structure for the Lakes District*. Lucas Associates, Christchurch.

Meurk,C.D. 1997. Rediscovering and restoring natural heritage in the Wakatipu Basin. Landcare Research contract report LC 9697/081. Wakatipu Environmental Society.

Patrick,B.H. 2000. Lepidoptera of small-leaved divaricating *Olearia* in New Zealand and their conservation priority. Science for Conservation 168, DoC, Wellington.

Patrick,B.H. & Dugdale,J.S. 2000. *Conservation status of the New Zealand Lepidoptera*. Science for Conservation 136, DoC, Wellington.

Peat,N. & Patrick, B. 1999. *Wild central; discovering the natural history of Central Otago*. University of Otago Press, Dunedin.

Simpson,N.C. 2001. Report on the botanical values of the proposed Jacks Point golf course resort, Remarkables Station, Queenstown. NC Simpson Conservation Consultancy Ltd., Queenstown.

Wilson,H. & Galloway,T. 1993. *Small-leaved shrubs of New Zealand*. Manuka Press, Christchurch.

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APPENDIX 6 – Planning Bibliography (accompanying document)