

Ecological Assessment

Plan Change 25

Kingston Village

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Contract Report: NS 79 /06A

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Plan Change 25 - Kingston Village

Executive Summary

Background

Queenstown Lakes District Council has resolved to initiate a Plan Change that would rezone land owned by Kingston Village Limited, situated directly to the south of the Kingston township, and bounded by the Kingston railway line.

The purpose of Plan Change 25 – Kingston Village Plan Change, is to enable a strategic assessment of the ability of the Plan Change area to accommodate the need for growth within the Kingston Community while addressing the Community's requirements for improvements in the infrastructural services of reticulated water and sewage.

The adoption of a Plan Change enables consideration of wider urban design issues more likely to ensure that development respects the character of Kingston.

This report forms a part of the analysis which the Queenstown Lakes District Council is required to undertake under section 32 of the Resource Management Act 1991 (the Act).

The land is legally described as Lot 1 DP12725 (61.97 ha), Lot 2 DP 12725 (5.7 ha), Section 18 Blk 1 Kingston SD. A 4.07 ha recreation reserve is bounded on three sides by land owned by Kingston Village Ltd. Devon Street bounds the Plan Change area to the north and railway tracks which are still used by the Kingston Flyer surround the site to the south.

The land is currently used for pastoral activities, primarily sheep grazing. A golf course is formed over both the recreation reserve and a portion of Lot 1, this area is also grazed. The total area of consideration is approximately 88 hectares. Refer to Attachment A which identifies the land included within the Plan Change.

Natural Solutions *for Nature* Ltd was commissioned to undertake an ecological assessment for the Plan Change site. A site visit with consultants from Connell Wagner and Te Ngahere facilitated consideration of issues and solutions relating to physical works. Outcomes from the NSN assessment and discussions on site have been integrated into recommendations for the minimisation of any actual or potential adverse effects. Opportunities for the enhancement of indigenous biodiversity were also incorporated into recommendations in the report.

Ecological Values

Lake Wakatipu fills a trough formed by a succession of glaciers dating back to at least 500,000 years before present (BP). During the most recent glacial advance¹, ice of the 'Wakatipu glacier' extended to the current location of Kingston. A "spectacular terminal moraine" was formed and is likely to have been relatively static.

The gently undulating land of the Plan Change site is immediately north of the terminal moraine wall on fluvioglacial deposits of well sorted fine gravel on storm beach ridges².

Water draining from the Eyre Mountains has been channelled across the western paddocks and the toe of the slope via a system of drainage ditches and culverts that run towards the Lake. Spring rainfall and fluctuating water tables result in seasonal inundation of lower laying areas.

The Kingston Creek tributary has been diverted from its likely natural course of flow into the eastern low laying areas. It now flows around (north-east of) the railway tracks and Plan Change site.

Indigenous vegetation of the site has almost entirely been cleared but for the remnant *Juncus* rushland – *Carex* sedgeland associations present over about five percent of the total area.

There are small isolated patches of browsed silver tussock *Poa cita*. Porcupine shrub *Melicytus alpinus* and matagouri *Discaria toumatou* along fence lines or on slightly raised ground around the Plan Change boundary. A list of species identified within the Plan Change site is provided in Attachment E.

The Plan Change site does not contain species or values of ecological significance although it is likely to be within the territory of an 'Eastern' falcon, seen foraging during one of the site visits. Falcon, tuis and kereru are all likely to use the mature trees in the golf course as perching posts from where territories can be "guarded" and feeding opportunities identified. Kereru are a species in gradual decline as a result of recruitment failure. They will be more dependent upon the habitat within the adjacent Ta Kere Haka and Glen Allen Scenic Reserves than the Plan Change site.

Historic condition

Prior to Polynesian fires (c. 800 years BP), mixed red, silver and mountain beech forest would have extended over the Plan Change site following the retreat of the Wakatipu glacier. Wetlands within historic beech forest would probably have contained ferns, sphagnum moss, shrubs and podocarps such

¹ Late Otiran, Oxygen Isotope (OI) Q2 18,000 – 24,000 BP _ Turnbull, I. M (compiler) (2000): *Geology of the Wakatipu Area 1:250,000 geological map 18*. Institute of Geological and Nuclear Sciences Ltd.

² Turnbull, I. M (compiler) (2000): *Geology of the Wakatipu Area 1:250,000 geological map 18*. Institute of Geological and Nuclear Sciences Ltd.

as mountain totara *Podocarpus hallii*, matai *Prumnopitys taxifolia* and kahikatea *Dacrydium dacrydioides*.

By the time of European arrival grassland – shrubland communities prevailed throughout a largely deforested landscape. Seral shrubland and remnant forests still remain in the surrounding landscape, now characterised by mixed short and tall tussock grassland. Wetland vegetation remains within some of the undulations, creeks and seepages of the Plan Change site as well as on the surrounding mountain slopes and valley floor.

Significance - geopreservation site – wetlands - wildlife

The Kingston terminal moraine wall and spillway channel south of the Plan Change site is classified by the New Zealand Geopreservation Inventory as regionally significant and vulnerable to modification³. These will not be affected by the Plan Change.

No rare or threatened vegetation species were found to be resident within the Plan Change site.

The Plan Change site, when considered as a whole and in context with the surrounding landscape, is unquestionably substantially modified. It contains a very few species previously associated with the historical vegetation or subsequent seral stages.

Wetlands nationally have seen losses of over 90% of their former cover through drainage, modification and deterioration resulting from infestations by exotic weeds^{4, 5}. The Plan Change site is among those losses. Species present are among the common associates of lowland rushland and sedgeland communities.

“Q2 environments” within which this site sits are chronically under represented within the network of protected areas on a national scale although they are very well represented within the Queenstown Lakes District Council (Lakes Ecological District). The indigenous vegetation of the Plan Change site is not representative of communities currently or historically found within Q2 environments.

New Zealand eastern falcon is a species in gradual decline⁶. It is likely the Plan Change site is within a small proportion of the territory of a falcon observed during site visits.

³ New Zealand Geopreservation Inventory accessed 12/12/06 <http://homepages.ihug.co.nz/~bw.hayward/NZGI/>

⁴ Ministry for the Environment (1997): *The State of New Zealand's Environment – The State of our Waters*. Accessed on www.mfe.govt.nz on 20/12/06.

⁵ Department of Conservation and Ministry for the Environment (2000): *The New Zealand Biodiversity Strategy*.

⁶ Hitchmough, R. (2002): *New Zealand threat classification system lists*. Wellington, Department of Conservation (accessed 6/9/2005)

Assessment of Potential Environmental Effects

Landform

- The excavation of drainage channels associated with pasture development, the establishment of the railway and golf course have already modified the natural drainage pattern of the Plan Change site.
- The proposed establishment of a storm water attenuation system with a network of open swales and channels will further drain the site resulting in the continued loss of landform diversity. Residential development of the Plan Change site also has the potential to obscure the rolling topography.

Vegetation

- The existing areas of *Juncus* rushland and *Carex* sedgeland indicate the site's potential for natural regeneration or managed restoration. The presence of woody weeds along the western boundary and gorse hedges provide a further indication of the land's potential to revert to woody vegetation.
- Under the current land use, the land's potential for more extensive natural regeneration is inhibited by farm practices.
- The Plan Change and subsequent development of the land has the potential to diversify and redistribute indigenous vegetation from wet depressions to the swales, storm water systems and open spaces. The incorporation of indigenous vegetation within riparian areas (swales), as well as in open space plantings, and along trails will enable structural and floristic diversity of the site to be enhanced. Elements of the surrounding reserves can be drawn through the Plan Change site drawing in and linking with the character of the surrounding landscape. Attachment H provides an indication of species that could be used in swale plantings.
- Development of the site will reduce the existing albeit modified habitat of wetland dependent birds (such as paradise shelducks, white-faced heron, and South Island pied oystercatcher) as well as those which may potentially visit the site in transit to other more intact habitat.
- Residential development and the retention of the large park like setting of the golf course, open spaces and reserves along with swale planting and the establishment of residential gardens will provide structural and floristic diversity not currently present. Riparian planting along swales will continue to provide habitat (albeit reduced) for the species mentioned above.

Recommendations

The over arching recommendation articulated by the points made below is for the incorporation of a greater level of indigenous biodiversity into the Plan Change site and any future residential development within it.

1. Low or medium density subdivisions and open spaces should be designed to perpetuate and highlight the undulating landform. Earthworks should therefore be kept to a minimum.
2. A *Carex* sedgeland remaining in the central portion of the Plan Change site will be affected by the development and associated earthworks. It is recommended that the species listed in Attachments G and H be planted within the portion of the *Carex* sedgeland that will be retained in the local reserve labelled “L10” in the Te Ngahere Plan. This part of the linear park should be managed as a “wild” space where *Carex secta* dominates and is supported by other indigenous species. Provision for people to sit on the periphery or on a bench seat on a boardwalk winding along or through the wetland would be appropriate. These detailed design issues can be addressed further at the subdivision stage. Earthworks should however be minimised in order to retain as much of the natural character of the rafted or floating wetland as possible.
3. The species from the lists provided in Attachments G and H should preferentially guide the planting of open spaces and reserves including swales and the storm water network. In this way the existing site character will as far as is possible be retained within the context of the proposed future development.
4. The lists in Attachments G and H are intended to provide an indication of the range of species that could be incorporated into any enhancement or landscape plans. They are not intended to be definitive or strictly prescriptive but should guide and inform planting design.
5. In addition it is recommended as a general approach, that the network of watercourses, swales and wetlands are naturalised and incorporated into a network of green or open spaces and/ or walking trails. These should provide physical linkages and therefore improved connectivity between the Plan Change site and the scenic reserves to the west and ultimately to the Lake foreshore.
6. Land currently heavily infested with noxious woody weeds along the western boundary should be cleared and replanted with forest fringe – wetland associations, using species identified in Attachment G. By reinstating indigenous species into the swales and open spaces of the Plan Change site will provide enhanced habitat for native birds. Residential gardens will no doubt supplement the diversity of managed open spaces.

7. The unformed legal road to the west of the site should be used to establish linkages between the Plan Change site and the western reserves.
8. If *Uncinia strictissima* is found anywhere within the Plan Change site it should be relocated (if in danger of being disturbed) into one of the landscaped riparian areas.
9. Kingston Creek and an un-named tributary draining off Lorn Peak and running through the Campground provides spawning habitat for brown trout. While it is noted that Kingston Creek is outside of the Plan Change site, it may be vulnerable to modification as a result of storm water management within the Plan Change site. To this end, it is recommended that streams and swales remain as open channels. Spawning gravel should not be interfered with, covered or replaced by culverts if this can be avoided. Riparian vegetation should be enhanced in order to improve and potentially extend available habitat into the Plan Change site.
10. The Kingston flyer routinely creates small fires along the railway track – this is evident by the charred remains of gorse and broom. Incorporation of species with a low flammability classification into the landscaped area around the railway boundary may help reduce the potential for future fires to spread while reinstating indigenous vegetation north of the railway within the Plan Change site. Walkways around the railway track may also provide an interesting buffer and amenity area between the train and any development.

1. Background

1.1 Introduction / Description of Proposal

Queenstown Lakes District Council has resolved to initiate a Plan Change that would rezone land owned by Kingston Village Limited, situated directly to the south of the Kingston township, and bounded by the Kingston railway line.

The purpose of Plan Change 25 – Kingston Village Plan Change, is to enable a strategic assessment of the ability of the Plan Change site to accommodate the need for growth within the Kingston Community while addressing the Community's requirements for infrastructural improvements in their reticulated water and sewage services.

This report forms part of the analysis which the Queenstown Lakes District Council is required to undertake under section 32 of the Resource Management Act 1991 (the Act).

The land is legally described as Lot 1 DP12725 (61.97 ha), Lot 2 DP 12725 (5.7 ha), Section 18 Blk 1 Kingston SD and is bounded by Devon Street to the north and the Kingston Flyer railway tracks to the south. The site is bounded by the Eyre Mountains to the west.

The land is currently used for pastoral activities, primarily sheep grazing. A golf course is formed over both the recreation reserve and a portion of Lot 1, this area is also grazed. The total area of consideration is approximately 88 hectares. Refer to Attachment A which identifies the land included within the Plan Change site.

The Plan Change site is located at the southern boundary of the Queenstown Lakes District, south of the existing Kingston township.

Natural Solutions *for Nature* Ltd was commissioned to undertake an ecological assessment for the Plan Change site.

This report provides the following:

- A description of the existing values of the Plan Change site.
- A description of the significance of the values identified.
- A description of the potential adverse and/ or beneficial effects that may result from development within this site;
- Recommendations for the minimisation of any actual or potential adverse effects, and enhancement that could be achieved.

1.2 Methods

The Plan Change site was visited on the 2nd, 8th and 21st of December 2006 and again on the 28th May, 2008 with Connell Wagner and Te Ngahere. The site was surveyed on foot and observations regarding the value of the site, species present and wetlands have been made. Plants were identified with the assistance of Johnson and Brooke (1989), Healy and Edgar (1980), Moore and Edgar (1976) and Wilson (1996).

A desktop assessment was undertaken which incorporated research of published reports relevant to the identification of known values in the areas surrounding Kingston. These are referenced throughout the document.

The site visit undertaken in conjunction with Connell Wagner and Te Ngahere enabled discussion of issues relating to physical works and agreement regarding appropriate solutions to be considered and incorporated into the recommendations of this report.

2. Values

2.1 Geology, landform and soils

The township of Kingston is located at the southern shore of Lake Wakatipu. It is cradled between the Eyre Mountains to the west and Lorn Peak atop the Hector Mountains to the east.

Lake Wakatipu fills a trough formed by a succession of glaciers dating back to at least 500,000 years before present (BP). During the most recent glacial advance¹, ice extended to the current location of Kingston. A “spectacular terminal moraine” was formed and is likely to have been relatively static. Outwash plains formed downstream draining water and sediment deposits from the glacier into the Mataura catchment. Glacial melt-water channels cut meanders into older outwash deposits from previous glacial advances. One such channel is visible south east of Kingston and another south west where the Kingston Flyer railway track now runs².

Alluvial fan gravels from Lorn Peak later blocked the eastern Kingston outlet and a small moraine wall developed blocking the western melt water channel. This led to the formation of a post-glacial lake in the Wakatipu Basin³ which then drained into the Kawarau River.

¹ *Late Otiran, Oxygen Isotope (OI) Q2 18,000 – 24,000 BP* – Turnbull, I. M (compiler) (2000): *Geology of the Wakatipu Area 1:250,000 geological map 18*. Institute of Geological and Nuclear Sciences Ltd.

² *Land Information New Zealand (2002): Crown Pastoral Land Tenure Review. Conservation Resource Report.*

Allendale/ Greendale Pastoral Lease Released 2002, Inspected 1999. Pages 11 to 15.

³ *Ibid.*

The gently undulating land affected by the Plan Change site is located immediately north of the terminal moraine wall. The township of Kingston, including the Plan Change site is on fluvioglacial deposits of well sorted fine gravel on storm beach ridges⁴.

Well developed terraces were eroded into the surrounding basin slopes north east of the Plan Change site at about 350 metres. The Plan Change site is at about 335 to 340 metres above sea level (asl).

A topographic map of the Kingston area is included as Attachment C. This also shows the Kingston terminal moraine and spillway channel south of and outside the Plan Change site (referred to above).

The soils of the Kingston township are mapped as Maude Dry – Hygrous Upland and High Country Yellow – Brown Earth (on rolling lands and hills)⁵ a cool, mesic, firm brown, and poorly drained soil under the New Zealand revised soil classification system. This soil is found extensively throughout New Zealand and generally contains active populations of soil organisms, particularly earthworms⁶. This contributes to the maintenance of good soil aeration and moderate to high fertility.

Within the Plan Change site swamps have formed in depressions and seepages. Open standing water (ephemeral) was noted particularly in the south eastern paddocks. Spring rainfall and fluctuating water tables will result in seasonal inundation of lower laying areas.

Water draining from the Eyre Mountains has been channelled across the western paddocks and the toe of the slope via a system of drainage ditches and culverts that run towards the Lake. Swamps and seepages have been partially drained by this network.

A small tributary likely to be carrying water from the Plan Change site enters Lake Wakatipu from a point west of the Kingston Jetty near the boundary of the Te Kere Haka Scenic Reserve outside of the Plan Change site. The extensive subterranean storm water network through Kingston makes it difficult to discern exactly where water draining from the central part of the Plan Change site is ultimately discharged. Attachments B and D show the general direction of drainage through the property.

⁴ Turnbull, I. M (compiler) (2000): *Geology of the Wakatipu Area 1:250,000 geological map 18*. Institute of Geological and Nuclear Sciences Ltd.

⁵ Cutler (1964): *Soil map of the South Island, New Zealand (1964)* Cutler, E.J.B. (compiled)

⁶ Manaaki Whenua Landcare Research Geospatial Data Integration Portal. *Soil, Geology and Geophysics topic, NZ Revised Soil Classification layer*. Accessed on 20th December, 2006 <http://gisportal.landcareresearch.co.nz>

Kingston Creek flows from the slopes of Lorn Peak under State Highway 6, through the Kingston Campground and Section 12 Block I Kingston SD (which is outside of the Plan Change site) and down to the Lake. The banks of the creek are armoured with schist stone walling in places between Kent Street and the foreshore reserve (areas of existing residential development) where it ponds before passing over and/ or percolates through a raised gravel beach to the Lake.

A willow lined un-named tributary of Kingston Creek drains around (north east of) the Plan Change site, diverted by the railway. Drainage ditches and seepages from the Plan Change site also flow into the tributary. Its confluence with Kingston Creek is within Section 12 Block I Kingston SD – outside the Plan Change site.

Beyond the terminal moraine south of the railway tracks, all surface flow drains south into the Maitara River catchment and so is unaffected by the potential Plan Change.

2.2 Climate

The site is located within the Eyre Ecological District. Climatically this District is intermediate between the wetter Fiordland region to the west and Central Otago region to the east⁷. Kingston normally receives 911mm of rain per annum, with a May maximum of 94mm and February minimum of 59mm. The area receives 5 - 5.25 mean daily sunshine hours per annum⁸.

2.3 Vegetation

Widespread clearance following the arrival of humans in New Zealand/ Aotearoa and early settlement along with subsequent pasture development and drainage have significantly reduced the extent of indigenous cover and modified patterns of natural drainage. The potential for spontaneous wetland recovery via natural successional processes has been diminished by the loss of local seed sources and land drainage.

The vegetation of the Plan Change site is dominated by pasture grass with *Juncus* rushland and *Carex* sedgeland identifying the wetland areas of the site. Refer to Attachment D. A list of species identified within the Plan Change site is provided as Attachment E. The following is a summary of the vegetation within the Plan Change site.

⁷ Land Information New Zealand (2002): *Crown Pastoral Land Tenure Review. Conservation Resource Report.*

Allendale/ Greendale Pastoral Lease Released 2002, Inspected 1999.

⁸ *Tait, A. B. (2001): The Climate of Otago. Patterns of Variation and Change. NIWA and Otago Regional Council.*

Pasture grasses which are closely grazed and/ or grown for silage dominate the land. *Juncus* rushland and *Carex* sedgeland are present in the central, western and south eastern areas.

Juncus Rushland associations in the western (A) and south eastern (B) areas are the most diverse with up to four *Juncus* species, *Carex secta* and *Eleocharis* sedges and scattered *Coprosma propinqua* shrubs present (refer to Attachments D, E and photos in Attachment F). The wetland in the south east portion of the Plan Change site has the largest area of indigenous cover and diversity. Only one of the identified rush species (*Juncus distegus*) was endemic to New Zealand, *Juncus edgariae* is native to both Australia and New Zealand, others were exotic but naturalised with a widespread distribution within wetlands of New Zealand.

A wetland in the central portion of the Plan Change site (C) supports a large, *Carex* sedgeland within a partially and somewhat seasonally rafted (floating) wetland. It contains *Carex secta*, *C. geminata*, *Juncus edgariae* and *Coprosma propinqua*. It is surrounded by Douglas fir *Pseudotsuga menziesii* and contains a dense sward of rank pasture grasses.

Exotic shelterbelts around the pastures and golf course incorporate a limited variety of species including eucalypts and Douglas fir and poplars *Populus* sp are under planted with flax *Phormium tenax* and toetoe *Cortaderia richardii* in places.

A gorse *Ulex europaeus* control programme has resulted in the clearance of this noxious weed which along with the drainage ditches and fences assisted in the subdivision of the farm paddocks. While some gorse remains, most has been cleared and piled into wind rows.

In the vicinity of an unformed legal road west of the golf course and directly outside the Plan Change site, rank pasture grass dominates clearings within areas of dense broom *Cytisus scoparius*, gorse, mature and seedling crack and grey willows *Salix fragilis* and *Salix cinerea*. Poplar *Populus* sp., birch *Betula* sp., sycamores *Acer pseudoplatanus* and elder *Sambucus nigra* were also noted. Fox glove *Digitalis purpurea* and hemlock *Conium maculatum* provide an exotic understory.

Creeks draining from the steep slopes to the west flow through and to the west of the Plan Change site and then north towards the lake.

The Plan Change site was searched for the threatened⁹ hook grass *Uncinia strictissima* but it was not found. It is present on an alluvial fan amongst wet

⁹ *Uncinia strictissima* was reclassified from "insufficiently known" in 1995 to "vulnerable" by the 1999 review of the list of Threatened and Uncommon plants of New Zealand. The 2004 review (de Lange et. Al., 2004), NZ J of Botany 2004, Vol. 42:45 -76 has subsequently reclassified the species to "nationally endangered".

pasture grass below the Glen Allen Scenic Reserve about 2 kilometres south west of the Plan Change site¹⁰, refer to Attachment C. Another historical record of the plant exists within the Ta Kere Haka Scenic Reserve about 1 kilometre north-west of the Plan Change site but this record has not been relocated recently.

The golf course contains several mature specimen trees and shrubs including Eucalypts, Douglas fir, birch, sycamores, limes (*Tilia* sp), cedars *Cedrus* sp. and *Photinia* sp. and has a mature, open woodland character unique to the rest of the Plan Change site but similar to other parts of Kingston.

There are small isolated patches of browsed silver tussock *Poa cita*. Porcupine shrub *Melicactus alpinus* and matagouri *Discaria toumatou* are present along fence lines or on slightly raised ground around the Plan Change boundary where not cleared along with the gorse. Many of these natives have been crushed and browsed.

2.4 Fauna

Avifauna

The Plan Change site and surrounds provide habitat for a variety of endemic, native and introduced species.

Endemic 'Eastern' Falcon are known to breed in the rocky bluff areas overlooking the lake near Kingston, and were observed hunting over the Plan Change site during one of the site visits. 'Eastern' Falcons are in a human induced gradual decline¹¹ but have in the past been sighted within regularly spaced territories throughout the Lakes Ecological Region.

The mature trees contribute to the habitat requirements of territorial species such as NZ falcon *Falco novae zelandiae* and Tui *Prosthemadera novaeseelandiae* by providing perching posts (tall emergent trees that enable a view and therefore defence of or prey detection within the surrounding territory). The Eucalypts within the Plan Change site provide nectar for honeyeaters – Tui, bellbird *Anthornis melanura* and the opportunistic silvereyes *Zosterops lateralis*.

A Kereru *Hemiphaga novaeseelandiae* was observed flying west over the township of Kingston towards the Ta Kere Haka Scenic Reserve in January 2007.

¹⁰ Simpson, N.C. (unpublished): *Uncinia strictissima*, a rare New Zealand sedge: a report on its status in Southland and Otago. Department of Conservation, Southland Conservancy.

¹¹ Hitchmough, R. Bull, L. and Cromarty, P (compiled 2007): *New Zealand Threat Classification System lists - 2005*. Department of Conservation, Science and Technical Publishing, Wellington, NZ

Kereru are also a species in gradual decline as a result of recruitment failure. This may in time lead to a catastrophic population failure (Hitchmough et al., 2007).

Other birds observed during the site visits were Australasian harrier *Circus approximans*, white-backed magpie *Gymnorhina tibicen*, bellbird *Anthornis melanura*, blackbird *Turdus merula*, starling *Sturnus vulgaris*, grey warbler *Gerygone igata*, greenfinch *Carduelis chloris*, redpoll *Carduelis flammea*, sparrow *Passer domesticus*, yellowhammer *Emberiza citrinella*, skylark *Alauda arvensis*, California quail *Callipepla californica*, South Island pied oystercatcher *Haematopus ostralegus*, mallard *Anas platyrhynchos*, paradise shelduck *Tadorna variegata* and white-faced heron *Ardea novaehollandiae*.

Freshwater Fish

No fish surveys were undertaken as part of this assessment. However, creeks flowing into Lake Wakatipu north of Kingston are known to support Koaro *Galaxias brevipinnis*, a native freshwater fish¹². It is therefore very likely that they also populate Kingston Creek.

Kingston Creek provides very good spawning habitat for brown trout. NZ Fish and Game report local observations of rainbow trout *Oncorhynchus mykiss* upstream as far as the Kingston Campground¹³ below the State Highway culvert.

A non-migratory Galaxiid *Galaxias gollumoides* (a species in gradual decline¹⁴) has been recorded on the valley flats of Allendale in a tributary of Allen Creek and in Bushy Creek well south of the Plan Change site^{15, 16} in Allen Creek and Bushy Creek. This species is also found on Stewart Island, in the Catlins and Southland with the nearest populations being in the Maitai and the Nevis Rivers. It is highly unlikely that this species would be present within the Plan Change site based on the lack of suitable stream habitat.

¹² The author electro-fished some of the lake facing tributaries north of Kingston during field work undertaken for tenure review for Glen Nevis station in 1996. Records from these surveys were viewed on the NIWA freshwater fish database 10 December 2006.

¹³ Morgan Trotter, NZ Fish and Game, Cromwell; personal communication 20/12/06.

¹⁴ Hitchmough, R. Bull, L and Cromarty, P. (compiler) (2007): New Zealand threat classification system lists. Department of Conservation.

¹⁵ Land Information New Zealand (2005): Crown Pastoral Land Tenure Review. Conservation Resource Report. Glen Nevis Pastoral Lease Released 2005, Inspected 1996.

¹⁶ NIWA Freshwater Fish Database accessed 8/10/07.

Invertebrates

No invertebrate surveys were specifically undertaken as part of this assessment however incidental searching for *Mecodema chiltoni* occurred. None were observed during any of the site visits.

Day flying moths (Order: Lepidoptera), flies (Order: Diptera) and native bees (Order: Hymenoptera) were observed pollinating a very large *Muellenbeckia australis* growing on a mature *Pinus radiata* along the northern, railway boundary. Dragon flies (Order: Odonata) were noted over ephemeral open water in the Juncus rushland in the south eastern area and golf course ponds. Native spittle bugs (*Carystoterpa* sp.) were noted elsewhere where ever rank grass was found¹⁷. Their presence does not make this site special.

Lizards and Amphibians

The Plan Change site is within the known range of 6 lizard species. The Southern mini gecko *Hoplodactylus* sp. 'southern mini', Otago gecko *Hoplodactylus* sp. 'Otago', McCann's skink *Oligosoma maccanni*, Common skink *Oligosoma n. polychroma*, Cryptic skink *Oligosoma inconspicuum* and Green skink *Oligosoma chloronoton*¹⁸.

Most are found in rocky and/ or drier habitats not present within the Plan Change site. Cryptic skinks tend to be found in damp, densely vegetated habitats and Green skinks are sometimes found in pastures¹⁹. However, none were seen during the site inspections which occurred on three occasions when the weather was warm and sunny, calm and overcast and then cool and windy with occasional rain on the final visit.

It is highly unlikely that the Plan Change site hosts a lizard population as a result of the absence of suitable rocky habitat and the lack of indigenous vegetation.

Tadpoles were observed in open water inundating the south eastern corner (B) pastures. While difficult to confirm the species from the tadpole stage, they were very likely of the introduced genus *Litoria* which has two species in the Kingston area, the Southern Bell frog *L. raniformis* or the smaller brown tree frog *L. ewingi*²⁰. The later being the most probable species present. This species is not threatened.

¹⁷ Grant, E.A. (1999): *An Illustrated Guide to some New Zealand Insect Families*. Manaaki Whenua Press. Lincoln, New Zealand.

¹⁸ Whitaker, Tocher and Blair (2002): *Conservation of Lizards in Otago Conservancy*. Department of Conservation, Otago Conservancy, Dunedin.

¹⁹ Ibid.

²⁰ New Zealand Frog Survey website: <http://www.otago.ac.nz/zoology/research/bishop/frogs/index.html> accessed on 19th March 2007

3. Significance and ecological context

Geology, Landform and soils

Kingston and the Plan Change site lay north of the Kingston terminal moraine and spillway channel classified by the New Zealand Geopreservation Inventory as regionally significant and vulnerable to modification²¹. Attachment C identifies the location of these features south of and outside the Plan Change site. They will not be affected by the Plan Change.

Vegetation

No rare, threatened or significant species were found or are known to occur within the Plan Change site.

The Nationally endangered hook grass *Uncinia strictissima* has been found within the nearby Glen Allen and adjacent Ta Kere Haka Scenic Reserves – refer to Attachment C. Although it has been found elsewhere within vegetation and habitats similar to those recorded within the Plan Change site, it has not been found within the Plan Change site.

The Plan Change site retains patches of *Juncus* rushland and *Carex* sedgeland. These are likely to be naturally regenerating and are composed of endemic, native and naturalised exotic species. Continued succession is being inhibited by current farming practices.

The large area of rushland in the south eastern part of the site (area B on Attachment D) contains an endemic rush species *Juncus distegus* which has a scattered distribution. It is found throughout the north and south islands and on Stewart Island and is associated with forest fringe habitats²², its presence at within the Plan Change site is not significant.

²¹ New Zealand Geopreservation Inventory accessed 12/12/06 <http://homepages.ihug.co.nz/~bw.hayward/NZGI/>

²² Johnson and Brooke (1989): *Wetland Plants in New Zealand*. DSIR Publishing, Wellington

Historical Vegetation/ Land Environments of New Zealand (LENZ)

LENZ, developed by Landcare Research Ltd is a model that classifies New Zealand's landscapes using climate, landform and soil variables chosen for their roles in driving geographic variation in biological patterns. LENZ provides a framework to predict a range of biological and environmental attributes and aids the assessment of the values and significance of existing ecosystem remnants (Leathwick, 2003). The Plan Change site has been classified as "Q2"²³. Comparisons between existing condition and a potential historical or future condition (vegetation cover) associated with Q2 environments have therefore been made.

The original vegetation of local Q environments is well indicated by surviving stands. Q1 and Q2 environments occur throughout much of Otago in close proximity with Q2 being drier and lower in elevation. On a national scale, Q2 environments are critically under protected within the protected area network²⁴; however they are well represented locally.

Prior to Polynesian fires, mountain totara *Podocarpus hallii* and toatoa *Phyllocladus alpinus* were widely dominant in Q1 and Q2 environments east of Lakes Wanaka and Wakatipu, with matai *Prumnopitys taxifolia* and kahikatea *Dacrycarpus dacrydioides* probably being confined to the warmest, moistest localities, especially near the lakes. Only fragments remain. In the more southern Q1 and Q2 environments, mixed beech forest containing red *Nothofagus fusca*, silver *N. menziesii* and mountain beech *N. solandri* var. *cliffortioides* grade into pure mountain beech forest with increasing elevation. Mountain beech and, in deep ravines, silver beech still occur as blocks of forest near the Lake and as tiny pockets on drier sites (in Q2). By the time of European arrival, grassland prevailed throughout the deforested areas²⁵. Seral shrublands also remained.

Q2 environments surrounding Lake Wakatipu are well represented within the local reserves such as the Ta Kere Haka Scenic Reserve, the reserve below the State Highway between Jardine Park and Kingston, Staircase and Wye Creek catchments, the Sunshine Bay and Bobs Cove Recreation Reserves, the recreation reserve along the Glenorchy – Queenstown Road and on Pig and Pigeon Island Scenic Reserves.

²³ Leathwick, J. Wilson, G. Rutledge, D. Wardle, P. Morgan, F. Johnston, K. McLeod, M and Kirkpatrick, R. (2003): *Land Environments of New Zealand. Nga Taiiao o Aotearoa. Ministry for the Environment. Manaaki Whenua – Landcare Research publication.*

²⁴ Manaaki Whenua Landcare Research LENZ Threatened Environments Classification Level IV. Access on www.landcareresearch.co.nz/databases/lenz on 27 December 2006

²⁵ *Ibid.* pages 142 to 145

The lake face vegetation (Q2) on the slopes west of Kingston supports species such as tree daisy *Olearia fragrantissima* (Sparse²⁶), lemonwood *Pittosporum eugenioides*, Kohuhu *P. tenuifolium*, *Melicope simplex*, fuchsia *Fuchsia excorticata*, lancewood *Pseudopanax crassifolius*, fierce lancewood *P. ferox* (Sparse), kowhai *Sophora microphylla*, *Pennantia corymbosa*, broadleaf *Griselinia littoralis*, wineberry *A. serrata*, weeping mapou *Myrsine divaricata*, mapou *M. australis*, *Helichrysum aggregatum*, yellow wood *Coprosma linariifolia*, *C. crassifolia*, *C. rotundifolia*, *C. rigida*, *C. propinqua*, mahoe *Melicytus ramiflorus*, putaputaweta *Carpodetus serratus* and climbing aniseed *Scandia geniculata*²⁷.

Mixed red, silver and mountain beech forest would have extended over the valley floor within which the Plan Change site sits following the retreat of the Wakatipu glacier. Wetlands within historic beech forest would probably have contained ferns, sphagnum moss and shrubs and podocarps. Subsequent tussock grassland, sedgeland, rushland and shrubland have been largely converted to pasture.

The Plan Change site, when considered as a whole and in context with the surrounding landscape, is unquestionably substantially modified. As a Q2 environment the Plan Change site contains a very few species previously associated with the historical vegetation or subsequent seral stages.

Juncus rushlands and *Carex* sedgeland vegetation present provides patchy cover over the Plan Change site. Approximately 5 percent of the land area of the Plan Change site supports these wetland associations, all of which are low in natural character.

The nearest foreshore reserves to the north support kowhai, southern rata *Metrosideros umbellata*, Coprosmas, Olearias, wineberry *Aristotelia serrata*, *Hebe salicifolia*, *Pittosporum tenuifolium*, cabbage tree, flax, ferns, bracken native grasses such as *Poa colensoi* and Lianes, bush lawyer *Rubus schmidelioides* and *Muellenbeckia australis*.

South of the terminal moraine, the land has been classified as a mixture of N2, N3 environments with a small pocket of N1. Wetlands described from the meander channels and streams in these environments (refer Attachment C which identifies wetlands A and B), include native and endemic sedges *Carex diandra*, *C. virgata*, *C. gaudichaudiana*, *C. coriacea*, *C. sinclairii* and *Eleocharis acuta*. On either side of wetland A, modified fescue tussockland *Festuca novae-zelandiae*

²⁶ Hitchmough, R. Bull, L. and Cromarty, P (compiled 2007): *New Zealand Threat Classification System lists - 2005*. Department of Conservation, Science and Technical Publishing, Wellington, NZ

²⁷ Land Information New Zealand (2002): *Crown Pastoral Land Tenure Review. Conservation Resource Report*. Allendale/ Greendale Pastoral Lease Released 2002, Inspected 1999.

with abundant matagouri was recorded²⁸. A meander channel between Kingston and Fairlight crossed by State Highway 6 contains a dense cover of flax, *Coprosma* and *Juncus* rushland vegetation. The vegetation of these meander channels is being progressively reduced by burning and pasture development. The naturalness of the vegetation in these areas is more intact and therefore more representative of the historical vegetation associations for N environments than the Plan Change site is for the Q2 environment.

In summary;

- The indigenous vegetation (or lack of it) in the Plan Change site is illustrative of the pattern of loss of lowland forest and wetland ecosystems throughout much of the eastern and southern portions of the South Island.
- Wetlands nationally have been substantially reduced through drainage, modification and deterioration resulting from infestations by exotic weeds^{29, 30}. Q2 environments are chronically under represented within the network of protected areas in general although they are very well represented within the Queenstown Lakes District Council (Lakes Ecological District).
- The indigenous vegetation of the Plan Change site is not representative of communities currently or historically found within Q2 environments.
- The rushland and sedgeland vegetation present contains species commonly found in swamp habitats and although modified in composition, would provide a starting point for any local restoration. However they could not be considered significant in terms of this existing and surrounding ecosystem or land environment type.

Recommendations addressing how or whether the historical indigenous vegetation communities could be reinstated into any future change in land use are provided in Part 5 of this report.

²⁸ Land Information New Zealand (2002): *Crown Pastoral Land Tenure Review. Conservation Resource Report. Allendale/ Greendale Pastoral Lease Released 2002, Inspected 1999.*

²⁹ Ministry for the Environment (1997): *The State of New Zealand's Environment – The State of our Waters.* Accessed on www.mfe.govt.nz on 20/12/06.

³⁰ Department of Conservation and Ministry for the Environment (2000): *The New Zealand Biodiversity Strategy.*

Fauna

There are no wildlife species of significance residing within the Plan Change site. However, Kingston and the Plan Change site are within the territory (foraging habitat) of at least one New Zealand eastern falcon. The surrounding territory is highly likely to incorporate the Ta Kere Haka Scenic Reserve and lake shore areas.

Locally significant spawning habitat for brown trout is also found within the Kingston Creek. This habitat is significant only insofar as there are not many spawning creeks in the southern portion of Lake Wakatipu but Kingston Creek is outside of the Plan Change site.

4. Assessment of Potential Environmental Effects

4.1 Geology, landform and Soils

As previously described, the excavation of drainage channels associated with pasture development, the establishment of the railway, golf course and agricultural activities have already modified the natural drainage pattern of the Plan Change site.

The proposed establishment of a storm water attenuation system with a network of open swales and channels to further drain the site will result in the continued loss of landform diversity. Residential development of the Plan Change site also has the potential to obscure the rolling topography formed under the Kingston tongue of the Wakatipu glacier.

4.2 Vegetation

The existing areas of *Juncus* rushland and *Carex* sedgeland indicate the site's potential for natural regeneration or managed restoration.

The presence of woody weeds along the western boundary and gorse hedges provide a further indication of the land's potential to revert to woody vegetation.

Under the current land use, the land's potential for more extensive natural regeneration is inhibited by farm practices. Areas of wet pasture in low laying areas also contain *Juncus* species within the sward. However these are cut along with pasture grasses in late summer or autumn and thereby prevented from establishing further as they have in the south eastern and western portions of the site. Initial estimations of site coverage by native rushland have therefore been reduced in light of more recent observations. The distribution of the existing wetland vegetation is illustrated in Attachment D.

An area of *Carex* sedgeland present in the centre of the Plan Change site is currently surrounded by Douglas fir and already partially drained. Under the Master Plan – Attachment B (Woods Bagot Kingston Village Urban Design Master Plan/ Revision C/ 17th September, 2008) it would be surrounded and further reduced by high density residential development. The extent of likely reduction is illustrated in the figure appended as Attachment I. The figure shows the overlay of the subdivision and the linear park and stormwater system. The wettest area of the *Carex* sedgeland is located within the proposed linear park.

In order to implement the Master Plan as shown in Attachments B and I, this area is likely to require draining and/ or re-contouring (fill and/ or excavation). Planting indigenous species back into this area following earthworks would retain elements of the present wetland.

The Open Space and Reserves Establishment and Management Plan prepared by Te Ngahere for the Plan Change site acknowledges the integration of “engineering functionality, biodiversity and amenity” as well as the opportunity to include “ecological corridors” within the stormwater areas passing through local reserves and swales. The Te Ngahere report also suggests plant mixes for use within the Open Spaces and Reserves. Species recommended by Te Ngahere are consistent with and have drawn on the recommended species lists included in Attachments G and H of this Assessment with the exception of the species mentioned in part 3.2.5 of the Plan. Some of the species identified for used in wetland areas (refer page 21 of the Te Ngahere report), are not naturally present in this area. It is therefore recommended that the species lists provided in Attachments G and H are preferentially used to guide wetland plantings.

The Plan Change and subsequent development of the land has the potential to diversify and redistribute indigenous vegetation from wet depressions to the swales, storm water systems and open spaces. The incorporation of indigenous vegetation within riparian areas, swales, open space and reserve plantings, and along trails will enable structural and floristic diversity of the site to be enhanced and connected with the surrounding reserves. Attachment H provides an indication of species that could be used in swale plantings. The diversity of these and other areas can be supplemented by the inclusion of species from the list in Attachment G.

4.3 Fauna

Development of the site would reduce the existing albeit modified habitat of wetland dependent birds (such as paradise shelducks, white-faced heron, and South Island pied oystercatcher) as well as those which may potentially visit the site in transit to other more intact habitat.

Residential development and the retention of the large park like setting of the golf course, open spaces and reserves along with swale planting and the establishment of residential gardens will provide structural and floristic diversity not currently present. Open spaces, riparian planting along swales will continue to provide habitat (albeit reduced) for the species mentioned above.

The incorporation of increased indigenous diversity in the Plan Change site and any subsequent development is likely to favour both insectivorous and nectar feeding species such as silver eyes, grey warbler, fantails, tomtits, bellbirds and kereru as well as exotic passerines. All of these species are found within the adjoining scenic reserve and established gardens of Kingston.

The NZ falcon may also be supported by any improvement in the abundance of prey (small birds). The habitat of the NZ falcon is otherwise unlikely to be significantly affected by the Plan Change as the surrounding land provides foraging opportunities of a quality that well exceeds those available within the farmed paddocks of the valley floor.

Kingston Creek is outside of the Plan Change site and is therefore unlikely to be adversely affected by this provided storm water discharge into Kingston Creek does not result in any deterioration in water quality and the spawning habitat is maintained. For example, where possible an open channel and natural gravel substrates should be retained.

5. Recommendations to minimise actual or potential adverse effects and provide opportunities for enhancement

The Plan Change site is currently open pasture with pockets of *Juncus* rushland and *Carex* sedgeland. The overarching recommendation articulated by the points made below is for the incorporation of a greater level of indigenous biodiversity into the Plan Change site and any future residential development within it.

The recommendations below align naturally with the background concepts, technical information and design guidelines of the New Zealand Handbook – Subdivision for People and the Environment (SNZ HB 44:2001). Where recommendations are highly consistent with the stated objectives of SNZ HB 44:2001, this has been noted.

1. Low or medium density subdivisions and open spaces should be designed to perpetuate and highlight the undulating landform. Earthworks should

therefore be kept to a minimum. These recommendations provide consistency with objectives 3.1.1 and 3.6.1 of SNZ HB 44:2001 – reproduced below.

3.1 *Positive Utilization of the Landscape*

3.1.1 *Objectives*

- (1) *To develop an understanding for the landscape character and values associated with a site.*
- (2) *To enhance the character and values of the landscape through its positive utilization in a land development design, where appropriate.*

3.6 *Earthworks*

3.6.1 *Objective*

To limit earthworks to the minimum possible by considering a range of design solutions that include utilization of natural landforms.

2. It is recommended that the species listed in Attachments G and H be planted within the portion of the *Carex* sedgeland that will be retained in the local reserve labelled “L10” in the Te Ngahere Plan. This part of the linear park should be managed as a “wild” space where *Carex secta* dominates and is supported by other indigenous species. Provision for people to sit on the periphery or on a bench seat on a boardwalk winding along or through the wetland would be appropriate. These detailed design issues can be addressed further at the subdivision stage. Earthworks should however be minimised in order to retain as much of the natural character of the rafted or floating wetland as possible. This area may also support the attenuation of storm water.
3. The species from the lists provided in Attachments G and H should preferentially guide the planting of open spaces and reserves including swales and the storm water network. In this way the existing site character will as far as is possible be retained within the context of the proposed future development. These recommendations provide consistency with objectives 3.1.1 (above), 3.2.1 and 4.1 (3), of SNZ HB 44:2001.

3.2 *Integrating People and Places with the Landscape*

3.2.1 *Objectives*

- (1) *To integrate the development with the landscape by building on existing landscape character and ecological processes and managing the effects of change.*
- (2) *To provide restoration opportunities, landscaping and open space within a development for the benefit of future occupants in terms of creating a sense of place, privacy, amenity, climate control and to encourage appreciation of local ecosystems.*

4.0 *Storm water as a Resource: Treatment and Use*

4.1 *Objectives*

- (3) *To integrate development with natural water systems through design.*

4. In addition it is recommended that the network of watercourses, swales and wetlands are naturalised and incorporated into a network of green or open spaces and/ or walking trails. These should provide physical linkages and therefore improved connectivity between the Plan Change site and the scenic reserves to the west and ultimately to the Lake foreshore.
5. Land currently heavily infested with noxious woody weeds along the western boundary should be cleared and replanted with forest fringe – wetland associations, using species identified in Attachment G. By reinstating indigenous species into the swales and open spaces of the Plan Change site will provide enhanced habitat for native birds. Residential gardens will no doubt supplement the diversity of managed open spaces.
6. The unformed legal road to the west of the site should be used to establish linkages between the Plan Change site and the western reserves.
7. Species identified in Attachment G should be used to guide the reinstatement of indigenous species into the Plan Change site. The list is intended to provide an indication of the range of species that could be incorporated into any enhancement or landscape plans. The list is not intended to act as a definitive or prescriptive list but it should guide and inform planting design. This recommendation provides consistency with the objectives of 3.2.1 of SNZ HB 44:2001 (as above).
8. If *Uncinia strictissima* is found anywhere within the Plan Change site it should be relocated (if in danger of being disturbed) into one of the landscaped riparian areas. They are reported to do better in semi-shaded positions. The New Zealand Plant Conservation Network³¹ advises that the species is easily grown from fresh seed and the division of whole plants. Seed could be sourced from local populations in consultation with the Department of Conservation and grown on for incorporation into this site.
9. Kingston Creek and an un-named tributary draining off Lorn Peak and running through the Campground provides spawning habitat for brown trout. While it is noted that Kingston Creek is outside of the Plan Change

³¹ http://nzpcn.org.nz/vascular_plants/detail.asp?PlantID=101 accessed 19th March 2007

site, it may be vulnerable to modification as a result of storm water management within the Plan Change site. To this end, it is recommended that streams and swales remain as open channels. Spawning gravel should not be interfered with, covered or replaced by culverts if this can be avoided. Riparian vegetation should be enhanced in order to improve and potentially extend available habitat into the Plan Change site.

10. The Kingston flyer routinely creates small fires along the railway track – this is evident by the charred remains of gorse and broom. Incorporation of species with a low flammability classification into the landscaped area around the railway boundary may help reduce the potential for future fires to spread while reinstating indigenous vegetation north of the railway within the Plan Change site. Walkways around the railway track may also provide an interesting buffer and amenity area between the train and any development.

5.1 Conclusion

The land affected by Plan Change 25 – Kingston Village Plan Change is currently used for pastoral activities, primarily sheep grazing. A golf course is formed over both the recreation reserve and a portion of Lot 1, this area is also grazed.

Within the Plan Change site the presence of *Carex* sedgeland and *Juncus* rushland vegetation associations identify the location of seepages and punctuate seasonally inundated depressions. Water draining from the Eyre Mountains has been channelled across the western paddocks via a system of drainage ditches and culverts that run towards the Lake.

The lack of indigenous vegetation within the Plan Change site is illustrative of the pattern of loss of lowland forest and wetland ecosystems throughout much of the eastern and southern portions of the South Island. It is unquestionably substantially modified by the historic clearance of indigenous vegetation and drainage and now retains very few species previously associated with the historical vegetation or subsequent seral stages. No significant ecological values were found on the Plan Change site.

Under the current land use, the land's potential for more extensive natural regeneration is inhibited by the lack of seed sources and meadow management.

If the recommendations of this report were implemented within the Plan Change site, indigenous diversity found within the surrounding reserves would be incorporated into the swales, open spaces and trails. In this way, the site would be enhanced and integrated with the character of the surrounding landscape.

Such enhancements, guided by Attachments G and H would support insectivorous and nectar feeding birds as well as the NZ falcon.

Kingston Creek while outside of the Plan Change site will indirectly benefit from the enhancement planting recommendations relating to the network of watercourses, swales and wetlands. The naturalisation of the stormwater attenuation system will eventually support invertebrate fauna down stream in Kingston Creek and therefore freshwater fish passing through the lower catchment.