

Vegetation and Flora of the Proposed Lake William

Survey report prepared for Hydro Developments Ltd

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September 2008

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Executive Summary

Background

Hydro Developments Ltd (HDL) is proposing to develop a hydro electric power scheme which would take waters which currently enter, and are largely responsible for reducing the water quality of the Mangatini River and Ngakawau Rivers on the northern end of the Stockton plateau. The scheme would divert waters affected by acid mine drainage (AMD) and heavy metals from current and historical mining activity. It would impound these waters in two reservoirs to be constructed on Weka Creek and St Patrick's Stream, before piping them to a power station located at the base of the hill in Granity before discharge to the sea.

The power scheme is to be constructed on crown land and requires approval from a number of organizations in order for it to proceed. An assessment of environmental effects is required for consideration of the likely impacts and a decision on whether to proceed.

This document fulfils part of the requirements for the overall assessment. A report by Norton and Roper examining the values of the area proposed for the construction of the Lake Weka reservoir was finalized in 1997. Charteris and Buckingham (2008) completed a faunal survey of the area likely to be affected by the proposal and an archaeological report has been prepared also.

An investigation of the significance of the vegetation and flora values for the area likely to be affected by the proposed Lake William reservoir was called for in June 2008. This report documents the results of the investigation.

Objectives of the survey

- To document the vegetation associations that exist within the footprint area of the dam and to record any rare or threatened plant species.
- To determine whether comparable vegetation associations are represented outside of the reservoir footprint area.

Survey Methods

Site inspection and field survey was carried out on 5th and 10th of June and 29th August 2008 by the author.

Reconnaissance vegetation plots of variable size were randomly placed within the footprint area. The number of plots per vegetation association was approximately proportional to their mapped area within the footprint area. Plot size varied between 10 x 10m plots for open grassland and shrubland and 20 x 20m plots for forest. All species within each plot were recorded and checked off against, or added to the species list for the overall footprint area. A vegetative mapping unit name was derived for each site, following Atkinson (1985).

Compilation of a full species list of all species encountered within the footprint area, paying special attention to recognised threatened species or species with a limited distribution.

Results

Ten vegetation plots were established, across the variety of communities and throughout the footprint area. Eleven distinct associations are described and this includes nine indigenous community types and two adventive associations. These plant associations range from low sub-alpine communities on gravel or coal measure substrate through to tall forest on river margins and slopes.

No listed threatened species were observed during survey though there were species noted which are uncommon or which occur within an association of species which are uncommon. *Exocarpus bidwillii* was seen only at a single site in the west of the footprint area and this species is uncommon within the Ngakawau Ecological District and is localised on the West Coast (Wilson and Galloway, 1993). Cedar or Pahautea (*Libocedrus bidwillii*) is uncommon in the Ecological District (Overmars et al, 1998) but was seen throughout the area of the proposed Lake William, from young seedlings through to old-age specimens.

The presence of *Metrosideros parkinsonii* and *Actinotus novae-zealandiae* is of botanical interest.

Discussion

The complex vegetation mosaic within the area of the proposed Lake William includes some species which, though not listed as threatened species, deserve consideration as part of recommended measures for mitigation and avoidance. It is recommended that a wider search for *Exocarpus bidwillii* is undertaken, at least in the west of the footprint area and that efforts be made to try and relocate the specimens which are found.

Cedar or Pahautea (*Libocedrus bidwillii*) is uncommon within the Ecological District, as is the mountain beech-cedar association in which it is most conspicuous. While it is recognised that this species is probably better represented outside of the footprint area, efforts should be made to try and relocate small specimens for rehabilitation efforts elsewhere.

Other recommendations include measures related to weed control, removal of valuable timber and large trees which will be drowned by the rising lake level, amongst others.

1. Introduction:

Hydro Developments Ltd (HDL) is proposing to develop a hydro-electric power scheme which would take waters which currently enter the Mangatini and Ngakawau Rivers at the northern end of the Stockton plateau. The scheme would divert waters currently affected by acid mine drainage (AMD) and heavy metals from current and historical mining activity. It would impound this water in two reservoirs within the Weka Creek and St Patrick's Stream catchments before piping them to a power station located at the base of the hill in Granity before discharge to the sea.

The Proposed Lake William footprint area is a 53.60 ha block occupying conservation land within a shallow basin of the upper St Patrick's Stream catchment. The pipe-line from this dam will be constructed under crown land, and will connect it with the proposed Lake Weka further to the north.

A report by Norton and Roper (1997) examining the values of the area proposed for the construction of the Lake Weka reservoir was finalized in 1997. This report was prepared within the wider context of reviewing the boundary and conservation values of part of the Ngakawau Ecological Area. The Ecological Area later gazetted excluded the proposed Lake Weka as a result of Norton and Ropers recommendations. This amendment to the Ecological Area boundary has resulted in the HDL project taking shape in the way it has.

A number of approvals will need to be forthcoming for the overall project to proceed and formation of the earth dam on St Patrick's Stream ultimately requires approval from the Conservation Minister before this part of the project can proceed. This document fulfils part of the requirements for the overall assessment, and documents the flora and vegetation of the area of the proposed Lake William.

2. Site description:

The proposed dam will be built across the main St Patrick's stream at about the 540m contour and the reservoir level behind this dam will be 575 metres above sea level, the dam thereby being up to 35m deep in places. The area of inundation includes the junctions of Plover, Fly and T31 streams and the impoundment of these streams will inundate short sections of these as well as parts of two smaller unnamed creeks to the east of the Fly Creek Mine Road.

The ecological values of the wider area have been well documented. Mason and Moar (1955) documented an early investigation of the flora around Mt Augustus, adding a number of plant species previously unknown in the district. While Norton raised the public profile of this unique area in *Forest and Bird* magazine in 1995, the definitive text on the Ngakawau Ecological District (Overmars et al, 1998) provided detailed information especially on the botanical values of the Denniston and Stockton coal plateaux.

The footprint area comprises of a complex mosaic of vegetation associations which range from modified exotic shrubland through to unmodified beech-podocarp forest. Historical mining in the area has left a legacy in the form of mining relics, spoil dumps and tracking as well as acid mine drainage and coal fines. The vegetation of the area reflects this history of disturbance in places, especially along the north-west and northern boundaries of the area.

Significant portions of the footprint area are sparsely vegetated – due either to the natural exposure of the coal measure sandstone or due to the loss of natural vegetation and soils through historical activities. Fire has been implicated in the loss of soil down to bare rock according to Mason and Moar (1955) though the presence of large trees indicates that much of the footprint area has remained untouched by fire.

3. Survey Methods

Field work programme:

- Site inspection, general description of observed vegetation patterns and initial vegetation survey was carried out on 5th and 10th of June 2008. Conditions were fine on the first day of survey and overcast/drizzly on the second. A further visit, on the 29th August 2008, was undertaken to complete vegetation survey and, in particular, to check whether communities represented within the proposed footprint area are also represented elsewhere.
- Vegetation plots of variable size appropriate to vegetation association (forest, shrubland, tussock grassland etc) were randomly placed within the footprint area. The number of plots per vegetation association was approximately proportional to their mapped area within the footprint area. Plot size varied between 10 x 10m plots for open grassland and

shrubland and 20 x 20m plots for forest. Vegetation cover classes were derived from assessment of successive tiers. All species within each plot were recorded and checked off against, or added to the species list for the overall footprint area. A vegetative mapping unit name was derived for each site, following Atkinson (1985).

- Compilation of a full species list of all species encountered within the footprint area, paying special attention to recognised threatened species or species with a limited distribution.

4. Survey Results:

4.1 Vegetation Associations of Survey area

Ten vegetation plots were established, across the variety of communities and throughout the footprint area (map 1). Field observations and plot information allowed the following associations to be recognised and described:

i) Mountain beech-yellow silver-pink pine forest

A short forest type, canopy usually only up to about 8m. Mountain beech (*Nothofagus solandri* var. *cliffortioides*) dominates the canopy, with yellow-silver pine (*Lepidothamnus intermedius*), pink pine (*Halocarpus biforme*) and less frequent southern rata (*Metrosideros umbellata*).

Photo 1. View up St Patrick's stream showing low forest typical of the catchment slopes.

These species along with *Pseudopandax linearis*, *Phyllocladus alpinus*, *Quintinia acutifolia*, kamahi (*Weinmannia racemosa*), *Dracophyllum longifolium*, Hall's totara (*Podocarpus hallii*) and mingimingi (*Cyathodes juniperina*) are prominent throughout the sub-canopy. The ground tier includes *Gahnia procera*, mountain flax (*Phormium cookianum*) and *Gleichenia dicarpa* while moss and forest floor litter frequently form a significant component of the forest floor cover.

Map 1. Vegetation plot locations within area of proposed Lake William; location of *Exocarpus bidwilli* and location of cedar concentration (see appendices for grid references).

Epiphytes are occasionally seen on damper sites and include *Tmesipteris tannensis*, *Luzula parviflora* and *Grammitis spp.*

Southern rata sometimes shares dominance with mountain beech in the canopy of a taller variation (10-15m) on this forest community. The podocarps still remain but are present in the sub-canopy and their presence may be less obvious.

Rimu (*Dacrydium cupressinum*) and mountain cedar (*Libocedrus bidwillii*) are emergent above the low canopy in localised sites (photo 2), and specimens may reach in excess of 20m in height along the true left of Plover Stream near the western edge of the footprint area.

Photo 2. Tall cedar specimen amongst lower podocarp canopy.

Communities on such sites aren't relegated to a distinct association, despite the much greater overall height, since the vegetation species composition appears similar otherwise.

This association, or communities showing close similarities, are widespread throughout the Ecological District and well represented on the Denniston-Stockton plateaux.

ii) Manuka shrubland

A widespread shrubland community, typically growing between 2 and 5m in height. Manuka tends to dominate in situations where the canopy height is lower, especially in the 2-3m range while increased species diversity and structural complexity is noted within a taller growing (4-5m) shrubland community in which mountain beech is often emergent above the lower manuka canopy.

The lower stature manuka shrubland community typically includes up to 70% manuka cover but includes *Cyathodes juniperina*, *Leucopogon fasciculata*, *Dracophyllum uniflorum*, *Coprosma tayloriae* and *Gahnia rigida*, yellow-silver pine and pink pine. The ground tier may include wire rush, *Blechnum procerum*, *Lycopodium scariosum* and *Uncinia spp.* Gorse seedlings and the invasive *Juncus squarossus* are found along stream edges within this association when seed is introduced in the stream-flow.

The taller manuka shrubland in which mountain beech dominates over the lower manuka sub-canopy is frequently transitional between the aforementioned forest community and manuka-*Epacris pauciflorus* shrubland. It frequently includes within its composition species such as *Pseudopanax linearis*, *Phyllocladus alpinus*, *Quintinia acutifolia*, kamahi, *Dracophyllum longifolium* and *Myrsine divaricata*. The ground tier within the 4-5m manuka shrubland includes wire rush, *Gahnia procera*, mountain flax (*Phormium cookianum*) and *Gleichenia dicarpa*, while moss and litter are prevalent on the forest floor.

The manuka shrubland association is well represented throughout the Ngakawau Ecological district and especially on the Denniston- Stockton plateaux. This community is important as wildlife habitat especially for *Powelliphanta spp.* and geckos (though none were found in the vicinity of the proposed Lake William).

iii) Manuka-*Epacris pauciflora* shrubland

This association is dominated by manuka and the shrub *Epacris pauciflorus* between 1 to 1.5m tall less than a metre in height. This community is relatively low in species diversity. Manuka contributes up to 50% cover and *Epacris* typically makes up about 20% vegetative cover. *Gleichenia dicarpa*, *Empodisma minus*, *Gentianella spp.*, *Celmisia similis* and *Carpha alpina* are minor species within this association.

This community occurs on a variety of sites i.e along the ridge to which the northern limb of the dam reaches, and is often transitional between taller manuka and other associations such as wire rushland or red tussock grassland.

iv) Mountain flax-*Dracophyllum spp./* wire rush flaxland

Mountain flax dominates a variable community which includes also manuka, and either *Dracophyllum longifolium* or *Dracophyllum uniflorum* within the uppermost tier. Beneath this *Gahnia rigida* or *G. procera* contribute a conspicuous component, while *Pittosporum rigidum*, *Pseudopanax linearis*, *Cassinia leptophylla*, and *Epacris alpina* are sometimes present over the predominant ground tier of *Gleichenia dicarpa* and wire rush. This community often occupies small patches within a larger vegetation mosaic. Mountain flax tends to be the main species where it occurs on well-drained slopes interspersed with sparse shrubby species.

Where this community occupies gully situations, *Coprosma tayloriae*, manuka and *Gahnia spp.* co-occur and form a dense vegetative cover. This community is seen throughout the footprint area i.e on the slopes immediately to the south-west of the bridge over Plover Stream, as well as on hillslopes above Plover and T31 streams.

This association is well represented elsewhere in the district i.e in places where fire has modified the original vegetative cover, for example in the upper Conglomerate Stream catchment on the flank of Mt Rochfort.

v) [*Baumea teretifolia*] wire rush rushland

Baumea teretifolia dominates the upper tier within this wetland community while wire rush makes up the main vegetative cover, typically contributing 40-50% of the vegetative cover. Red tussock (*Chionocloa rubra*) typically contributes 5-15% of the vegetative cover, *Gleichenia dicarpa* and *Lycopodium laterale* are less conspicuous and *Oreobolus pectinatus* is found only occasionally. *Schoenus pauciflorus*, *Cyathodes empetrifolia* and *Anisotome aromatica* are seen in places while mountain flax, which prefers better drainage, is often seen on the edges of this community.

This community inhabits the flat ground on the true left of Plover Stream, below the bridge where it is transitional between taller manuka shrubland and the riverbank itself. It is also seen on the true right of one of the tributaries of T31 stream. *Baumea teretifolia* rushland dominates extensive areas of the northern end of the Stockton plateau (Overmars et al, 1998).

vi) Red Tussock grassland

A grassland community dominated by red tussock over a low tier of wire rush, tanglefern (*Gleichenia dicarpa*), carpet grass (*Chionocloa australis*), *Celmisia dubia*, and *Carpha alpina*. Manuka, *Dracophyllum uniflorum*, and *Gahnia rigida* are scattered amongst this distinctive community.

This association is often transitional between the previous community and manuka-*Epacris pauciflorus* shrubland (photo). It occurs in low gradient gully basins in the north of the footprint area and the colluvial flats on the margins of St Patricks Stream.

Photo 3. Rushland association grading through to red tussock grassland and shrubland behind.

Red tussock grassland is extensive in the upper Waimangaroa Valley (i.e. Happy Valley), though this is itself threatened by proposed mining.

vii) Manuka-*Chionocloa juncea*/ wire rush rushland

Prostrate manuka and *Chionocloa juncea* and hybrid *C. juncea* x *C. rubra* form open cover over wire rush, moss, *Carpha alpina*, *Epacris pauciflorus*, *Gleichenia dicarpa*, *Celmisia dubia*, and *Lycopodium scariosum*. *Chionocloa australis*, *Donatia novae-zelandiae*. Dwarf yellow silver pine x pygmy pine hybrids form minor elements within this community. While this community frequently occurs on fairly moist sites, bare ground or rock exposures are often a feature of neighbouring sites and carpet grass often dominates on the ecotonal areas in between.

This association was seen in the middle of the footprint area, on the flat ridge crest between T31 and Plover Streams. This association is well represented elsewhere on the Denniston-Stockton plateaux.

viii) *Chionocloa australis* gravelfield

An unusual isolated community near the northern boundary of the footprint area in which the ground cover of small quartzose pebbles exceeds that of the low vegetative cover. Carpet grass (*Chionocloa australis*) is the predominant species, comprising between 20-30% ground cover, with lesser amounts of manuka, and wire rush. *Gleichenia dicarpa*, *Dracophyllum densusum*, *Celmisia dubia*, *Drosera spathulata* and *Donatia novae-zelandiae* are all present in minor amounts.

This community straddles the northern boundary of the footprint area and while the species composition is entirely indigenous, it is not certain whether it is an entirely natural association or induced by human modification.

ix) *Chionocloa australis* rockland

A similar association to the previous, but in this instance the community is present on exposures of coal measure substrate and includes a number of species not seen in the previous community. Carpet grass (*Chionocloa australis*) typically contributes 15% vegetative cover, growing amongst small depressions and on the solid rock surface, while *Dracophyllum densusum* and stunted pink pine (*Halocarpus biformis*) typically make up less than 5% cover each. Other species found in low numbers include *Celmisia dubia*, *Pentachondra pumila*, *Actinotus novae-zelandiae*, wire rush, the sun dew

Drosera spathulata, prostrate manuka, *Brachyglottis bellidiodes*, *Celmisia similis* and stunted southern rata.

This association is well represented on the ridge-crests extending north and south of the road access to the Mount William Coal Bins.

In addition two adventive vegetation communities characterised by the predominance of invasive species are described:

x) Gorse shrubland

Gorse (*Ulex europaeus*) is found throughout the footprint area and is prevalent on sites with soil disturbance such as road verges, disused 4WD tracks and spoil heaps. In places where gorse is well established and is the predominant species, *Dracophyllum longifolium* and manuka co-occur. Elsewhere, especially where there is greater soil development, broadleaf (*Griselinia littoralis*), kio kio (*Blechnum novea-zelandiae*) and the water-fern (*Histiopteris incisa*) are often seen, and in riparian situations gorse shares available space with korimiko (*Hebe salicifolia*).

xi) *Juncus squarrosus* gravelfield

The invasive rush *Juncus squarrosus* is sometimes the sole vascular plant species occurring on some sites of disturbance from mining activity. Here there is usually little organic material, and coal fines and gravels provide an inhospitable environment in which this invasive rush is able to colonise and thrive.

Manuka, *Dracophyllum longifolium*, kamahi and southern rata (*Metrosideros umbellata*) have been later colonisers of some sites where the physical conditions are less restrictive.

This community is seen on both sides of the road in the northern part of the footprint area, with a *Juncus squarrosus* mono-culture being evident in the vicinity of some areas of overburden.

5. Discussion

5.1 Vegetation associations:

Nine indigenous vegetation associations and two adventive associations are described for the footprint area. These units are not mapped due to the complexity of undertaking such an exercise. This is because the vegetation communities form a complex mosaic of species associations and attempting to draw lines on maps to delineate these is fraught with difficulties (photo 4).

Photo 4. Diverse mosaic of vegetation associations typical of the proposed area of application. Included in this frame are at least five different vegetation communities.

The most widespread of the communities are manuka shrubland, mountain beech-yellow silver-pink pine forest, and *Chionocloa australis* rockland respectively. Together it is estimated that they make up approximately 60-70% of the footprint area.

Two indigenous vegetation communities appear to be induced associations which have established as a result of human interference. The mountain flax association appears to have established preferentially after fire events, as evidenced by the remains of burnt trees. This flax community was seen also on clearings on the edge of, or amongst tall forest communities.

The carpet grass (*Chionocloa australis*) gravelfield community may have been induced by past disturbance, judging by a succession seen across an area where an old road had cut through an area of rocky terrain. The species composition was similar to that seen on adjacent coal measure exposures but the low diversity of the association and the nature of the substrate would suggest that the community has established on areas affected by mining in the past, before the wider spread of gorse and *Juncus* species.

Minor associations range in size from perhaps a hectare or two upwards, within the 53ha footprint area. While most of the associations with more restricted ranges are represented elsewhere in the Ngakawau Ecological District, the *Carpha alpina* gravelfield stood out as an unusual community not encountered elsewhere. This community lies near the northern boundary of the foot-print area and it is not certain whether it would be affected by the proposed raising of water levels. It is noted that while the community is low in species diversity and is likely to support few faunal values, the community is

quite distinctive. While it is not certain that this community is a natural one, its proximity to a similar but more diverse community type on coal measures, and the absence of exotic elements within the association would suggest that it is.

Two associations are named after the invasive exotic species which characterise them. These are found largely in the northern portion of the footprint area.

5.2 Significant Indigenous Vegetation and Habitats of Indigenous Fauna

For the purposes of Section 6(c) of the Resource Management Act 1991, the Buller District Council contains the following criteria as guidelines to identifying areas of significant indigenous vegetation and significant habitats of indigenous fauna (taken directly from The Buller District Plan):

1. **Representativeness:** *The area is one of the best examples of an association of species which is typical of the ecological district.*
2. **Distinctiveness:** *The area has indigenous species or an association of indigenous species which is unusual or rare in the ecological district, or endemic, or reaches its distribution limit.*
3. **Intactness:** *The area has a cover of predominantly indigenous vegetation, is little modified by human activity, and is not affected in a major way by weed or pest species.*
4. **Size:** *The area of indigenous vegetation or habitat is 5ha or more in size or together with adjacent indigenous habitat is larger than 5ha; or in the case of natural wetlands is larger than 1ha in size.*
5. **Protected Status:** *The area has been set aside by statute or covenant for protection or preservation.*
6. **Connectivity:** *The area is connected to one or more other significant areas in a way (through ecological processes) which make a major contribution to the overall functioning of those areas.*
7. **Threat:** *The area supports an indigenous species or community of species which is threatened within the ecological district or ecological region or threatened nationally.*
8. **Migratory Habitat:** *The area is important as habitat for significant migratory species or for feeding, breeding or other vulnerable stages of indigenous species, including indigenous freshwater fish.*
9. **Scientific or Cultural Value:** *The area is a scientific reference area, is listed as a geopreservation site, or has significant amenity value.*

In the absence of a schedule of Significant Natural Areas, the above criteria provide guidance to Council in making decisions on resource consent applications.

The following information, in relation to the above criteria, pertains to the area under application:

Representativeness: The area includes a significant number of communities which are representative of the character of the Ngakawau Ecological District. *None* of these communities is found solely within the footprint area and *all* these communities find better representation outside of the area of the application.

Distinctiveness:

No species listed on the latest threatened species database (Hitchmough, Bull and Cromarty, 2007) were found within the survey area.

The area of the proposal *does* contain some features which are distinctive and/or unusual : *Exocarpus bidwillii* was noted within the western part of the proposed area of application, where a few plants were seen. This species is uncommon within the Ngakawau Ecological District (Overmars et al, 1998) though it is locally common elsewhere i.e east of the main divide (Wilson and Galloway, 1993).

Cedar or Pahautea (*Libocedrus bidwilli*) is a conspicuous component within some communities of the application area and individuals of a number of cohorts were noted. Cedar is not a threatened species but is regarded as uncommon within the Ngakawau Ecological District (Overmars et al, 1998). Further, the mountain beech-cedar forest association within which this species is best represented, is recognised as a distinctive, yet uncommon vegetation type within the Ecological District. This community is well represented outside of the proposed application area: it occurs on the toe-slopes of the Mt William Range, flanking the Waimangaroa river, and it occurs as part of a complex forest-scrub mosaic east of the Blackburn pakihi. Recently it was found by the author on the southern end of the Denniston plateau.

Metrosideros parkinsonii is a rata species confined to Great Barrier Island and the Northwest South Island. It was found on only few occasions within the survey area. It is not listed as a threatened species though and has been found

by the author in a number of places on both the Denniston and Stockton plateaux including in the upper Mangatini catchment (Nichol, 2008).

Actinotus novae-zelandiae, a small sub-alpine herb with a localised national distribution, was found within the survey area. *Actinotus* prefers cushion bogs and flushed areas in forest and scrub (Mark and Adams, 1986) and was seen in a number of situations within the anticipated application area. It appears to be reasonably common on the Denniston-Stockton plateaux and is not listed as a threatened species.

No species, or association of species, are at their limit of distribution.

Intactness: The area of the application area has had a history of human modification, and localized sites have been modified by road formation, mining activity, fire and weed incursion. Mining activity impacts have been greatest in the north and west of the application area. Roading has bisected the footprint area and unmaintained tracks extend widely throughout the proposed application area. These have largely revegetated with gorse, while native broadleaf (*Griselinia littoralis*), korimiko (*Hebe salicifolia*) and gorse have colonized the Fly Creek Mine road margins.

Size: The area of the proposed dam is approximately 54 hectares. This is relatively small compared with some hydro-electric proposals elsewhere.

Protected Status: The area of the proposal is currently conservation (stewardship) land.

Connectivity:

The area of the proposal is surrounded by other semi-natural as well as unmodified areas and is considered to make a low-moderate contribution to the overall functioning.

Migratory habitat: The area is not known to contain habitat of particular importance for migratory species.

Scientific (or Cultural) Value: The area of the proposal does not contain plant values of particular scientific value and does not contain any plant

species on the Department of Conservation threatened species database. (For cultural value refer Watson archaeological report, *in prep*).

6. Recommendations:

The current proposal to inundate an area of the St Patricks basin will have relatively minor impacts given the overall generating capacity of the overall scheme. A number of measures are suggested as mitigation for the loss of habitat due to the construction of the Lake William and some recommendations are made to enhance the habitat of the proposed lake.

6.1 Avoidance and Mitigation:

- Further survey work in the Fly Creek and Plover Stream area to better determine the extent of *Exocarpus bidwillii*, to assess whether some live plants can be relocated.
- Undertake relocation of cedar seedlings and saplings, focusing on areas where these have been observed to be concentrated¹.
- Take cuttings of *Metrosideros parkinsonii* affected by the proposal for off-site propagation of this species for rehabilitation on suitable sites affected by the larger HDL project.
- Relocation of red tussocks affected by the proposal for rehabilitation work on the plateau.
- Utilise the timber resource affected by inundation, for instance offering Ngai Tahu salvageable logs of Hall's totara for cultural purposes. Remove trees likely to extend above the surface of the lake and down to a depth of about a metre in depth to avoid obstruction to water-craft.
- Creating wetland areas within the shallower parts of the new Lake William, thereby utilising vegetation within the zones of complete submergence and providing new wildlife habitat. Employ expert knowledge in the creation of these areas.
- Undertake a programme of *Juncus squarrosus* control on new earthworks within the HDL project, preventing the establishment of this invasive weed. Undertake planting of native, eco-sourced species on bare earth surfaces.

6.2 Off-site mitigation:

- Undertake wetland enhancement work elsewhere in the Buller District to compensate for loss of habitat within the area of the proposal. This

¹ See appendix for Grid references of seedling concentrations.

could involve weed control within indigenous wetland ecosystems, fencing off of stock from impacted habitat and amenity planting of areas enjoyed by the public.

6.3 Monitoring

- Ongoing monitoring of weed incursion within areas subject to earth disturbance and appropriate control initiated to address any issues.

Acknowledgements:

My thanks to Anthony Black and Tania from Hydro Developments Limited, Phil Knightbridge from the Department of Conservation for assistance with plant identification during this survey and Marie Ryan for reviewing this document.

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Appendices

Vegetation species list:

Native

Abrotanella linearis
Actinotis novae-zelandiae
Anisotome aromatica
Astelia (A. aff. nervosa)
Baumea teretifolia
Blechnum discolor
Blechnum fluviatile
Blechnum penna-marina
Blechnum procera
Blechnum novae-zelandiae
Brachyglottis bellidioides
Carpha alpina
Celmisia dallii
Celmisia
Celmisia densum
Celmisia dubia
Celmisia gracilentata
Celmisia similis
Chionocloa australis
Chionocloa juncea
Chionocloa rubra
Coprosma colensoi
Coprosma decurva
Coprosma depressa
Coprosma foetidissima
Coprosma linearis
Coprosma parviflora
Coprosma pseudocuneata
Coprosma tayloriae
Cortaderia richardii
Cyathodes empetrifolia
Cyathodes juniperina
Cyathea smithii
Dacrydium cupressinum
Dianella nigra

Dicksonia squarrosa
Donatia novaeseelandiae
Dracophyllum densum
Dracophyllum longifolium
Dracophyllum traversii
Dracophyllum uniflorum
Drosera spathulata
Dicksonia squarrosa
Elaeocarpus hookerianus
Empodisma minus
Epacris alpina
Epacris pauciflora
Exocarpus bidwillii
Gahnia procera
Gahnia rigida
Gaultheria antipoda
Gaultheria rupestris
Gaultheria sp. x G.macrostigma
Gentianella montana var.stolonifera
Gleichenia dicarpa
Grammitis billardierei
Griselinia littoralis
Halocarpus bidwillii
Halocarpus biformis
Hebe salicifolia
Histiopteris incisa
Hymenophyllum multifidum
Lepidothamnus intermedius
Lepidothamnus laxifolius x intermedius
Lepidothamnus laxifolius
Lepidosperma australe
Leptospermum scoparium
Leucopogon fasciculata
Libocedrus bidwillii
Luzula picta
Lycopodium laterale
Lycopodium scariosum
Metrosideros parkinsonii
Metrosideros umbellata
Microlaena avenacea

Microsorium pustulatum
Myrsine divaricata
Neomyrtus pedunculata
Nertera depressa
Nothofagus menziesii
Nothofagus solandri var. cliffortioides
Olearia arborescens
Oreobolus impar
Oreobolus pectinatus
Oreobolus strictus
Paesia scaberula
Pentachondra pumila
Pratia angulata
Phormium cookianum
Pimelia longifolium
Pittosporum rigidum
Podocarpus hallii
Polystichum vestitum
Pratia angulata
Pseudopanax colensoi
Pseudopanax linearis
Pseudopanax simplex
Quintina acutifolia
Schoenus pauciflorus
Sticheris cunninghamii
Tmesipteis tannensis
Uncinia gracilentia
Weinmannia racemosa

Exotic

Agrostis capillaris
Anthoxanthum odoratum
Digitalis purpurea
Holcus lanatus
Hypochoeris radicata
Lotus pedunculata
Juncus effusus
Juncus squarrossus
Senecio spp.
Ulex europeus

- Grid reference position for *Exocarpus bidwillii* was E2418711, N5946788
- Grid reference position for concentration of cedar (*Libocedrus bidwillii*) of various cohorts was E2418981, N5947534