



**Lower Shadow Basin Lift  
Station  
Freshwater Assessment**

**Prepared for NZ Ski  
Limited**

*March 2022*



**Lower Shadow Basin Lift Station  
Freshwater Assessment**

**Document Status**

Version	Purpose of Document	Prepared By	Reviewer	Review Date
0.1	Draft for internal review	M. Jager	B. Miller	11/03/2022
1.0	FINAL	M. Jager	B. Miller	14/03/2022
1.1	FINAL with revisions	M. Jager	B. Miller	28/03/2022



## TABLE OF CONTENTS

<b>1</b>	<b>Introduction</b>	<b>3</b>
	1.1 <b>Report Structure</b>	<b>4</b>
	1.2 <b>Limitations</b>	<b>4</b>
<b>2</b>	<b>Description of the Existing Environment and Proposed Activity</b>	<b>5</b>
	2.1 <b>Environmental Setting</b>	<b>5</b>
	2.2 <b>Biological Environment</b>	<b>6</b>
	2.2.1 Aquatic Vegetation	6
	2.2.2 Regional Plan: Water for Otago	6
	2.3 <b>Proposed Activity</b>	<b>7</b>
<b>3</b>	<b>Assessment Methodology</b>	<b>10</b>
	3.1 <b>Desktop Research and Site Visit</b>	<b>10</b>
	3.2 <b>Ecological Assessment</b>	<b>10</b>
	3.3 <b>Macroinvertebrate Sampling</b>	<b>10</b>
	3.4 <b>Macrophyte Survey</b>	<b>11</b>
	3.5 <b>Visual Fish Passage Assessment</b>	<b>11</b>
	3.6 <b>Ecological Impact Assessment Methodology</b>	<b>12</b>
<b>4</b>	<b>Results</b>	<b>13</b>
	4.1 <b>Macroinvertebrate Results</b>	<b>13</b>
	4.1.1 Sample 1	13
	4.1.2 Sample 2	14
	4.1.3 Sample 3	14
	4.2 <b>Macroinvertebrate Summary</b>	<b>15</b>
	4.3 <b>Macrophytes</b>	<b>17</b>
	4.4 <b>Fish</b>	<b>17</b>
<b>5</b>	<b>Ecological Values</b>	<b>18</b>
<b>6</b>	<b>Ecological Impact Assessment</b>	<b>19</b>
	6.1 <b>Sedimentation and Sediment Plumes</b>	<b>19</b>
	6.2 <b>Habitat and Macroinvertebrate Loss</b>	<b>20</b>
	6.3 <b>Water Diversion</b>	<b>20</b>
	6.4 <b>Riparian Margin Habitat Disturbance</b>	<b>20</b>
	6.5 <b>Fish Passage Restrictions</b>	<b>21</b>
	6.6 <b>Introduction of Unwanted Organisms</b>	<b>21</b>
	6.7 <b>Ecological Impact Assessment Summary</b>	<b>21</b>



<b>7</b>	<b>Summary and Recommended Consent Conditions</b>	<b>25</b>
<b>7.1</b>	<b>Recommended Consent Conditions</b>	<b>25</b>
<b>8</b>	<b>References</b>	<b>27</b>

## LIST OF FIGURES

Figure 1: Location of the proposed stream works (red circle). .....	3
Figure 2: Site layout with study area in red. Inset: close-up view of study area. ....	5
Figure 3: Location of macroinvertebrate samples. ....	11

## LIST OF TABLES

Table 1: Macroinvertebrate results. ....	16
Table 2: Ecological values. ....	18
Table 3: Summary of potential effects on the unnamed tributary and proposed impact management. ....	22



# 1 Introduction

NZ Ski Limited (NZ Ski) are seeking resource consent to undertake instream works in an unnamed tributary of the Rastus Burn, Queenstown (see Figure 1). It is proposed to remove the existing raised platform that was created for the current Shadow Basin Lower Lift Station and lower this area to be level with the learners' slope. The lowering of this area will require the removal of a rock wall waterfall and fill material installed by NZ Ski as part of the initial works to create the original platform. e3Scientific Limited (e3s) has been commissioned by NZ Ski to undertake a freshwater ecological assessment of the area of stream to be modified. This report identifies the freshwater ecological values and assesses the potential impacts associated with the instream works proposed to create the new station platform.



**Figure 1: Location of the proposed stream works (red circle).**



## 1.1 Report Structure

The ecological freshwater assessment is structured as follows:

- Section 2: Description of the proposed activity and environmental context.
- Section 3: The methodology employed during the ecological assessment.
- Section 4: Results from the site visit and ecological assessment.
- Section 5: Ecological values.
- Section 6: Ecological impact assessment.
- Section 7: Summary and recommended consent conditions.

## 1.2 Limitations

e3Scientific Limited (e3s) performed the services in a manner consistent with the normal level of care and expertise exercised by members of the environmental science profession. No warranties, express or implied, are made. The confidence in the findings is limited by the Scope of Work, and limited data due to the singular site visit at one time of year. A full range of biota that are present at this site may not have been seen or recorded, however, desktop research was utilised to aid the assessment.

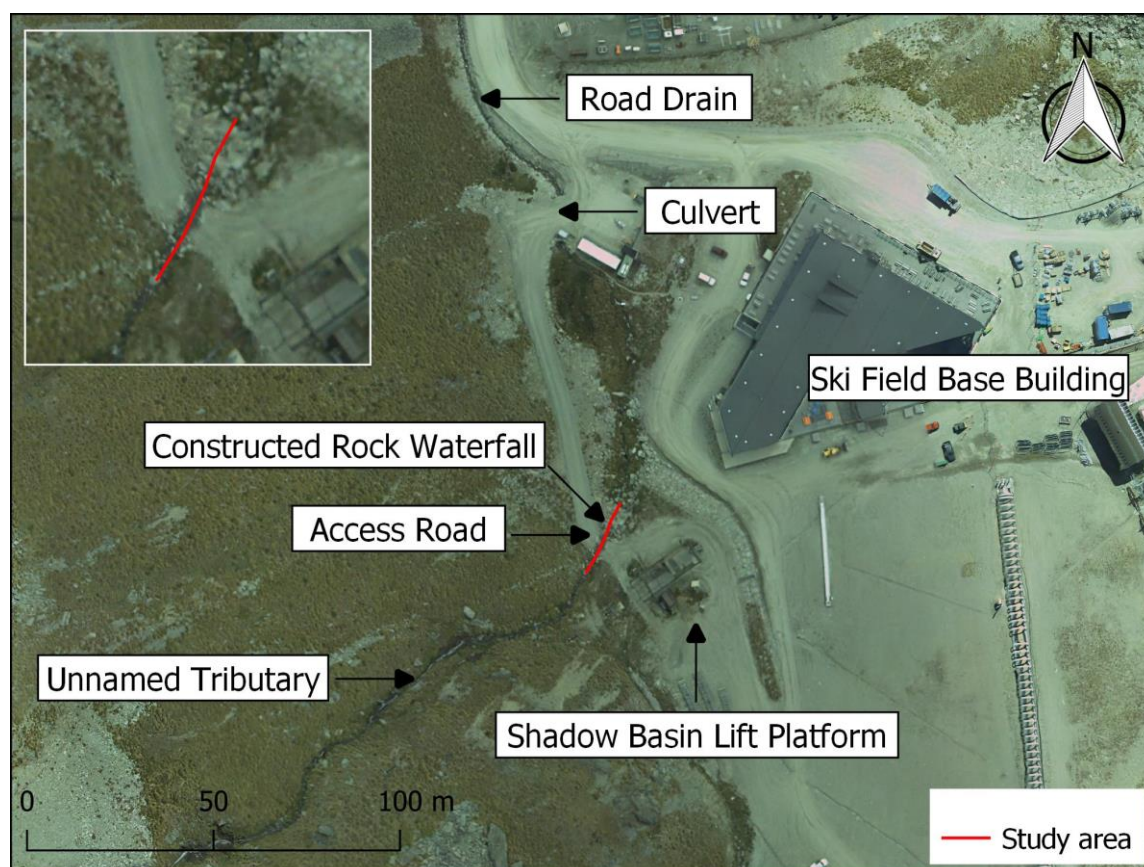
The results of this assessment are based upon a site inspection conducted by e3s personnel, and information provided in scientific literature. All conclusions and recommendations regarding the properties are the professional opinions of e3s personnel involved with the project, subject to the qualifications made above. While normal assessments of data reliability have been made, e3s assumes no responsibility or liability for errors in any data obtained from regulatory agencies, statements from sources outside e3s, or developments resulting from situations outside the scope of this project.



## 2 Description of the Existing Environment and Proposed Activity

### 2.1 Environmental Setting

The unnamed tributary is located near the upper reach of the Rastus Burn, approximately 6 km upstream from the Kawarau River and 1.5 km downstream from Lake Alta. Instream works are proposed at an elevation of 1613 m above sea level (asl), approximately 300 m upstream from the confluence of the unnamed tributary with the Rastus Burn (see Figure 1). The lower section of this tributary has received modification in the past. The tributary has two culverts installed and has been modified to be a roadside drain along most of the lower length. A waterfall constructed out of large rocks was installed in the study area to raise the elevation of the stream bed when the current elevated shadow lift platform was created. An access road through the stream is present immediately upstream of the constructed rock waterfall (see Figure 2). Upstream of the access road, little modification to the stream has occurred.



**Figure 2: Site layout with study area in red. Inset: close-up view of study area.**



## 2.2 Biological Environment

The NZ Freshwater Fish Database (NZFFD) holds three records for the Rastus Burn and one for Lake Alta. These records are all upstream of the study area but are still within the ski field area, and all have no species recorded.

The Ministry for Primary Industries spawning indicator does not list the upper Rastus Burn or tributaries within the ski field as spawning habitat for any freshwater species.

### 2.2.1 Aquatic Vegetation

No macrophytes were observed within the stream, however the riparian vegetation upstream and downstream of the site consisted predominately of native alpine herbs, wetland vegetation and tall tussocks. The margins of the waterways in these areas are partially shaded by these species as they overhang the water column. No riparian vegetation is present within the central area of the site due to the access road.

### 2.2.2 Regional Plan: Water for Otago

Schedule 1A of the Regional Plan: Water for Otago (2020) identifies the natural and human use values of Otago's surface water bodies. The Rastus Burn is listed in Schedule 1A, however the tributary is not specified. The listed ecosystem values of the Rastus Burn include:

- Free from aquatic pest plants.
- Presence of riparian vegetation of significance to aquatic habitats.
- Presence of a boulder bed composition of importance for resident biota.
- Presence of indigenous invertebrates threatened with extinction upstream of NZMS 260 F41:806641.
- Presence of significant fish spawning areas.
- A high degree of naturalness above 900 metres asl.

The tributary includes most of these ecosystem values, however, is unlikely to have significant fish spawning areas, and the downstream location of the area of invertebrates threatened with extinction is approximately 500 m upstream of the confluence of the Rastus Burn and unnamed tributary, however, is at a similar elevation as the study area.





## 2.3 Proposed Activity

The proposed activity includes the recontouring of approximately 20 m of the stream bed in an unnamed tributary within the Remarkables Ski Field. However, of this 20 m proposed to be affected, approximately 10 m has been previously modified. The proposed works will include removing a constructed rock waterfall and associated fill material behind it and shifting the rock waterfall upstream by approximately 10 m, in order to allow the top of the waterfall to align with the top of the surrounding earthworks batter (see Plate 1 and Plate 2). The surrounding stream batters would be removed to be level with the learners' slope and current stream bed (see Plate 3). Only the stream bed within the access road and above access road would be lowered. This would allow the level of the stream bed to be lowered to align with the current elevations downstream of the current rock waterfall (see Plate 3). The vehicle access is proposed to be in the same location, albeit lower and immediately below the new rock waterfall, rather than currently above the waterfall. The current vehicle crossing is primarily used as groomer access; however, this is proposed to be reduced to service vehicles only once the new chairlift is installed. The stream bed within the access road is proposed to be reinstated to the same substrate as currently present, and the substrate within the area of the existing rock wall will be reflective of the surrounding downstream substrate.

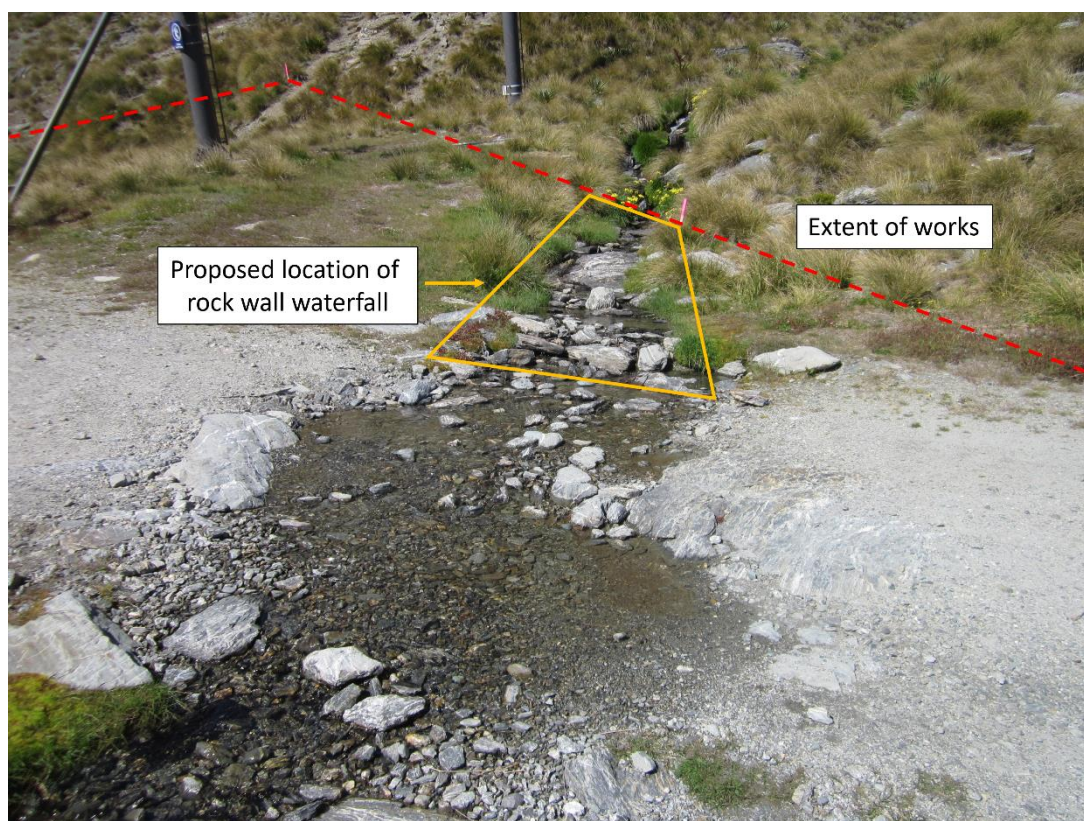
To undertake the works the stream will be temporarily dammed (using sandbags or similar) 2 m upstream of the works area, and the water diverted around the works area back into the channel approximately 5 m downstream of the site. Water will be hydraulically pumped through suitably sized pipes and is not proposed to come into contact with any exposed earthwork areas prior to discharge back into the channel. Water will be pumped at either a rate that does not result in scouring at the downstream location, or a temporary geotextile cloth with rocks will be installed on the embankment to create prevent scouring of the stream bed at the discharge point. The natural stream conditions (water depth, velocities, channel width and benthic substrate) will be reinstated, as all benthic material will be stored during the construction process and used within the stream bed to simulate natural stream gradients and processes.

Sediment controls to prevent sediment pollution during the earthworks phase will also be installed, such as sandbags. No visible sediment plumes will enter the



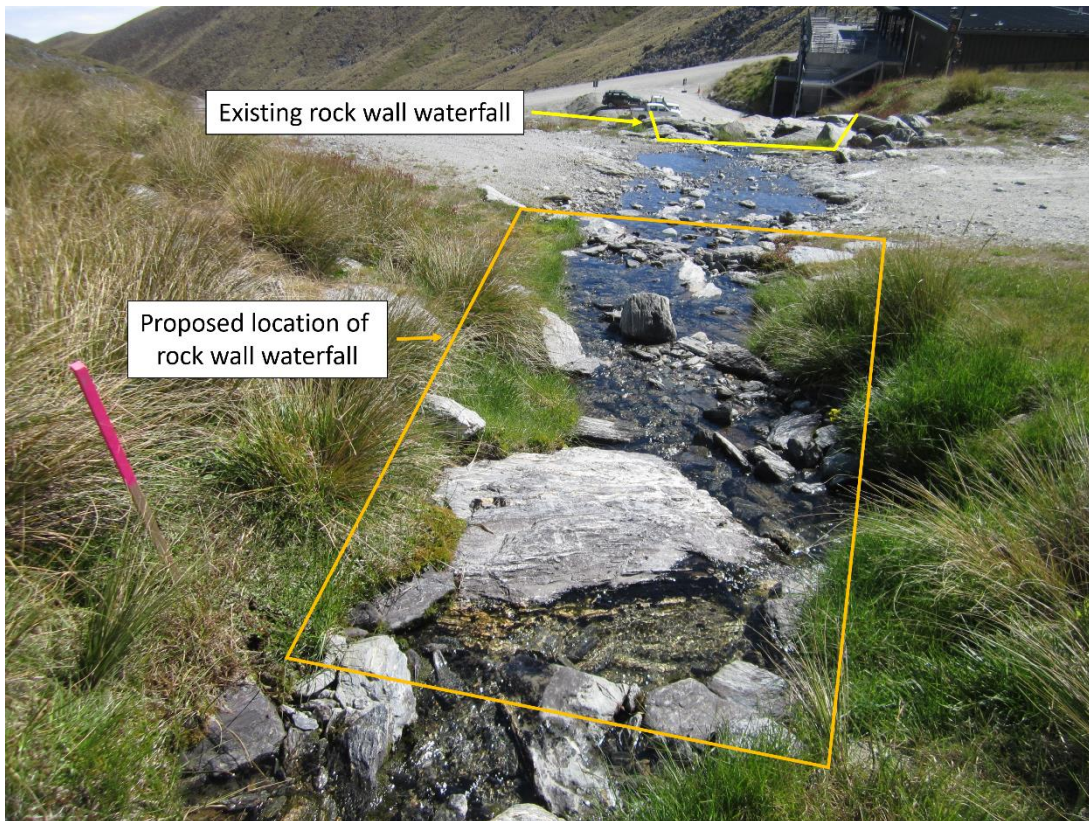
stream and any suspended sediments will be restricted to the immediate works vicinity and be temporary in nature. All instream works should be carried out during periods of low flow, however, due to the short construction season within the alpine environment, this may not be possible.

Fish passage is not proposed as part of these works. The current rock wall waterfall would restrict fish passage, and the proposed rock wall waterfall is the same design. Immediately upstream of the site, natural waterfalls act as fish passage barriers.

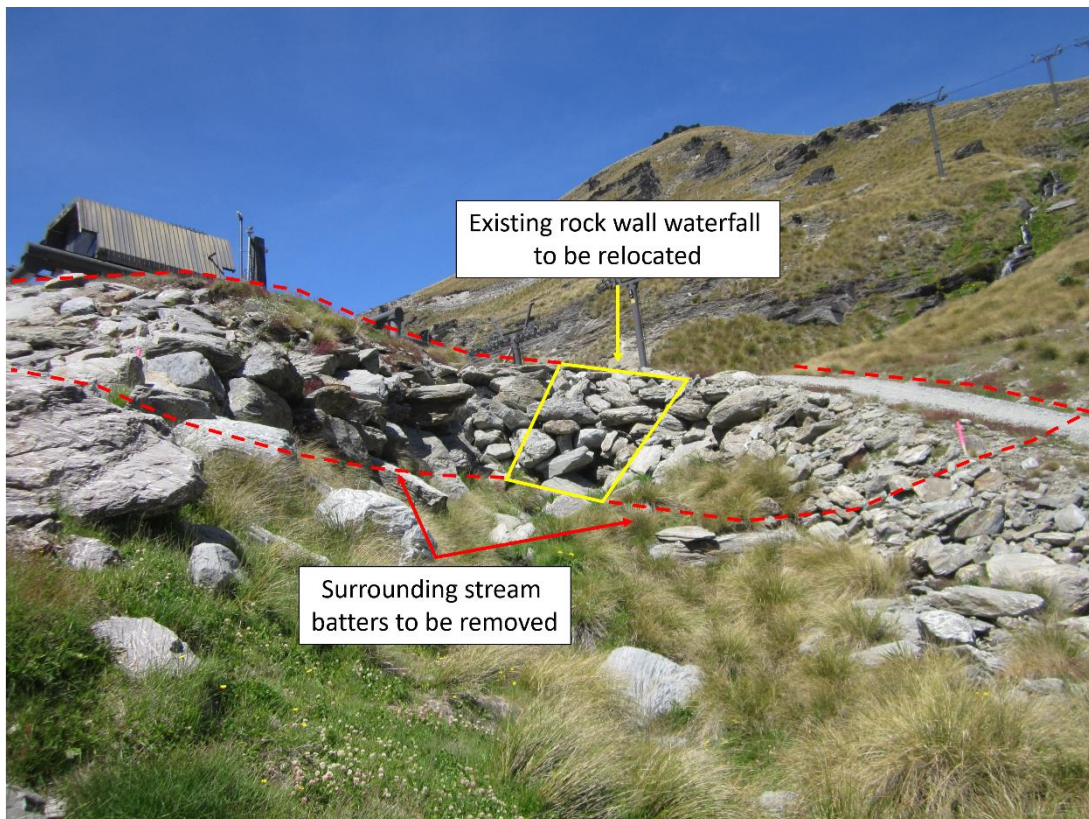


**Plate 1: Photograph looking upstream showing the location of the proposed rock wall waterfall.**





**Plate 2: Photograph looking downstream showing the location of the proposed rock wall waterfall.**



**Plate 3: Photograph looking upstream showing the location of the existing rock wall waterfall to be removed along with surrounding batters.**



## 3 Assessment Methodology

The ecological assessment for the proposed instream works is based on a desktop study, and site visit completed on 14 February 2022.

### 3.1 Desktop Research and Site Visit

The desktop and site visit included:

- Review of existing ecological information to determine ecological habitats and species likely present on the site;
- A site visit to survey the ecological habitat present; and
- Macroinvertebrate sampling.

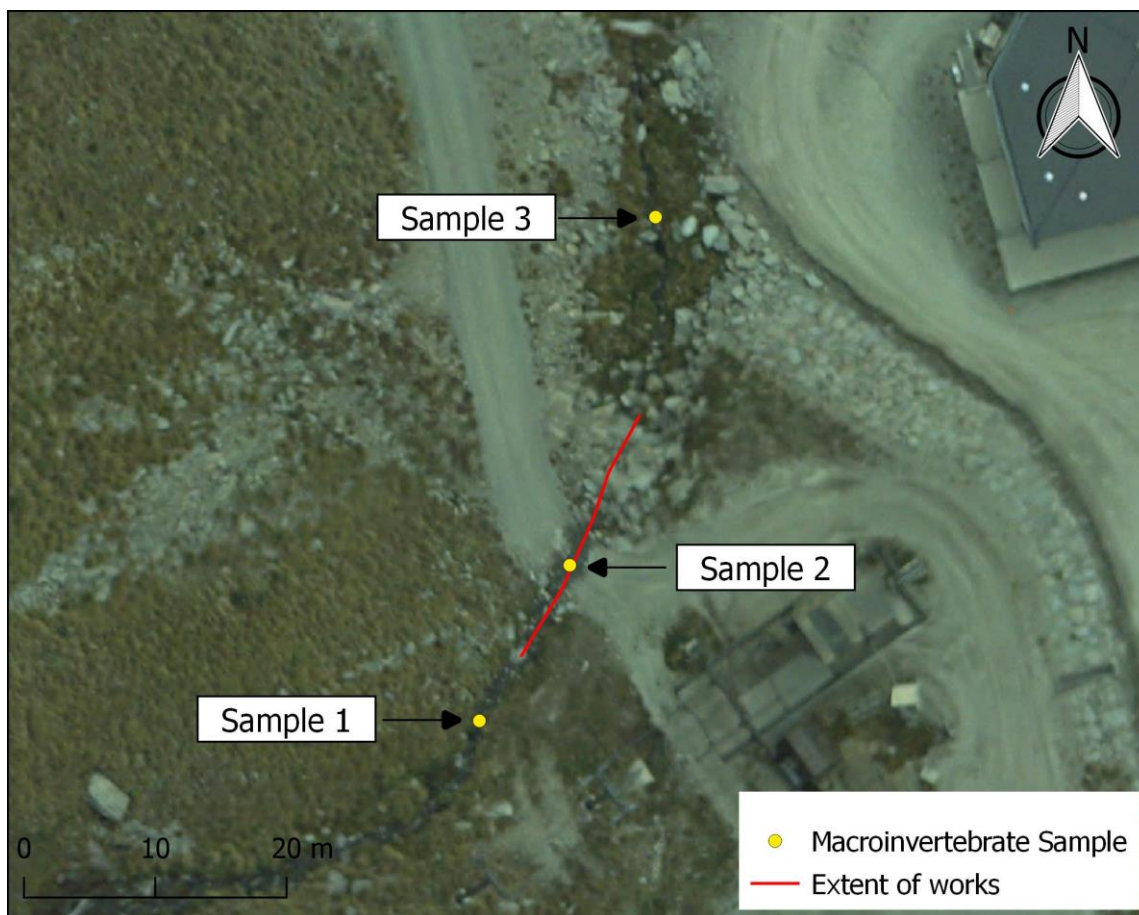
### 3.2 Ecological Assessment

The ecological assessment included field work, macroinvertebrate sampling, macrophyte visual assessments, visual fish passage assessment, and a desktop review of the New Zealand Freshwater Fish Database (NZFFD) and Ministry for Primary Industries Fish Spawning Indicator for freshwater fish and other ecological values. No specific fish sampling was undertaken.

### 3.3 Macroinvertebrate Sampling

Macroinvertebrate sampling was undertaken at three locations along the unnamed tributary using protocols from the National Environmental Monitoring Standards for Macroinvertebrates (NEMS, 2020). The locations of these samples were upstream from the access track (Sample 1), within the access track (Sample 2), and below the constructed rock waterfall (Sample 3) (see Figure 3). At each location substrate particles were washed into a kick net with a mesh size of 500 µm to collect macroinvertebrates. Macroinvertebrates, detritus and fine sediment collected in the net were transferred to a 500 mL sample jar and preserved in 70 % ethanol. Macroinvertebrates were returned to the laboratory, identified, and enumerated to species level where possible.





**Figure 3: Location of macroinvertebrate samples.**

Macroinvertebrate community health was determined by using the macroinvertebrate data collected to calculate health indices. The indices used included the Macroinvertebrate Community Index (MCI) score, Ephemeroptera, Plecoptera and Trichoptera Percentage Abundance Index (EPT), and Shannon Wiener Diversity Index (SWDI).

### 3.4 Macrophyte Survey

Macrophyte surveying was undertaken through a visual assessment of the proposed works area as well as the areas surrounding the macroinvertebrate samples.

### 3.5 Visual Fish Passage Assessment

A visual fish passage assessment was undertaken during the site walkover. This included noting and looking for any natural and unnatural fish passage restrictions including waterfalls, overhangs, undercut banks and areas of channelised flow.



### 3.6 Ecological Impact Assessment Methodology

The assessment of ecological effects for the proposed instream works has been completed using the Environment Institute of Australia and New Zealand Ecological Impact Assessment (EclA) guidelines (Roper-Lindsay, *et al.* 2018).



## 4 Results

### 4.1 Macroinvertebrate Results

Macroinvertebrate community indicators have been used to determine the health of the macroinvertebrate community within the three sample locations. Table 1 presents the results of the macroinvertebrate samples taken from the unnamed tributary.

#### 4.1.1 Sample 1

Sample 1 is located upstream of the proposed rock wall waterfall within an unmodified run section of the tributary (see Figure 3 and Plate 4). The water at this location was 6 cm deep and the stream bed had a medium to large schist cobble bottom substrate with coarse schist gravels. Water clarity was very clear with no odours present. The wetted stream bed was 1 m wide. The riparian margin at this location was predominantly indigenous vegetation and included overhanging tussocks (*Chionochoa macra*) and the yellow snow marguerite (*Dolichoglottis lyallii*). Other native species present included liverworts, moss, *Anaphalioides bellidioides*, *Acaena saccaticupula*, as well as the exotic common dandelion.

The MCI score for Sample 1 is 134 and the Quantitative MCI score is 7.76. These scores represent 'Excellent conditions and Clean Water' (Stark & Maxted, 2007). The National Policy Statement for Freshwater Management (2020) has target macroinvertebrate index scores for ecosystem health. The MCI and QMCI scores for Sample 1 both fall within the top Band A where the macroinvertebrate community is 'indicative of pristine conditions with almost no organic pollution or nutrient enrichment'.

The EPT % abundance score in Sample 1 is 89.8 %, which shows that there is a very high percentage abundance of individuals within the EPT orders present within this section of the tributary. The EPT % taxa abundance score was a bit lower at 71.4 % indicating that there are other species outside the EPT order present. The Shannon Weiner Diversity Index (SWDI) score was moderately low at 1.22 which shows that the overall diversity of species in this sample is not particularly high.



### 4.1.2 Sample 2

Sample 2 was taken from the middle of the access road (see Figure 3 and Plate 4). The water at this location was 5 cm deep and the stream bed had a small to medium schist cobble bottom substrate with medium to coarse schist gravels and some fine silts. Water clarity was very clear with no odours present. The wetted stream bed has been modified and widened at this site and is now 2.5 m wide. No riparian vegetation is present either side of the stream.

The MCI score for Sample 2 is 120 and the Quantitative MCI score is 7.50. These scores also represent 'Excellent conditions and Clean Water' (Stark & Maxted, 2007). However, under the National Policy Statement for Freshwater Management (2020) target macroinvertebrate index scores for ecosystem health, the MCI score falls within Band B where the macroinvertebrate community is 'indicative of mild organic pollution or nutrient enrichment. Largely composed of taxa sensitive to organic pollution/nutrient enrichment', however, the QMCI score for Sample 2 falls within Band A.

The EPT % abundance score in Sample 2 is 96.9 % which shows that most of the individuals within this sample are within the EPT orders. The EPT % taxa abundance score was a bit lower at 80 % indicating that there are still other species outside the EPT order present. The SWDI score was moderately low at 1.12 which shows that the overall diversity of species in this sample is also not particularly high.

### 4.1.3 Sample 3

Sample 3 is located in a run downstream of the current rock wall waterfall (see Figure 3 and Plate 4). The water at this location was 6 cm deep and the stream bed had a medium to large schist cobble bottom substrate with coarse schist gravels. Water clarity was very clear with no odours present. The wetted stream bed was 1.1 m wide. The riparian margin at this location was predominantly indigenous vegetation and mainly included overhanging tussocks and yellow snow marguerite.

The MCI score for Sample 3 is 120 and the Quantitative MCI score is 7.59. These scores also represent 'Excellent conditions and Clean Water' (Stark & Maxted, 2007). However, under the National Policy Statement for Freshwater Management (2020) target macroinvertebrate index scores for ecosystem health, the MCI score falls within Band B where the macroinvertebrate community is 'indicative of mild





organic pollution or nutrient enrichment. Largely composed of taxa sensitive to organic pollution/nutrient enrichment', however, the QMCI score for Sample 3 falls within Band A.

The EPT % abundance score in Sample 3 was 96.3 % which shows that most of the individuals within this sample are within the EPT orders. The EPT % taxa abundance score was much lower at 66.7 % indicating that there are other species outside the EPT order present. The SWDI score was moderately low at 1.14 which shows that although this is the most diverse sample collected, the overall diversity of species is still not particularly high.



**Plate 4: Photographs showing macroinvertebrate sample locations. Top left: Sample 1. Top right: Sample 2. Bottom: Sample 3.**

## 4.2 Macroinvertebrate Summary

The macroinvertebrate samples taken from the three sample locations have been used to calculate a range of macroinvertebrate community indicators. These indicators are reflective of the highly stable environments, with good quality habitat and substrate that were sampled.



Table 1: Macroinvertebrate results.

Order	Family	Subfamily	Genus/Species	MCI	Sample 1	Sample 2	Sample 3
Ephemeroptera	Leptophlebiidae		<i>Deleatidium</i>	8	58	39	167
			<i>Zephlebia</i>	7	7	14	69
Plecoptera	Notonemouridae		<i>Spaniocerca</i>	8	1	-	2
	Austroperlidae		<i>Austroperla</i>	9	-	-	1
	Gripopterygidae		<i>Zelandoperla</i>	10	21	5	10
			<i>Taraperla</i>	5	-	-	1
	Antarctoperlinae	<i>Zelandobius</i>	5	-	4	9	
Trichoptera	Philopotamidae		<i>Hydrobiosella</i>	9	1	-	1
Coleoptera	Elmidae			6	-	-	7
	Helodidae			-	6	2	1
Diptera	Chironomidae	Tanypodinae		5	4	-	1
Neuroptera	Sisyridae	Sisyrinae	<i>Sisyra</i>	-	-	-	1
<b>MCI Score</b>					<b>134</b>	<b>120</b>	<b>120</b>
<b>QMCI Score</b>					<b>7.76</b>	<b>7.50</b>	<b>7.59</b>
<b>Abundance</b>					<b>98</b>	<b>64</b>	<b>270</b>
<b>Taxa Richness</b>					<b>7</b>	<b>5</b>	<b>12</b>
<b>EPT % Abundance</b>					<b>89.8</b>	<b>96.9</b>	<b>96.3</b>
<b>EPT % Taxa Abundance</b>					<b>71.4</b>	<b>80</b>	<b>66.7</b>
<b>Shannon Diversity Index</b>					<b>1.22</b>	<b>1.12</b>	<b>1.14</b>



### 4.3 Macrophytes

The macrophyte assessment was undertaken by walking the tributary between macroinvertebrate Sample 1 and Sample 3 (see Figure 3) and identifying any species present. No macrophyte species were identified within the stream that was assessed, however, alpine water loving terrestrial plants were present immediately adjacent to the stream as well as areas of wetland vegetation and margins. The patches of wetland vegetation are present adjacent to the wetted bed, particularly upstream of the existing access road, and immediately below the existing rock wall waterfall.

### 4.4 Fish

No fish were observed in the unnamed tributary, and through desktop research it is unlikely that fish species are present at this elevation. The rock wall waterfall acts as a fish passage barrier, and immediately upstream of the site natural rock waterfalls will also act as fish passage barriers.



## 5 Ecological Values

The ecological values of the surveyed section of the unnamed tributary are associated with the benthic habitat, macroinvertebrates, and riparian margin vegetation. No fish are recorded as being present within the unnamed tributary. The ecological values are summarised below in Table 2.

**Table 2: Ecological values.**

Ecological Values	Description
<b>Benthic substrate and habitat</b>	The schist cobble and gravel substrate present within the study area provides suitable habitat for macroinvertebrate species. Very few fine sediment particles were present within this stretch.
<b>Presence of macroinvertebrates</b>	Macroinvertebrate community health scores MCI and QMCI were indicative of Excellent water quality. This is reflective of the generally unmodified catchment upstream of the sample site within Shadow Basin.
<b>Indigenous riparian margin</b>	No macrophytes were recorded within the stream, however the riparian margin along the stream (with the exception of the access road) is predominantly indigenous vegetation including areas of wetland. Patches of wetland vegetation are present adjacent to the wetted bed, particularly upstream of the existing access road, and immediately below the existing rock wall waterfall.



## 6 Ecological Impact Assessment

The proposed instream and stream bank works within the unnamed tributary include relocating the rock wall waterfall and removing the stream batters. These activities could have the potential to result in adverse ecological impacts. Potential adverse effects could include sedimentation, habitat disturbance, habitat loss, and the introduction of unwanted organisms. The following section summarises potential effects and provides mitigating options.

### 6.1 Sedimentation and Sediment Plumes

Sedimentation and sediment plumes may occur within the tributary during the removal of the rock wall waterfall, excavation of the benthic substrate for the installation of the new rock wall waterfall and the access road, and reinstatement of the habitat and benthic substrate. An increase in suspended sediment within the water column can degrade water quality and sediment deposition can adversely affect benthic habitat for macroinvertebrate communities. This is particularly problematic to the macroinvertebrate species present which are highly sensitive to pollution, such as the EPT taxa. Sedimentation in tributaries that have shallow water depths and low flow rates means that the sediment is likely to settle out onto the benthic substrate or settle out in the adjoining wetlands.

These potential sedimentation impacts are proposed to be mitigated by using appropriate methodologies including damming and diverting the stream, and the preparation of site-specific sediment and erosion control plans. This plan will detail the sediment and erosion control measures required for each activity being undertaken and will ensure there are no downstream sedimentation effects on the ecology of the site. This plan is to be prepared by a suitable qualified sediment and erosion control specialist and submitted to council for approval prior to works commencing. The level of effect of the sedimentation and sediment plumes is therefore considered to be Low (a High ecological value and Low magnitude of effect).



## 6.2 Habitat and Macroinvertebrate Loss

Macroinvertebrate communities and their habitat will be lost from the proposed works site temporarily where stream bed disturbance occurs. However, these effects are considered to be temporary as these areas will be readily re-colonised by macroinvertebrates from upstream and the immediate surrounding areas once the works have been completed. The benthic substrate from within the disturbed area of the stream will be stockpiled or immediately reused in the construction of the new rock wall waterfall. The remainder of the stockpiled substrate will be used to recreate the natural stream conditions (water depth, velocities, channel width and benthic substrate). The ecological value of the substrate utilised as macroinvertebrate habitat is High, and the magnitude of effect of disturbing this habitat is Low, as this is only on a short, temporary basis. The level of effect is considered to be Low.

## 6.3 Water Diversion

Diversion of the water channel will be required for the instream works. The diversion of the creek will result in a temporary loss of habitat and provide further fish passage restriction for instream fauna. However, as no fish species are expected to be present within this tributary therefore the timing of the works does not require spawning season restrictions, and the works are proposed to take no longer than one week. Although fish are not expected to be present, the use of fish screens on all diversion piping will further reduce any potential impact. The ecological value of the habitat and species that this water body supports are High, however, as the water take will be indiscernible for instream fauna upstream and downstream of the site the magnitude of effect is Negligible. The level of effect of temporarily diverting the flow is Very Low.

## 6.4 Riparian Margin Habitat Disturbance

The riparian margin consists of terrestrial plants and wetland vegetation. Patches of wetland vegetation are present adjacent to the wetted bed, particularly upstream of the existing access road, and immediately below the existing rock wall waterfall. The wetland areas are small and extend approximately 0.5 m to 1 m out from the wetted bed. The ecological value of the riparian margin, in particular the wetland vegetation is Very High and the magnitude of effect of disturbing this habitat is Low. Therefore, the level of effect is Moderate. However,



the riparian community will be uplifted, stored appropriately and reinstated back onto the newly contoured riparian margin and stream edge.

## 6.5 Fish Passage Restrictions

Natural fish passage restrictions are already present along the tributary, and the construction of the existing rock wall waterfall has added to these restrictions. However, no fish species are expected to be present within this tributary, therefore maintaining fish passage in accordance with the New Zealand Fish Passage guidelines (Franklin *et. al.*, 2018) is not required.

## 6.6 Introduction of Unwanted Organisms

Strict aquatic biosecurity measures are required to prevent aquatic pests being introduced into the unnamed tributary and the Rastus Burn. These include equipment inspection and cleaning prior to and after entering the site to avoid the introduction and spread of unwanted aquatic organisms such as didymo (*Didymosphenia geminata*) from both machinery and personnel.

The ecological value of the habitat and species that are present is High, and the magnitude of effect of introduced aquatic pests establishing within the tributary and the Rastus Burn is High. The level of effect of introducing unwanted organisms to the waterway Very High without management strategies. Considering the avoidance biosecurity measures recommended above the residual Level of Effect is considered Low.

## 6.7 Ecological Impact Assessment Summary

Overall, it is assessed that the ecological value of the tributary is High. However, the overall risk to the ecology at this location from the proposed instream works is considered Low. This is predominantly due to the methodologies proposed to be adopted by the applicant via management strategies and avoidance techniques. Table 3 summarises the potential effects and the associated proposed impact management.



**Table 3: Summary of potential effects on the unnamed tributary and proposed impact management.**

Proposed Activity	Potential Impacts	Rationale	Ecological Value	Magnitude of Effect	Level of Effect	Proposed Impact Management	Residual Level of Effect
Disturbance of benthic substrate.	Sedimentation and sediment plumes.	The proposed instream works will result in sediment plumes and sedimentation onto downstream habitat.	High	Low	Low	<ul style="list-style-type: none"> <li>• Appropriate methodologies including damming and diverting the stream.</li> <li>• Preparation of site-specific sediment and erosion control plans. This plan will detail the sediment and erosion control measures required for each activity being undertaken and will ensure there are no downstream sedimentation effects on the ecology of the site.</li> <li>• This plan is to be prepared by a suitable qualified sediment and erosion control specialist and submitted to council for approval prior to works commencing.</li> </ul>	Low
	Habitat disturbance and loss of macroinvertebrates.	The proposed benthic disturbance will result in the temporary loss of habitat and macroinvertebrates communities.	High	Low	Low	<ul style="list-style-type: none"> <li>• Habitat loss is temporary.</li> <li>• Re-colonisation of macroinvertebrates will occur from upstream.</li> <li>• The benthic substrate from within the disturbed area of the stream will be stockpiled or immediately reused in the</li> </ul>	Low





						<p>construction of the new rock wall waterfall.</p> <ul style="list-style-type: none"> <li>The remainder of the stockpiled substrate will be used to recreate the natural stream conditions (water depth, velocities, channel width and benthic substrate) once works completed.</li> <li>Substrate will be reinstated to reflect the substrate composition prior to disturbance.</li> </ul>	
Water diversion.	Lowering of water level.	The tributary is proposed to be dammed and diverted during the period of works.	High	Negligible	Very Low	<ul style="list-style-type: none"> <li>Water will be diverted around site and immediately back into the stream.</li> <li>Water levels upstream and downstream are not likely to be affected. Any change in water level will not be discernible for instream fauna.</li> </ul>	Very Low
Disturbance of riparian margin vegetation.	Loss of riparian vegetation.	The proposed instream works will cause disturbance to riparian vegetation.	Very High	Low	Moderate	<ul style="list-style-type: none"> <li>The riparian margin consists of terrestrial plants and wetland vegetation.</li> <li>Riparian vegetation will be uplifted, stored appropriately and reinstated back onto the newly contoured riparian margin and stream edge.</li> </ul>	Low
Construction of a rock wall waterfall	Fish passage restrictions.	The moving of the rock wall waterfall will maintain fish passage restrictions.	Low	Low	Very Low	<ul style="list-style-type: none"> <li>No fish species are expected to be present within this tributary.</li> </ul>	Very Low



Presence of machinery.	Spread of unwanted organisms.	Instream works may result in the introduction of aquatic pests into the tributary and the Rastus Burn.	High	High	Very High	<ul style="list-style-type: none"><li>• Aquatic biosecurity measures including equipment inspection and cleaning prior to and after entering the site to avoid the introduction and spread of unwanted aquatic organisms from both machinery and personnel.</li></ul>	Low
------------------------	-------------------------------	--	------	------	-----------	---	-----



## 7 Summary and Recommended Consent Conditions

NZ Ski Limited are in the process of applying for a resource consent for instream works in an unnamed tributary of the Rastus Burn, Queenstown. This work is proposed as a wider project to develop the Shadow Basin area and install a new chairlift. As part of installing the lower lift station, earthworks are proposed to remove the existing raised platform. The lowering of this area will require the removal of a rock waterfall and fill material installed by NZ Ski as part of the initial works to create the original platform. The ecological values present within this section of the tributary are associated with the macroinvertebrate community, benthic substrate, and riparian margin vegetation therefore, the proposed works have the potential to result in a range of adverse ecological effects. However, the proposed activities are considered to be short in duration and can be mitigated by appropriate methodologies. A suite of consent conditions is proposed to mitigate the effects on the freshwater ecology.

### 7.1 Recommended Consent Conditions

In order to mitigate the potential ecological impacts from the proposed works, the following consent conditions are proposed:

- A site-specific sediment and erosion control plan is to be prepared. This plan is to detail the methodology for in-stream works (i.e., installing the dam, removing the rock wall, installing the new rock wall, removing and stockpiling benthic substrate, removing the dam and reinstating natural flow) and the required sediment and erosion control associated with each proposed activity. This plan is to be prepared by a suitable qualified sediment and erosion control specialist and submitted to council for approval prior to works commencing.
- Pumping of water around the site is to be at a rate at which the tributary water level at the time of the proposed works is maintained. The pumping cannot lower the water level in the upstream or downstream reach as this may affect instream fauna. The diverted water is not to come into contact with any exposed or disturbed ground prior to being discharged back into the waterway.



- Water will be pumped at a rate that does not result in scouring at the downstream discharge location or a temporary geotextile cloth with rocks is to be installed on the embankment to create a discharge point to prevent scouring of the stream bed.
- All pumping equipment is to have a 2 – 5 mm fish screen attached.
- All equipment and machinery associated with the proposed works is to be washed down thoroughly prior to entering the worksite to ensure unwanted aquatic organisms such as didymo from both machinery and personnel is not spread.
- The stream is to be reinstated to reflect the natural stream conditions (water depth, velocities, channel width). Any benthic substrate removed is to be reinstated to reflect the substrate composition prior to disturbance or improves it.
- All excess excavated material is to be removed immediately from site and not stored on the bank or within the riparian margin.
- All riparian vegetation is to be removed and temporarily stored upright in appropriate environmental conditions (i.e., wetland vegetation stored within a water course) and then reinstated back onto the recontoured stream bank.
- No fuel storage or re-fuelling is to occur within the area. Fuel storage and refuelling of any equipment must be a minimum of 20 m away from the waterbody.

Provided these consent conditions are met, e3s considers the potential effects on the freshwater ecology of the tributary from the proposed activities to be less than minor.



## 8 References

Franklin, P., Gee, E., Baker., C & Bowie., S. (2018). *New Zealand Fish Passage Guidelines for Structures up to 4 metres*. Hamilton: National Institute of Water & Atmospheric Research

NPSFM. (2020). *National Policy Statement for Freshwater Management 2020*. Ministry for the Environment.

NEMS. (2020). *National Environmental Monitoring Standards Macroinvertebrates Collection and Processing of Macroinvertebrate Samples from Rivers and Streams*. National Environmental Monitoring Standards.

ORC. (2020). *Regional Plan: Water for Otago*. Otago Regional Council.

Roper-Lindsay, J., Fuller S.A., Hooson, S., Sanders, M.D., & Ussher, G.T. (2018). *Ecological impact assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition*.

Stark, J.D., & Maxted, J.R. (2007). *A User Guide for the Macroinvertebrate Community Index Cawthron Report No. 1166*. Cawthron Institute; Nelson, New Zealand.

Aerial imagery for Figures has been sourced from NZ Ski Limited or from LINZ Data Service for re-use under the Creative Commons Attribution 4.0 New Zealand licence.

