RAKAIA RIVERBED WEED CONTROL STRATEGY

FIVE-YEAR REVIEW

A report prepared for
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Christchurch

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SUMMARY

This report reviews the Upper Rakaia Riverbed Weed Control Strategy. That strategy was prepared in 2013 to guide the control of weed species that affect the open braided bed of the upper Rakaia River. These weeds pose a significant threat to the ecology and functioning of the braided bed of the upper Rakaia River, an area identified in the Canterbury Water Management as important habitat for threatened bird species.

The purposes of this review are to re-survey riverbed weeds in the upper Rakaia catchment, determine changes in abundance, search for new weed infestations, and control remote smaller infestations. Areas surveyed were the upper valleys (above the Rakaia/Wilberforce confluence), with emphasis on vehicle tracks, access routes, the uppermost known weed infestations, and control sites.

The survey was undertaken between November 2017 and June 2018. Consultation with landholders occurred prior to and during the survey. At the completion of each sub-catchment survey, landowners went sent maps of weed distributions. Consultation with Environment Canterbury staff, Department of Conservation staff (Liz Gunning), and the weed control operator (Matt Ford) occurred throughout the survey period.

The distribution and density of riverbed weed species are described in Section 3 and illustrated on maps in Section 4. This survey confirms that most key riverbed weed species (broom, gorse, crack willow, grey willow and tree lupin) remain widespread, but with no significant increase in their distribution since 2013. In some parts of the upper catchment there has been a noticeable reduction in the extent and density of infestations, as a direct result of recent weed control work.

Conversely, there has been a substantial increase in the distribution and abundance of false tamarisk and, to a lesser extent, stonecrop. The wind-dispersed seeds of false tamarisk appear to have enabled its rapid spread to new sites in the upper catchment. Stonecrop has also established at new distant sites; its spread or success apparently assisted by southern black-backed gulls.

Control of riverbed weeds in the upper Rakaia River catchment since 2013 appears to have been undertaken competently and thoroughly. Pooling of funds from the main agencies, and then allocation by one agency (DOC), has enabled a strategic and cost-effective approach to weed control. Riverbed weed distribution, an assessment of the effectiveness of recent weed control, and priorities for weed control are presented for each sub-catchment of the upper Rakaia River in Section 4.

Riverbed weed control in the upper Rakaia River catchment is challenging. It is constrained by the extent of the weed infestations, the ecological success and persistence of the weed species, difficult access and terrain, insufficient funds and, in some locations, lack of complementary weed control on adjacent land. Actions are recommended in Section 5 to address these constraints.

SUMMARY OF RECOMMENDATIONS

General Recommendations:

1. Continue with the pooled-funding model to help ensure coordinated and efficient allocation of weed-control funds.
2. Continue contracts with existing weed-control operators to help ensure competent and thorough weed control and to benefit from their knowledge of infestation sites.
3. Preferentially allocate funds to ground-based control methods, accompanied by aerial surveillance/wand-control where appropriate, to ensure control is effective and to minimise the risk to non-target species.
4. Continue to place higher priority on those riverbed weed species for which eradication is feasible with present resources, such as Russell lupin.
5. Continue, as a general strategy, to control weed species downriver from the up-valley extent of their distributions.
6. Ensure control sites are revisited within two years to control young plants before they set seed.
7. Liaise with landholders to ensure that complementary weed control is undertaken on land adjacent to riverbed control sites (especially control that is required by the Regional Pest Management Plan).
8. Restrict if possible and otherwise discourage vehicle use in the upper valleys.

Recommended control in order of priority for each Sub-Catchment:

Cameron-Smite-Lake:

1. Broom, gorse, crack willow, grey willow, false tamarisk: Cameron and Smite valleys.
2. Planted willow trees: lower Smite valley, lower Cameron valley and shores of Lake Heron.
3. Broom, gorse, crack willow, grey willow, false tamarisk in Lake Stream.
4. Stonecrop at southern black-backed gull colonies: Cameron and Smite valleys.

Upper Rakaia:

1. All riverbed weed species in the upper valley above the Jagged Stream confluence.
2. Remove cattle from Crown riverbed land in the upper Rakaia valley (above the Washbourne Hut flats), in consultation with Upper Lake Heron Station, LINZ and DOC.
3. All riverbed weed species: Rakaia River between Jagged Stream and Hydra Island.
4. Gorse, crack willow, grey willow and false tamarisk at Walkers Island.

Mathias:

1. All riverbed weed species: upper Mathias valley above Mistake Creek.
2. Broom and gorse in Mistake Creek.
3. All riverbed weed species: Mathias valley below Mistake Creek.

Wilberforce:

1. All riverbed weed species: upper valley above Moa Stream.
2. All riverbed weed species: open bed of the Wilberforce River between Moa Stream and the Harper River confluence.
3. Broom and gorse on areas adjacent to the riverbed below Bristed Stream on the true-left and below Moa Stream on the true-right.

Harper-Avoca:

1. Russell lupin: Lake Lilian and lower Harper valley; and monitor infestation sites annually.
2. Broom, grey willow and false tamarisk: on the valley floor of the Avoca River.
3. Broom, gorse, grey willow and false tamarisk: upper Harper valley, above the Avoca River confluence.

1.0 INTRODUCTION

This report reviews the Upper Rakaia Riverbed Weed Control Strategy[1]. That strategy was prepared in 2013 to guide the control of invasive naturalised plants (weeds) that affect the open braided bed of the upper Rakaia River. The Canterbury Water Management Strategy recognises the value of braided riverbeds as an important habitat type, notably for threatened bird species. Invasive weeds pose a significant threat to the ecology and functioning of that habitat.

The purposes of this review were:

1. To re-survey and assess the braided riverbed weeds in the upper Rakaia catchment to determine changes in abundance and extent of key weed species with a focus on high priority areas;
2. Search for new weed infestations;
3. Control remote smaller weed infestations.

High priority areas required to be covered by this survey were:

- Upper valleys (above the Wilberforce/Harper confluence);
- Vehicle tracks and access routes;
- Upper tributaries beyond the uppermost known weed infestations;
- Known infestation sites;
- Infestations of Russell lupin, yellow flag iris, and buddleia.

The area covered by this review is the upper Rakaia River and its tributaries above the confluence of the Wilberforce and Rakaia rivers. Review of the buddleia infestation just above Rakaia Gorge is reported elsewhere[2]. All naturalised species that have the potential to modify the ecology or functioning of the braided riverbed habitat are included.

This review is presented in two parts. The first part (Section 3) provides a general description of the location and extent of weed infestations, including new infestations. It also summarises the weed control work undertaken during this survey. The second part (Section 4) describes the weed infestations and the effectiveness of the past three seasons' weed control in each of the five sub-catchments.

[1] Harding, M. 2013.Upper Rakaia riverbed weed control strategy. *Environment Canterbury Report No. R13/81*.
[2] Harding, M. 2018. Upper Rakaia River Buddleia Infestation, 2018 Review/Assessment. 6pp.

2.0 SURVEY AND REVIEW METHOD

The survey commenced with a helicopter reconnaissance flight in November 2017. The ground-based field survey was undertaken over several separate trips between December 2017 and June 2018. These surveys were undertaken on foot and by four-wheel-drive vehicle where practical. Survey effort during late summer and autumn was constrained by consistently high river levels, which limited the effectiveness of survey in the upper Mathias. Weed distribution here was supplemented by records from Matt Ford.

The survey area was searched by scanning the riverbed and river banks through binoculars and traversing areas of open riverbed on foot. A key objective of the field survey was to determine the up-valley extent of each invasive weed species, especially new infestations. Therefore, the upper valley tributaries were searched more thoroughly. Particular effort was made to survey recently disturbed sites, especially those associated with vehicle tracks, buildings and flood protection works.

Each weed infestation observed was recorded as a point or polygon on hard-copy aerial images or maps, map-referenced by GPS (Garmin Etrex) and described in a field notebook. A separate point or polygon was recorded for each infestation. These data were transferred to computer-based maps (QGIS) following each field survey.

Weed distributions distant from riverbeds are mapped less precisely. Polygons depicting this peripheral spread provide an indication of the known distribution and density of the species to the extent required to guide control priorities. Recently-disturbed areas on the active floodplain of the river are not included within weed-distribution polygons (as they are too recent to have been colonised by weeds). However, surveillance for weeds on these areas of active riverbed should be undertaken as part of control of adjacent weed infestations.

Small isolated weed infestations, mostly at the upper extent of species' distributions, were controlled by hand-pulling, herbicide granules (Tordon™ 2G) or by cutting with a hand saw and treating with herbicide gel (Vigilant®). Larger infestations were not treated.

Consultation with Environment Canterbury (ECan) staff, Department of Conservation (DOC) staff (Liz Gunning), and the weed control operator (Matt Ford) occurred throughout the survey period. Consultation with landowners occurred prior to survey (to arrange access and discuss known infestations) and during the survey. At the completion of each sub-catchment survey, landowners went sent (as emailed jpeg files) images of the mapped weed distribution for their information and comment.

Review of past weed control efforts included analysis of each season's control work, as described in reports provided by the coordinator of weed control (Liz Gunning, DOC), comparison of weed distribution between 2013 and 2018, field observations of infestation sites, and discussions with the weed control operator (Matt Ford).

3.0 DISTRIBUTION OF WEED SPECIES

3.1 Distribution of Invasive Weed Species

The location and density of weed infestations recorded during this survey are illustrated on maps in Section 4 of this report. These distributions, and significant changes in distributions since 2013, are described for each of the main weed species below.

Broom:

Broom (*Cytisus scoparius*) is present throughout the upper Rakaia River catchment except for the upper reaches of the tributary valleys, and the Rakaia River above Lake Stream. The distribution of broom is largely unchanged since the 2013 survey. Significant changes are a decrease in infestations in Smite River/Lake Stream, the south side of Rakaia River between Lake Stream and Little Double Hill (Mathias River confluence), and control of large infestations on Glenthorne Station adjacent to the lower Harper River. The 2018 maps show a wider distribution of broom in the Lake Stream catchment, Mistake Creek and in the Kiwi Stream (Wilberforce) area. This is due to greater survey effort (including aerial survey) and more accurate mapping in 2017/2018 than in 2013, rather than increased spread. No new isolated infestations of broom were observed.

Gorse:

Gorse (*Ulex europaeus*) is present throughout the upper Rakaia River catchment, though is absent from most upper valleys. It is more widely distributed than recorded during the 2013 survey, though this is likely due to greater survey effort in 2017/2018. Significant changes are a decrease in infestations in Smite River/Lake Stream, the south side of Rakaia River between Lake Stream and Little Double Hill (Mathias River confluence), and an increase in the lower Harper River. The 2018 maps show a wider distribution of gorse in the Lake Stream area and in the Kiwi Stream (Wilberforce) area. This is due to greater survey effort (including aerial survey) and more accurate mapping in 2017/2018 than in 2013, rather than increased spread.

Additional infestations of gorse were recorded in lower Smite River (on flood protection works), Mistake Creek, and the upper Harper River just below the confluence of Hamilton Creek. It is likely that these infestations were present in 2013.

Crack willow:

Crack willow (*Salix fragilis*) is present in Lake Stream (and Lake Heron), Rakaia River below Lake Stream, Harper River, and Wilberforce River below the Harper River confluence. The distribution of crack willow is largely unchanged since the 2013 survey. Significant changes are a decrease in infestations in Lake Stream, the south side of Rakaia River between Lake Stream and Little Double Hill (Mathias River confluence), and an increase in infestations at Manuka Island and Hydra Waters (adjacent to Mt Algidus). Crack willow control has been very effective, though this species continues to pose a significant threat to open river habitats.

A new infestation of crack willow was recorded in the upper Rakaia River at Jagged Stream confluence. This infestation was controlled during this survey.

Grey willow:

Grey willow (*Salix cinerea*) is present in the Cameron River-Lake Stream-Smite River area, Hydra Waters (Mt Algidus), lower Harper River, and lower Wilberforce River. There are scattered isolated plants elsewhere, but it not common at those locations. Significant changes in distribution since the 2013 survey are a decrease in infestations in Lake Stream, Cameron River and Smite River. The 2018 maps show a wider distribution of grey willow in this area, due to greater survey effort in 2017/2018 than in 2013. Also significant are apparent decreases in spread in the upper Rakaia River and Mathias River, though the Mathias was surveyed less thoroughly in 2018.

New infestations of grey willow were recorded, and controlled, in the Wilberforce River above Moa Stream.

Tree lupin:

Tree lupin (*Lupinus arboreus*) is present in the lower Harper River, Wilberforce River below the Harper confluence and Rakaia River below the Mathias confluence. A few plants have been controlled in the Rakaia River valley just above the Mathias confluence[3]. Distribution in 2018 is very similar to that recorded in 2013, except for some spread upriver from existing infestations in the Rakaia, Harper and Wilberforce rivers. Widespread dieback of tree lupin was observed in May/June 2018 presumably due to fungal disease, which periodically affects lupin populations.

One new infestation of tree lupin was recorded and controlled in the upper Wilberforce River by Matt Ford.

Russell lupin:

Russell lupin (*Lupinus polyphyllus*) is present at three discrete locations in the upper Rakaia River catchment: Glenariffe Stream; Harper Diversion; and Lillian Creek (lower Avoca River). There appears to have been some spread at the Harper infestation to another location adjacent to the diversion canal. It has also been previously recorded at the confluence of Lake Stream and Rakaia River[4].

The Lillian Creek infestation was not recorded in 2013. It is presently confined to stream edges at and adjacent to the buildings It has presumably established from flowers (seed) discarded by visitors. The stream-edge infestation was controlled during this survey. The landowner was advised of the infestation at the buildings.

False tamarisk:

False tamarisk (*Myricaria germanica*) infestations have increased in size and become widespread in the upper Rakaia River catchment. It is present in Smite River, Lake Stream, Rakaia River below Jagged Stream, lower Mathias River, Wilberforce River below Harper River confluence, and Harper River and its upper tributary Hamilton Creek. There has been a dramatic increase in the distribution of false tamarisk since 2013, and an increase in the density of infestations and the stature of plants at those infestations.

[3] Matt Ford, pers.comm.
[4] Matt Ford, pers.comm.

New infestations of false tamarisk were recorded in Smite River, Lake Stream, Rakaia River at Jagged Stream confluence, Mathias River, and upper Harper River (including Hamilton Creek).

Stonecrop:

Stonecrop (*Sedum acre*) is present in Smite River, Cameron River fan, Rakaia River below Lake Stream confluence, lower Wilberforce River and lower Harper River. It is a difficult plant to detect during surveys, due to its low-growing habit. A notable observation is the presence of dense infestations of stonecrop in the upper Smite River (at Godley Stream confluence) and Cameron River fan at southern black-backed gull (*Larus dominicanus*) colonies.

New infestations of stonecrop were recorded at Smite River, Cameron River fan, Rakaia River below Lake Stream, and Wilberforce River just above Harper River confluence.

3.2 Weed Control

The field survey included control of isolated and/or small infestations of riverbed weeds. Most control was of infestations at or near the up-valley distribution of the weed species. The locations of these control sites are illustrated (as yellow dots) on the weed distribution maps. The main species controlled were gorse, broom, false tamarisk and grey willow, as summarised in Table 1.

Table 1: Weed control undertaken during this survey

Weed Species	Number of Control Sites	Number of Plants Controlled
gorse	17	117
broom	31	61
false tamarisk	17	50
grey willow	10	10
wilding conifer	5	7
sweet brier	4	5
crack willow	2	2
apple	2	2
tree lupin	2	2
Russell lupin	1	2
Total	94	258

4.0 SUB-CATCHMENT INFESTATIONS AND CONTROL

Weed infestations in each sub-catchment of the upper Rakaia River are described and illustrated in this section of the report. The weed control effort over the past three seasons (2014 to 2017) in each of these sub-catchments is described and its effectiveness analysed. A strategy for future weed control is proposed for each sub-catchment. These strategies include priorities for control in that sub-catchment, in the context of control priorities in the wider upper Rakaia River catchment. This analysis is separated into sub-catchments to enable more detailed illustration of weed distributions and to provide more focussed recommendations for weed control. It is also expected that this will provide information that is more useful to adjoining landowners.

Analysis of the effectiveness of recent weed control is not always easy. Weeds that have been controlled may have since disappeared or may be less obvious. Several upper Rakaia riverbed weed species have durable long-lived seeds, such as broom, gorse, tree lupin and Russell lupin. Therefore, new plants may arise at a control site many years later. Other weed species have light seeds that are easily dispersed by wind to new sites, such as false tamarisk and stonecrop. These species can readily establish infestations at new distant locations despite control of existing infestations.

Dead plants of riverbed weed species that were encountered during this survey are depicted on the maps as red dots. However, it is more difficult to map larger patches of dead plants. These are depicted on the maps as low-density infestations, as regrowth of weed species will likely occur and has occurred at some locations. Therefore, the maps alone are not good indicators of the success or otherwise of recent weed control. The effectiveness of weed control is described in the text.

In many parts of the upper Rakaia River catchment there has been a noticeable decline in weed infestations. Good examples are the Smite River/Lake Stream area, the true-right (south) bank of the Rakaia River between Lake Stream and Little Double Hill, and the open riverbeds of the Mathias and upper Wilberforce rivers. Also, there are very few extensions in weed species distributions in the upper valleys with the notable exception of false tamarisk.

However, despite these successes, riverbed weed infestations are still widespread in the upper Rakaia River catchment. This is not surprising considering the size of the area and intractability of some of the weed problems. Riverbed weed control in the upper Rakaia River catchment is constrained by limited funds, difficult access, rough terrain and, at some locations, lack of complementary control on adjacent land. These constraints are acknowledged in the strategies (and control priorities) proposed below.

4.1 Cameron-Smite-Lake

This sub-catchment comprises the catchment of Lake Stream, including Cameron River, Smite River and Lake Heron. The riverbeds lie within Upper Lake Heron and Glenfalloch stations.

Cameron River:
The only riverbed weed species observed in the upper Cameron River (above Highland Home) was grey willow at two locations (treated[5]). Weed species in the mid-lower Cameron are broom, grey willow and gorse (at one location; dead). There is one large patch of planted crack willow trees at the head of Cameron fan. A small dense patch of stonecrop is present at a southern black-backed gull colony on the Cameron fan, with low-density spread downriver on the fan.

Lake Heron:
There are several patches of crack willow on and adjacent to the shores of Lake Heron, some of which have been controlled. Willow control at one site has also killed a substantial area of native sedgeland. Broom is present at several locations adjacent to the western shore of the lake.

Smite River:
Broom, grey willow, false tamarisk and stonecrop are present in the Smite valley downriver from the confluence of Godley Stream. Broom is present as scattered plants and patches, much of which is dead. Grey willow and false tamarisk are present as occasional plants (treated). Stonecrop is present as a small dense patch at a southern black-backed gull colony in lower Godley Stream, with low-density spread downriver. Willow and gorse are present on the flood-protection bank on the true-left of the Smite River fan.

Lake Stream:
Crack willow and grey willow are present in the large Cameron fan wetland, though at low densities due to recent control. Yellow flag iris is present in Lake Stream, near Upper Lake Heron homestead. Broom, gorse, crack willow, grey willow, and false tamarisk are present in Lake Stream, with densities generally increasing downstream. Most large willow trees are dead, though a large patch in the lower valley has not been controlled. Dead broom and gorse are present near Downs Hut. Russell lupin has been previously recorded in lower Lake Stream.

Adjacent land:
Occasional plants and small patches of broom and, less-commonly, gorse are present distant from the riverbeds on Upper Lake Heron and Glenfalloch stations (viewed during the reconnaissance flight). This spread is indicated by a large low-density polygon, though the outer boundaries of this polygon are indicative rather than precise. Elderberry (*Sambucus nigra*) trees are present in the lower Cameron and Smite valleys, and a single tree in the upper Cameron. A single conifer tree is also present in the upper Cameron valley. An infestation of cherry (*Prunus avium*) is present at Downs Hut. Himalayan honeysuckle (*Leycesteria formosa*) has been observed in the Lake Stream catchment[6].

[5] "treated" indicates that plants were controlled during this survey.
[6] Donna Field, pers.comm.

Recent Control

Broom, gorse, crack willow and grey willow were controlled in the Smite valley and upper Lake Stream in 2015. These weed species and false tamarisk were controlled in lower Lake Stream in 2016, and in the Smite valley and the full length of Lake Stream in 2017. Evidence of this control work was observed during this 2018 survey. Control work has also been undertaken in the Cameron valley, with dead plants of grey willow observed in the lower valley.

This control work appears to have substantially reduced infestations of broom, gorse, crack willow and grey willow in this sub-catchment. Frequent (annual or two-yearly) ground-based control will have helped achieve this result. Important issues for future riverbed weed control are:

- Infestations of stonecrop at southern black-backed gull colonies.
- By-kill of native sedges at a crack willow control site at Lake Heron.
- Replacement of planted willow species in lower Cameron River and at flood-protection works in lower Smite River with less spread-prone species.
- Broom and gorse infestations on adjacent land (Upper Lake Heron Station and Glenfalloch Station), especially isolated infestations for which control is required by the Canterbury Regional Pest Management Plan 2018 (RPMP).

Control Strategy

Actions, in order of priority, for control of riverbed weeds in this sub-catchment are:

1. Control broom, gorse, crack willow, grey willow and false tamarisk in Cameron and Smite valleys.
2. Liaise with Upper Lake Heron and Glenfalloch stations to ensure that complementary weed control (especially that required by the RPMP) is undertaken on those properties.
3. Remove planted willow trees from the lower Smite valley, lower Cameron valley and shores of Lake Heron (using methods that do not cause by-kill of native species).
4. Control broom, gorse, crack willow, grey willow and false tamarisk in Lake Stream.
5. Control the two dense infestations of stonecrop at southern black-backed gull colonies in the lower Cameron and upper Smite valleys. This will remove the main seed sources from this area.

4.2 Upper Rakaia

This sub-catchment comprises the upper main-stem of the Rakaia River above the confluence of the Wilberforce River. It does not include the catchment of Lake Stream. Adjacent properties are Upper Lake Heron, Glenfalloch, Double Hill and Glenariffe stations on the true right (south) side of the valley, and Manuka Point and Algidus stations on the true left (north) side of the valley.

<u>Rakaia River above Lake Stream</u>:
Riverbed weed species observed in the upper Rakaia River (above the confluence of Lake Stream) were a single patch of gorse (treated) near Reischek Hut and crack willow (treated) at the confluence of Jagged Stream. Infestations of false tamarisk are present at the confluence of Jagged Stream and on the true-left of the riverbed adjacent to Prospect Hill.

Grey willow has been previously recorded on the true-left of the upper valley[7], though was not observed during this survey.

Rakaia River between Lake Stream and Mathias River:
The main infestation sites in the Rakaia River between the confluences of Lake Stream and Mathias River are at Walkers Island and along the true-right (south) bank. Gorse and crack willow are relatively common at Walkers Island, and false tamarisk present at the downriver end of the island. Occasional plants of broom, gorse and crack willow are present on the south bank, and larger patches of false tamarisk in the riverbed. Stonecrop is present, though not common, on the flood-protection bank downriver from Glenfalloch. A few plants of tree lupin have been controlled on the riverbed just above the Mathias River confluence. Poplar (*Populus nigra*) is present in lower Glenfalloch Stream.

Rakaia River between Mathias and Wilberforce rivers:
This section of the Rakaia River has substantial infestations of riverbed weeds. Broom, gorse and false tamarisk are common at the Rakaia-Mathias confluence, Hydra Island and on the riverbed above the Wilberforce River confluence. Crack willow and grey willow are common at Hydra Waters/Hydra Island and on stable gravels downriver. Broom and gorse are also present as scattered plants (controlled) on the north side and flats below Little Double Hill. Tree lupin is present on the riverbed adjacent to Little Double Hill and increasingly common downriver. Russell lupin is present at one location at Glenariffe Stream.

Adjacent land:
Occasional plants and small patches of gorse are present distant from the riverbeds, on the south side of the river. Patches of broom and crack willow are present on the south side of Double Hill. Cotoneaster (*Cotoneaster* sp.) is present near Manuka Point homestead and on the steep cliff on the south side of the river at Glenfalloch. Also present on this cliff are wild strawberry (*Fragaria vesca*) and wilding conifers.

Recent Control

Ground control (presumably of gorse and crack willow) was undertaken at Walkers Island and the Rakaia-Mathias confluence in 2015. All riverbed weeds (presumably broom, gorse, crack willow, grey willow, tree lupin and false tamarisk) were controlled in the Rakaia River between Lake Stream and the flats below Little Double Hill in 2016. All riverbed weed species were controlled by ground and aerial methods/surveillance in the upper Rakaia (above Lake Stream) and between Lake Stream and the flats below Little Double Hill by ground methods in 2017. Evidence of this control work was observed during this 2018 survey, notably gorse at Walkers Island and on the main riverbed, and false tamarisk adjacent to Glenfalloch. Also apparent is the considerable reduction in weed infestations on the south bank between Glenfalloch and Little Double Hill, and of broom and gorse on the flats below Little Double Hill, since 2013.

This control work appears to have reduced infestations of gorse and crack willow at Walkers Island, and substantially reduced infestations of broom, gorse and crack willow on the main riverbed between Jagged Stream and Little Double Hill. Important issues for future riverbed weed control are:

[7] Matt Ford, pers.comm.

- Gorse near Reischek Hut; an infestation that was recorded and controlled as long ago as 1998[8].
- Cattle on the valley floor (riverbed and terraces) of the upper Rakaia valley up to and above Reischek Hut (posing a weed-spread threat and damaging river terrace vegetation, including threatened plant species).
- Rapid spread of false tamarisk upriver since 2013.
- Stature and density of false tamarisk infestations on the riverbed below Little Double Hill.

Control Strategy

Actions, in order of priority, for control of riverbed weeds in this sub-catchment are:

1. Control gorse (and any other riverbed weeds) in the upper valley above the Jagged Stream confluence.
2. Remove cattle from Crown riverbed land in the upper Rakaia valley (above the Washbourne Hut flats), in consultation with Upper Lake Heron Station, LINZ and DOC.
3. Control all riverbed weeds (broom, gorse, crack willow, grey willow, tree lupin and false tamarisk) on the open riverbed between Jagged Stream and Hydra Island.
4. Control gorse, crack willow, grey willow and false tamarisk at Walkers Island.
5. Control gorse and broom on the north side of Little Double Hill and on the shrubland-dominated terrace downriver from Little Double Hill.
6. Control riverbed weed species on the open riverbed at and downriver from Hydra Island.

4.3 Mathias

This sub-catchment comprises the Mathias River. It includes a major tributary, Mistake Creek. Adjacent properties are Manuka Point Station on the true right (south-west) side of the valley, and Mt Algidus Station on the true left (north-east) side of the valley.

Mathias Valley:
Occasional plants of broom and gorse are present in the upper valley between Boundary Stream and Mistake Creek. Low-density infestations of both species are present on the true-left (Mt Algidus) side downriver to the Rakaia confluence, with a denser infestation of gorse on a riverbed island in the lower valley. One false tamarisk plant was observed and controlled this season on the true-left of the riverbed just above Mistake Creek[9].

Mistake Creek:
A large infestation of broom is present on steep rocky slopes on the true-right of upper Mistake Creek. Scattered broom plants are present down Mistake Creek to the Mathias River. A small patch of gorse is present on the slopes just down-valley from the broom infestation. A small patch of poplar is present on the Mistake Stream fan.

[8] Harding, M. 1998. A report on weed infestations on DOC-administered areas in the Rakaia, Cameron, Lawrence, Clyde, and Havelock valleys. *Unpublished Report* to Department of Conservation, Raukapuka.
[9] Matt Ford, pers.comm.

Adjacent land:
Infestations of broom and gorse are present on the moraine (The Downs) and river terraces on the Mt Algidus side of the river. Two small patches of broom are present mid-slope in the lower valley on Manuka Point Station, and controlled annually[10].

Recent Control

Aerial control of broom was undertaken in Mistake Creek, and of all riverbed weeds in the lower Mathias in 2015. Broom and gorse were controlled throughout the Mathias River (excluding Mistake Creek) in 2016. All riverbed weed species were controlled by ground methods, with aerial surveillance/control, in the Mathias River and Mistake Creek in 2017. Survey coverage of the Mathias catchment was restricted by high river levels, so observations of the effects of this control work were limited.

Important issues for future riverbed weed control are:

- Continued regular control of broom and gorse at the source infestations at Mistake Creek and the upper Mathias River to help protect the lower Mathias riverbed from new infestations.
- Annual surveillance of the valley to prevent the establishment of other riverbed weeds, such as false tamarisk and grey willow.

Control Strategy

Actions, in order of priority, for control of riverbed weeds in this sub-catchment are:

1. Annual control of broom and gorse (and any other riverbed weed species) in the upper Mathias valley above Mistake Creek.
2. Control broom and gorse in Mistake Creek.
3. Control broom and gorse (and any other riverbed weed species) in the Mathias valley below Mistake Creek.
4. Liaise with Manuka Point and Mt Algidus stations to ensure that complementary weed control (especially that required by the RPMP) is undertaken on those properties.

4.4 Wilberforce

This sub-catchment comprises the Wilberforce River and its minor tributaries. It does not include the Harper River catchment. Adjacent properties are Mt Algidus Station on the true right (west) side of the valley and Glenthorne Station on the true left (east) side of the valley.

Upper Wilberforce Valley (above Boulderstone Stream):
Occasional plants of broom were observed (and treated) in the upper valley near the confluence of Burnet Stream. Isolated plants are present near the confluence of Bristed Stream, grading to more extensive moderate-density spread downriver on the true-left. The upper extent of broom on the true-right is Moa Stream, where isolated plants grade downriver to denser infestations. The upper extent of gorse is at Fanghill Stream on the true-left and Moa Stream on the true-right. More extensive infestations are present downriver. Isolated grey willow plants were observed (and treated) in the upper valley near Bristed Stream.

[10] Don Paterson, Manuka Point, pers.comm.

Lower Wilberforce Valley (below Boulderstone Stream):
The lower Wilberforce River, especially the area below the Harper River confluence, has widespread infestations of most riverbed weeds, especially on areas of stable gravel and at the river sides. Infestations of broom, gorse, crack willow, tree lupin, false tamarisk, and stonecrop are common. Grey willow is present, and Russell lupin recorded (and controlled) just below the Harper River confluence[11].

Adjacent land:
Infestations of broom and gorse are present on areas adjacent to the riverbed above the Harper River confluence. Land adjacent to the lower river was not inspected closely but is likely to support infestations of broom, gorse and crack willow. Substantial areas adjacent to the riverbed on Glenthorne Station have been cleared of broom and gorse since the 2013 survey.

Recent Control

Ground control of riverbed weeds was undertaken in the upper Wilberforce in 2015. Broom, gorse, tree lupin and Russell lupin were controlled in the Wilberforce River at the Harper River confluence in 2016. There has been no recent control of riverbed weeds in the lower Wilberforce River. Evidence of this control work was observed during this 2018 survey, notably broom and gorse in the upper valley. Some early (pre-2015?) control of broom and gorse has resulted in by-kill of matagouri shrubland and subsequent dense regrowth of the weed species. Also observed during this survey were dead inaka (*Dracophyllum longifolium*) shrubs in the upper valley, presumably mistaken for broom and treated with herbicide.

Important issues for future riverbed weed control are:

- The risk of weed spread from vehicle use in the upper valley.
- By-kill of matagouri shrubland from indiscriminate use (aerial application) of herbicide.
- Apparent death of native inaka shrubs, presumably misidentified as broom.
- Threat posed to the lower valley by infestations of riverbed weed species in the lower Harper River, notably Russell lupin.

Control Strategy

Actions, in order of priority, for control of riverbed weeds in this sub-catchment are:

1. Control broom, gorse, grey willow and any other riverbed weeds in the upper valley above Moa Stream.
2. Maintain the open bed of the Wilberforce River free of riverbed weeds between Moa Stream and the Harper River confluence.
3. Control broom and gorse on areas adjacent to the riverbed below Bristed Stream on the true-left and below Moa Stream on the true-right, in cooperation with Mt Algidus and Glenthorne stations.
4. Liaise with Mt Algidus and Glenthorne stations to ensure that complementary weed control (especially that required by the RPMP) is undertaken on those properties.

[11] Matt Ford, pers.comm.

4.5 Harper-Avoca

This sub-catchment comprises the Harper River and its major tributary, the Avoca River. The main adjacent property is Glenthorne Station.

Avoca Valley:
The upper extent of broom in Avoca valley is near Amphitheatre Creek (treated). Scattered plants and patches are present downriver, mostly on adjacent hill slopes. Grey willow was observed (and treated) near Centre Creek. False tamarisk was observed (and treated) just below Triangle Creek. Russell lupin is present at the huts (The Retreat) in the lower Avoca valley at Lilian Creek.

Harper Valley:
The upper extent of broom is near Hut Creek in the Harper valley (treated). It is present as low-density spread downriver. Gorse was observed (and treated) just below the confluence of Hamilton Creek. Occasional plants are present downriver. Grey willow was observed (and treated) at several locations in the upper Harper valley, and is present as a low-density infestation downriver. Crack willow is present at Lilian Creek and increasingly common downriver. False tamarisk was observed (and treated) at several locations in Hamilton Creek. It is present, and increasingly common, down the Harper River. The area below the Harper Diversion is dominated by weeds, notably broom, gorse, crack willow, grey willow, tree lupin, false tamarisk, and stonecrop. Russell lupin is present at the Harper Diversion and near the Wilberforce Diversion canal.

Adjacent land:
Infestations of broom and gorse are present on adjacent land, notably broom on hill slopes in the lower Avoca (Corner Creek) and lower Harper valleys. Substantial areas adjacent to the riverbed on Glenthorne Station have been cleared of broom and gorse since the 2013 survey. Crack willow and rowan are present in the vicinity of Lilian Creek. Numerous weed species, including Khasia berry (*Cotoneaster simonsii*) and sycamore (*Acer pseudoplatanus*), are present at and near residences/baches at the Harper Diversion.

Recent Control

Control of broom, gorse and willow was undertaken throughout the Harper and Avoca sub-catchment in 2015. Broom, gorse, tree lupin and Russell lupin were controlled in the lower Harper River area, below the Harper Diversion in 2016. Evidence of this control work was observed during this 2018 survey, notably broom in the lower Avoca and Russell lupin at the Wilberforce Diversion.

Important issues for future riverbed weed control are:

- The risk of weed spread from vehicle use in the upper valleys.
- Introduction of weed species, such as Russell lupin, by visitors to the huts at Lilian Creek.
- The abundance and diversity of weed species associated with hydro diversion works and residences in the lower Harper valley.
- The importance of complementary weed control (especially broom) on land adjacent to the riverbed.

Control Strategy

Actions, in order of priority, for control of riverbed weeds in this sub-catchment are:

1. Control Russell lupin at Lake Lilian and monitor infestation sites annually.
2. Control Russell lupin in the lower Harper valley and monitor infestation sites annually.
3. Control broom, grey willow and false tamarisk on the valley floor of the Avoca River.
4. Control broom, gorse, grey willow and false tamarisk in the upper Harper valley, above the Avoca River confluence.
5. Liaise with Glenthorne Station to ensure that complementary weed control (especially that required by the RPMP) is undertaken on that property.
6. Control all riverbed weeds in the Harper valley between the Avoca confluence/Lilian Creek and Harper Diversion.

5.0 DISCUSSION

This survey of riverbed weeds in the upper Rakaia River catchment confirms that key riverbed weed species, such as broom, gorse, crack willow and grey willow, remain widespread. Tree lupin remains common below the Wilberforce-Harper confluence. The survey also records a substantial increase in the distribution and abundance of false tamarisk and, to a lesser extent, stonecrop.

Despite the continued presence of these important riverbed weeds, there has been no significant increase in the distribution of broom, gorse, crack willow and grey willow. In some parts of the upper catchment there has been a noticeable reduction in the extent and density of infestations. Most new distributions of these species recorded during this 2018 survey are most likely due to better survey coverage (including aerial survey) than during the earlier 2013 survey.

Unfortunately, this is not the situation for false tamarisk and stonecrop. False tamarisk has light wind-dispersed seeds which appear to have enabled its rapid spread to new sites in the upper catchment. Earlier infestations have become tall dense stands at a wider range of sites than the damp sandy channels at which it was first recorded. Stonecrop has also established at new distant sites; its spread apparently assisted or its growth encouraged by southern black-backed gulls.

Control of riverbed weeds in the upper Rakaia River catchment since 2013 has been undertaken primarily by Matt Ford Contracting Ltd. Funding from the main agencies has been pooled and then allocated under the supervision of one agency (Liz Gunning, DOC). This formula has worked well. The weed control work appears to have been undertaken competently and thoroughly. And, the pooling of funds has enabled a strategic and cost-effective approach to weed control.

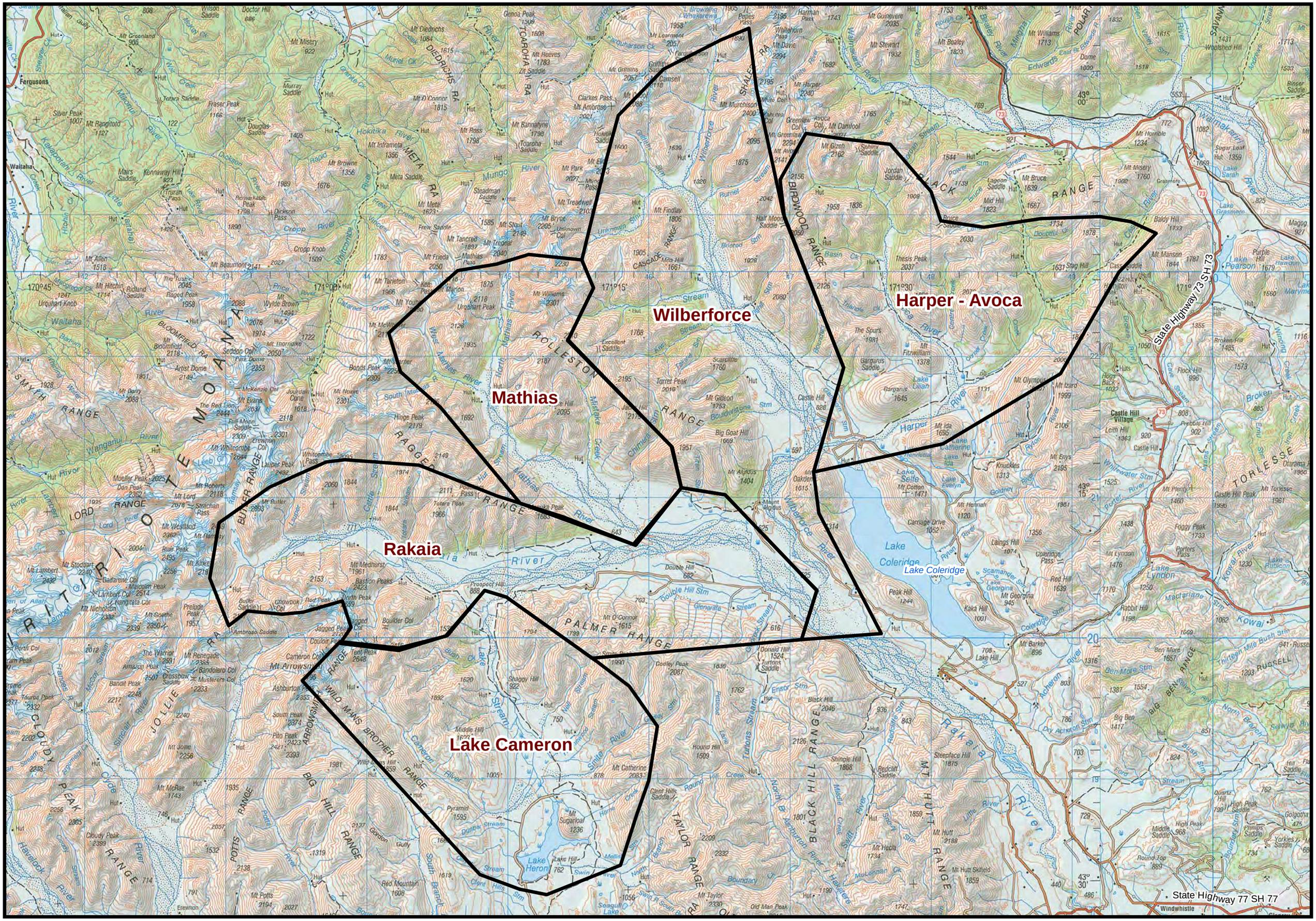
Riverbed weed control in the upper Rakaia River catchment is constrained by the extent of the weed infestations, the ecological success and persistence of the weed species, difficult access and terrain, insufficient funds and, in some locations, lack of complementary weed control on adjacent land. The following actions to address these constraints are recommended.

6.0 RECOMMENDATIONS

1. Continue with the pooled-funding model to help ensure coordinated and efficient allocation of weed-control funds.
2. Continue contracts with existing weed-control operators to help ensure competent and thorough weed control and to benefit from their knowledge of infestation sites.
3. Preferentially allocate funds to ground-based control methods, accompanied by aerial surveillance/wand-control where appropriate, to ensure control is effective and to minimise the risk to non-target species.
4. Continue to place higher priority on those riverbed weed species for which eradication is feasible with present resources, such as Russell lupin.
5. Continue, as a general strategy, to control weed species downriver from the up-valley extent of their distributions.
6. Ensure control sites are revisited within two years to control young plants before they set seed.
7. Liaise with adjacent landholders to ensure that complementary weed control is undertaken on land adjacent to riverbed control sites (especially control that is required by the RPMP).
8. Restrict if possible, and otherwise discourage vehicle use in the upper valleys.

Acknowledgements

A number of people provided important assistance for this survey and review. Frances Schmechel (ECan) coordinated the project; Liz Gunning (DOC) provided comprehensive information about recent weed control and supplied herbicide for control work; Matt Ford provided invaluable information about the location of weed infestations and the history of control; Donna Field provided information about weed infestations, Tom Harding assisted with the field survey work; and landowners/occupiers of the upper Rakaia valley enabled access, the use of huts and tracks, and provided important information about weed infestations: Phillip and Anne Todhunter (Upper Lake Heron), Chas and Deitlin Todhunter (Glenfalloch), Don and Julie Paterson (Manuka Point), Tim and Anna Hutchison (Double Hill), Peter and Chris Angland (Mt Algidus), and Chris and Jo Johns (Glenthorne).



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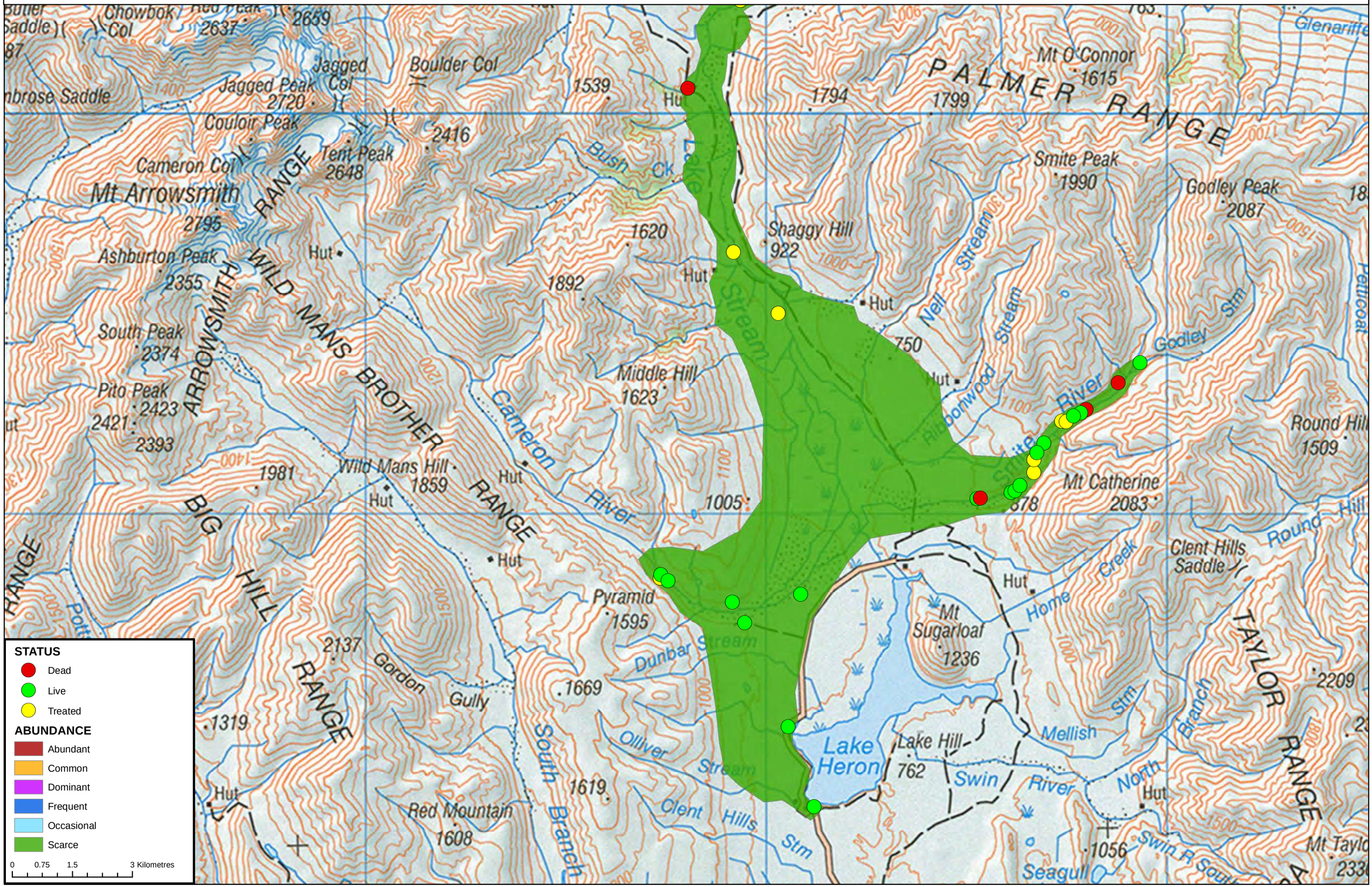
Broom - Lake Stream / Cameron River

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N



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False Tamarisk - Lake Stream / Cameron River

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS
- Dead
- Live
- Treated

ABUNDANCE
- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

Document Path: \\gisdata\Projects\BIO\11242 Upper Rakaia Weed Survey\FalseTamarisk.mxd

Gorse - Lake Stream / Cameron River

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS
- Dead
- Live
- Treated

ABUNDANCE
- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

Document Path: \\gisdata\Projects\BIO\11242 Upper Rakaia Weed Survey\Gorse.mxd

Stonecrop - Lake Stream / Cameron River

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS
- Dead
- Live
- Treated

ABUNDANCE
- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

Document Path: \\gisdata\Projects\BIO\11242 Upper Rakaia Weed Survey\Stonecrop.mxd

Willow Species - Lake Stream / Cameron River

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS
- Dead
- Live
- Treated

ABUNDANCE
- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

Document Path: \\gisdata\Projects\BIO\11242 Upper Rakaia Weed Survey\WillowSpecies.mxd

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Broom - Rakaia

N

STATUS

- Dead
- Live
- Treated

ABUNDANCE

- Abundant
- Common
- Dominant
- Frequent
- Occasional
- Scarce

0 1 2 4 Kilometres

Document Path: \\gisdata\Projects\BIO\11242 Upper Rakaia Weed Survey\Broom.mxd

False Tamarisk - Rakaia

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS

- Dead
- Live
- Treated

ABUNDANCE

- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 1 2 4 Kilometres

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Gorse - Rakaia

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS
- Dead
- Live
- Treated

ABUNDANCE
- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 1 2 4 Kilometres

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Russell Lupin - Rakaia

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS

- Dead
- Live
- Treated

ABUNDANCE

- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 1 2 4 Kilometres

Document Path: \\gisdata\Projects\BIO\11242 Upper Rakaia Weed Survey\RussellLupin.mxd

Stonecrop - Rakaia

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS

- Dead
- Live
- Treated

ABUNDANCE

- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 1 2 4 Kilometres

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Tree Lupin - Rakaia

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS

- Dead
- Live
- Treated

ABUNDANCE

- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 1 2 4 Kilometres

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Willow Species - Rakaia

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS

- Dead
- Live
- Treated

ABUNDANCE

- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 1 2 4 Kilometres

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Broom - Mathias

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS
- Dead
- Live
- Treated

ABUNDANCE
- Abundant
- Common
- Dominant
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

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False Tamarisk - Mathias

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

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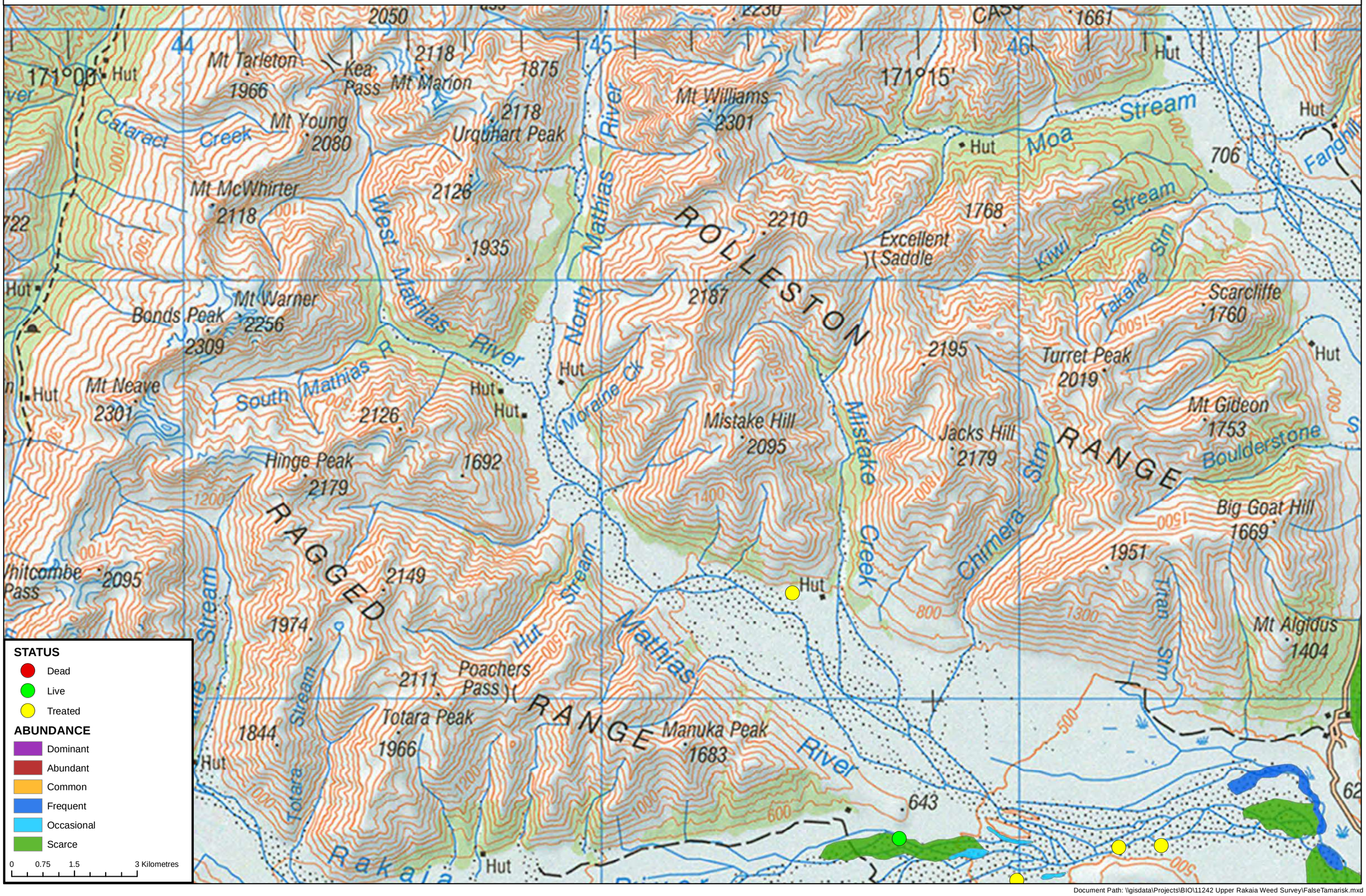

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Gorse - Mathias

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS
- Dead
- Live
- Treated

ABUNDANCE
- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

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Stonecrop - Mathias

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

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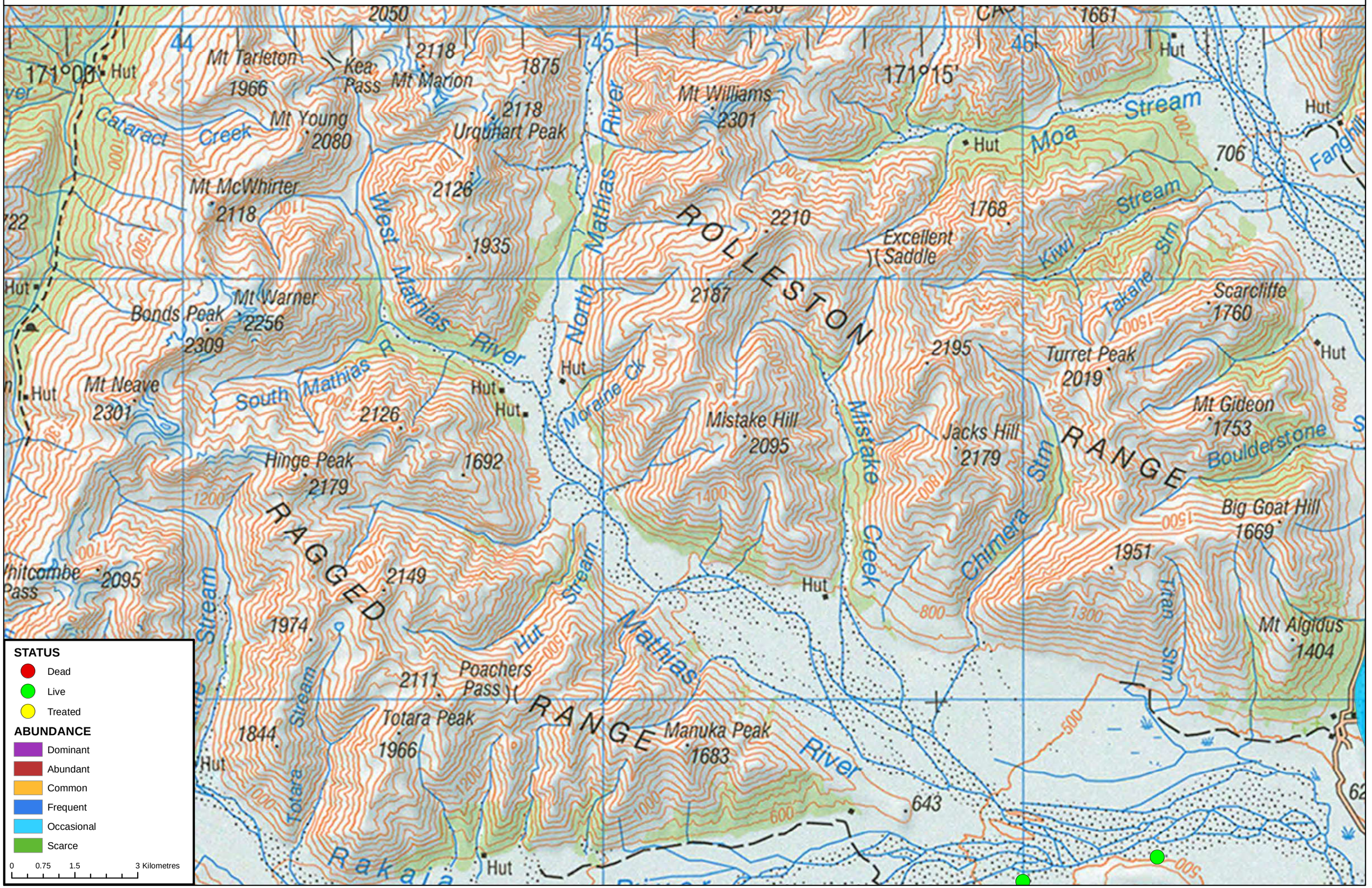

STATUS

- Dead
- Live
- Treated

ABUNDANCE

- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

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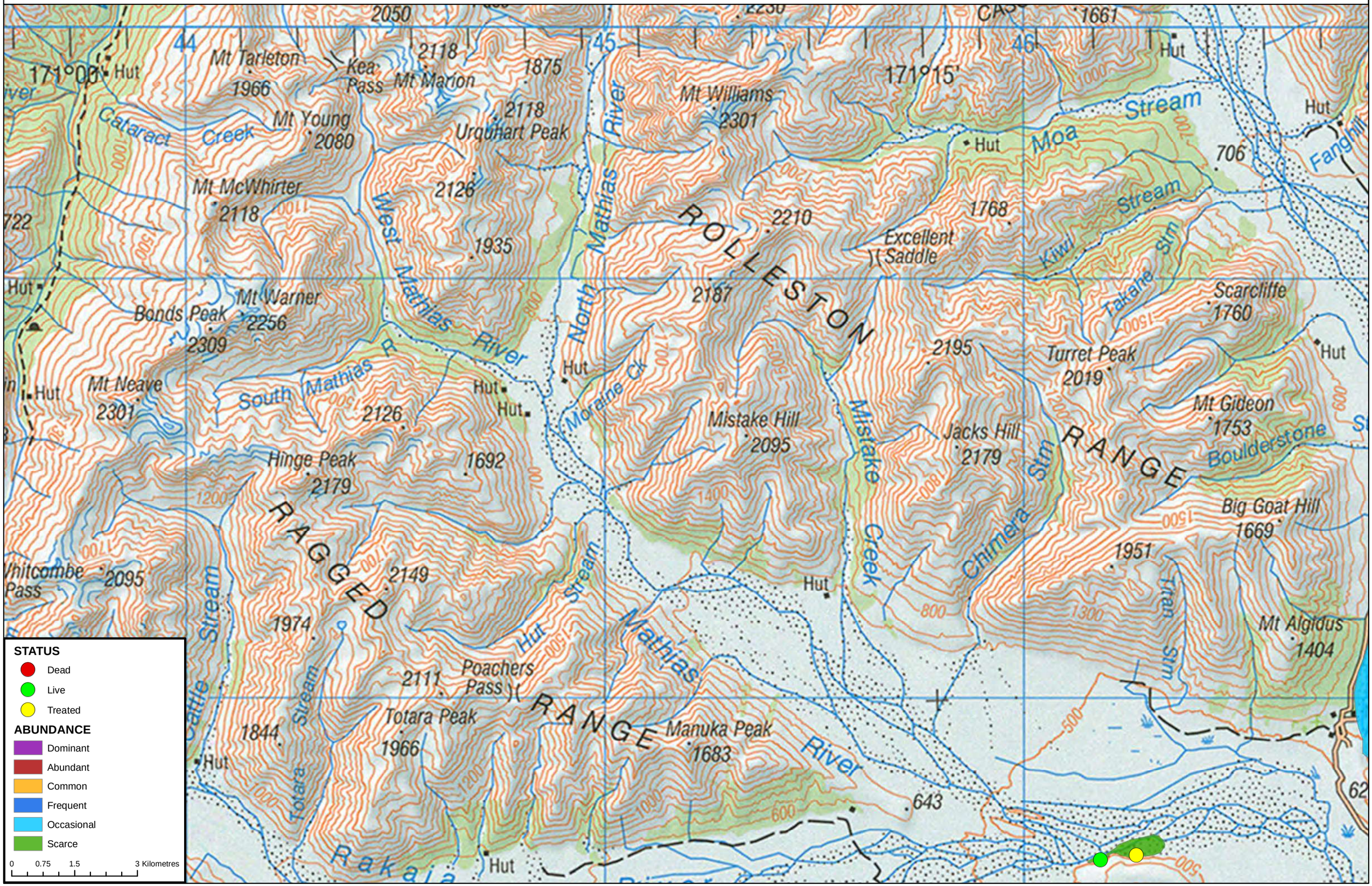
Tree Lupin - Mathias

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N



STATUS

- Dead
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- Treated

ABUNDANCE

- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

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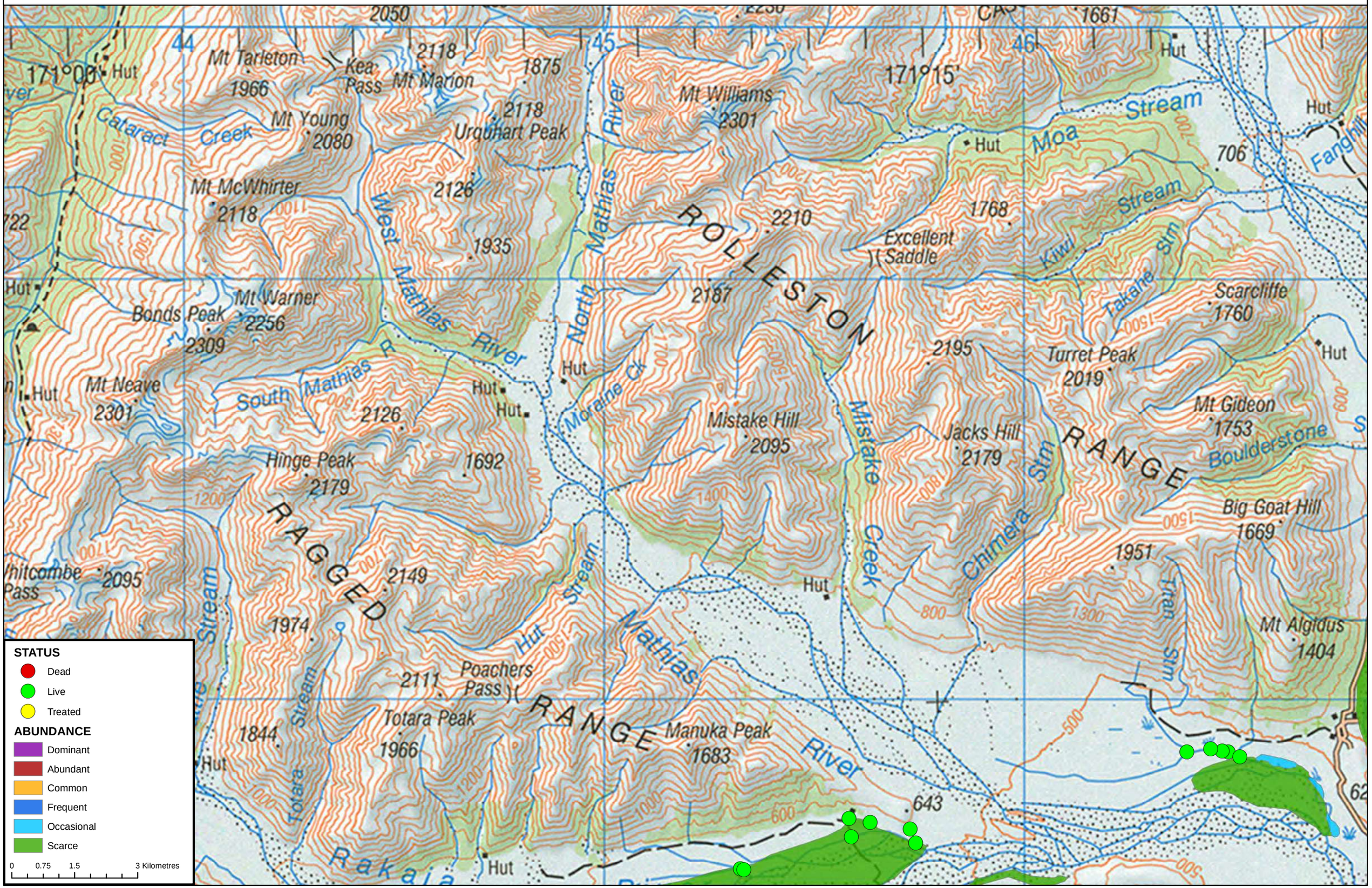
Willow Species - Mathias

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N



STATUS

- Dead
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- Treated

ABUNDANCE

- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

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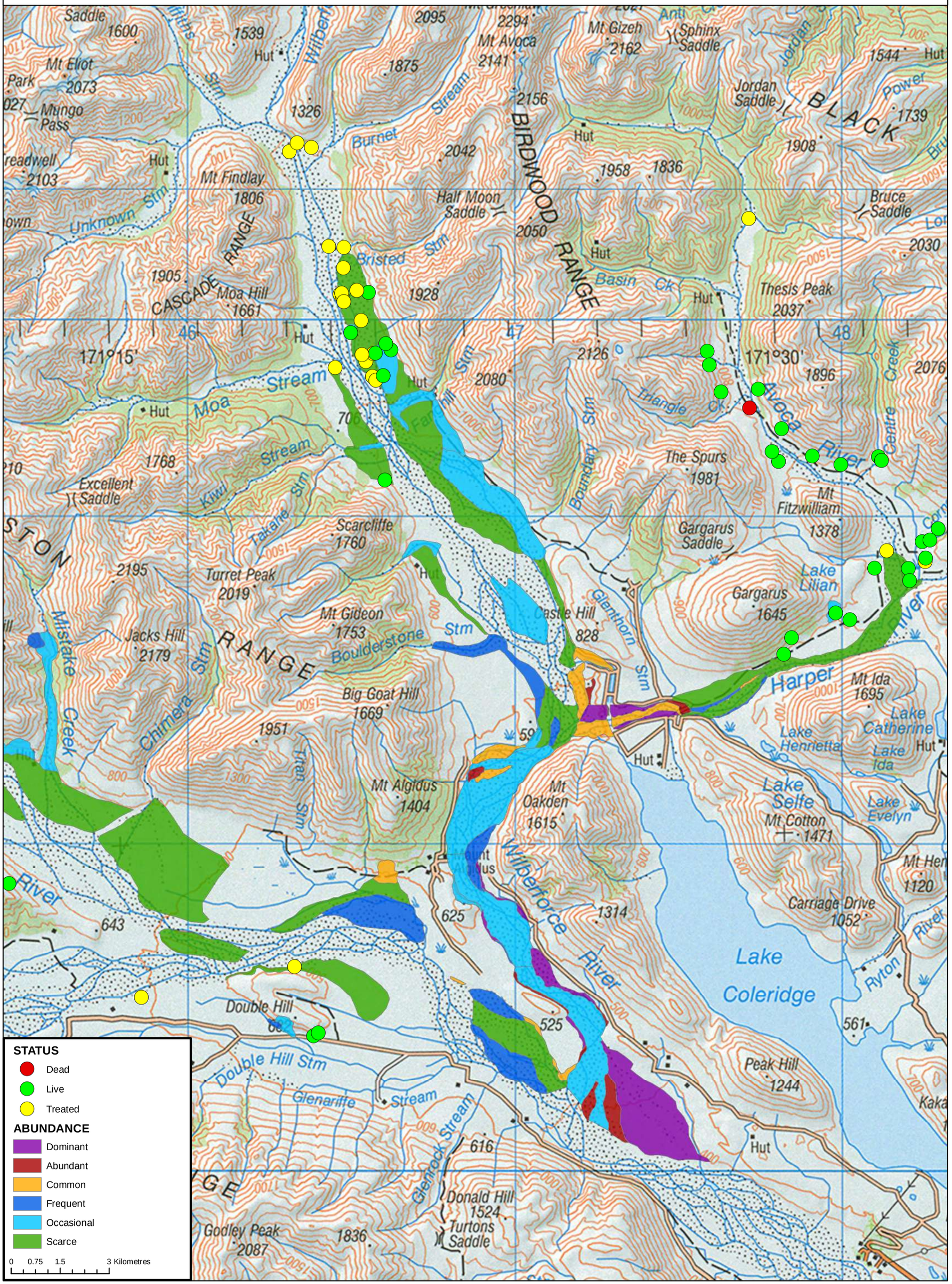
Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Broom - Wilberforce

N



STATUS
- Dead
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- Treated

ABUNDANCE
- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

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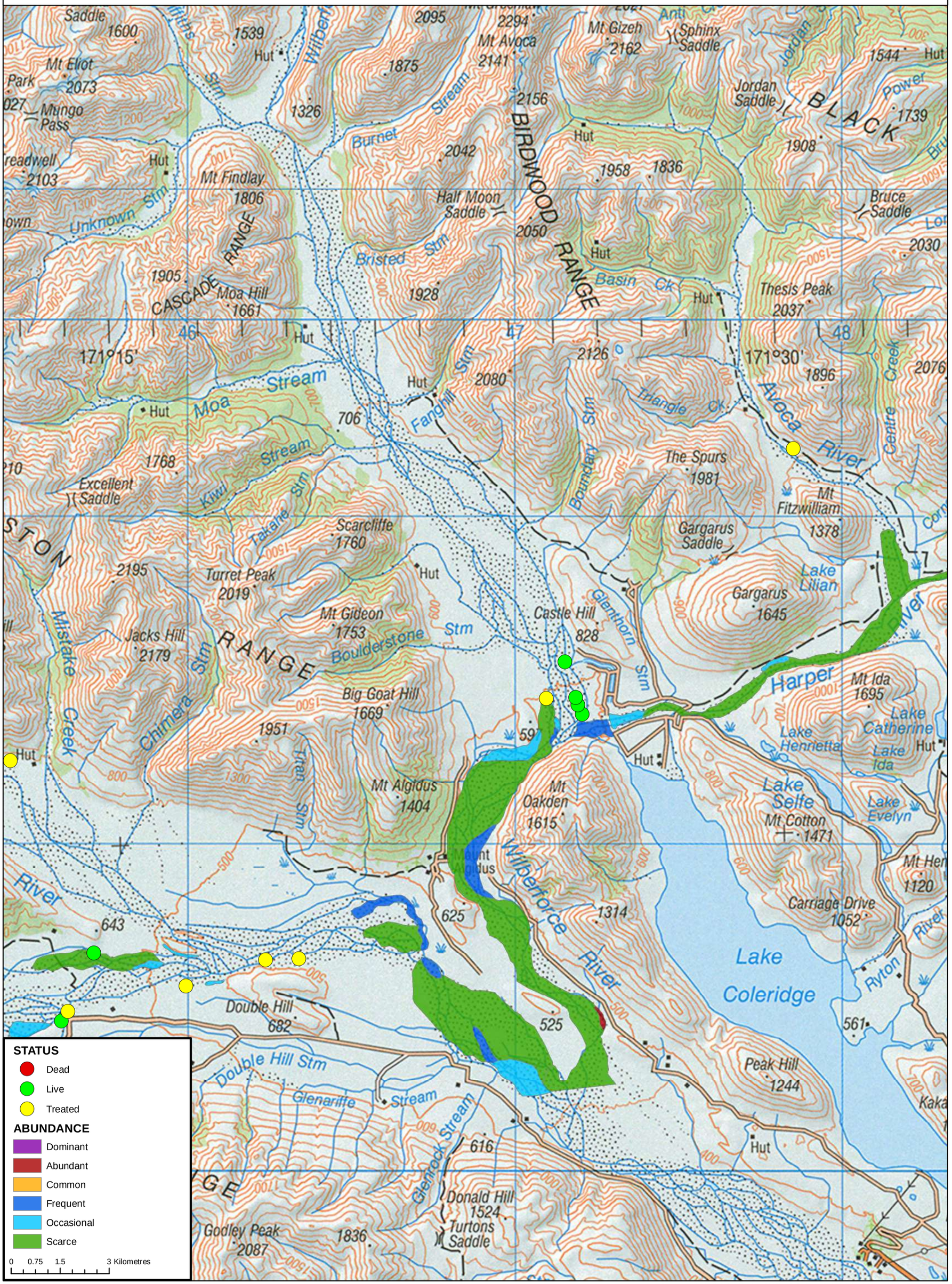
Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

False Tamarisk - Wilberforce

N



STATUS
- Dead
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- Treated

ABUNDANCE
- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

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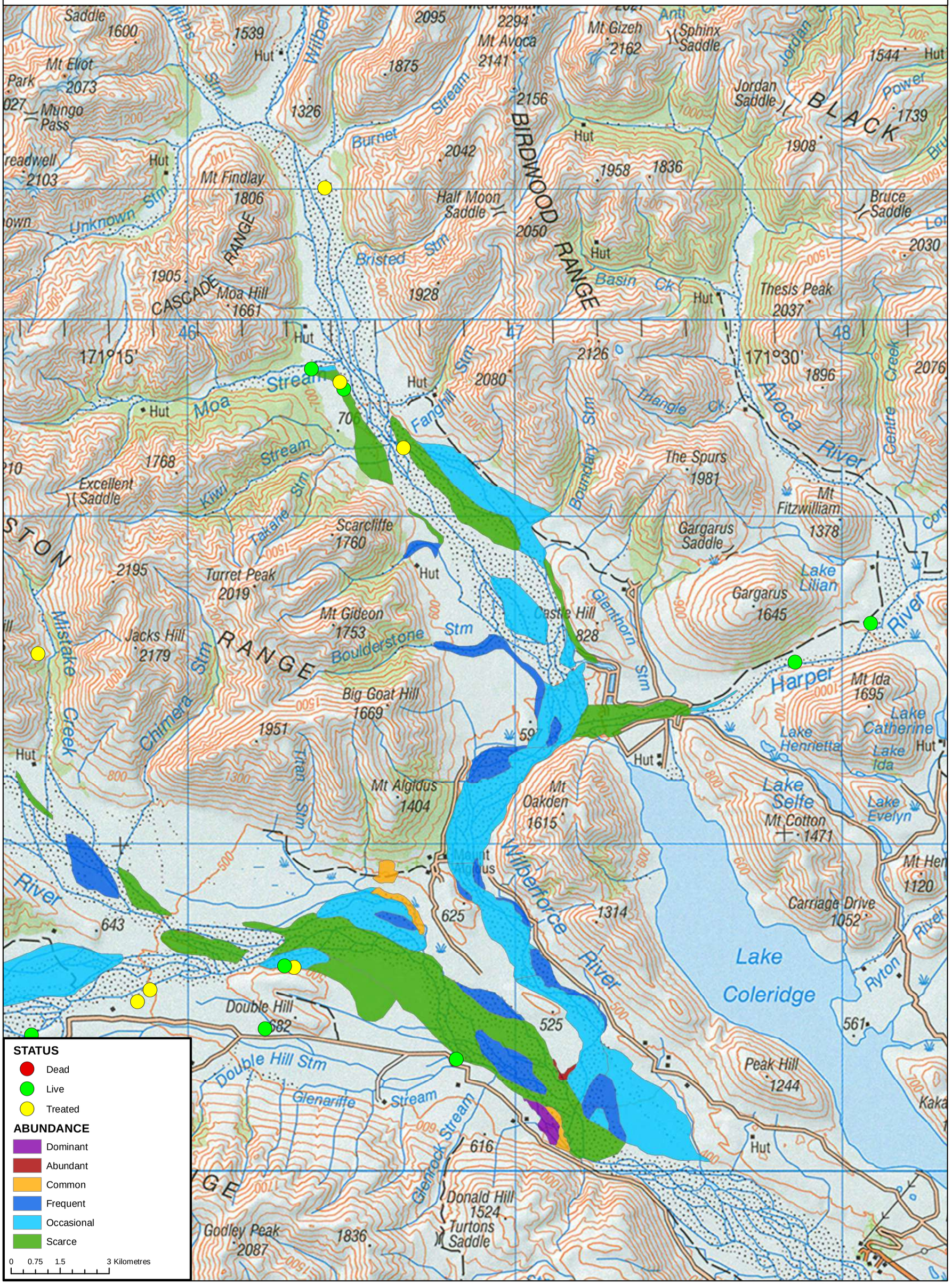
Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Gorse - Wilberforce

N



STATUS

- Dead
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- Treated

ABUNDANCE

- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

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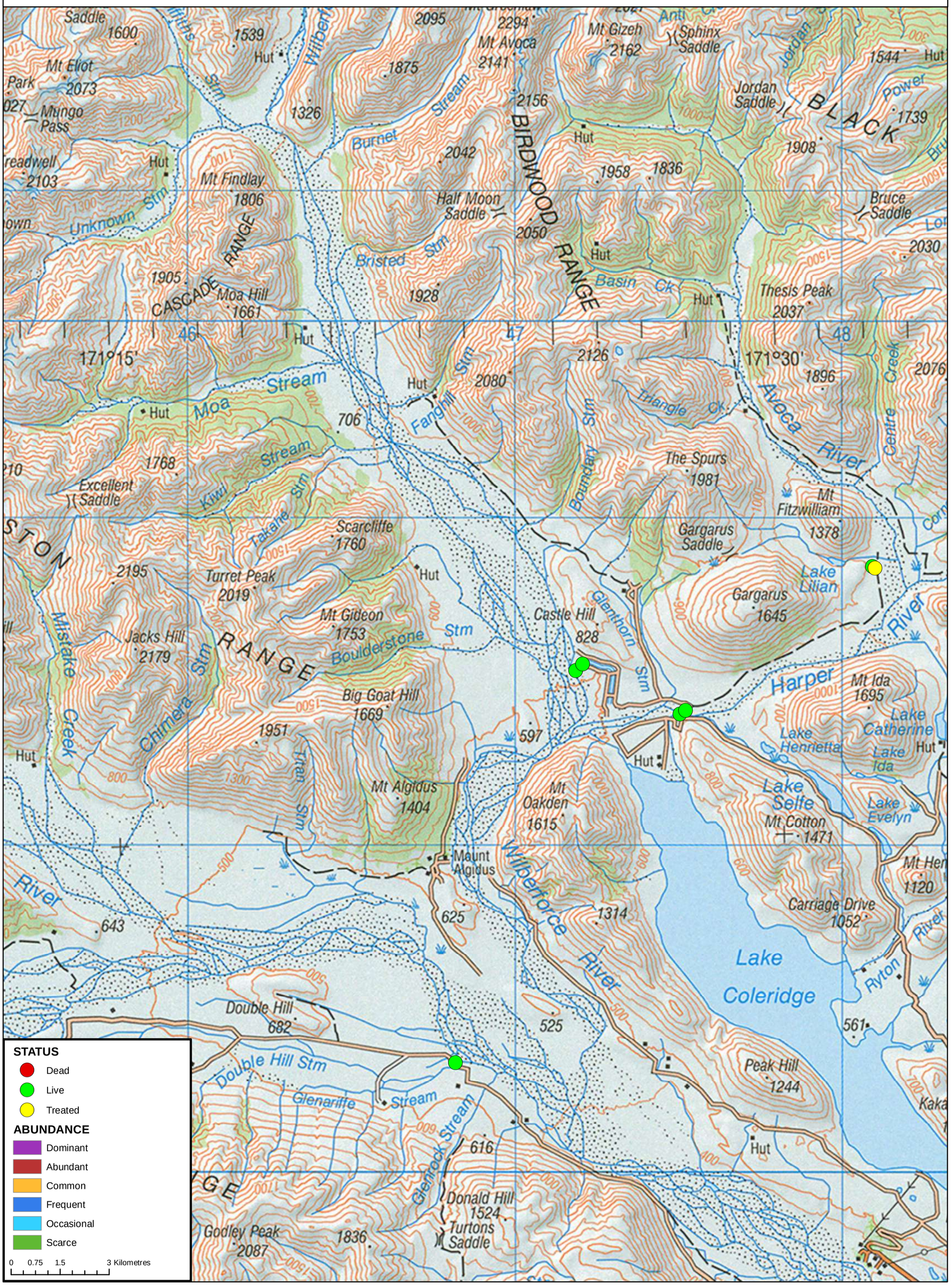
Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Russell Lupin - Wilberforce

N



STATUS

- Dead
- Live
- Treated

ABUNDANCE

- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

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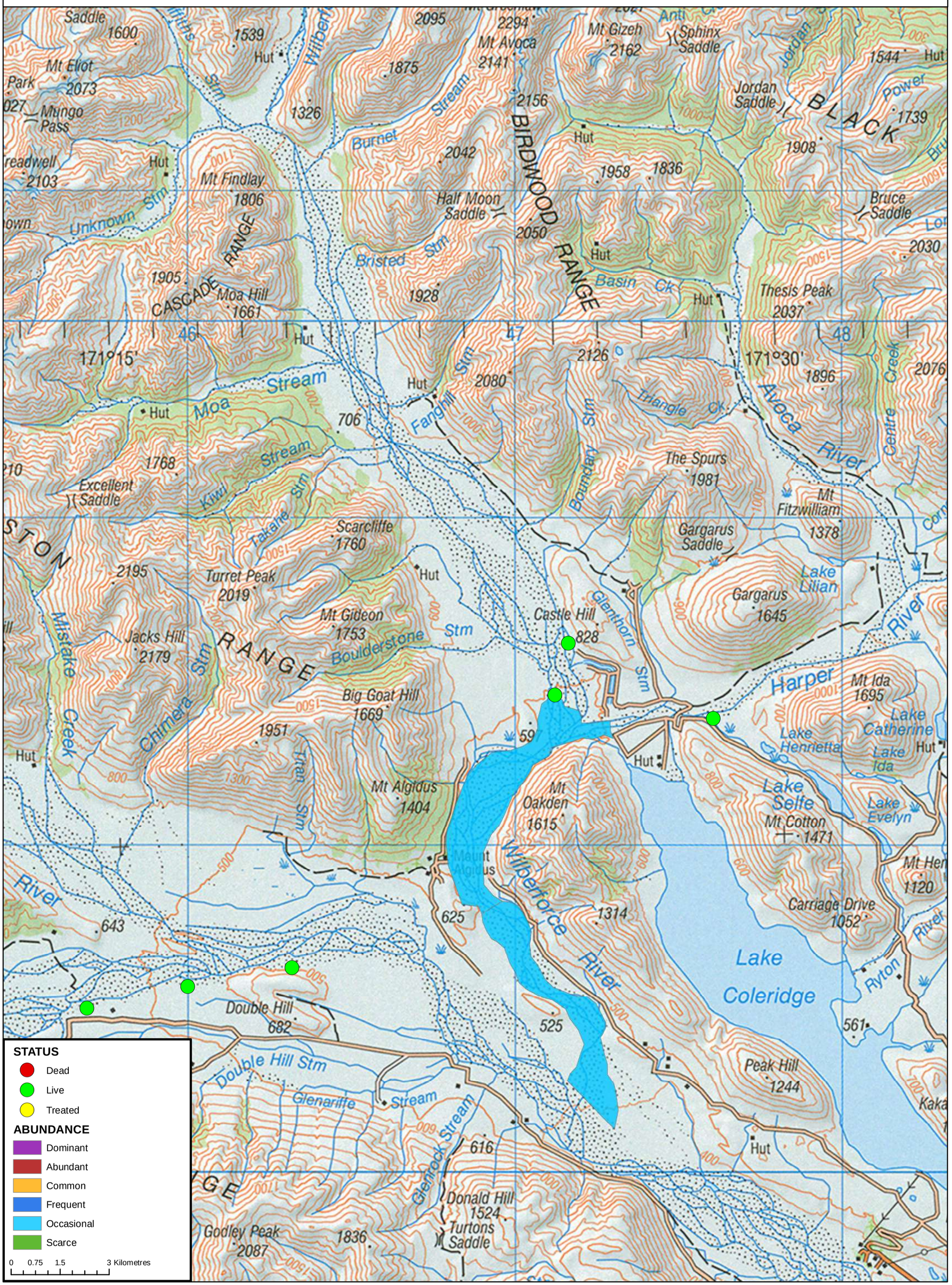
Stonecrop - Wilberforce

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N



STATUS

- Dead
- Live
- Treated

ABUNDANCE

- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

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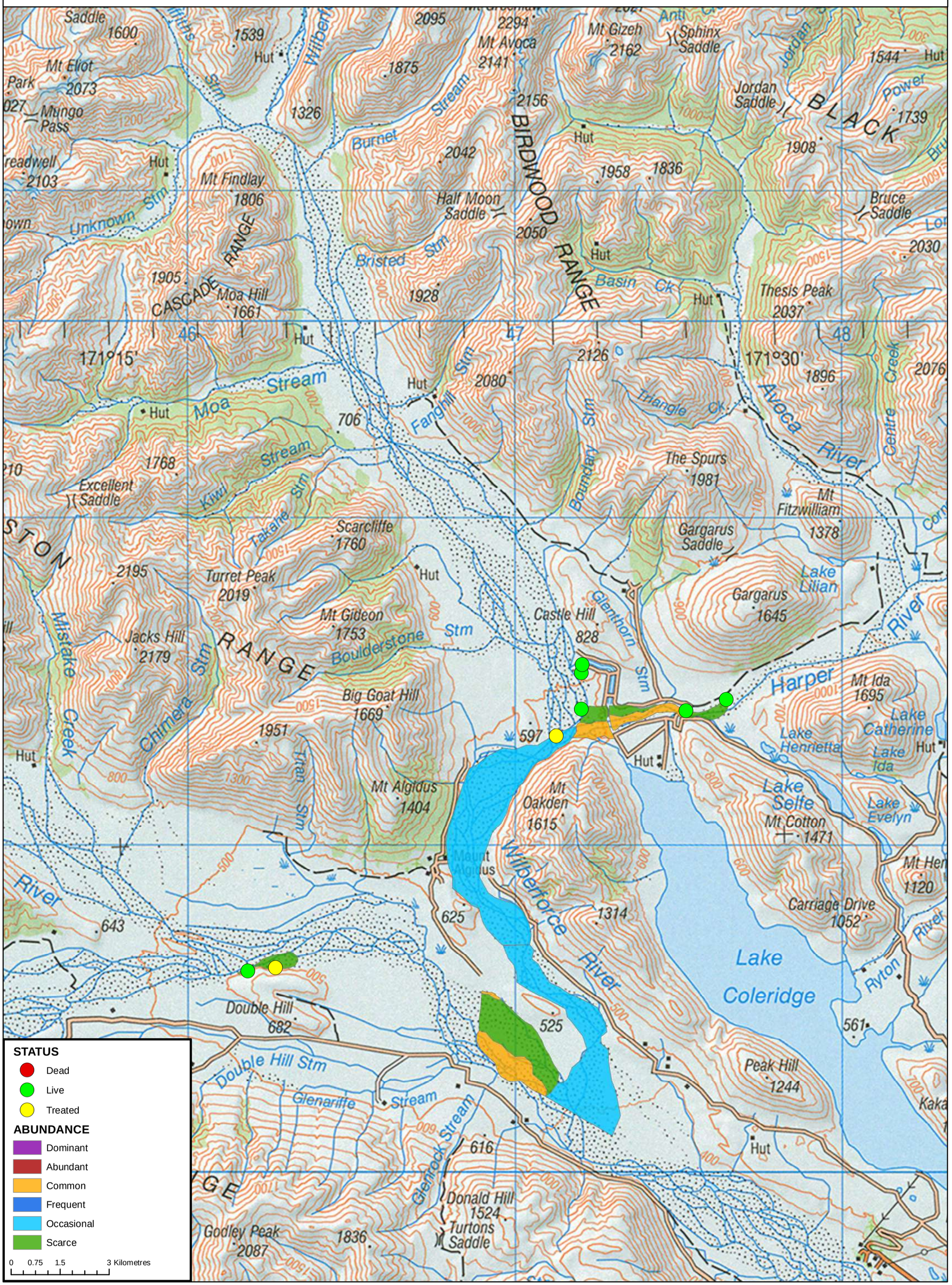
Tree Lupin - Wilberforce

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N



STATUS

- Dead
- Live
- Treated

ABUNDANCE

- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

Willow Species - Wilberforce

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS
- Dead
- Live
- Treated

ABUNDANCE
- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

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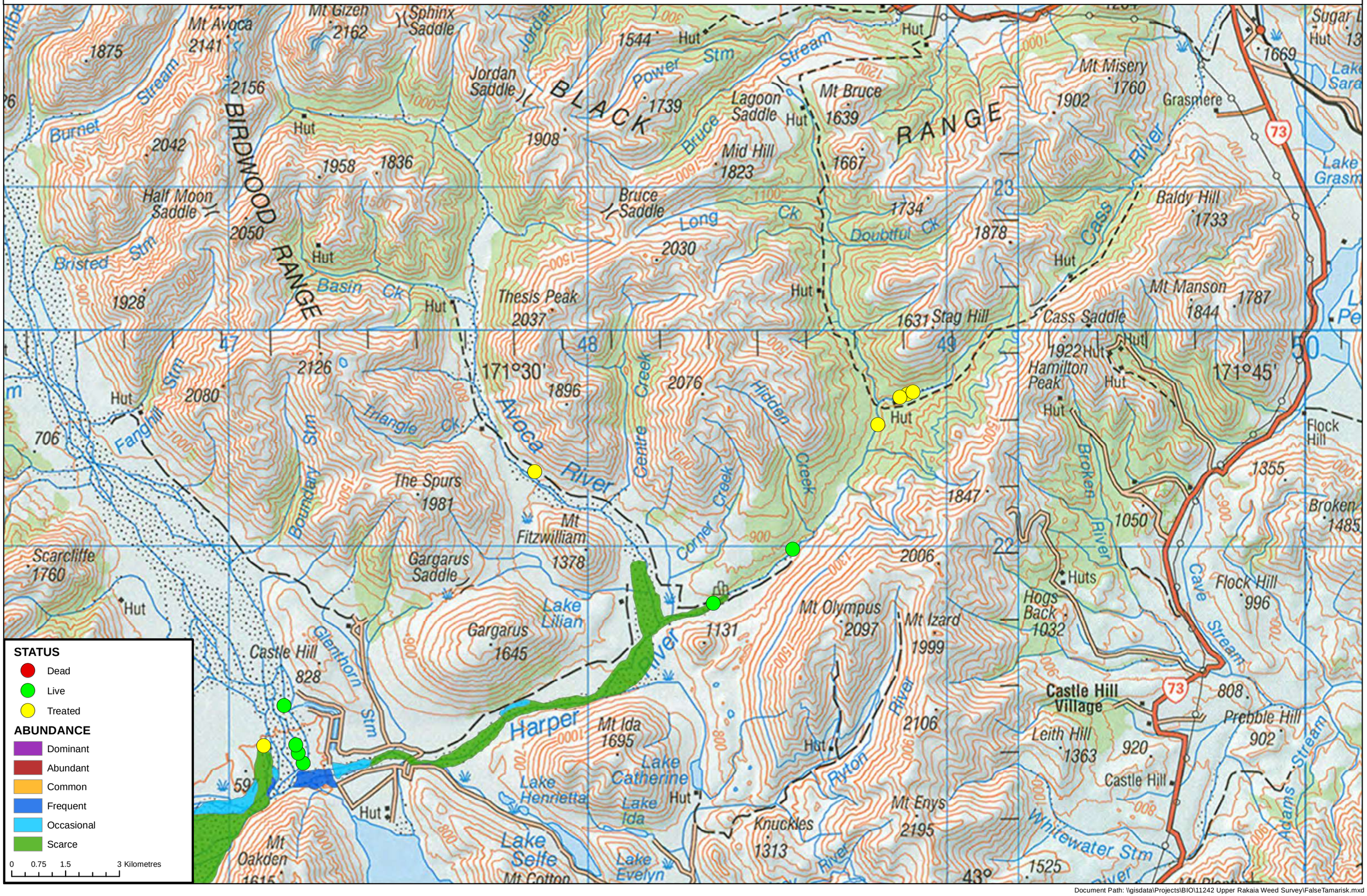
False Tamarisk - Harper River / Avoca River



STATUS

- Dead
- Live
- Treated

ABUNDANCE

- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

Document Path: \\gisdata\Projects\BIO\11242 Upper Rakaia Weed Survey\FalseTamarisk.mxd

Gorse - Harper River / Avoca River

N

STATUS

- Dead
- Live
- Treated

ABUNDANCE

- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

Document Path: \\gisdata\Projects\BIO\11242 Upper Rakaia Weed Survey\Gorse.mxd

Broom - Harper River / Avoca River

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS
- Dead
- Live
- Treated

ABUNDANCE
- Abundant
- Common
- Dominant
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

Document Path: \\gisdata\Projects\BIO\11242 Upper Rakaia Weed Survey\Broom.mxd

Russell Lupin - Harper River / Avoca River

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS
- Dead
- Live
- Treated

ABUNDANCE
- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

Document Path: \\gisdata\Projects\BIO\11242 Upper Rakaia Weed Survey\RussellLupin.mxd

Stonecrop - Harper River / Avoca River

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS
- Dead
- Live
- Treated

ABUNDANCE
- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

Document Path: \\gisdata\Projects\BIO\11242 Upper Rakaia Weed Survey\Stonecrop.mxd

Tree Lupin - Harper River / Avoca River

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS
- Dead
- Live
- Treated

ABUNDANCE
- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

Document Path: \\gisdata\Projects\BIO\11242 Upper Rakaia Weed Survey\TreeLupin.mxd

Willow Species - Harper River / Avoca River

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

N

STATUS

- Dead
- Live
- Treated

ABUNDANCE

- Dominant
- Abundant
- Common
- Frequent
- Occasional
- Scarce

0 0.75 1.5 3 Kilometres

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