

Tiromoana Bush photo-point summary 2005-2023

Emeritus Professor David A. Norton
Biodiversity Solutions Ltd.
12 December 2023

This report updates the 2021 report.

Introduction

In December 2004, eleven panorama photo-points were established at Tiromoana Bush with two additional photo-points established in April 2006 and January 2008. The 2004 photo-points were set up at the start of the restoration project (while livestock were still grazing the property) as it was hoped that they would be able to provide a good visual summary of the changes that occurred over subsequent years because of restoration management. These photo-points provide a broad overview of the Tiromoana Bush landscape and now with 20-years of photo coverage (2004-2023) some of the major land cover changes that are taking place as a result of the restorative management being implemented at Tiromoana Bush are becoming apparent (representative examples are included in Appendix 1). This report summarises these changes and makes recommendations for the future management of the photo-point network.

Methods

A detailed description of the location of each photo-point is included as Appendix 2 to this report and their locations are mapped in Figure 1 for reference.



Figure 1. Photo-point locations and the Tiromoana Bush walkway (blue dotted line).

From each photo-point, an overlapping set of panoramic photos (comprising 3-12 individual images) has been taken in late December/early January each summer, excepting 2010, 2012 and 2022. All the images have been individually labelled and stored on the Transwaste Canterbury Ltd. computer system (the list of folders is included here as Appendix 3). For referencing purposes, the year of the photos is given as the December year of the summer the photo was taken (so an image taken in January 2017 is referenced as 2016).

Land cover changes 2004-2023

While all the images show changes, many of the images show similar patterns of change and the following notes highlight the main changes that are occurring. Reference is made to photo-pairs included in Appendix 1 and just focus on the overall change from 2004 to 2023. The 2004 images were taken on December 14 while the 2023 images were taken on November 27.

Thick grass sward (PPs 1b, 6d, 13e): The presence of a thick tall grass sward dominated by cocksfoot (*Dactylis glomerata*) across pasture areas. This was an inevitable consequence of removing livestock and while this thick grass sward does present challenges for woody species regeneration (due to competition), the evidence below highlights that woody regeneration is occurring, and this grass sward is a transitional stage to native forest.

Increase in native woody cover: A general increase in native woody cover is apparent right across Tiromoana Bush. Three main pathways of woody expansion appear to be occurring:

- Existing native plants growing in open sites, especially kanuka (*Kunzea robusta*), have become taller and have a greater canopy cover and in many places are starting to coalesce to form continuous cover canopies (PPs 8b, 9g, 11e).
- A similar process is evident in many areas of grey shrubland where matagouri (*Discaria toumatou*), mingimingi (*Coprosma propinqua*) and mākaka (native broom; *Carmichaelia australis*) are increasing in stature and stands thickening up (PPs 10c, 12b, 13b).
- The third pathway and perhaps the most widespread is the infilling of gaps and marginal expansion of a variety of native woody species within existing shrubland and regenerating forest areas which is resulting in a steady expansion of native woody vegetation at the expense of pasture (virtually all photo-points comparisons!).

While the increase in woody vegetation has not been quantified, it would seem likely that this is of the order of 10-20% across the whole site (although some of this expansion might also include gorse, *Ulex europaeus* – see below).

Increase in exotic woody cover (PPs 1b, 3b, 8b, 11e): In parallel to the expansion of native woody vegetation, gorse has become locally dominant in several areas as it readily invades the exotic grass sward. European broom (*Cytisus scoparius*) behaves in a similar way but is less widespread. The decision at the outset of the Tiromoana Bush project to allow gorse expansion was made because gorse acts as a nurse for subsequent forest regeneration and there is increasing evidence of native woody species coming through older gorse areas (see below).

Changes in woody vegetation composition: In areas where grey-shrub species were abundant (especially matagouri and mingimingi), mahoe (*Meliccytus ramiflorus*) is becoming a lot more dominant signifying a shift from shrubland towards forest. A similar pattern can be seen in some older patches of gorse where plants like kōhūhū (*Pittosporum tenuifolium*) and pohuehue (*Muehlenbeckia australis*) appear to be establishing into or growing up through the gorse (no specific examples included in Appendix 1 but these changes are apparent).

Restoration plantings (PPs 3b, 3c, 9e, 9f, 9g, 12b, 12c, 12d, 12e): The substantial areas of restoration plantings we have established over the last 20 years are now forming new forest in several areas of Tiromoana Bush, especially on the valley slopes around the Kate Valley flats and Kate Pond, and in the coastal section of Kate Stream. Many of these plantings are now well over 5 m tall and some subsequent regeneration is occurring under them (although not apparent in these photos).

Decrease in pasture cover: In response to the increases in woody cover (native and exotic regeneration and plantings) described above, the area of pasture across Tiromoana Bush has shown a marked decline over the last 20 years. This is clear across all of the photos.

Wetland expansion (PPs 12b, 12c): Kate Pond was formed in 2005 and initially had a fringe of rushes. However, raupō (*Typha orientalis*) has since established and expanded around the wetland. This species was present prior to restoration in the small pond to the north (PP 12d, 12e) and has naturally invaded Kate Pond. If Kate Pond was to silt up, then raupō would eventually dominate the whole pond. Interestingly Ella Pond has hardly changed over the life of the project, although it has nearly dried up in some years (e.g. 2007 – photo taken in January 2008)

Pig damage: While most impacts of deer and pigs are not visible in these photos, as they are generally at too small a spatial scale, pig impacted raupō in the wetland apparent in PPs 12c, 12d, 12e in 2020. Pigs were presumably feeding on the succulent rhizomes and shoot bases, but after the major knock down of pig numbers in 2021, these raupō stands have recovered.

Loss of native species (PPs 4a, 6d, 11e): A few native species are being lost from Tiromoana Bush with the most obvious example being silver tussock (*Poa cita*), and presumably other native grassland species. These are being outcompeted by the dense grass sward. This loss is an expected result of the succession to woody vegetation. The weedy nassella tussock, *Nassella trichotoma*, is also being lost through this process.

Erosion (PPs 6d, 9f, 12c): A major storm event in winter 2008 resulted in the formation of a small delta where Kate Stream enters Kate Pond. This appears to have stabilised since then, although the pond itself has continued to be turbid either because of sediment that was deposited into the pond by this storm or because of fresh sediment still eroding into the pond (perhaps out of the delta). Several erosion scars evident in the 2004 photos have now largely healed up, while on going erosion (slips) are apparent especially in the coastal section of Kate Stream, although erosion appears to be less where native woody vegetation has established into previously pasture areas.

Infrastructure and plantation: The final set of changes are the obvious expansion of plantation forest on the hills surrounding Tiromoana Bush and the recovery of the land around the water supply dam that was disturbed during its construction.

Recommendations on future management of the photo-points

- These photo-points are an invaluable record of changing land cover and should be continued annually or every two years, making sure that they are done as close to the end of December as possible.
- Some sites (e.g. PP4, PP6) will require management of adjacent vegetation to maintain the views, although PP2 is beyond recovery now and has been abandoned.

- The photo-point comparisons have considerable potential to be used in promotional material about the Tiromoana Bush project.

Appendix 1: Seventeen representative photo-pairs.

PP1b (2004-2023)



PP01b



This image shows marked expansion of woody vegetation on the hillslope in the middle distance (and plantation forest beyond) and the expansion of gorse in the foreground. Also note the removal of old-man radiata pine that are present in 2004, and the dense cocksfoot in the front of the 2023 image. The expansion of the landfill is also very evident.

PP3b (2004-2023)



PP 03b



This image shows several areas of restoration plantings (slopes in foreground, valley flats and up enclave into kānuka opposite) and expansion of native woody vegetation (especially on the hill slopes on the right above the track). Some gorse expansion can also be seen in the grassy corridor through the kānuka on the left.

PP3c (2004-2021)



This image shows the establishment of Kate Pond (2005), restoration plantings on the near shore of the pond and up the valley beyond and left of the pond, and the general thickening of woody vegetation cover (mainly native) on slopes below the hill with the line of pine trees.

PP4a (2004-2023)



PP 04a



Obvious expansion of woody vegetation on the hillslope in the middle distance (left of the new pine plantation) and the expansion of gorse on the grassy slopes in the middle of the image. Also note the removal of two old-man radiata on the hill with the woody regeneration, but establishment of more pines subsequently. Mānuka in the foreground likely to need cutting to maintain this viewpoint. Silver tussock in 2004 foreground have gone.

PP6d (2004-2023)



PP 06d



This image again shows the marked expansion of woody vegetation across hillslopes over this image. Interesting that many erosion scars visible in 2004 are not visible in 2023. Also note how the dense cocksfoot in the foreground has smothered a silver tussock and is blocking out the view but broadleaf (and European broom) are regenerating in this.

PP8b (2004-2023)



PP 08b



This image shows marked expansion of woody vegetation on the hillslope with a general increase in the size of kānuka, infilling of gaps and expansion outwards from edges – both native woody species and gorse are involved in this.

PP9e (2004-2023)



PP 09e



This image shows really good growth of restoration plantings and natural regeneration on the hill slopes, but note the wilding pines establishing from the old shelter belt.

PP9f (2004-2023)



This image shows really good growth of restoration plantings both on the valley floor and on the slopes to the right, as well as foreground regeneration. The image also shows the ongoing erosion that is a feature of the coastal section of Kate Stream and wilding pinus.

PP9g (2004-2023)



This image is immediately to the right of the previous image and again shows really good growth of restoration plantings on the valley floor and on the hill slopes on the left. Whauwhaupaku five-finger and māhoe in the foreground have also increased in size.

PP10c (2004-2023)



PP 10c



General woody expansion on the far hillslopes and infilling of gaps on the near hill slope are both clearly evident. Expansion of woody vegetation, including mahoe, and loss of silver tussocks to the dense grass sward can be seen downslope from the photo point.

PP11e (2004-2023)



PP 11e



This image shows an increase in stature and infilling of kānuka plants on the far hill side above the continuous kānuka forest (very dry north facing). Also, marked gorse expansion on the south facing hillslope in the middle of the image. Development of the dense grass sward is also clearly evident and silver tussock plants have again been lost.

PP12b (2005-2023)



PP 12b



This image shows the success of restoration plantings around Kate Pond and the expansion of woody regeneration on the hill slopes beyond. The wetland marginal vegetation on the far side of the pond is planted, but raupo is establishing against the weir/picnic area. The 2005 image was taken in April 2006 and was clearly a very dry summer.

PP12c (2005-2023)



PP 12c



This image shows the delta that has formed where the creek drains into Kate Pond. The actively spreading raupo around the lake margin is also evident.

PP12d (2005-2023)



PP 12d



This image shows quite a big change in the right-hand wetland, where pigs damaged the raupo back in 2020 – it has since recovered with a higher purei component now. Restoration plantings on the right and infilling/expansion of predominantly native vegetation on the hillsides behind the restoration planting are clear, while the woody vegetation on the spur below the photo-point has shifted from matagouri and mingimingi to broadleaved species.

PP12e (2005-2023)



PP 12e



Similar to the last image and really highlights the restoration plantings up the valley and the good infilling/expansion of predominantly native vegetation on the hillsides to the left and right of the restoration plantings.

PP13b (2007-2023)



PP 13b



This image shows strong native woody regeneration on far hill side and thickening up of native shrubs including native broom on steep slopes in foreground. The 2007 image was taken in January 2008 and was clearly a dry summer.

PP13e (2007-2023)



PP 13e



This image shows strong woody regeneration (gorse to left) on hill sides and the marked rank grass sward that has formed across previously pasture areas (mown track in the foreground indicates how dense this grass sward has become). Some new slips are evident on the hillslope in the middle.

Appendix 2: Tiromoana Bush landscape photo-points: locations and methods (updated 12 December 2023).

Background

The Tiromoana Bush permanent photo-points were established on 14 December 2004, with two additional photo-points added in 2005 and 2007. The full set of 13 photo-points have been re-photographed annually, except for 2010, 2012 and 2022. This report explains the location of the photo-points and the process used in taking the photographs.

Location

There are 13 photo-points located at different vantage points around Tiromoana Bush. Most are marked with a metal standard in the ground. The location of the photo-points is marked on Figure 1 and the GPS coordinates are given in Table 1. However, because of growth of exotic plantation trees, Photo-point 2 has not been rephotographed since 2020. The following notes provide more detailed information on locating individual photo-points.



Figure 1. Permanent photo-point locations, Tiromoana Bush.

Table 1. Photo-point coordinates (NZ Map Grid).

Code	Easting	Northing
1	2497055	5788896
2	2497996	5789497
3	2498316	5789701
4	2497278	5790335
5	2498185	5789993
6	2498936	5790558
7	2499360	5789964
8	2499481	5789360
9	2499816	5789275
10	2499084	5789533
11	2498526	5789560
12	2498419	5790183
13	2498877	5790008

General notes on taking photos

Ensuring the photographs are repeated at the same time of the year and covering the same angles can greatly increase their value as a monitoring tool. All photographs have been taken using digital cameras with a variable focal length lens (various camera models have been used),. Photographs are taken as close to the end of December as possible – this is the best time of year for these as it is past the spring growth flush but before summer moisture deficits result in marked drying out of the vegetation.

From each photo-point, an overlapping set of panoramic photos (comprising 3-12 individual images) has been taken. Photographs are taken with the camera held directly above the metal standard (but not resting on it). In taking photographs it is important that a copy of the original (2004) photos is used as a guide to ensure that each photo covers the same view (a variable focal length lens is helpful for this). Failure to do this can reduce the comparability of photographs between years. Use the horizon (e.g. hills) and prominent vegetation features as guides to ensure that photos cover the same scene each year (but be aware that some features change – e.g., the felling of pine trees or growth of kānuka).

It is also important to be aware of sun angles, with some photo-points best not photographed early in the morning (PP4) or late in the day (PP1 and 2). While a 4x4 vehicle was used in the earlier years to get around the photo-points, the amount of regrowth means that access is now just as easily done on foot utilising the walking track. However, to save time, access to PP1 is best done by 4x4 vehicle using farm tracks to the water tank on the hill south of this site. Photographing the photo-points usually takes about 6 hours.

All the images have been individually labelled and stored on the Transwaste Canterbury Ltd. computer system. For referencing purposes, the year of the photos is given as the December year of the summer the photo was taken (so an image taken in January 2017 is referenced as 2016).

Detailed location information

Photo-point 1: This site is accessed from the Ella Peak ridge track running inside the deer fence. Leave vehicle adjacent to the deer fence (near the water tank) then walk downhill (north) through the plantation (*ca.* 110 m) and cross the fence into Tiromoana Bush at the point where the fence does a sharp bend. Continue for *ca.* 150 m due north down the main spur until you reach the metal standard (Figure 2).

Eight photos are taken from here forming a complete 180° panorama scanning in a clockwise direction.



Figure 2. Access route to Photo-Point 1 (yellow line is deer fence, red dotted line is access to photo-points, blue lines are walkway, and black dotted line is 4x4 track).

Photo-point 2: This site has become increasingly difficult to re-photograph because of pine tree growth and was abandoned after 2020 as the pine trees were completely blocking the view. For reference the access notes are as follows:

This site has traditionally been accessed from the stock water pond *ca.* 200 m northeast from Ella Peak. From here it is possible to walk down the spur following the old fence-line heading north-northeast for *ca.* 400 m to the metal standard (Figure 3). However, in the last couple of years it was photographed access involved walking up from the deer fence gate just below the water supply dam (see purple line on Figure 3).

Five photos are taken from here facing north and panning clockwise from northwest to northeast across Kate Valley.



Figure 3. Access route to Photo-point 2.

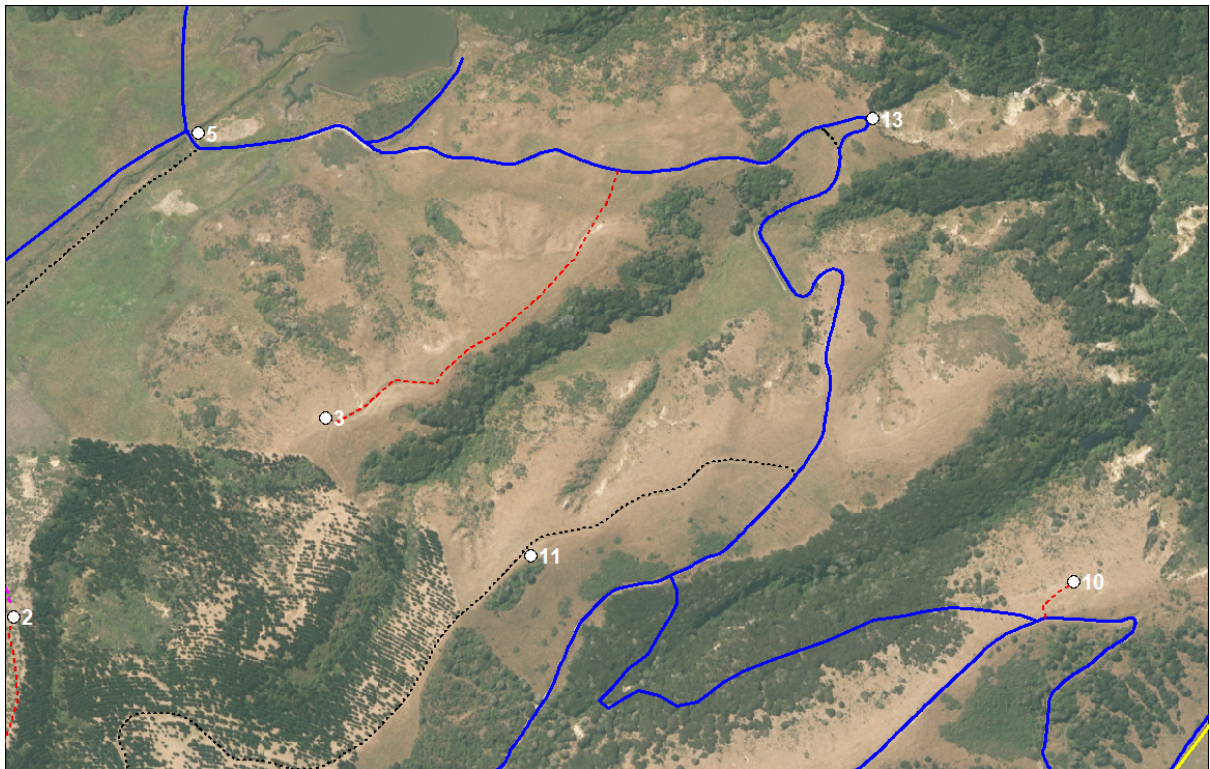


Figure 4. Access route to Photo-points 3, 10, 11 and 13.

Photo-point 3: This site is located adjacent to an old over-grown farm track that heads down from Ella Peak towards the walkway above Kate Pond. This track is not maintained and

cannot be followed through the pines and the photo-point is best accessed by walking up *ca.* 450 m from the walkway (Figure 4). The photo-point is marked by a metal standard and is located immediately north and down slope from the track.

Five photos are taken from here facing north and panning clockwise from northwest to northeast across Kate Valley.

Photo-point 4: This site is reached from the Te Ara Tawhai section of the walkway and is located on the ridge just above this (Figure 5).

Three photos are taken from here looking south to Remnant B and then panning anticlockwise around to the southeast. Some cutting of mānuka is likely to be required in the future to maintain this view.



Figure 5. Access route to Photo-point 4.

Photo-point 5: This site is located adjacent to where the walkway crosses Kate Stream above Kate Pond (Figure 4). The metal standard has been lost but was located on the southeast side of the stream at the bridge. Photos have been generally taken by standing on the back of a 4x4 vehicle which is backed in close to the creek and bridge.

Nine photos are taken from here forming a complete 180° panorama around Kate Valley scanning in a clockwise direction.

Photo-point 6: This site is located on the ridge on the northern side of Tiromoana Bush overlooking Ella Pond (Figure 6). The metal standard is located on the inside of the deer fence which needs to be climbed to access it.

Five photos are taken from here facing southwest and panning anticlockwise from west (along the ridgeline) to southeast (down Kate Valley to the ocean).

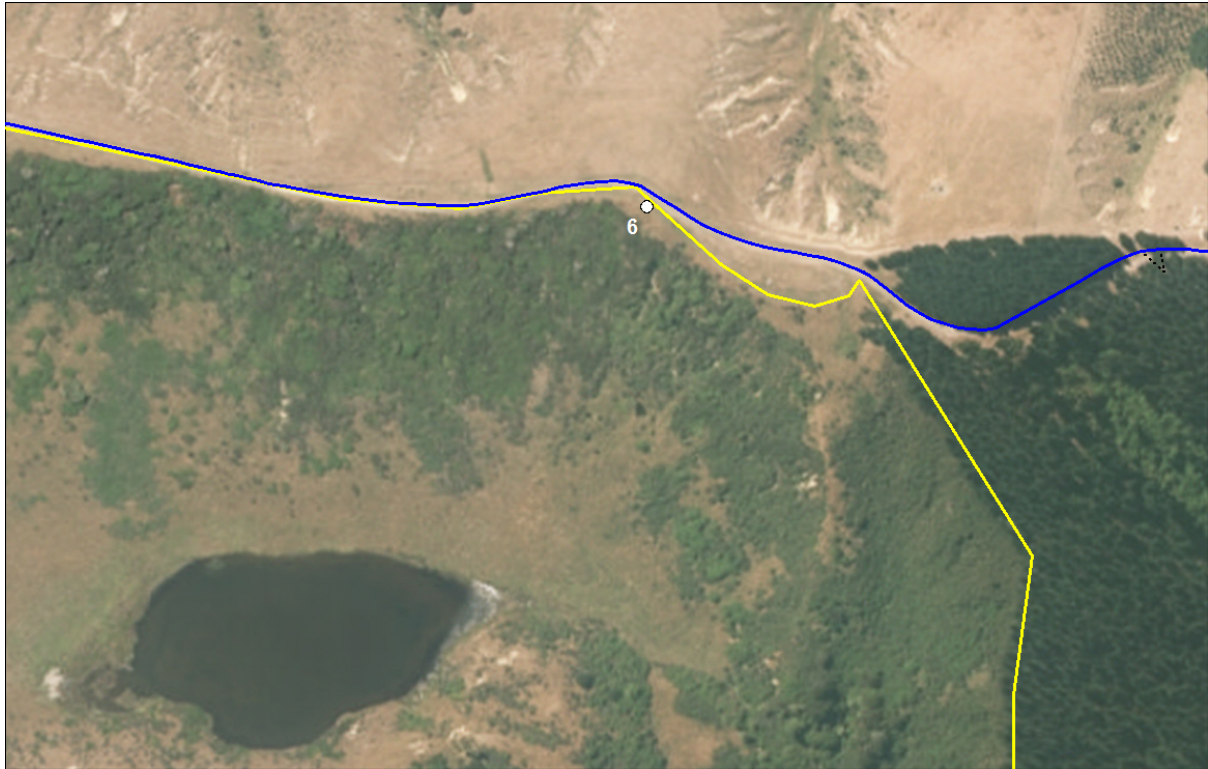


Figure 6. Access route to Photo-point 6.

Photo-point 7: This site is west of the top of the prominent hill (Pt 162) on the eastern side of Tiromoana Bush. Access is by foot through the deer fence gate adjacent to the pine plantation, heading south up the broad spur towards the hilltop and then west following old sheep/cattle tracks across to the metal standard (ca. 300 m; Figure 7).

Ten photos are taken from here forming a complete 180° panorama scanning in an anticlockwise direction.

Photo-point 8: This site is located at the gate adjacent to the deer fence where the farm track enters the paddocks to the west (Figure 8). The photo-point is located by standing on the fence post (there is no metal standard).

Seven photos are taken from here facing north and panning clockwise from southwest to southeast.

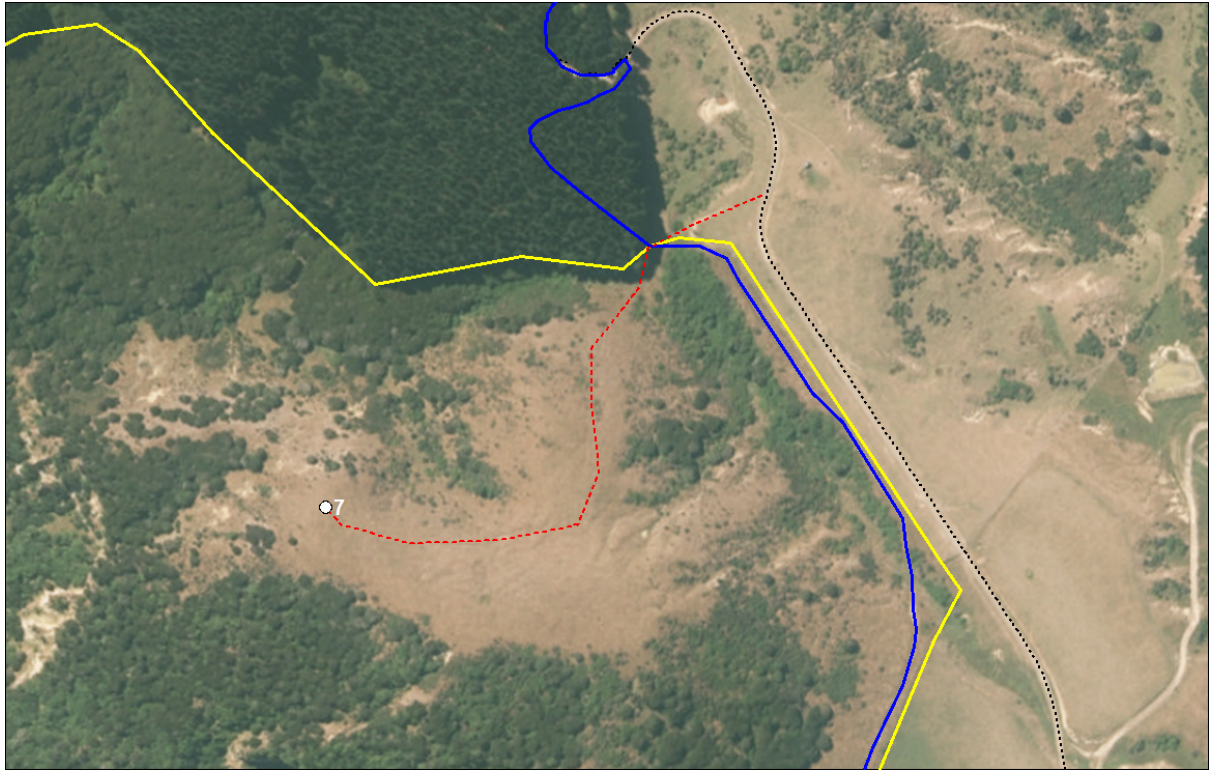


Figure 7. Access route to Photo-point 7.



Figure 8. Access route to Photo-points 8 and 9.

Photo-point 9: This site is located at the end of a short spur jutting high above lower Kate Stream (Figure 8). It is accessed from just past the gate on the Te Ara Matairangi section of

the walkway, then heading east out along the spur for ca. 70 m. Care needs to be taken as the drops off this spur are steep and long. This site is eroding but to date the metal standard has not been affected.

Two sets of photos are taken from here, both sets facing east and panning clockwise from northwest to southeast. The first set comprising seven photos are shot at approximately a horizontal angle, while the second set of four photos focus on the valley floor.

Photo-point 10: This site is located on the upper north slopes of the coastal spur of Tiromoana Bush. Access is from the walkway where the Te Ara Kānuka section of the walkway leaves the main walkway (Figure 4), with the metal standard located ca. 50 m northeast of here and slightly down the slope.

Five photos are taken from here facing north and panning anticlockwise from northeast to southwest.

Photo-point 11: This site is located on the spur above the Te Ara Kānuka section of the walkway (Figure 4). A 4x4 track heads up the spur from the main walkway and although the grass can be rank it is easy to follow (although pig rooting has made the ground surface very uneven). The metal standard is located adjacent to a small outcrop of calcareous rocks (which are stood on for the photos).

Seven photos are taken from here facing north and panning clockwise from west to south.

Photo-point 12: This site is located on top of the prominent spur separating Kate Pond from Ella Pond. Access has traditionally been from the main walkway heading east towards Ella Pond and then across the valley and up through the large outcrops to the ridge (ca. 400 m; Figure 9). In 2021 and 2023 the site was accessed following the bird monitoring/pest control line up through the regenerating forest on the south side of the hill starting from below the Kate Pond outfall. There is no metal standard, but the photos are taken from the end of an obvious rock platform that juts out along the ridge. This site was first photographed in January 2005.

Six photos are taken from here facing southwest and panning clockwise from south to north.

Photo-point 13: This site is located at the viewing area that looks out across the lower parts of Kate Valley (Figure 4). There is no metal standard with photos taken from the top of the fence around the viewing area. This site was first photographed in January 2008 (2007 photos).

Nine photos are taken from here forming a complete 180° panorama scanning in a clockwise direction (note you have to move across the fence to maintain the vista when taking the photos).



Figure 9. Access route to Photo-point 12.

Appendix 3: Tiromoana Bush landscape photo-points folders stored on the Transwaste Canterbury Ltd. computer system.

- Photopoints 1 2004
- Photopoints 2 2005 (Jan 06)
- Photopoints 3 2006
- Photopoints 4 2007 (Jan 08)
- Photopoints 5 2008
- Photopoints 6 2009
- Photopoints 8 2011
- Photopoints 10 2013
- Photopoints 11 2014
- Photopoints 12 2015
- Photopoints 13 2016 (Jan 17)
- Photopoints 14 2017
- Photopoints 15 2018 (Jan 19)
- Photopoints 16 2019
- Photopoints 17 2020
- Photopoints 18 2021
- Photopoints 20 2023