Kahikatea Green Wheel

Your forest health-check tool

Waikato
REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

Contents

Kahikatea Green Wheel

Are you restoring a kahikatea forest patch on your land, or planning to? Are you managing a reserve or covenant with one? Do you need to show funders you are making a difference?

If you are putting time and money into protecting and restoring your kahikatea forest patch, it's worth checking on how it's doing to make sure your efforts are paying off.

The Kahikatea Green Wheel (KGW) will help you check on the health of your kahikatea forest patch or track how your restoration project is going.

Here's how it works

- Use this guide to score important features (sub-attributes) from 1-5 stars.
- Enter your results into a spreadsheet provided.
- Instantly create a wheel chart showing how well your site is doing.
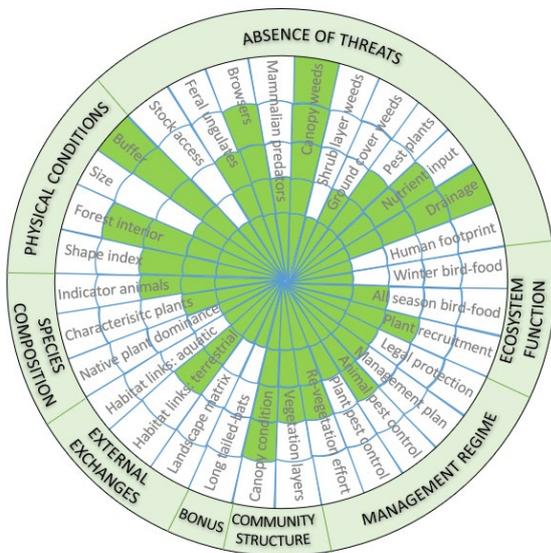
The greener your wheel spokes, the healthier and better managed your site is.

Why kahikatea forest?

Kahikatea *(Dacrycarpus dacrydioides)* is an ancient podocarp and New Zealand's tallest native tree. Before humans arrived in the Waikato, around 189,772 hectares of kahikatea forest grew in the wet areas beside lakes and swamps, and on floodplains.

Today there are only around 2760 hectares – a 98.5 per cent decrease. Many are secondary forests, grown anew on land previously cleared by early settlers. They are tiny, mostly under five hectares, and vulnerable to pests, stock damage and other threats.

Yet they remain a classic landscape feature of the Waikato lowlands – often the only native vegetation around – and provide core habitat and stepping-stones for native birds.

Waikato Regional Council has taken steps to encourage protection and restoration of these iconic indigenous forest stands.

The council:

- supports kahikatea research and monitoring
- encourages landowners to protect and enhance kahikatea forest patches
- provides funding incentives and how-to factsheets for people who want to restore or replant kahikatea forest
- created the Kahikatea Green Wheel for landowners to check on the health and to monitor recovery progress of their kahikatea forest
- encourages and promotes kahikatea restoration by sharing restoration success stories.
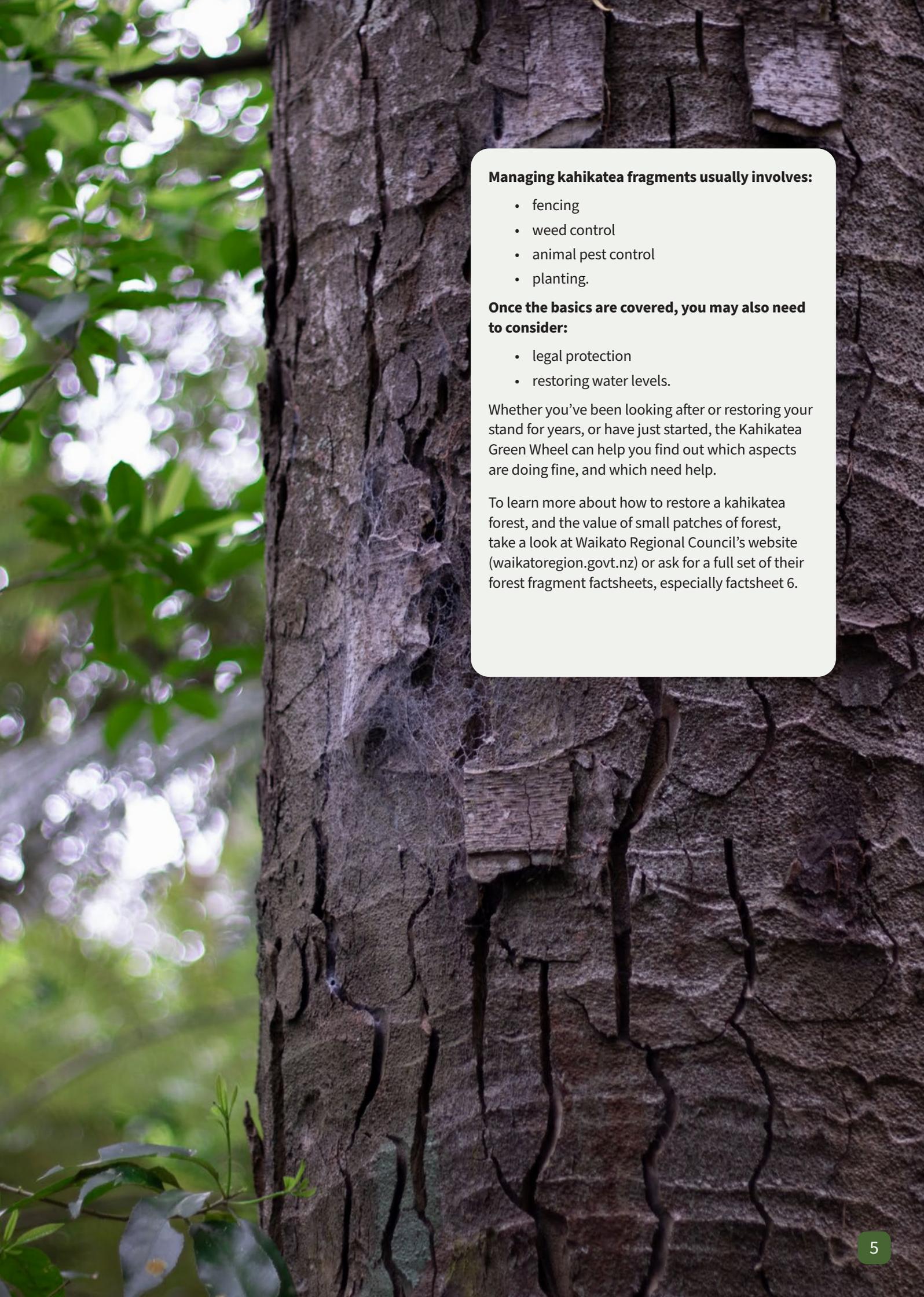
Managing kahikatea fragments usually involves:

- fencing
- weed control
- animal pest control
- planting.

Once the basics are covered, you may also need to consider:

- legal protection
- restoring water levels.

Whether you've been looking after or restoring your stand for years, or have just started, the Kahikatea Green Wheel can help you find out which aspects are doing fine, and which need help.

To learn more about how to restore a kahikatea forest, and the value of small patches of forest, take a look at Waikato Regional Council's website (waikatoregion.govt.nz) or ask for a full set of their forest fragment factsheets, especially factsheet 6.

Kahikatea 'warrant of fitness'

Like a vehicle Warrant of Fitness, the Kahikatea Green Wheel assesses a range of important features, so you can easily see which ones are doing well, and which need to go back to the mechanic for a tune up.

Instead of giving each feature a pass or fail, though, the Kahikatea Green Wheel ranks them from 1 to 5. The best score is 5 stars, the worst is 1 star. A high or improving score shows that you are on the right track.

The important health features to look for in a kahikatea forest are things like stock damage, weeds or pest animals. These are listed below, along with suggestions as to who can do the scoring.

Assessor

👤 Landowner or site manager   🎓 Botanist   🏛 Waikato Regional Council

A Threats

1. Stock access 👤
2. Feral ungulates 👤
3. Browsers 👤
4. Mammalian predators 👤
5. Canopy weeds 🎓
6. Shrub layer weeds 🎓
7. Ground cover weeds 🎓
8. Pest plant presence 🎓
9. Nutrient input 👤
10. Drainage 👤
11. Human damage 👤

B Physical conditions

12. Size 🏛
13. Shape 🏛
14. Forest interior 🏛
15. Buffering 🎓

C Species composition

16. Dominance of native plants 🎓
17. Characteristic plant species 🎓
18. Indicator animal species 👤

D Community structure

19. Vegetation layers 🎓
20. Canopy condition 🎓

E Ecosystem function

21. Winter bird food 🎓
22. All season bird food 🎓
23. Plant recruitment 🎓

F External exchanges
– links to other natural areas

24. Landscape matrix (nearby habitat) 🏛
25. Habitat links (terrestrial) 🏛
26. Habitat links (aquatic) 👤

G Management regime

27. Legal protection 👤
28. Management plan 👤
29. Animal pest control effort 👤
30. Invasive plant control effort 👤
31. Revegetation effort 👤

Bonus (optional)

32. Long-tailed bats 👤

The kahikatea health features have been bundled into seven broad "attributes" such as threats, physical conditions, etc. These form the outer hub of the green wheel. Each individual feature is called a "sub-attribute" and these form the 32 spokes of the wheel.

Thirty-two sub-attributes might seem like a lot but it's easier than it sounds!

- You only need to assess the wheel every five years – although you will want to make quick checks on features like fence condition more frequently to keep on top of things.

- Waikato Regional Council will calculate the score for five of the sub-attributes and place that information on the **web** – find your patch on their kahikatea forest map to get the scores. This **website** will be updated every five years.

- Some are dead-easy to apply – you will know the answer for some sub-attributes already, such as how much pest control you do.

- Several sub-attributes can be scored from information gathered simultaneously – for instance, you can use tracking tunnels to check for rats as well as native wētā (indicator animals).

- Spreadsheets have been created to do the maths for you – just download from the council's website, and plug in the information from your site check or contractor.

- You can fill out the Kahikatea Green Wheel even if you don't have any information for some sub-attributes – just leave out the ones you can't assess for now.

Reading the wheel

On the right is an example of a completed Kahikatea Green Wheel. The forest is doing really well for some features:

- It has a dense vegetation buffer to shelter it from wind.
- There are virtually no weeds in the canopy.
- It hasn't been drained so its water levels have remained high.

But it's not doing so well for other features (the white areas):

- Livestock can get in and damage the understorey.
- There isn't much food for forest birds.
- It's really small.

Some of these are easy to fix, like planting suitable fruit-bearing plants for the birds. Others might be more costly but well worthwhile, like putting in a fence.

Spot the difference!

The key to the Kahikatea Green Wheel is to repeat the assessment every five years. Look at the KGW for 2020 and see what changed from 2015.

1. Over the past five years, the site has been fully fenced and gets 5 stars for stock access. The fence was also built to keep out feral ungulates – wild animals on the hoof like goats, pigs and deer – so that score has also gone up. See how the sub-attributes in the red circle numbered "1" have changed in the 2020 wheel.

2. The other big changes have been to how the ecosystem functions. Thanks to planting carefully selected kahikatea forest species, there is now a lot more food for tūī and kererū in winter and year-round. Also, since stock have been fenced out, seedlings aren't getting trampled, so the score for plant recruitment (seedling survival) has gone up too.

3. With planting and natural seed recruitment there are more characteristic native plants, and native species are becoming more abundant than introduced ones, especially as the landowner got rid of groundcover weeds to plant natives. So scores have gone up for the native plant sub-attributes, and for vegetation layers.

> The wheel shows where your focus should lie, so you can plan future steps to restore your forest and improve its health.

2015

2020
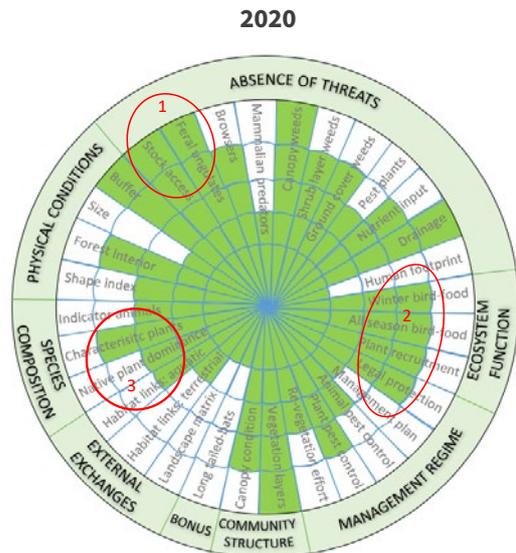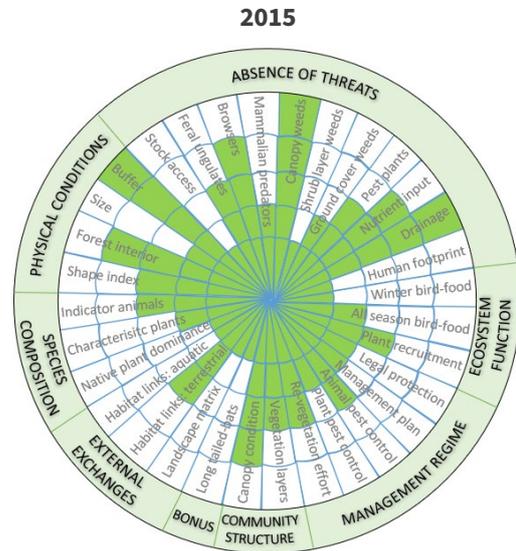
Small steps – big change

These Kahikatea Green Wheel charts, from the same site taken five years apart, show how a couple of actions can improve a wide range of things in your forest. It also demonstrates how the Kahikatea Green Wheel can show the progress you have made in graphic detail.

Some things haven't changed – it's still the same size and shape – but the overall score has gone from 85 to 110 (of a possible 155).

Broad approach

Some of the Kahikatea Green Wheel sub-attributes can be completed indoors, but most of them will involve at least one visit to the forest site.

If you want to collect information on pest animals and native wētā, you will need to visit twice to set up and retrieve tracking tunnel cards – but each visit might only take an hour or so.

The information needed to complete the Kahikatea Green Wheel will come from:

- checking the land outside the bush
- looking inside the bush
- using your own knowledge (or information from the council website).

This diagram below gives a broad picture of where to collect information for each sub-attribute. The sub-attribute numbers relate to the Kahikatea Green Wheel Star Ranking tables you will use to assign a score.
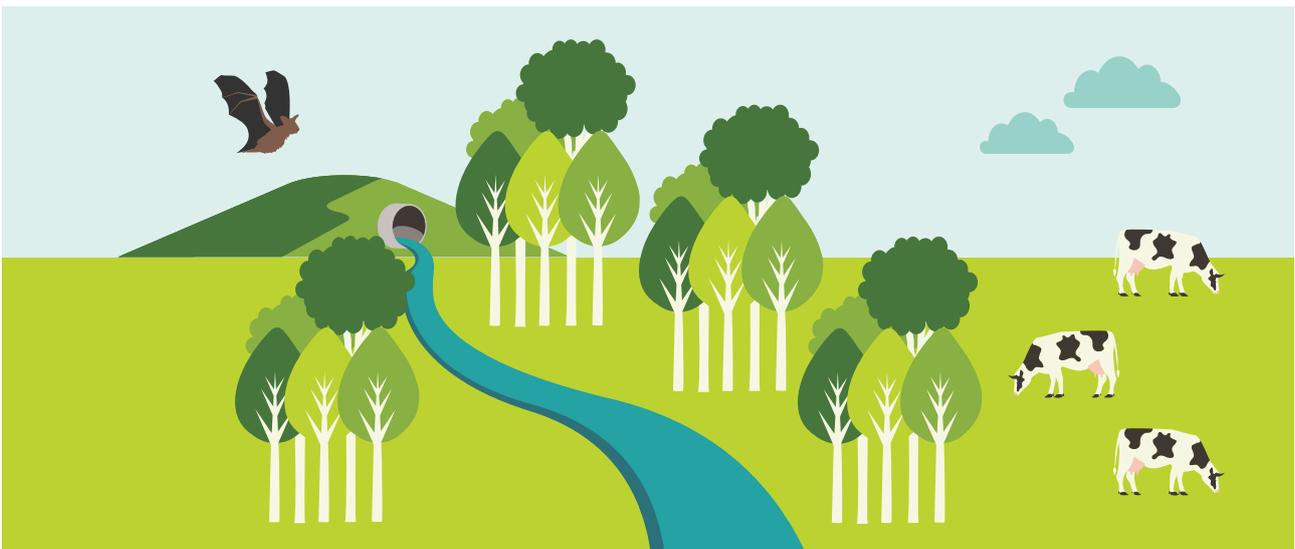
Outside the bush

Look for

- **1** **Stock access**
- **5** **Canopy weeds**
- **9** **Nutrient input**
- **10** **Drainage**
- **15** **Buffering**
- **19** **20** **Canopy condition**
- **26** **Habitat links (aquatic)**
- **32** **Long-tailed bats**

Inside the bush

Look for

- **1** **Stock access**
- **2** **3** **4** **Pest animals**
- **5** **6** **7** **8** **Weeds**
- **11** **Human damage**
- **16** **17** **21** **22** **23** **Native plants**
- **18** **Native animals**
- **19** **20** **Vegetation layers**

In the office

Use your own site knowledge and information from the council's online kahikatea map for:

- **12** **13** **14** **24** **25** **Spatial info**
- **27** **28** **29** **30** **31** **Management**

Some of these require botanical skills.

Before you start

Gather the tools you will need to do the job. These are available on the council's Kahikatea Green Wheel webpage. Put a rough plan together – when, what, who, how.

Visit the webpage

Look through the documents and tools that will help you. **waikatoregion.govt. nz/kahikatea-green-wheel**

Download the spreadsheet

After you collect your data you will enter it into a spreadsheet to make your Kahikatea Green Wheel chart. Lots of fields are automated to do the maths for you.

Print out datasheets

Print out the **Site Datasheet** to jot down scores for your site. Collect the KGW scores from the council website for sub-attributes **12**, **13**, **14**, **24**, **25** and from your botanist (botanical sub-attributes). Fill in the rest of the sub-attributes by visiting the site and from your own knowledge. Jot down notes on the Site Datasheet to explain why each score was chosen. Or, you may prefer to download the Site Datasheet to your mobile device to type in your notes directly during the visit, then later add in the required sketch map.

It's also handy to keep a photo record for comparison over time. Print off the **Photo Datasheet** to note down where and when photos were taken.

Look at a completed example

The KWG webpage has a completed example of a **Site Datasheet** for Turney Bush which you can visit at Rotopiko reserve off SH3 near Ōhaupō. It may be handy to visit Turney Bush with a copy of the completed example to see what it looks like and how it was scored.

Find a botanist

Decide if you will need to engage a botanist or if you have the skills to do that yourself. See the separate **Kahikatea Green Wheel Botanist's Guide** for instructions and datasheets you can use to assess the botanical sub-attributes. A good botanist should be able to do the job in half a day if the site is easy to reach. While you can skip this step, botanical data will help you complete 11 of the 32 sub-attributes.

Plan your site visits

Use the safety and timing notes in this guide to plan a site visit.

If someone else is taking care of the botanical sub-attributes with a late summer/autumn visit, you may prefer to gather all the other site information when you collect in your pest tracking tunnel cards in late winter/spring. That will save you an extra trip. Plus, after two visits to set up and collect tracking cards for wētā, you'll be more familiar with your bush stand and will find it easier to apply the field sub-attributes.

Make a list of the gear you will need (safety gear, monitoring devices, datasheets to fill in, camera etc).

Handy field gear checklist

- This guide
- Photo Datasheet
- Pencils/clipboard (or enter directly into a device e.g. smartphone or tablet)
- Safety gear – fully charged phone, map and compass or GPS and spare batteries
- Site Datasheet
- Binoculars, camera
- Kahikatea Green Wheel Spreadsheet (if using a device)

Plan your visits

Define your site

If part of your kahikatea stand is fenced, assess the fenced and unfenced parts separately. If your site extends onto your neighbour's just assess the portion on your property.

If you have more than one kahikatea stand do a separate KGW for each.

Stay safe

Staying safe is your number one priority. If you are the landowner or site manager, you probably already know how to visit your site safely.

Things to consider are:

- Working alone – make sure someone responsible knows where you are and when you plan to return.
- Terrain – watch out for swampy ground; walk if it's not safe to take a vehicle to your site.
- Sharp or poisonous plants – including blackberry, native cutty grasses and Jerusalem cherry.
- Dangerous animals – e.g. wasps in summer, overly protective or aggressive livestock, wandering dogs, trespassers.

Standard safety gear to take:

- Charged up phone or other communication device.
- Company – even a reliable dog is better than being on your own.
- Suitable clothing – sturdy footwear, weather protection, high vis clothing so you can be found if you get hurt.
- Plenty of water and energy food.
- Map or GPS if your site is large.

When to go

How often

The Kahikatea Green Wheel is designed to be repeated every five years, although you may wish to take a check on the following items more often to keep on top of problems while they are manageable:

- stock trespass – check the fences regularly to ensure no breaches
- pest animals – tracking tunnels once a year, and keep an eye out for feral goats, pigs or deer
- weeds – check for the ones you are familiar with, or any you are unsure of
- canopy condition – look for signs of ill-health/dieback
- human damage – in public reserves check for signs of littering, vandalism or other damage.

The council will provide the data for five sub-attributes (**12**, **13**, **14**, **24**, **25**), on its online Vegetation map. Note that the data may only be updated every five years.

Time of year

Many sub-attributes can be applied at any time of year, but botanical and animal ones are better collected in season. Pick a quiet time to compile all the information collected during the year, applying all sub-attributes to complete your wheel. Stick to the same timetable when you repeat the Kahikatea Green Wheel assessment, so results are comparable.

Late summer/autumn. It's easier to identify plants when they have flowers or fruit, so late summer or autumn is a good time for a plant expert to visit and make a full plant list, including weed species. This will tick off 11 sub-attributes in one hit (**5** to **8**, **16**, **17**, **19** to **23**). Late summer is also a good time to check for seedlings that survived summer drought – they are more likely to establish successfully.

Late winter/spring. This is a good time to put out tracking tunnel cards for **4** **Mammalian predators** including rodents and stoats, and also for wētā (**18** **Indicator animal**). If you have time, do this annually and average your results for your five-yearly Kahikatea Green Wheel assessment. Gathering tracking tunnel data yearly will help you refine your pest management regime. If your site is still in a natural, swampy state you may need to choose a drier time of year or put tunnels on logs, or use chew cards instead – tracking tunnels are useless when they get wet!

Outside the bush

Follow these steps and use the following Star Ranking tables to apply a score for each listed sub-attribute.

Write the scores and the notes that justify them on the **Site Datasheet**. Don't worry if the sub-attribute numbering seems out of order in this "to do" list – they're listed in the order in which you will see the clues you need to assess them. Simply go to the relevant section of your Site Datasheet to fill in as you go. Fill in the top information about site name, location, date and do a sketch map on the Site Datasheet.

Start looking at nutrient sources, drains and waterways as you walk towards the site. If you are doing the botanical sub-attributes yourself, also look for pest plants as you go. Then walk around the bush as much as you can to look at fences, protective buffers and the canopy.
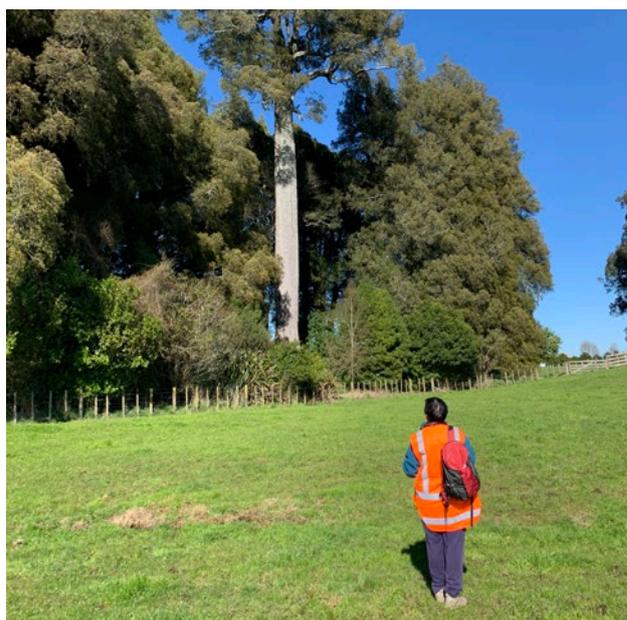
⑨ Nutrient input

Look for signs of human-derived sources of nutrient input (e.g. fertiliser applied within a 300m radius, upslope grazing land, septic tanks within 300m, stock grazing in the stand, high numbers of birds, e.g. geese/paradise ducks).

⑩ Drainage

Look for signs of old or active drains that may be draining water from the stand. See if there are signs of water seepage into them indicating that drainage is still occurring.

㉖ Look at waterway links

Look for streams entering or leaving your stand, or adjacent rivers that may provide connections to other areas during floods. Check up and downstream on the property to ensure there are no barriers to fish movement (e.g. perched culverts).

❶ Stock access

Assess the condition of stock fences (if relevant). Even if the fence looks good, check inside the forest for signs of stock trespass before completing this star ranking.

⑮ Check for buffers

Assess the condition of any planted or self-grown buffer vegetation (describe height and density on your **Site Datasheet**) and shrubs in the dripline (vegetation margin). Buffers can include plantation forest – anything tall and dense enough to seal off the forest from sun and wind.

⑳ Check for canopy dieback

Estimate what percentage of the canopy is showing signs of ill-health, such as yellowing foliage or bare branches. If you are engaging a botanist you could ask them to assess this.

Score your site

Make notes on your **Site Datasheet**. Use a pencil so you can make changes if you need to as you look under and around the forest.

Photos

Take photos to record the items above. Establish at least one permanently marked photopoint[1] outside the forest. Record details on the **Photopoint Record Sheet**. It's also a good idea to take photos of your **Site Datasheet** as a backup.

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1   Look for the Wetmak Photopoint video on Youtube

Outside the bush: Star Ranking table

⑨ Nutrient input

Clues

Use your eyes and nose to check for non-natural sources of excess nutrients on the property in the vicinity of the forest. These may include animal dung, crops such as maize that are likely to be fertilised, septic tanks, effluent drain fields, adjacent races or offal pits, or unusually high numbers of exotic birds in the forest. Very lush grass or vegetation may indicate high nutrients.

Use your judgement and knowledge of the property to select the KGW star value, but if in doubt, score your site based on the lowest star value for which any example applies.

★	★★	★★★	★★★★	★★★★★
Constant high nutrient enrichment. Examples: - septic wastewater pipes or year-round effluent disposal in site, and/or - forest permanently stocked with grazing animals, and/or - year-round high numbers of roosting birds.	Regular but not constant high nutrient enrichment. Examples: - grazed on a rotational basis and/or - regular fertiliser application and/or - heavy grazing on adjacent upslope paddocks and/or - periodic/seasonal high number of roosting birds	Regular small amounts of nutrient enrichment. Examples: - adjacent upslope paddocks are moderately grazed and/or - forest is lightly grazed (e.g. by sheep) and/or - moderate numbers of roosting birds	Occasional small amounts of nutrient enrichment. Examples: - forest never grazed but subject to runoff from lightly grazed adjacent slopes.	No obvious sources of nutrient enrichment.

⑩ Drainage

Clues

Look for drains in or near the site. Check if water is seeping into them – an indication of ongoing drainage. Look for signs of recent drain deepening (freshly exposed drain sides, spoil heaps, diggers), or conversely blockages/infilling to restore water levels.

★	★★	★★★	★★★★	★★★★★
Site has been, and still is, subject to severe drainage with evidence of active, regularly maintained drains through, around or near the forest stand.	Drains affecting the stand are present but have not been actively maintained in the past five years. Landowner has no plans to restore formerly higher water levels.	Site is subject to a plan to restore water levels.	Drains are in the process of being blocked or filled in, although some drains remain active.	Site has never been drained and is still subject to regular flooding, or former flooding regime has been completely restored (e.g. all drains filled in). Or site was never subject to flooding.

㉖ Habitat links (aquatic)

Clues

Look at waterways on your land that may connect your site to other natural areas, and check for things like pipes or culverts that may impede fish passage, or drains that divert water away from the site. Do adjacent rivers still regularly flood the site, maintaining a natural condition, or have they been diverted away?

★	★★	★★★	★★★★	★★★★★
No natural links remain, site no longer inundated.	Partial links to nearby stream or wetland via extreme flood events.	Streams or drains flow through or beside the stand, but most of them are unvegetated, and/or have perched culverts on the property. Partial links via moderate to extreme flood events.	All waterways are connected upstream and downstream (with no perched culverts) on the property but some have breaks in riparian cover on the property. Partial inundation via surface flows/ flood events.	All waterways in the stand (if any) are fully connected with continuous riparian buffers and no perched culverts or other fish barriers between the site and property boundary. Regular inundation via flooding or surface flows. Or was likely never connected to a waterway.

1 Stock access

Landowner / Site manager

Clues

In grazing land, look at the condition of the fence around the entire stand if possible. Check for fence damage, signs of animal entry, signs of animals in the stand, e.g. pugging, browsing, dung. Fence repairs will be a priority for action.

★	★★	★★★	★★★★	★★★★★
No fences and heavily grazed throughout - signs include bare or mainly unpalatable plants in ground layer, heavily pugged, abundant cattle dung.	No fences and moderately grazed - minor amounts of dung, many unpalatable plants, some pugging, but site not heavily grazed throughout.	Fenced but not complete, or ineffective, or livestock are placed in the stand and site is heavily or moderately grazed.	Not or incompletely fenced, but site has minor signs of stock presence, livestock access is infrequent or does not penetrate more than 10m into the site because of impediments e.g. blackberry, wet ground, drains, thick exposed roots, dense woody vines.	No stock have access, e.g. securely fenced or not in grazing land.

15 Buffering (dense vegetation around the stand)

Landowner / Site manager

Clues

Walk around the outside edge where it's safe to do so. Look for areas of adjacent forest (e.g. kānuka or tawa forest, even plantation forest or tall planted vegetation), which can protect the forest from sun and wind. Where there is no buffer, look at how thick the vegetation is at the bush margin to apply your score. Double check the buffer as you wander around inside the forest.

★	★★	★★★	★★★★	★★★★★
Less than 25% of the site is protected from to edge effects by a dense margin and/or forest buffer.	From 25% to 50% of the site is protected from to edge effects by a dense margin and/or forest buffer.	From 50% up to 75% of the site is protected from edge effects by a dense margin and/or forest buffer.	From 75% to 95% of the site is protected from edge effects by a dense margin and/or forest buffer.	Over 95% of site is protected from edge effects by a dense margin and/or forest buffer.

20 Canopy condition (signs of damage/dieback etc)

Botanist

Clues

Look from the outside, with binoculars and/or from a high point if possible, for signs of yellow or dying foliage, or dead trees. To visualise the % values, mentally divide your forest into four to get a feel for 25% segments. Ignore exotic deciduous trees turning yellow in autumn.

★	★★	★★★	★★★★	★★★★★
Over 75% of the indigenous foliage in the canopy is showing signs of yellowing or defoliation.	50-74% of the indigenous foliage in the canopy is showing signs of yellowing or defoliation.	25-49% of the indigenous foliage in the canopy is showing signs of yellowing or defoliation.	2-24% of the indigenous foliage in the canopy is showing signs of yellowing or defoliation.	Up to 1% of the canopy is showing signs of yellowing or defoliation.

Some weeds you may see in the **canopy**
(*= a regional pest management species):

Crack willow
*Salix fragilis**

Grey willow
*Salix cinerea**

Tasmanian blackwood
Acacia melanoxylon

Gum
Eucalyptus sp.

Brush wattle
Paraserianthes lophantha

Taiwanese cherry
Prunus campanulata

Inside the bush

Follow these steps and use the following Star Ranking tables to apply a score for each listed sub-attribute.

Write the scores and notes justify them on the **Site Datasheet**. If you are also collecting botanical information, bring the **Botanists Kahikatea Green Wheel Guide** and **Plant Datasheets** with you – you will need to make a list of all native and non-native species. See **Check for Critters** if you also want to monitor small mammals and wētā.

Take a good look around

If your site is fairly small and safe to move around in, wander about to get a good feel for it. How dense is the vegetation? Can you identify any bad weeds? Are you hearing many birds? Any signs of human damage? Are the vegetation layers (canopy, mid storey, ground) all present, or are there big gaps or is it bare underneath? Does it show signs of past drainage (exposed roots)? Stop periodically and take a good look: up, down and around.

❶ Stock access
❷ Feral ungulates

If your site is in grazing land, double check inside for signs of stock trespass (adjust your score for ❶ if needed). Look for signs of feral ungulates – wild goats, pigs, deer – for ❷. Visual clues for both stock and feral ungulates include seeing live or dead animals, smell (particularly goats), dung, hoof marks, pugged ground, browsed or trampled trees, bare understorey, dug up earth (pigs).

❸ Browsers

Look for signs of rabbits or hares. Clues may include seeing them, dung heaps, burrows or diggings, and damaged small plants.

⑪ Human damage

Particularly in areas with public access, look for signs of damage, such as litter, damage to trees, unauthorised structures. Some may be minor in nature – things like small bivouacs are a sign of children exploring and enjoying nature.

⑲ Vegetation layers
⑳ Canopy condition

Assess the condition of the three vegetation layers that would be typical of forest: canopy, shrub layer and ground cover. Use your notes from your view of the canopy outside the bush, as well as what you see from inside, to score ⑲ **Vegetation layers** and ⑳ **Canopy condition**. You could ask your botanist to do these.

Score your site

Make notes on your **Site Datasheet** for these sub-attributes. Use pencil so you can make changes if you need to as you look under and around the forest.

Photos

Take photos to record the items above. Establish at least one permanently marked photopoint inside the forest. Record details on the **Photopoint Record Sheet**. It's also a good idea to take photos of your **Site Datasheet** as a backup.

Inside the bush: Star Ranking table

② Feral ungulates (deer/goats/pigs) 👤 Landowner / Site manager

Clues

Check for live or dead animals, smell (particularly goats), dung, hoof marks, pugged ground, browsed or trampled trees, bare understorey, dug up earth (pigs).

★	★★	★★★	★★★★	★★★★★
Abundant signs of feral ungulates, dung pellets or signs of shrub browse across the entire site.	Ungulate dung pellets or signs of shrub browse across 50% to 75%.	Faecal pellets or shrub browse across 25% to 50% of the site.	Minor signs, e.g. some hoof prints or dung but little signs of vegetation damage.	No evidence of feral ungulates.

③ Browsers (rabbits/hares) 👤 Landowner / Site manager

Clues

Clues may include seeing them, dung heaps, burrows or diggings. Also look for damage to young seedlings, including stems snipped in half. Signs may be more abundant in sunny gaps or edges.

★	★★	★★★	★★★★	★★★★★
Abundant signs of rabbits or hares, faecal pellets or signs of browse across the entire site.	Faecal pellets or signs of browse across 50% to 75% of the site.	No rabbits or hares seen, and faecal pellets are present in 25% to 49% of the site.	Minor signs. Very old or just a few piles of pellets or minor browse seen.	Fully pest fenced or pest-free island, or no signs that rabbits or hares have been recently in the site.

⑪ Human damage (rubbish/trampling etc)   👤 Landowner / Site manager

Clues

Look for signs of damage, such as cut trees, trampling, litter, structures. You may choose to exclude walkways, boardwalks designed to reduce trampling, as well as ecological monitoring devices, but make notes about them on your **Site Datasheet**. If in doubt, score your site based on the lowest star value for which any example applies.

★	★★	★★★	★★★★	★★★★★
Damage is moderate to intense across 75% or more of the site.	Damage is moderate to intense across 50-74% of the site.	Damage is moderate to intense across 20% to 49% of the site.	Damage is moderate to intense across 5-24% of the site. Or minor damage is evident across 25% or more of the site.	Minimal or no visual evidence of human presence (e.g. few structures or litter). Minor damage in less than 25% of the stand.

⑲ Vegetation layers (shrub/canopy layers etc)   😎 Botanist

Clues

Healthy kahikatea forest should have at least three layers:

1. A canopy of large trees, mostly kahikatea, with pukatea, tītoki and sometimes mataī or tawa.

2. A middle layer of small-leafed trees and shrubs like coprosmas, māhoe, and tree ferns.

3. A dense ground cover of native ferns, sedges, herbs and seedlings (kahikatea seedlings are naturally rare in dense shade).

They may also have an emergent layer of very tall old trees.

★	★★	★★★	★★★★	★★★★★
No vegetation tier is intact (all layers have less than 50% cover of indigenous vegetation).	One tier is relatively intact (greater than 50% indigenous cover).	Two tiers are relatively intact (50% or more indigenous cover).	All tiers have 50% or more indigenous cover, but at least one of them has less than 75% cover.	All layers have >75% cover comprising indigenous species. Emergent trees (standing well above the rest of the forest) may or may not be present.

Some weeds you may see in the **shrub layer** (mid-tier):
(*= a regional pest management species):

Barberry
Berberis glaucocarpa

Japanese honeysuckle
Lonicera japonica

Large leaved privet
*Ligustrum lucidum**

Blackberry
Rubus fruticosus agg

Hawthorn
Crataegus monogyna
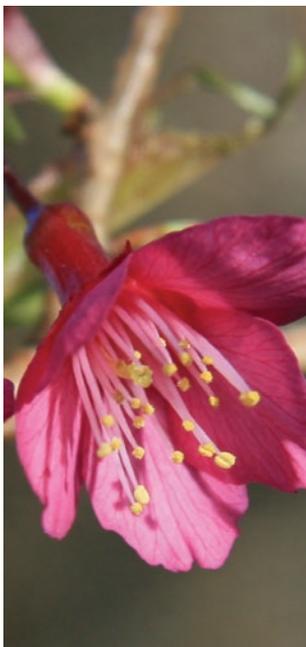
Taiwanese cherry
*Prunus serrulatus**

Woolly nightshade
*Solanum mauritianum**

Moth plant
*Araujia hortorum A.
sericifera**

Some weeds you may see in the **ground layer**:
(*= a Regional Pest Management species):

*Photo: John Smith-Dodsworth
nzpcn.org.nz*

Creeping buttercup
Ranunculus repens

*Photo: Trevor James
weedbusters.org.nz*

Jerusalem cherry
Solanum pseudocapsicum

*Photo: Carolyn Lewis
weedbusters.org.nz*

Ivy
Hedera helix

*Photo: Trevor James
weedbusters.org.nz*

Wandering dew
Tradescantia fluminensis

*Photo: Trevor James
nzpcn.org.nz*

Beggar's tick
Bidens frondosa

*Photo: Trevor James
weedbusters.org.nz*

Pampas species
Cortaderia species*

*Photo: Carolyn Lewis
weedbusters.org.nz*

Royal fern
*Osmunda regalis**

*Photo: Trevor James
nzpcn.org.nz*

Carex
Carex divulsa

*Photo: Trevor James
weedbusters.org.nz*

Stinking iris
Iris foetidissima

*Photo: Trevor James
weedbusters.org.nz*

Selaginella fern
Selaginella kraussiana

*Photo: Carolyn Lewis
weedbusters.org.nz*

Arum lily
Zantedeschia aethiopicum

*Photo:
reference*

Kahili ginger
*Hedychium gardnerianum**

Checking for critters

Kahikatea forests can be home for native birds, skinks, long-tailed bats and invertebrates. They can also be habitat for a number of pest animals such as rodents and stoats, which threaten the native plants and animals in your kahikatea stand.

The Kahikatea Green Wheel has a sub-attribute for (4) **Mammalian predators** to help track whether your pest control efforts are keeping their numbers down. It also has a sub-attribute for (18) **Indicator animal species**, using wētā as the indicator animal because they are a good sign that pest numbers are low enough to allow native species to flourish. There is an optional bonus sub-attribute for (32) **Long-tailed bats** which have been found in many Waikato kahikatea forest fragments. Pest control can make your stand a safer place for bats to roost in, but bat presence is an optional measure because bats are highly mobile and may choose to roost elsewhere (beyond your control).

All of these animals are seldom seen, so we use devices that record their presence. There are several ways to detect animals in native bush, including tracking tunnels, chew cards, wax tags, traps and automatic recorders.

Tracking tunnels with ink cards are a cheap and easy way to get an idea of how many pest animals (4) **Mammalian predators**) or native wētā (18) **Indicator animal species**) are in your site. Small animals love to run through tunnels – they will get harmless ink on their feet and leave their footprints on the card. Long-tailed bats can be detected with a hand-held detector and confirmed using an automatic recorder (available for loan from Waikato Regional Council). These are all great tasks for kids to get involved in.

Check for wētā, pests and bats once per year every year for five years, then use your scores over the five years to create your Kahikatea Green Wheel star value. You can enter your tracking card data into the worksheets in the **Kahikatea Green Wheel Spreadsheet** – your annual Kahikatea Green Wheel star value will be calculated automatically.

See more details in the **Fauna Monitoring factsheet** on the **Kahikatea Green Wheel website**.

Checking for critters: Star Ranking ta ble

④ Mammalian predators (rats etc) 👤 Landowner / Site manager

Clues

Prints on tracking cards set out for seven nights at 20m spacing – an alternative option is chew cards.

★	★★	★★★	★★★★	★★★★★
Very high pest numbers, detection on nine or 10 out of 10 chew cards or tracking tunnels.	Moderately high pest numbers, >50% to 80% detection on chew cards or tracking tunnels.	Moderate pest numbers, up to 50% detection on chew cards or tracking tunnels.	No evidence of predators, zero detection on chew cards or tracking tunnels but site is not fully pest fenced.	Fully pest fenced or pest-free island and monitoring shows pests are absent, or at best recorded only infrequently (incursions).

⑱ Indicator animal (wētā) 👤 Landowner / Site manager

Clues

Wētā prints on tracking cards set out for seven nights at 20m spacing.

★	★★	★★★	★★★★	★★★★★
No wētā tracks recorded in seven nights.	10% weekly tracking rate (wētā tracks in one of 10 tunnels).	20% weekly tracking rate (wētā tracks in two of 10 tunnels).	30% weekly tracking rate (wētā tracks in three of 10 tunnels).	Greater than 30% weekly tracking rate (wētā tracks in four or more of 10 tunnels).

㉜ Bonus indicator (long-tailed bats) 👤 Landowner / Site manager

Clues

Bats are hard to see – use an automatic bat detector to check for them. Available from Waikato Regional Council.

★	★★	★★★	★★★★	★★★★★
Long-tailed bats not detected in the kahikatea stand in the past five years.	Long-tailed bats detected in the kahikatea stand in one of the past five years.	Long-tailed bats detected in the kahikatea stand in two of the past five years.	Long-tailed bats detected in the kahikatea stand in three of the past five years.	Long-tailed bats detected in the kahikatea stand in four or all of the past five years.

Back in the office

Grab your Site datasheet

Get out the **Site Datasheet** you started to complete in the field and your animal tracking tunnel monitoring. Enter in the **Site Datasheet** the scores you collected in the field for sub-attributes ❶ ❷ ❸ ❹ ❾ ⓿ ⑪ ⑮ ⑱ ⑳ ㉖ and ㉜ (optional).

🏛 From the Waikato Regional Council Vegetation map

Find your kahikatea patch, and write on your **Site Datasheet** the Kahikatea Green Wheel scores for sub-attribute numbers ⑫, ⑬, ⑭, ㉔ and ㉕. See the image on the next page to help with these steps. **waikatoregion.govt.nz/vegetation-biodiversity-map**

To find your kahikatea patch:

(1) Open the Biodiversity and Environment Map on the council website.

(2) Ensure the 'Layers List' box is visible on the right. If not click the 'layers' button on the top toolbar.

(3) Tick Biodiversity & Environment and click the little triangle beside it to open more layers.

(4) Tick Kahikatea and the triangle beside it.

(5) Tick Kahikatea 2012 (or the most recent version).

(6) Turn off all other layers, including Pre-human Kahikatea and Biodiversity Vegetation, so only kahikatea forest is visible on the map.

(7) Type your address into the search box to find patches on your land. You can turn on a satellite photo or topographic map from the Base Map Gallery, to make it easier to find your stand.

(8) Click on the stand you want to gather information on, and enter the Green wheel rank values for the following attributes into your **Site Datasheet**.

⑫ **Size**
⑬ **Shape**
⑭ **Forest interior**
㉔ **Landscape matrix (nearby habitat)**
㉕ **Habitat links (terrestrial)**

🎓 From your botanist

Ask your botanist for a copy of their **Site Datasheet** with scores and justification notes for these sub-attributes:

⑤ **Canopy weeds**
⑥ **Shrub layer weeds**
⑦ **Ground cover weeds**
⑲ ⑳ **Vegetation layers**
⑧ ⑯ ⑰ ㉑ ㉒ ㉓ **Botanical indicators**

Also ask your botanist for a copy of the Kahikatea Green Wheel Spreadsheet with the Native plant and Unwanted plants worksheets completed. This will give you a full species list for your site, as well as auto-generated scores for sub-attributes ⑧, ⑯, ⑰, ㉑, ㉒ and ㉓.

Add the scores and notes to your **Site Datasheet**.

👤 From your own knowledge

Use the Star Ranking table in the Appendix to score these sub-attributes on your **Site Datasheet**, along with explanatory notes:

㉗ **Legal protection**
㉘ **Management plan**
㉙ **Animal pest control effort**
㉚ **Invasive plant control effort**
㉛ **Revegetation effort**

Enter these into your green wheel

The Kahikatea Green Wheel Spreadsheet has boxes where you can write the score for each of the sub-attributes and notes to justify the score. See the first tab called "My Green Wheel".

Some scores will be automatically calculated if you complete the Tracking Tunnels, Native Plants and Unwanted Plants worksheets. These are coloured green in the Star Ranking column of the **Kahikatea Green Wheel Spreadsheet**. The blue boxes are the sub-attributes provided on the council's **kahikatea forest map**, available on the web.

2. Enter your star ranking and notes

3. Click here to update your wheel

1. Fill in these tabs first to auto-fill the green boxes

Enter and save all your tracking tunnel data for wētā and for all animal pests detected on your tracking cards. These will automatically calculate your Kahikatea Green Wheel star value for each year, but you will want to average the scores from the annual data you collected over the past five years each time you redo your green wheel. The spreadsheet can do that automatically for you — see the image below.

2. Your 5-year average star value auto-calculates here

1. Enter the species on your tracking cards for five years

The My Green Wheel page will calculate the average star value for the seven broad attributes (**A** to **G**), and the total site score for you at the base of the Kahikatea Green Wheel star ranking table**.**

Once all the star values are entered (along with relevant notes), click the Update my Wheel button to create a picture of how your forest is doing.

Complete your Site Datasheet for a final record

Use the snip tool or screen shot to make a picture of your Kahikatea Green Wheel and paste it into a word document version of your Site Datasheet. Save it somewhere secure and /or print it off and file it as your master record of how your site is doing. Pull it out in five years' time to see how it has changed.

	AVERAGE SCORES PER ATTRIBUTE	
31	ATT 1. Absence of threats	3.5
32	ATT 2. Physical conditions	1.8
33	ATT 3. Species composition	1.0
34	ATT 4. Community structure	2.5
35	ATT 5. Ecosystem function	1.7
36	ATT 6. External exchanges	3.3
37	ATT 7. Management regime	1.6
39	TOTAL SITE SCORE (max 35)	15.3

My Green Wheel | Completed example | Wētā tracking
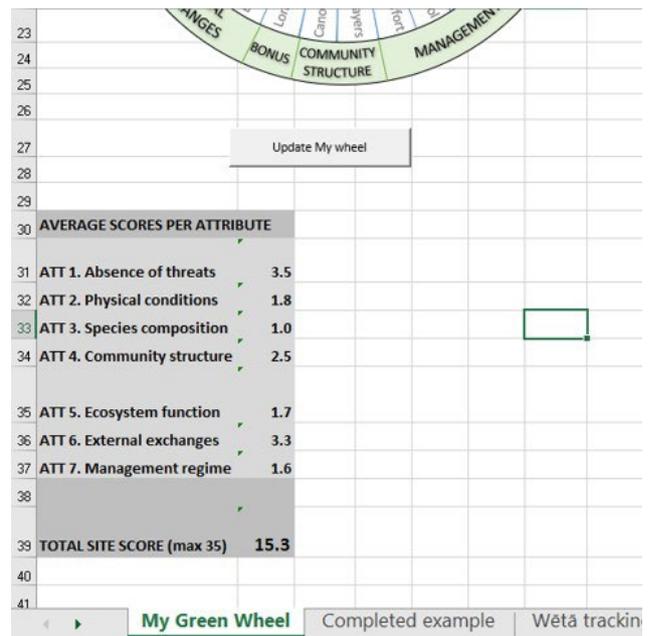
What it all means

You can look at the total score of all of the sub-attributes (from a maximum of 155), or you can look at the site score based on the broad attributes (from a maximum of 35). The site score is a more useful measure if you are unable to rank some of the sub-attributes (for instance if you have not had time to put out tracking tunnels for pests or wētā). Simply divide each total attribute score by the number of sub-attributes that you were able to assess to get the average score.

Look at areas where your score could be improved and take pride in the aspects that are scoring well. Check the **Complete Star Ranking table** (pages 31-44) to find out to find out what the indicators mean and why they matter.

Keep a copy of your **Site Datasheet** as well as your **Kahikatea Green Wheel Spreadsheet**. The **Site Datasheet** has your sketch map and notes on what changes you can make to improve the score for next time. Both are useful sources of information.

Repeat your Kahikatea Green Wheel assessment in five years' time to see what has changed and what your next priority management actions are to ensure your site is as healthy as it can be.

Complete Star Ranking table

This is a full list of the sub-attributes[2]. Those provided by the council are shaded blue – get the scores for your site from the council's **online map**. Those that will require botanical expertise are shaded light green, but for many of these sub-attributes, the Kahikatea Green Wheel spreadsheet will automatically generate a score simply by ticking which species are present in the forest stand. If in doubt or you are undecided between two star levels, be conservative and select the lowest star value that applies.

1 Stock access   👤 Landowner / Site manager

Livestock can destroy the undergrowth of native forest. Their presence kills off young plants that are the future canopy trees, and bare understories make the ground layer dry and more prone to fire risk.

A well-fenced kahikatea stand, or one that is not in grazing land, will have a healthier understorey, as long as weeds are kept in check. If in doubt, select the lowest score for which any of the descriptions apply.

★	★★	★★★	★★★★	★★★★★
No fences and heavily grazed throughout - signs include bare or mainly unpalatable plants in ground layer, heavily pugged, abundant cattle dung.	No fences and moderately grazed - minor amounts of dung, many unpalatable plants, some pugging, but site not heavily grazed throughout.	Fenced but not complete, or ineffective, or livestock are placed in the stand and site is heavily or moderately grazed.	Not or incompletely fenced, but site has minor signs of stock presence, livestock access is infrequent or does not penetrate more than 10m into the site because of impediments, e.g. blackberry, wet ground, drains, thick exposed roots, dense woody vines.	No stock have access, e.g. securely fenced or not in grazing land.

2 Feral ungulates (deer/goats/pigs)   👤 Landowner / Site manager

Feral hoofed animals can destroy the undergrowth of native forest. Their presence kills off young plants that are the future canopy trees, and makes the ground layer dry and more prone to fire risk.

A kahikatea stand that is protected from wild hoofed animals will have a healthier understorey, as long as weeds are kept in check.

★	★★	★★★	★★★★	★★★★★
Abundant sign of feral ungulates, dung pellets or signs of shrub browse across 75% or more of the site.	Ungulate dung pellets or sign of shrub browse across 50% to 74%.	Faecal pellets or shrub browse are present across 25% to 49% of the site.	Some evidence of feral ungulates, e.g. some hoof prints or dung but little sign of vegetation damage.	No evidence of feral ungulates.

2   This table is an updated version of that presented in the 2018 report Kahikatea Forest Green Wheel: developing a tool to assess ecosystem recovery of kahikatea remnants in the Waikato Region, Waikato Regional Council Technical Report 2019/1. Please use the attributes presented in this factsheet to apply the KGW.

③ Browsers (rabbits, hares)

Landowner / Site manager

Browsers, like rabbits and hares, can destroy the undergrowth of native forest. This kills off young plants that are the future canopy trees, and makes the ground layer dry and more prone to fire risk.

A kahikatea stand that is protected from rabbits and hares will have a healthier understorey, as long as weeds are kept in check.

★	★★	★★★	★★★★	★★★★★
Abundant sign of rabbits or hares, faecal pellets or signs of browse across 75% or more of the site.	Faecal pellets or signs of browse across 50% to 74% of the site.	Faecal pellets or signs of browse across 25% to 49% of the site.	Minor sign. Very old or just a few piles of pellets or minor browse seen.	Fully pest fenced or pest-free island, or no sign rabbits or hares have been recently in the site.

④ Mammalian predators

Landowner / Site manager

Mammalian predators (introduced animals like rats, possums and stoats) kill native birds and destroy eggs.

In a kahikatea forest where numbers of mammalian predators are low or absent, birds will have a much higher chance of raising young.

★	★★	★★★	★★★★	★★★★★
Very high pest numbers, detection on 9 or 10 out of 10 chew cards or tracking tunnels.	Moderate to high pest numbers, detection on 5-8 out of 10 chew cards or tracking tunnels.	Low to moderate pest numbers, detection on 1-4 chew cards or tracking tunnels.	No evidence of predators, zero detection on chew cards or tracking tunnels but site is not fully pest fenced.	Fully pest fenced or pest-free island and monitoring shows pests are absent, or at best recorded only infrequently (incursions).

⑤ Canopy weed abundance

Botanist

Canopy weeds in a kahikatea forest can shade out native plants or, if they are vines, smother and kill native trees. Deciduous trees are uncommon in New Zealand forests and can change the ecology by creating a big pulse of nutrients when they drop their leaves in autumn, opening the forest to unnatural amounts of light during the winter. They also change the look of the forest, affecting its natural character.

★	★★	★★★	★★★★	★★★★★
75% or more of the canopy (where visible or estimated from vine stems) comprised or covered in exotic species.	Exotic species cover or comprise 50-74% of the canopy.	Exotic species cover or comprise 25-49% of the canopy.	Exotic species cover or comprise 5-24% of the canopy.	Exotic species cover or comprise less than 5% of the canopy.

⑥ Shrub layer weed abundance (>30 cm tall)   ⬡ Botanist

Shrub weeds like privet take up space and resources, replacing native plants that would otherwise occur there. They also affect the natural character of a native forest area. To apply this score, mentally ignore native plants and assess how much of the mid tier space is occupied by weeds when viewed from a birds eye view. If you have a very sparse shrub layer you will have a low % value, even if all of the shrub layer is weeds.

★	★★	★★★	★★★★	★★★★★
Exotic species cover 75% or more of the mid-tier zone of the forest stand.	Exotic species cover 50-74% of the mid-tier zone.	Exotic species cover 25-49% of the mid-tier zone.	Exotic species cover 5-24% of the mid-tier zone.	Exotic species cover less than 5% of the mid-tier zone.

⑦ Ground cover weed abundance (<30 cm tall)   ⬡ Botanist

Exotic ground cover plants like wandering dew can form a thick carpet, stopping seeds of native plants from being able to reach the soil and take hold. This can prevent establishment of future canopy trees – over centuries as the old trees die there will be few younger ones to replace them.

★	★★	★★★	★★★★	★★★★★
75% or more of the entire forest floor is covered with exotic species (include vine thickets).	Exotic species comprise 50-74% of the forest floor.	Exotic species cover 25-49% of the forest floor.	Exotic species cover 5-24% of the forest floor.	Exotic species cover less than 5% of the forest floor.

⑧ Pest plant presence   ⬡ Botanist

Pest plants are weed species that have been declared to be a pest by the council. All land occupiers are responsible for managing plant pests on their land, while the council controls the highest threat pests, and aim to fully eradicate some of them from the region. The more plant pest species present, the more effort will be required to control them because they may need different treatments. Therefore, this indicator is scored on the number of plant pests present. Only species on the property where the kahikatea forest exists are included, because pest plants on a neighbouring property are beyond the ability of the landowner to control.

★	★★	★★★	★★★★	★★★★★
More than five regional pest plant species in the site and/or within 50m of it within the property.	Four or five regional pest plant species in the site and/or within 50m of it within the property.	Two or three regional pest plant species in the site and/or within 50m of it within the property.	One regional pest plant species in the site and/or within 50m of it within the property.	No regional pest plant species present in the site and/or within 50m of it within the property.

Kahikatea forests in a natural situation would receive pulses of nutrients and sediment during flood events, but these would be infrequent.

Continual high levels of nutrient input are not a natural situation for kahikatea forest and can encourage weed growth. Very excessive amounts, such as from livestock or high bird numbers, can "burn off" young seedlings.

Large amounts of nutrient-rich liquid can cause nuisance algal blooms in kahikatea forests that are still swampy. When bacteria break down rotting algae, they rob oxygen from the water which can lead to fish kills.

Sites with few inputs of excess nutrient from human activities will therefore be more natural and score more highly.

★	★★	★★★	★★★★	★★★★★
Constant high nutrient enrichment.	Regular but not constant high nutrient enrichment.	Regular small amounts of nutrient enrichment.	Occasional small amounts of nutrient enrichment.	No obvious sources of nutrient enrichment.
Examples: - septic wastewater pipes or year-round effluent disposal in site, and/or - forest permanently stocked with grazing animals, and/or - year-round high numbers of roosting birds.	Examples: - grazed on a rotational basis and/or - regular fertiliser application and/or - heavy grazing on adjacent upslope paddocks and/or - periodic/seasonal high number of roosting birds	Examples: - adjacent upslope paddocks are moderately grazed and/or - forest is lightly grazed (e.g. by sheep) and/or - moderate numbers of roosting birds	Examples: - forest never grazed but subject to runoff from lightly grazed adjacent slopes.	

⑩ Drainage

Landowner / Site manager

Prior to human arrival, kahikatea forests grew in places that experienced annual or more frequent floods, and for periods of the year would have had standing water. However, most of the ancient kahikatea swamp forests have been drained, and many Waikato kahikatea forest stands today are younger sites that developed on drier land. Sites that have been drained will have lost many sensitive species including fish and wetland plants, so drained sites are given a low score. Drained stands will have evidence of drains in or near them, and the trees may have exposed roots where the soil has dried and shrunk.

If the stand is a relatively young stand that developed on drier land it will score well for this indicator, because it has not experienced a change from wet to dry.

★	★★	★★★	★★★★	★★★★★
Site has been, and still is, subjected to severe drainage with evidence of active, regularly maintained (dug out) drains through, around or near the forest stand.	Drains affecting the stand are present but have not been actively maintained in the past five years. Landowner has no plans to restore formerly higher water levels.	Landowner has a plan to restore water levels in this stand.	Drains are in the process of being blocked or filled in, although some drains remain active.	Site has never been drained and is still subject to regular flooding, or former flooding regime has been completely restored (e.g. all drains filled in). Or site was never subject to flooding.

⑪ Human damage (rubbish/trampling etc)

Landowner / Site manager

Human damage such as vegetation felling, waste dumps, wide tracks or a lot of structures can reduce the natural character of a site and displace native plants. Does not apply to sprayed weeds, but does apply to native plants deliberately or accidentally sprayed with herbicide.

Minor structures, such as boardwalks or narrow tracks, can increase access to forests for nature appreciation and management, and therefore a 5-star score allows for some human structures.

★	★★	★★★	★★★★	★★★★★
Damage is moderate to intense across 75% or more of the site.	Damage is moderate to intense across 50% to 74% of the site.	Damage is moderate to intense across 25% to 49% of the site.	Damage is moderate to intense across 5% to 24% of the site. Or minor damage is evident across 25% or more of the site.	Minimal or no visual evidence of human presence (e.g. few structures or litter). Minor damage in less than 25% of the stand.

⑫ Size

Large sites score better because they can support more species of plants and animals, and they can protect themselves better from harsh edge effects (higher light, wind, temperatures). Therefore, larger sites are given higher Kahikatea Green Wheel scores. Planting up edges or between nearby sites can increase size and improve the score.

★	★★	★★★	★★★★	★★★★★
The kahikatea forest area is less than 1ha.	The kahikatea forest area is 1 to <5ha.	The kahikatea forest area is 5 to <10ha.	The kahikatea forest area is 10 to <20ha.	The kahikatea forest area is 20ha or more.

⑬ Shape

Sites that are "blocky" – square or circular – are cheaper to fence than narrow sites of the same size, and they will be less affected by edge effects. Planting between fingers of convoluted sites will square them up and improve their Kahikatea Green Wheel score.

★	★★	★★★	★★★★	★★★★★
Shape index is 3 or more (very convoluted or narrow).	Shape index is 2.5 to <3 (somewhat convoluted).	Shape index is 2 to <2.5 (blocky but stretched out).	Shape index is 1.5 to <2 (oval or round with some slight protrusions).	Shape index is less than 1.5 (very round or square).

⑭ Forest interior

The first 60m into kahikatea forest patches have higher light and wind levels, temperature extremes and lower humidity than the forest interior. These harsh 'edge effects' can reduce seedling survival, especially of some canopy tree species, and reduce the number and kinds of perching plants. They can also create an open or weedy forest understorey along the margin. Planting up edges and connecting them to other areas of native forest can increase the amount of forest interior over time. Sites with a bigger percentage of forest interior are given a higher Kahikatea Green Wheel score.

★	★★	★★★	★★★★	★★★★★
None of the kahikatea forest vegetation is more than 60m from a native forest edge.	Less than 10 % of the kahikatea forest vegetation is more than 60m from a native forest edge.	From 10 up to 25% of the kahikatea forest vegetation is more than 60m from a native forest edge.	From 25 up to 30% of the kahikatea forest vegetation is more than 60m from a native forest edge.	30% or more of the kahikatea forest vegetation is more than 60m from a native forest edge.

⑮ Buffering (dense vegetation around the stand) 👤 Landowner / Site manager

Areas of tall, dense vegetation (whether native or not) can protect, or "buffer" a kahikatea forest from harsh edge effects.

Sites with a forest buffer all the way round, or a very densely vegetated margin that blocks out high light, wind and temperature, will score more highly for the Kahikatea Green Wheel than sites that are exposed to harsh edge conditions.

★	★★	★★★	★★★★	★★★★★
Less than 25% of the site is protected from to edge effects by a dense margin and/or forest buffer.	From 25% to 49% of the site is protected from to edge effects by a dense margin and/or forest buffer.	From 50% to 74% of the site is protected from edge effects by a dense margin and/or forest buffer.	From 75% to 94% of the site is protected from edge effects by a dense margin and/or forest buffer.	Over 95% of site is protected from edge effects by a dense margin and/or forest buffer.

⑯ Dominance of native plants 🪱 Botanist

A very high proportion of native plants in New Zealand are endemic, meaning they grow nowhere else in the world and we have a special responsibility to protect them. Sites with a high proportion of native plants (that are naturally found in a kahikatea forest) help protect global biodiversity. See the list of native plants that naturally occur in kahikatea forest on the Kahikatea Green Wheel **web page**.

★	★★	★★★	★★★★	★★★★★
Fewer than 20% of species present are indigenous species that naturally occur in kahikatea forest.	From 20% to 49% of the plant species in the forest are indigenous species that naturally occur in kahikatea forest.	From 50% to 69% of the plant species in the forest are indigenous species that naturally occur in kahikatea forest.	From 70% to 79 % of the plant species in the forest are indigenous species that naturally occur in kahikatea forest.	80% or more of the plant species in the forest are indigenous species that naturally occur in kahikatea forest.

⑰ Characteristic plant species 🪱 Botanist

Biodiversity is not just about the range of species, it is also about the range of ecosystems. To protect biodiversity, it is important that each ecosystem type retains a typical mix of species – so that each one is distinctive and unique. New Zealand has many distinct forest types, each with its own natural complement of species. Many native plants are not typical of kahikatea forests, including upland species, plants that typically grow on volcanic soil, or estuarine plants. The Kahikatea Green Wheel gives higher scores to sites that have a characteristic suite of plant species, those that are the most likely to be found in a healthy kahikatea forest stand. You cannot improve your Kahikatea Green Wheel score simply by planting any native species, the score is based only on species that are typical of a kahikatea stand (found in over half of a set of healthy Waikato kahikatea stands). See the list of characteristic kahikatea forest plants on the Kahikatea Green Wheel **web page**.

★	★★	★★★	★★★★	★★★★★
Up to 10 characteristic species are present.	11-15 characteristic species are present.	16-20 characteristic species are present.	21-25 characteristic species are present.	More than 25 characteristic species are present.

18 Indicator animal (wētā)

Animal species that are vulnerable to pest animals or habitat degradation can provide information on whether the site is healthy for them and other sensitive species.

Birds are often used as indicators of forest health, but most kahikatea forests are small and forest birds will come and go depending on what is fruiting in the neighbourhood. Wētā have been chosen as a kahikatea forest indicator species because they won't move far from a forest site, are vulnerable to rodents and other predators, and easy to monitor. A change in wētā abundance is more likely the result of changes within the site (such as rodent control, vegetation recovery and microclimate) so high numbers are a sign that management actions are working.

★	★★	★★★	★★★★	★★★★★
No wētā tracks recorded in seven nights.	10% weekly tracking rate (wētā tracks in one of 10 tunnels).	20% weekly tracking rate (wētā tracks in two of 10 tunnels).	30% weekly tracking rate (wētā tracks in three of 10 tunnels).	Greater than 30% weekly tracking rate (wētā tracks in four or more of 10 tunnels).

19 Vegetation layers (shrub/canopy layers etc)

Botanist

Healthy kahikatea forests have almost solid cover of native plants in the canopy, shrub layer and ground tier. However, in very wet or very shaded areas the ground cover may be naturally sparser. Ground tier is defined as vegetation lower than 30cm.

★	★★	★★★	★★★★	★★★★★
No vegetation tier is intact (all layers have less than 50% cover of indigenous vegetation).	One tier is relatively intact (50% or more indigenous cover).	Two tiers are relatively intact (50% or more indigenous cover).	All tiers have 50% or more indigenous cover, but at least one of them has less than 75% cover.	All layers have >75% cover comprising indigenous species. Emergent trees (standing well above the rest of the forest) may or may not be present.

20 Canopy condition (signs of damage/dieback etc)   ⬡ Botanist

A healthy kahikatea forest will have a healthy canopy with very few dead or dying trees. A native forest typically has 1% of its trees dead at any one time. Higher values indicate something is not right – maybe the site is too dry, or has been trampled by stock, or the trees have a disease.

Kahikatea foliage can come in a wide range of colours, and male trees may take on a yellow tinge when they are covered with their tiny cones, therefore ensure any yellow colour is die-back when assessing this score.

★	★ ★	★ ★ ★	★ ★ ★ ★	★ ★ ★ ★ ★
75% or more of the indigenous foliage in the canopy is showing signs of yellowing or defoliation.	50% to 74% of the indigenous foliage in the canopy is showing signs of yellowing or defoliation.	25% to 49% of the indigenous foliage in the canopy is showing signs of yellowing or defoliation.	2% to 24% of the indigenous foliage in the canopy is showing signs of yellowing or defoliation.	1% or less of the canopy is showing signs of yellowing or defoliation.

21 Winter bird food availability   ⬡ Botanist

Winter is a particularly lean time for native birds. Kahikatea stands with many winter food plants will help keep native birds alive and prime them for the breeding season. Such sites will score highly in the Kahikatea Green Wheel assessment, and planting depleted stands with suitable winter bird food plants can increase their score. See the list of winter bird food plant species on the Kahikatea Green Wheel **web page**.

★	★ ★	★ ★ ★	★ ★ ★ ★	★ ★ ★ ★ ★
No winter bird food species are present.	One to five winter bird food species are present.	Six to 10 winter bird food species are present.	11-15 winter bird food species are present.	More than 15 winter bird food species are present.

22 All season bird food availability   ⬡ Botanist

Waikato kahikatea stands are typically small with a limited supply of food for native birds. Stands with a large number and diversity of fruiting and flowering plants can better provide year-round food for native birds, reducing their need to burn up energy flying to other forest areas. Sites with a greater number of bird food trees (that are typical of kahikatea forest vegetation) will get a higher KGW score. See the list of all season bird food species on the Kahikatea Green Wheel **web page**

★	★ ★	★ ★ ★	★ ★ ★ ★	★ ★ ★ ★ ★
Fewer than five bird food species are present.	Five to nine bird food species are present.	10-19 bird food species are present.	20 to 40 bird food species are present.	More than 40 bird food species are present.

23 Plant recruitment

Botanist

In healthy forests there is a regular cycle of plant growth, from flower to fruit to seed to seedling to sapling to mature plant. Where animal pests are abundant, flowers, fruit and seeds can be eaten out, leaving few young plants to replace the old ones as they die out. The presence of seedlings is a sign that the regeneration process is working properly – the more species that are present as seedlings, the better the chance of the forest continuing to thrive into the future.

★	★★	★★★	★★★★	★★★★★
Fewer than 25% of the native trees or shrubs in the stand are present as established seedlings.	25% to 49% of native trees or shrubs in the stand are present as established seedlings.	50% to 74% of native trees or shrubs in the stand are present as established seedlings.	75% to 90% of native trees or shrubs in the stand are present as established seedlings.	Over 90% of native trees or shrubs in the stand are present as established seedlings.

24 Landscape matrix (nearby habitat)

Waikato Regional Council

The type of land cover around a kahikatea fragment will affect how healthy it is. Similar land cover types, like native forest or native scrub, are usually the best 'next door neighbour'. Kahikatea forest patches surrounded by large areas of native habitat will have a better chance of being colonised by birds and native seeds. This can help them recover if they are damaged by pests or livestock. Native animals living in them will also have a better chance of survival if there is a lot of alternative habitat nearby to find food throughout the year.

In addition, nearby areas of fernland and shallow freshwater wetlands, such as flaxland, sedgeland or willow-invaded wetlands, are sites where the kahikatea stand may distribute its seed to continue its legacy.

Sites with a lot of native vegetation or shallow freshwater wetlands around them get higher Kahikatea Green Wheel scores.

★	★★	★★★	★★★★	★★★★★
There is no indigenous forest, scrub, fernland or shallow freshwater wetland within a 1km radius of the site.	Less than 25% of the land within a 1km radius of the site is in indigenous forest, scrub, fernland or shallow freshwater wetland.	From 25% up to 50% of the land within a 1km radius of the site is in indigenous forest, scrub, fernland or shallow freshwater wetland.	From 50% up to 75% of the land within a 1km radius of the site is in indigenous forest, scrub, fernland or shallow freshwater wetland.	75% or more of the land within a 1km radius of the site is in indigenous forest, scrub, fernland or shallow freshwater wetland.

25 Habitat links (terrestrial)

Wildlife living in isolated kahikatea stands can struggle to find enough food or a breeding partner. Species that can't travel safely between forest fragments may die out in smaller isolated stands.

Sites that are close to another patch of native forest or scrub get a higher KGW score. Planting shrub corridors along rivers and streams can help reconnect isolated stands and improve their score.

★	★★	★★★	★★★★	★★★★★
Site is 4km or more from another patch of indigenous forest and/or scrub greater than 25ha.	Site is 2km-4km from another patch of indigenous forest and/or scrub greater than 25ha.	Site is 500m-2km from another patch of indigenous forest and/or scrub greater than 25ha.	Site is 100m-500m from another patch of indigenous forest and/or scrub greater than 25ha.	Site is less than 100m from another patch of indigenous forest greater than 25ha.

26 Habitat links (aquatic)

Historically, many Waikato kahikatea fragments would have been near rivers or streams that periodically flooded, replenishing the site with aquatic plants and animals. Drainage or river training, including installing perched culverts, can destroy those aquatic connections.

Younger kahikatea stands that established on land cleared by settlers may have never had such connections and will automatically score 5 stars because they have not lost any former waterway linkages. Where original aquatic habitat links have been retained, reconnected, or never existed, the site will score highly in the Kahikatea Green Wheel assessment.

★	★★	★★★	★★★★	★★★★★
No natural links remain, site no longer inundated.	Partial links to nearby stream or wetland via extreme flood events.	Streams or drains flow through or beside the stand, (may be dry in summer) but most of them are unvegetated, and/or have perched culverts on the property. Partial links via moderate to extreme flood events.	All waterways are connected upstream and downstream (with no perched culverts) but some have breaks in riparian cover on the property. Partial inundation via surface flows/flood events.	All waterways in the stand (if any) are fully connected with continuous riparian buffers and no perched culverts or other fish barriers between the site and property boundary. Regular inundation via flooding or surface flows. Or was likely never connected to a waterway.

27 Legal protection

Sites that are legally protected, through rules in a district plan, or gazetted as a public reserve or a private covenant, will have ongoing security, even if the land changes hands. Fully protected sites score a higher Kahikatea Green Wheel value, but medium scores apply to sites where steps are being taken to ensure protection in perpetuity or where part of the site on this property is legally protected, or the site is legally protected for a fixed term. Choose the highest score that applies to the site being assessed. If only a portion of your site is legally protected, consider completing separate Green Wheel assessments for each portion, but be sure to always reassess those portions separately in the future.

★	★★	★★★	★★★★	★★★★★
No formal legal protection or plans for such.	Legal protection is being pursued (e.g. application lodged with QEII National Trust or Ngā Whenua Rāhui).	Site is not a reserve or covenant/ kawenata, but is listed on a district or regional council schedule of significant areas. Or the site is partly or fully protected via a council management agreement. Or, up to 50% of the stand on this property is protected as a gazetted reserve	From 50 to 90% of the stand on this property is legally protected as a gazetted reserve or private covenant or kawenata.	Over 90% of the stand on this property is legally protected in perpetuity as a gazetted reserve or private covenant or kawenata.

28 Management plan

Waikato kahikatea fragments are typically small and in need of active management to protect them from edge effects, pests, weeds and other threats. Having a plan that identifies the site's needs with clear, specific actions to address them is a crucial first step for a successful restoration project. A professionally produced plan that specifically addresses the site is considered a 5-star level. Implementing the plan is covered in other sub-attributes.

★	★★	★★★	★★★★	★★★★★
No management plan exists or intended.	Informal (unwritten) plan exists for the site, or a plan is in preparation.	Site is subject to a wider farm or reserve plan, but with minimal specific reference to the site.	Site is subject to a wider farm or reserve plan with specific reference and action points.	Professionally prepared management plan exists specifically for the fragment.

(29) Animal pest control effort

Landowner / Site manager

Animal pest control, to enable native plants and animals to survive, is an essential forest management activity for almost every natural area on the New Zealand mainland. To be effective, however, it must be regular and sustained control. Permanent exclusion of animal pests such as via a predator fence, will be given a five-star Kahikatea Green Wheel ranking.

★	★★	★★★	★★★★	★★★★★
No animal pest control is conducted, and no plans are in place to implement animal pest control.	No animal pest control is conducted but control plans are being or have been developed though not yet implemented.	Animal pest control has been implemented but is irregular or does not target all major animal pest species present.	Site is subject to an ongoing programme of predator monitoring and control for all major pest species likely to be present.	Site is fully pest-fenced or on a pest-free island and animal pests are absent or managed in the event of an incursion.

(30) Invasive plant control effort

Landowner / Site manager

Invasive plants can compete with native plants, smother and kill them, or cover the ground and prevent seedlings from getting established.

Regular weed control of invasive plants is essential to maintain the health of kahikatea forests, which are particularly vulnerable to invasion because they are typically small with a high proportion of edge favoured by many weed species.

Other sub-attributes can provide information to show how effective weed control work has been.

★	★★	★★★	★★★★	★★★★★
Site is highly or moderately degraded (scoring average 1 or 2 stars for sub-attributes (5) (6) (7) (8)) and no invasive plant / weed control has been planned or undertaken.	Site is highly or moderately degraded (scoring average 1 or 2 stars for sub-attributes (5) (6) (7) (8)) but plant pest control is planned or being implemented.	Site is slightly degraded (average 3 or 4 stars for sub-attributes (5) (6) (7) (8)) and no invasive plant / weed control has been planned or undertaken.	Site is slightly degraded (average 3 or 4 stars for sub-attributes (5) (6) (7) (8)), but plant pest control is planned or being implemented.	Site has relatively few plant pests, scoring 5 stars for all sub-attributes (5) (6) (7) (8), so plant pest control is not needed or is being highly effective.

31 Revegetation effort

Most Waikato kahikatea forests are small and many have been grazed in the past, leaving them with missing shrub layers, big gaps in the canopy, bare understoreys and exposed edges.

Planting edges is a high priority to seal off the forest and improve the forest interior, along with getting canopy trees planted to fill in gaps where big trees have been felled.

Understoreys will often come away themselves if weeds are cleared, but if species diversity is unnaturally low, enhancement planting of characteristic kahikatea species, including bird food ones, can improve the Kahikatea Green Wheel score. Sites that have retained high scores for vegetation sub-attributes, or that are subject to extensive revegetation will score highly for revegetation effort.

★	★★	★★★	★★★★	★★★★★
Site scores an average <=3 stars for sub-attributes 15 16 17 19 21 22 23 but no revegetation has been planned or recently undertaken.	Site scores an average <=3 stars for sub-attributes 15 16 17 19 21 22 23 but replanting is underway.	Site scores an average >3 to <5 stars for sub-attributes 15 16 17 19 21 22 23 and no revegetation has been planned or recently undertaken.	Site scores an average >3 to <5 stars for sub-attributes 15 16 17 19 21 22 23 and replanting is underway.	No revegetation is required – site ranks five stars for all of sub-attributes 15 16 17 19 21 22 23.

32 Bonus indicator (long-tailed bats)

In the Waikato lowlands, kahikatea forests may be among the few natural areas left for long-tailed bats to roost in.

While landowners can't control where bats choose to roost, you can increase the survival of any bats that are present or that move to your site by leaving suitable roosting habitat (this can also include exotic trees) and managing predators (rats, mustelids, cats) to low numbers. Regularly used bat roosts can be further protected by banding trees above and below the roost, however, ensure you involve the experts to reduce risk to the bats (which may be present during the day).

★	★★	★★★	★★★★	★★★★★
Long-tailed bats not detected in the kahikatea stand in the past five years.	Long-tailed bats detected in the kahikatea stand in one of the past five years.	Long-tailed bats detected in the kahikatea stand in two of the past five years.	Long-tailed bats detected in the kahikatea stand in three of the past five years.	Long-tailed bats detected in the kahikatea stand in four or all of the past five years.

He taiao mauriora   Healthy environment

He ōhanga pakari   Strong economy

He hapori hihiri   Vibrant communities

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Waikato

REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato