Wakapuaka River Care Day

24 March 2018, Hira Domain

Table of Contents

Contents

1 Overview of what is a healthy stream and what makes up good water quality

Annette Litherland, Janet Gregory, NZ Landcare Trust

Email: annette.litherland@landcare.org.nz
Mobile 027 7244445

1.1 Introduction

A River Care day was held at the Hira Domain on the 24 March 2018 to support the "Wakapuaka Bursting with Life" campaign. These notes include presentations that were made on the day and some background information to help the community understand more about water quality. It also outlines the priorities and direction that were obtained in discussion with the 25 participants at the end of the day. These are designed to be emailed to people living in the Wakapuaka catchment so they have access to the information and discussions that occurred at the River Care Day. All the photos in this document were collected within the Wakapuaka catchment.

The aim of the "Bursting with Life" campaign for the Wakapuaka catchment is to build community involvement in improving the water quality and health of the streams and rivers in this catchment.

Haven't seen the video made on the Wakapuaka to launch the campaign.

You can view the video via this link. Bursting with Life video project on Vimeo. https://vimeo.com/259226187 password = bwl123 or on the Landcare Trust Top of the South facebook page

An understanding of the measures of stream health and water quality will help with interpreting the test results for the Wakapuaka river, and understanding the impact you may be having on the river and how you can help it "Burst with Life" for yourself, everything that lives in it and for future generations.

A healthy stream and good water quality results from everyone working together in the catchment to make it happen.

Communities are working together over the whole of New Zealand to improve the catchments that they live in. Here is a video of another catchment project which has improved water quality.

https://www.ruraldelivery.net.nz/stories/Pomahaka-Catchment-Project

In New Zealand, a key to preserving the environment is to maintain healthy water and healthy streams and rivers. Water quality and stream health in our country is excellent in rivers draining bush areas and in less intensively run sheep and beef farming and in some forestry areas. It is poorer in areas where there is intensive farming, some forestry areas and high populations of people.

Water quality and stream health means many things to different people.

A healthy stream has good quality water, so that stream life can happily live, grow and breed (native species, trout etc) in the water. Important factors for health of aquatic life are water temperature, water pH, oxygen levels and competing life forms. Low bacteria levels are important for shellfish, and for kai-gathering.

Good quality water from a recreational point of view means that the water is clear, doesn’t contain algae or weeds, sediment and contains no harmful bacteria. That is, it is swimmable.

Swimability maps for Nelson.

http://www.mfe.govt.nz/fresh-water/about-freshwater/nelson

Good water quality can be defined by some as fit to drink.

With farming it is often the chemical tests of water and the count of bacterial levels that are considered important, however these are very impacted by flow levels.

1.2 Definitions of a healthy stream

When you are looking at the health of your section of the stream or river you can use the National Rapid Habitat scoring assessment which was developed locally by the Cawthron Institute. It uses a scoring method to determine the health of the stream.

In their definition a healthy stream has the following:

- Low levels of fine sediment (you can assess this by shuffling your feet in the stream or by assessing how much of the stream bed contains sediment)
- A non-eroding bank (you can see and score this)
- Plenty of habitat for macro-invertebrates and fish (you can catch and count these).
- Shading cover, especially on the northern side, with vegetation with good diversity in a sizeable riparian strip (you can see and score this).
- A water course with pools, with of variety in flow depths and the stream meanders with curves (you can see and score this)

National Rapid Habitat scoring assessment table

Habitat parameter	Condition category										SCORE
1. Deposited sediment	*The percentage of the stream bed covered by fine sediment.*										
	0	*5*	*10*	*15*	*20*	*30*	*40*	*50*	*60*	*≥ 75*	
SCORE	10	9	8	7	6	5	4	3	2	1	
2. Invertebrate habitat diversity	*The number of different substrate types such as boulders, cobbles, gravel, sand, wood, leaves, root mats, macrophytes, periphyton. Presence of interstitial space score higher.*										
	≥ 5	*5*	*5*	*4*	*4*	*3*	*3*	*2*	*2*	*1*	
SCORE	10	9	8	7	6	5	4	3	2	1	
3. Invertebrate habitat abundance	*The percentage of substrate favourable for EPT colonisation, for example flowing water over gravel-cobbles clear of filamentous algae/macrophytes.*										
	95	*75*	*70*	*60*	*50*	*40*	*30*	*25*	*15*	*5*	
SCORE	10	9	8	7	6	5	4	3	2	1	
4. Fish cover diversity	*The number of different substrate types such as woody debris, root mats, undercut banks, overhanging/encroaching vegetation, macrophytes, boulders, cobbles. Presence of substrates providing spatial complexity score higher.*										
	≥ 5	*5*	*5*	*4*	*4*	*3*	*3*	*2*	*2*	*1*	
SCORE	10	9	8	7	6	5	4	3	2	1	
5. Fish cover abundance	*The percentage of fish cover available.*										
	95	*75*	*60*	*50*	*40*	*30*	*20*	*10*	*5*	*0*	
SCORE	10	9	8	7	6	5	4	3	2	1	

6. Hydraulic heterogeneity	*The number of of hydraulic components such as pool, riffle, fast run, slow run, rapid, cascade/waterfall, turbulance, backwater. Presence of deep pools score higher.*										
	≥ 5	*5*	*4*	*4*	*3*	*3*	*2*	*2*	*2*	*1*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
7. Bank erosion	*The percentage of the stream bank recently/actively eroding due to scouring at the water line, slumping of the bank or stock pugging.*										
Left bank	*0*	*≤ 5*	*5*	*15*	*25*	*35*	*50*	*65*	*75*	*> 75*	
Right bank	*0*	*≤ 5*	*5*	*15*	*25*	*35*	*50*	*65*	*75*	*> 75*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
8. Bank vegetation	*The maturity, diversity and naturalness of bank vegetation.*										
Left bank AND Right bank	*Mature native trees with diverse and intact understorey*		*Regenerating native or flaxes/sedges/tussock > dense exotic*			*Mature shrubs, sparse tree cover > young exotic, long grass*			*Heavily grazed or mown grass > bare/impervious ground.*		
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
9. Riparian width	*The width (m) of the riparian buffer constrained by vegetation, fence or other structure(s).*										
Left bank	*≥ 30*	*15*	*10*	*7*	*5*	*4*	*3*	*2*	*1*	*0*	
Right bank	*≥ 30*	*15*	*10*	*7*	*5*	*4*	*3*	*2*	*1*	*0*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
10. Riparian shade	*The percentage of shading of the stream bed throughout the day due to vegetation, banks or other structure(s).*										
	≥ 90	*80*	*70*	*60*	*50*	*40*	*25*	*15*	*10*	*≤ 5*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
TOTAL	(Sum of parameters 1-10)										

Learn more

http://envirolink.govt.nz/assets/Envirolink/1519-NLRC174-National-Rapid-Habitat-Assessment-Protocol-for-Streams-and-Rivers.pdf

2. Components of good water quality

Good water quality is defined in a number of ways.

2.1 Water clarity

Clear water. Water clarity (how far you can see through the water) is reduced by algal growth and more importantly by the presence of sediment. Poor water clarity makes it difficult for predators that live in the stream to catch their prey and reduces the light for algae which are their food source.

It can be measured in a tube or by viewing a black disc in the river.

2.2 Acceptable levels and types of weed and algae growth in water

Algae and weed growth decrease clarity of water, can be smelly, can clog pipes, reduce water flow, and smother other species. They can affect recreational use of the water, alter the pH and remove oxygen from the water, which can kill the fish. Sometimes they can even be toxic. But they also recycle nutrients and are a food source of other animals.

Periphyton (on exposed surfaces)		
		Peri. score
Thin mat/film:	green	7
(under 0.5 mm thick)	light brown	10
	black/dark brown	10
Medium mat:	green	5
(0.5-3 mm thick)	light brown	7
	black/dark brown	9
Thick mat:	green/ light brown	4
(over 3 mm thick)	black/dark brown	7
Filaments, short	green	5
(under 2 cm long)	brown/reddish	5
Filaments, long	green	1
(over 2 cm long)	brown/reddish	4

There are two types of algae. Those that grow on organic matter in the water (sewage fungi) and those that use sunlight as an energy source and use nutrients in the water (Plankton algae).

Periphytons are a mixture of algae, bacteria and microbes that attach to submerged surfaces in the streams and rivers. They are a food source for invertebrates which are themselves food sources for insects in the water and they in turn are eaten by fish and birds. The presence of *some* of these periphytons (eg long filamentous green) are an indicator of an unhealthy stream. Provided these are measured at standard flow levels (often in summer) they are less variable than the water quality chemical tests and reflect the health of a stream over a longer time period.

Researchers have looked at the various periphytons and given them a ranking from 1 to 10 with 1 being the found in very unhealthy streams and 10 being found in very healthy streams. The relative amount of each and aggregated to give a mean score can be used as an index of a healthy stream. The higher the periphyton score the better the water quality.

This can be done by anyone with some training by looking through a mask into the water and observing a number of rocks and recording the proportion on each rock of each of the periphytons classes outlined in the above table.

Trees planted along small and medium streams reduce water temperatures and light levels thereby reducing algal growth.

Figure 1. Top: blooms of long green filamentous algae. Bottom left: brown filamentous algae adheres to a tracer stone used to assess bed disturbance in a stream. Right: mature long green filaments amid a matrix of light brown mat-forming algae. Photos: Golder Associates.

Reference http://www.doc.govt.nz/Documents/science-and-technical/inventory-monitoring/im-toolbox-freshwater-ecology/im-toolbox-freshwater-ecology-periphyton-rapid-assessment-monitoring-(ram)-in-streams-method-1.pdf

Factors affecting weed and plankton algal growth include levels of carbon dioxide, warmth/light, phosphate, and nitrogen (nitrate and ammonia) and suitable river (flow rate, river bed material) or lake bed. Growth of algae is limited by the rate limiting factor. For example, there may be enough nitrogen but not enough phosphate for algal growth. So removing nitrogen will have no effect on algal growth. The growth limiting factor can vary over the season. In summer it may be one of the nutrients that is limiting but in winter it could be light, temperature or flooding that limits growth. During floods algae and weeds can be flushed out of the waterway and grazing by water, and animals (insects, snails, fresh water crayfish, grass carp) can also remove weed.

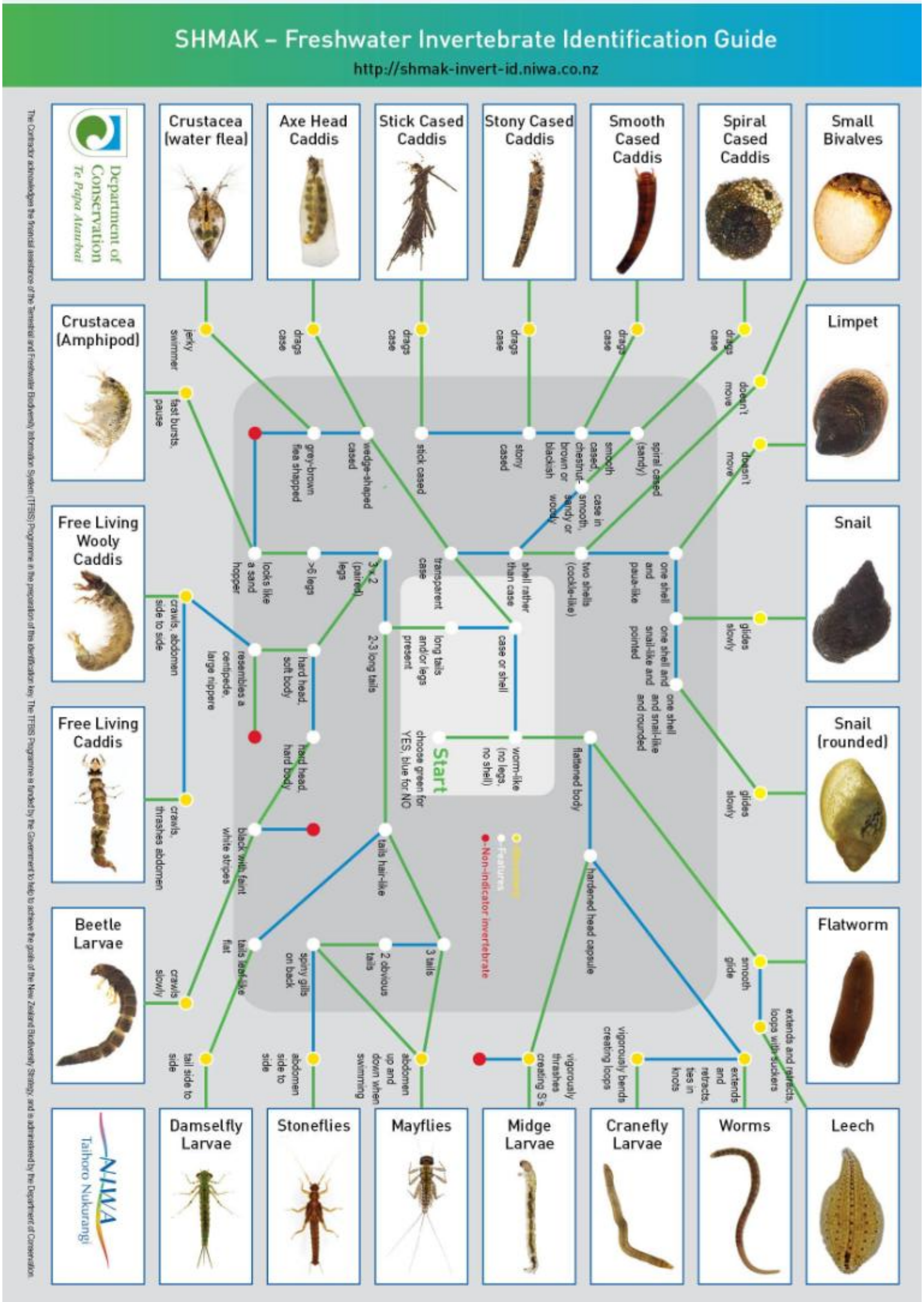
2.3 Acceptable types and levels of macro-invertebrate populations

The macro-invertebrates are a food source for fish. But they also indicate through their density and their type the health of a stream. Macro-invertebrates, such as insects, koura, mussels, snails and worms, don't have backbones and are big enough to see with the naked eye. They can be combined in a Macro-Invertebrate Community Index (MCI) that is most useful for tracking stream health over time. MCI Levels above 120 are considered to indicate very healthy streams.

Invertebrates	**Invert. score**
Enter type of sample (stone, gravel, silt, plant, etc.):	
Worms (e.g. thin brown/red *Tubifex*)	**1**
Flatworms, leeches	**3**
Snails (1–3 mm across, pointed end)	**4**
Snails (4–6 mm across, rounded)	**3**
Small bivalves (up to 4 mm across)	**3**
Limpet-like molluscs (*Latia*, up to 8 mm wide)	**7**
Freshwater crustaceans (amphipods, water fleas)	**5**
Ostracods ("seed shrimps") (up to 2 mm long)	**1**
Beetle larvae and adults	**6**
Midge larvae (3–7 mm long, white - red)	**2**
Cranefly larvae	**5**
"Axehead" caddis (*Oxyethira*, 2–3 mm long)	**3**
Caddisfly larvae (rough stony cases, or cases of sticks, etc. and free-living)	**6**
Smooth-cased caddisfly larvae (*Olinga*, up to 10 mm long, chestnut-brown colour)	**9**
Spiral caddis (*Helicopsyche*, up to 3 mm wide)	**10**
Mayfly larvae (2–15 mm long)	**9**
Stonefly larvae (large species, up to 20 mm)	**10**

Mayflies for example are sensitive to pollution and are given high scores whereas worms are not sensitive and get low scores (see Table to the left). You can see all the types of macro-invertebrates that can be found in a stream in the identification sheet below.

Reference https://www.niwa.co.nz/freshwater/management-tools/water-quality-tools/stream-health-monitoring-and-assessment-kit



2.4 Water with low nutrient levels

High nutrient levels in water ways promotes algal growth. It is largely levels of nitrogen and phosphate that are the nutrients measured for water quality and both need to be high for algal growth to occur.

2.4.1 Nitrogen

High levels of nitrate in the water can increase algae growth and at high levels can be toxic to fish, invertebrates and humans. Ammonia is also sometimes measured in the water and is an indicator of human impact on the waterway.

Nitrates enters the waterways from farmland, largely from urine patches, forestry as trash breaks down and from point sources associated with human effluent discharges. The higher the stocking rate of cattle or humans the more nitrate potentially enters the waterway. There is often surplus nitrogen in the diet of stock grazing on pastures and this surplus nitrogen is lost in urine. The nitrate in the urine patches is flushed during drainage through the soil beyond the reach of plant roots. More nitrate is lost from the bottom of unhealthy soils with little organic matter and during cultivation.

There are a number of different nitrogen tests done on water; some measure nitrate levels, others measure ammonia nitrogen which is an indicator of sewage in the waterway.

2.4.2 Phosphate

Human effluent, soaps and storm water are sources of phosphate contamination. Phosphate is also carried into waterways on sediment which can come from eroding stream banks, farmland and forestry. In some rivers phosphate levels have increased but overall the New Zealand trend is towards a reduction in levels. This is probably due to the recent improvements in storm and waste water processing in towns, better effluent control and reduced phosphate applications on farms near waterways.

The chemical test called "dissolved reactive phosphorous" provides the best measure of the potential for algal blooms.

As a landowner, when using phosphate fertiliser, be careful where you place it and soil test to make sure you are using it optimally. Avoid placing fertilisers close to waterways and in gullies where it can be washed into waterways. Avoid generating bare soil over winter and prevent pugging of soils. Graze your stock on crops starting a point most distance from the waterway and back fence to prevent pugging of soils.

You can also reduce sediment entering waterways by building sediment dams.

Learn more.

http://www.mfe.govt.nz/publications/environmental-reporting/environment-aotearoa-2015-fresh-water/state-our-fresh-water

http://www.gw.govt.nz/assets/Land-Management/Reducing-the-impacts-of-winter-grazing-factsheet.pdf

https://www.boprc.govt.nz/media/273658/futureproof_erosion_web.pdf

http://www.fertiliser.org.nz/Site/resource_center/Booklets.aspx

2.5 Water with low *E. Coli* bacteria levels

Faecal contamination is the main cause of high *E. coli* levels - and a major issue for the Wakapuaka river. *E. coli* levels are used as a potential indicator of the presence of other pathogenic bacteria (for example, Campylobacter). They are highest during or after storm events when faecal material is washed into the river.

Faecal contamination can also come from cattle defecating in waterways. Cattle are 70 percent more likely to defecate in the waterway than they are on land. They like to "poo" in water. Sheep don't like to enter water but their faeces does have high concentrations of *E. coli* and their faecal matter can be washed into waterways, especially during storm events.

Faeces from dogs, birds, horses and pigs can also be washed into the water and result in high *E. coli* levels.

Ways to prevent this includes fencing stock, especially cattle, from waterways.

Learn more about fencing waterways:

https://www.dairynz.co.nz/environment/waterways/fencing-waterways/

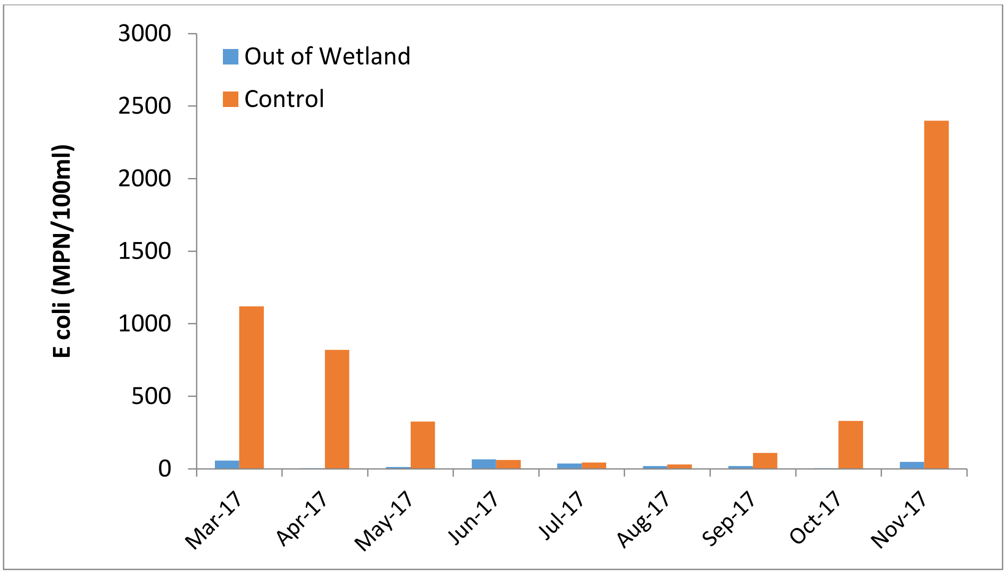
https://www.dairynz.co.nz/media/4329877/waterway-technical-notes.pdf

Leaving a five-metre strip of grass reduces the overland flow of faecal material into water. This can further be enhanced by strategic plantings in the riparian strip. These plantings can help protect the river bank from erosion, provide food for fish and also shade the river.

The riparian area is a buffer where nutrients travelling over land can be caught and taken up by plants. This can reduce the amount of nutrients and *E. coli* entering the waterways overland by 40-60 percent.

For example, in the Aorere catchment in Golden Bay the fenced and planted creeks had *E. coli* measures consistently below 100 cfu/ml whereas unfenced/planted creeks had *E. coli* levels from 80-500 cf/ml. And in creeks where critical source areas allowed effluent to enter waterways *E. coli* levels ranged from 1000-5000 cfu/ml.

Channelling water from small streams into wetlands to settle out *E. coli* (and sediment) has been shown to be very effective in reducing *E. coli* levels. In this study in Southland farmers have put in two small sediment dams along a stream and then have fed the water via a wetland before the water enters a larger stream. You can see below the water coming out of the wetland has a much lower levels of *E Coli.*

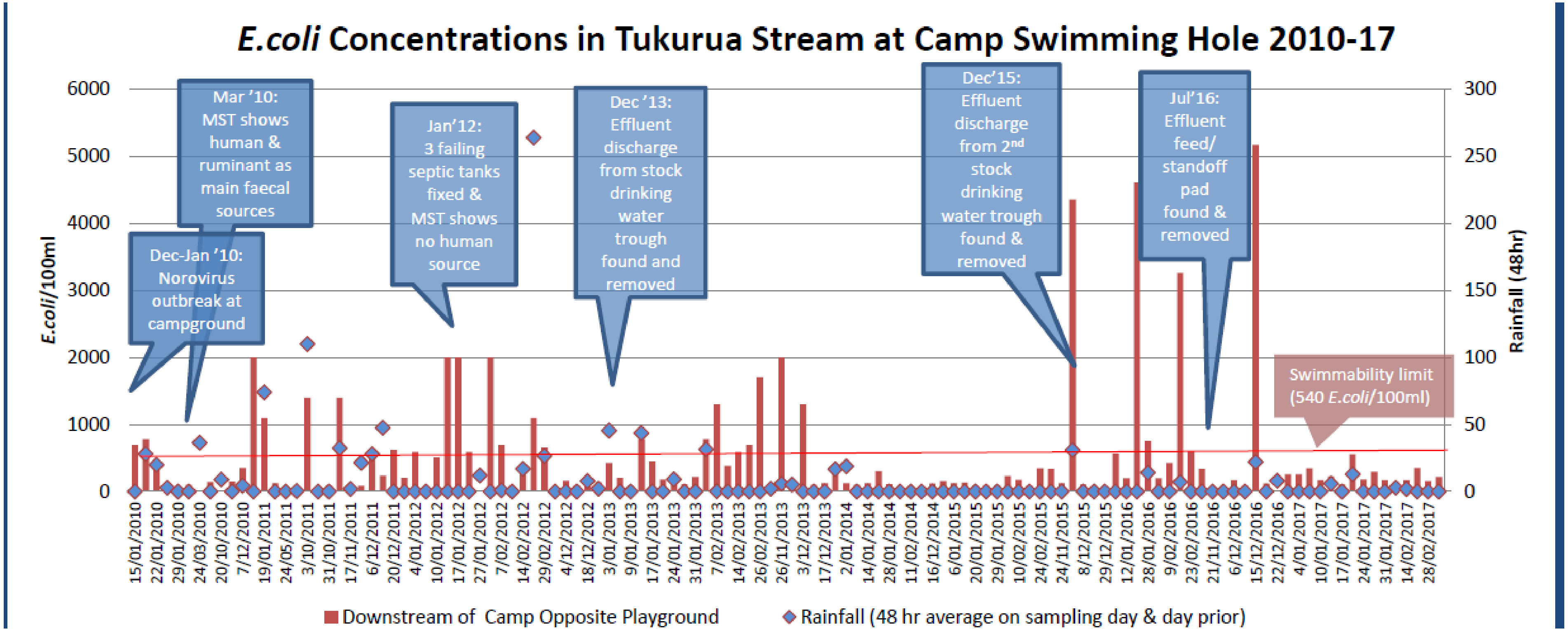


Learn more about planting waterways
https://www.dairynz.co.nz/environment/waterways/planting-waterways/#guides

Bunds can also be constructed to stop the overflow of water containing faecal material and sediment entering the waterway.

So finding those critical source areas where high concentrations of faecal matter flow into waterways is very important. Note where your stock camp, stock yards, chicken coops, pig pens, offal holes and such are and where faeces can be washed into waterways. Strategies to divert this material away into soak holes or into filter areas such as wetlands or away from waterways are important. In some cases, these critical source areas can be shifted back from the waterways or to places where the water won't flow from them into a waterway. It may be as simple as filling in around a trough or fixing a leaking septic tank.

See below a study by Trevor James, from Tasman District Council, where there were a number of critical source areas identified over time that were causing peaks in *E. Coli* in a small catchment running through a farm.


E.coli Concentrations in Tukurua Stream at Camp Swimming Hole 2010-17
Mar '10: MST shows human & ruminant as main faecal sources
Dec-Jan '10: Norovirus outbreak at campground
Jan'12: 3 failing septic tanks fixed & MST shows no human source
Dec '13: Effluent discharge from stock drinking water trough found and removed
Dec'15: Effluent discharge from 2nd stock drinking water trough found & removed
Jul'16: Effluent feed/ standoff pad found & removed
Swimmability limit (540 E.coli/100ml)
E.coli/100ml
Rainfall (48hr)
Downstream of Camp Opposite Playground
Rainfall (48 hr average on sampling day & day prior)

Human faecal material can also enter water. There are about 270,000 septic tanks in New Zealand. Results from a number of surveys showed between 15 and 50 percent of them were not functioning as they should because they are not emptied regularly or were poorly maintained. In some towns there are also overflows from town sewage systems. An example of this is Auckland, in older parts where storm water and sewage are transported in same pipes, and also smaller rural towns (Picton, Palmerston North).

E. coli can be tracked back to source using a DNA test which determines if it comes from ruminants, humans or birds. This has been done in the past for the Wakapuaka and has shown to be mainly ruminant or avian *E.coli* with occasional human DNA identified. More testing is going to be done.

Learn more

https://www.waternz.org.nz/documents/sigs/swans/120215%20_onsite_wastewater_maint%20_booklet.pdf

Healthy streams also contain water with low levels of chemical contaminants such as fertilisers, sprays, oil, petrol, chemicals from industries, zinc from urban roofs, chemicals from tar seal roads, wax from washing cars, and paint from washing paint brushes.

2.6 Water with low sediment levels

New Zealand loses between 200 and 300 million tonnes of soil to the oceans every year.

This rate is about 10 times faster than the rest of the world because of our young soils, steep terrain and the removal of trees from this land. Erosion is the main way that phosphate enters our waterways, attached to soil particles. This sediment covers the stream, river and sea beds and impedes the growth of many of organisms living there. It also makes the water turbid.

In the Tasman District, research has shown that much of the sediment is coming from forestry, cropping and river bank erosion. Learn more

Look for soil erosion on your properties. Sources can be:

- stream banks
- drains
- from rain on bare land (especially pugged land)
- from soil blown during cultivation
- from topsoil from hill slopes gradually and suddenly in slip events

Soil erosion control depends on three principles:

- Reducing the potential of water and wind to cause erosion by stopping water getting into the soil surface
- removing water safely from soil surfaces
- reducing water and wind speed

Erosion potential means how likely it is that erosion will occur on the land. This is determined by:

- The slope of the land
- Weather patterns in each season
- Soil properties

Landowners can reduce the amount of soil erosion in their fields a number of ways. These methods include:

2.6.1 Planting trees

- Pole planting on slopes is common in NZ. Most commonly planted are willow and poplar species. (Non wilding Willows are good for bank stability on big rivers)
- Plant trees on steep faces prone to slipping and turn into agro-forestry (spaced trees or forestry blocks or Manuka honey blocks)
- Graze wetter paddocks earlier in the winter to avoid pugging
- Fence off gullies and allow the bush to regenerate and/or plant up
- Plant vegetation along waterways to reduce the flow of sediment into the waterway.

2.6.2 Cropping

- Avoiding cultivating slopes steeper than 12 degrees
- Cultivate and plant *along* the contour or at a slight angle to it. A seedbed that goes up and down a slope has a high erosion risk
- Use direct drilling to put in crops or use strip cultivation for arable crops
- Strip graze crops so that you start the furthest way from the water way so there is a crop barrier between the bare soil and the water way for as long as possible
- Don't crop to the edge of the waterway, leave a pasture buffer barrier
- Establish autumn crops early so there is less bare ground come winter
- Don't put heavy cattle on crops or in paddocks that are prone to pugging over winter
- On off grazing so stock don't turn the crop into a sea of mud by or adjacent pasture paddocks
- Protect the ground surface by leaving crop residues in the soil during times when soil erosion (wind or rain) is high, then incorporate them back into the soil when the risk of high wind or rain is lower
- Avoid very fine seedbeds. Having surface roughness helps slow down runoff by absorbing more of the water, and prevents the wind from stripping the soil away.

2.6.3 Infrastructure

- Fence off waterways so stock don't erode the banks
- Put in culverts or bridges at regular stock crossings
- Plant up the waterway banks to help consolidate them
- Reduce runoff from tracks, races and yards and divert runoff to paddock and not streams
- Fence off boggy areas and springs and allow them to revert to wetlands
- Locate troughs away from boggy areas and these will be high traffic areas
- Fence off dams, plant around them and pipe water to troughs
- Build sediment traps to slow the water thereby dropping out the sediment before it gets to bigger water ways. This sediment can be removed from the water way and spread over the pastures. These are particularly effective when combined with a wetland filter
- Divert runoff from drains, roads, tracks and headlands away from arable paddocks
- Create open drains that intercept the water, to prevent any running water from reaching a speed that will cause erosion. A drain embankment at the top of a paddock will help achieve less erosion.

Learn more

http://www.gw.govt.nz/assets/Land-Management/Reducing-the-impacts-of-winter-grazing-factsheet.pdf

https://www.boprc.govt.nz/media/273658/futureproof_erosion_web.pdf

https://www.dairynz.co.nz/environment/waterways/

http://www.waikatoregion.govt.nz/menus/

http://www.beeflambnz.com/Documents/Farm/Trees-for-the-Farm-Booklet.pdf

2.7 Cool water

The temperature of the water affects flora and fauna living in the water. High water temperature reduces the number of fish and macro-invertebrates and increases algal growth. Ideally river and stream temperatures should be below 22°C. Water temperature is affected by the source water, the depth of water and the degree to which it is shaded.

Removing the shade from a stream can increase the mean water temperature by 5°C.

2.8 Water with high levels of oxygen

Macro-invertebrates and fish need a level of oxygen in the water to survive. Algae and aquatic weeds use up oxygen. Water holds less oxygen when warm so providing shade over the water will improve oxygen levels.

3 Wakapuaka River water quality monitoring and issues

By Paul Fisher, Nelson City Council

Contact Paul Fisher, Water Quality Scientist, paul.fisher@ncc.govt.nz 03 545 0785 (work)

Nelson Regional Plan

This is reviewed every 10 years. It is guided by the National policy for Freshwater Management (2014).

- This national policy requires Councils to maintain and improve freshwater bodies (streams and rivers) by a number of methods, including, setting water quality limits for each Freshwater Management Unit (catchment)
- Water quality limits (*thresholds*) support freshwater objectives
- The (draft) freshwater objective for all ecosystem health attributes in Nelson City Council area is to achieve grade A or B in all rivers and streams.
- Freshwater objectives (e.g. MCI) will require management of multiple stressors including sediment, temperature, dissolved oxygen and periphyton

Ecosystem health objective	MCI	Periphyton %WCC cover	Water temperature	pH	Toxicants/metals	Water clarity[19]	Deposited sediment % cover[20]
A	>120	<20 excellent	≤18°C	6.5 - 8.0	99% species protection	≥5m	≤15% cover
B	100 - 120	20-40 good	≤20°C	6.5 - 8.5	95% species protection	3.75m	≤20% cover
C	80 - 100	40-55 fair	≤24°C	6.0 - 9.0	80% species protection	1.6m	≤25% cover
D	<80 or declining trend	>55 poor	>24°C	<6 or >9	<80% species protection	<1.6m	>25% cover

Wakapuaka measurements

The Wakapuaka water quality monitoring site network includes a ‘reference’ site in the upper catchment and sites on the main river, tributaries and lower catchment.

Key water quality measures and issues are summarised below in the context of maintaining ecosystem health.

There are 9 water sampling sites in the Wakapuaka catchment.

Learn more https://www.lawa.org.nz/explore-data/nelson-region/river-quality/wakapuaka-river/

3.1 Wakapuaka Catchment

The land use of the catchment is indigenous bush 38%, exotic forestry 33%, pastoral farming 22%, other exotics 9%, unproductive 1%

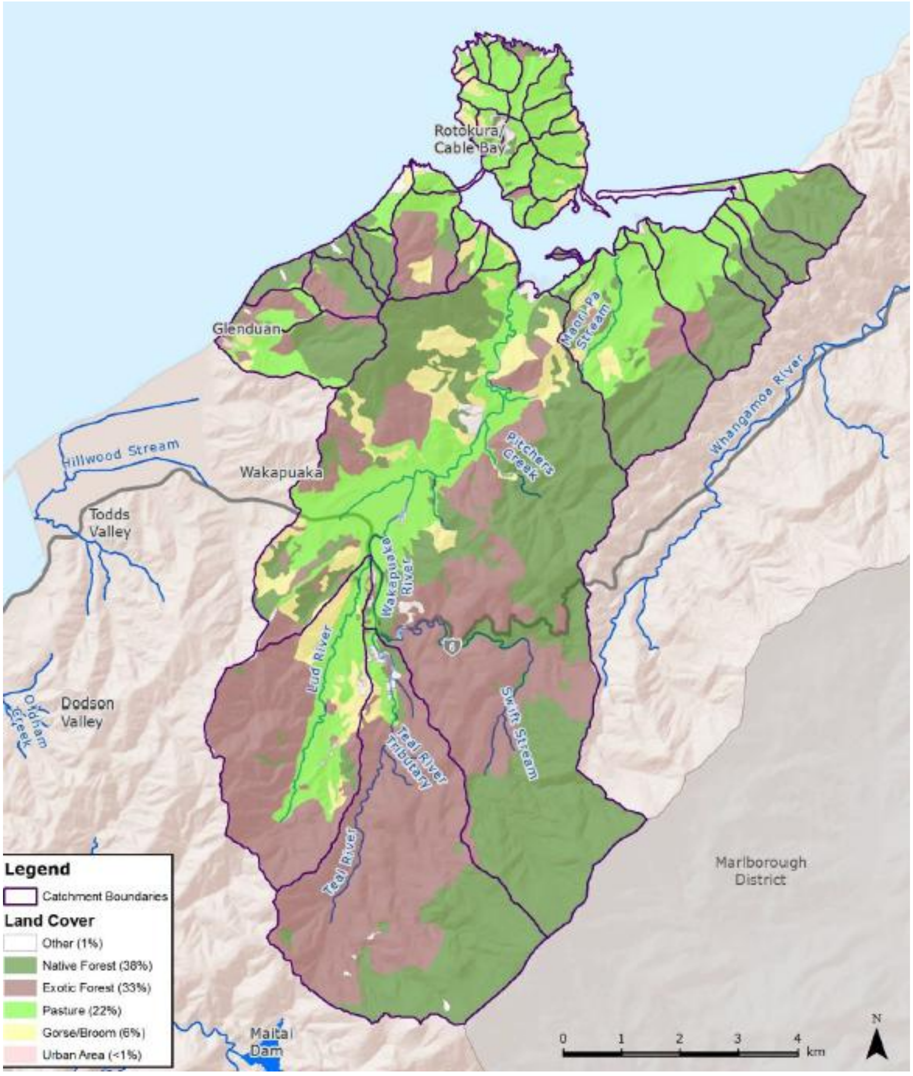
The catchment is 134 km long and drains 6500ha of land. 100 km of the river catchment comprises first and second order streams (small waterways). See map above.

Sedimentary (upper) and alluvium (lower) dominate the catchment geology and influence surface run off.

The catchment is prone to moderate soil slip (landslide) erosion and sheet erosion (gradual layers of the surface sediment are lost over a uniform area.

The sediment in the rivers comes from fine sediment from slips (forestry and bush) and gradual sheet and river bank erosion (pastoral farming, lifestyle)

(Source: Landvision Ltd, 2017)

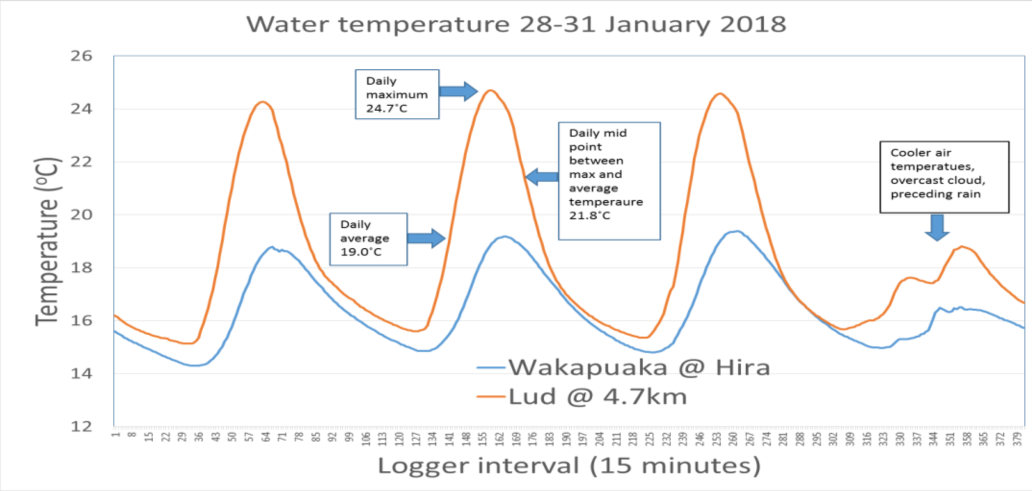


Map from Nelson Fresh Quality. K McArthur, 2016.

3.2 Water temperature

Water temperature in the Lud is high.

Increases in water temperature occur during periods of calm, sunny weather, particularly when summer daylight hours are extended and rivers are at low flow (see graph below).



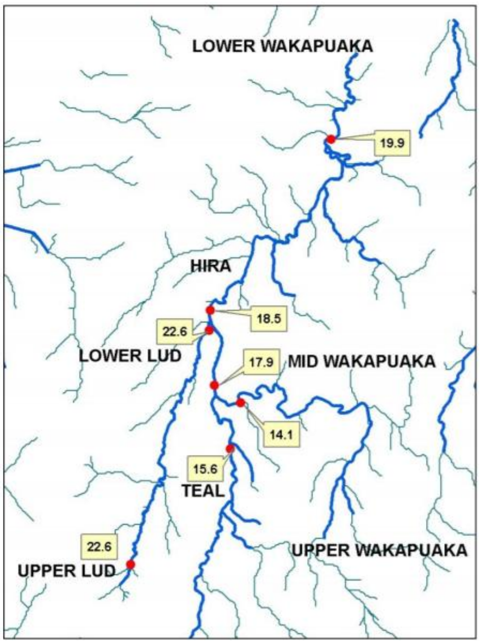
Elevated water temperatures are stressful to aquatic life, can cause reduce dissolved oxygen levels and can promote nuisance algae blooms.

Daily water temperatures over 21.5˚C (using *midpoint between the daily maximum and mean water temperature)* stress aquatic life and can cause 50% of mayfly and stonefly larvae (common aquatic bugs) to die, as well as being detrimental to trout and some native fish species.

The daily water temperatures in the main stem of the Wakapuaka River increase from 14.1°C in the upper reach (Duck Pond Road) to 19.9°C in the lower reach (Māori Pa Road) (see map below).

The Lud River has elevated temperatures of 22.6°C (upper and lower reach) that do not meet the freshwater objectives for water temperature <20°C, to maintain ecosystem health.

A reduction of a approximately 5°C can be made by planting trees that shade the river.



http://nelson.govt.nz/assets/Environment/Downloads/1140007-Wakapuaka-River-Temperature-Survey-2009-2011.pdf

3.3 Sources of contaminants in Wakapuaka Catchment

Forestry which occurs on moderately to steep rolling land is erosion prone. Phosphorous is carried into the waterway on sediment resulting from this erosion. When the forestry slash breaks down after harvesting it also contributes nitrates to the waterways.

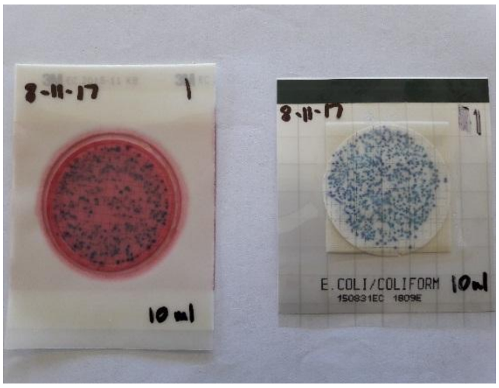
Pastoral farming and lifestylers in the Wakapuaka catchment normally run low stock rates of stock and use low inputs of N and P fertiliser. However, GNS nitrogen and oxygen isotope analysis shows some of inputs of nitrates into river are coming from fertilisers.

So more care is needed in the placement of nitrogen fertilisers well away from waterways and gullies and for these to be used only when necessarily. The areas along rivers and gullies often don't require fertiliser because their nutrient status is often already high.

E. coli levels in the Wakapuaka catchment

The presence of *E. coli* bacteria indicates that faeces have entered the waterways and raises the possibility of other pathogenic bacteria being present.

E. coli bacteria enters rivers either from specific (point) sources (e.g. from animals in the river, or septic tank and sewage leaks) or through diffuse runoff from land associated with rain and storm water. *E. coli* present in the Wakapuaka River comes from both of these sources.



E Coli colonies

The highest levels of *E. coli* are occurring in the Lud River and these either accumulate or are also being generated at the bottom of the catchment.

E. coli concentrations in the Lud River and Paremata Flats are above the median threshold of 130 E coli/100 ml for Human Health for Recreation. Source tracking has shown that ruminants and wildfowl are the primary sources, and we’re currently investigating further to determine the nature of these sources.

State of Environment (2002-2017)	n	Min	Max	Mean	Std Dev	Median	% 540 alert	Swimmability
Wakapuaka at Duckpond Rd	78	2	3,700	90	422	14	1.5	A
Wakapuaka at Hira	78	5	12,000	441	1,604	65	6.5	B
Wakapuaka at Maori Pa Rd	79	5	5,100	298	821	80	7.5	B
Teal at 1.9km	77	2	6,600	194	826	17	9	B
Lud at 4.7km	78	5	13,000	723	2,096	169	21	D
Lud at SH6	78	2	180,000	3319	20,469	250	27	D
Recreation bathing (2007-2017)								
Wakapuaka at Hira Reserve	211	10	[2,400]	207	359	99	7	B
Wakapuaka at Paremata Flats Reserves	212	31	[2,400]	364	363	254	17	C

The target for a good quality stream is <130 median E. coli throughout the year. For summer recreation bathing water quality a *E. coli* count of >540 is a red alert requiring health warning signage. This does occur frequently in the swimming hole at Hira.

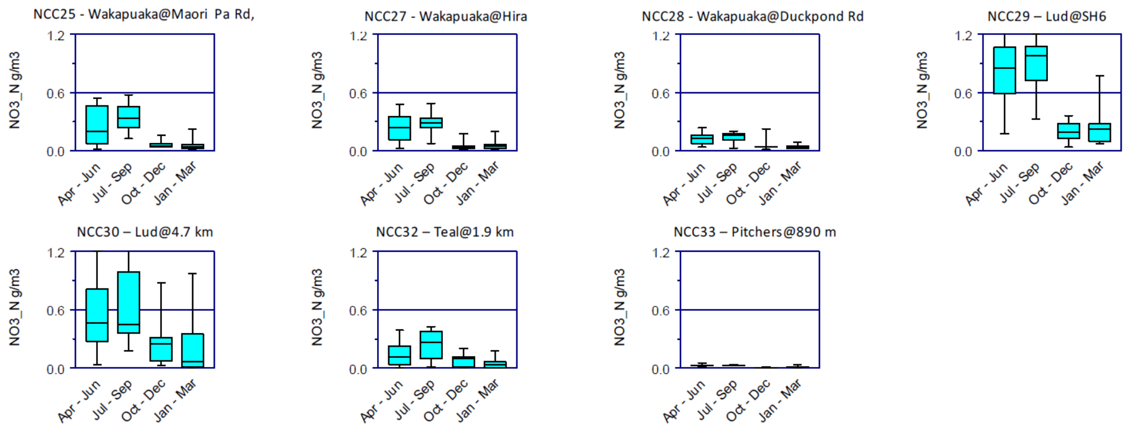
The large maximum *E coli* figures generally occur in storm events.

3.4 Nutrients, algae and fine sediment

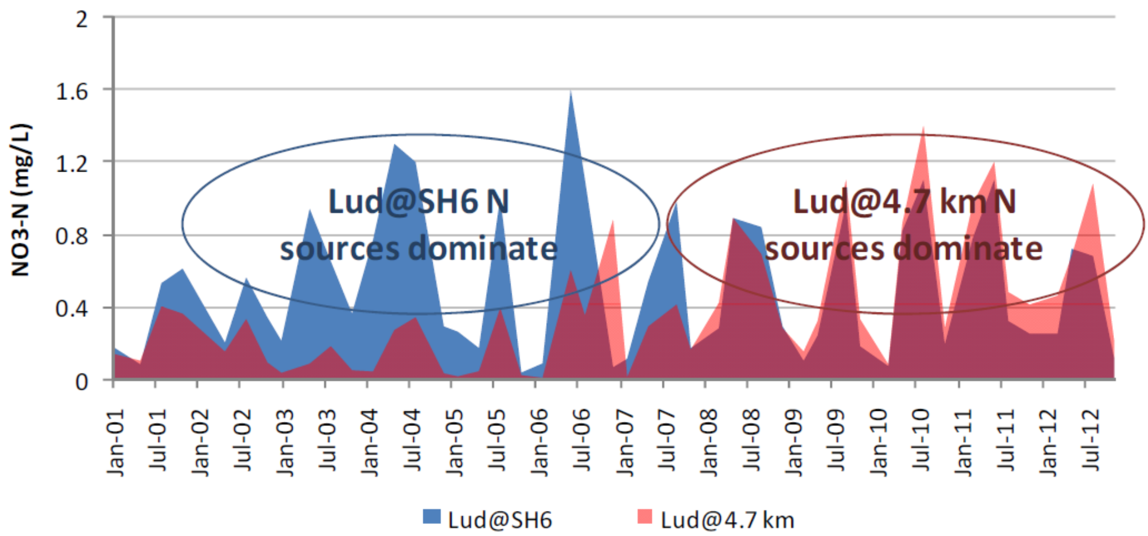
3.4.1 Nitrate levels

In the graphs below the black line in the middle of the box represents average nitrate levels and the box and the error bars show the range in levels. The horizontal line at 0.6 is the target level.

The data represents data collected over 10+years and are quarterly averages. The Lud with its number of animals, impacts of forestry and low flows often has nitrate levels that are higher than target.



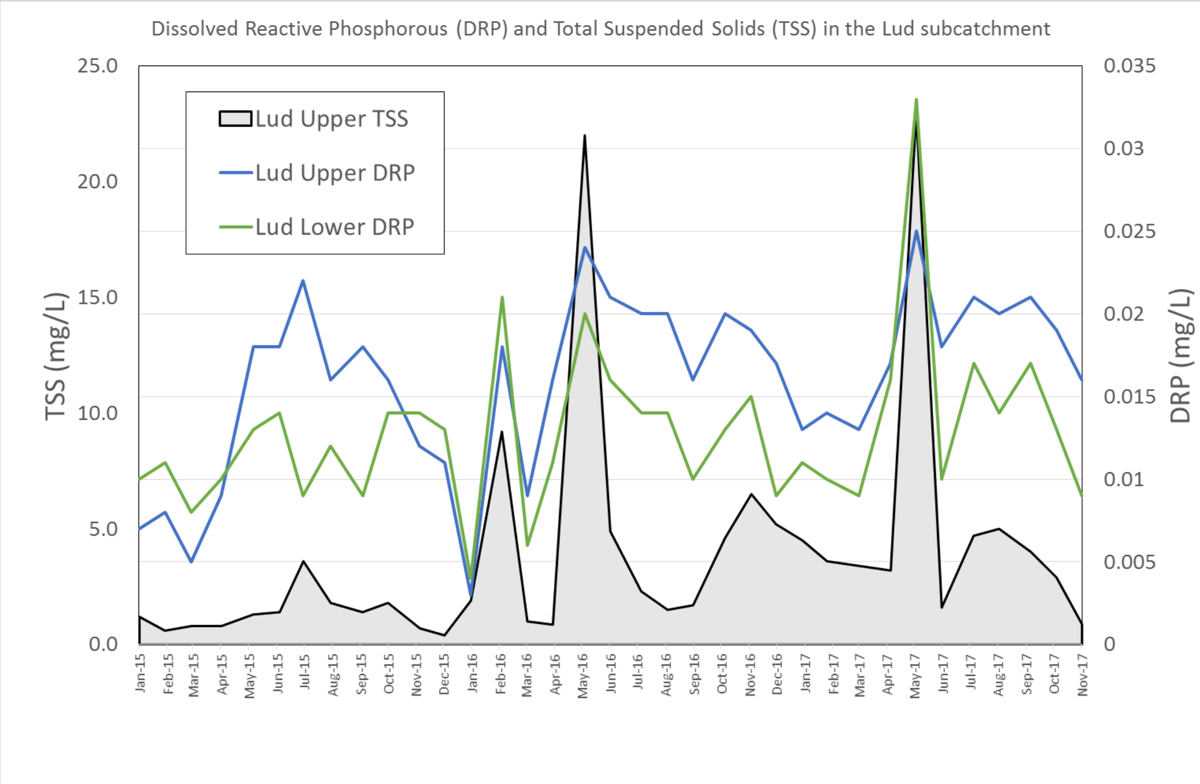
The time series below shows how complex interpreting trends can be, even within sub catchments.



Note that nitrates peak in winter when water is flowing through the soil profile. The changes from the lower and upper catchment, are largely related to the location of the forestry harvest with most of the nitrate coming from breakdown of forestry slash.

3.4.2 Phosphorous and sediment

Sediment bound phosphorous associated with soil erosion is the one of the main pathways phosphorous is entering streams. In the graph below you can see that there are peaks in sediment and dissolved reactive phosphorous (DRP) during high flow events. The upper catchment of the Lud has higher values than the lower because of the steepness of the terrain and soil types.



In summary the Lud has elevated nitrogen (lower catchment) and phosphorous (upper catchment) levels, which are likely to be contributing to elevated periphyton (algae and sludge) cover upstream.

The Teal has generally good water quality though monitoring has shown a declining trend in dissolved phosphorous and slightly elevated Ammonia (N).

The Wakapuaka has slightly higher than normal dissolved nitrogen and phosphorous levels.

Algae, sludge and deposited sediment are found on the river bed in the lower catchment. Cyanobacteria toxic algae is most common in the upper Lud and lower Wakapuaka, particularly in sections of the river where fine sediment has been deposited.

3.5 Perphyton algae and deposited sediment

- Excessive periphyton and deposited fine sediment are generally not good for river health impacting on water quality and habitat
- The fine sediment naturally settles out in the lower catchment due to slower flow velocities and lower elevation. So there are low levels of settled sediment (good is <20% cover) in the upper reaches of the catchment and but needs improvement in lower catchment. These sediments also make their way into the estuaries.

- Periphyton algae cover (filaments and mats) is generally low (<20% cover) in the river. But an improvement (reduction algae cover) is required in the upper Lud to meet the ecosystem health objective.
- Cyanobacteria (toxic) are present, and occasionally blooms (Lud, lower Wakapuaka) occur in the deposited sediment.

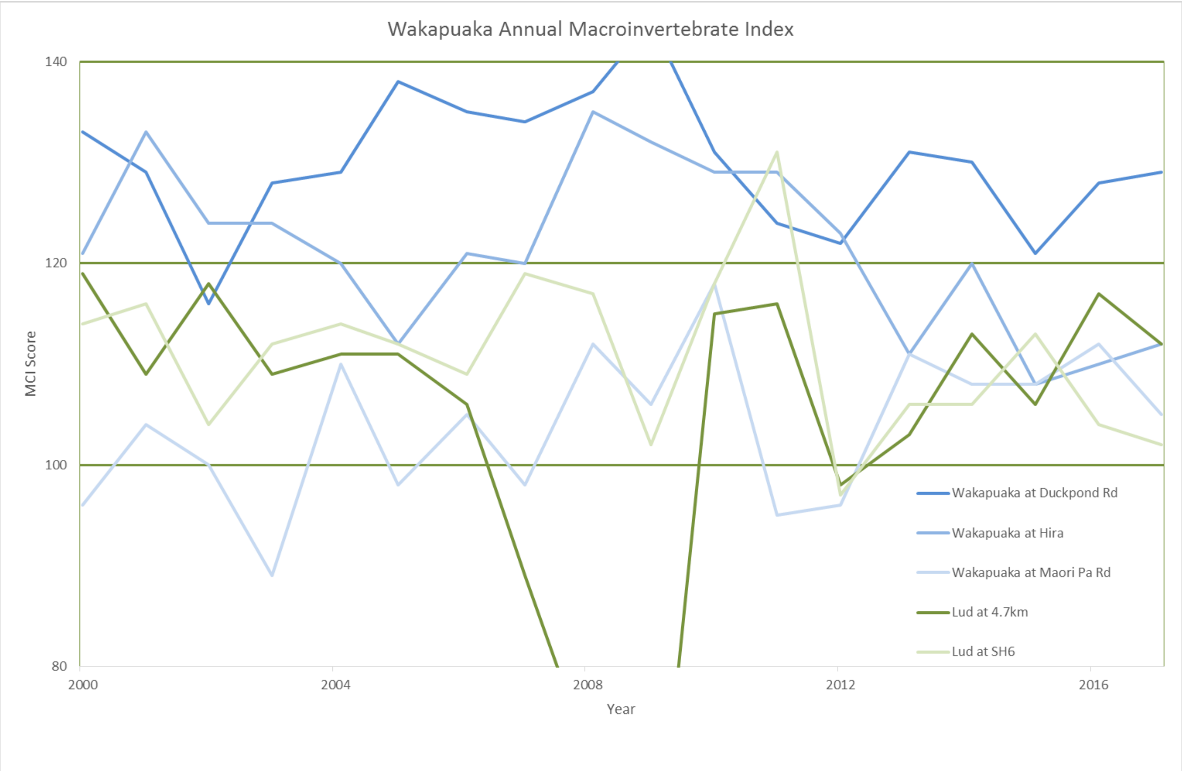
3.6 Macroinvertebrate community index (MCI)

Macroinvertebrates (aquatic bugs) are good indicators of river health because they are relatively long-lived and sensitive to pollution. They respond to changes in water quality over time and can be used to provide a score or community index of ecosystem health.

Overall the MCI score is Excellent-Good (MCI>120) in the upper catchment - Duckpond Road and Teal area. The lower catchment (Hira, Maori Pa Road) and Lud River is Good-Fair (MCI>100 to 120).

MCI monitoring by the Wakapuaka River Care Group have shown similar trends, with a decline in MCI at some sites in 2009 but this is probably a one off event rather than a worrying trend.

There is a trend downwards at Hira, a slight decline in Lud and Maori Pa (lower) is improving.



3.7 Future monitoring and Research with the Wakapuaka catchment

- Cultural Health Indicator monitoring will be carried out by Mel McColgan
- NCC will be shortly doing further E. coli source tracking with ESR labs during both normal flow and during high loads during rain events.

- There will be parallel E. coli citizen science monitoring (Philippa Eberlein, Friends of the Maitai)
- Riparian habitat assessments will be carried out by NMIT students
- SOE and hydrology monitoring will be carried out to track progress of Wakapuaka Burst in to Life community programmes

Learn more

The water quality tends from State of Environment monitoring are summarised on LAWA https://www.lawa.org.nz/explore-data/nelson-region/

Information can also be found on the Nelson City Council website: http://nelson.govt.nz/environment/environmental-monitoring/river-and-stream-health-2

Cyanobacteria toxic algae http://nelson.govt.nz/environment/water-3/toxic-algae/

4 River flows and allocation in the Wakapuaka River

Emma Reeves, Water Scientist Nelson City Council

Contact: emma.reeves@ncc.govt.nz; or 03 546 0306

National Policy Statement -Freshwater management

The National Policy Statement for Freshwater Management is a national level document that provides direction on how local authorities should carry out their responsibilities under the Resource Management Act. The National Policy Statement sits above the Nelson Resource Management Plan. The National Policy Statement is a framework for both water quality and water quantity. The objectives include:

- safeguard the life-supporting capacity, ecosystem processes and indigenous species
- avoid any further over-allocation of fresh water and phase out existing …
- improve and maximise the efficient allocation and efficient use …
- enable communities to provide for their economic well-being …

4.1 Flows

River flow is continuously recorded in the Wakapuaka River at Hira and monthly monitoring is carried out at sites on the Wakapuaka, the Teal and the Lud tributaries. Rainfall is measured at Hira reserve.

Quick stats for the Wakapuaka River:

Highest flow recorded	204.3 m^3/s (204,300 l/s) 23/02/1995
Lowest flow recorded	0.165 m^3/s (165 l/s) 12/06/2001
Mean Annual Low Flow (MALF)	306 l/s
5yr 7day low flow	245 l/s
Annual Average Rainfall	1419 mm

You can find see current river flows here:
http://www.tasman.govt.nz/environment/water/rivers/river-flow/

And rainfall here:

http://www.tasman.govt.nz/environment/water/rainfall/

4.2 Water abstraction

The Nelson Resource Management Plan (NRMP) is a combined land use, coastal, land disturbance and freshwater plan. The Freshwater appendix (28) relates to the use of freshwater resources.

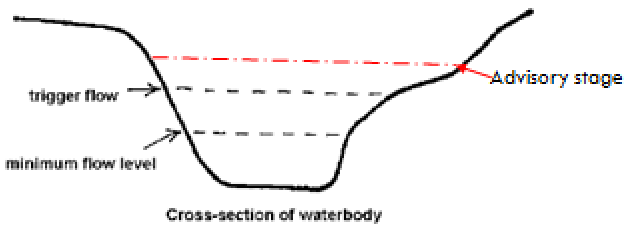
Permitted takes: The NRMP allows the abstraction of up to 1m^3 of surface or groundwater per residential unit for reasonable domestic, stock watering or firefighting where reticulated water is not available. For larger takes a consent is required.

Firefighting provisions: houses not connected to the reticulated supply must have a sprinkler system or water tanks with at least 45,000 L capacity.

The full details of the plan rules can be found here: http://nelson.govt.nz/environment/nelson-resource-management-plan/nelson-resource-management-plan-2/view-the-nrmp/download-the-nrmp-2/

4.3 Water restrictions

During extended dry periods, water restrictions may apply. There are currently three stages of restrictions.



Advisory stage: when flows are 10% above the trigger flow level, people are made aware that restrictions are likely and what they would mean.

Trigger flow: when flows reach the Mean Annual Low Flow, as listed in the Plan or consent, water restrictions apply

Minimum flow: when flows reach the 5yr 7 day low flow as listed in the Plan or consent, further water restrictions apply.

	Trigger Flow (MALF)	Minimum Flow (5yr 7d LF)
Wakapuaka @ Hira	304	243
Wakapuaka @ Maori Pa Rd	302	225
Teal	93.3	75.4
Lud	18.6	12.6

Last December 2017 we entered the advisory stage and got very close to Trigger Flows. Restrictions were also imposed in 2016.

4.4 Allocation

When all the consented and estimated permitted water takes are considered, the water available in the Wakapuaka catchment maybe fully allocated. This over-allocation is an "on paper" estimate - actual use may be more or less during certain seasons or times of the year.

Typically, we need to take more water during summer which is also when the river flows are at their lowest.

It is part of the stream's natural cycle to have low flows at certain times of year, but taking water for stock and household use during these periods can make the low flows unsustainable.

When the river flows are really low, nutrients may be less diluted, fish habitat is reduced, and the likelihood of algal growth is increased. River temperatures can become too high for aquatic life and amenity, recreation and cultural values can deteriorate.

The main ways to reduce the pressure on our rivers are:

Reduce: use less water and use water more efficiently

Reuse: use greywater for garden watering or irrigation

Rainwater: harvest and store rainwater during the year for a constant and reliable supply during dry periods. Council does not require rainwater that will be used as a potable source to be treated (unlike some other councils). It is the individual's responsibility to ensure their individual source is safe.

4.5 Teal-Lud water scheme

The resource consent allocation of water to the Teal-Lud water scheme is 3 l/s or 840 m^3 per week or 43,800 m^3 year and it services 63 people. This equates to 1% of the mean annual low flow and 1.8% of the lowest flow recorded and is 12% of the allocable flow.

4.6 Whakamahere Whakatū Nelson Plan

Nelson City Council is working on a full review of all its plans under the Resource Management Act. This will include changes to the freshwater provisions in the plan. Keep up to date with the new plan process and have a say here: http://nelson.govt.nz/environment/nelson-plan/

5 Riparian carbon forests to protect waterways and generate income

Sean Weaver, ekos

www.ekos.org.nz
sean@ekos.org.nz
027 3563601.

Sean Weaver is Executive Director of Ekos – a consulting social enterprise focusing on environmental financing and sustainable land management solutions. Sean is a specialist in the technical and business dimensions of forest carbon financing, sustainable land management, and performance-based 'payment for environmental services' (PES). He has a PhD in Forestry and over 25 years' experience in environmental financing including project & national level indigenous forest carbon and conservation management. He lives in Takaka, New Zealand, and is both an alumnus of VUW and a former staff member (senior lecturer in Environmental Studies). He is working on setting up a riparian carbon project in the Wakapuaka catchment that landowners with small areas of land could join.

A feasibility exercise has been funded by the Nelson City Council to determine if carbon forest riparian strips could be a potential solution for funding a riparian buffer and shading for the river. The aim is to over a time frame the riparian strip would pay for itself and maybe generate a small income.

Requirements

- The area cannot have been in trees in 1990
- To qualify for carbon credits the strip will need to be 30 m wide but it can be 15 m either side of the river.
- It must be a minimum contiguous area of 1 ha (but this could include the neighbour as well)
- The trees must occupy 30% of the ground cover and grow to at least 6 m high.

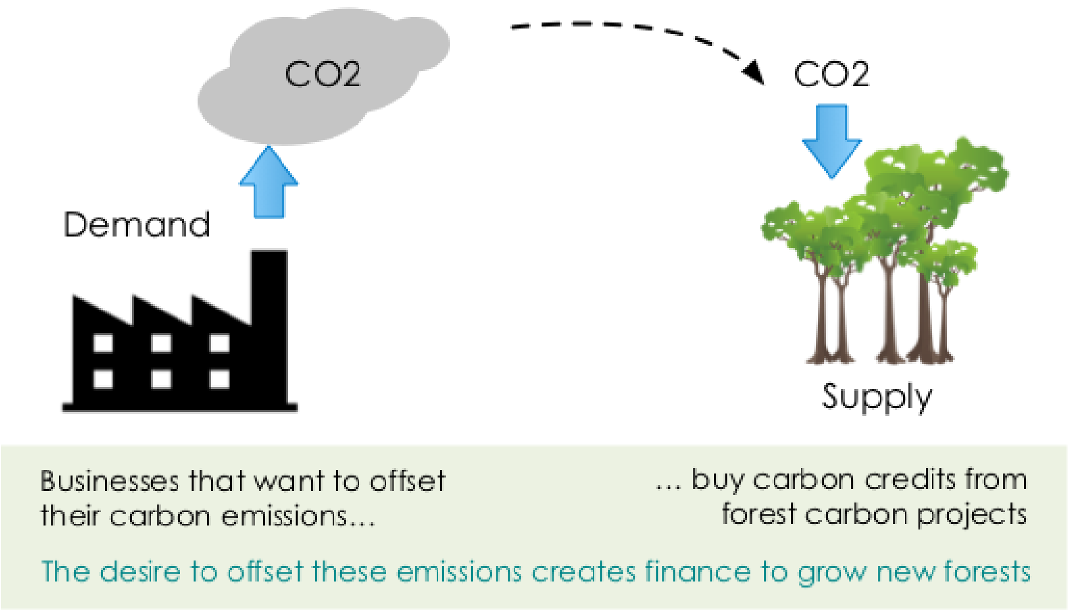
5.1 Demand

The compliance carbon market is the New Zealand Emissions Trading Scheme (NZETS). Here, demand for carbon credits comes from entities named by the government as 'points of obligation' in the NZETS. These are predominantly comprised of upstream entities in the energy, transport, and industrial processing sectors that are required by law to acquire (and then surrender to the Crown) carbon credits (measured in tonnes of CO_2 equivalent) to match a certain proportion of their total greenhouse gas emissions. Points of obligation are required to acquire (e.g. produce or purchase) particular carbon credit types, including New Zealand Units (NZUs) produced in the New Zealand forest sector.

The voluntary offsets market is made up of businesses and individuals that have no legal requirement to acquire or surrender carbon credits. Demand in this market is driven by "corporate social responsibility" aspirations in the business community (typically expressed as carbon neutrality or zero carbon) or individuals seeking to do the right thing by offsetting their greenhouse gas emissions.

Carbon neutrality or zero carbon involves arriving at a position of net carbon neutrality - similar in principle to net revenue neutrality. This involves measuring all greenhouse gas emissions (analogous to costs), and all greenhouse gas removals (analogous to income). When costs match income, we have a net neutrality (or zero) situation. Because most businesses and individuals do not have forests of their own to remove CO2 from the atmosphere[1], the only way that they can include CO2 removals in their carbon balance is to purchase carbon credits from projects that produce them.

Figure 1. Demand and supply in the carbon market



The demand side actors relevant to this report are compliance and voluntary carbon offset buyers.

5.2 Supply

This feasibility study focuses on a particular activity capable of generating a supply of compliance carbon credits for sale in the compliance and voluntary offsets markets. The purpose of creating and selling carbon credits in the Wakapuaka catchment under this initiative is to generate carbon revenue to cover the costs of indigenous reforestation along waterways and on steep lands unsuitable for pastoral farming. Such reforestation encompasses the establishment and enhancement of "ecological infrastructure" sufficient to cause improvements in the following "ecosystem services":

- River habitat and biodiversity.
- Flood protection and stream bank stability.
- Water quality and reduced stream sedimentation.
- Maybe riparian protection along forestry areas

There are two types of cost associated with reforestation for sustainable land management:

---

[1] Carbon accounting is more complicated than this, but this explanation will suffice for our purposes in this report. In fact, carbon credits can and are also produced from activities that avoid and/or reduce emissions against an emissions baseline, but this does not apply to the carbon credit supply chain referred to in this report.

1. Forest establishment and management costs (including seedlings, planting, fencing, weeding).
2. Opportunity costs (lost farming income on lands reforested).

Carbon revenue from the sale of carbon credits is designed to cover (or at least significantly co-finance) these costs. If carbon finance can cover these costs, then private landowners in this catchment are more likely to be willing to undertake reforestation activities that can deliver the private protection and enhancement of the public “ecosystem services” listed above.

5.3 Carbon and Indigenous Reforestation

The New Zealand Emissions Trading Scheme provides for carbon credits to be produced from indigenous reforestation in principle. In practice, however, the creation and sale of carbon credits from indigenous reforestation will typically fall way short of covering the true cost of such reforestation activity. This is due to the slow growth rates of indigenous tree species - much slower than exotic tree species.

This investment analysis shows that even at a large scale, indigenous reforestation cannot be successfully carbon financed. However, if you want to plant just natives and you meet the requirements they may help to offset some of your costs.

Indeed, the NZ forest carbon sector has long recognized that carbon financing for indigenous reforestation can be used successfully for forest establishment only if the following conditions apply:

1. The planting and maintenance is heavily co-financed through grant funding.
2. The carbon credit buyer is willing to pay a carbon price that is significantly higher than the market rate.
3. The planting involves the inclusion of exotic tree species.

In the absence of conditions 1. and 2., option 3 is required.

5.4 Exotic Hardwood Nursery Crop

The ecological restoration community in New Zealand has long recognized that some exotic species can facilitate indigenous reforestation. A notable example is gorse. If left alone, gorse will eventually succeed to native forest by providing shelter for indigenous species to regenerate. Once over-topped by indigenous tree species, gorse will die off leaving the site to become a native forest.

Gorse (*Ulex europaeus*) is an exotic flowering plant - an exotic hardwood shrub. In forestry parlance, the word ‘hardwood’ refers to a flowering tree. ‘Softwoods’ on the other hand refer to conifers such as *Pinus radiata*.

A reforestation project involving exotic tree species can generate carbon credit revenues sufficient to cover forest establishment costs. This is because exotic trees tend to grow a lot faster than indigenous species. The NZETS carbon credit allocations for forest projects illustrates this very well, as seen in table 3 below.

Table 3. NZETS ‘Look Up Tables’ for different forest types: Carbon stock per ha for Douglas-fir, exotic softwoods, exotic hardwoods, and indigenous forest (expressed as tCO2 per hectare)

Table 2: Carbon stock per hectare for Douglas-fir, exotic softwoods, exotic hardwoods and indigenous forest (expressed as tonnes of carbon dioxide per hectare)

Age (yrs)	Douglas-fir	Exotic softwoods	Exotic hardwoods	Indigenous forest
0	0	0	0	0
1	0.1	0.2	0.1	0.6
2	0.1	1	3	1.2
3	0.4	3	13	2.5
4	1	12	34	4.6
5	2	26	63	7.8
6	4	45	98	12.1
7	7	63	137	17.5
8	20	77	176	24.0
9	33	87	214	31.6
10	50	95	251	40.2
11	69	106	286	49.8
12	90	118	320	60.3
13	113	132	351	71.5
14	138	147	381	83.3
15	165	163	409	95.5
16	193	180	435	108.1
17	222	197	459	120.8
18	253	214	483	133.6

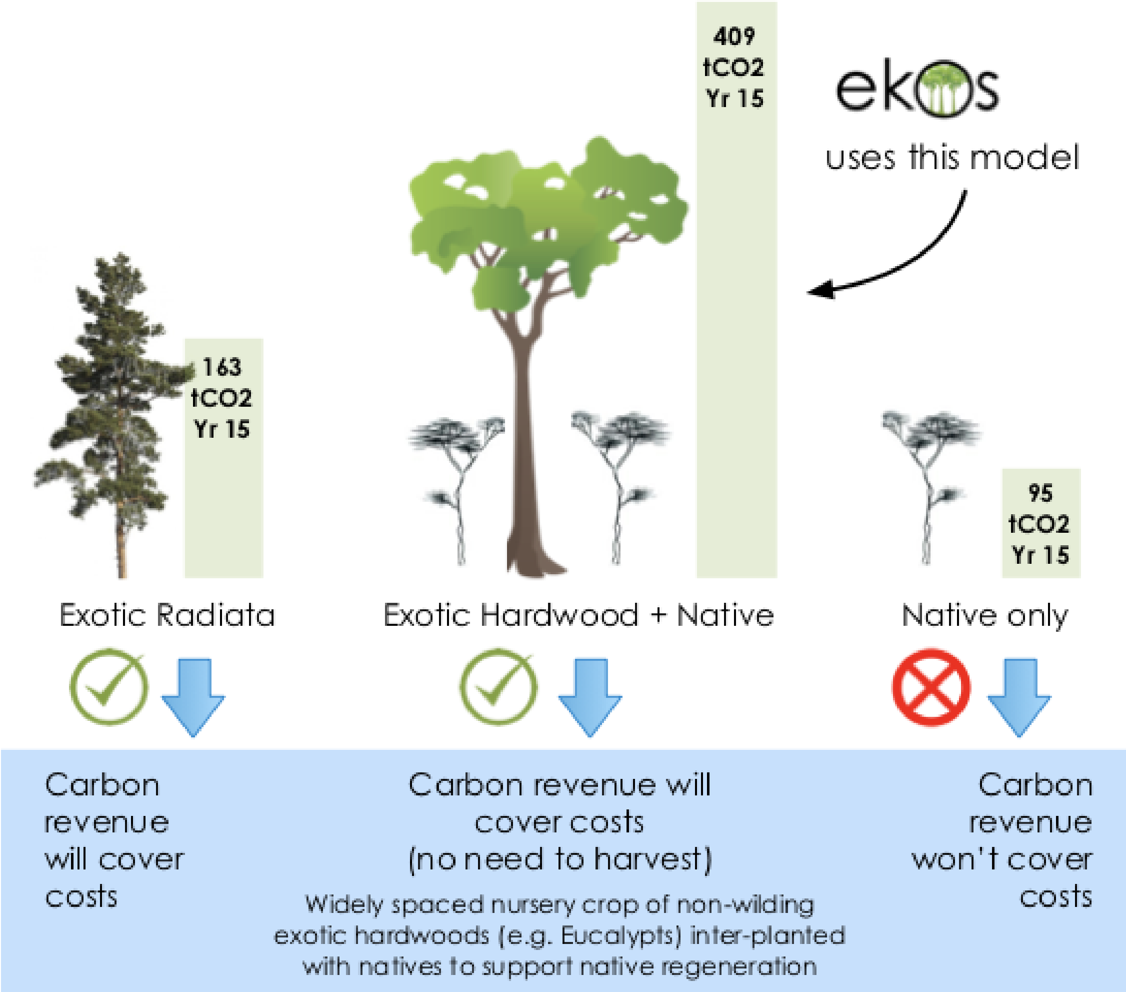
Reference file:///C:/Users/Annette.Litherland/Downloads/2017-ETS-look-up-tables-guide.pdf

As can be seen in Table 3 above, carbon accumulation after 15 years for indigenous species is less than 100tCO2e per ha, whereas exotic hardwoods accumulate four time this amount in the same time. Exotic softwoods perform better than indigenous but not as well as exotic hardwoods, which are the leaders in carbon accumulation.

Some recent commentators in the public arena have asserted that because indigenous plantings cannot be successfully carbon financed without massive subsidies, reforestation efforts should focus on exotic softwoods (e.g. E. Mason on Nine to Noon, Radio NZ). Others (e.g. G. Taylor on the same programme) argue that exotic softwoods will create a wilding pine problem, have less ecological value and that the carbon price needs to be inflated to enable indigenous forest plantings to become economically viable.

Ekos argues for a middle path solution to this problem that does not require any significant artificial inflation of the carbon price. This middle path involves establishing an indigenous forest beneath a nursery crop canopy of (non-wilding) exotic hardwood species (Figure 2 below).

Figure 2. The use of carbon credits to finance sustainable land management.



The NZETS requires all projects under 100ha to use the government-supplied carbon accumulation rates from the NZETS Look-Up Tables. The NZETS rules also allow for the planting of widely spaced crops of exotic hardwoods with a planting rate of approximately 40-50 stems per ha. If a project were to plant non-wilding exotic hardwoods (e.g. eucalyptus sp.) at this planting rate, but also planted indigenous tree species in the same hectare (e.g. 1,000 stems per ha), then the forest so established will be an indigenous forest, supported by an exotic hardwood nursery crop.

In principle, such a planting regime does not necessarily require any finance from the future harvesting of timber from the exotic hardwood crop, which instead can be used as the carbon finance engine to drive the economics of sustainable land management plantings. By the time these exotic hardwood trees die naturally (e.g. in years 60-), the indigenous trees will have grown sufficiently to take over the site. Furthermore, it is likely that in many parts of New Zealand, indigenous forest growth rates will be higher under a nursery crop canopy than if they were planted on their own. This is due to the micro-environment created by the exotic hardwood nursery crop (i.e. a larger and longer-term version of gorse succession to native forest).

Riparian Carbon

Riparian (riverside) reforestation focuses on replanting stream banks in indigenous forest in order to provide greater protection to streams, improve stream habitats for biodiversity, and contribute to improvements in water quality. Local government entities around the country have allocated significant funds to such plantings by community organizations and private landowner.

If riparian reforestation could be financed through carbon credits it would enable local government entities to significantly increase the impact per dollar spent, because the bulk of funds for forest establishment and management could come from the private sector under a market mechanism. This would enable local government to focus on:

- Start-up funding for forest carbon projects and programmes rather than covering the main project costs.
- Fully funding indigenous reforestation of biodiversity or water quality hotspots that require special attention over and above what can be commercially financed.

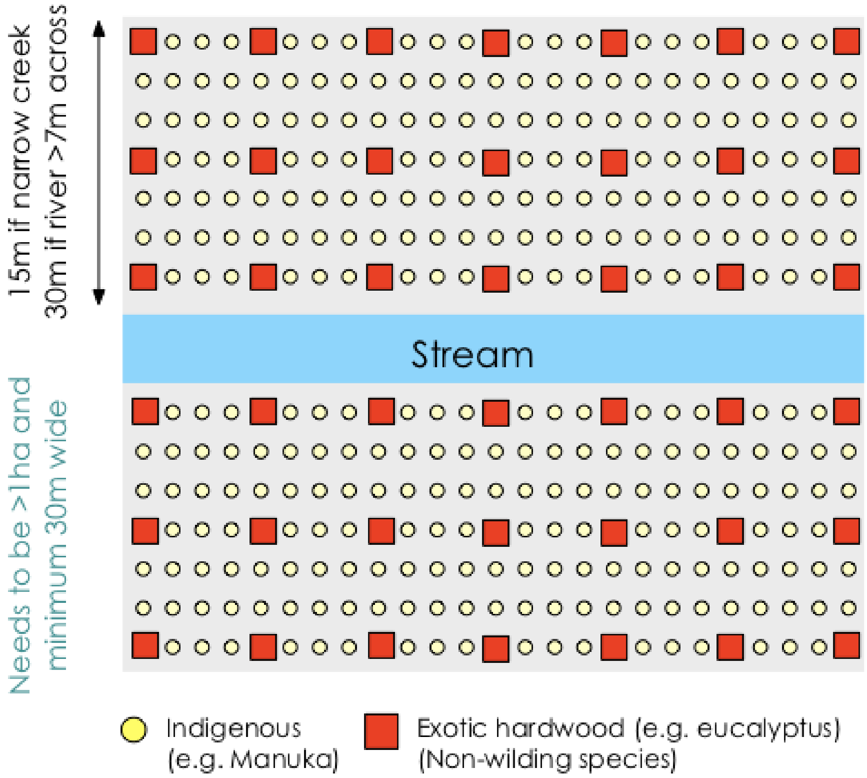
Riparian reforestation projects area difficult to carbon finance because:

a) The often do not meet the NZETS eligibility requirements of a minimum width of 30m, a minimum of 1ha in area, with a tree canopy cover of greater than 30% for each hectare, and with trees that can reach at least 6m in height in situ.
b) They are planted in indigenous species only and the carbon economics don't work (as shown above).
c) They are so small in total area (long and thin) that they cannot generate any economies of scale and remain economically unviable in practice.
d) They have high fencing costs per ha (because they are long and thin) and fencing costs are a significant contributor to total project costs.

In principle, the exotic hardwood + indigenous planting model described above mitigates strongly against these challenges by significantly increasing the annual carbon revenues per ha. In practice, this needed to be tested using a case study, and this current study does precisely this.

The current study used an exotic hardwood + indigenous planting model (Figure 3) to develop and test the business case for a riparian reforestation programme in the Wakapuaka catchment.

Figure 3. Exotic hardwood + indigenous riparian reforestation planting model



The analysis on the Wakapuaka for two landowners has found an internal rate of return of around 2 percent but this would improve if more landowners in the Wakapuaka were interested and fixed costs could be spread over more properties. Discussions are underway on whether a pilot trial will be established in the catchment. Please contact Annette (annette.litherland@landcare.org.nz) if you are interested

Key variables that impact on the analysis are:

- Cost of fencing
- Cost of planting including the native understory
- Price of carbon credits into the future and premiums that could attracted for protecting the waterways
- Amount of subsidies that could be accessed for the plantings and degree by which land owners could meet some of the costs themselves eg planting, weed control, growing their own plants.

If you are interested to hear more contact either Sean or Annette (NZ Landcare Trust). (annette.litherland@landcare.org.nz)

6 Riparian care, planting and weed control workshop

Robert Fryer, FuturEcology

027 545 1625
Rob@futurecology.co.nz

Robert along with his wife Jan lives in the Wakapuaka catchment and has many years experience in all things riparian. Robert began his interest in the environment as a very small boy, staring into rivers and asking numerous questions about all things natural. He followed this passion with a apprenticeship in Nursery Production, a Diploma in Horticulture and a Bachelor in Applied Science. He worked in these fields for a number of years also branching into viticultural management and caretaking on Stephens Island for the Department of Conservation. For the last 16 years he has worked in the conservation and ecology fields, running a large business focused on conservation in the top of the south. His main passion is providing ecological solutions especially around water quality issues.

6.1 Defining the project

Discussion – Do we need a planting project or a weed control project, how do we choose the best option?

- In many cases regeneration is occurring and will happen naturally with some assistance with weed control. In areas with abundant seed sources close by, birds will be spreading seed into riparian areas. In some areas of heavy weed such as the Wakapuaka there are abundant seedlings under the weed canopy. What is needed therefore is selective weed control rather than planting.
- A further option is to augment existing weedy areas with trees that will eventually form the canopy above most of the weed issues. This can be surprisingly successful as can be seen in places on the Wakapuaka. Trees such as the Podocarps like Totara and Kahikatea and or Beech and other Broadleafs are all great canopy trees that provide massive ecological benefits to the riparian zone.
- In some cases, where existing weeds need total control prior to planting then a scorched earth approach may be the best methodology. This involves completely clearing the margin of existing vegetation and starting from a blank canvas. This is almost certainly the case where convolvulus, Blackberry or similar weeds are present.

Wakapuaka River

6.2 Weed control

Weed control prep – What exists on site presently and how does that influence preparation. What preparation techniques are we going to use if any?

- Each site or project has its own unique set of variables. By this we mean what was the previous land use, what vegetation is present on the site, what is the community interest and what functions are the weeds providing already? These are but a few of the questions we need to ask ourselves before we start preparing the site for planting. Best case scenario is that no prep is necessary but this is not often the case.
- Is spraying the best method of preparation? There are obvious issues around the use of herbicides in the riparian area. Herbicides to be used need to be used according to label instructions and also in compliance with any local rules and regulations.
- In many instances there is no alternative to the use of herbicides, such as when there is a heavy cover of blackberry or convolvulus.
- Weed eating can create an easy surface to plant through but beware of perennial weeds that will grow in spring if they are not killed prior.
- Weed control can be a bit of a double edged sword. Herbicide spray creates a great planting environment but also a very fertile place for broadleaf weeds to establish in spring. Once herbicide spraying starts it needs to continue until canopy closure.
- http://www.weedbusters.org.nz/ This link is to the weedbusters site that provides excellent details on individual weed species and their control.

6.3 Plant selection

What are we going to plant and why do we choose those species and where do we find that information? Where do we purchase plants from and what size plants should we be planting?

- Plant selection really depends on what we are trying to achieve. This may be shading, erosion control or increasing biodiversity. For riparian planting we mainly utilise native species. It is important that these plants are grown from ecosourced seeds. What this means is that the Cabbage Tree you plant in the Wakapuaka originated from the Wakapuaka, not from a seed store in Rotorua or Northland. Those plants are different to ours that are uniquely adapted to our local conditions.

- Nelson has several nurseries that supply these kinds of plants

Titoki Nursery Brightwater www.titokinursery.co.nz

Nelmac Nursery Nelson www.nelmac.co.nz/nursery

Mainly Natives Redwood Valley
www.mainlynatives.co.nz

- For larger planting projects try and get your order in by December at the latest in the year
- preceding your planting. This gives the nursery time to produce your order. Plants are generally in short supply in Nelson, especially ecosourced to the North Nelson area so good planning pays off.
- We generally utilise root trainer grade plants in riparian planting for several reasons. They are cheap, easy to handle in bulk, easy to plant and have provide good establishment. We can use larger grades that may handle tougher conditions better but generally we keep these to the larger tree species that may be a bit slower to get away such as Kahikatea, Beech etc.
- http://nelson.govt.nz/environment/biodiversity-2/nelson-nature/resources/living-heritage-plant-guide/ This link takes you to Nelson City Council’s document on Ecosourcing and an online version of the Living heritage Guide which will help you select the correct plants for your planting situation.

6.4 Plant layout

How do we lay out the planting for maximum benefits, ecological and aesthetic?

- As mentioned previously we carry out riparian planting for several reasons. In each planting we may be trying to achieve different things so for a planting with a strong aesthetic component plant placement and species choice becomes critical as opposed to a more generic riparian planting.
- For small streams we may be utilising only a handful of species with the bulk of the planting being made up of grass species such as Carex secta with taller trees to break up the planting and provide some height.
- We will also consider other ecological gains that can be made through the planting such as provision of habitat for certain bird or invertebrate species or the conservation of or uncommon plant species.
- We are generally looking to provide shading to the stream to reduce water temperatures in the summer. This means species choice on the eastern and northern margins is critical to achieve the maximum benefit. Filtration and interception of sediments can also be critical to a good planting and maximising benefits. This can be achieved through the use of Carex grasses in wet or boggy margins.
- A very general rule of thumb is around one plant per sq metre. This provides a very dense planting and covers the ground quickly. We are trying to achieve canopy closure as quickly as possible to reduce future weed control. The sooner we have canopy closure the less chance of weed invasion.

6.5 Planting Technique

What technique should we use and what tools?

- Correct planting technique is covered in the planting demonstration at the workshop. This needs to be demonstrated practically rather than described.
- A good quality planting spade is essential for planting large numbers of plants quickly and correctly.
- Very stony margins require differ technique using a crowbar to form a suitable hole. In this case it is important to remember that we are still trying to cultivate or disturb as large a piece of ground as possible.
- We generally do not use fertiliser in the riparian zone. Fortunately, riparian margins are usually relatively fertile.
- Plants to be planted must be well watered and have firm but not root bound root balls.

6.6 Planting maintenance

What ongoing care is needed to optimise plant growth?

- Most plantings will require ongoing weed control. The best weed control is that which is done before planting. It is so important to gain control of perennial weeds prior to planting rather than attempting control following planting.
- We generally allow for three post planting visits for weed control in the year following planting. Four visits in some cases where weeds such as convolvulus are present.
- In some instances, simple grass cutting to release the plants may be all that is needed. If using a weedeater it is not recommended to use a line trimmer, stick to a steel blade. The line trimmer will quickly ring bark every tree leading to planting failure.
- Herbicide rings around plants can be a useful technique if the operator has the skill level required to accurately apply the herbicide away from the water and not in contact with any of the new plants.
- All plants need to be marked with at least a single 900mm bamboo stake to aid in finding the plants in areas of heavy growth. Riparian margins that were formerly pasture will grow grass and weeds quickly once they are fenced off and planted out. Without bamboo stakes it can be very hard to differentiate plants from weeds.
- Plant guards can be used but care should be taken using plastic in the riparian zone. FuturEcology have a biodegradable plant guard suitable for use in the riparian zone, the 'Em-Guard' available for the first time this year. Contact rob@futurecology.co.nz

6.7 Planting demonstration

We plant a plant correctly and how and why the use of the correct planting technique optimise plant growth.

7 Wakapuaka River fish biodiversity

Paul Fisher, Nelson City Council

Fresh water scientist Nelson City Council

paul.fisher@ncc.govt.nz or 03 546 0200

The Wakapuaka River is well connected to the Delaware Estuary and there are no significant natural or artificial fish passage barriers though the catchment. Because of this, the catchment is relatively rich in fish species, although giant and shortjaw kokopu and bluegill bully are not found.

Some of the more common species are showing patchy distribution within the region, with few records of banded kokopu, shortfin eels and redfin bully. Young lamprey (status - threatened) occur at Hira Reserve; other At Risk species have been recorded in their respective habitats throughout the catchment.

7.1 Fish species occurring in the Wakapuaka catchment

Common name	**Species name**	**DOC Threat Status**
Shortfin eel	Anguilla australis	
Longfin eel	Anguilla dieffendachii	At Risk - Declining
Koaro	Galaxias brevipinnis	At Risk - Declining
Inanga	Galaxias maculatus	At Risk - Declining
Banded kokopu	Galaxias fasciatus	
Upland bully	Gobiomorphus breviceps	
Common bully	Gobiomorphus cotidianus	
Giant bully	Gobiomorphus gobioides	
Redfin bully	Gobiomorphus huttoni	At Risk - Declining
Lamprey	Goetria australis	Threatened - Nationally Vulnerable
Torrentfish	Cheimarrichthys fosteri	At Risk - Declining
Brown trout	Salmo trutta	
Common smelt	Retropinna retropinna	
Yelloweye mullet	Aldrichetta forsteri	
Grey mullet	Mugil cephalus	
Cockabully	Grahamina nigripenne	
Species absent		
Giant kokopu	Galaxias argenteus	
Shortjaw kokopu	Galaxias postvectis	Threatened - Nationally Vulnerable
Bluegill bully	Gobiomorphus hubbsi	At Risk - Declining

Further information

http://nelson.govt.nz/environment/environmental-monitoring/river-and-stream-health-2

(Fish distribution reports and maps)

7.2 Fish habitat requirements

Juvenile and adult fish have different habitat requirements. Most freshwater species have a lifecycle connected to the estuary where larvae grow and migrate up stream. The distribution of species in the catchment is largely determined by their specific habitat requirements and climbing abilities, with eels, koaro, banded kokopu and redfin bully found furthest inland.

It's likely that habitat loss has impacted on the numbers of fish species found. Due to short, elevated reaches and river health issues, the coastal tributaries of Delaware and Cable Bay are less favourable for giant and banded kokopu, and inanga to a lesser extent.

Koaro – Hira (credit: Paul Fisher)

Species	Habitat requirements for threatened species
Lamprey	Boulders for nests and soft banks with forested margins for neonates
Longfin eel	Faster-flowing stony streams and rivers, pools and woody debris
Torrentfish	Fast flowing water and estuaries
Bluegill bully	Fast flowing water, riffles, and fast runs and associated substrate (gravel/cobble)
Redfin bully	Moderately to swift flowing water – low deposited sediment
Giant kokopu	Gently flowing weedy/boggy streams and swampy lagoons, wetland tributaries
Koaro	Swift boulder-cobble streams with riparian vegetation
Inanga	Gently flowing and still water
Shortjaw kokopu	Small bouldery streams with dense podocarp forest margins

Fish surveys are undertaken using a national protocol, which involves assessing a 150 m reach of the river or stream, divided in to 10 x 15 m sections.

We usually survey using an electrofishing machine (EFM) during the day and then spotlighting at night (on separate days). Both surveys may not capture all fish present but will show a representative sample of the species present.

We record the size of each fish found, which can provide a useful indication of breeding status and also whether fish passage barriers are affecting fish migration and community structure (which may be shown by an absence of juvenile fish).

Future surveys will also use DNA to assess the presence of rare or threatened fish species.

Young Lamprey – Hira (credit: Paul Fisher)

This is a great place for recording where fish can be found in the Nelson district.

http://nelsoncity.maps.arcgis.com/apps/webappviewer/index.html?id=0550cc5d9bb14f4788dead870edbe78a

\

Interested to learn more about native fish

http://www.landcare.org.nz/Regional-Focus/Hamilton-Office/Hooked-On-Native-Fish/Fish-Fact-Sheets1

8 Action plans by the community

- Increase the amount of riparian fencing and planted buffers along the river.
- Examine the impact the gravel roads are having on water quality in the river.
- Determine if the local private land fill is impacting on the water quality in the river.
- Examine the risks posed by septic tanks (especially the older ones) and come up with a plan to improve them.
- Arrange a visit from or to the forestry to discuss with them options (eg. use of slash, monitoring, flood impacts, riparian permanent plantings, long rotation trees) they are considering implementing to reduce the impact of the forestry on the catchment.
- Discuss the setting up and funding of a walkway with council and landowners that incorporates forest tracks and opens up the river more to recreation.
- Promote collaboration between landowners and the NCC to solve issues in the river
- Set up systems to promote rain harvesting. Look at assistance for putting in water tanks to reduce the water take along the river.
- Collect confidential information from the community on the amount of water being taken from the river so that the impact of water take can be assessed.
- Improve the weed control along the river, particularly the vines and other invasive weeds.
- Establish a stream care group to help with weed control and planting along the river and other aspects of improving the river.
- Consult with the Wakapuaka catchment community on their priorities for the river in an electronic survey.
- Examine using riparian carbon forests as a way to fund riparian planting.

The Estuary: Where all the water ends up.