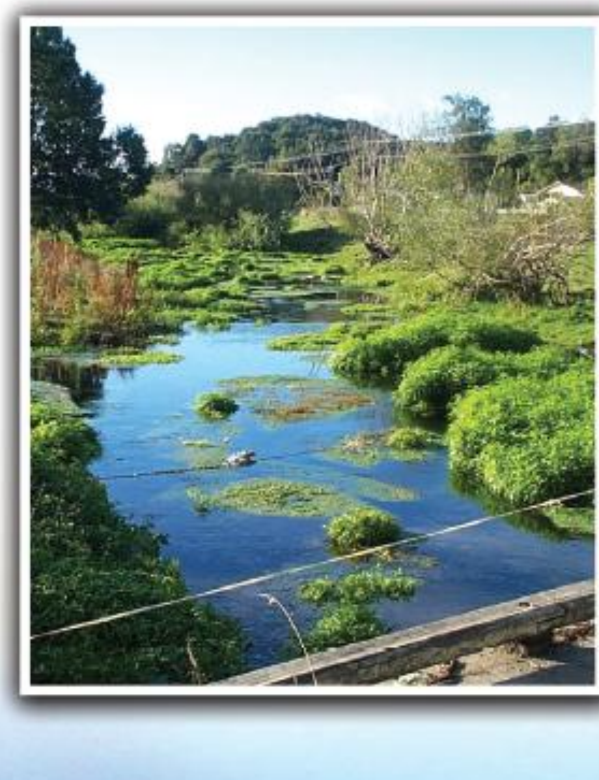
Tasman District Council

State of the Environment Report

Water Quality and Aquatic Ecology of the Motupipi Catchment

March 2007



Water Quality and Aquatic Ecology of the Motupipi Catchment

July, 2007

Tasman District Council

WATER QUALITY AND AQUATIC ECOLOGY OF THE MOTUPIPI CATCHMENT

Document Status: Interim Draft Report
(significant additional information will be added to this report over the next 12 months)

July 2007

The purpose of the report is to provide a summary of information known about the Motupipi catchment, based primarily on information from monitoring programmes undertaken by Tasman District Council. This report will be updated as new data becomes available, including data from new monitoring programmes instituted in the catchment.

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Cover Photos: Motupipi River upstream of Sunbelt Crescent looking upstream.

Tasman District Council Report Ref: 07001

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Executive Summary

Results from the Tasman District Council's 'State of the Environment' surface water quality sampling conducted at over 70 sites throughout the region have shown the Motupipi and some tributaries to have consistently poor water quality. In particular there are high nutrient concentrations, moderately high concentrations of disease-causing organisms, low dissolved oxygen and moderately high amounts of fine sediment deposited in the bed of the river. Macro-invertebrate populations have been found to be in poor health and there are indications that fish populations are impoverished.

A programme of more detailed investigations was started in 2005 in the Motupipi catchment with the aim of trying to determine the main sources of contamination, patterns of water quality over daily, monthly and seasonal cycles and in response to rainfall. A study in this catchment investigating the benefits of implementing the 'Dairy and Clean Streams Accord Programme' (particularly restricting stock access) began in July 2006. Studies investigating the state of groundwater and the Motupipi estuary are also under way.

The main findings from monitoring to date include:

- Average (median) dissolved organic nitrogen and total nitrogen are above ANZECC 2000 guidelines at all sites. Berkett Creek and a spring-fed tributary approximately 500m downstream of the dairy factory have particularly high nitrogen concentrations. Median dissolved organic phosphorus is above these guidelines at most sites, particularly in a tributary of the Motupipi River meeting the main stem opposite Sunbelt Crescent, McConnon Creek and 300m downstream of Reilly's bridge. Nutrient concentrations do not appear to rise significantly during or after rainfall.
- At stable base flows *E.coli* concentrations are greater than the maximum ("Alarm" level) prescribed by guidelines for bathing water quality for more than 25% of the time. The average (median) *E.coli* concentration at base flows is more than double that of guidelines (ANZECC 2000). There is no indication of reducing *E.coli* concentration. Only during or after significant rainfall events does the *E.coli* concentration exceed stock drinking water guidelines (ANZECC 1992).
- Dissolved oxygen concentrations monitored continuously over almost two weeks in February 2006 showed five sites (Motupipi and tributaries) were below 60% for over 10 hours of a typical day. The site in the upper Motupipi River and McConnon Creek experienced concentrations below 40% for over nine hours of a typical day. Lower Powell Creek experienced the lowest concentrations of less than 20% for over an hour of a typical day (under 40% for seven hours). Concentrations in the lower Motupipi River (upstream of Powell Creek confluence) were below 45% for eight hours of a typical day.
- Fine sediment deposits to the bed of the main stem of the Motupipi are typically 300mm thick in areas of extensive aquatic plant cover (open to the light). Exposed cobbly substrate was evident in areas where there was extensive shading by riparian trees. Downstream of the Powell Creek confluence fine sediment deposits were greater than one meter.

- All macro-invertebrate community indices at all monitored sites in the catchment other than upper Powell Creek indicate poor water quality. Inanga and eel (tuna) appear abundant in parts of the catchment particularly in spring.

The local community and landowners in the catchment are concerned about water quality and are taking measures to improve it. Over the past five years farmers in the catchment have undertaken a range of initiatives to improve water quality such as bridging, upgrades to effluent application and fencing waterways. Through a series of meetings an action plan has been drawn up to attempt to improve water quality by shading out the areas where aquatic plants are most prolific. An integrated catchment management approach is being used to ensure that all landowners are on board and all activities with potential to discharge contaminants to the catchment are investigated and addressed in priority order.

Contents

1.0 Introduction

Location and setting:

The Motupipi catchment drains an area of approximately 2855 hectares in the lower Takaka Valley of Golden Bay. Approximately 1040 ha of the catchment is relatively flat or gently rolling hill country. The mainly-steep hill country of Dry Creek makes up approximately 1200 hectares. The remaining area is either rolling hills (460ha) or estuary (40ha). The catchment is bounded in the west by the eastern part of Takaka Township through to Rototai. In the south the boundary runs along State Highway 60 from near the intersection of Motupipi Street to near the Kotinga Rd intersection. It then follows to the north of Rameka Creek. In the east the catchment boundary is formed by the Pikikiruna Range, rising up to Murray Peak at 110m in the South-eastern edge of the Dry Creek sub-catchment (see Figure 2).

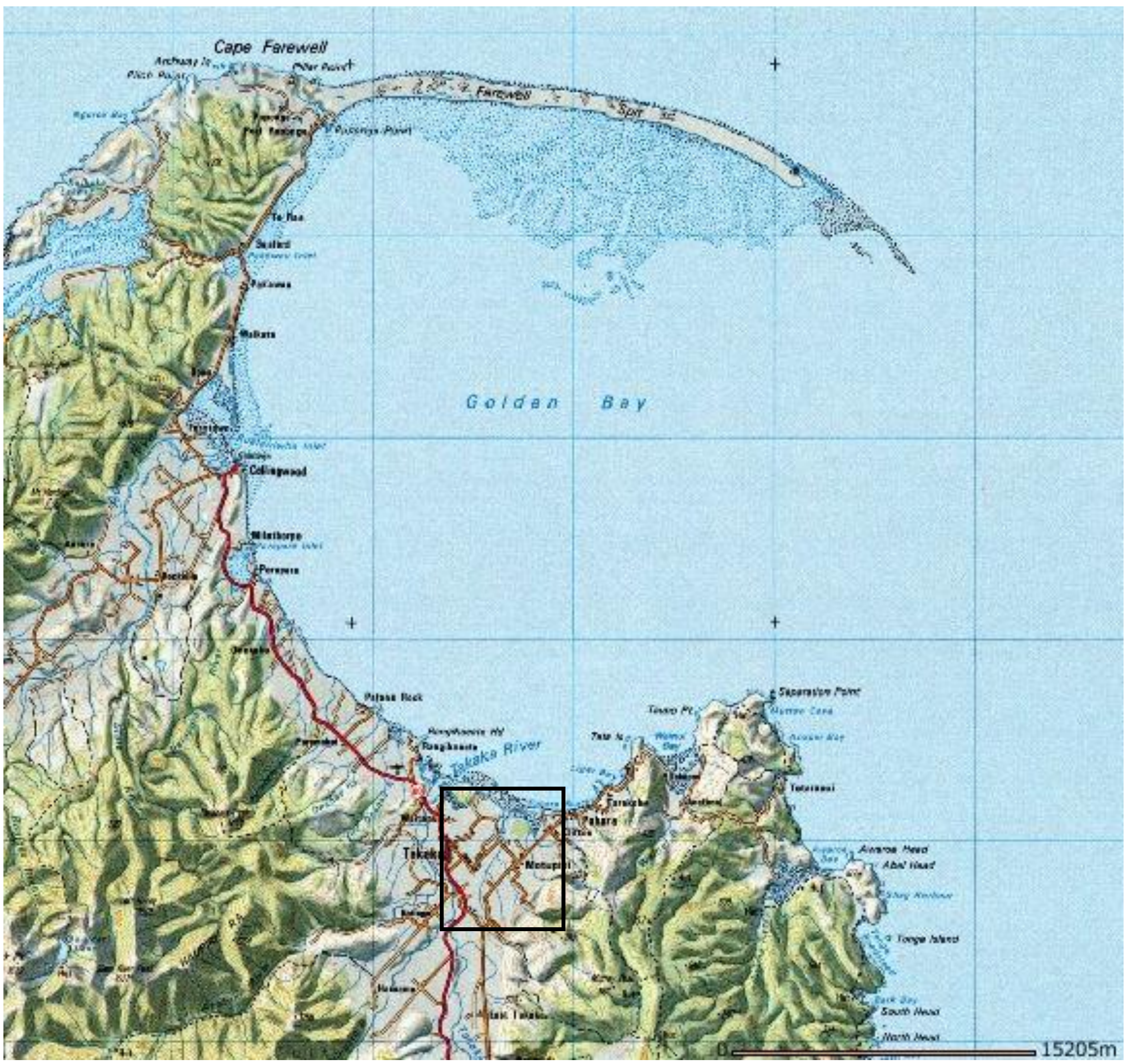
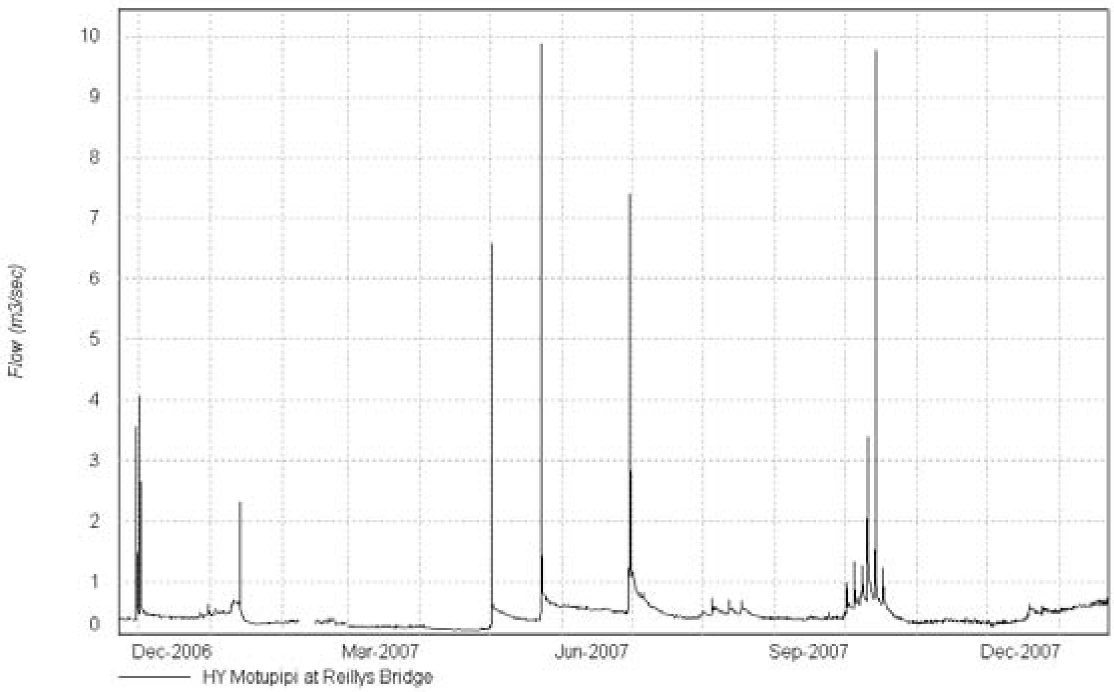


Figure 1.1 Map of Golden Bay, Tasman District. The inset box includes the Motupipi catchment shown in Figure 1.2.

Figure 1.2: Map of the Motupipi catchment showing the major land use types, monitoring sites and other features.

The flow in the Motupipi River is relatively stable with a mean flow of 0.45 m^3/sec, minimum of 0.2 m^3/sec and a maximum flow of 2.7 m^3/sec[1]. Springs in the main stem of the river from near Motupipi Street to Sunbelt Crescent, as well as tributaries feeding in in this area including Watercress Creek, supply much of the baseflow in the main stem of the Motupipi. While dominated by spring-flow, the upper Motupipi River (upstream of Reilly's Bridge) does experience flood flows from large floods in the Takaka River when flows cross 'Bridges Hollow' over State Highway 60. This has not happened since the mid 1990's, possibly due to the raising of stop banks along the true right bank of the



Takaka River.

Figure 1.?? Flow in the Motupipi River at Reilly's Bridge Dec2006 to Dec 2007

Lowland streams in the eastern part of the catchment, Powell[2], Berkett[2] and McConnon[2] Creeks, are and flow through clay country.

[1] This data is from the period of one year after a flow recorder was installed in the river at Reilly's Bridge.

[2] It should be noted that Berkett Creek is also known by some as Susan Creek and McConnon as Gold Creek. However, as these names are not is such common usage the aforementioned names will be used in this report.

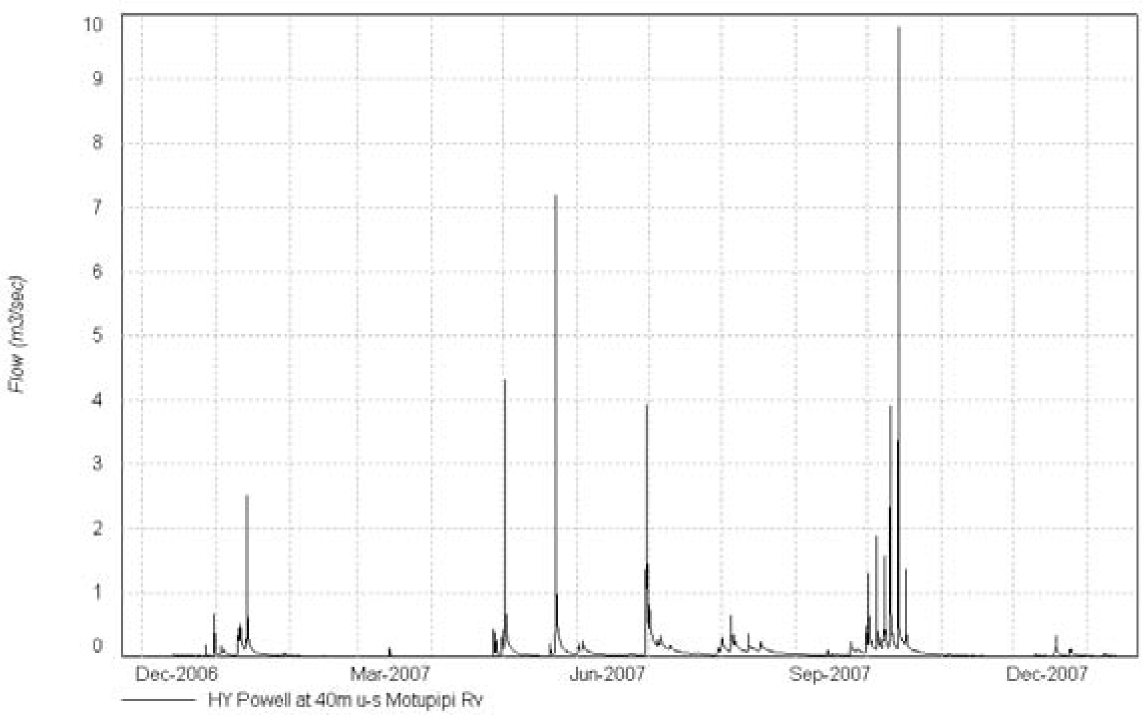


Figure 1.?? Flow in Powell Creek at Reilly's Bridge Dec2006 to Dec 2007

Streams in the Powell Creek catchment are generally soft-banked with considerable silt and mud in the bed matrix. Some parts of the catchment are dominated by silt and mud substrate While gravels and cobbles (see Table ??). The representation of woody debris in the waterways of the catchment is very low as a result of very little woody riparian vegetation.

SITE	LARGE COBBLES 120-250MM	SMALL COBBLES 60-120MM	GRAVELS 20-60MM	SAND 1-20MM	SILT/ MUD <1MM	WOODY DEBRIS
Powell Creek @ 40m upstream Motupipi	**1.5** (3+0)	**22** (44+0)	**54.25** (52+56.5)	**7.75** (1+14.5)	**14.5** (0+29)	**0** (0+0+0)
Berkett Creek @ Reilly upstream Boundary	**2** (2+0+4)	**31.8** (29+0+66.5)	**26.3** (8+55.5+11)	**5.5** (0+16.5+0)	**10.5** (59.5+27+18.5)	**0.83** (1.5+1)
Berkett Creek @ u-s Powell Creek	**10.5** (11+0)	**4.5** (9+0)	**12.5** (0+25)	**14** (0+28)	**62.75** (80+45.5)	**0.75** (0+1.5)
McConnon Ck @ upstream Powell Ck	**18.3** (12+0+43)	**15.7** (20+4+23)	**35** (22+77+15)	**0** (0+0+0)	**28** (46+19+19)	**0** (0+0+0)
Powell Ck @ upstream McConnon Ck	**0** (0+0+0)	**7.3** (14+0+8)	**11.8** (2+12.5+21)	**4.5** (0+13.5+0)	**70** (81.5+57.5+71)	**6.3** (2.5+16.5+0)
Powell Ck @ Glenview Rd	**2.5**	**15**	**56.25**	**1.25**	**25**	**0**

Table ??: Stream substrate % cover as assessed at the sampling sites in this programme (bracketed values represent the range of actual data).

Not represented at these sites was bedrock and boulders. While mudstone bedrock has been found in the catchment, it is likely to make up less than 1%. The only boulders found in the catchment are those placed for erosion protection around culverts and one erosion scarp in lower Powell Creek.

Plants rooted in the bed were not included in this assessment but made up 50-100% cover at times. These plants included the introduced species Reed Sweet Grass (*Glyceria maxima)* and Swamp Willow Weed (*Persicaria decipiens*). Reed Sweet Grass is common in Powell Creek for about 200m upstream of the McConnon Creek confluence and Swamp Willow Weed is common in the lower reaches of Powell Creek. Pasture grasses invade the channel in Berkett Creek in summer when flows are low.

The catchment geology is complex, with Takaka limestone underlying the entire catchment with various prominent outcrops. Tarakohe mudstones on the river terraces are poorly drained with sheet-wash run-off possible after heavy rain. Rockville and Bainham gravels are also a feature of the terraces. Recent river alluvium is present as a result of the Takaka River flood plain.

Two soil types dominate in the lowland areas: recent flood plain soils (Karamea Silt loams) and terrace soils (Rameka brown granular loam to clay and yellow brown earths). Refer to Figure 1.3. The streams flowing through the Rameka soils such as Powell, McConnon and Berkett Creeks, are generally soft-bottomed (having considerable fine sediment in the bed and little hard gravels or cobbles). Due to the poorer drainage on these soils the runoff after rain is much greater with bank-full flows occurring after 60-80mm of rain. Soils in parts of the upper and mid Motupipi catchment have had very high Olsen P levels (150-160 mg/kg on one farm and up to 300 mg/kg on another). These concentrations have reduced considerably over time and are now 40-60 mg/kg (the guideline for Olsen P is 30 mg/kg) over much of the catchment. This high Olsen P concentration is a legacy from discharges of dairy factory wastewater.

How the contaminants discharged from the catchment will affect water quality in Golden Bay has not been studied to date. However, some indication is available from Tuckey et al who produced simulated depth-average tidal residual circulation models for Golden Bay. These models confirm the circulation patterns found by Heath (1976). These models show that there is relatively little current near the Motupipi River mouth compared to the shallow banks inside Farewell Spit (at the top of Figure 1.4) where the currents are up to 20cm/second. However, local observations suggest that material from the Takaka River mouth is deposited more to the eastern side of the river mouth than to the west.

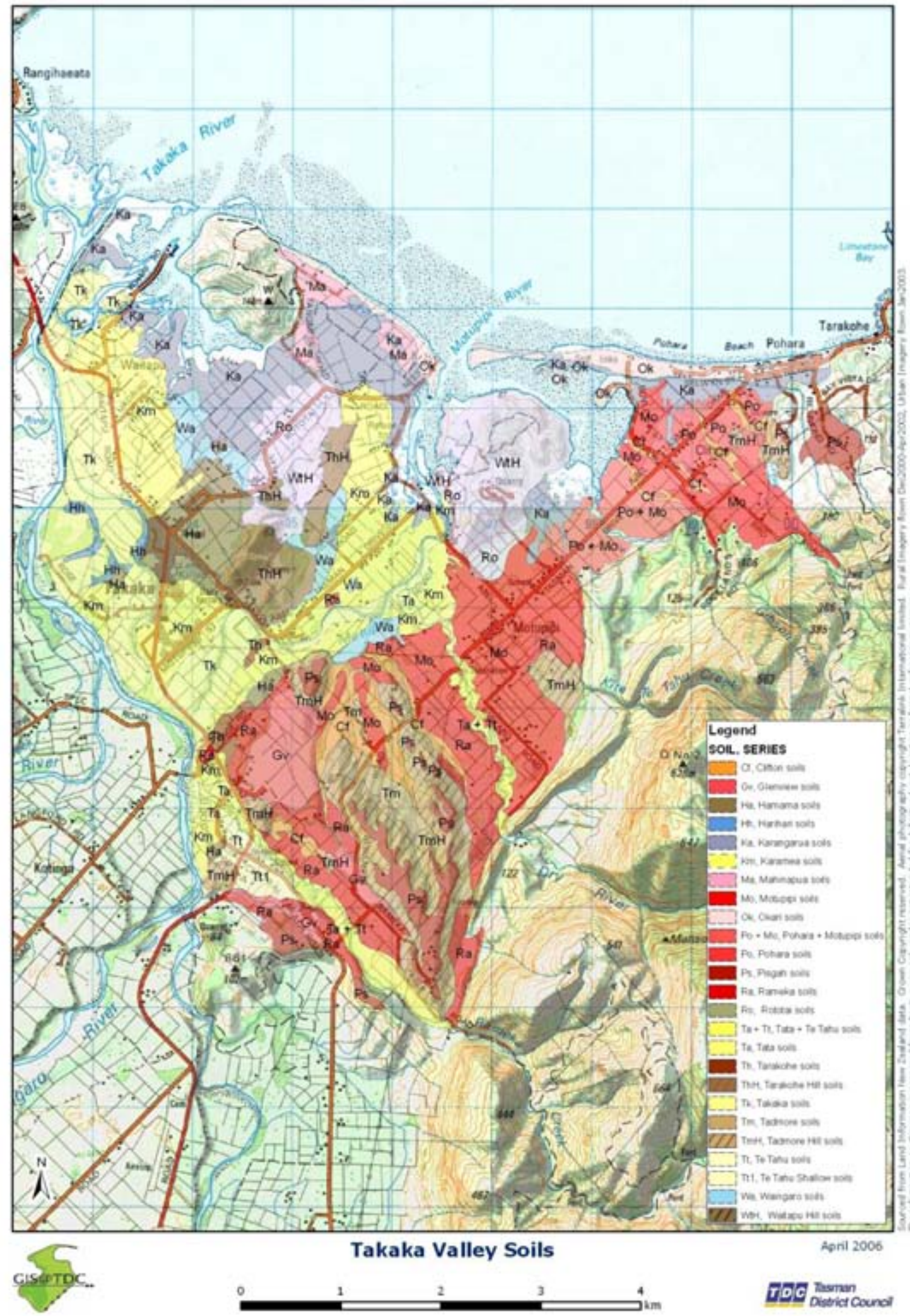


Figure 1.3: Soils of lowlands around Takaka

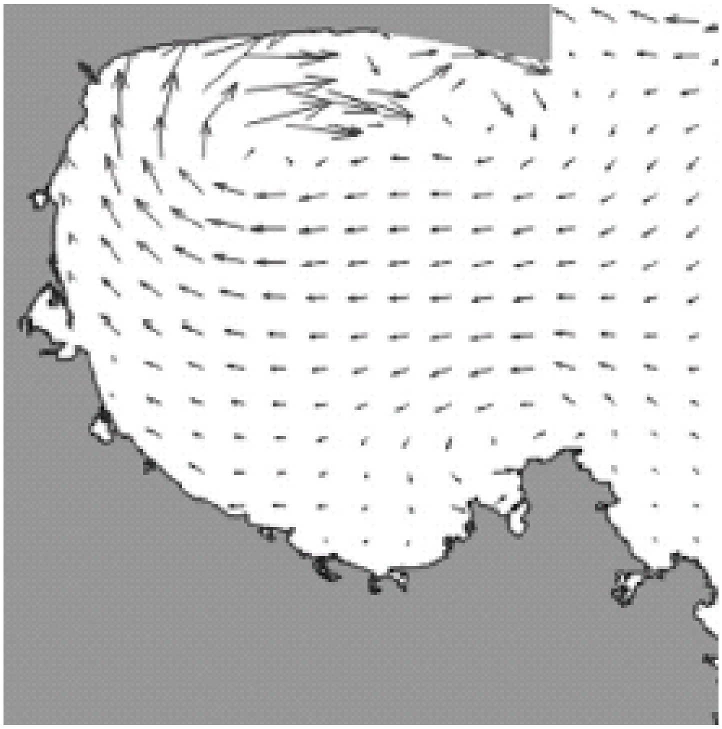


Figure 1.4 Simulated depth-average tidal residual circulation for Golden Bay (from Tuckey et al, 2006).

Catchment land uses:

Farming:

About 1040ha of the catchment is in lowland pasture used for livestock farming. Of this, about 728 (70%) is in intensive dairy farm land use with the rest in sheep, beef or cultivated cropping (mostly maize). There were 2810 dairy cows in the catchment as at 2006-07 dairy season. The population of dairy cows in the catchment has been relatively stable over the past decade numbering about 2500-2800 cows. Stocking rates in the area are stable ranging from 2.7 to 4.0 cows per hectare. The dairy farms have intensified over recent years, with greater amounts of feed purchased or brought onto the farms from other areas, lifting per cow performance.

The main point sources of contaminants from dairy farms are typically effluent discharges, silage leachate, feed pads or wintering pads and runoff from races and stock crossings. There are three unbridged cattle crossings in the catchment, with only one of these crossing waterways with permanent flow (Motupipi River downstream of Abel Tasman Drive where the cattle cross every 4-6 weeks).

Figure 1.5 A bridged stock crossing on Reilly's farm

Figure 1.6 Significant pugging caused by a mob of cows during a night of rain Powell Creek sub-catchment

Feed pads or wintering off pads are used in the catchment, particularly in winter. This feed pad on clay soils has resulted in heavy pugging and run-off of fine sediment and effluent into waterways.

Silage pits are common on most dairy farms. If poorly managed, there can be leachate discharged to waterways that can cause significant adverse effects such as oxygen depletion and excessive plant and algal growth after reasonable mixing.

Figure 1.7 A silage pit near a waterway

About 942 kg/ha/yr of artificial fertiliser is applied to the catchment, averaging 118 kg.ha/yr per farm.

Industrial wastewater:

Historically 1.5M litres/day of wastewater from the dairy factory was discharged to Watercress Creek, a tributary of the Motupipi. From the 1980's until the factory fire in 2005, whey waste was irrigated onto farms in the catchment. It was recommended in the late 1990's that whey should not be discharged to areas of the catchment underlain by mudstone because of the high potential for run-off into waterways (Thoma, 1997). In 2004 k-line irrigators were set up and no wastewater has been discharged to rivers in the catchment since. The strength of the wastewater since the factory reconstruction in 2005 is greatly reduced with no whey being generated for disposal. Burst pipes in the irrigator system have been a problem in the past but the problem section of pipe has since been replaced.

<u>Sewage:</u>

Sewer overflows have occurred frequently at three pump-stations in the catchment in recent years; Motupipi Street, Sunbelt Crescent and Casidy's Corner. In response to this Tasman District Council has in 2004-06 replaced much of the sewer line with a new continuous plastic (HDPE) pipe that should not leak. Baffles were placed in the drains downstream of the pump-stations in 2004 which ensured that most of the sewage was intercepted, collected and disposed of to the Takaka Sewage Treatment Plant. Several of the overflow events were due to power supply problems; the cause of which was not at all obvious. The pump-stations at Motupipi Street and Sunbelt Crescent were upgraded in 2006 and were provided with six hours storage of overflow sewage. The pump-station at Cassidy's Corner will be upgraded in the 2007-08 year with one remaining input upgraded the following year. This should ensure that there will be very limited discharge after 2007-08 and no further discharges of sewage in the catchment after the 2008-09 year from sewer failures.

<u>Landfill leachate:</u>

Discharges from the refuse transfer station located on Scott Road (on the Western side of Abel Tasman Drive between Sunbelt Crescent and Rototai Road) are contained and piped to the main Takaka sewer line.

The Rototai landfill located on the edge of the estuary near the mouth is another potential source of contamination. This landfill operated for almost 40 years up until 1994. Groundwater, leachate, sediments and shellfish have been sampled and analysed for heavy metals around Rototai landfill in 1994 and 1996. No pesticides or petroleum contaminants have been tested. The results showed:

- Concentrations of cadmium, copper and zinc in groundwater and leachate were slightly above guidelines (ANZECC 1992 Guidelines for Protection of Marine Organisms).
- Contaminants in sediment and shellfish were acceptable (ANZECC 1992 B, Environmental Investigation)

Since this monitoring there has been further remedial work done at the site. At this stage TDC is considering the need for further monitoring. It is very unlikely that the tip is a major contributor to the Motupipi River for the following reasons:

- the loading of contaminants (total quantity of contaminant discharged over time) is likely to be very small compared to other loadings
- the type of contaminants from the landfill are generally not as mobile (particularly heavy metals and pesticides) and will be strongly bound to the estuary sediments so are unlikely to move a long way
- the tip has been closed for some time now (13 years) and in that time the tide will have flushed a large proportion of the contaminants that are more mobile (such as nutrients) out of the edge of the tip and dispersed in the estuary and beyond. It is very unlikely that the tip is a signficant source of nutrients.

Conservation:
321 hectares of the high country near the ridgelines of Dry Creek catchment is in Department of Conservation management.

Values of the Waterway
The Motupipi Estuary is recognised as nationally important for natural ecosystem values (Schedule 25.1F in Tasman Resource Management Plan). Values for the Motupipi catchment were developed with full public participation at meeting on 13 December, 2006 at the Motupipi Hall. The whole community was invited to this meeting with a total attendance of 30 people. The values are listed below (in no particular order):

- Aesthetics – water and surrounds
- Pleasant odour
- Fishing – whitebaiting & mulleting
- Habitat for birds
- Water quality good for farm animals to drink

The waterway appears not to be valued for swimming as the water is regarded by many as too cold. However, water from the Motupipi is likely to affect beach water quality at Rototai and potentially Pohara and management of water quality may have to regard water for swimming or other contact recreation.

2.0 Water Quality

Results of Tasman District Council's 'State of the Environment' surface water quality sampling at over 70 sites around the region have shown the Motupipi River to have consistently poor water quality. This is characterised chiefly by high nutrient concentrations, moderately high faecal concentrations, low dissolved oxygen and moderately high amounts of fine sediment deposited in the bed of the river. Sampling has shown that macro-invertebrate populations are in poor health and there are indications that fish populations are impoverished (Deans, N 1997). A detailed sampling programme of soils and surface water undertaken in 1997 showed several potential significant sources of nutrient contamination of the Motupipi River (Thoma, 1997). All these issues are discussed in detail over the following sections of this document.

Most of the monitoring undertaken at sites listed in Table 1 occurs at stable baseflows, however some limited stormflow sampling has occurred in 1996, 1997 and 2006 (Thoma 1997 and unpublished results). The monitoring sites shown below are ordered from most upstream to downstream. The furthest upstream sites near the spring sources are covered with aquatic plants rooted in the bed.

Figure 2.1 Watercress Ck @ u-s dairy factory

Figure 2.2 Motupipi Rv @ u-s Watercress Ck

Figure 2.3 Motupipi Rv @ factory farm bridge

Figure 2.4 Motupipi Rv @ Reillys Bridge **Figure 2.5** Motupipi Rv @ Abel Tasman Dr

Figure 2.6 Motupipi Rv @ ~300m d-s Abel Tasman Dr

Figure 2.7 Powell Ck @ u-s McConnon

Figure 2.8 Powell Ck @ 400m u-s Motupipi

Figure 2.9 McConnon Ck @ u-s Powell Ck

Figure 2.10 Berkett Ck @ u-s Powell Ck

Table 1.1: Monitoring sites in the Motupipi Catchment

SITE NAME (LISTED IN ORDER FROM UPSTREAM TO DOWNSTREAM)	LENGTH OF SAMPLE RECORD	
Motupipi River Main Stem		
Watercress Creek upstream of Dairy Factory	2000 - present	
Motupipi River at upstream Watercress Ck	2005 – present	
Motupipi River at Factory Road	2002 – present	
Motupipi River at Reilly's Bridge	2000 – present	
Motupipi River at Abel Tasman Drive	2002 – present	
Powell Creek subcatchment		
Powell Creek at Glenview Road[1,2]	2005 – present	
Powell Creek upstream McConnon Ck[2]	2005 – present	
McConnon Creek upstream Powell Ck[2]	2005 – present	
Berkett Creek upstream Powell Creek[2]	2006 – present	
Powell Ck at Reilly's Bridge[2]	2004 – present	
Dry Creek subcatchment		
Dry Creek at Packard's Road	2006 (one off samples when flowing at Glenview Road)	
Dry Creek at Glenview Road	2006 (one off samples when flowing)	

[1] Fonterra have also sampled this site for many years
[2] Currently Monthly sampling as part of the Dairying & Clean Streams Accord

An automated water quality monitoring station was set up at Motupipi River at Reilly's Bridge in October 2006 with the aim of better understanding trends in water quality and to determine any particularly daily, seasonal, rainfall-derived or other patterns in water quality. Currently Tasman District Council only samples the Motupipi River quarterly only in stable base flows which is insufficient to understand trends until we have almost another 10 years worth of data and, even then we will not be able to understand many of the patterns of water quality. When looking at water quality response to a rainfall event continuous flow monitoring is needed. When installing flow monitoring gear and remote communications equipment, it is relatively cost-effective to add other parameters for measurement. The parameters measured at the site are listed in Table 1.2.

Table 1.2 Parameters measured at automated water quality monitoring station at Motupipi River at Reilly's Bridge

PARAMETERS MEASURED AT THE SITE	RELEVANCE OF THE RESULTS
Flow	Calculated from water level, this parameter is used alongside data of contaminant concentration to provide data on the total quantity (load) of a contaminant flowing past the site. It is also useful to determine whether there are certain flows that are producing the greatest contamination.
Dissolved oxygen	Without sufficient oxygen aquatic animals will not survive. Oxygen concentrations in the Motupipi in summer and autumn

	get very low. Dissolved oxygen is lowest in the early morning and so must be measured at least 2-4 times each hour.
Conductivity	This is a surrogate for nutrients as nutrients cannot be measured continuously. High conductivity is mostly likely to mean high nutrient concentration at this site.
Turbidity	Turbidity is how murky the water is. This data can be used to calculate how must sediment is getting into the waterway and how clear the water is.
Water temperature	Water temperature has not been found to be an issue in this waterway but it is very cheap and efficient to measure. It is also very useful for modeling, such as dissolved oxygen effects.
Solar radiation	Important when determining the rate of plant growth (metabolism) in the waterway.
Soil moisture	Useful for farm management.
Air temperature	Useful background information and cheap to measure
Rainfall	Useful for farm management. Along with soil moisture, rainfall data can be used to develop run-off models for the catchment.

Tasman District Council has received several complaints in the last few years about the water quality in this waterway, particularly with regard to a dark brown layer near the bottom of pools and a scum on the surface in the Motupipi River near Abel Tasman Drive.

2.1 Disease-causing organisms

The presence of high numbers of disease-causing organisms in the water can affect the health of swimmers and others immersed in the water (contact recreation) as well as the health of stock when the water is used for drinking. *E.coli* is the indicator commonly used to assess human disease-risk. While *E.coli* itself can cause disease it is also used to indicate the presence of other disease-causing organisms such as *Campylobacter* and *Cryptosporidium*. Cattle and humans are by far the greatest source of disease-causing organisms in the catchment. The production of *E.coli* from 2000 cows is 2 x10^{12} *E.coli* per day (based on $10^{4.3}$ E.coli/g and 50kg/day dung production: Todar, 2002 and Dairy Insight 2006). Assuming the human population of the catchment is 500, the total *E.coli* produced by humans is about eight times less than that of dairy cattle in the catchment: 3.75 x10^{11} *E.coli* per day (based on $10^{6.7}$ E.coli/g of faeces and 150g/day faeces production: Todar, 2002 and Altman 1999).

At the lower end of the catchment (Motupipi River at Reilly's Bridge, twenty-five percent of sample results at stable (base) flows had *E.coli* concentrations above water quality guidelines for contact recreation (Ministry for the Environment, June 2003 Alarm Levels (550 *E.coli*/100ml), (see Figure 2.11)).

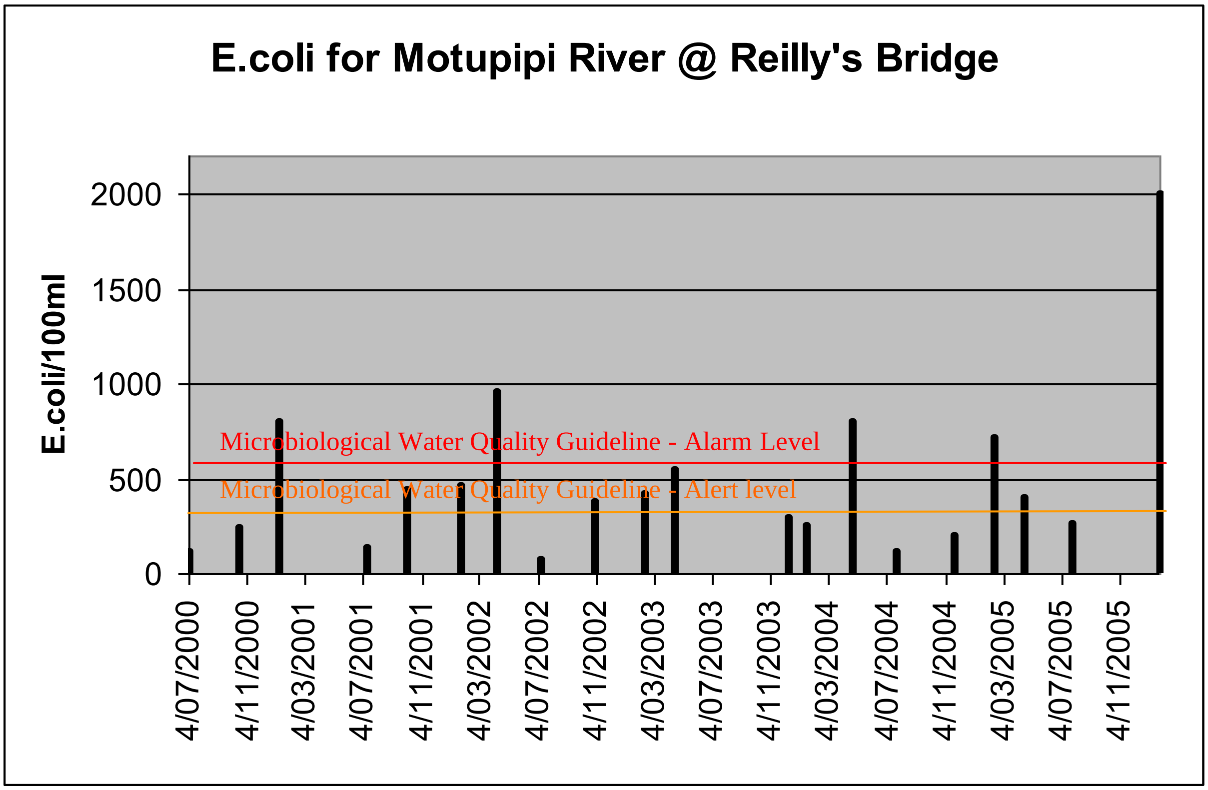


Figure 2.11

The "Alert Level" was not met greater than 60% of the time. These levels are among some of the highest for sites monitored regularly by Tasman District Council.

The average (median) *E.coli* concentration at base flows was 379 cfu/100ml which is more than double that of the ANZECC 2000 guideline (150 cfu/100ml). There is no indication of reducing *E.coli* concentration. Only during or after significant rainfall events does the *E.coli* concentration exceed stock drinking water guidelines (ANZECC 1992).

Stock drinking water guidelines (1000 faecal coliforms/100ml) were only exceeded once (ANZECC 1992). The ANZECC 2000 guidelines suggest a 100 faecal coliforms/100ml limit but this is precautionary. Canadian research shows that adverse effects on cattle body weight and physiology occurs above 1000 faecal coliforms/100ml.

There appears to be a peak in March-April each year. No explanation of this occurrence is possible at this stage.

Of the four sites monitored over the last five years the Reilly's Bridge site appears to have the highest concentration of *E.coli* (see Figure2.12). The source of this contaminant is unknown but could be from cumulative discharges from a number of properties.

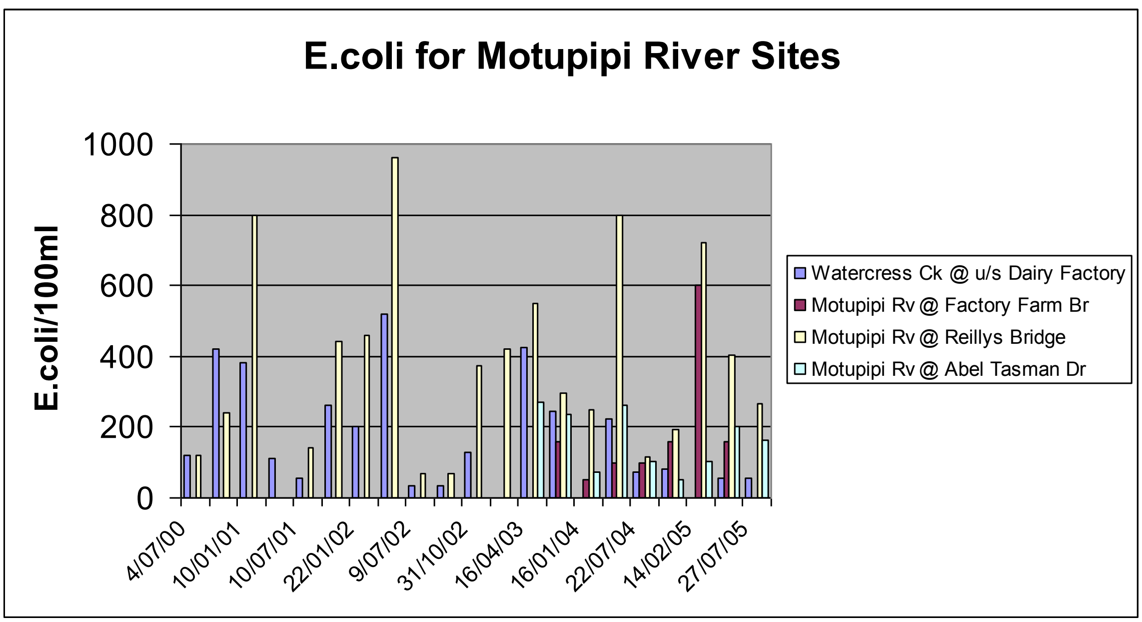


Figure 2.12

The highest concentrations of *E.coli* occurred after rainfall. This is because disease-causing organisms survive for much longer periods in sediment (weeks rather than hours in the water column) and this sediment gets remobilised into the water column during storm runoff events. Studies in various parts of New Zealand show that about 99% of *E.coli* load is discharged from pastoral farmland to streams during storm runoff. During stable baseflows approximately half of the *E.coli* load (0.5% of the total load) has been found to come from cattle with direct access to waterways. Figure 2.13 is an example of a sampling event that took place during a storm in January 2006. Several potential hotspots were identified in this sampling event: Berkett Creek draining from the industrial area, Dry Creek at Packard Rd, and Watercress Creek. Note that 10,000 *E.coli*/100ml was the upper limit of detection for these samples (Figure 2.13). This concentration is ten times the level that is considered safe for stock to drink.

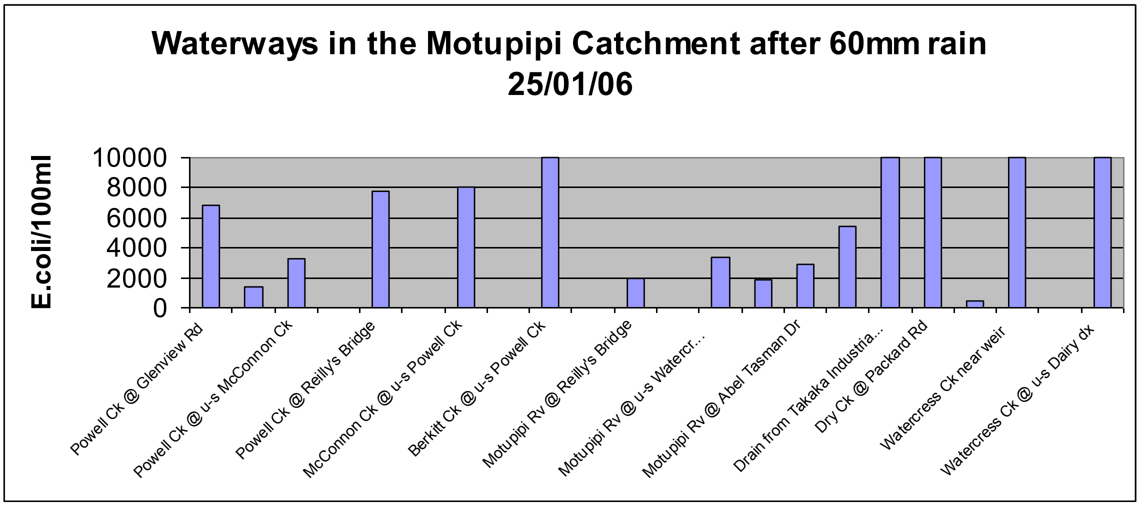


Figure 2.13

2.2 Nutrients

Nutrients in high concentrations are a problem in waterways because they contribute to the excessive growth of algae and aquatic plants that can become unsightly, sometimes odorous and may lead to the depletion of oxygen as they decay. These Algal blooms have also caused several dog deaths in New Zealand. Some nutrients, such as ammonia, are toxic to fish and invertebrates. The high nutrient concentration in the Motupipi River is a likely reason for the prolific growth of algae that causes the brown turbid layer near the bottom of the water column in the River near Abel Tasman Drive.

The concentration of the nutrients nitrogen and phosphorus in the Motupipi are among some of the highest for sites monitored regularly by Tasman District Council.

The high concentration of nutrients (particularly nitrogen compounds) could be due to a number of sources:

- Discharges of wastewater and whey from the dairy factory (this has now ceased) over many years continuing to leach from the soils into the groundwater and into the river and tributaries.
- Leaching of nitrogen from cattle urine in intensive farming (well known as a significant source of nitrogen)
- Leaching from fertilizer applied in ways that lead to loss to the river from the pasture system (leaching and runoff).
- Leaching from silage pits

2.2.1 Nitrogen

Most samples (taken at stable flows) have been found to exceeded guideline levels for Dissolved Inorganic Nitrogen and Total Nitrogen (0.444 and 0.614 g/m^3 respectively) (ANZECC 2000). Such concentrations are high enough to promote the excessive algal and other plant growth found in the stream in summer.

Box-whisker plots shown in Figure 2.14a and 2.14b show the variability within the data set for each site. 50% of the data fits in the box and 75% of the data falls within the area bound by the lines extending from the top and bottom of the box (whiskers). The plots with taller boxes and longer whiskers show higher variability in the data. The median is represented by the line within the box.

Figure 2.14a shows that the whole catchment contributes to high nitrogen concentrations. While it may appear that dissolved inorganic nitrogen is higher in Berkett Creek, this is a smaller waterway and so the contributions to the overall concentration in Powell Creek or the Motupipi River will be relatively lower (loadings have not been calculated for these data sets yet).

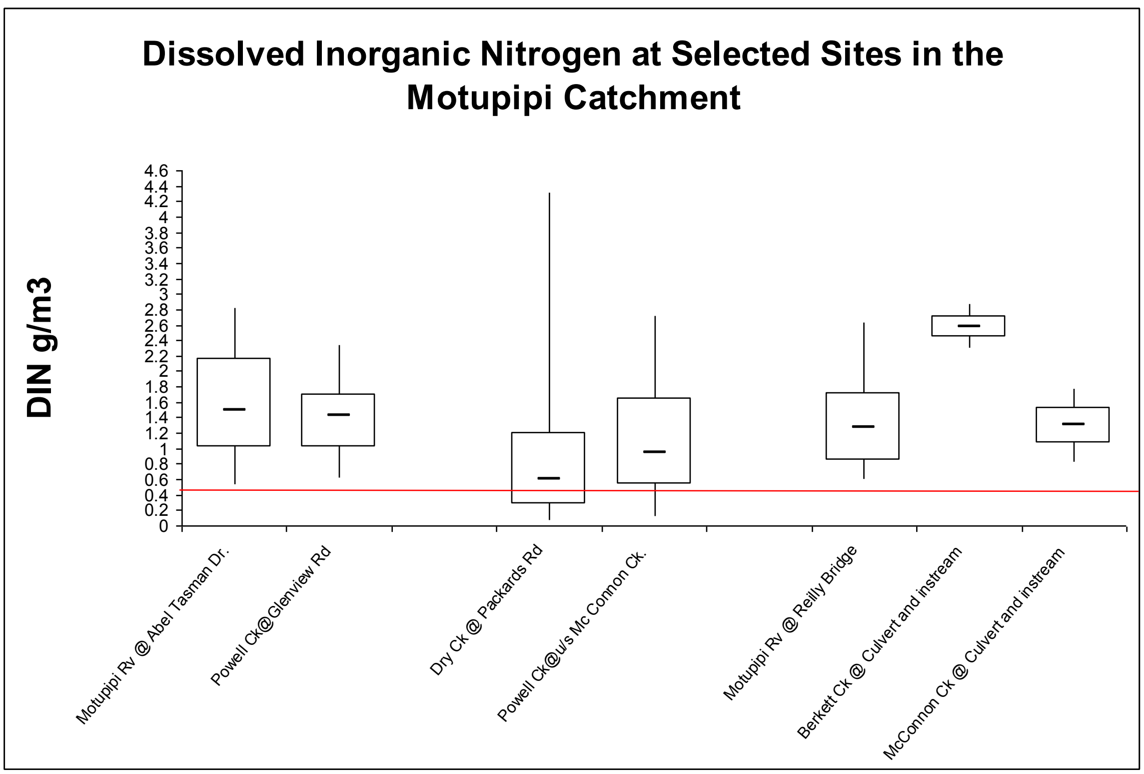


Figure 2.14a

No particular trend seems to be evident with nitrogen concentration at stable (base) flows in the Motupipi River (see Figure 2.14b).

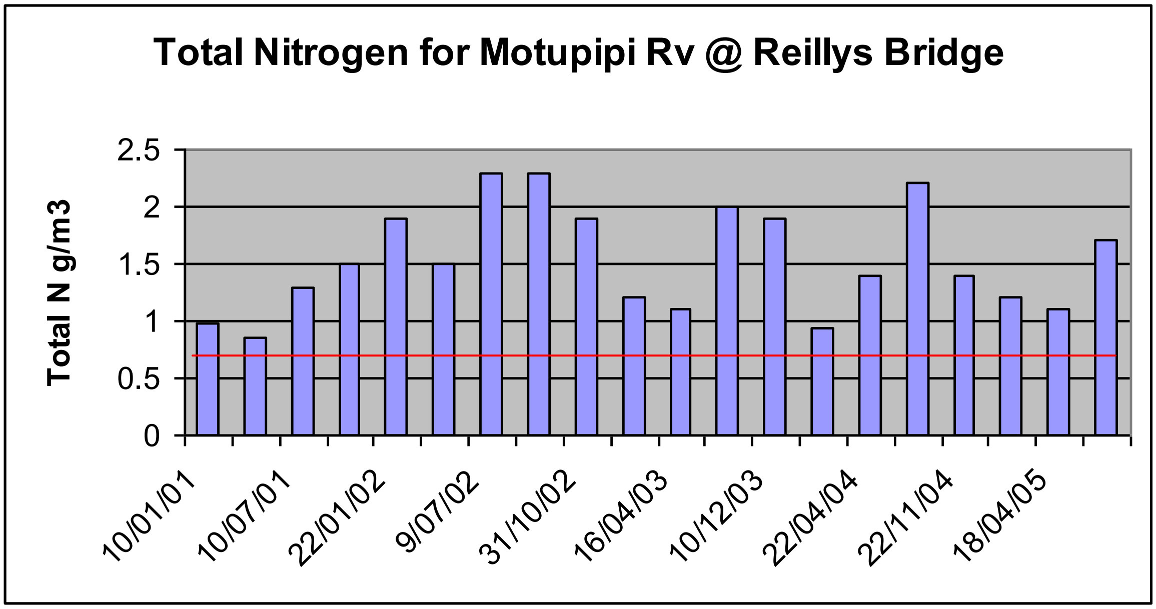


Figure 2.14b

Samples taken during a storm event do not appear to cause any significant increase in nitrogen concentrations (see Figure 2.15).

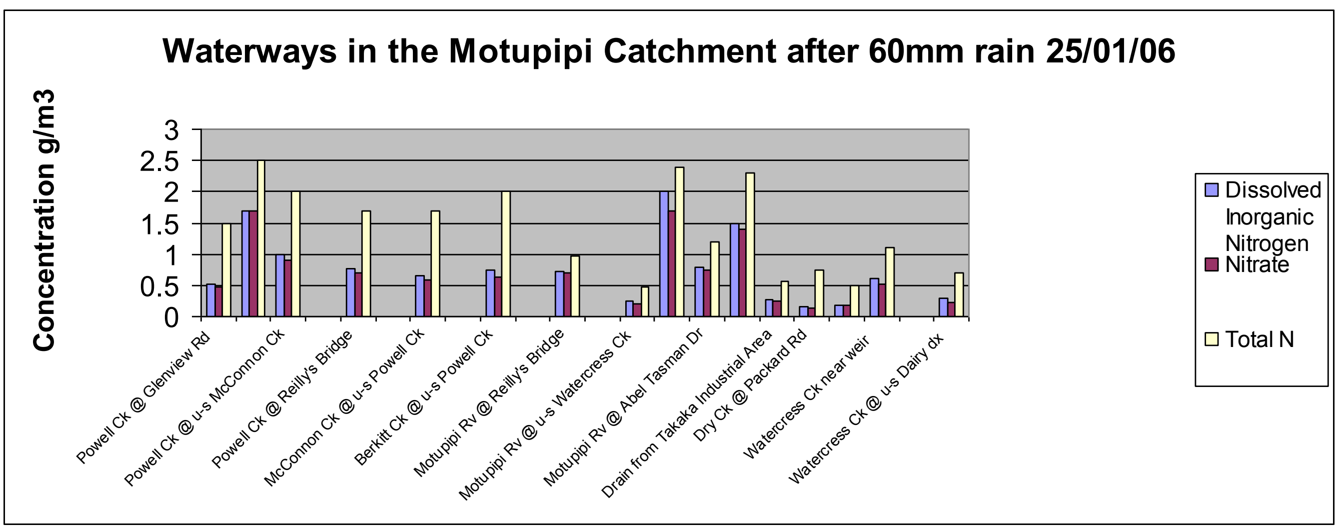


Figure 2.15

2.2.2 Phosphorus

The concentration of Dissolved Reactive Phosphorus at various sites is shown in comparison to ANZECC guidelines in Figure 2.16. As phosphorus binds strongly to sediment it tends to have a slower path to the waterway. It could be that the elevated nitrogen levels are promoting growth and the phosphorus is being taken up by plants. Under low oxygen conditions in the waterway phosphorus can be released from the stream bed; this could be the reason for the nuisance algal growths experienced by members of the public visiting the lower reaches of the river. Alternatively, the presence of the saltwater-freshwater interface in this area could also be a reason for the blooms downstream of Abel Tasman Drive. To this effect the algae would use nitrogen from freshwater and phosphorus from saltwater. In addition the water density difference and good light conditions, through changing tide levels, provide ideal growing conditions.

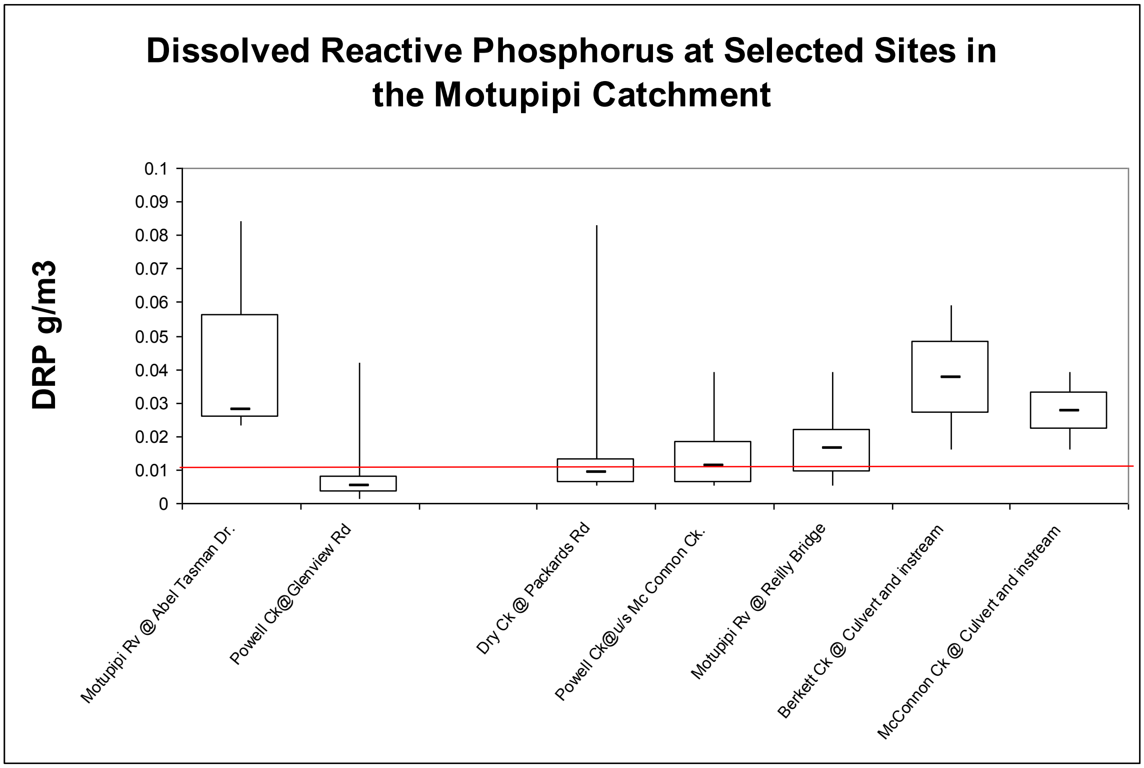


Figure 2.16a

No particular trend seems to be evident with phosphorus concentration at stable (base) flows in the Motupipi River at Reilly's Bridge (see Figure 2.16b).

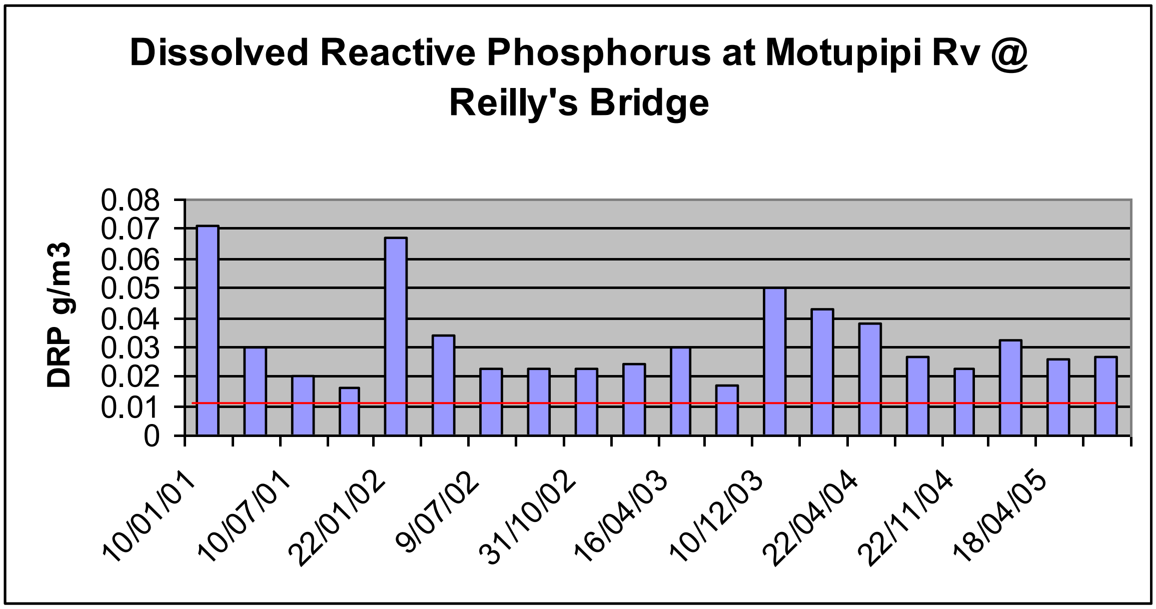


Figure 2.16b Note: The guideline marked on the graph is from ANZECC 2000.

There appears to be little difference in nutrient concentrations in dry weather compared to moderate rainfall events. These nutrient levels are among some of the highest for sites monitored regularly by Tasman District Council.

2.2.3 Water Quality Along a Longitudinal transect

Samples were taken on a longitudinal transect down the Motupipi River from the dairy factory to Abel Tasman Drive on October 12, 2006. Nitrate concentration, which forms the bulk of the dissolved inorganic nitrogen fraction, was highest in the mid reaches of the river where two spring-fed tributaries enter the waterway between Sunbelt Crescent and the dairy factory (see Figure 2.17a). Phosphorus concentrations showed a different pattern with three sites showing particularly high phosphorus concentrations:

- One of the spring-fed tributaries (near Sunbelt Crescent) - total phosphorus 0.21 g/m^3 and dissolved reactive 0.015 g/m^3
- McConnon Ck - total phosphorus 0.11 $g/m^3$and dissolved reactive 0.024 g/m^3
- Motupipi River approximately 300m downstream of Reilly's Bridge - total phosphorus 0.048 $g/m^3$and dissolved reactive 0.027 g/m^3

Because phosphorus concentrations increase with distance down the catchment it suggests that the source is non-point (diffuse).

Total ammonia concentrations were also elevated for these sites, as well as Berkett Creek.

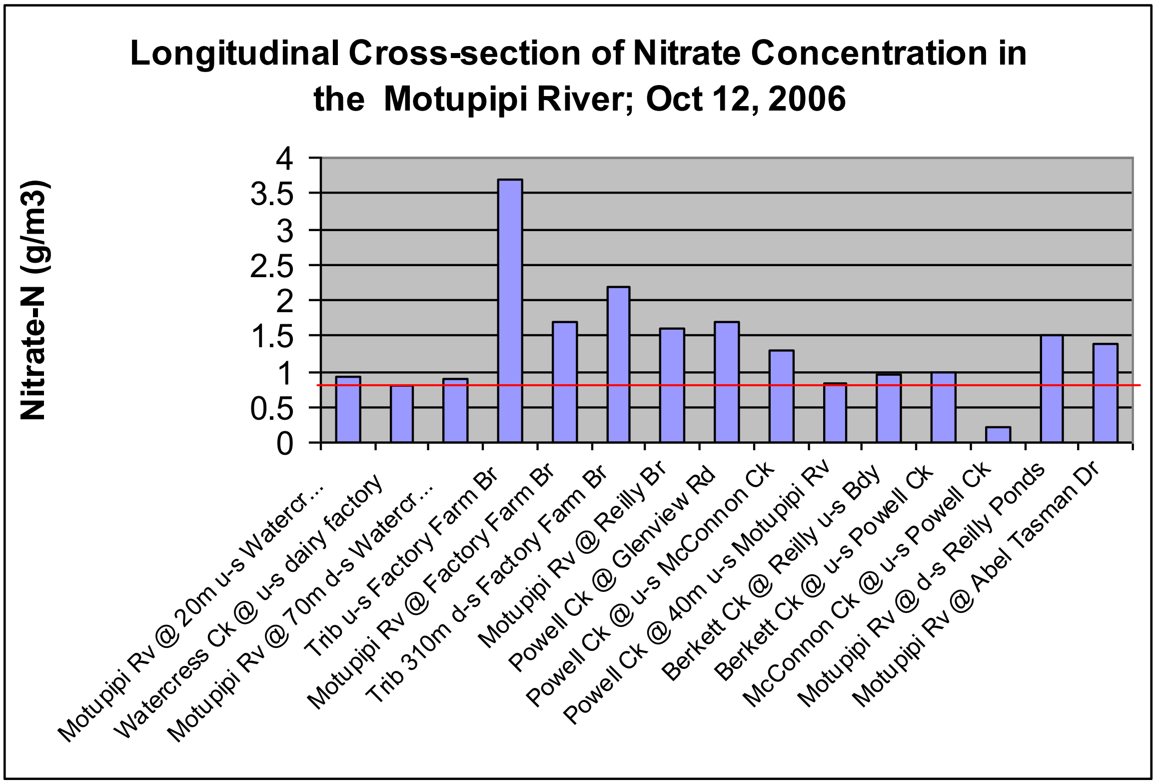


Figure 2.17a

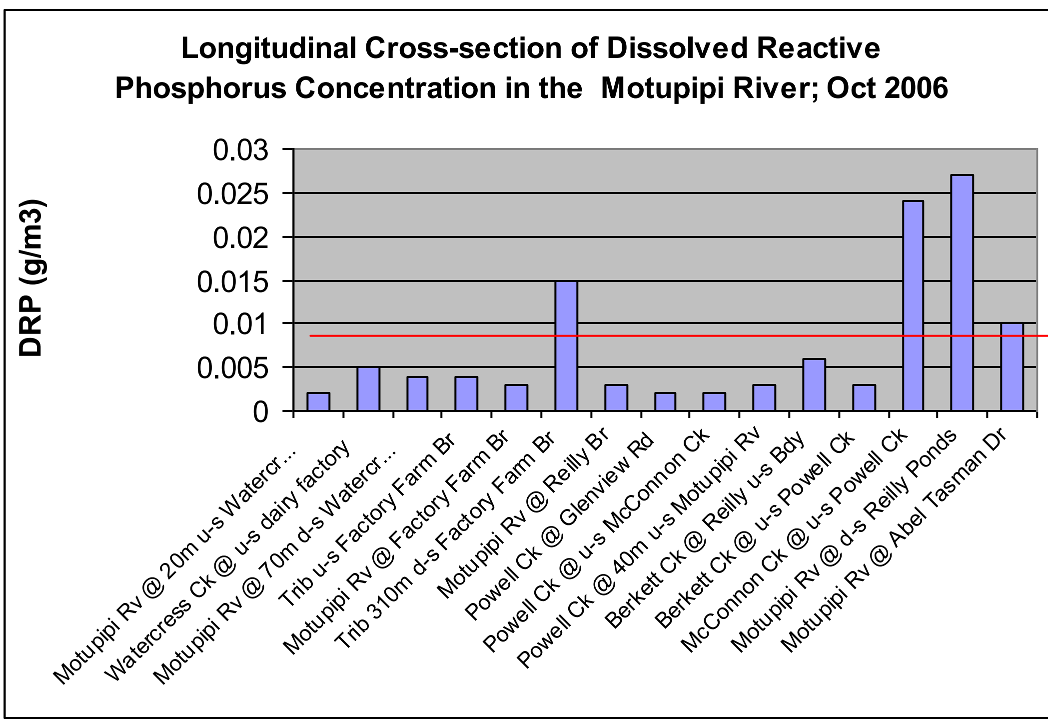


Figure 2.17b

2.3 Water Clarity, Scums & Brown Turbid Layer

Water clarity is measured by horizontal sighting of a black disc and measuring the distance at which the disc just disappears from sight. Reduced water clarity and the presence of scums affect the public enjoyment of the waterway and the ability of fishers to catch fish. When the water gets very murky (less than 1 metre clarity) it can cause fish to have reduced feeding success, thereby decreasing the ecological productivity of the waterway.

Water clarity in the Motupipi River is generally good at stable base flows but would be expected to be better given the high clarity water that feeds the stream from springs. Clarity near the source of the springs (upstream of Watercress Creek) is typically 8-10m. Further downstream at Reilly's Bridge the typical range is 5 - 6.5m, while Powell Creek typically ranges from 1 – 3m. Water clarity is not expected to be as high as the main stem in this tributary, and others such as McConnon and Berkett Creeks, due to the fact that they drain clay soils and are not spring-fed. As yet there has been limited sampling of water clarity at high flows but it is estimated that water clarity in McConnon Creek was less than 0.3m during and after at least two storm events due to earthworks in that catchment. Other sources found to adversely affect water clarity in the catchment include feed pads or stand-off pads, highly pugged pasture, freshly cultivated land and earthworks.

Near the bridge over the Motupipi River at Abel Tasman Drive, where salt water from the tide reaches its furthest extent inland, a brown turbid layer associated with the salty water forms near the bottom of the water column. It is present in spring especially after particularly high tides. Scums also form on the water surface under similar conditions. It is acknowledged that these features are unsightly and cause whitebaiters difficulty sighting fish and keeping their nets clean.

The reason for the brown turbid layer is the high concentration of free-swimming micro-algae. Samples taken in during a bloom in November 2007 showed a dominance of the non-toxic small flagellate cryptophyte, *Cryptomonas* with no potentially toxic cyanobacteria species detected. Samples taken in May 2007 again showed the dominance of small flagellates (<5µm, unidentified but likely to be *Cryptomonas*). Cyclotella were rare-common with the following taxa being rare: *Fragilaria, Gyrosigma, Navicula, Phormidium. Phormidium* can produce toxins.

This algae is associated with high nutrient concentrations and possibly dissolved organic carbon from algae and aquatic plant matter originating from the river and tributaries. Analysis of water samples in this lower layer show low concentrations of disease-causing organisms (*E.coli)* but high concentrations of nutrients. Some discolouration could also be coming from dissolved organic matter from material sloughed off algae and plants. This process is likely to be most prevalent in spring when plant growth is greatest. Algal matter originating in the Motupipi estuary and flowing upstream with the tide may also be accumulating in this area. The storm event of 17 November, 2006 that produced a significant flow in Dry Creek may be the reason that the brown turbid layer was not present for several weeks after this date.

The visual nature of the scum in this lower part of the waterway is very similar to scums located further upstream in the catchment that are formed by accumulation of vegetation hanging into the water. This suggests that at least part of the cause of the scum is from activities further upstream in the catchment.

Algal blooms are common in estuaries receiving high concentrations of nutrients all around New Zealand, particularly in spring. This organic matter is slimy and deposits on the tidal flats on an outgoing tide, only to be picked up again by the incoming tide and pushed up to near the Abel Tasman Road bridge, where it forms on the surface as a scum. Wave action on the tidal flats can stir it up until it forms a foamy 'mousse'. Salt water reacts with dissolved organic matter from the river and forms a denser material that may be part of the scum/foams. Micro-algal growth on the estuary itself could also be blooming and being caught up on the in-coming tide to form the scum also. These microscopic algae are well known to produce high biomass in spring blooms that can lead to production of foams in natural systems.

Another contributing source could be methane (found to be bubbling out of the ground in the upper catchment near Motupipi Street) or leachate from silage pits. Both these sources contain high concentrations of dissolved organic matter and are likely to be more prevalent in spring. Photo 2.18 below shows the discharge of leachate from a silage pit in the catchment.

Figure 2.18 Leachate plume from a silage pit discharge.

2.4 Fine Sediment Bed Load

Fine sediments deposited to cobble-bottom waterways such as the Motupipi are well known to cause significant adverse effects to invertebrate habitat and, together with high nutrient concentrations, cause prolific plant growth.

A depth profile of fine sediment deposits on the bed of the Motupipi main stem was conducted by boat on October 12, 2006 using a real-time water quality meter (see Figure 2.19). An average depth of approximately 250mm of fine sediment was found to be present on the bed of the river where there was considerable aquatic plant density. Below this layer was a hard cobbly bottom.

Aquatic plants are well known to trap fine sediment in streams with stable flow. Nutrients can also build up in this sediment and continue to feed the plants as they put more roots into the sediment layer. In areas where there was significant shading by riparian plants, such as near Sunbelt Crescent, the cobbly bed was visible for 40-60% of the bed with aquatic plants covering the remaining part of the bed but with much reduced vigour. Fine sediment depth in these shaded areas was generally less than 20mm. The greatest amount of fine sediment in the bed was found downstream of Powell Creek and upstream of Dry Creek. Here over 1 – 1.5 m of fine sediment has accumulated with heavy aquatic plant cover growing on top. This is likely to be due to stream bank erosion, perhaps exacerbated by stock trampling and roading activity in this part of the catchment. Downstream of Dry Creek the sediment depth becomes much reduced, possibly due to scouring from this tributary which experiences high flows after significant storm events. Approximately 200m downstream of Dry Creek there are no aquatic plants, this is probably due to the presence of saline water at high tide. Without the aquatic plants the sediment is not trapped to the same extent.

Discharges from feed pads or stand-off pads and earthworks have been observed to produce significant increases in fine sediment to this waterway during rainfall events. Due to the spring-fed nature of this waterway and the low frequency of flushing flows such fine sediment can accumulate in significant amounts.

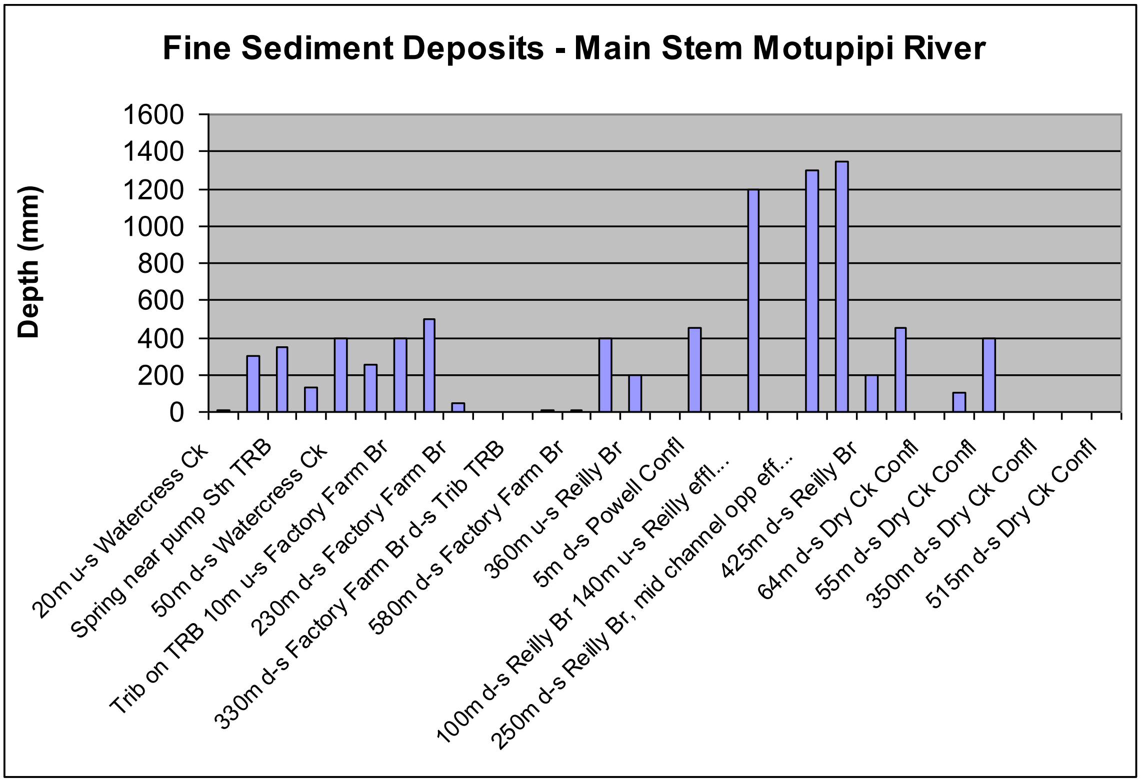


Figure 2.19

2.5 Sediment Quality

Two discrete samples of sediment were taken from a drain that runs alongside Waitapu Engineering and drains a commercial and industrial part of Takaka on 7th December 2006 and analysed for *E.coli*, petroleum hydrocarbons, polyaromatic hydrocarbons and metals. The purpose of this investigation was to find out whether any toxic chemicals have been spilt from this part of town that may contribute in any way to the ecological health of the Motupipi River. The results showed Nickel and Zinc above guidelines (13% and 36% above for the two nickel samples respectively and 13% above in only one of the samples for Zinc; ANZECC Interim Sediment Quality guidelines; ISQG-high). *E.coli*, petroleum hydrocarbons and polyaromatic hydrocarbons were low or below detection. The source of high Nickel and Zinc is currently not known but it is unlikely to be natural.

A composite sediment sample was collected in Watercress Creek upstream of the dairy factory and sampled for nutrients. Results are showed high concentrations of total N and P but low soluble fractions of these nutrients. This means that the sediments are not likely to ‘bleed’ significant amounts of biologically available nutrients to the stream. This is what we see at the Watercress Creek water quality monitoring site with median dissolved inorganic nitrogen lowest amongst sites in the catchment but still almost at guideline levels (ANZECC,2000) and median dissolved reactive phosphorus about average across the sites but above guidelines (ANZECC, 2000). However these nutrients may be available to the plants in this part of the waterway through uptake from the roots.

2.6 Dissolved Oxygen and Plant Metabolism Studies

Intensive dissolved oxygen monitoring was conducted at seven sites in the Motupipi River and Te Kakau Stream catchments in Jan-Feb 2006 (see Figure 2.21). YSI DataSondes were installed for up to two weeks at sites and recorded dissolved oxygen, conductivity, temperature and pH at 15 minute intervals. Solar radiation was also recorded at one site central in the catchment.

Dissolved oxygen is a very important parameter controlling the life-supporting capacity of waterways. Sensitive species of fish, invertebrates and other life will be absent if concentrations are low. Guidelines for the protection of aquatic life (ANZECC 2000) suggest dissolved oxygen must be greater than 6.5 mg/L or above 80% saturation.

Oxygen concentrations vary on a daily basis due to plant metabolism. During the day plants harness energy from the sun by photosynthesis leading to the production of oxygen. During the night plants cannot photosynthesise and undergo a different sort of metabolism called respiration. In this process plants take up oxygen and produce carbon dioxide. The rate of plant growth and oxygen uptake can also be used to indicate the health of a river system. Healthy rivers are those with more moderate plant growth and oxygen uptake; too little growth limits the abundance of grazers (particularly snails, some insects and birds) and too much can lead to large changes in dissolved oxygen and choking of waterways. Figure 2.20 shows how the dissolved oxygen concentration changes in a healthy stream over a 24-hour period.

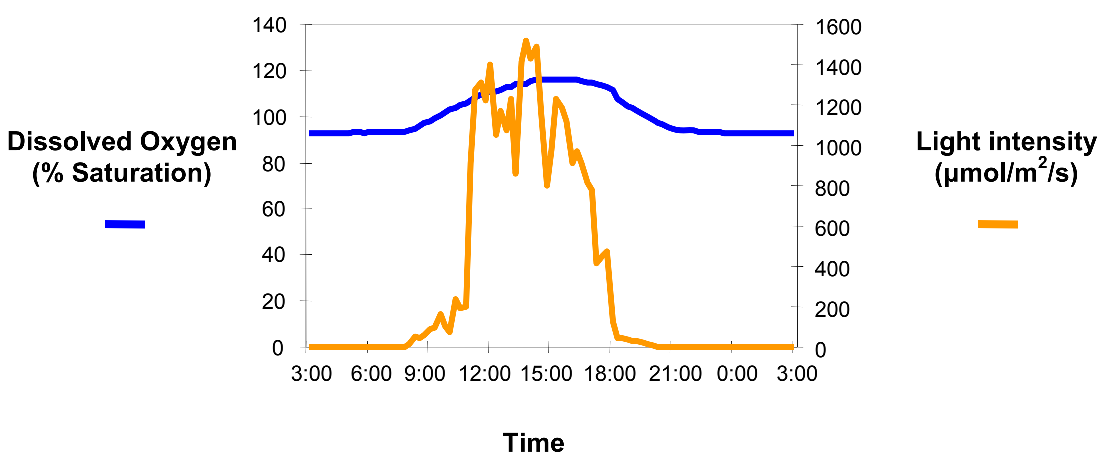


Figure 2.20: Typical dissolved oxygen concentration in a healthy stream over a daily cycle.

Continuous sampling for over almost two weeks showed that five sites (Motupipi and tributaries) had dissolved oxygen concentrations below 60% for over 10 hours of a typical day (see Figure 2.22). The site in the upper Motupipi River and McConnon Creek experienced concentrations below 40% for over nine hours. Lower Powell Creek experienced the lowest concentrations of less than 20% for over an hour (under 40% for seven hours). Concentrations in the lower Motupipi River (upstream of Powell Creek confluence) were below 45% for eight hours.

The main reason for low dissolved oxygen concentrations is the high rates of plant growth/accumulation and associated oxygen demand, although this is made worse by low dissolved oxygen concentrations in groundwater (as low as 60%). The effects are pronounced because of the deep, slow flowing nature of the river as there is lowered potential for oxygen exchange with the atmosphere. The plant growth is fuelled by high nutrient concentrations (both in water and sediment), fine sediment deposits, abundant light, and steady river flows.

The low dissolved oxygen is a very likely cause of lowered biodiversity and abundance of stream life. Higher fish abundance found during spring could be because dissolved oxygen concentrations appear reasonable during this period. The affect of lowered dissolved oxygen in summer on fish populations is not known.

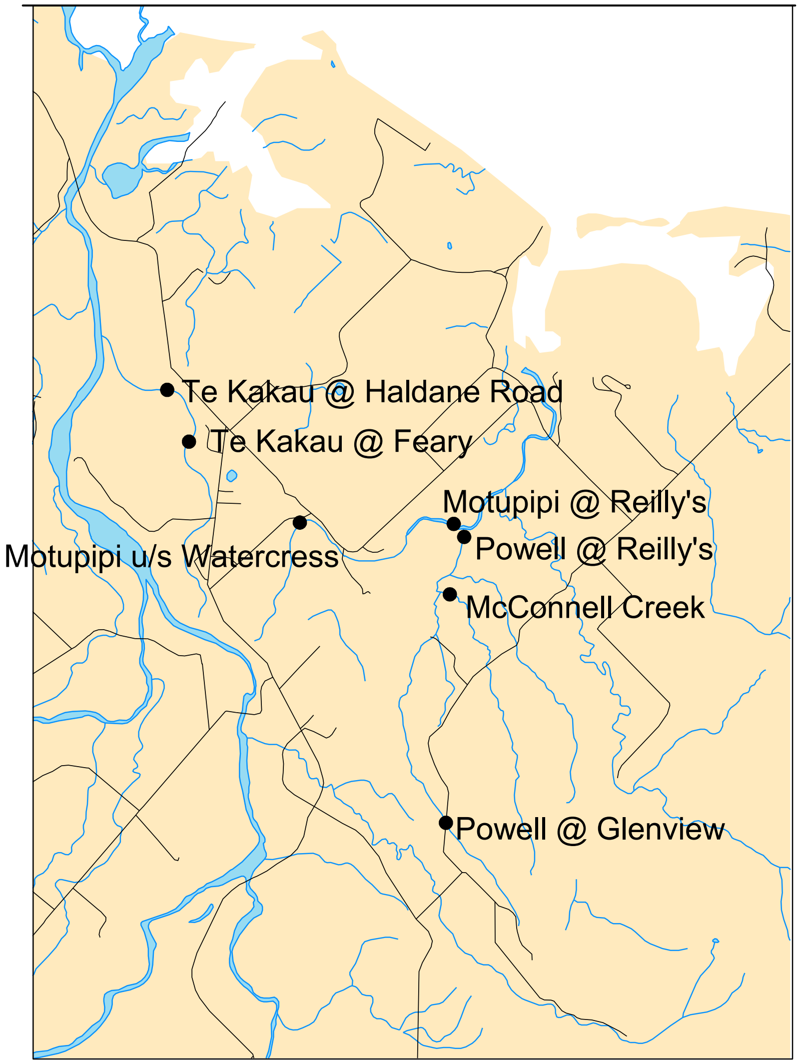


Figure 2.21: Sites sampled using continuous dissolved oxygen meters

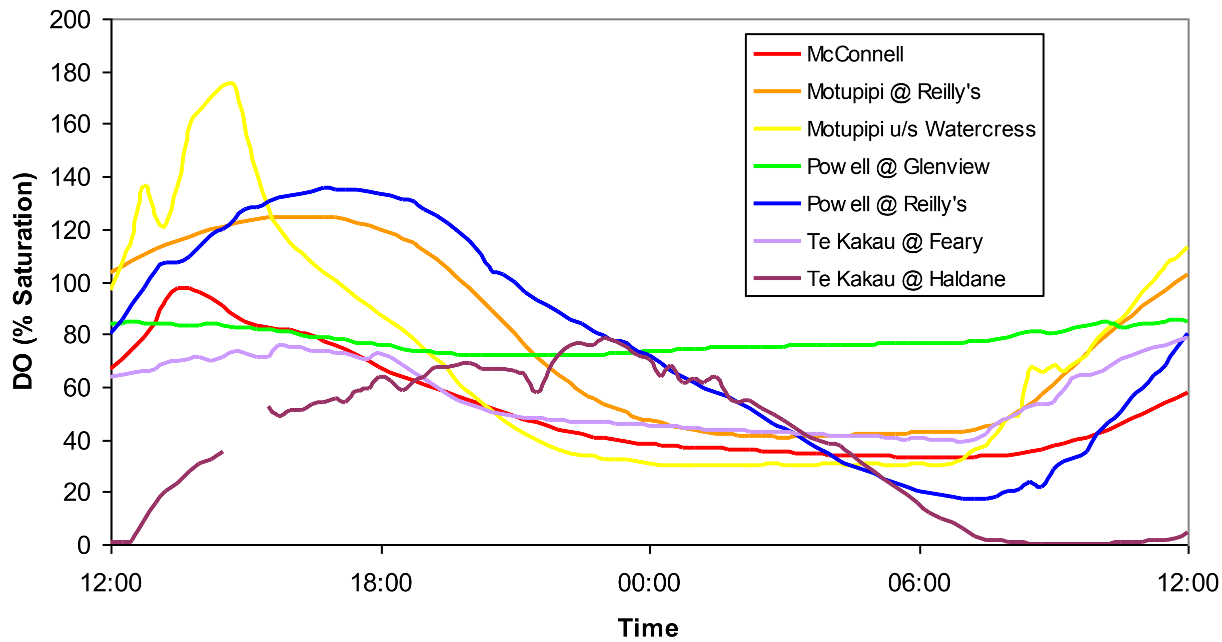


Figure 2.22 Examples of the daily changes in dissolved oxygen saturation at each of the sites.

For those areas that have excessive aquatic plant growth and consequently high rates of metabolism the water will experience depressed levels of oxygen and may exhibit reduced fish and insect diversity as a result. Figure 2.23 shows the respiration and production rates calculated for a selection of sites. In areas with the greatest levels of oxygen uptake we can expect to see anoxic sediments. Once sediment becomes anoxic, conditions are then suitable for the release of soluble phosphorus and methane gas.

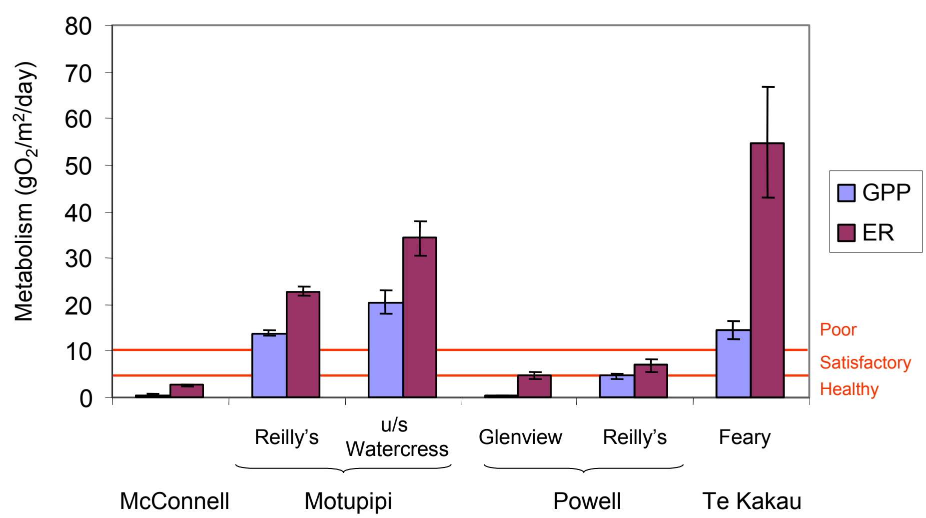


Figure 2.23 Average rates of plant production (GPP) and oxygen uptake (ER) at each of the sites. Thresholds for 'healthy', 'satisfactory' and 'poor' ecosystem health are shown with red lines.

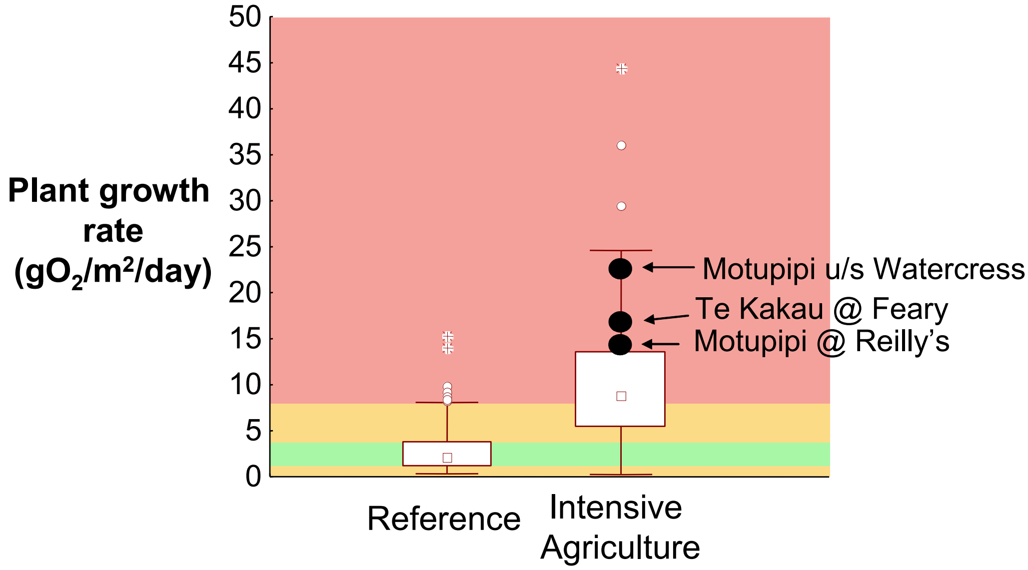


Figure 2.24 Box plots showing a comparison of plant growth rate measurements with those measured in other parts of New Zealand and internationally. The box represents the central 50% of data around the median, while ends of the whiskers represent the 5th and 95th percentiles. Measurements indicating good, satisfactory and poor ecosystem health are shown with green, orange and red shading, respectively.

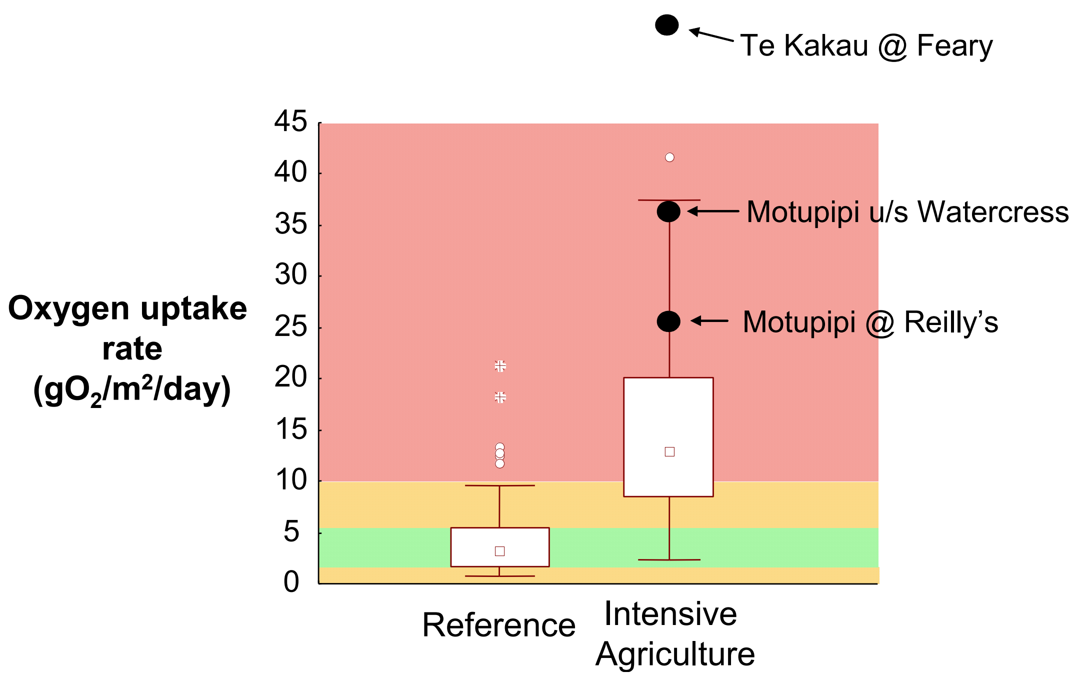


Figure 2.25 Box plots showing a comparison of oxygen uptake rate measurements with those measured in other parts of New Zealand and internationally. The box represents the central 50% of data around the median, while ends of the whiskers represent the 5th and 95th percentiles. Measurements indicating good, satisfactory and poor ecosystem health are shown with green, orange and red shading, respectively.

3.0 Stream Habitat Including Riparian Condition

A full assessment of stream habitat has not yet been conducted in this catchment. From monitoring undertaken by a Tasman District Council compliance officer and as part of the Dairying and Clean Streams Accord it is recorded that six of the eight dairy farms have fenced off 50% of streams on their farms. From general observations, the fencing out of cattle along Powell Creek has produced a greater level of cover and shade.

There are three sections of the main stem of the Motupipi where there are dense populations of crack willow cover the full channel width. These are between about 150m downstream Watercress Creek and the most upstream houses on Sunbelt Crescent. Another patch of willows exist downstream of Powell Creek for about 160m but these do not currently block the whole channel. Several sections have been removed over the last 10-20 years.

4.0 Pest Plants

Reed Sweet Grass (*Glyceria maxima*), an invasive aquatic pest plant, was discovered in the mid and lower reaches of Powell in the early 2000's. It is currently known to exist in two locations in Tasman District (near Owen River in the Buller catchment and here). In October 2006 the extent of coverage was found to be several 100 meters of the stream, mostly upstream of McConnon Creek and downstream of the upper Reilly boundary. It can be seen in Figure 4.1 the coverage of the stream is extensive with a total affected area of the incursion estimated to be $500m^2$. The proposed Pest Management Strategy lists this weed as a Total Control plant. Controls with herbicide have not been successful at eradicating the plant. It was sprayed hard in November-December 2006 but regrowth was evident in January 2007. It is palatable to stock so the stock exclusion in the area is likely to have allowed the plant to proliferate.

Figure 4.1 *Glyceria maxima* in Powell Ck

Figure 4.2 *Lagarosiphon major* in Te Kakau Stm

The very invasive oxygen weed *Lagarosiphon major* has the potential to spread into the Motupipi River from Lake Kilarney which is located on the very western edge of the catchment in Takaka Township. This weed is known to cause very low dissolved oxygen concentrations and block waterways as it has done in Te Kakau Stream which flows on the Western edge of Takaka. Preventing this weed from getting into the waterways is preferable to very expensive control (if it is indeed possible).

It is estimated that shading from riparian vegetation is present to a significant degree on less than 10% of waterways in the catchment.

5.0 Stream Life – Plants, Invertebrates and Fish

From observations, the dominant aquatic plants include *Elodea*, *Myriophyllum* and *Ranunculus* in the middle part of the Motupipi River and Swamp Willow Weed, Watercress and Forget-me-not in the upper reaches.

Macroinvertebrate surveys undertaken in recent years indicate that the health of the catchment as macroinvertebrate habitat is poor-to-average in the Motupipi River at Reilly's Bridge, Powell Creek at Reilly's Bridge and the Motupipi at upstream Watercress Creek, while the Watercress Creek at upstream Dairy Factory site is of poor quality. There were very low few taxa of mayflies, stoneflies or caddisflies other than the pollution-tolerant *Oxyethira albiceps*. Typically there are only 2-3 of these pollution sensitive insects in the lower Motupipi and lower Berkett, McConnon and Powell Creeks. Macro-invertebrate community index (MCI) indicates poor water quality (typically below 100) at all monitored sites in the catchment other than upper Powell Creek. Similarly the semi-quantitative MCI indicates a similar pattern; typically less than 4.0 for most sites other than upper Powell Creek. Koura (freshwater crayfish) appear to be relatively abundant in this catchment.

It is likely that high levels of sediment, and, at times, very low levels of dissolved oxygen are the main contributors to the lack of sensitive macroinvertebrates found during surveys, and the relatively higher numbers of pollution-tolerant species found.

A fish survey using spotlighting, trapping and an electric fishing machine was carried out in October, 2006. Results of this investigation are still being analysed but general observations showed that Short-fin eels and Inanga were abundant in Powell Creek and lower Motupipi and moderate numbers of these fish were found in the upper Motupipi. Red-fin Bullies were found in a riffle upstream of Reilly's Bridge (these have not been previously discovered in this catchment). Only one juvenile Banded Kokopu was found in this study (Berkett Creek).

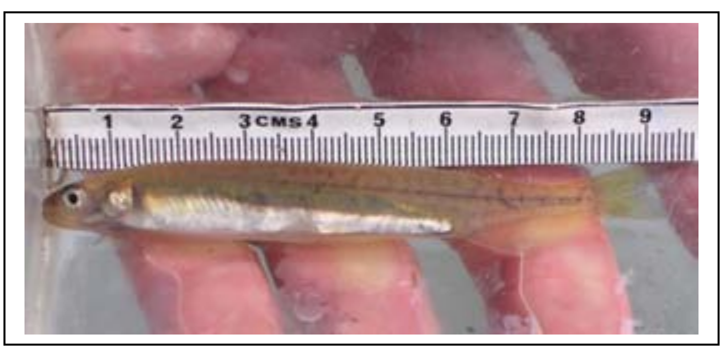


Figure 5.1: Inanga from Powell Creek

No trout or other introduced fish have been found to date in the catchment.

Figure 5.2: Common Bully from Powell Creek

6.0 What can be done about poor water quality and aquatic health?

The water quality problems currently faced in the Motupipi catchment are probably due to both current land use practice and a legacy of past land use practices such as effluent discharge from the dairy factory. Initiatives involving the restriction of stock access to waterways, riparian plantings and more careful nutrient management would be expected to improve stream health in the catchment. Any improvements may take decades, particularly considering the length of time it takes for trees to grow to a height where significant shading can be achieved and if there is a significant legacy of slow-moving contaminated groundwater.

Discharges from sewerage schemes, septic tanks, commercial and industrial premises, a landfill (Rototai) and farms are all present in the catchment and all need investigating thoroughly.

Farmers have undertaken a number of projects to improve water quality in the Motupipi catchment, such as installing bridges or culverts for cattle crossings, fencing (with Tasman District Council provision of fencing materials) to exclude cattle from waterways, re-aligning raceways away from waterways and careful nutrient management. Some voluntary work has also been undertaken such as willow removal and riparian planting alongside Motupipi River downstream of Watercress Creek.

All dairy farmers in the Motupipi River catchment are expected to meet the requirements of the Dairying and Clean Streams Accord that has established targets and frameworks for improvements to the quality of New Zealand waterways. The outcomes from farmers in the catchments exceed the targets for 2007 and are very close to the targets for year 2012.

Figure 6.1 Areas of severely pugged ground where retirement into wetlands could be considered to improve water quality downstream (at least during winter and the wetter times of year)

Installing wetlands in boggy parts of paddocks (such as those shown in Figure 6.1 a & b) will be essential to mitigate nutrient and sediment run-off. It has been found in many studies that 2% is the minimum area of wetland extent required in a catchment dominated by farmland to achieve a significant improvement in water quality.

Most farmers have completed nutrient budgets for the responsible use of fertilizers, which balance nutrient inputs with nutrient outputs. Nutrient management plans may need to be scrutinized in to come up with a nutrient budget for the catchment. Also some farmers have applied the nitrate inhibitor, Eco N to minimize the leaching effects of applied nitrogen. One farmer has used this produce for over 30 hectares, particularly those areas near streams.

Environmental Management Plans are now part of the annual Fonterra Farm Dairy Assessment inspections. These plans aim to improve water quality and provide shade and shelter for waterways. Such plans cover all aspects of environmental management and set priorities for action.

If the waterway receives flushing flows from the Takaka River water quality may be improved greatly by the removal of sediment which is a source of nutrients and contributes to reduction of invertebrate habitat.

Physical removal of prolific aquatic plants from the waterway is likely to cause excessive disturbance and ecological damage to the waterway. It is generally accepted that it is best to shade the waterway and let nature take its course.

A catchment management plan addressing all known sources of contamination of the waterways is recommended using information from monitoring. The management plan would address farming practice as well as other contaminant sources such as urban runoff with the aim of improving water quality and ecological health of the river and the estuary. A full nutrient budget for the catchment would be a very useful tool for managing discharges of nutrients to water.

A priority in the short term is to ensure that all effluent discharges comply with resource consents or Tasman Resource Management Plan rules as well as ongoing steps to achieve the Dairying and Clean Streams Accord Targets. Of particular note is the need to develop nutrient budgets for each farm.

Sewage Discharges:

Figure ?? Sewage reticulation network in the Motupipi catchment as at Nov, 2007

7.0 Goals and Suggested Targets for Water Quality and Aquatic Ecology

7.1 Goals for Motupipi Catchment

1. Water quality
    a. Good clarity. Ensuring the unsightly brown layer near Abel Tasman Rd happens rarely or not at all.
    b. Acceptable for swimming (clarity, filamentous algae (slime) & *E.coli*)
    c. Acceptable for whitebaiting (clarity, filamentous algae (slime)
    d. Maximises ecological potential (invertebrates, fish, birds) - Low level of fine sediment on bed, reduced aquatic plant cover, acceptable dissolved oxygen)
2. Habitat for ecosystem health
    a. Quality spawning habitat for whitebait
    b. Good riparian cover
    c. In-stream woody debris
3. Mahinga kai – preservation of food resources (eg tuna & inanga/kokopu)
4. Flood capacity – maintenance of channel capacity (eg remove willows)
5. Public access
6. Landscape enhancement

7.1 Targets for Water Quality and Aquatic Ecology

Having targets for improved water quality and aquatic ecology is useful to focus the direction of any mitigation or remedial efforts. Using targets in the management of water quality in the catchment were suggested by members of the farming community. The draft targets suggested in Table 2 below are based on a combination of factors:

- national guidelines for the protection of values put forward by the community
- existing water quality in the catchment
- recognising what is practically achievable in the catchment within 10 years if environmental best practice is achieved throughout the catchment

It is recognised that this catchment will never have near pristine water quality but that significant improvements can be made. These draft targets are preliminary only. They have not been work-shopped with the community and will need to be revised with public input. At this stage there are no plans to make these targets part of any regulation.

Table 2: Suggested Targets to Improve Various Aspects of Water Quality and Aquatic Ecology

PARAMETER	SUGGESTED TARGET
Water clarity	- Powell Creek subcatchment - 3 m median, 2m minimum - Motupipi River upstream of Reilly's Bridge - 8m median, 3m minimum
E.coli	260/100ml
Filamentous green algae cover	<30%
Fine sediment bed load	Not conspicuous and <100g/m3 in resuspendable solids plume
Aquatic plants	<60% cover
Dissolved oxygen	60% minimum, 80% mean over three days of sampling at 15 min intervals
Occurrence of brown layer at Abel Tasman Dr	<20 times
Riparian shade	>20% within 10 years >50% within 20 years
Maintenance of long grass or coastal rushes	At least from Jan – April each year

8.0 Future Work Programme

8.1 Monitoring

Further investigations are planned with the overall aim of determining the dominant sources and relative loadings of contaminants to the Motupipi River and tributaries, in order to provide information for a programme to improve the water quality and aquatic ecology of the catchment.

INVESTIGATION	TIMEFRAME
1. Determine the effects of discharges to surface water e.g. from Takaka, Fonterra factory, dairy farm effluent, silage pits, stock crossings and other potential contaminant sources.	Ongoing as part of regular compliance monitoring, complaints from the public or other surveillance.
2. Determining the level of nutrient and faecal contamination in groundwater in the upper Motupipi (also pull together the historical dairy factory compliance monitoring).	Began February 2007
3. Determining the relative contribution of faecal contamination from septic tanks or sewage overflows.	Likely start date late 2007
4. Determining the response of disease-causing organisms to rainfall.	Likely start date spring 2007
5. Determining the cause of benthic algae and scum downstream of Abel Tasman Drive. This would need to use either stable isotope analysis or microbial genetic tracer techniques that are expensive.	Unconfirmed whether this will go ahead.
6. Determine the ecological condition of the Motupipi Estuary (building on the information gathered from a resource consent application for subdivision in the area). A fine-scale and broad mapping of the Motupipi Estuary will occur in 2007-08. Determine the broad pattern of mixing in the estuary.	Will be contracted out in mid 2007.
7. Determine the extent of the issue of saline intrusion in bores in the lower part of the catchment.	From Tasman District Council records there is only one significant groundwater abstraction in the lower catchment. This is consented and unlikely to cause significant adverse effects. There have been no complaints. No investigation is planned.
8. Determine the effect of passive discharges from the closed Rototai landfill on the surrounding estuary. Analyse seepage and groundwater samples for hydrocarbons and a range of pesticides likely to have been dumped to this landfill.	Likely start date mid 2007. Jenny Easton and Engineering Dept to oversee.
9. Determine the numbers and diversity of birds in the estuary.	Commission the Ornithological Society or a Royal Society fellow to carry this out.

The Motupipi catchment has been identified as a Tier 2 Monitor Catchment under the Dairying and Clean Streams Accord and as such Tasman District Council has recently received funding from Ministry for the Environment for monitoring water quality in the catchment.

8.2 Riparian Fencing and Planting

Fencing waterways that do not naturally exclude stock –
Targets: * 80% (on per farm basis) within 2 years (several farms are at 100% now). Include streams with average flow >1 l/sec (typically average width wider than 300mm and deeper than 100mm). Pasture streams are typically narrower eg Berkett Ck.
* 100% within 5 years. Includes fencing off spring heads.

Fencing boggy pasture at strategic points to reduce the export of contaminants to streams – Target: 2% of catchment within 5 years

Riparian plantings – 20% of total stream length in 5 years, 50% in 10 years, 75% maximum desired)

8.3 On-Farm Actions

In addition to any farm environmental plans that may be in place:

Silage pit leachate discharges – fully treated or controlled within 6 months

Dairy Shed Effluent discharges to land – spreading rate should be based on an application rate well less that the Tasman Resource Management Plan allows (200kgN/ha/yr). Target: 100-150 kgN/ha/yr.

8.4 Other Potential Actions that Could be Worth Considering

Install a flood gate on Takaka River bank at Bridges Hollow to allow for greater number of flushing flows.

Removing willows along Motupipi within 5 years

9.0 References

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