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Catchment Environmental Monitoring Report: 2008/09

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1 Introduction

1.1 Background

As part of Project Watershed and Peninsula Project implementation, the Catchment Environmental Monitoring (CEM) Programme was developed to demonstrate the long term benefits of soil conservation. To date, monitoring has been established in selected priority catchments for soil conservation in the Waipa, Lower Waikato, Upper Waikato and Coromandel management zones.

The Catchment Environmental Monitoring (CEM) programme allows Environment Waikato to:

- demonstrate the long term benefits of soil conservation and river management work programmes
- better utilise resources and leverage opportunities to co-ordinate monitoring internally and externally (e.g. within Environment Waikato, NIWA and Landcare Research)
- integrate new monitoring requirements into existing regional monitoring networks.

Prior to the CEM programme soil conservation implementation relied on regional monitoring information being reinterpreted at a catchment scale. However, this information is often misleading because regional scale information is being applied at a finer scale (catchment scale).

This report provides CEM programme results for the 2008/2009 year. Copies of reports as described in the list of references can be obtained by contacting Environment Waikato (the Library) on 0800 800 401, or in electronic format from the publications page of the Environment Waikato website www.ew.govt.nz/publications or email: inforeq@ew.govt.nz.

1.2 Report content

This report provides information on the annual monitoring of the environmental effects of soil conservation and river management works implemented in soil conservation priority catchments across the Waikato region. It includes updated results from the 2008/09 monitoring period. Interpretations of the results and identification of trends (where applicable) and results from additional monitoring sites are also included.

1.3 Monitoring approach

The aim of the CEM programme is to provide a representative (and where possible quantitative) indication of changes in various environmental parameters resulting from soil conservation and river management work. Parameters include changes in the hillslope erosion, stream bank erosion, riparian vegetation and fencing, sedimentation in surface water, water temperature and in-stream ecological habitat. Monitoring has been selected to measure changes on land and in surface water to provide some indication of the resulting on-site and off-site benefits. Details of the methods used are provided in the internal series report Catchment Environmental Monitoring Methods (Grant, Littler and Hill, 2009a).

It is important to note that not all priority soil conservation catchments are monitored. However, the results for the monitored catchments should be more applicable to other priority catchments in a given zone than monitoring results from elsewhere in the region. A standard monitoring approach is recommended for all monitored catchments but the specific suite of monitoring will differ from catchment to catchment depending

on the type of soil conservation and river management issues within each catchment. There are several key outcomes of the CEM programme:

- An understanding of the long-term benefits of soil conservation, river management and catchment issues in the Waikato region.

- A long-term picture of the land and water quality benefits of soil conservation and river management initiatives provided by Environment Waikato.

- A regional framework for obtaining, managing and implementing catchment scale monitoring information.

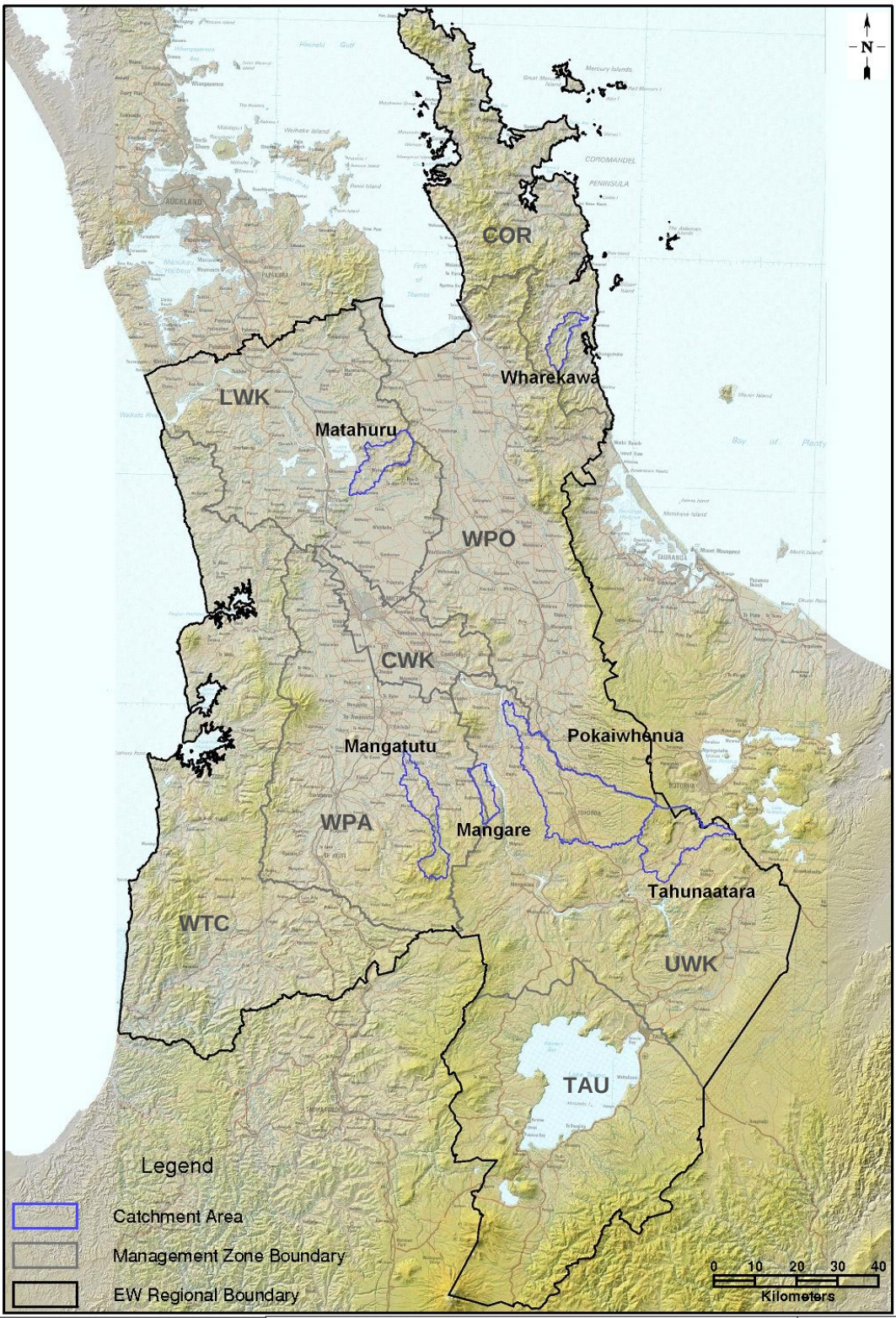
- Efficient integration of existing State of the Environment regional monitoring, Crown Research Institute catchment monitoring, Environment Waikato implemented works consent monitoring, and Environment Waikato initiatives specific catchment monitoring (e.g. Peninsula Project).

1.4 Management zone boundaries

The monitored catchments are positioned in four management zones, as described in Table 1. Zones which do not contain monitored catchments at this stage are Central Waikato (CWK), West Coast (WTC), Waihou-Piako (WPO) and Lake Taupo (TAU) zones. The priority catchments covered in this report are shown in Figure 1, in addition to the management zone boundaries.

Table 1: Location of the monitored catchments as at 2008/09.

Monitored catchment	Management zone
Matahuru	Lower Waikato (LWK)
Mangare	Upper Waikato (UWK)
Pokaiwhenua	Upper Waikato (UWK)
Tahunaatara	Upper Waikato (UWK)
Mangatutu	Waipa (WPA)
Wharekawa	Coromandel (COR)



Monitored Catchments

Created by: Philippa Status: Complete **A4**
Projection: NZTM Request No.: 17058
Date: 25/08/2008 File name:17058CatchmentsSallyG

ACKNOWLEDGEMENTS AND DISCLAIMERS

The catchment boundary is a watershed delineation and has no relationship to Environment Waikato's Regional boundary, or to any property boundaries. This catchment boundary is not an Environment Waikato legal boundary. The boundary has been captured from the NZMS260 map sheet series and is accurate to +/- 200 metres at best. The boundary is very subjective in areas with sinkholes, underground streams or drains. The boundary is not suitable for use in detailed, property-specific analysis.

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Figure 1: Monitored priority catchment locations, with management zone boundaries (labels explained in Table 1).

1.5 Monitoring information

The reported monitoring information is provided through specific catchment scale monitoring in selected soil conservation priority catchments. In addition, on-going regional monitoring information (Table 2) is utilised to increase our knowledge of the state and changes in soil erosion and sedimentation of water within the various management zones.

Table 2: Environment Waikato regional land and water monitoring programmes

Programme	Main measures	Last assessment/ frequency
Regional soil stability assessment	Soil stability and soil conservation	2002/03; assessment 5-10 yearly
Regional riparian characteristics assessment	Riparian fencing, vegetation and erosion	2008/09; assessment 5-10 yearly
Permanent suspended sediment sites	Water quality including sediment and peak flows	8 sites; reviewed annually
River ecological monitoring sites (REMS)	Stream biological and habitat condition	Ongoing (~10yrs data)
Regional rivers	Water quality including sediment	Ongoing (>10yrs data)

2 Lower Waikato zone

2.1 Introduction

Monitoring is present in one catchment in the Lower Waikato zone; Matahuru catchment.

2.2 Matahuru catchment

2.2.1 Monitoring progress

Monitoring is focused on the lower section of the Matahuru catchment (refer to Grant, Kotze and Hill, 2009b for survey locations). Table 3 presents monitoring completed up until 2008/09.

Table 3: Lower Waikato zone monitoring completed by 2008/09

Monitoring	Activity	Completion	Included in this report (or year last reported)
Soil stability	Soil stability and soil conservation assessment	2005	2005/06
Riparian characteristics assessment	Complete assessment along the lower section of the Matahuru Stream	2003/04, 2005/06 2007/08	2007/08
Photo points	Complete assessment along the lower section of the Matahuru Stream	2003/04, 2004/05 2005/06, 2007/08	2007/08
Permanent suspended sediment sampling site	Event driven sampling	Installed 2003 and ongoing	✓
Suspended sediment snapshots	• Low flow snapshot • Medium flow snapshot • High flow snapshot at next sufficient rainfall event	2003 2008 Not completed	2005/06 2007/08
Water temperature	Install loggers and record stream temperatures along the lower section of the Matahuru Stream	2003/04, 2004/05 2005/06, 2006/07 2007/08, 2008/09	✓

2.2.2 Soil stability

Refer to Hill, Blair and Hopkins (2006) for the soil stability information in this catchment.

2.2.3 Riparian characteristics

No riparian characteristics data was collected in the 2008/09 monitoring period in the Matahuru catchment. Refer to Grant et al. (2009b) for the most recent results.

2.2.4 Water temperature

The water temperature loggers were deployed in the lower section of the Matahuru Stream; the upstream logger in the vicinity of the Mangapiko Valley Road Bridge and the downstream logger next to the Environment Waikato recorder station by Waiterimu Road. The distance between the two loggers is approximately 20km.

Results

To date six deployments have been made with data collected during each summer between 2003/04 and 2008/09. The average of the daily maximum water temperature

is derived to produce a single temperature for each site. The upstream temperature is then subtracted from the downstream temperature to provide a single number for the monitored section of river (Table 4).

Table 4: Matahuru Stream average daily maximum water temperatures for the 10 week period starting 1 January

Year	Upstream average daily maximum (°C)	Downstream average daily maximum (°C)	Temperature difference between u/s and d/s locations (°C)
2003/04	21.86	20.84	-1.02
2004/05	22.78	21.87	-0.91
2005/06	22.20	21.22	-0.98
2006/07	22.61	21.62	-0.99
2007/08	22.60*	22.41	-0.18*
2008/09	22.34	21.76	-0.59

*The upstream logger was out of the water during January 2008, so the daily maximum average temperature is unlikely to be representative.

The downstream temperature has been cooler than the upstream temperature by approximately 1°C for most years of assessment. There is no obvious trend in the data at this stage.

Shading of the Matahuru Stream is sporadic between the two sites with a variety of vegetation types present. As existing vegetation combined with any new plantings establish and grow, shading will increase and result in a larger temperature difference between the upstream and downstream monitoring sites (i.e. a net decrease in water temperature downstream).

2.2.5 Photo points

No photos were collected in the 2008/09 monitoring period in the Matahuru catchment. Refer to Grant et al. (2009b) for the most recent results and comparisons.

2.2.6 Suspended sediment

Permanent sampling site

A permanent suspended sediment sampling site has been in place at the Myjer farm bridge since July 2006. The data below includes all results up until 31/12/2008. During this time 18 events have been sampled using an automatic sediment sampler. The data set is analysed to estimate sediment variables (Table 5). For more detailed information, refer to the Suspended Sediment Monitoring Report (Kotze, Grant and Hill, 2008).

Table 5: Matahuru permanent suspended sediment sampling site description and estimated sediment variables

Site name:	**Myjers**	**Map Ref (NZMS260):**	**S13:116-095**
River:	**Matahuru**		
		Start – End Date	**No of samples**
Flow Time Series		17/07/2006 – 31/12/2008	N/A
Sediment Samples		19/07/2006 – 20/08/2007	242
ISCO Period of Record		19/07/2006 – 07/08/2008	18 events

Specific yield ($t/km^2/yr$)	Average sediment yield (kt/yr)	% of sediment yield in gauged range of flow	% Error in Yield Estimate
108	9.0	66.1	4.3

Sediment snapshot sampling

No sediment snapshots were completed in the Matahuru catchment during 2008. Please refer to Grant et al. (2009b) and Hill et al. (2006) for previously completed sediment snapshot results.

2.2.7 Main points

Riparian Characteristics

- No riparian characteristics data or photo points were collected in the 2008/09 monitoring period in the Matahuru catchment. Refer to Grant et al. (2009b) for the most recent results.

Sedimentation of surface water

- A specific yield of 108 $t/km^2/yr$ has been estimated based on results from a permanent suspended sediment monitoring site. A longer time period is required to produce a more accurate result.

- No sediment snapshots were completed in 2008 in the Matahuru catchment.

Aquatic habitat

- The downstream temperature has been cooler on average than the upstream temperature for all monitored years. There is no clear trend in the data at this stage.

- Since 2003/04 river management and soil conservation works have occurred but in general shading of the Matahuru Stream remains sporadic.

- Measurable improvements in aquatic habitat are likely to be evident after about 10 years of monitoring.

3 Upper Waikato zone

3.1 Introduction

Monitoring is present in three catchments in the Upper Waikato zone; Pokaiwhenua, Mangare and Tahunaatara catchments. Monitoring progress and results are presented for each catchment individually.

3.2 Pokaiwhenua catchment

3.2.1 Monitoring progress

The monitoring locations in the Pokaiwhenua catchment are detailed in Grant et al. (2009b). Table 6 presents monitoring completed by 2008/09.

Table 6: Pokaiwhenua catchment monitoring completed by 2008/09

Monitoring	Activity	Completion	Included in this report (or year last reported)
Soil stability	Soil stability and soil conservation assessment	2005	2005/06
Riparian characteristic assessment	Complete assessment along the middle section of the Pokaiwhenua River	2003/04, 2005/06 2007/08	2007/08
Photo points	Complete assessment along the mid section of the Pokaiwhenua River	2003/04, 2004/05 2005/06, 2007/08	2007/08
Permanent suspended sediment sampling site	None planned	N/A	N/A
Suspended sediment snapshots	• Low flow snapshot • High flow snapshot at next sufficient rainfall event	2003 Not completed	2005/06
Water temperature	Install loggers and record stream temperatures along the middle section of the Pokaiwhenua River	2003/04, 2004/05 2005/06, 2006/07 2007/08, 2008/09	✓
Stream ecological health	Assess stream ecological health along the middle section of the Pokaiwhenua River	2003/04, 2004/05 2005/06, 2006/07 2007/08, 2008/09	✓

N/A = not applicable

3.2.2 Soil stability

Refer to Hill et al. (2006) for the most recent soil stability information in this catchment.

3.2.3 Riparian characteristics

No riparian characteristics data was collected in the 2008/09 monitoring period in the Pokaiwhenua catchment. Refer to Grant et al. (2009b) for the most recent results.

3.2.4 Water temperature

The water temperature loggers are deployed in the middle section of the Pokaiwhenua River. The distance between the two loggers is approximately 1km. To date six deployments have been made with data collected each summer between 2003/2004 and 2008/2009 inclusive. The average of the daily maximum water temperature is derived to produce a single temperature for each site. The upstream temperature is

then subtracted from the downstream temperature to provide a single number for the monitored section of river (Table 7).

Table 7: Pokaiwhenua Stream average daily maximum water temperatures for the 10 week period starting 1 January

Year	Upstream average daily maximum (°C)	Downstream average daily maximum (°C)	Temperature difference between u/s and d/s locations (°C)
2003/04	18.44	18.21	-0.23
2004/05	18.78	18.47	-0.31
2005/06	18.32	17.98	-0.33
2006/07	18.51	18.15	-0.36
2007/08	19.21	18.63	-0.58
2008/09	19.07	18.32*	-0.75*
*The downstream logger was out of the water during March 2009, so the daily maximum average temperature is unlikely to be representative.			

Table 7 illustrates the downstream temperature has been slightly cooler on average than the upstream temperature for all monitored summers. Although sections of the stream have been fenced and planted, little shading occurs between the upstream and downstream monitoring sites. The data suggests there is a decrease in the temperature at the downstream site compared to the upstream site over time. However, it is unknown whether this can be attributed to the effects of riparian planting; with the width of the river in this vicinity being 5-7m it will be a number of years before any significant vegetative shading influence on the river is observed.

3.2.5 Photo points

No photo points were collected in the 2008/09 monitoring period in the Pokaiwhenua catchment. Refer to Grant et al. (2009b) for the most recent results.

3.2.6 Stream ecological health

The dominant surrounding land use in the vicinity of both of the sampling sites in the Pokaiwhenua River is pastoral/horticultural. The stream ranges between 5-7m in width with the substrate predominantly consisting of a combination of cobble, gravel and sand. The canopy cover is open.

Invertebrate sampling is carried out in the same two locations where the water temperature probes are deployed in the middle section of the Pokaiwhenua River. The initial year of assessment was completed in 2003/04 with subsequent assessments completed annually.

Table 8 lists the MCI values as calculated for the upstream and downstream sampling sites in the Pokaiwhenua River.

Table 8: MCI values for the Pokaiwhenua River. Samples are taken between January and March of each year.

Site	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Pokaiwhenua upstream	99	103	113	113	115	113
Pokaiwhenua downstream	113	109	116	103	108	102

In the vicinity of the two sampling sites in the Pokaiwhenua River the presence and abundance of identified invertebrate species and the associated MCI scores indicate that the stream has a mild degradation in ecological health (Wright-Stow & Winterbourn 2003). A longer monitoring period is required to identify a trend in the MCI values.

3.2.7 Main points

Riparian characteristics

- No riparian characteristics data or photo points were collected in the 2008/09 monitoring period in the Pokaiwhenua catchment. Refer to Grant et al. (2009b) for the most recent results.

Aquatic habitat

- The downstream temperature is consistently cooler on average than the upstream temperature for all monitored summers.
- There is an emerging trend in the data showing the downstream site recording increasing cooler temperatures than the upstream site.
- Soil conservation works have occurred along some stretches of bank, but due to the width of the river, the shading effect on the stream temperature may be limited.
- Assessments of the invertebrates in Pokaiwhenua Stream indicate that there is a mild degradation in ecological health.
- Measurable improvements in aquatic habitat are likely to be evident after about 10 years of monitoring.

3.3 Mangare catchment

3.3.1 Monitoring progress

For survey locations in the Mangare catchment, refer to Grant et al. (2009b). Table 9 contains monitoring completed by 2008/09.

Table 9: Mangare catchment monitoring completed by 2008/09

Monitoring	Planned activity	Completion	Included in this report (or year last reported)
Soil stability	Not planned	N/A	N/A
Riparian characteristic assessment	Complete assessment along the middle section of the Mangare Stream	2003/04, 2005/06 2007/08	2007/08
Photo points	Complete assessment along the middle section of the Mangare Stream	2003/04, 2004/05 2005/06, 2007/08	2007/08
Permanent suspended sediment sampling site	Not planned	N/A	N/A
Suspended sediment snapshot	Not planned	N/A	N/A
Water temperature	Install loggers and record stream temperatures along the middle section of the Mangare Stream	2006/07, 2007/08 2008/09	✓
Stream ecological health	Assess stream ecological health along the mid section of the Mangare Stream	2005/06, 2006/07 2007/08, 2008/09	✓

N/A = not applicable

3.3.2 Riparian characteristics

No riparian characteristics data was collected in the 2008/09 monitoring period in the Mangare catchment. Refer to Grant et al. (2009b) for the most recent results.

3.3.3 Water temperature

The water temperature loggers are deployed in the middle section of the Mangare Stream, with a distance between the two loggers of approximately 1km. The loggers have collected summer data annually between 2006/07 and 2008/09 inclusive. The average of the daily maximum water temperature is derived to produce a single temperature for each site. The upstream temperature is then subtracted from the downstream temperature to provide a single number for the monitored section of river (Table 10).

Table 10: Mangare Stream average daily maximum water temperatures for the 10 week period starting 1 January

Year	Upstream average daily maximum (°C)	Downstream average daily maximum (°C)	Temperature difference between u/s and d/s locations (°C)
2006/07	21.53	21.27	-0.26
2007/08	22.82	22.28	-0.55
2008/09	22.03	21.44	-0.59

Table 10 illustrates the downstream temperature has been slightly cooler on average than the upstream temperature for all monitored summers. The shading of Mangare Stream has greatly improved for one section of the stream during the years of assessment, however a longer time period is required for the water temperature to reflect these changes.

3.3.4 Photo points

No photo points were collected in the 2008/09 monitoring period in the Mangare catchment. Refer to Grant et al. (2009b) for the most recent results.

3.3.5 Stream ecological health

The dominant surrounding land use in the vicinity of both of the sampling sites in the Mangare Stream is pastoral. The stream ranges between 1.5-3m in width with the substrate predominantly consisting of a combination of cobble, gravel, and sand with some bedrock in places. The canopy cover is open however partial shading of the stream is beginning to occur from willow poles planted in 2005.

Invertebrate sampling is carried out in the same two locations where the water temperature probes are deployed in the middle section of the Mangare Stream. The initial year of assessment was completed in 2006, with subsequent assessments conducted annually.

Table 11 lists the MCI values as calculated for the upstream and downstream sampling sites in the Mangare Stream.

Table 11: MCI values for the Mangare Stream. Samples are taken between January and March of each year.

Site	2005/06	2006/07	2007/08	2008/09
Mangare upstream	99	113	96	104
Mangare downstream	92	93	82	88

In the vicinity of the two sampling sites in the Mangare Stream the presence and abundance of identified invertebrate species and the associated MCI scores for the

assessment indicate that this stream has a moderate degradation in ecological health (Wright-Stow & Winterbourn 2003). A longer monitoring period is required to identify a trend in the MCI values.

3.3.6 Main points

Riparian characteristics

- No riparian characteristics data or photo points were collected in the 2008/09 monitoring period in the Mangare catchment. Refer to Grant et al. (2009b) for the most recent results.

Aquatic habitat

- The downstream temperature has been slightly cooler on average than the upstream temperature, but a longer time period is needed before trends emerge.

- Shading has increased for half of the assessed stream reach, but the water temperature is unlikely to reflect this improvement for a number of years.

- Assessments of the invertebrates in Mangare Stream indicate that this stream has a moderate degradation in ecological health.

3.4 Tahunaatara catchment

3.4.1 Monitoring progress

Monitoring focuses on the middle section of the Pokaitu Stream, a sub-catchment of the Tahunaatara Stream, which feeds into Lake Atiamuri. For survey locations in the Pokaitu catchment, refer to Grant et al. (2009b). Table 12 contains monitoring completed by 2008/09.

Table 12: Upper Waikato zone monitoring completed by 2008/09

Monitoring	Planned activity	Completion	Included in this report (or year last reported)
Soil stability	Not planned	N/A	N/A
Riparian characteristic assessment	Not planned	N/A	N/A
Photo points	5km photo survey along the Pokaitu Stream	2003/04, 2008/09	✓
Permanent suspended sediment sampling site	Not planned	N/A	N/A
Suspended Sediment snapshot	Not planned	N/A	N/A
Water temperature	Install loggers and record stream temperatures along the middle section of the Pokaitu Stream	2003/04, 2004/05 2005/06, 2006/07 2007/08, 2008/09	✓
Stream ecological health	Assess stream ecological health along the middle section of the Pokaitu Stream	2003/04, 2004/05 2005/06, 2006/07 2007/08, 2008/09	✓

N/A = not applicable

3.4.2 Water temperature

Water temperature loggers are deployed in the middle section of the Pokaitu Stream, with a distance between them of approximately 5km. To date, the temperature data for

six summers have been recorded, between 2003/2004 and 2008/2009 inclusive. The average of the daily maximum water temperatures is derived to produce a single temperature for each site. The upstream temperature is then subtracted from the downstream temperature to provide a single number for the monitored section of river (see Table 13).

Table 13: Pokaitu Stream average daily maximum water temperatures for the 10 week period starting 1 January

Year	Upstream average daily maximum (°C)	Downstream average daily maximum (°C)	Temperature difference between u/s and d/s locations (°C)
2003/04	17.52	16.91	-0.61
2004/05	17.87	17.23	-0.64
2005/06	17.01	16.63	-0.38
2006/07	17.13	16.85	-0.28
2007/08	17.53	17.16	-0.37
2008/09	17.39	17.00	-0.39

As Table 13 illustrates, the downstream temperature has been slightly cooler on average than the upstream temperature for all years of assessment. At present sparse and sporadic shading of the stream occurs between the two temperature probes. A longer time period is required before any trends can be determined, particularly as clearance of pine trees along the stream have affected the shading of the water.

3.4.3 Photo points

A photo survey was undertaken along the Pokaitu Stream in 2008/09, the first completed since the baseline survey in 2003/04. Photos are taken along the stream every 250m for a distance of nearly five kilometres. These photos will be published along with those from other catchments in a future Catchment Environmental Monitoring report. While the majority of the stream showed little change in vegetation over the five year period, sections which were fenced displayed an improvement in riparian vegetation and shading (Figure 2 a and b).

Figure 2: Pokaitu Stream photo point examples of visual change at 4250m, a) 2003/04; b) 2008/09.

3.4.4 Stream ecological health

The dominant surrounding land use in the vicinity of the sampling site is pastoral. The stream is 3-4m in width with the substrate predominantly consisting of gravel with some cobble and sand. The canopy cover is open.

Invertebrate sampling is conducted in the Pokaitu Stream under the southern Apirana Road bridge (where the downstream temperature probe is deployed). The initial year of assessment was in 2003/04 with subsequent assessments completed annually. Table 14 lists the MCI values as calculated for the Pokaitu Stream sampling site.

Table 14: MCI values for the Pokaitu Stream. Samples are taken between January and March of each year.

Site	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Pokaitu downstream	104	116	120	126	122	117

In the vicinity of the sampling site in the Pokaitu Stream the presence and abundance of identified invertebrate species and the associated MCI scores indicate that the stream has mild to clean water quality in terms of ecological health (Wright-Stow & Winterbourn 2003). A longer monitoring period is required to identify a trend in the MCI values.

3.4.5 Main points

Riparian characteristics

- A comparison of visual change was made using a photo survey between 2003/04 and 2008/09. No major improvements in riparian vegetation and water shading have been made during this time as very little vegetation has been planted.

- In general, shading of the Pokaitu Stream remains sparse and sporadic, affected by tree clearance along the stream.

Aquatic habitat

- The downstream temperature has been slightly cooler on average than the upstream temperature for all assessed summers.

- A longer time period is required before water temperature trends will emerge.

- Assessments of the invertebrates in Pokaitu Stream indicate that the stream has mild to clean water quality in terms of ecological health.

- Measurable improvements in aquatic habitat are likely to be evident after about 10 years of monitoring.

4 Waipa zone

4.1 Introduction

Monitoring is present in one catchment in the Waipa zone; Mangatutu catchment. A summary of the riparian characteristics is provided in Appendix 1.

4.2 Mangatutu catchment

4.2.1 Monitoring progress

Monitoring focuses on the Mangatutu Stream catchment where river management and soil conservation initiatives are being implemented. For survey locations in the Mangatutu catchment, refer to Grant et al. (2009b). Table 15 contains monitoring completed by 2008/09.

Table 15: Waipa zone monitoring completed by 2008/09

Monitoring	Activity	Completion	Included in this report (or year last reported)
Soil stability	Not planned	N/A	N/A
Riparian characteristic assessment	Complete assessment along the lower section of the Mangatutu sub-catchment	2004/05, 2006/07 2008/09	✓
Photo points	Complete assessment along the lower section of the Mangatutu sub-catchment	2004/05, 2006/07 2008/09	✓
Permanent suspended sediment sampling site	Event driven sampling	Ongoing since June 2004	✓
Suspended sediment snapshots	• Low flow snapshot • High flow snapshot at next sufficient rainfall event	2004 Not completed	2005/06
Water temperature	Install loggers and record stream temperatures along the lower section of the Mangatutu River.	2003/04, 2004/05 2005/06, 2006/07 2007/08, 2008/09	✓
Stream ecological health	Assess stream ecological health along the middle and lower section of the Mangatutu River.	2004/05, 2005/06 2006/07, 2007/08 2008/09	✓

N/A = not applicable

4.2.2 Riparian characteristics

Introduction

Seven 1km samples were selected for assessment through the lower section of the Mangatutu sub-catchment with four of the samples on the Mangatutu Stream and three on the tributaries. The assessments on the Mangatutu Stream are at locations where Environment Waikato funded river management and soil conservation works are scheduled. Those on tributaries of the Mangatutu Stream provide for greater geographic spread within the Mangatutu sub-catchment and therefore wider representation of riparian characteristics. The initial assessment was conducted in the 2004/05 year with the latest assessment conducted in 2008/09.

The reported data for each parameter represents a percentage of the total assessed riparian margin in the catchment. Tabled summary riparian assessment data is located in Appendix 1.

The following summary data was collected where riparian soil conservation has been recently implemented or is planned for the Mangatutu catchment. Erosion, vegetation and fencing data summaries are presented in Figures 3 to 6. The number in brackets in each figure is the percentage change from the baseline data collected in the 2004/05 assessment.

Vegetation

Riparian vegetation contributes to stream bank stability and the shading of the stream to help minimise increases in stream temperatures. Natural biodiversity along the riparian margin can be increased through the planting of native vegetation. Riparian vegetation is split into grass and woody vegetation (native + willow + exotic other). Figure 3 shows 55% of the riparian margin is grass. The remaining 45% is woody vegetation, of which 1% of the total length is native, 22% is willow and 22% is other exotic species. The length of riparian margin containing willows has increased from 6% of the total length in 2004/05 to 22% in the most recent survey, while exotic other woody vegetation has had a proportionate decrease.

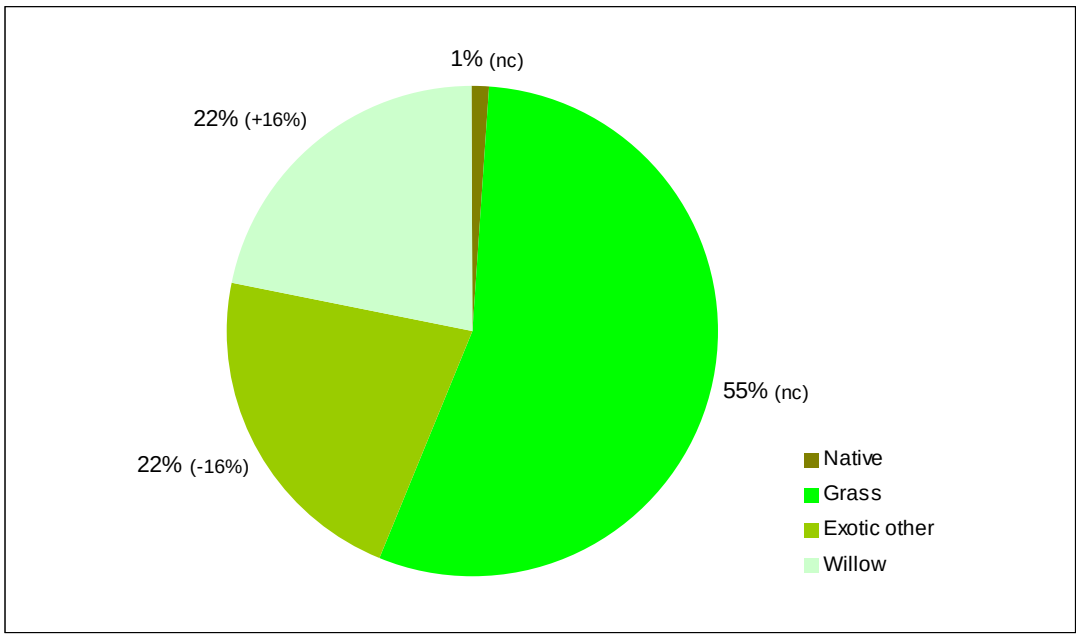

Figure 3: Mangatutu riparian vegetation (value in brackets represents the percent change from baseline data – 2004/05).

Fencing

The amount of fencing on one side or both sides of the waterway is an indicator of likely stock exclusion from the waterway. Stock exclusion reduces direct contamination of water by pathogens, damage to the stream ecology by trampling of the stream bed and indirectly reduces sediment load from stock trampling the banks.

Stock is excluded from both sides for 16% of the waterway, from one side for 70% of the waterway and are not excluded either side for 14% of the waterway (Figure 4). The length of stream bank unfenced on both sides has decreased (from 32%) since the 2004/05 assessment.

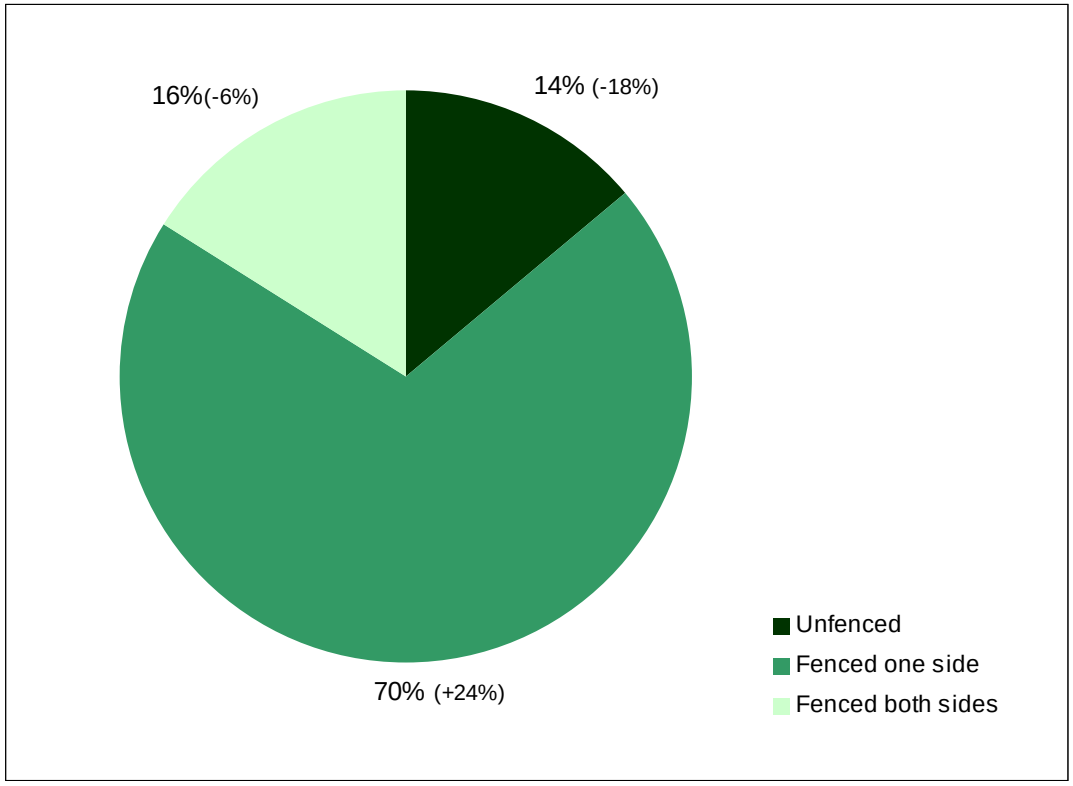

Figure 4: Mangatutu stock exclusion by bank length (value in brackets represents the percent change from baseline data – 2004/05)

There has been an increase in fencing over the total stream bank length since the baseline assessment, from 45% (incorrectly stated as 27% in Grant et al., 2009b) to 51%. The majority of the fenced banks (57% of the total fenced bank length) have woody vegetation (Figure 5). The proportion of stream bank that is fenced off and has woody vegetation has increased from 24% (not 6% as incorrectly reported in Grant et al. 2009b) to 29% of the total length. There is unfenced woody vegetation on 17% of the total stream bank length. In Grant et al. (2009b) the unfenced woody vegetation was incorrectly stated as 39% rather than 21% for 2004/05.

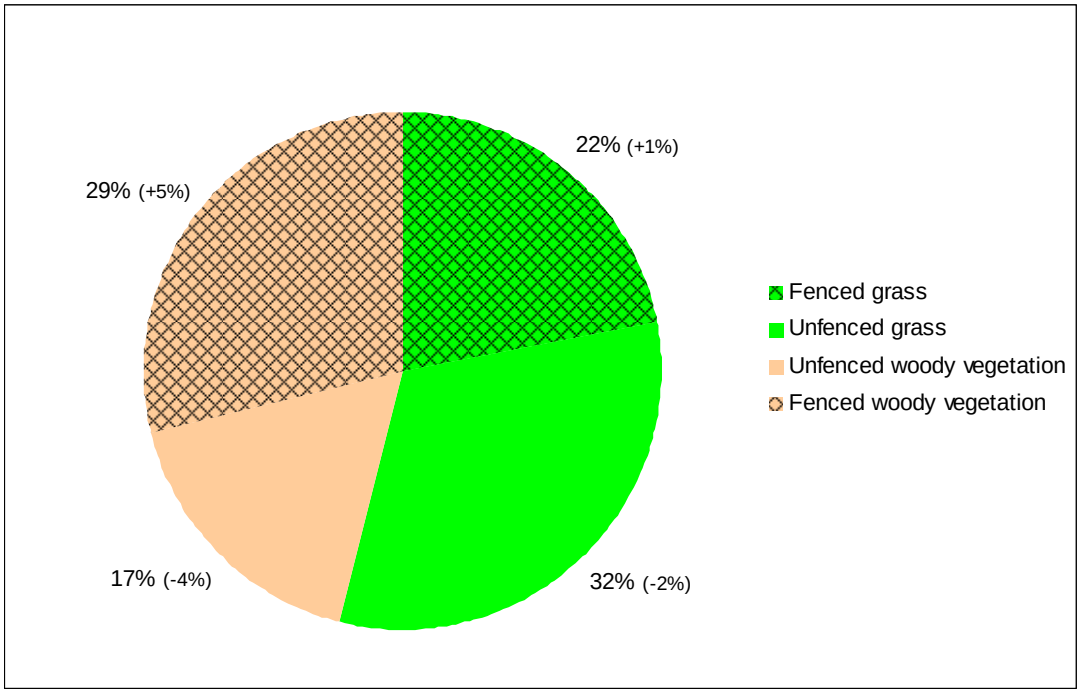

Figure 5: Mangatutu bank length fencing and vegetation combinations (value in brackets represents the percent change from baseline data – 2004/05).

Stream bank stability

Stream bank stability is measured as unstable stream banks are one of the main sources of sediment in waterways. Stream bank stability can be improved through the type of riparian vegetation, and by fencing out stock.

An estimated 78% of the assessed riparian bank length is considered stable (Figure 6), up from the 57% measured in the 2004/05 assessment but decreased from 86% in the 2006/07 survey. The remaining 22% is unstable. A greater portion of unstable stream bank is unfenced (13% of the total stream length) than fenced (9%). Grass vegetation is present on 59% of the total unstable bank length.

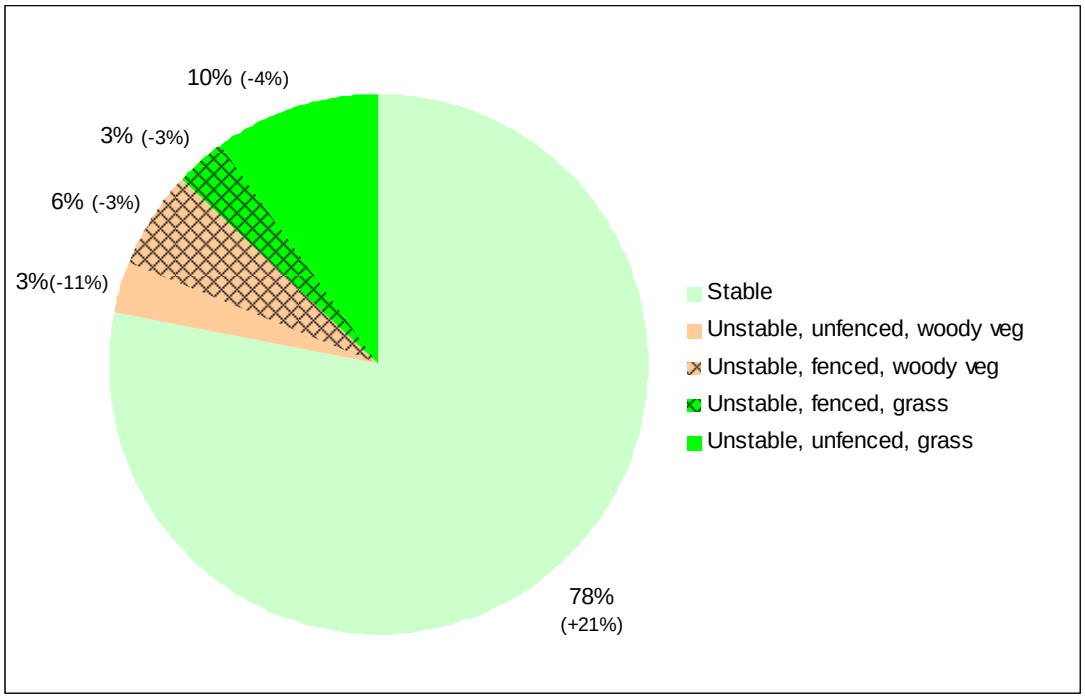

Figure 6: Mangatutu erosion (value in brackets represents the percent change from baseline data – 2004/05).

4.2.3 Water temperature

Water temperature loggers are deployed in the lower section of the Mangatutu Stream. The downstream logger is under the Walker Road bridge, the midstream logger is beneath the Lethbridge Road bridge and the upstream logger is near the Wharepuhunga Road bridge. The distance between the upstream and downstream loggers is approximately 18km. To date six deployments have been made with data collected for the summers between 2003/04 and 2008/2009. The 2003/2004 temperature data collected was only for the period of February to March; therefore the daily maximum average for this summer is not representative and cannot be compared to the other summer's results.

The average of the daily maximum water temperature is derived to produce a single temperature for each site. The upstream temperature is then subtracted from the downstream temperature to provide a single number for the monitored section of river (see Table 16).

Table 16: Mangatutu Stream average daily maximum water temperatures for the 10 week period starting 1 January.

Year	Upstream average daily maximum (°C)	Midstream average daily maximum (°C)	Downstream average daily maximum (°C)	Temperature difference between u/s and d/s locations (°C)
2004/05	19.85	20.85	20.22	+0.38
2005/06	19.41	20.12	19.89	+0.48
2006/07	20.01	21.15	20.33	+0.32
2007/08	21.74	22.70	21.07	-0.67
2008/09	20.07	22.20*	20.29	+0.22
*The midstream logger was out of the water during most of February and March 2009, so the daily maximum average temperature is unlikely to be representative.				

As Table 16 illustrates, the downstream temperature has mostly been warmer on average than the upstream temperature. Only the data from the 2007/08 summer has shown the downstream temperature to be cooler than the upstream temperature. No temperature difference trends have emerged, a longer monitoring period is required. Shading of the Mangatutu Stream remains sporadic between the temperature monitoring sites however this level of shading should increase over the long term as new plantings mature.

4.2.4 Photo points

The initial year of assessment was 2004/05 with subsequent assessments completed in 2006/07 and 2008/09.

Seven 1km samples of stream were assessed giving a total of 35 photos for the Mangatutu catchment. Large sections of stream have shown improvements due to soil conservation planting. Other sections which have been fenced are covered in rank grass (Figures 7a - d).

	2004/05	2008/09
Assessment 3 at 0m		
Assessment 6 at 750m		

Figure 7: Mangatutu River photo point examples of visual change, assessment 3 at 0m (a and b) and assessment 6 at 750m (c and d).

4.2.5 Suspended sediment

Permanent sampling site

A permanent suspended sediment sampling site has been in place at Walker Road bridge on the Mangatutu River since June 2004. During this time 30 events have been sampled using an automatic sediment sampler. The data set is analysed to estimate sediment variables (Table 17). Data includes all results up until 31/12/2007. The specific yield for the Mangatutu catchment is estimated to be 49 t/km^2/yr. For more detailed information refer to the Suspended Sediment Monitoring Report (Kotze et al., 2008).

Table 17: Mangatutu permanent suspended sediment sampling site description and estimated sediment variables.

Site name:	**Walker Road**	**Map Ref (NZMS260):**	**S15:203-423**
River:	**Mangatutu**		
		Start – End Date	**No of samples**
Flow Time Series		08/06/2004 – 31/12/2008	N/A
Sediment Samples		22/06/2004 – 07/10/2008	814
ISCO Period of Record		22/06/2004 – 07/10/2008	38 events

Specific yield (t/km^2/yr)	Average sediment yield (kt/yr)	% of sediment yield in gauged range of flow	% Error in Yield Estimate
49	6.0	97.9	3.5

A continuing focus is to carry out manual depth-integrated suspended sediment gaugings while the automatic sampler is activated. The collection of these concurrent

samples will allow for the automatic series to be calibrated to the whole river cross-section.

Snapshot sampling

Refer to Hill et al. (2006) for the low flow snapshot results taken in April 2004. A high flow sediment snapshot will be undertaken at the next opportunity.

4.2.6 Stream ecological health

The dominant surrounding land use in the vicinity of the sampling site is pastoral. The stream is 4-5m in width with the substrate predominantly consisting of gravel and sand with some silt. The canopy cover is partly shaded although the removal of nuisance riparian willow will in the short term reduce canopy cover.

Invertebrate sampling is conducted in the Mangatutu River immediately upstream of the Walker Road Bridge, near the downstream temperature logger. The initial year of assessment using these methods was in 2005 with subsequent assessments completed annually. Table 18 lists the MCI values as calculated for the Mangatutu River sampling site.

Table 18: MCI values for the sampling site in the Mangatutu River. Samples are taken between January and March of each year.

Site	2004/05	2005/06	2006/07	2007/08	2008/09
Mangatutu downstream	114	110	104	108	115

In the vicinity of the sampling site in the Mangatutu River the presence and abundance of identified invertebrate species and the associated MCI scores indicate that the ecological health of the stream is considered to be mildly degraded (Wright-Stow & Winterbourn 2003). A longer monitoring period is required to identify trends in the MCI values.

4.2.7 Main points

Riparian characteristics

- The proportion of grass and woody vegetation has remained relatively the same between the 2004/05 and 2008/09 assessments. Woody vegetation covers 45% of the riparian margin, of which 1% of the total length is native, and 44% is exotic (including willows).

- There has been an increase in fencing over the total stream bank length from 45% in 2004/05 to 51% in the most recent survey (2008/09).

- The proportion of stream bank that is fenced off and has woody vegetation has increased from 24% to 29% of the total length over the four years separating the assessments. The length of unfenced grass has decreased slightly to 32% of the stream bank length.

- An estimated 78% of the assessed riparian bank length was considered stable, up from 57% in 2004/05, but decreased slightly since the 2006/07 survey.

- Out of the total unstable length of stream bank, grass is the predominant vegetation covering 59%, and the majority of the same length is not fenced.

- Photo assessments have shown some small changes to areas where soil conservation plantings have occurred, and where rank grass has grown.

Sedimentation of surface water

- The specific yield for the Mangatutu catchment above Walker Road bridge is 49 t/km^2/yr after four years of sampling. However a longer monitoring period is required (at least 10 years) in order to produce a more accurate result.

- A low flow snapshot was taken in 2004, with results described in Hill et al. (2006). A high flow snapshot will be done at the next opportunity.

Aquatic habitat

- Water temperature has been monitored annually since 2004/05. With the exception of the 2007/08 monitoring period, the downstream site has recorded warmer temperatures than the upstream site. This is likely to improve as soil conservation plantings grow and shade the water. A longer monitoring period is required before a trend can be identified.

- Assessments of the invertebrates in Mangatutu Stream indicate that there is a mild degradation in ecological health.

4.2.8 Other monitoring

Automatic sediment samplers are installed on the Otewa and Mangapu rivers to monitor suspended sediment in the Waipa zone. For more details, refer to the Suspended Sediment monitoring report (Kotze et al., 2008). *Mangatutu Stream Ecological Monitoring Results – 2004 to 2007* has been completed by Gibbs (2008) as an Environment Waikato Internal Series report, and can be accessed internally on DOC #1212429 or by contacting Environment Waikato. This report describes the changes in ecological health in the Mangatutu Stream resulting from the soil conservation work which has occurred since 2004.

5 Coromandel zone

5.1 Introduction

Monitoring is present in one catchment in the Coromandel zone; Wharekawa catchment. A summary of the catchment characteristics for Wharekawa is provided in Appendix 1.

5.2 Wharekawa catchment

5.2.1 Monitoring progress

Monitoring will focus on the Wharekawa River catchment where river management and soil conservation initiatives are being implemented. For survey locations in the Wharekawa catchment, refer to Grant et al. (2009b). Table 19 contains monitoring completed by 2008/09.

Table 19: Coromandel zone monitoring completed by 2008/09.

Monitoring	Activity	Completion	Included in this report (or year last reported)
Soil stability	Not planned	N/A	N/A
Riparian characteristic assessment	Complete assessment along the monitored section of Wharekawa River.	2006/07, 2008/09	✓
Photo points	Complete assessment along the monitored section of the Wharekawa River	2006/07, 2008/09	✓
Permanent suspended sediment sampling site	Event driven sampling, concluded in 2003.	April 2000 until Feb 2003	✓
Suspended sediment snapshots	Not planned	N/A	N/A
Water temperature	Install loggers and record stream temperatures along the Wharekawa River	2006/07, 2007/08 2008/09	✓
Stream ecological health	Assess stream ecological health along the Wharekawa River	2004/05, 2006/07 2007/08, 2008/09	✓

N/A = not applicable

5.2.2 Riparian characteristics

Introduction

For the 2008/09 assessment, four 1km samples and one 500m assessment of the riparian margin have been assessed in the Wharekawa River. These are locations where the Peninsula Project funded works have been completed or are scheduled, where stream riparian margin access is possible, and where landowner participation is forthcoming. The samples are the same as used in previous assessments. The baseline assessment was conducted during the summer of 2006/07 with a further assessment undertaken in 2008/09. Just prior to the second assessment willow removal took place at some sections of the river, decreasing the length of stream bank with woody vegetation, and increasing the level of erosion. The reported data for each parameter represents a percentage of the total assessed riparian margin in the catchment. A summary table of the riparian data is located in Appendix 1. Vegetation,

fencing and stream bank stability data summaries are presented in Figures 8 - 11. The number in brackets in each figure is the percentage change from the baseline data collected in the 2006/07 assessment.

Vegetation

Riparian vegetation contributes to stream bank stability and the shading of the stream to help minimise increases in stream temperatures. Natural biodiversity along the riparian margin can be increased through the planting of native vegetation. Riparian vegetation is split into grass and woody vegetation (native + willow + exotic other). Figure 8 shows 11% of the riparian margin is grass. The remaining 89% is woody vegetation, of which 54% of the total length is native, 20% is willow and 15% is exotic other.

The length of the riparian margin in grass has increased by 9%; associated with a corresponding 9% decrease in riparian woody vegetation. The decrease in woody vegetation is from a decrease in native vegetation (12%), with a slight increase in exotic woody vegetation (3%).

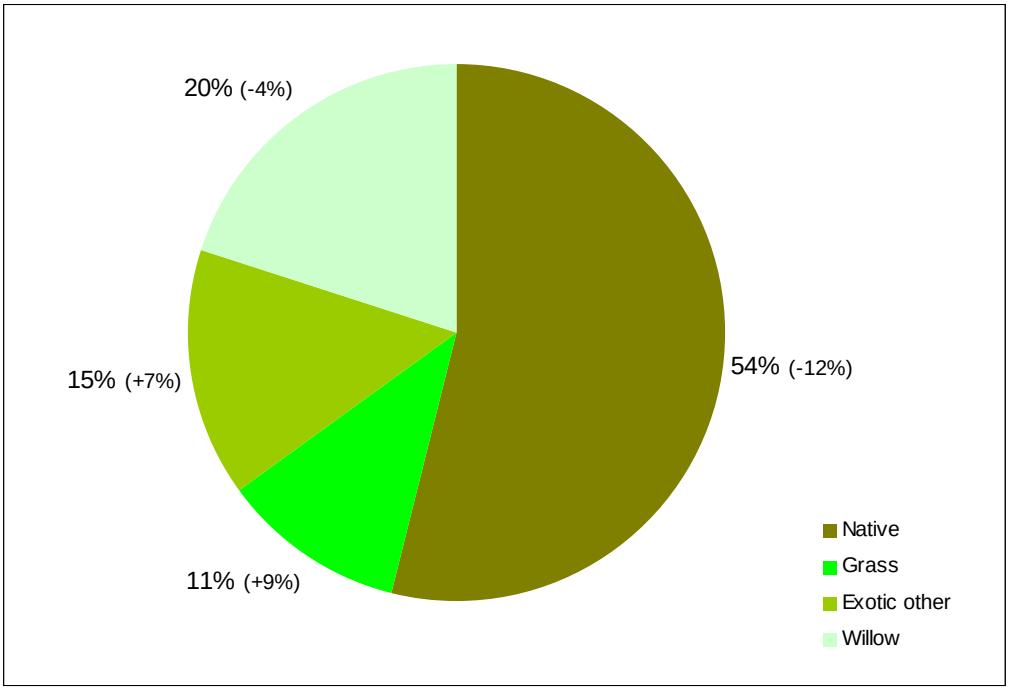

Figure 8: Wharekawa riparian vegetation (value in brackets represents the percent change from baseline data – 2006/07).

Fencing

The amount of fencing on one side or both sides of the waterway is an indicator of likely stock exclusion from the waterway. Stock exclusion reduces direct contamination of water by pathogens, direct damage to the stream ecology by trampling of the stream bed and indirectly reduces sediment load from stock trampling the banks.

Stock is excluded from both sides for 37% of the waterway, from one side for 52% of the waterway and are not excluded either side for 11% of the waterway (Figure 9).
There has been a decrease in the length of stream fenced on both sides since the 2006/07 assessment.

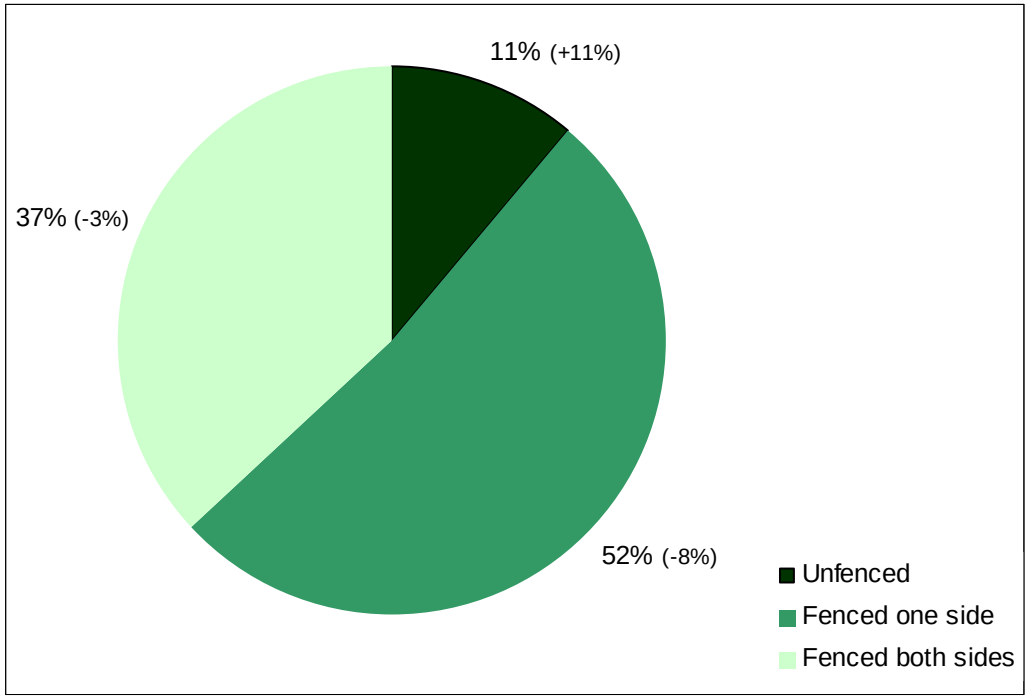

Figure 9: Wharekawa stock exclusion by stream length (value in brackets represents the percent change from baseline data – 2006/07).

There has been a decrease in fencing over the total stream bank length since the baseline assessment, from 70% to 63%. The majority of the fenced banks (90% of the total fenced bank length) have woody vegetation (Figure 10). The proportion of stream bank that is fenced off and has woody vegetation has decreased from 69% to 57% of the total length over the two years separating the assessments.

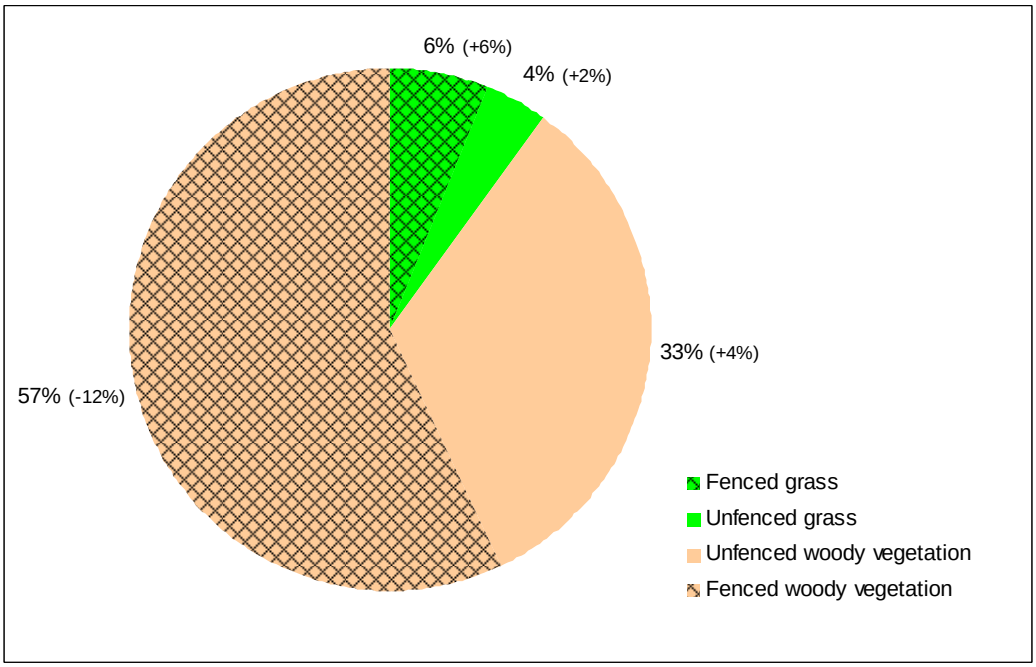

Figure 10: Wharekawa riparian margin fencing and vegetation combinations (value in brackets represents the percent change from baseline data – 2006/07).

Stream bank stability

Stream bank stability is measured, as unstable stream banks are one of the main sources of sediment in waterways. Stream bank stability can be improved through the type of riparian vegetation used, and by fencing out stock.

An estimated 80% of the assessed riparian bank length is considered stable, down from the 90% measured in the 2006/07 assessment (Figure 11). The remaining 20% is unstable. A greater portion of unstable stream bank is unfenced (13% of the total stream length) than fenced (7%). Grass is the predominant vegetation on 20% of the unstable bank length.

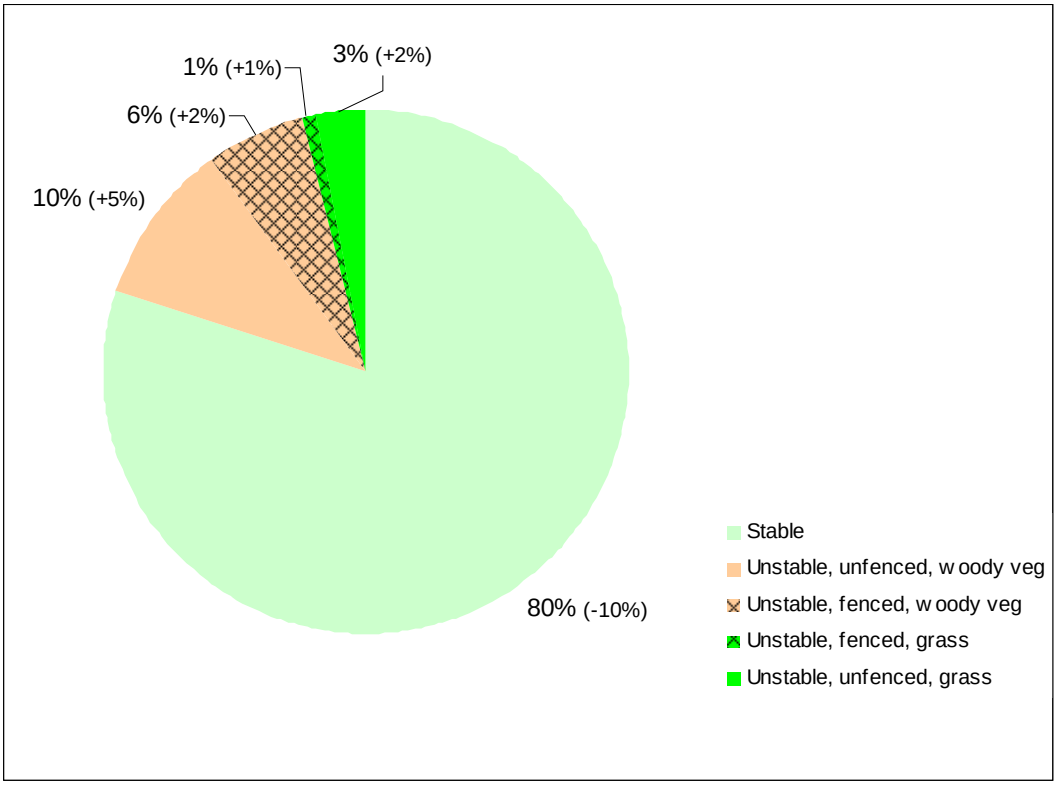

Figure 11: Wharekawa stream bank instability for fencing and vegetation combinations (value in brackets represents the percent change from baseline data – 2006/07).

5.2.3 Water temperature

Water temperature loggers are deployed in the lower section of the Wharekawa River. The downstream logger is near the SH25 bridge, and the upstream logger is approximately 3km further upstream, near where the river emerges from the forest. Three deployments have been made with data collected for the summers of 2006/07, 2007/08 and 2008/09.

The average of the daily maximum water temperature is derived to produce a single temperature for each site. The upstream temperature is then subtracted from the downstream temperature to provide a single number for the monitored section of river (Table 20).

Table 20: Wharekawa River average daily maximum water temperatures for the 10 week period starting 1 January

Year	Upstream average daily maximum (°C)	Downstream average daily maximum (°C)	Temperature difference between u/s and d/s locations (°C)
2006/07	21.78	21.07	-0.71
2007/08	22.13	21.54	-0.59
2008/09	22.16	21.47	-0.69

As Table 20 illustrates, the downstream temperature has been slightly cooler on average than the upstream temperature. A longer monitoring period is required before

a trend can be identified. The downstream temperature is expected to decrease in temperature further compared to the upstream temperature as vegetation continues to grow and shade the water.

5.2.4 Photo points

Photo assessments have been done along the Wharekawa River in 2006/07 and 2008/09. Five samples were done along the river totalling 26 photos over a total distance of 4500m. As willow removal was done just before the second assessment, some of the samples (in particular samples 3 and 5) showed a decrease in riparian vegetation and increase in erosion. However some samples showed an increase in vegetation, such as that shown in Figure 12 (the river has moved towards the left of the picture in figure 12B). Samples which have had soil conservation plantings in the riparian margin are expected to show positive visual changes in future assessments.

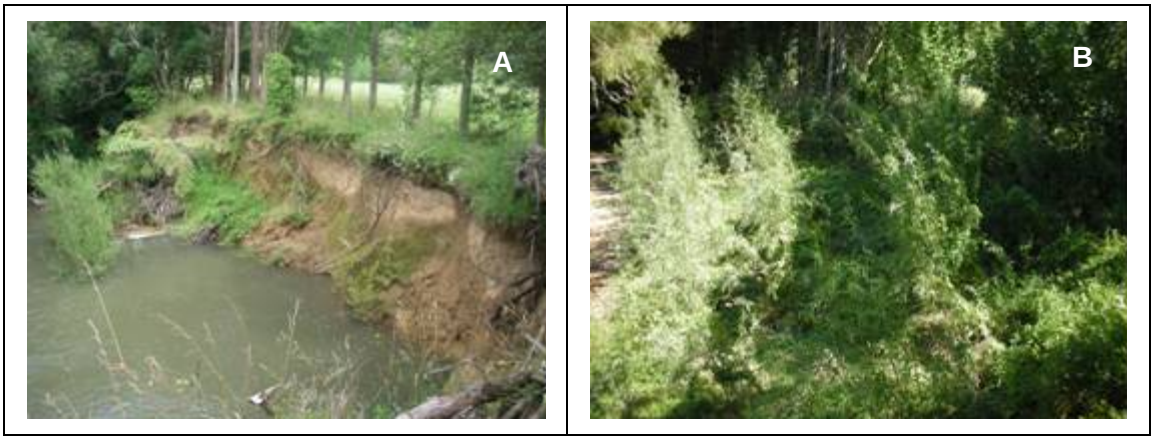

Figure 12: Wharekawa River photo point examples of visual change, assessment 4 at 0000m, a) 2006/07, b) 2008/09.

5.2.5 Suspended sediment monitoring

A permanent sediment sampling site has been in place at Adams farm bridge on the Wharekawa River since June 1991. During this time 19 events have been sampled using an automatic sediment sampler, which was on site between April 2000 and February 2003. The data set is analysed to estimate sediment variables (Table 21). Data includes all results up until 31/12/2007. For more detailed information refer to the Suspended Sediment Monitoring Report (Kotze et al., 2008).

Table 21: Wharekawa permanent suspended sediment sampling site description and estimated sediment variables.

Site name:	**Adams Farm Bridge**	**Map Ref (NZMS260):**	**T12:623-468**
River:	**Wharekawa**		
		Start – End Date	**No of samples**
Flow Time Series		10/06/1991 – 31/12/2008	N/A
Sediment Samples		25/09/1991 – 27/02/2003	478
ISCO Period of Record		20/04/2000 – 27/02/2003	19 events

Specific yield ($t/km^2/yr$)	Average sediment yield (kt/yr)	% of sediment yield in gauged range of flow	% Error in Yield Estimate
34	1.6	84.2	3.6

The automatic sediment sampler is currently not deployed at this site. However reinstallation is planned as part of the long term monitoring of this catchment. Manual

sediment gaugings continue to be taken, which support the information gathered and increase the size of the dataset.

5.2.6 Stream ecological health

The dominant surrounding land use in the vicinity of the sampling site is pastoral but the riparian zone is generally planted. The stream is up to 14m wide with the substrate predominantly consisting of gravel and sand with some cobbles. The canopy cover is partly shaded.

Invertebrate sampling is conducted in the Wharekawa River in the vicinity of the Adam's Farm bridge, midway between the upstream and downstream temperature loggers. The initial year of assessment using these methods was in 2004/05 with sampling undertaken annually since then, except for in 2005/06 when no samples were taken. Table 22 lists the MCI values as calculated for the Wharekawa River sampling site.

Table 22: MCI values for the sampling site in the Wharekawa River. Samples are taken between January and March of each year.

Site	2004/05	2006/07	2007/08	2008/09
Wharekawa	95	94	94	86

In the vicinity of the sampling site in the Wharekawa River the presence and abundance of identified invertebrate species and the associated MCI scores indicate that there is a moderate degradation in ecological health (Wright-Stow & Winterbourn 2003). A longer monitoring period is required before trends in the MCI values can be identified.

5.2.7 Main points

Riparian Characteristics

- Eighty nine per cent of the riparian margin is woody vegetation, 54% of which are native species.
- Of the entire length of stream bank, 63% is fenced, and 57% is both fenced and has woody vegetation.
- The riparian margin is stable for 80% of the total length.
- The majority of the unstable stream bank is unfenced.
- Photo assessments have shown improvements in erosion and vegetation growth in small areas of the Wharekawa River riparian margin. Willow clearance has caused temporary negative change at some sites.

Suspended sediment monitoring

- The specific yield for the Wharekawa catchment is estimated to be 34 t/km^2/yr, based on samples taken both manually and from an automatic sediment sampler since 1991.
- Continued manual sediment sampling adds to the existing dataset.

Aquatic habitat

- The downstream temperature has been cooler on average than the upstream temperature for all of the monitored years. A longer monitoring period is required to identify a trend.
- Assessments of the invertebrates in Wharekawa River indicate that there is a moderate degradation in ecological health.

5.3 Other monitoring

An automatic sediment sampler is installed on the Opitinui River to monitor suspended sediment. Further details are in the Suspended Sediment Monitoring Report (Kotze et al., 2008).

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Appendix 1: Riparian characteristics summary

Mangatutu catchment – Waipa zone 2008/09

For each table the number in brackets is the percent change from the 2004/05 assessment, which was the first year the assessment was done.

Mangatutu erosion

Riparian **erosion** characteristics – Mangatutu (% of total bank length)									
Erosion	stable 78(+21)	unstable 22(-21)							
Fencing	nd	fenced 9(-6)				unfenced 13(-15)			
Vegetation		grass 3(-3)	willow woody veg. 4(+4)	other exotic woody veg. 2(-6)	native woody veg. 0(-<1)	grass 10(-4)	willow woody veg. 2(nc)	other exotic woody veg. 1(-11)	native woody veg. 0(-<1)

nd = not detailed

Mangatutu vegetation

Riparian **vegetation** characteristics –Mangatutu (% of total bank length)			
Grass 55(nc)	Woody vegetation 45(nc)		
	Exotic 44(nc)		Native 1(nc)
	Willow 22(+16)	Non-willow 22(-16)	

nc = no change

Mangatutu fencing

Riparian **fencing** characteristics - Mangatutu								
Fencing: % of stream length	**no fence on both sides** 14(-18)				**fenced on one side** 70(+24)		**fenced on both sides** 16(-6)	
Fencing: % of total bank length	**not fenced** 49(-6)				**fenced** 51(+6)			
Breakdown by vegetation	grass 32(-2)	willow woody veg. 7(+4)	other exotic woody veg. 9(-9)	native woody veg 1(+1)	grass 22(+1)	willow woody veg. 15(+11)	other exotic woody veg. 14(-5)	native woody veg. 0(-1)

Wharekawa catchment – Coromandel Zone 2008/09

For each table the number in brackets is the percent change from the 2006/07 assessment, which was the first year the assessment was done.

Wharekawa erosion

Riparian **erosion** characteristics – Wharekawa (% of total bank length)									
Erosion	stable 80(-10)	unstable 20(+10)							
Fencing	nd	fenced 7(+3)				unfenced 13(+7)			
Vegetation		grass 1(+1)	willow woody veg. 2(+2)	other exotic woody veg. 0	native woody veg. 4	grass 3(+2)	willow woody veg. 2(+1)	other exotic woody veg. 0	native woody veg. 8(+4)

nd = not detailed

Wharekawa vegetation

Riparian **vegetation** characteristics – Wharekawa (% of total bank length)			
Grass 11(+9)	Woody vegetation 89(-9)		
	Exotic 35(+3)		Native 54(-12)
	Willow 20(-4)	Non-willow 15(+7)	

Wharekawa fencing

Riparian **fencing** characteristics – Wharekawa								
Fencing: % of stream length	**no fence on both sides** 11(+11)				**fenced on one side** 52(-8)		**fenced on both sides** 37(-3)	
Fencing: % of total bank length	**not fenced** 37(+6)				**fenced** 63(-6)			
Breakdown by vegetation	grass 4(+2)	willow woody veg. 7(+2)	other exotic woody veg. 5(+3)	native woody veg 21(-1)	grass 6(+6)	willow woody veg. 13(-6)	other exotic woody veg. 11(+5)	native woody veg. 33(-11)