Channel morphology and sedimentation in the Waianakarua River

ISBN 1-877265-71-3

Published November 2008

Foreword

Understanding the channel morphology and sedimentation characteristics of Otago's rivers enables their effective management. Increasing growth throughout the Otago region has implications for management of river systems, primarily the extraction of gravel.

To help maintain the integrity of the region's gravel resources, the Otago Regional Council (ORC) undertakes scheduled cross-section surveys as part of the natural hazards programme. This information is utilised to understand the dynamic fluvial processes of each watercourse and general state of the gravel resource.

This report explores how the morphology and sedimentation of the Waianakarua River has changed over the surveyed periods, while providing a synthesis of the study's results to guide management strategies into the future.

Executive summary

A desktop analysis of channel morphology and sedimentation in surveyed reaches of the Waianakarua River has been undertaken using aerial photography, cross-section surveys and relevant documentation. This information can be used to support assessment of community vulnerability and river management.

The Waianakarua River has a catchment area of 255 km^2 and is located in North Otago. The river is divided into three branches (namely the North branch, Middle branch and South branch), and the North and South branches meet approximately 1 km downstream of the State Highway 1 bridges. Gravel extraction is carried out in both branches of the river and river management techniques have included channel re-alignment and willow planting where bank erosion has impacted on adjacent land.

Aerial photograph analysis of the Waianakarua River has revealed small changes to the position of the active channel over past decades and recent vegetation of river banks and gravel bars. Change in the mean bed level of the cross-section sites are both positive and negative and range from -0.25 to 0.45 m.

While gravel extraction and past flood events have notably contributed to both localised erosion and aggradation along the lower Waianakarua River, previous records and reports note an overall degrading river system with a supply-limited gravel resource. Further cross-section surveys will contribute to a better understanding of sedimentation and morphology changes in the Waianakarua River.

Table of contents

1. Introduction 1
2. Waianakarua River Catchment 2
    2.1 Geology 2
    2.2 Geomorphology 4
3. Cross-sections 8
    3.1 Cross-section WA1 10
    3.2 Cross-section WA2 11
    3.3 Cross-section WA3 12
    3.4 Cross-section WA4 13
    3.5 Cross-section WA5N 14
    3.6 Cross-section WA6N 15
    3.7 Cross-section WA7N 16
    3.8 Cross-section WA8N 17
    3.9 Cross-section WA5S 18
    3.10 Cross-section WA6S 19
    3.11 Cross-section WA7S 20
    3.12 Cross-section WA8S 21
    3.13 Cross-section WA9S 22
    3.14 Cross-section WA10S 23
    3.15 Cross-section WA11S 24
    3.16 Cross-section WA12S 25
    3.17 Cross-section WA13S 26
    3.18 Cross-section WA14S 27
    3.19 Cross-section WA15S 28
    3.20 Longitudinal profile 29
4. Conclusions 30
    4.1 Main branch cross-sections (WA1 to WA4) 30
    4.2 North branch cross-sections (WA5N to WA8N) 30
    4.3 South branch cross-sections (WA5S to WA15S) 30
5. References 31

List of figures

Figure 2.1 Waianakarua River Catchment locality map 3
Figure 2.2 Aerial photographs depicting the upper (A) and lower (B) catchments of the Waianakarua River. The dotted line in Figure B indicates terrace edges..... 4
Figure 2.3 Aerial images of the Waianakarua River-main branch in 1957, 1960, 1996 and 2005 6
Figure 2.4 Aerial images of the Waianakarua River-South branch in 1960, 1996 and 2005 7
Figure 2.5 Aerial images of the Waianakarua River-north branch in 1957, 1996 and 2005 7
Figure 3.1 Location of surveyed cross-sections for the Waianakarua River superimposed on 2005 aerial photograph 9
Figure 3.2 Cross-section WA1, looking downstream 10
Figure 3.3 Cross-section WA2, looking downstream 11
Figure 3.4 Cross-section WA3, looking downstream 12
Figure 3.5 Cross-section WA4, looking downstream 13
Figure 3.6 Cross-section WA5N, looking downstream 14
Figure 3.7 Cross-section WA6N, looking downstream 15
Figure 3.8 Cross-section WA7N, looking downstream 16
Figure 3.9 Cross-section WA8N, looking downstream 17
Figure 3.10 Cross-section WA5S, looking downstream 18
Figure 3.11 Cross-section WA6S, looking downstream 19
Figure 3.12 Cross-section WA7S, looking downstream 20
Figure 3.13 Cross-section WA8S, looking downstream 21
Figure 3.14 Cross-section WA9S, looking downstream 22
Figure 3.15 Cross-section WA10S, looking downstream 23
Figure 3.16 Cross-section WA11S, looking downstream 24
Figure 3.17 Cross-section WA12S, looking downstream 25
Figure 3.18 Cross-section WA13S, looking downstream 26
Figure 3.19 Cross-section WA14S, looking downstream 27
Figure 3.20 Cross-section WA15S, looking downstream 28
Figure 3.21 Longitudinal profile of the Waianakarua River using minimum bed level . 29

List of tables

Table 3.1 Mean bed level results for surveyed cross-sections of the Waianakarua River. (a) Denotes the full active channel width; (b) Denotes a channel width smaller than the active channel..... 8

1. Introduction

This document provides a background into morphological change and sedimentation in the Waianakarua River Catchment, North Otago. Aerial photography, cross-section analyses and anecdotal information is collated and interpreted, to provide a comprehensive review of change over surveyed periods. This information can be used to support assessment of community vulnerability and river management.

2. Waianakarua River Catchment

The Waianakarua River has a catchment area of 255km^2. The river is divided into three branches (namely the North branch, Middle branch and South branch), and the North and South branches meet approximately 1km downstream of the State Highway 1 bridges (Figure 2.1). The South branch (including Middle branch) has a catchment area of 114km^2 and rises to a height of 1,020m near Conical Peak about 21km from the coast. The North branch rises to about 1,550m at Siberia, about 31km from the coast, and contributes about 74% of the flow downstream of the confluence (Ministry of Works, 1975).

Vegetation types and land use vary between the upper and lower catchment. The upper-most part of the catchment is tussock scrub and native forest with rocky outcrops and deep incised valleys, with large pastoral farming lots on the flat ridge tops. Herbert State Forest is an exotic pine plantation and the North branch passes through this vegetation before it meets with the South branch of the river. The lower catchment is mainly pastoral land with some crop land over a series of flat river terraces. The boundary between the upper and lower catchment is here defined as the geological boundary between sedimentary and volcanic rock on the lower plains, and the metamorphic schist.

2.1 Geology

The upper catchment of the Waianakarua River comprises the Haast Schist group of both non- or poorly-foliated quartzofeldspathic schist with phyllite, marble and lesser chlorite schist (Ministry of Works, 1975). The lower catchment of the Waianakarua River comprises marine sandstone and mudstone (including concretions) of the Onekakara Group and lesser Deborah Volcanics. These become overlain by Quaternary glacial outwash fans of the little weathered greywacke schist gravels of the river terraces nearer the coast (Forsyth, 2001; Ministry of Works, 1975).

The Onekakara Group rock has wide lithological variation and therefore also has a wide range of strength properties; the Onekakara Group mudstones are very prone to slumping (Forsyth, 2001). Schist is likely the predominant source of fluvial gravel.

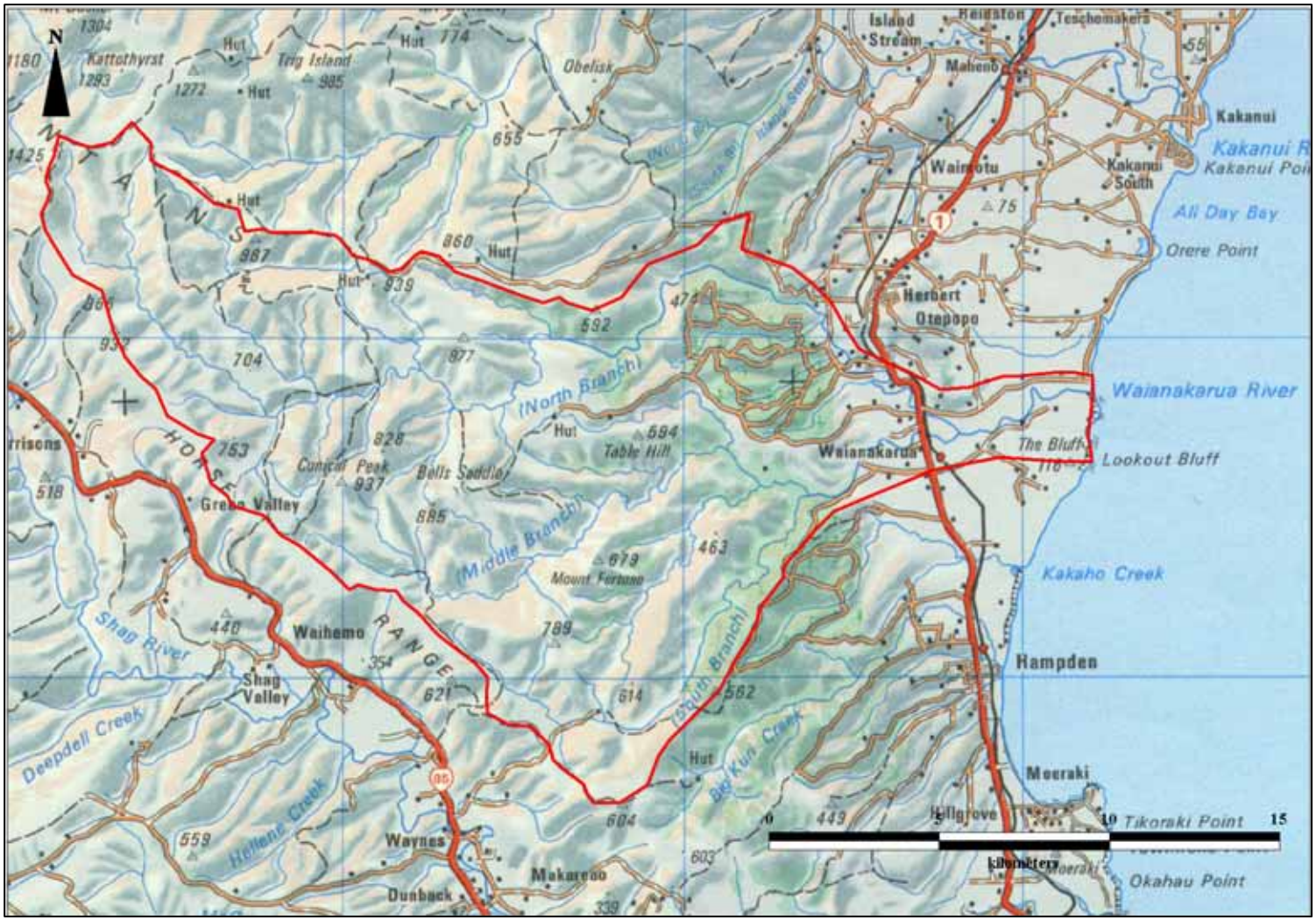

Figure 2.1 Waianakarua River Catchment locality map

2.2 Geomorphology

The Waianakarua River Catchment is bound by the Horse Range along the south-west. The Shag River Catchment is south of the Waianakarua River Catchment and the Kakanui River Catchment is north. The upper catchment is relatively steep with incised valleys and a confined meandering channel cutting into the schist bedrock (Figure 2.2A). The river bed here is partly exposed bedrock and partly graveled (Swabey and Lojkine, 2004). In the lower catchment the active channel becomes partially braided in localised areas, but is predominantly confined to one channel which can shift over time and with flood events (Figure 2.2B).

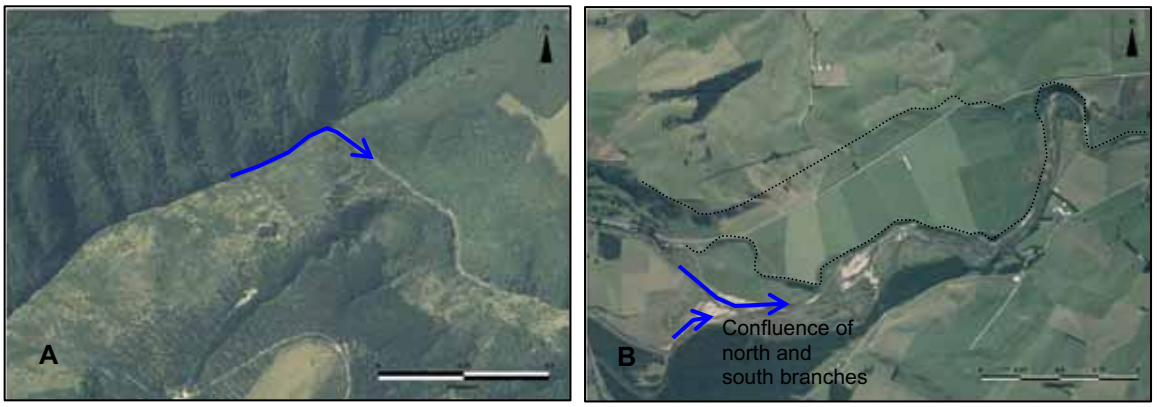

Figure 2.2 Aerial photographs depicting the upper (A) and lower (B) catchments of the Waianakarua River. The dotted line in Figure B indicates terrace edges

Weathering and mass movement in the upper catchment will shift schist sediment into the river system; numerous scarps are notable on recent and historic aerial photography. Forested areas appear to have less outcrops and erosion scarps suggesting that sediment supply through weathering and mass movement comes from the upper-most part of the catchment where tussock scrub exists. Bank erosion will also account for some sediment input, however, estimated volumes of both of these sediment sources are not known.

The lower catchment is incised in an elevated gravel floodplain through the reaches that experience most gravel extraction. The gravel cliffs are up to 15m high and therefore can provide significant gravel to the channel. The main gravel bars that continue to build up, and which have been extracted from include:
a) Sharps Bend.
b) Upstream of Graves Dam on the North branch.
c) A 1 km section on the South branch upstream of the southern SH1 bridge.
d) The confluence of the North and South branches.
e) On the main branch approximately 1km downstream from the confluence.
Refer to Figure 3.1 for these locations.

In places, the river has been realigned in its bed for management purposes to reduce scouring and erosion where necessary, predominantly in the lower catchment. Bank erosion and slips have occurred and have needed stabilisation through reshaping the channel and directing flow away from the banks, armouring the toe of slips with rock rip rap and willow plantings. Consent for gravel extraction was heavily reduced by ORC in 2004 as the river was deemed to have limited gravel supply and was, at the time, being over-extracted (Swabey and Lojkine, 2004).

Aerial photography is used to indicate changes in the river form over time. On the main branch (from the river mouth upstream to the confluence of the North and South branches) the active channel has stayed within the confines of its banks (Figure 2.2). The 2005 aerial photograph shows that the active channel has become more vegetated and potentially reduced in width compared to the 1960 and 1996 aerial photographs.

On the South branch of the river (Figure 2.3), the active channel has changed course since the 1960 photograph. Paleochannels are visible in the 1960 photograph across the entire terrace and, by 1996, this area was well established as pastoral land with grass and scrub. As with the main branch, the active channel has become more vegetated, compared to the situation in 1960 and 1996.

On the North branch of the river (Figure 2.4), around Sharps Bend, the active channel has widened since 1960, but still remains a braided channel. The active channel has also become more vegetated compared to 1996, similarly to the main branch and the North branch.

Figure 2.3 Aerial images of the Waianakarua River-main branch in 1957, 1960, 1996 and 2005

Figure 2.4 Aerial images of the Waianakarua River-South branch in 1960, 1996 and 2005

Figure 2.5 Aerial images of the Waianakarua River-North branch in 1957, 1996 and 2005

3. Cross-sections

ORC undertakes scheduled cross-section surveys for selected rivers every year. The cross-section programme enables changes in river morphology to be monitored and supports assessments of potential effects on communities.

Nineteen cross-section locations have been surveyed on the Waianakarua River (Figure 3.1), firstly in 2004 and again in 2008. Four cross-sections are located on the main branch of the river, four cross-sections are located on the North branch in the vicinity of the quarry and the remaining 11 cross-sections are located on the South branch.

The mean bed level of the active channel in each cross-section was calculated using the X-Sect cross-section database. The database compiles a list of widths and their associated elevations for each cross-section and survey period. X-Sect calculates all output information (minimum, maximum and mean bed levels) from the respective widths and elevations. Table 3.1 shows each year surveyed and the respective mean bed level calculation for each cross-section. Some historical surveys only include part of the active channel. In this instance, mean bed levels have been calculated over these distances but are not directly comparable to the wider active channel results.

Table 3.1 Mean bed level results for surveyed cross-sections of the Waianakarua River. (a) Denotes the full active channel width; (b) Denotes a channel width smaller than the active channel

Branch	X-section	Width (m)	Mean bed level (m)		
			Jun-04	Feb-08	Net change
Main branch	WA1	108.56	106.49	106.61	0.12
	WA2	86.53	111.02	110.90	-0.12
	WA3	175.08	112.14	112.43	0.29
	WA4	70.47	112.44	112.19	-0.25
North branch	WA5N	192.90	132.84	132.78	-0.05
	WA6N	296.17	134.18	134.33	0.15
	WA7N	146.51	135.32	135.29	-0.03
	WA8N	29.44	135.64	135.44	-0.21
South branch	WA5S	38.31	120.68	120.46	-0.22
	WA6S	54.54	121.86	121.95	0.09
	WA7S-a	79.44	123.64	123.51	-0.13
	WA7S-b	72.07	123.30	123.33	0.03
	WA8S	66.32	123.84	124.04	0.20
	WA9S	62.54	124.69	124.45	-0.23
	WA10S-a	54.89	125.45	125.25	-0.20
	WA10S-b	13.03	124.66	124.52	-0.13
	WA11S	47.05	126.15	126.29	0.15
	WA12S	45.13	126.48	126.58	0.10
	WA13S-a	45.22	127.81	127.70	-0.11
	WA13S-b	40.21	127.29	127.31	0.01
	WA14S	164.97	128.97	129.01	0.04
	WA15S	48.86	129.07	129.52	0.45

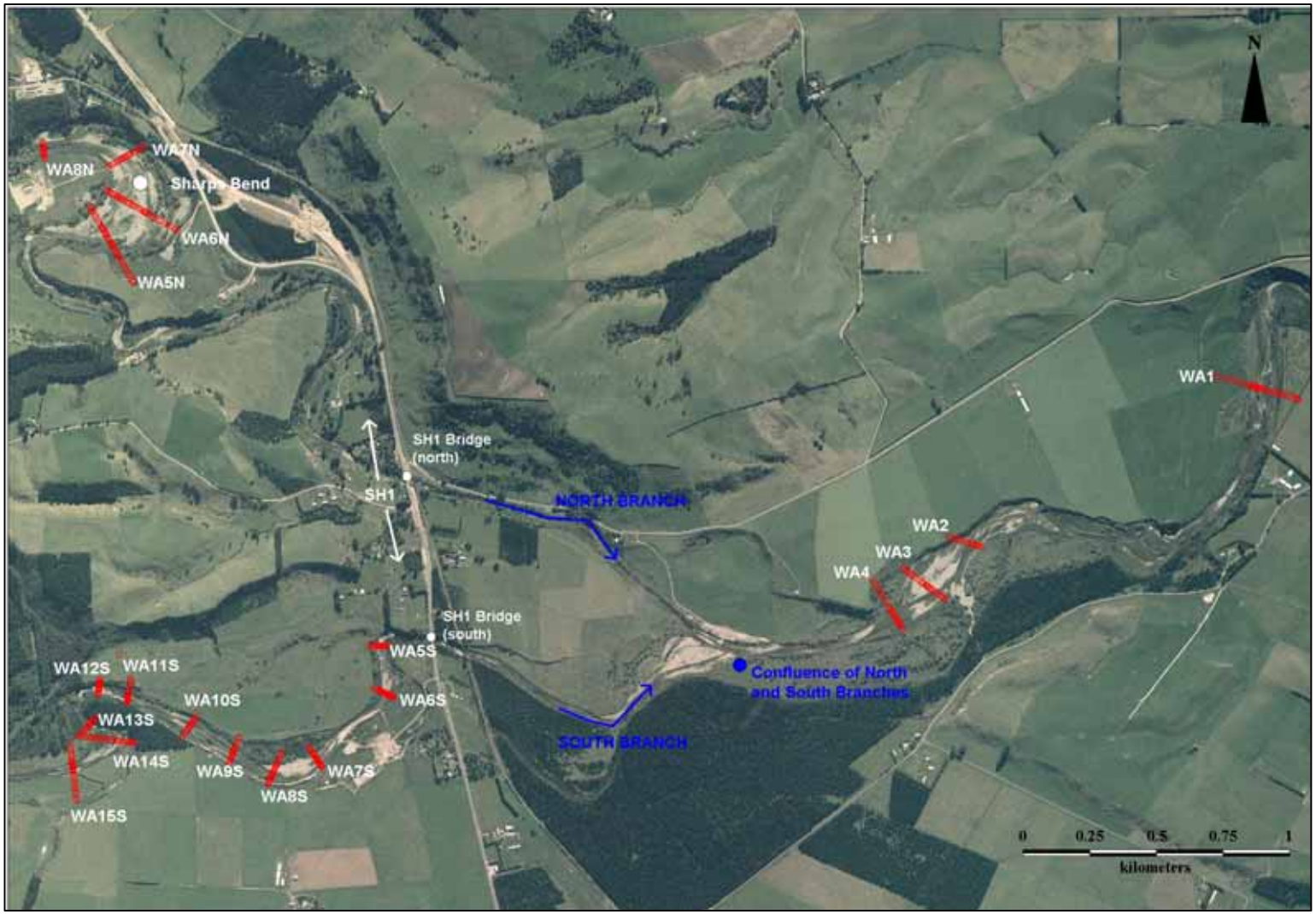

Figure 3.1 Location of surveyed cross-sections for the Waianakarua River superimposed on 2005 aerial photograph

3.1 Cross-section WA1

Cross-section WA1 is located approximately 2.65km upstream of the Waianakarua River mouth. Figure 3.2 shows a plot of cross-section WA1 for the 2004 and 2008 surveys.

The active channel is located in the middle of the cross-section and has a width of 109m. Mean bed level analysis shows that the active channel of this location has experienced net aggradation of 0.12m. The main channel of flow has deepened and shifted toward the true left since 2004, but for the rest of the active channel there have been localised areas of gravel build-up.

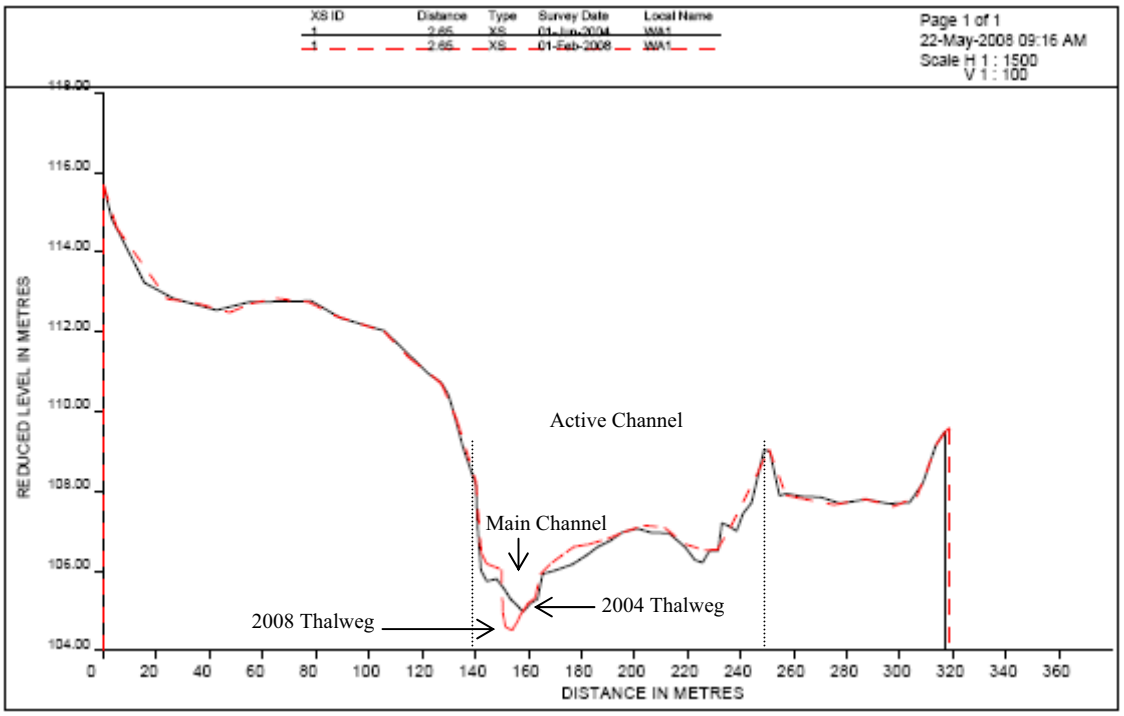

Figure 3.2 Cross-section WA1, looking downstream

3.2 Cross-section WA2

Cross-section WA2 is located approximately 4.35km upstream of the Waianakarua River mouth. Figure 3.3 shows a plot of cross-section WA2 for the 2004 and 2008 surveys.

The active channel is located in the middle of the cross-section and has a width of 87m. Mean bed level analysis shows that the active channel of this location has experienced net degradation of 0.12m. The most significant change at this location is the erosion of the true right bank by greater than 20m. Gravel build-up has occurred over the true left half of the active channel but the bank erosion on the true right has led to overall degradation of the mean bed level.

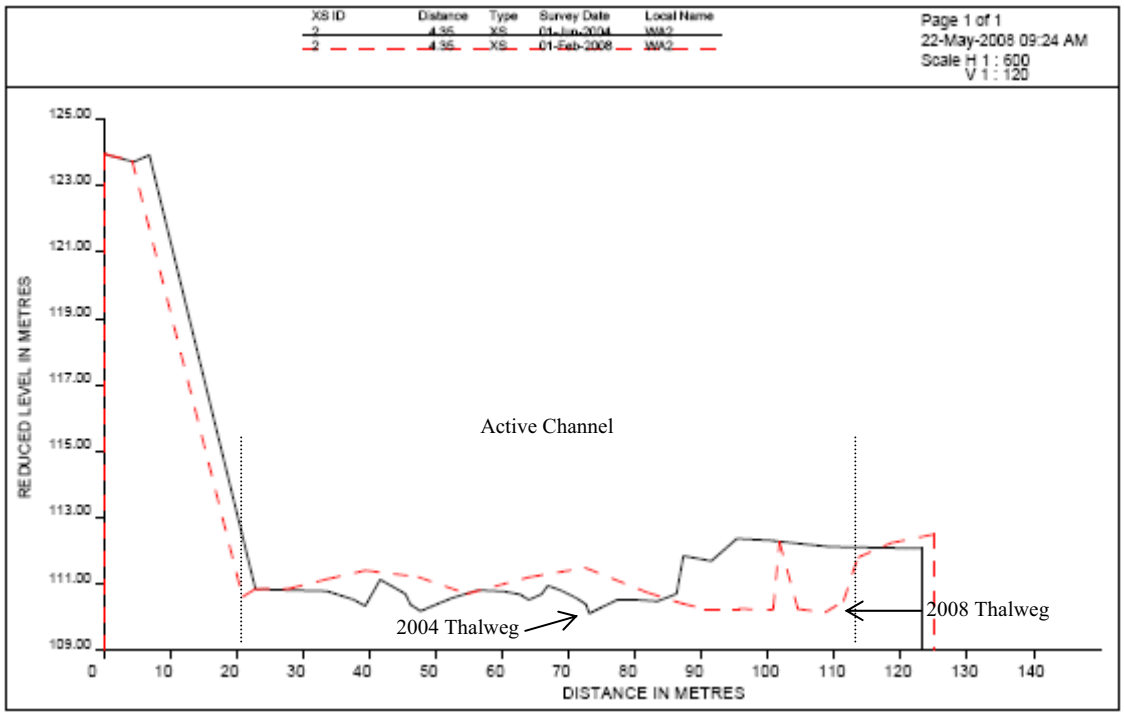

Figure 3.3 Cross-section WA2, looking downstream

3.3 Cross-section WA3

Cross-section WA3 is located approximately 4.60km upstream of the Waianakarua River mouth. Figure 3.4 shows a plot of cross-section WA3 for the 2004 and 2008 surveys.

The active channel is located in the middle of the cross-section and has a width of 175m. Mean bed level analysis shows that the active channel of this location has experienced net aggradation of 0.29m. Gravel build-up has occurred over the majority of the active channel, particularly on the true right half. The deepest part of the channel has shifted further to the true right, however, at the time of surveying, the main flow path was further to the true left than the 2004 thalweg.

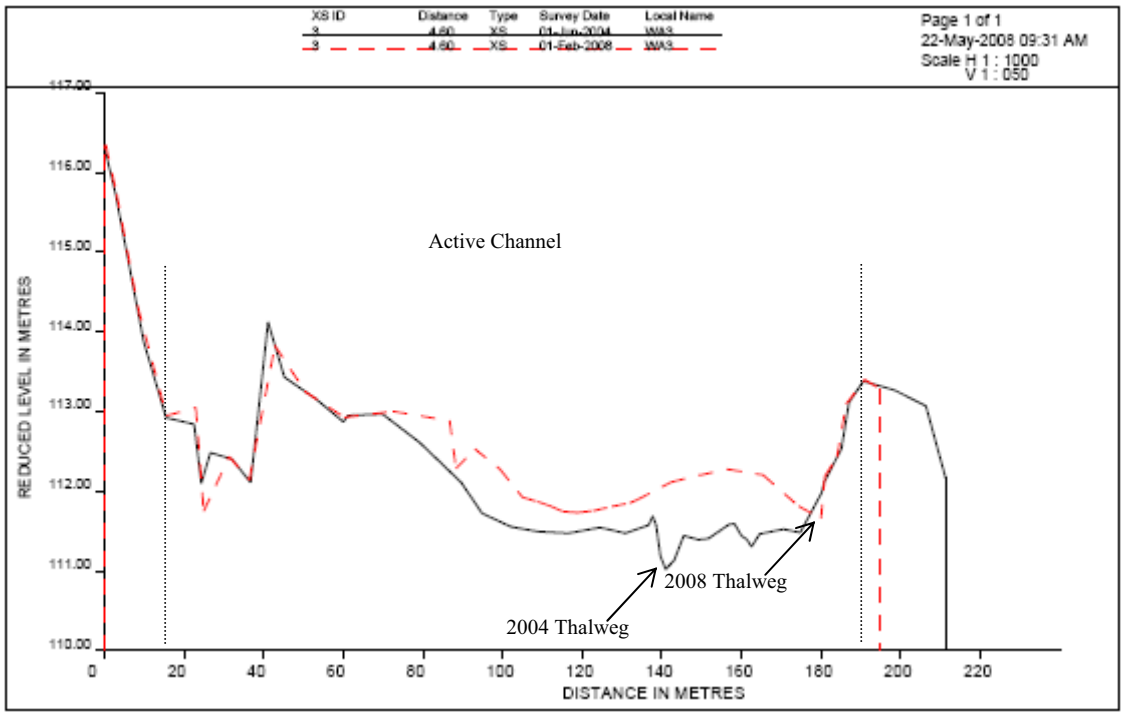

Figure 3.4 Cross-section WA3, looking downstream

3.4 Cross-section WA4

Cross-section WA4 is located approximately 4.79km upstream of the Waianakarua River mouth. Figure 3.5 shows a plot of cross-section WA4 for the 2004 and 2008 surveys.

The active channel is located on the true right of the cross-section and has a width of 70m. Mean bed level analysis shows that the active channel of this location has experienced net degradation of 0.25m with an overall lowering of the active channel.

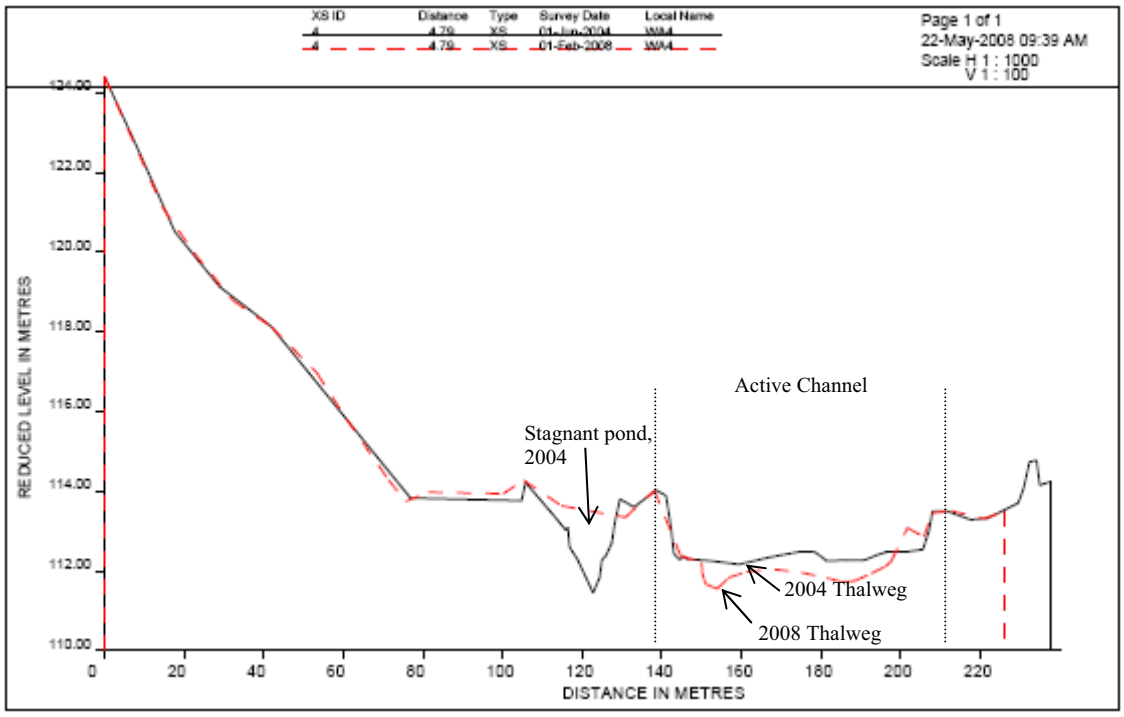

Figure 3.5 Cross-section WA4, looking downstream

3.5 Cross-section WA5N

Cross-section WA5N is located approximately 9.60km upstream of the Waianakarua River mouth. Figure 3.6 shows a plot of cross-section WA5N for the 2004 and 2008 surveys.

The active channel is 193m wide and extends to the true right of the cross-section. Mean bed level analysis shows that the active channel of this location has experienced net degradation of 0.05m.

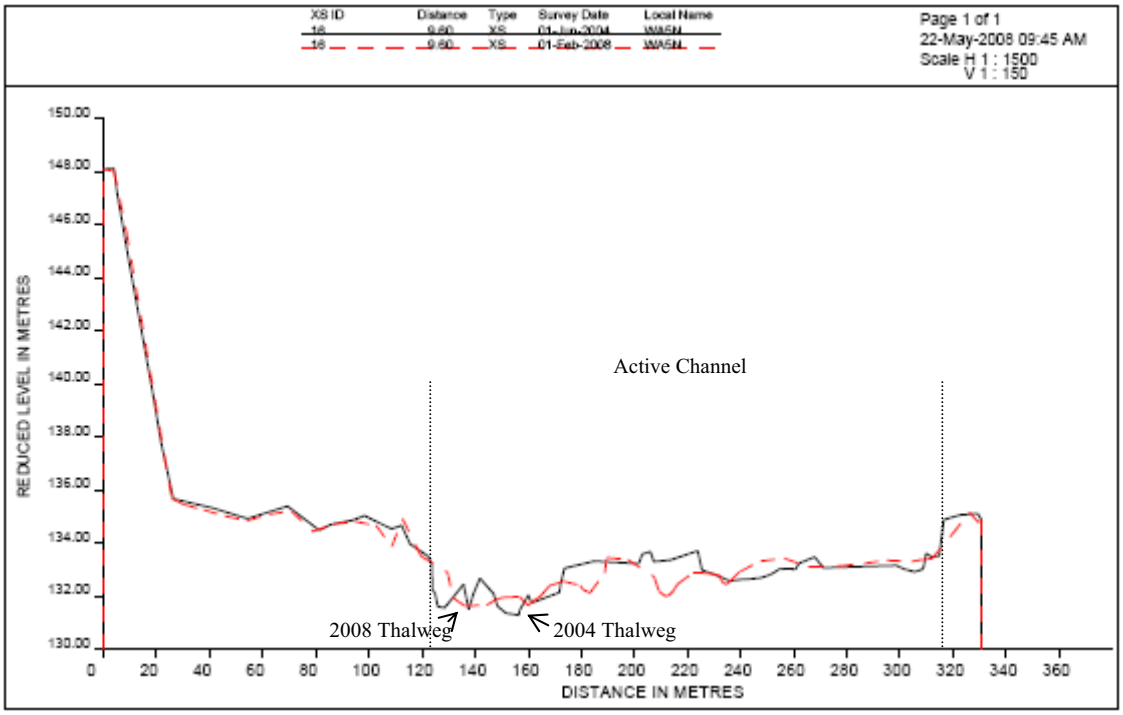

Figure 3.6 Cross-section WA5N, looking downstream

3.6 Cross-section WA6N

Cross-section WA6N is located approximately 9.75km upstream of the Waianakarua River mouth. Figure 3.7 shows a plot of cross-section WA6N for the 2004 and 2008 surveys.

The active channel is 296m wide and extends across the majority of the cross-section. Mean bed level analysis shows that the active channel of this location has experienced net aggradation of 0.15m.

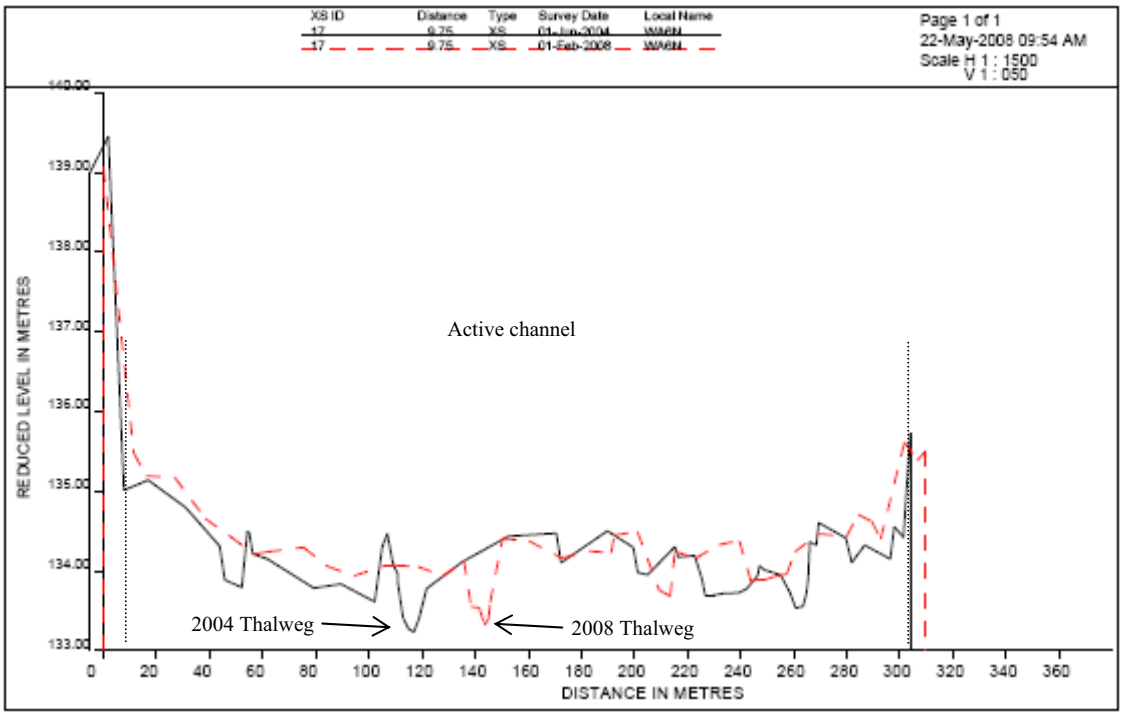

Figure 3.7 Cross-section WA6N, looking downstream

3.7 Cross-section WA7N

Cross-section WA7N is located approximately 9.90km upstream of the Waianakarua River mouth. Figure 3.8 shows a plot of cross-section WA7N for the 2004 and 2008 surveys.

The active channel extends across the majority of the cross-section and has a width of 147m. The 2004 survey extends a further 516m to the true right across paddocks of inner Sharps Bend; this survey data is not required for the purposes of this report. Mean bed level analysis shows that the active channel of this location has experienced net degradation of 0.03m, including bank erosion on the true right.

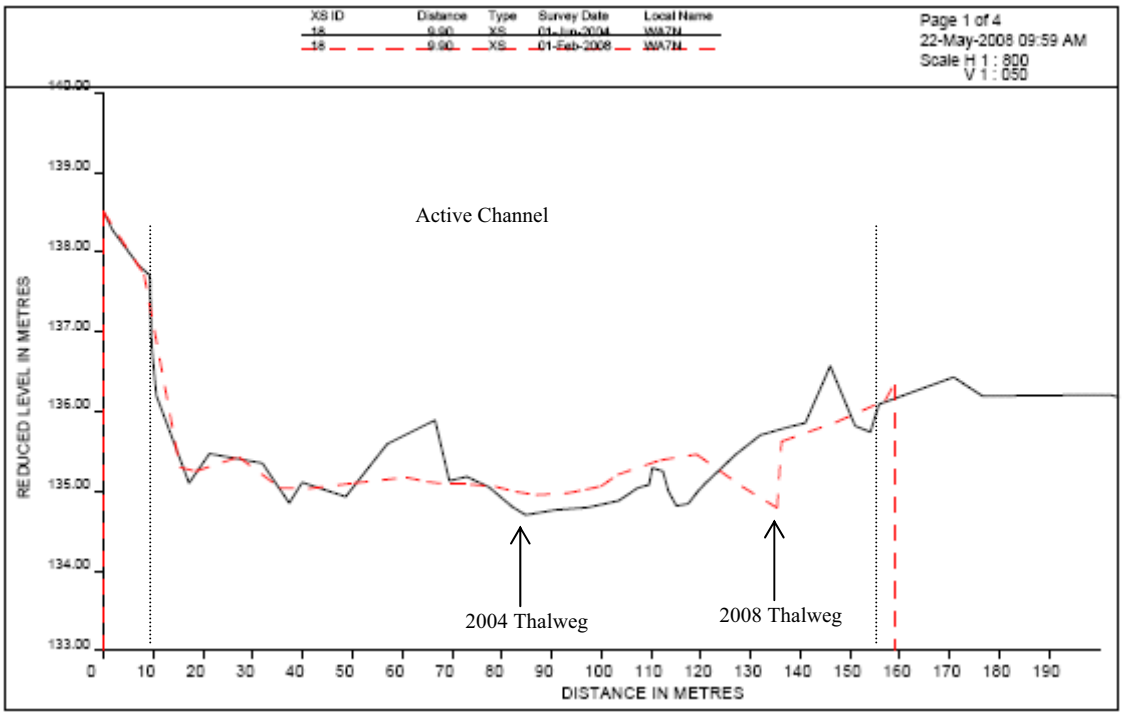

Figure 3.8 Cross-section WA7N, looking downstream

3.8 Cross-section WA8N

Cross-section WA8N is located approximately 10.25km upstream of the Waianakarua River mouth. Figure 3.9 shows a plot of cross-section WA8N for the 2004 and 2008 surveys.

The active channel extends across the middle of the cross-section and has a width of 29m. The 2004 survey extends a total of 274m to the true left and true right, predominantly across the paddocks of inner Sharps Bend; this survey data is not required for the purposes of this report. Mean bed level analysis shows that the active channel of this location has experienced net degradation of 0.21m. The bed level has lowered to the true right of the channel with bank erosion on the true right as well.

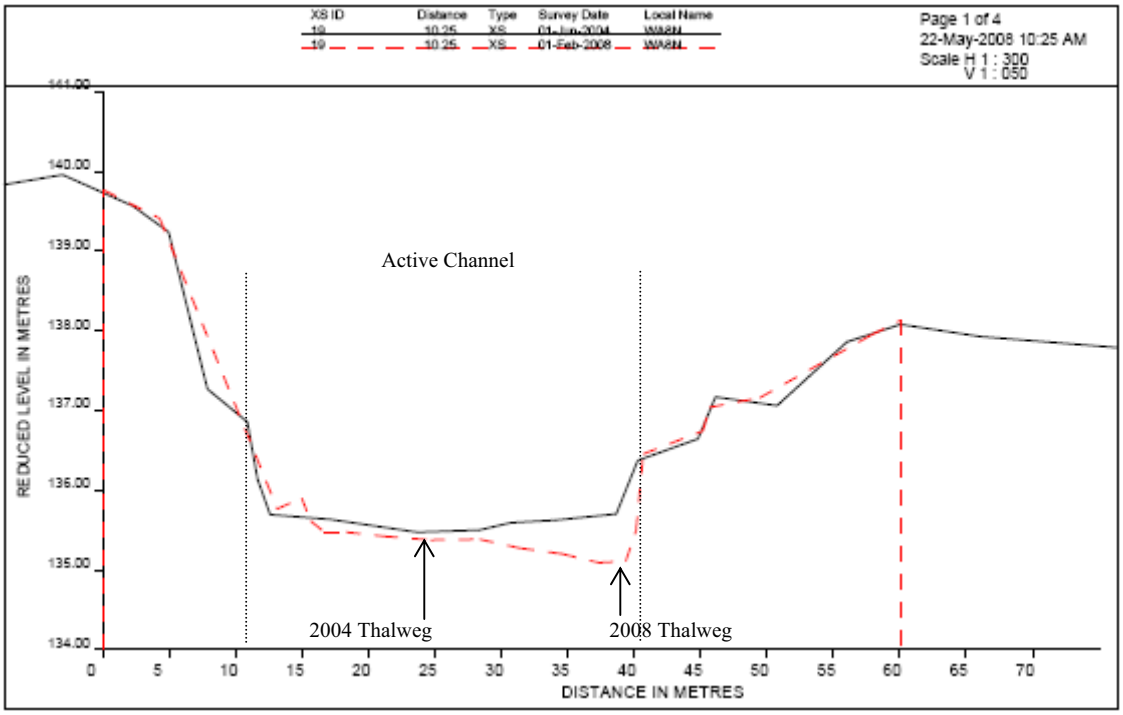

Figure 3.9 Cross-section WA8N, looking downstream

3.9 Cross-section WA5S

Cross-section WA5S is located approximately 6.85km upstream of the Waianakarua River mouth. Figure 3.10 shows a plot of cross-section WA5S for the 2004 and 2008 surveys.

The active channel extends across the middle of the cross-section and has a width of 38m. Mean bed level analysis shows that the active channel of this location has experienced net degradation of 0.22m. Erosion has been concentrated on both the true right and true left banks.

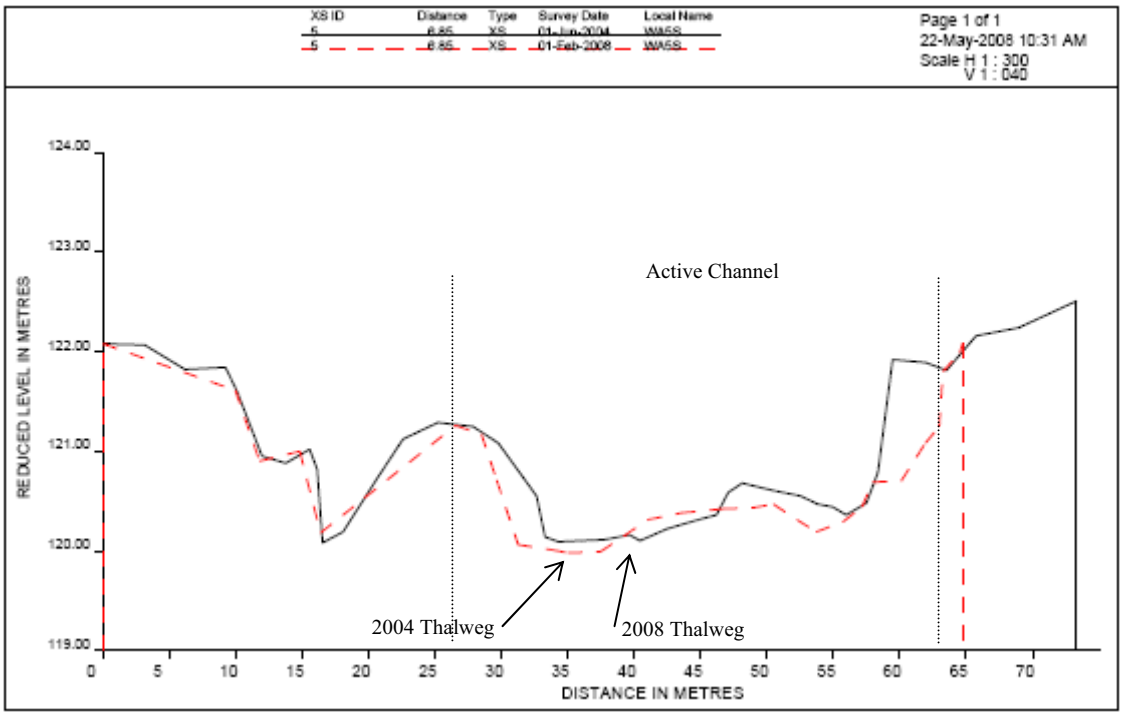

Figure 3.10 Cross-section WA5S, looking downstream

3.10 Cross-section WA6S

Cross-section WA6S is located approximately 7.07km upstream of the Waianakarua River mouth. Figure 3.11 shows a plot of cross-section WA6S for the 2004 and 2008 surveys.

The active channel extends across the middle of the cross-section and has a width of 55m. The 2004 survey extends a further 165m to the true right into paddocks; this survey data is not required for the purposes of this report. Mean bed level analysis shows that the active channel of this location has experienced net aggradation of 0.09m. Gravel has built-up on the true left half of the active channel, and the bed level has lowered slightly on the true right half of the active channel.

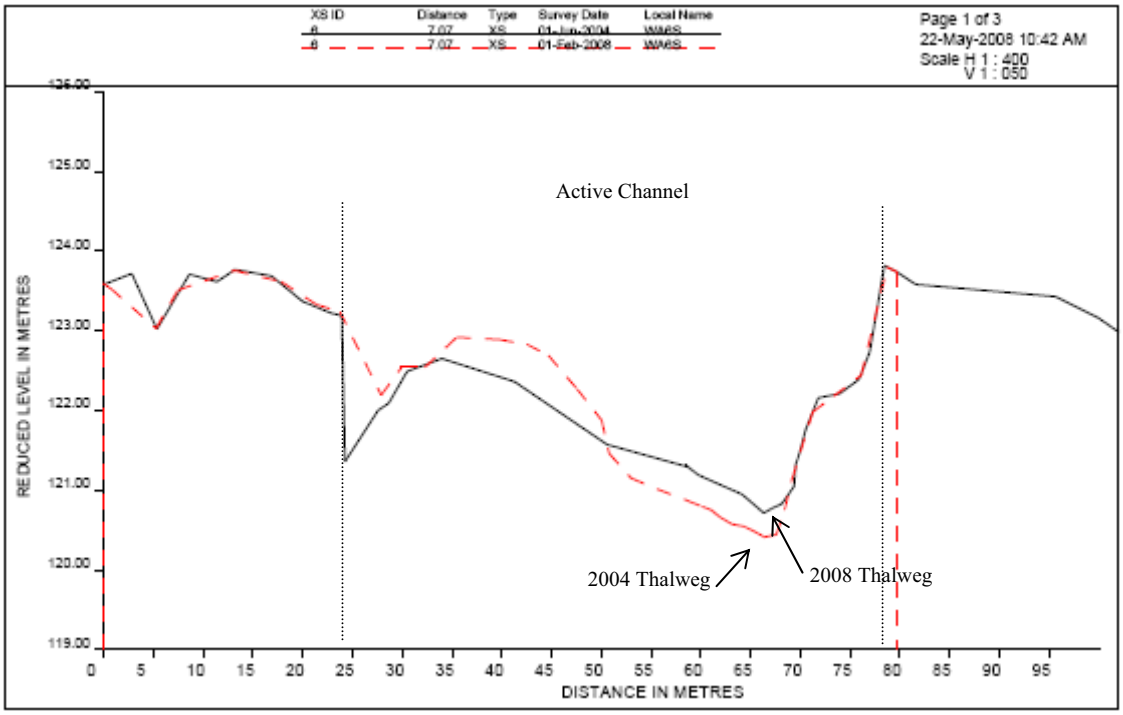

Figure 3.11 Cross-section WA6S, looking downstream

3.11 Cross-section WA7S

Cross-section WA7S is located approximately 7.46km upstream of the Waianakarua River mouth. Figure 3.12 shows a plot of cross-section WA7S for the 2004 and 2008 surveys.

The active channel extends across the majority of the cross-section and has a width of 79m. The 2004 survey extends a further 55m to the true left into vegetation; this survey data is not required for the purposes of this report. Mean bed level analysis shows that the active channel of this location has experienced net degradation of 0.13m. The most significant change at this location has been erosion of the true right bank. This cross-section is located just before a bend in the river and a gravel bed; the channel is pushed by this bed to the true right of the river thereby inducing continual scour of this bank.

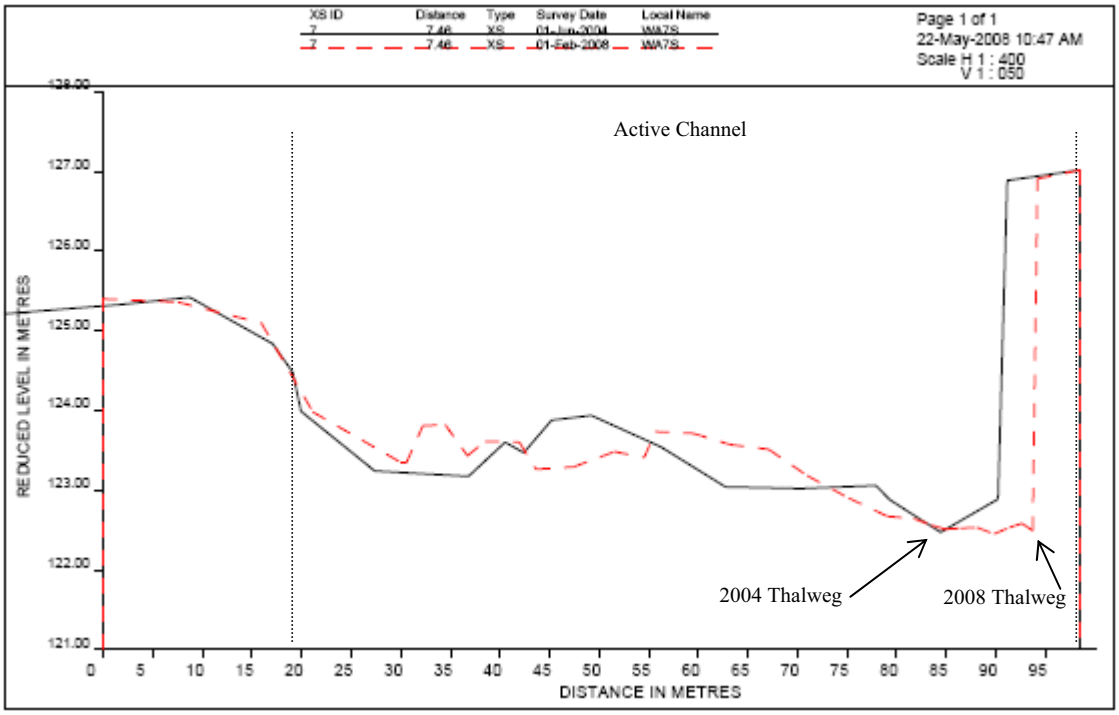

Figure 3.12 Cross-section WA7S, looking downstream

3.12 Cross-section WA8S

Cross-section WA8S is located approximately 7.70km upstream of the Waianakarua River mouth. Figure 3.13 shows a plot of cross-section WA8S for the 2004 and 2008 surveys.

The active channel is located in the middle of the cross-section and has a width of 66m. The 2004 survey extends a further 65m to the true left into vegetation; this survey data is not required for the purposes of this report. Mean bed level analysis shows that the active channel of this location has experienced net aggradation of 0.20m. The bed level at the main flow path has lowered, but gravel build-up has occurred across the active channel toward the true left.

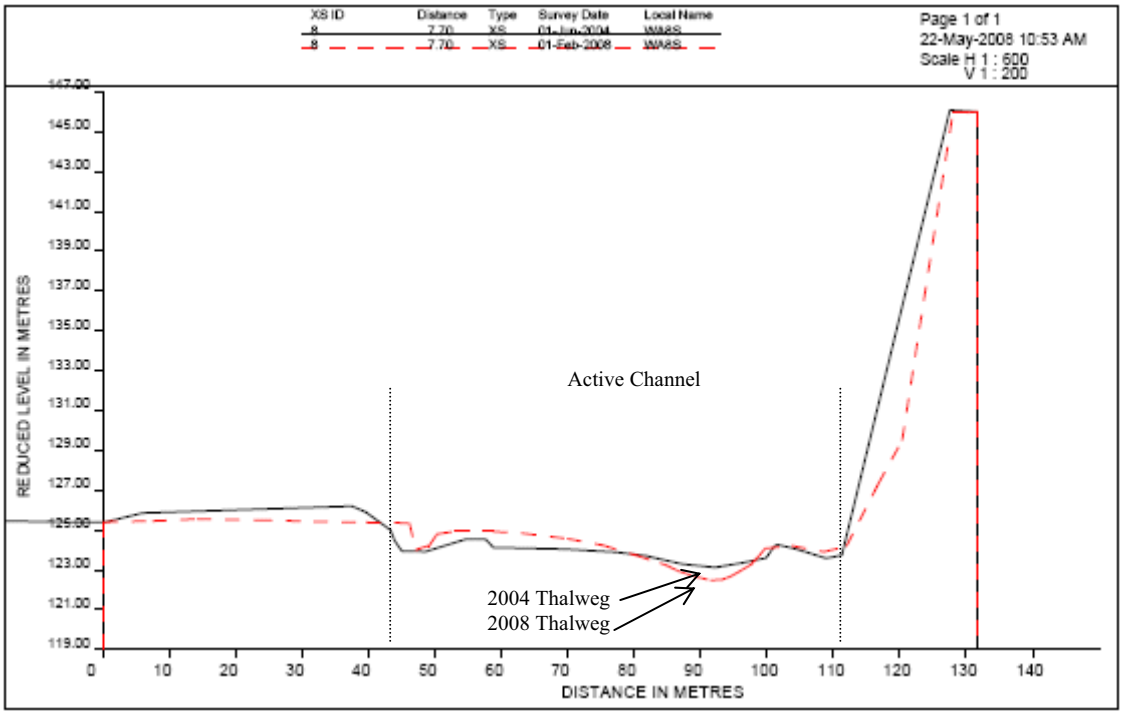

Figure 3.13 Cross-section WA8S, looking downstream

3.13 Cross-section WA9S

Cross-section WA9S is located approximately 7.85km upstream of the Waianakarua River mouth. Figure 3.14 shows a plot of cross-section WA9S for the 2004 and 2008 surveys.

The active channel is located in the middle of the cross-section and has a width of 63m. The 2004 survey extends a further 372 m to the true left across an entire terrace top; this survey data is not required for the purposes of this report. Mean bed level analysis shows that the active channel of this location has experienced net degradation of 0.23m. The true left bank has degraded and the main flow path has shifted toward the true left. Aerial photographs suggest this true left side has become more vegetated.

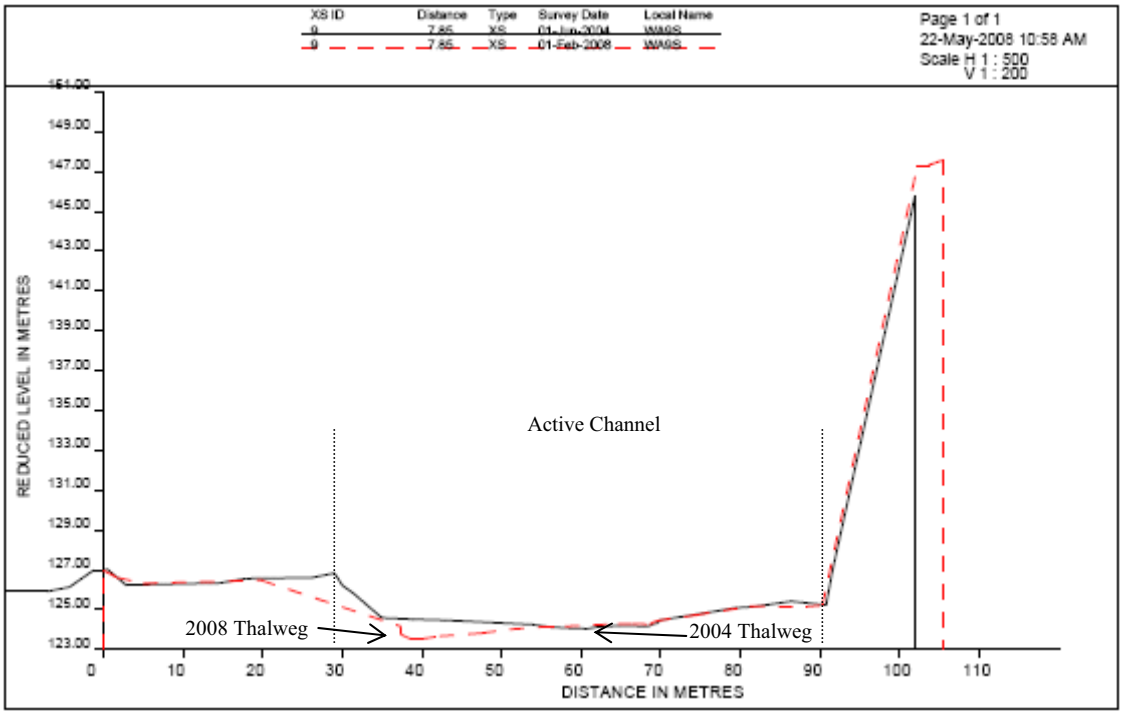

Figure 3.14 Cross-section WA9S, looking downstream

3.14 Cross-section WA10S

Cross-section WA10S is located approximately 9.85km upstream of the Waianakarua River mouth. Figure 3.15 shows a plot of cross-section WA10S for the 2004 and 2008 surveys.

The active channel is located to the true left of the cross-section and has a width of 55m. The 2004 survey extends a further 172m to the true left across paddocks; this survey data is not required for the purposes of this report. Mean bed level analysis shows that the active channel of this location has experienced net degradation of 0.20m. The bed level of the main flow path has lowered slightly (near the centre of the active channel) and bank erosion has occurred on the true right.

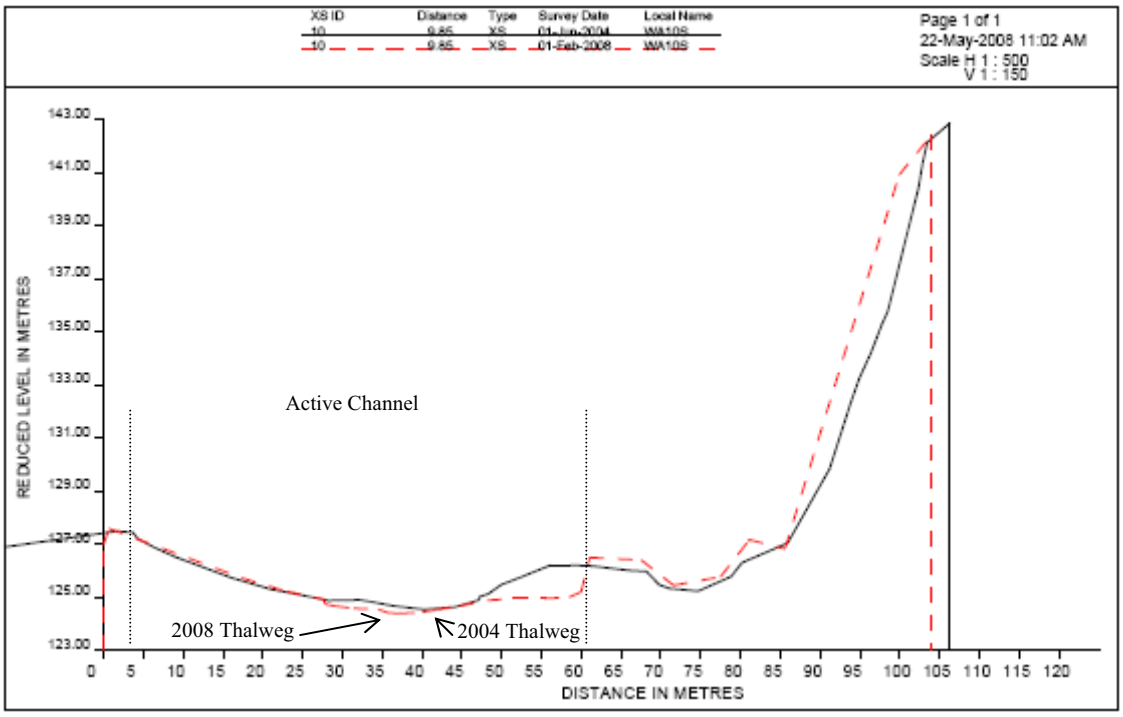

Figure 3.15 Cross-section WA10S, looking downstream

3.15 Cross-section WA11S

Cross-section WA11S is located approximately 10.10km upstream of the Waianakarua River mouth. Figure 3.16 shows a plot of cross-section WA11S for the 2004 and 2008 surveys.

The active channel is located in the middle of the cross-section and has a width of 47m. Mean bed level analysis shows that the active channel of this location has experienced net aggradation of 0.15m. Gravel build-up and bank accretion has occurred on the true right, seemingly pushing the main flow path toward the true left as indicated by the location of the thalweg.

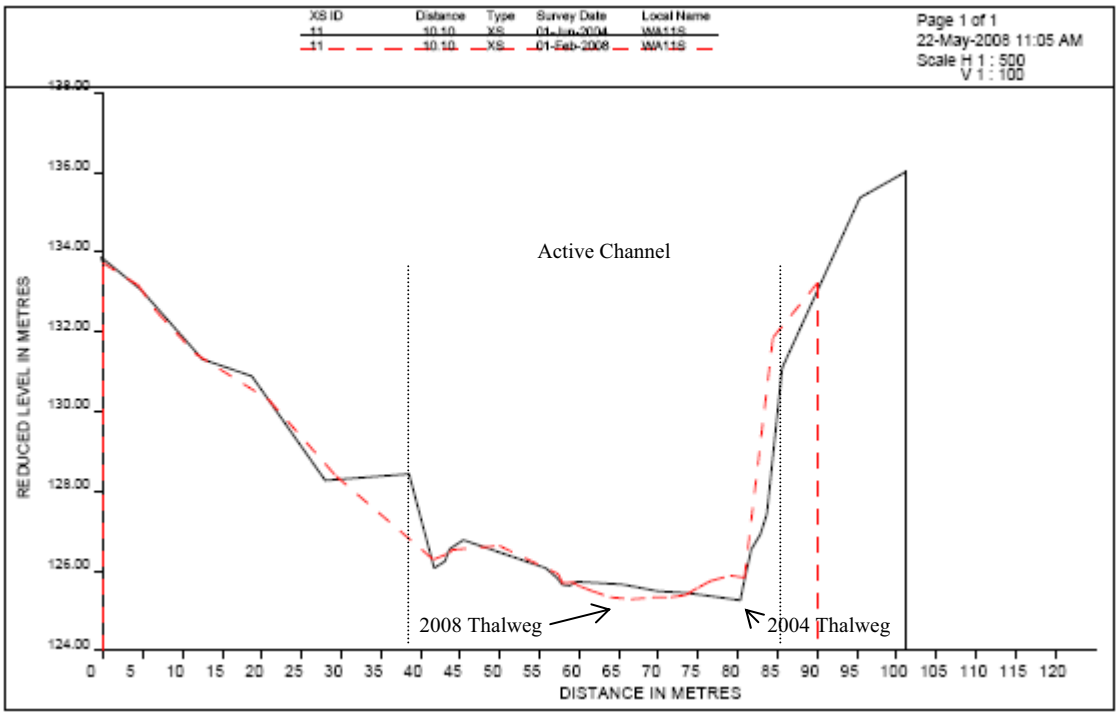

Figure 3.16 Cross-section WA11S, looking downstream

3.16 Cross-section WA12S

Cross-section WA12S is located approximately 10.40km upstream of the Waianakarua River mouth. Figure 3.17 shows a plot of cross-section WA12S for the 2004 and 2008 surveys.

The active channel is located in the middle of the cross-section and has a width of 45m. The 2004 survey extends a further 13m to the true left into paddocks; this survey data is not required for the purposes of this report. Mean bed level analysis shows that the active channel of this location has experienced net aggradation of 0.10m. The true left bank appears to have stabilised (slope angle has reduced toward equilibrium) and the main flow path has established itself further toward the true left. Gravel build-up has occurred to a small degree across the middle of the active channel.

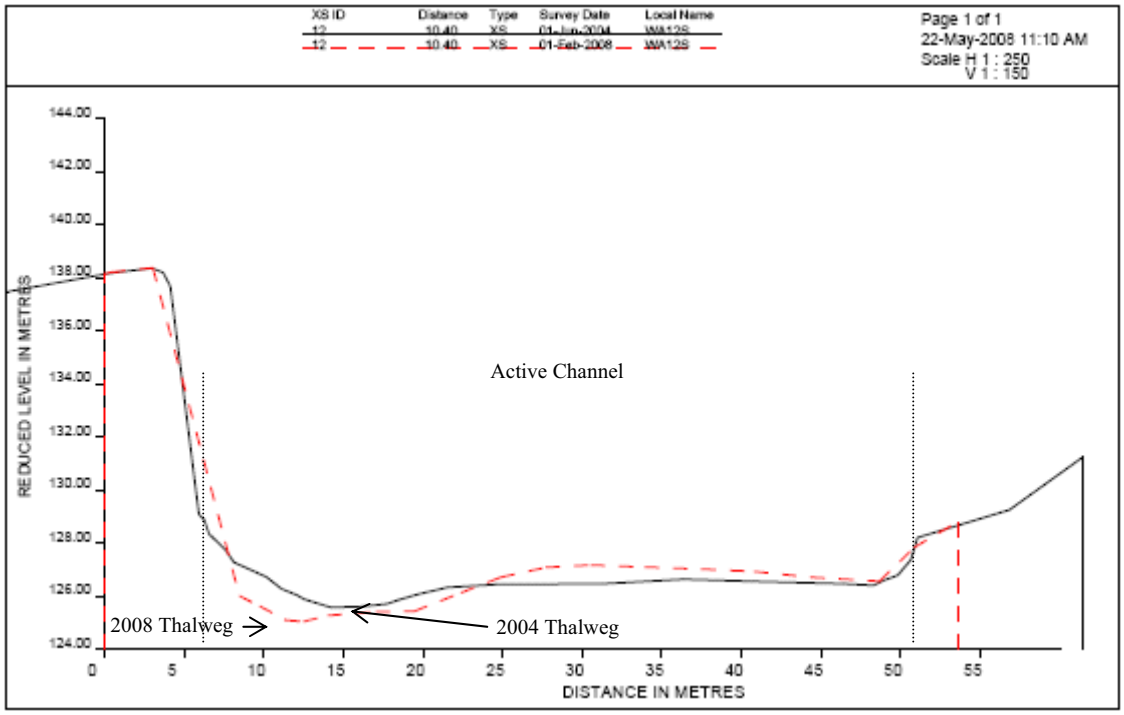

Figure 3.17 Cross-section WA12S, looking downstream

3.17 Cross-section WA13S

Cross-section WA13S is located approximately 10.70km upstream of the Waianakarua River mouth. Figure 3.18 shows a plot of cross-section WA13S for the 2004 and 2008 surveys.

The active channel is located toward the true right of the cross-section and has a width of 45m. Mean bed level analysis shows that the active channel of this location has experienced net degradation of 0.11m. The lowering of the mean bed level appears to be the result of bank erosion or stabilisation on the true right and the true left.

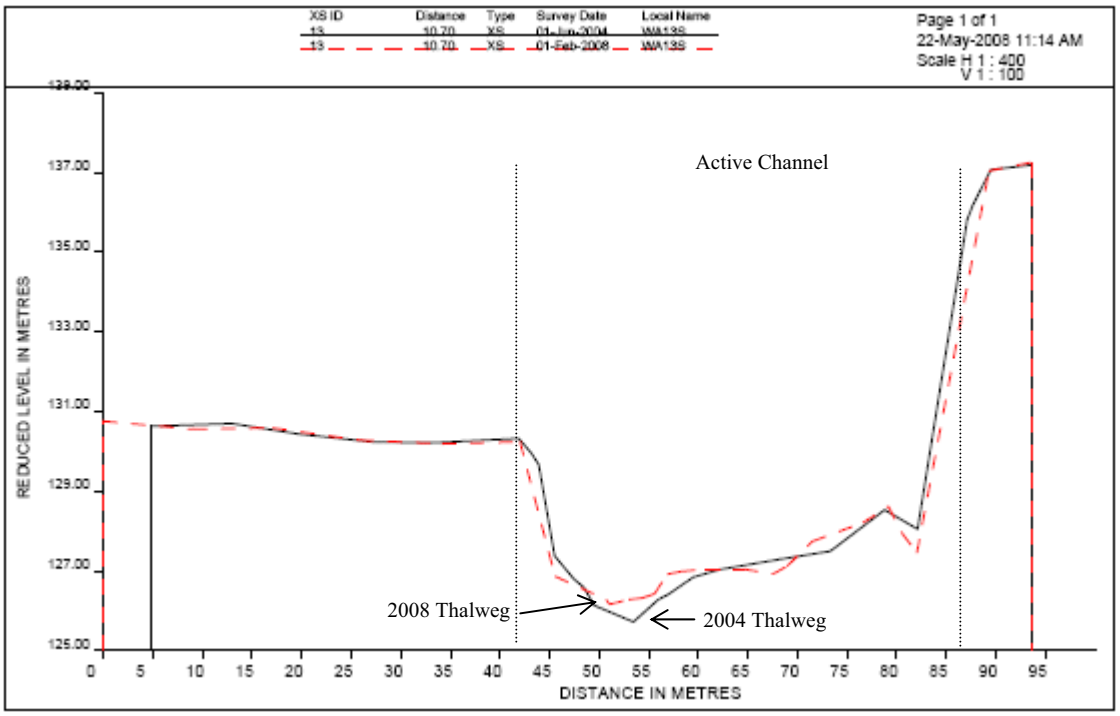

Figure 3.18 Cross-section WA13S, looking downstream

3.18 Cross-section WA14S

Cross-section WA14S is located approximately 10.90 km upstream of the Waianakarua River mouth. Figure 3.19 shows a plot of cross-section WA14S for the 2004 and 2008 surveys.

The active channel is located toward the true right of the cross-section and has a width of 165m. Mean bed level analysis shows that the active channel of this location has experienced net aggradation of 0.04m. The most notable change in this location is bank erosion on the true right. The thalweg has also shifted toward the true right suggesting that the main flow path is cutting into this side of the river. The net aggradation is accounted for by slight gravel build-up toward the true left of the active channel.

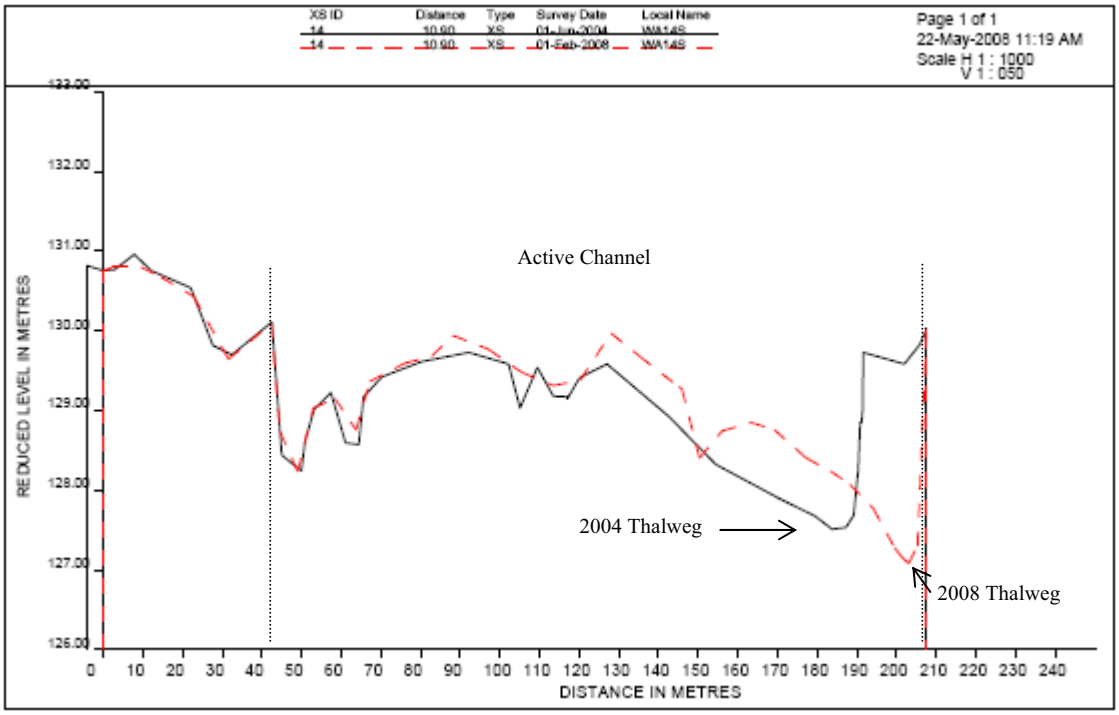

Figure 3.19 Cross-section WA14S, looking downstream

3.19 Cross-section WA15S

Cross-section WA15S is located approximately 11.10km upstream of the Waianakarua River mouth. Figure 3.20 shows a plot of cross-section WA15S for the 2004 and 2008 surveys.

The active channel is located in the middle of the cross-section and has a width of 49m. Mean bed level analysis shows that the active channel of this location has experienced net aggradation of 0.45m. Gravel build-up has occurred to a small degree across the extent of the active channel and most notably on the true right bank of the river.

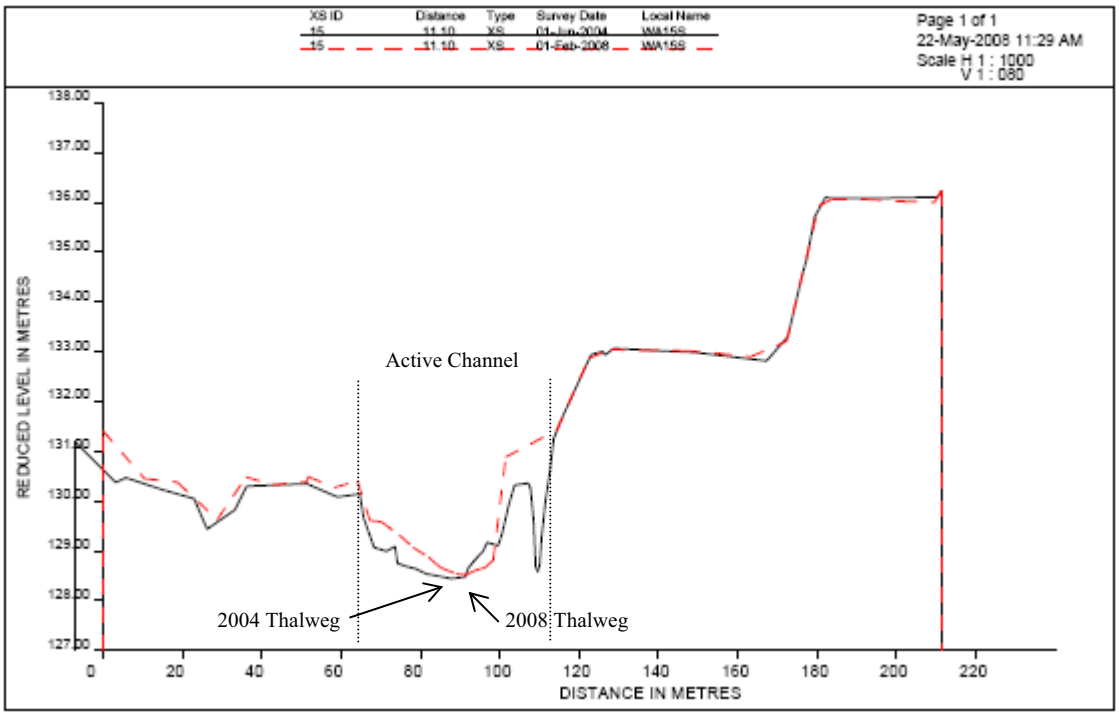

Figure 3.20 Cross-section WA15S, looking downstream

3.20 Longitudinal profile

A longitudinal profile has been graphed for both the North and South branches of the Waianakarua River (Figure 3.21) to give an indication of changes in the slope of the river bed between 2004 and 2008. The main branch (5km and less from the river mouth) and the North and South branches have overall steepened. The longitudinal profile also indicates that the North branch sits at a higher elevation than the South branch.

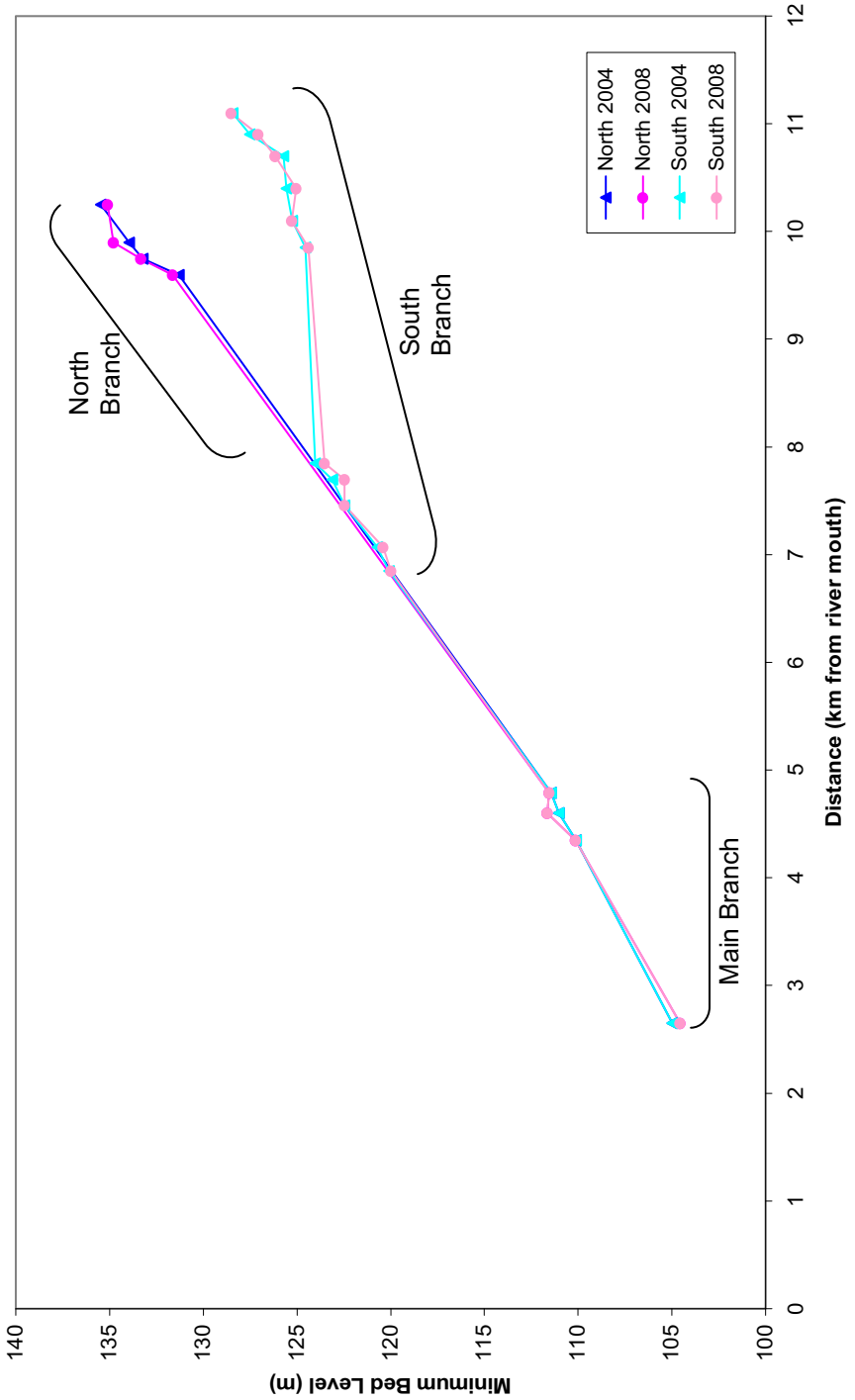

Figure 3.21 Longitudinal profile of the Waianakarua River using minimum bed level

4. Conclusions

A desktop analysis of channel morphology and sedimentation in surveyed reaches of the Waianakarua River has been undertaken using aerial photography, cross-section surveys and relevant documentation. This section provides a synthesis of the study's results to provide an indication of how the river system is changing over time. This will be expressed for the main branch, North branch and South branch cross-sections with a general overview discussing notable variation and trends.

4.1 Main branch cross-sections (WA1 to WA4)

Aerial photograph analysis of the Main branch showed that the active channel has stayed within the confines of its banks and has recently become more vegetated. The active channels of cross-sections WA1 and WA3 have slightly aggraded; however, for cross-section WA1, the main channel has become more entrenched on the true left. The active channels of cross-sections WA2 and WA4 have slightly degraded with a significant shift to the true right at cross-section WA2 and an overall lowering of the river bed at cross-section WA4.

4.2 North branch cross-sections (WA5N to WA8N)

Gravel extraction occurs at Sharps Bend and, to a lesser degree, upstream of Graves Dam. Around Sharps Bend, where cross-section surveys are undertaken, the river morphology has continued to naturally evolve, but without significant morphological change. The active channel of cross-section WA6N showed slight aggradation without major change to the profile of the river bed. The active channels of the other cross-sections on the North branch have degraded overall as a result of channel migration and scour towards the true right for all three sites.

4.3 South branch cross-sections (WA5S to WA15S)

A number of channels apparent in 1960 aerial photographs are now only evident as paleochannels, indicating that the channel of the South branch has become more confined. The cross-sections are located along the stretch of the river where gravel builds up and where gravel extraction has occurred. The active channels of each cross-section have experienced both aggradation and degradation, most ranging from 0.1-0.2m. The maximum mean bed level change was 0.45m at cross-section WA15S. Bank erosion and aggradation, as well as bed level change, is evident in all cross-sections regardless of overall positive or negative values for mean bed level change.

While gravel extraction and past flood events have notably contributed to both localised erosion and aggradation along the lower Waianakarua River, previous records and reports note an overall degrading river system with a supply-limited gravel resource. Further cross-section surveys will contribute to a better understanding of sedimentation and morphology changes in the Waianakarua River.

5. References

Forsyth PJ. (2001). Geology of the Waitaki area, Institute of Geological and Nuclear Sciences Limited, Lower Hutt.

Ministry of Works and Development (Water and Soil Division). (1975). Waianakarua Proposed Irrigation Scheme – Detailed Feasibility Report, Ministry of Works and Development, Dunedin.

Swabey S, Lojkine F. (2004). Gravel extraction in Shag and Waianakarua Rivers, Otago Regional Council Report 2004/230.