Environment Canterbury

Rangitata River Report Status of Gravel Resources and Management Implications

Report No R06/8
ISBN 1-86937-589-0

Prepared by:

Neil Sutherland

MWH New Zealand Ltd
Christchurch

January 2006

Environment Canterbury
Your regional council

Report No R06/8
ISBN 1-86937-589-0

MWH New Zealand Ltd
Tower 2, Deans Park,
7 Deans Avenue
P O Box 13 249
Christchurch
Tel: 64-3-366 7449
Fax: 64-3-366 7780

58 Kilmore Street
P O Box 345
CHRISTCHURCH
Phone: (03) 365 3828
Fax: (03) 365 3194

Environment Canterbury
Your regional council

75 Church Street
P O Box 550
TIMARU
Phone: (03) 684 0500
Fax: (03) 684 0505

Website: www.ecan.govt.nz
Customer Services Phone 0800 324 636

Contents

1. Introduction

As part of Environment Canterbury's wider "Regional Gravel Management Investigation" MWH have been commissioned to prepare reports on the Status of Gravel Resources and Management Implications for ten "Priority One" rivers within the Canterbury Region.

The Rangitata River in North Canterbury is one of the ten "Priority One" rivers. Investigation of the Rangitata River's gravel resources is important because:

- River gravels are used extensively throughout Canterbury (including from the Rangitata River) as a construction material for roads, buildings and other infrastructure.
- Gravel aggradation in the Rangitata River is a crucial aspect of flood management. Allowing gravel to accumulate in the channel has the effect of reducing the channel capacity and increases the likelihood of a flood escaping the main channel.
- Extracting too much gravel risks damage to infrastructure such as stopbank collapse and bridge pier undermining. These types of events are hazardous to life and property.

This report provides an initial overview of the Rangitata River before reviewing its changing bed profile and gravel extraction records to assess the available gravel supply. On the basis of the assessed available gravel supply recommendations are made as to the river's future gravel resource management.

2. Rangitata River Description

The Rangitata River runs for around 105km from the confluence of the Havelock and Clyde Rivers to the ocean. The Havelock and Clyde Rivers have their headwaters on the Main Divide of the Southern Alps. The upper part of the river immediately above the Rangitata Gorge has a relatively gradual slope of 0.002 to 0.0025. Below the gorge the river is considerably steeper at 0.005 to 0.007.

The catchment area of the Rangitata River is 1,773km^2.

The upper parts of the river above the gorge drains mountainous country characterised primarily by greywacke and argillite of low to medium induration.

The lower river reaches cross glacial outwash deposits of the Burnham formation.

The Rangitata River catchment includes the small towns of Arundel, Ealing and Rangitata. Other habitation is generally limited to isolated dwellings. State Highway 1 and the main trunk railway cross the Rangitata River about 18 river kilometres from the sea.

3. River Processes

3.1 Flooding

The Rangitata River rating district has two main aims. These are to minimise erosion and flooding on the south side of the river, and to prevent flood flows entering the South Branch at flows less than 1500m^3/s. The main type of work on this river is tree planting with impermeable and rock groynes and a very small amount of stopbanking.

3.2 Bed Profile

The bed profile drops in slope from the gorge to the sea as shown by Carson (1984). This report indicates that the river has very little bed load and is degrading immediately downstream of the gorge and gradually picks up bed load from the river banks and sides streams, such as Lynn Stream. Therefore it is unlikely there is any significant sediment supply from the upper parts of the catchment above the gorge.

The river becomes more braided downstream of Lynn Stream indicating it has more bed load. It may be possible that there could be some supply downstream of SH1 bridge. It would require cross-section survey results or a more detailed geomorphic study of the river processes in this area to confirm a supply.

4. Gravel Extraction

Environment Canterbury monitor gravel extraction from the Rangitata River by requiring extractors to submit returns indicating how much, when and where gravel is taken. The Rangitata River gravel returns for the period from 1990 to June 2003 have been made available to us.

Our analysis of the returns data has been to determine the patterns of where and when gravel has been extracted from the Rangitata River over the 13.5 years of record. The following table extends the record to 14 years (by extending the 2003 returns out to a full year.)

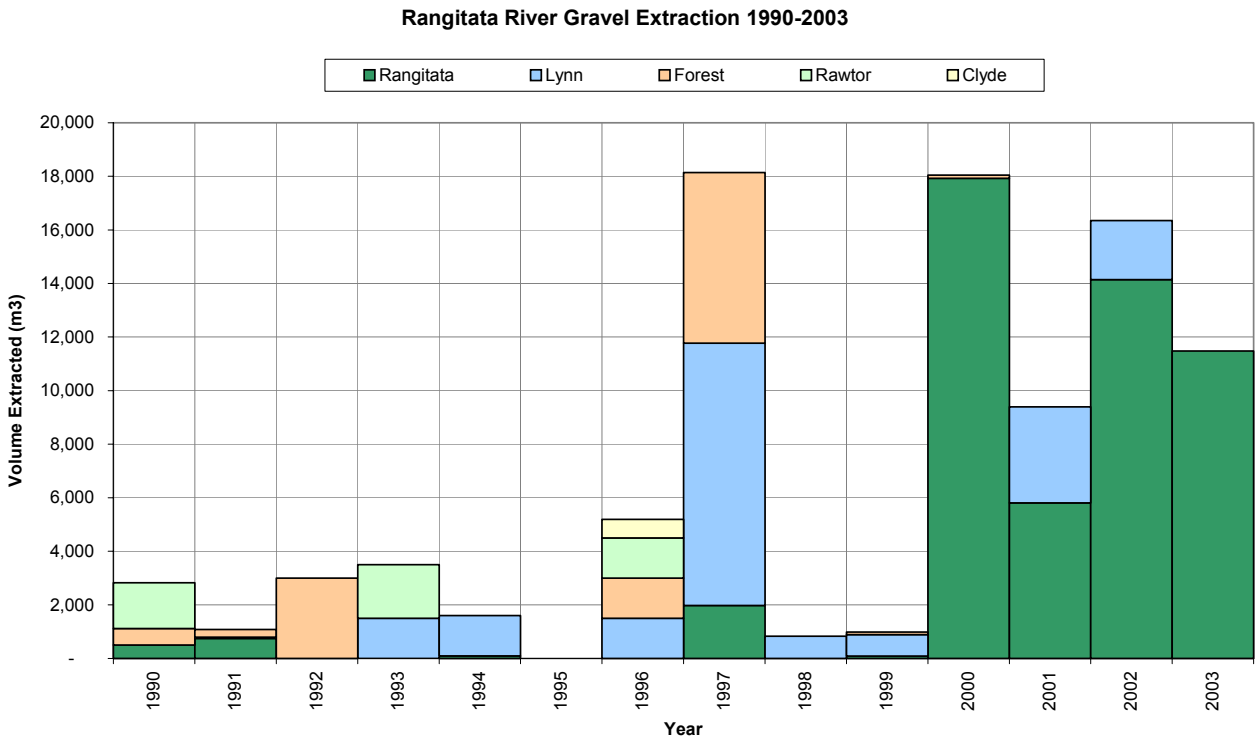
Table 4.1: Gravel Returns by Year for the Rangitata River and Tributaries

Year	Rangitata	Lynn	Forest	Rawtor	Clyde
1990	500		612	1,700	
1991	750	42	288		
1992	-		3,000		
1993	-	1,500		2,000	
1994	96	1,500			
1995	-				
1996	-	1,500	1,500	1,500	688
1997	1,970	9,800	6,366		
1998	-	830			
1999	90	800	100		
2000	17,924		1,200		
2001	5,807	3,586			
2002	14,145	2,200			
2003	11,480				
Total by Part	**52,762**	**21,758**	**13,066**	**5,200**	**688**

[1] Returns for year 2003 to June have been doubled to estimate full year extractions

For the Rangitata River the total volume of gravel extracted over the period of record was 92,000 m^3, at an average rate of 6,600 m^3/yr.

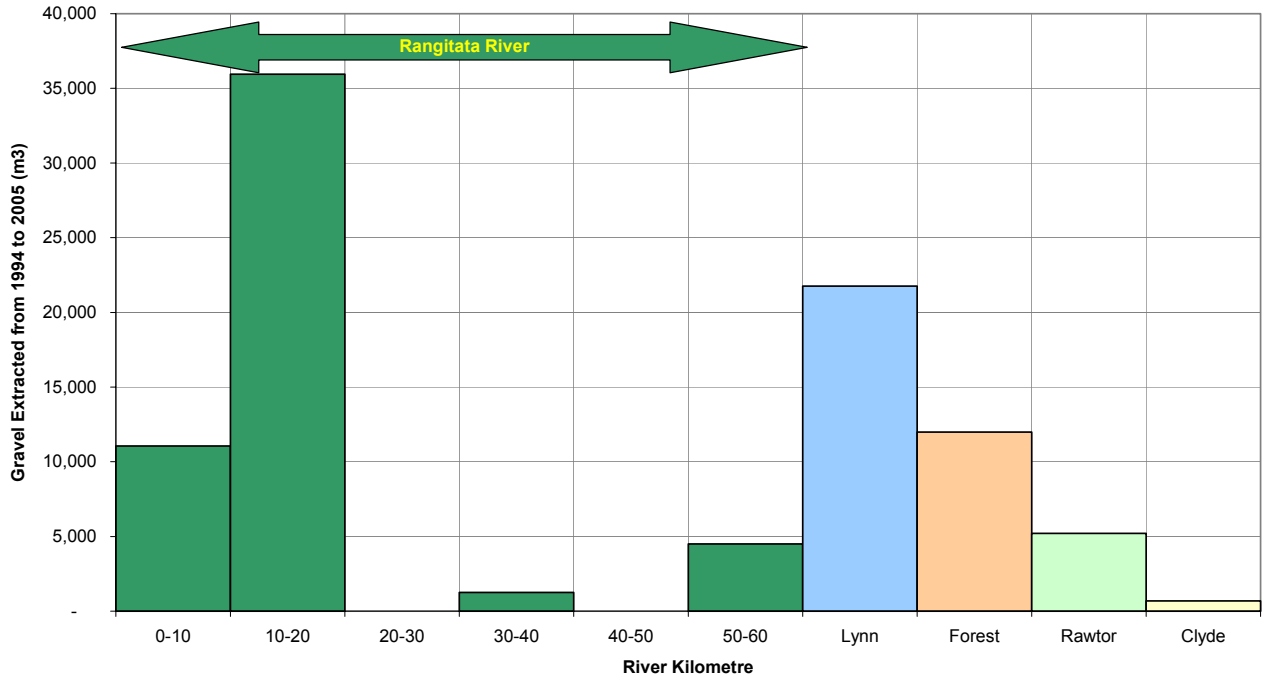
The temporal distribution of the extractions has not been even over the 14 years of return records. The following chart shows very low rates of extraction up to 1995, followed by higher levels of activity from 1996 onwards (with the exception of 1998 and 1999, which were low).



The spatial distribution of the gravel extraction shows most of the gravel is taken within 20km of the coast and from the Lynn River. The Lynn River extractions are necessary to clear

aggradation at its mouth. Around 20 percent of the gravel extraction is from above the Rangitata Gorge.

Rangitata River Gravel Extractions (1990 to 2003) by River Kilometre



5. River Bed Changes

No conclusions are possible for the Rangitata River bed levels. No monitoring has been undertaken by Environment Canterbury.

6. Gravel Supply

In the absence of any monitoring surveys to work with, the gravel supply assessment for the Rangitata River is based on the Waimakariri River assessment.

The Rangitata River and the Waimakariri River share two key commonalties. Both rivers:

- Are major Canterbury Rivers with extensive headwaters extending to the Main Divide and long channels extending across the Canterbury Plain.
- Have similar catchment geology characterised by greywacke and argillite in the headwater and glacial outwash deposits across the plain.

The key difference between the two rivers affecting gravel supply are:

- The relative catchment areas: the Rangitata's catchment area is 1,773km2 and the Waimakariri's catchment area is 3,540km2.
- The Rangitata River has a significant reach of gradual slope (0.002 to 0.0025) above the gorge, which effectively traps gravel above the gorge and reduces the amount of gravel passing through the gorge. The area of the Rangitata catchment that is above the gorge exceeds 80 percent of the total catchment.

- Being starved of upstream gravel the Rangitata River below the gorge will tend to erode its banks and bed more than it would otherwise, allowing some recovery of the "missing" bed load.
- The riverbed slopes across the plain. The Waimakariri River's slope is more gradual and decreases markedly close to the ocean (the approximate slope 50km from the coast at RL 200m is 0.005 and the final 20m fall to the sea has a slope of around 0.0015). The Rangitata River's slope is steeper (the approximate slope 34.5km from the coast at RL 200m is 0.0063 and the final 20m fall to the sea has a slope of around 0.004). In the case of the Waimakariri the bed load drops out before the river gets to the sea. The Waimakariri's bed within 2km of the mouth consists of silt. The Rangitata River's greater slope means it is more capable of transporting gravel to the mouth and beyond.

Based on the above similarities and differences the estimated sustainable bed load of the Rangitata River is derived from the previously assessed Waimakariri River sustainable bed load as follows:

1. Use the estimated 250,000m^3/yr sustainable bed load of the Waimakariri River as the basis.
2. Use the relative catchment areas of the Rangitata and Waimakariri Rivers to pro-rata the Waimakariri figure by 50 percent.
3. Use the observation about the gravel trap above the gorge to pro-rata the Waimakariri figure by a further 50% (based on 80 percent of the catchment area being above the gorge, reducing the bedload from that area by 80 percent and allowing some bed load recovery from the river bed and banks below the gorge).
4. Use the observation that the bed load transport capacity of the Rangitata at the coast exceeds that of the Waimakariri at the coast to further reduce the Waimakariri figure by 50 percent.

Therefore the estimated sustainable gravel yield from the Rangitata River is around 30,000m^3/yr (calculated as 250,000 x 0.5 x 0.5 x 0.5).

7. Discussion and Recommendations

The indicative gravel budget based on the Waimakariri River assessment shows that there is likely to be a sustainable gravel supply of around 30,000m^3/yr in the Rangitata River.

It is likely that the current rate of gravel extraction (average of 6,600m^3/yr from 1990 to 2003) is less than what can be sustainably taken without lowering the river bed levels.

There is no design bed level or bed level survey information to draw conclusions about possible local extractions.

A monitoring programme to record riverbed levels for use in assessing bed status and changes should be commenced.

The Rangitata River above the gorge is a potential location for mass gravel extraction.

To decide whether gravel extractions from the Rangitata River should occur in the future (and if so where from and in what quantity) an assessment of the required and existing flood capacity and minimum bed levels to protect infrastructure is required.
This assessment would yield design bed levels against which river management decisions could be made.

8. References

EMA (2005), “Waimakariri River: Status of Gravel Resources and Management Implications”, Report Ro5/15 for Environment Canterbury, ISBN # 1-86937-569-6.