BEFORE THE HEARINGS PANEL

IN THE MATTER **of hearings on submissions concerning the Proposed One Plan notified by the Manawatu-Wanganui Regional Council**

SECTION 42A REPORT OF MR PETER LINDSAY BLACKWOOD
RE: BEDS OF RIVERS AND LAKES
ON BEHALF OF HORIZONS REGIONAL COUNCIL

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1. INTRODUCTION

My qualifications/experience

1. My full name is Peter Lindsay Blackwood. I am currently employed as the Manager - Investigations and Design, Horizons Regional Council. I have held this position since 30 October 2006. From September 1996 to October 2006 I was employed as the Manager - Technical Services for the Bay of Plenty Regional Council.

2. I am qualified with a Bachelor of Engineering (Hons) and gained my Engineer's Registration in 1982. I have 33 years experience in civil engineering, including project management, flood control and drainage (policy, asset management, design and supervision), river management and protection works, coastal hazards (storm surge and wave run-up), environmental engineering, water resources (particularly flood frequency), global warming policy and design, civil design (including bridging), financial analysis, irrigation, and power station construction.

3. I have authored or supervised the production of numerous designs and reports on river hydrology and hydraulics, floodplain management, climate change impacts, river alignments, gravel management and erosion protection works.

4. I have managed or supervised detailed floodplain management studies on the Whakatane-Waimana, Waioeka-Otara, Waikanae and Otaki River Schemes.

5. I have carried out a detailed assessment of the gravel management of the Otaki River and have supervised and mentored similar assessments on the Hutt River and, over a period of 10 years, on 13 rivers in the Bay of Plenty. These rivers required various management stratagems ranging from carefully managed recovery of bed levels in reaches of the Whakatane and Waimana Rivers to assessment of options for rivers on perched fans, such as the Horomanga.

6. I have also instigated and supervised the fluvial processes investigations in the Bay of Plenty, including supervising the production of a comprehensive report on the Whakatane and Whirinaki Rivers.

7. Over the past 15 years I have engaged in several consultations with tangata whenua over their values and viewpoints on gravel extraction in several parts of New Zealand. Chief amongst these were in-depth presentations to the Whakatohea Maori Trust Board

in Opotiki, the Taiatahape hapu of the Tuhoe in Waimana, and Te Runanga o Raukawa in Otaki.

8. I confirm that I have read the Environment Court's Code of Conduct for Expert Witnesses and that I agree to comply with it.

My role in the Proposed One Plan

9. In my role as Manager - Investigations and Design for Horizons, I have provided professional advice on policies and rules in the Proposed One Plan (POP) pertaining to gravel extraction.

Scope of evidence

10. My evidence focuses on two central themes:
    - Gravel extraction policy; and
    - Specifics of gravel extraction for the Manawatu and Rangitikei Rivers.

2. EXECUTIVE SUMMARY OF EVIDENCE

Background

11. The gravel phase of the river extends from the headwaters to a point downstream where the river grade (ie. slope) is such that either the velocities are inadequate to transport the gravel further, or the small amount that is transported is effectively smothered by the deposition of silt during the later stages of floods. Generally a significant proportion of the deposition of gravel occurs in the reach of river nearing the downstream end or the sand/silt phase boundaries, often where there is a marked drop in the grade of the river. In reaches upstream of this deposition zone there may well be a fluctuation in bed levels according to the spectrum of flood flows experienced. In this reach, gravel may also travel down the river in "waves", resulting in above average bed levels for a while and average, or below average levels at other times. In the upstream reaches there is frequently a "degradational" (ie. bed lowering) trend, except following major storms.

12. Streams that exit the ranges are often located on aggrading alluvial fans, where naturally substantial deposition will take place following severe storms. This fan-building process means that the streams will periodically "avulse" (ie. change course) and management of these reaches may be required where adjacent and particularly downstream farmland, houses and communication routes are threatened. Removal of

this excess gravel can be totally impracticable, due to the large volumes involved and lack of a marketable use.

13. The gravel bed phase is characterised by sustaining flood flows of high velocity, often associated with much turbulence in the water. There will often be much erosion (of the bed and/or riverbanks) during these floods, transport of the gravel and subsequent deposition.

14. One of the challenges facing wise management of gravel extraction is the fact that very large proportions are carried in the major floods of say 5% (20-year) Annual Exceedance Probability (AEP) or greater. This can be at least an order of magnitude more than that carried in small floods (of say 50% or two-year AEP). Thus gravel transport is an extremely episodic process and there can be long periods when rivers carry relatively little gravel. Therefore, the supply rate per year is most definitely not constant and this has to be taken into account when optimising extraction strategy.

Rate of gravel transport

15. The rate of gravel transport, and indeed the occurrence of any transport at all, depends on three factors:
    i. The depth of the flow (ie. once the river depth exceeds a critical amount the gravel can no longer stay still and it starts to move).
    ii. The gradient of the river (ie. a steeper gradient transports more gravel).
    iii. The size of the gravel (ie. smaller gravel is easier to transport).

Gravel extraction policy

16. Gravel extraction policies must take full account of the following critical factors:
    i. Maintaining bed levels within a desirable range.
    ii. Keeping bed levels compatible with existing river protection assets.
    iii. Keeping roughly in balance with natural supply rates.
    iv. Maintaining good river alignments.
    v. Minimising any adverse impacts on in-stream and riparian ecology.
    vi. Minimising any adverse impacts on tangata whenua values.
    vii. Impacts on the gravel extraction industry.

Critical factors

Maintaining bed levels within a desirable range

17. In terms of optimum bed levels there are no set engineering criteria. Each case requires assessment of its own merits. Lowering bed levels excessively may improve flood-carrying capacity, but it can also lead to serious undermining of riverbanks, protection works and bridges.

18. On the converse side, if a stream becomes too aggraded, then flood risks are increased, or in the case of a shingle fan it may avulse onto a new course, with obviously serious problems resulting.

19. While there are no set engineering criteria, there are some major themes, as follows:
    i. The depositional zone is obviously the appropriate place to extract gravel. If extraction does not proceed in this reach then the flood risk in that area will be aggravated and the river may change course.
    ii. Extreme care must be taken in a reach that is degrading, or is already degraded, possibly because of over-extraction in distant earlier times.
    iii. Rapid aggradation may occur on shingle fans. Where possible, extraction can alleviate attendant flood risks generated by this aggradation and riverbank erosion threats. However, this problem can become almost insurmountable and wise planning of land use is also required to mitigate the hazard.

20. Refer to Figure 2: Gravel Extraction Strategy: Optimum Bed Levels.

Keeping bed levels compatible with existing assets

21. In determining the optimum bed levels heed needs to be taken of the levels of other assets. In particular it is imperative that bed levels do not degrade below the prevailing levels for river protection works in the vicinity – be they rock riprap linings, groynes, protection plantings, or some other works. If the bed is allowed to degrade below the levels of these works then the works may well collapse, resulting in significant erosion. It is also important that the extraction of gravel does not cause the undermining of bridge foundations and the undermining or exposure of service crossings, such as gas lines or sewer lines.

22. Conversely, in some cases the river protection works may have been installed when the river bed is slightly below the natural level. Unless there is good reason it may well be better to accept that level as part of the optimum range.

Keeping roughly in balance with natural supply rates

23. In terms of a holistic overview, the total gravel extracted from the river system must not exceed the total gravel supplied to the river. Failure to observe this principle would see a progressive decline in river bed levels, with undermining of riverbanks and structures. It has to be recognised that the supply of gravel is episodic; therefore the match between gravel supplied and extracted will not be exact year by year. The long-term match is important.

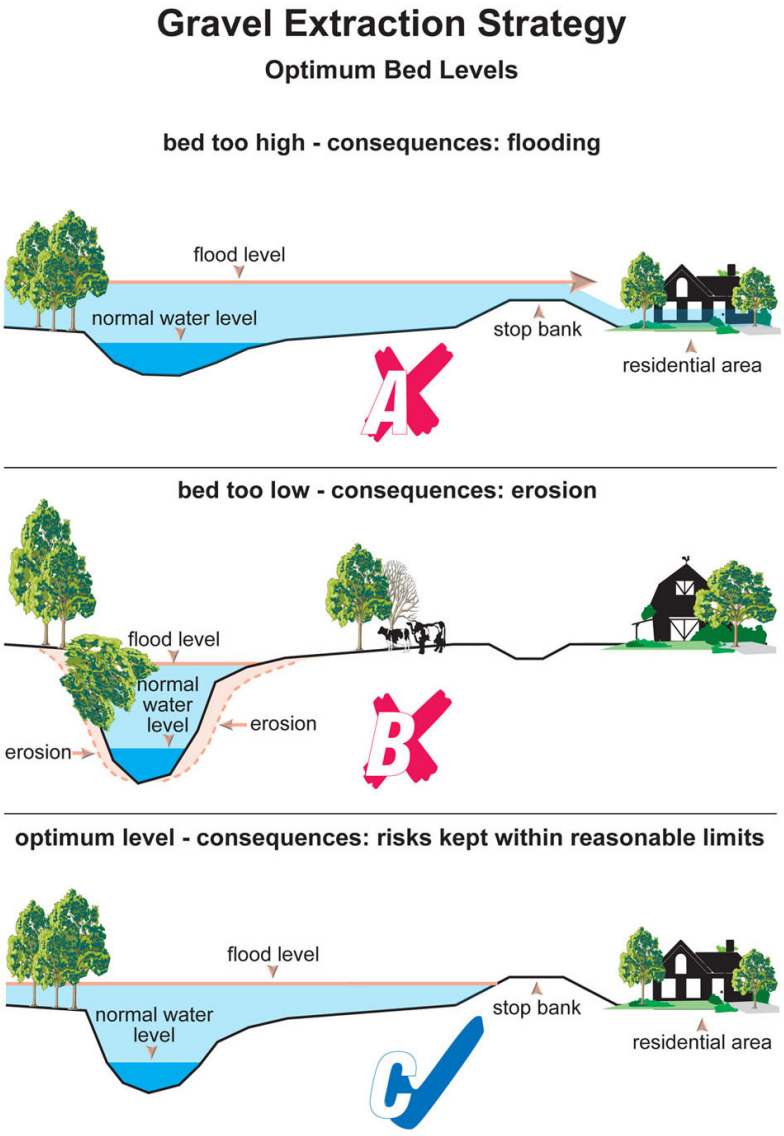

Figure 2. Gravel Extraction Strategy: Optimum Bed Levels

24. The supply quantities presented in Tables 6.3 and 6.4 of the Proposed One Plan as notified have been adjusted to present estimates of the long-term supply rates. They are not maximum rates, except for the Lower Manawatu River, where the rates are based on the maximums specified in the global consent for gravel extraction granted to Horizons in 2008, for 20 years, expiring on April 2028). The supply quantities are based on several sources of information, as follows:

i. Detailed cross-section analyses of the mass balance between successively recorded river surveys, taking account of recorded extraction. Particularly detailed analyses have been conducted on the Lower Manawatu and Rangitikei Rivers (refer Section 2 of this evidence).
ii. Examination of past extraction rates and the response of river bed levels.
iii. Examination of unit supply rates per unit of headwaters catchment area.

25. A further factor of importance is to ensure that the supply of gravel to downstream reaches is not adversely reduced. Interception of gravel can cause downstream channel lowering. The submission to the Proposed One Plan from Byford's Quarry, while having several other helpful points, states "*In reality HRC may be better to encourage the removal of gravel from nearer the source rather than allow it to accumulate in the river system".* Unfortunately this practice will result in degradation of downstream river reaches in most cases.

Maintaining good river alignments

26. A common problem on river bends is the development of an asymmetrically shaped channel. The channel on the outside of the bend tends to deepen, due to the higher velocity of the river and the scouring and eddying generated as the river changes direction through the bend. As this process continues, the riverbank on the outside of the bend becomes prone to erosion. Conversely, on the inside of bends the river tends to deposit both gravels and silts. Beaches form and grow on the inside of the bend.

27. Looking at the river bend in plan form (ie. "from the sky") the bend shape begins to sharpen and a serious misalignment of the river channel may result. The result is severe turbulence and energy losses at the bend, causing erosion and a rise in upstream flood levels.

28. A common way of arresting this process is to lower the beach on the inside of the bend, thereby both increasing the cross-section area and reducing the misalignment of flow. This reduces the erosive forces on the outside of the bend.

29. This application of gravel extraction thus improves the river alignment and has a very positive influence on reducing erosion. While this is sometimes only a temporary benefit, it provides an effective river management tool for usually a significant period of time.

30. When a river reach is in a degraded state gravel extraction is not normally an appropriate tool. That is because extraction will remove gravel from the total river system, resulting in a vicious cycle of degradation and further cross-section asymmetry both locally and downstream, and also in the immediate vicinity upstream.

31. Refer to Figure 3: Gravel Extraction Strategy: Remedying Erosion Risks at Bends.

Minimising any adverse impacts on in-stream and riparian ecology

32. Minimising any adverse impacts on in-stream and riparian ecology is covered in detail in the evidence of James Lambie.

Minimising any adverse impacts on tangata whenua values

33. All rivers and streams are regarded as “taonga” (highly regarded physical or spiritual treasure) by the respective tangata whenua. As such, the tangata whenua expect wise environmental management of these taonga. Therefore, gravel management has to be carried out in a fashion that minimises and avoids adverse environmental effects. Any extraction that causes erosion, flood risk, siltation, pollution, and landscape or other impacts would be culturally offensive.

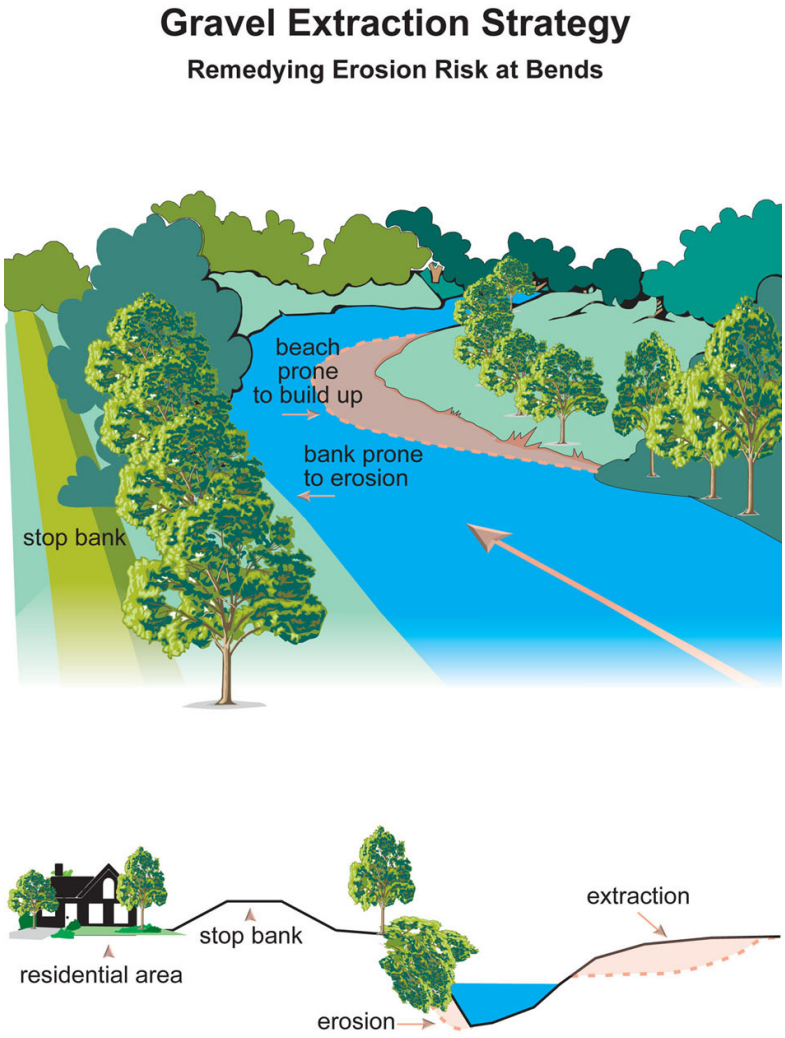

Figure 3. Gravel Extraction Strategy: Remedying Erosion Risks at Bends

34. The tangata whenua, in conducting their right of "kaitiakitanga" (the ethic of stewardship and guardianship) under the Treaty of Waitangi, and pursuant to Section 7(a) of the Resource Management Act 1991 (RMA), wish to have an appropriate level of consultation in gravel extraction. In the recent global consent granted for gravel extraction in the Lower Manawatu River, condition 10 required the consent to be exercised in accordance with the provisions of the Protocol entitled Protocol between Manawatu-Wanganui Regional Council (HRC) (Operations) and Tanenuiarangi Manawatu Incorporated (TMI), dated 14 April 2008, or any approved updates of that Protocol.

35. Details of the Protocol are presented in the main text of this report.

36. Great care obviously has to be taken to avoid damaging any wāhi tapu site and gravel extraction must stay well clear of these. Should any sites be discovered then works should cease and appropriate procedures followed.

Impacts on the gravel extraction industry

37. The role of the gravel extraction industry is key to enabling gravel extraction. This industry must receive some certainty on likely extraction quantities. The supply quantities presented in Tables 6.3 and 6.4 of the notified Proposed One Plan have been adjusted to present estimates of the long-term supply rates and will give a good guide to the gravel extraction industry on long-term gravel availability.

38. At the same time, gravel can only be taken in appropriate quantities from locations where it will provide benefit to the river system. It cannot be taken from areas where there will be no benefits and resultant damage (ie. undue degradation and other environmental effects).

Recommended matters of discretion

39. Based on the Critical Factors outlined earlier (including the detailed report of James Lambie) the following are matters of discretion that should be considered when writing any gravel extraction rule:

i. Volume of gravel extracted.
ii. Location of gravel site.
iii. The extent and nature of disturbance to or deposition on the bed.
iv. Rate, timing and duration of extraction.
v. Location of gravel stockpile area(s).
vi. Effects on aquatic habitats.
vii. Overall effect on water quality.
viii. Effects on riparian margins.
ix. Effects on channel, bank and bed stability;
x. Erosion and flooding issues.
xi. Effects on public access.
xii. Procedures in the event of discovering or disturbing an archaeological site, wāhi tapu or kōiwi remains.
xiii. Dust management.
xiv. Financial contributions.
xv. Duration of consent.

xvi. Review of consent conditions.

xvii. Compliance monitoring.

Specific analyses

A. Lower Manawatu River

40. Detailed information is presented in the main text on the recent global gravel extraction consent granted to Horizons. The consent decision is attached in Appendix I. The following paragraphs summarise the key points.

Introduction

41. The Manawatu River rises in the southern Ruahine and northern Tararua Ranges. The total catchment area is about 6,000 square kilometres. The river downstream of the Gorge is known as the "Lower Manawatu River".

The Lower Manawatu Flood Control Scheme

42. The Lower Manawatu Flood Control Scheme (LMS) protects 280 square kilometres of pastoral, horticultural and urban land from flooding by the Manawatu River and its major tributaries between Ashhurst and the sea. The LMS relies mainly on stopbanks to contain the water. A total length of 250 km of stopbanking was constructed, with 150 km containing the Manawatu River and 100 km containing the major tributaries.

43. Other works include riverbank protection in the form of rock or concrete rubble linings and live willow protection.

44. The consequences of stopbank failure during a major flood are severe. In Palmerston North, thousands of houses can potentially be flooded, with damage costs amounting to hundreds of millions of dollars. In the rural areas, thousands of hectares can be flooded, with damage costs amounting to tens or hundreds of millions of dollars.

Gravel river bed

45. The Manawatu River has a gravel bed between its headwaters and a point just downstream of Hamilton's Line, near the Opiki Bridge on State Highway 56, about 15 km south-west of Palmerston North. In most years the floods in the river move very little

gravel, but in 2004 there were six floods large enough to move significant quantities of gravel.

46. For the 30 km reach between the Manawatu Gorge and Karere Road, the river bed level has become progressively lower, largely due to commercial gravel extraction.

47. Downstream of Karere Road, the river bed is aggrading because the gradient is flat, and therefore the river flows too slowly to keep the gravel moving.

48. Historically, gravel extracted from the Manawatu River downstream of Ashhurst has been a valuable resource, used in concrete aggregates, roading works, and other construction works. The Region has gained considerable economic benefit from this resource, but it has been clear for a number of years that the historic rates of gravel removal from the river are not sustainable, because they have resulted in a continuous lowering (degradation) of the river bed.

Impact of river bed degradation on the LMS

49. If bed degradation continues to occur in the Manawatu River, the edge protection will eventually be undermined, and will fail. The resulting erosion of the riverbank has the potential to undermine stopbanks and the consequences of stopbank failure are likely to be severe. Replacement of the channel edge protection would be expensive at up to $3,000 per linear metre.

50. For these reasons, gravel management aimed at avoiding bed degradation is an essential component to maintain the integrity of our flood protection structures.

Impact of river bed aggradation on the LMS

51. Aggradation of the river bed downstream of Karere Road has already caused a loss of flood carrying capacity, and will continue to do so unless we remove the excess gravel. During the flood of February 2004, flood levels were higher than expected, in part because of the gravel aggradation. Fortunately freeboard was generous in the affected reach, and the stopbanks were able to contain the flood in that reach. However, the risk of a stopbank failure will obviously continue to increase if no action is taken.

52. Closure of State Highway 57 at the Opiki Bridge due to inundation by the river now occurs more frequently than in the past. This is a result of gravel aggradation. The

northern approach crosses the floodplain between the bridge and the true right stopbank, and consequently is occasionally submerged by the river, for up to three days at a time. Before February 2004 the river flow had to exceed 1,200 cumecs before the road could be flooded, whereas now a flow of 950 cumecs is sufficient to cause flooding. The average intervals between floods of this size are 14 months and six months respectively.

Consents issued in 2001

53. A report prepared in 2001 confirmed that gravel extraction in the Lower Manawatu River was occurring at an unsustainable rate, and must be reduced. This was clearly signalled to applicants who obtained consents in 2001. The background section of gravel extraction consents issued in 2001 contained a note advising applicants that applications had been placed on hold pending further investigations, and that gravel extraction would be allowed to continue for a further five years, during which time alternatives would be investigated.

Investigations since 2001

54. After 2001 it become clear that for much of the river, the sustainable rate of gravel extraction is very low, and possibly zero. In particular, a few sub-reaches of the river were studied in response to applications for consents to extract gravel. In most of the reaches studied, it appeared that over a 10-15 year period, the volume of gravel removed approximately equalled the volume of degradation. Thus, little or no gravel could be removed on a long-term sustainable basis.

55. Opus International Consultants completed an investigation, entitled Lower Manawatu River Gravel Resource Study, confirming that most of the LMS gravel reach could sustain little or no ongoing removal of gravel.

56. Most of the Lower Manawatu gravel reach was found to have degraded, but a reach of several kilometres at the downstream end of the gravel was aggrading. This is due to the gradient flattening.

Availability of gravel between Ashhurst and Karere Road

57. Bed degradation in the Manawatu River between Ashhurst and Karere Road is greatest at the locations where the largest volume of gravel has been extracted. The most pronounced degradation in this reach has occurred at the right-angle bend about 1 km

downstream of Raukawa Road. However, gravel has been extracted at many locations and consequently, the entire bed between Ashhurst and Karere Road has been lowered to varying degrees over time.

58. It is concluded that, for the Ashhurst to Karere Road reach, ongoing regular removal of gravel for commercial reasons must cease.

Permissible gravel extraction between Ashhurst and Karere Road following large floods

59. There might be some occasions when there will be a need to extract gravel. Large floods temporarily alter the usual state of dynamic equilibrium, and can introduce additional gravel into the river.

60. Following a flood of 20-year return period or more, a one-off removal of gravel might be required in locations and quantities that would have to be determined at the time. A total quantity of 50,000 cubic metres over the 20-year period of the global consent granted to Horizons in 2008 was allowed in the consent conditions. The intention is that gravel should only be removed when flood carrying capacity has demonstrably been lost, and gravel raking or redistribution are not expected to be adequate responses.

The aggradation reach downstream of Karere Road

61. It is proposed to remove enough gravel to restore the channel cross-sectional area that existed in 1993. The 1993 survey was used to calculate design levels for the LMS design upgrade that was subsequently approved in 1999. It has been assumed in the recent upgrade proposals that the 1993 cross-sectional area would be restored.

Karere Road to 1 km downstream of Jackeytown Road

62. This 3.5 km reach has a tendency to aggrade, but the aggradation is much less severe than in the reach further downstream.

63. It appears that the volume of gravel extraction in recent years has approximately equalled the volume of aggradation. Extraction volumes have varied but have usually been in the order of a few thousand cubic metres per year. In general, the future rate of gravel extraction should equal the past rate.

64. However, there was a significant build-up of gravel in the flood of 2004, and it appears that a large one-off extraction is required to remedy this deposition episode. The one-off extraction volume could be in the vicinity of 70,000 cubic metres. This is in addition to the one-off extraction consent granted to Mr B. Whitelock in December 2005.

1 km downstream of Jackeytown Road to 2 km upstream of Opiki Bridge

65. This 5 km reach is aggrading severely, and as a result flood carrying capacity is being lost. A sharp transition from mild to severe aggradation at a point 1 km downstream of Jackeytown Road is made very evident when historic aerial photographs are inspected.

66. It appears that in the absence of major floods, approximately 15,000 cubic metres per year needs to be extracted from the 5 km reach.

67. A large one-off extraction of perhaps as much as 200,000 cubic metres is needed as a consequence of the 2004 floods. This estimate can be refined by resurveying four more cross sections.

68. The gravel in the main aggradation reach is less attractive to commercial extractors than is gravel further upstream. The aggrading gravel contains a smaller proportion of large stones, and more sand. For many applications there are larger haul distances. Some incentives may need to be offered to ensure that sufficient gravel is removed.

Management of existing gravel consents

69. The global gravel consent granted to Horizons in 2008, for a 20-year period, represented a fundamental shift in approach for management of gravel extraction for the Lower Manawatu River. In the main there will now be no separate consents issued to commercial extractors. The only party to extract gravel would then be Horizons, who would then select gravel extractors to remove gravel from locations that were appropriate in terms of river management.

70. The effect of this is that essentially all the available gravel in the Lower Manawatu River has been allocated to Horizons, which has developed a Protocol with existing extractors that will implement this new approach.

71. The principal exception to this would be any necessary gravel extraction necessary to realign the river in Palmerston North city at Anzac Cliff Park. This will require a separate consent application.

Conclusion

72. The proposed gravel management regime is essential to ensure that bed degradation upstream of Karere Road does not occur in the future and that the Lower Manawatu Scheme's expensive bank protection works are not subjected to an increased undermining risk. It is also essential to ensure that vital flood carrying capacity is not lost downstream of Karere Road.

73. The Hearing Committee for the Horizons global gravel consent granted consent for a term of 20 years, expiring on April 2028, with the following maximum gravel extraction volumes. These volumes are consistent with the preceding information and include provision for additional gravel generated by floods during this period. The full decisions and conditions are presented in Appendix 1.

i. 700,000 cubic metres from the 2 km aggrading reach between BM 604 and BM 622.
ii. 350,000 cubic metres from the 2 km aggrading reach between 39 Mile to BM 643.
iii. 300,000 cubic metres from the 4 km transitional reach between BM 643 to 43 Miles.
iv. 50,000 cubic metres from the 32 km degrading reach upstream of 43 miles.

B. Rangitikei River

Introduction

74. The Rangitikei River rises in the Kaimanawa and Ruahine Ranges and drains a 90 km length of the North Island Main Divide, from a point east of Rangipo to a point east of Rangiwahia. The catchment area is 4,144 square kilometres. The river carries gravel down to the lower reaches and, as the gradient flattens in the last 15 km, gravel aggrades in this reach.

75. The Rangitikei River Scheme provides erosion control from Rewa to the sea, a river distance of 63 km. No tributaries of the Rangitikei River are included in the Scheme and it does not aim to prevent all erosion. The philosophy is that the river should be allowed to follow its natural processes of migrating meander patterns, provided it does not move

outside of a defined zone, which is approximately 500 metres wide – although the active channel is significantly narrower than this. The meander zone is covered in trees, which has the advantage of slowing erosion and the disadvantage of exacerbating silt deposition.

76. In the lower reaches of the Rangitikei River, flood protection to approximately 2,000 ha is provided by slightly over 21 km of stopbanking. The nominal design standard is the 2% AEP (50-year) flood plus 600 mm of freeboard. The stopbanking constructed is intermittent over five locations, with the stopbanks linking into higher ground at each location, with works yet to be completed at Tangimoana.

77. The Rangitikei River Scheme has had several reviews, the last major one being in 1994. In this review problems of gravel aggradation and berm siltation were identified and a 20-year stopbank upgrade programme was recommended and adopted.

78. Following the major 2004 flood, a major review of the stopbank capacity was commissioned by Horizons and conducted by AC Consulting Ltd. A full report completed in March 2006 resulted in Horizons embarking on a major programme of stopbank upgrades.

79. Following significant flood damage sustained in the recent flood of 30 July 2008 (approximately 10% AEP) Horizons has embarked on a major review into the channel management of the Rangitikei River Scheme, titled Rangitikei River Scheme Review No. 4. This review will focus on channel management, erosion control and gravel management.

1994 scheme review

80. The conclusions of the 1994 review were:

i. Most of the gravel supply to the Rangitikei River is from the Kawhatau River, which delivers an estimated average annual supply of 20-30,000 m^3 per year.

ii. More than 120,000 m^3 of gravel had been removed from the Rangitikei and Kawhatau Rivers annually since 1961. This is based on the amounts reported by commercial extractors but these are believed to underestimate the total. The annual amounts exceeded 240,000 m^3 for many years.

iii. Between 1977-90 gravel extraction had caused a mean bed lowering of 0.5 metres in the 28 km reach upstream from the Tutaenui Stream (from 4 km downstream of Bulls to 15 km upstream of the Kakariki Bridge).

iv. A moderate amount of gravel aggradation is occurring as a natural process in the reach from 2.5 to 14 km. This amounted to an average rate of 26,250 m^3 per year between 1977-89; equivalent to a bed rise of 30 mm per year.

v. The gravel deposition in the reach from 2.5 to 14 km is causing the main channel to become significantly narrower and shallower.

vi. In the same reach from 2.5 to 14 km, 3,000,000 m^3 of silt accumulated on the river margins between 1972 and 1994, with the average rate of accumulation being 130-140,000 m^3 per year.

81. The review also noted that the average rates of gravel supply and transport may be greatly exceeded in rare (ie. major) flood events and it was probable that very large volumes of sediment are stored in upper catchments and tributaries to be moved into storage in lower parts of the river system should a large flood occur. Thus the long-term supply may be greater than estimated.

82. This review considered many factors and recommended that the maximum amounts of gravel extracted should not exceed:

i. 40,000 m^3 per year from the Rangitikei River upstream of 15 km (this was to be from selected beaches to alleviate erosion due to bend deposits).

ii. 35,000 m^3 per year from the Kawhatau River.

iii. Up to a total of 300,000 m^3, and then not more than 25,000 m^3 per year from selected beaches in the lower 15 km of the river.

83. An environmental charge of $2.50 per cubic metre has been applied to all gravel extracted from upstream of 15 km and tributaries to cover river management costs in these locations, where of extraction is almost unavoidable.

AC Consulting Ltd analysis

84. AC Consulting Ltd carried out a major gravel and flood flow capacity analysis in 2006. The reach above Kakariki was not analysed, as the 2004 cross-sectional surveys had not been completed through this reach. An analysis of this reach is currently underway as part of Review No. 4.

Past trends

85. The main trend identified in the AC Consulting report is the continuation of degradation in the lower reaches from the river mouth to around 15 km upstream, and degradation

from 15 km upstream to the end of the study reach at Kakariki, 32 km upstream. The full area of berm aggradation has been included in the sections from 2 km upstream and the mouth area does not reflect the whole situation. The aggradation that occurred on these 1 km wide berms between 1977-2004 is of the order of 500 mm.

86. The average aggradation has been calculated at 25 mm per year over the whole cross-section for the lower 15 km, and 20 mm per year degradation above 15 km.

87. Figure 6 gives a summary of the mean bed level changes between 1977-2004 for the reach of river from the mouth to Kakariki.

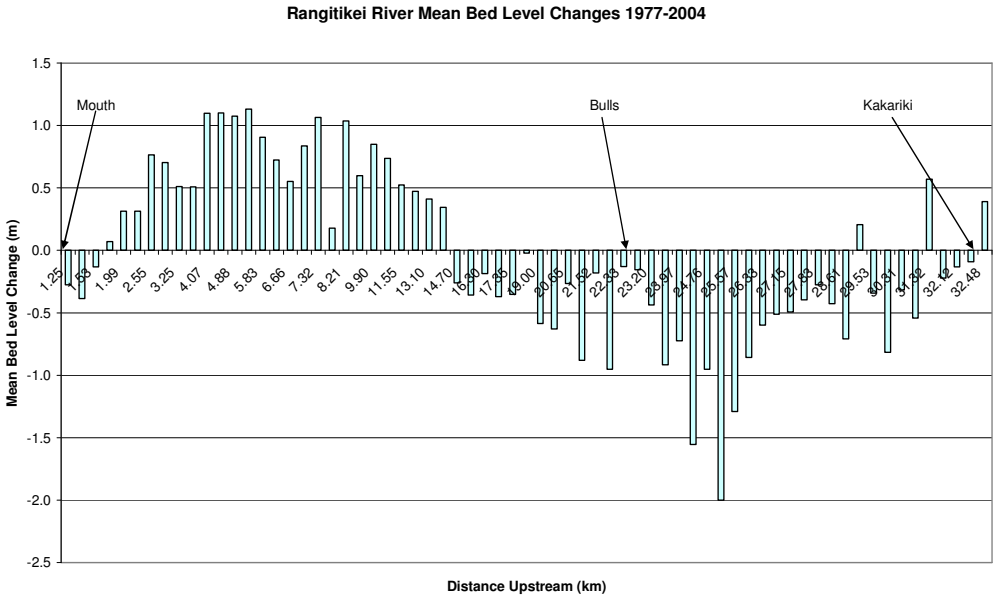

Figure 6. Rangitikei River Mean Bed Level Changes 1977-2004

Historic gravel extraction

88. The AC Consulting report states that it is estimated that 2.1 million cubic metres of gravel was extracted from the river channel between Kakariki and the river mouth between 1977-2004. This extraction was undertaken in the reach between 8 km and 32 km upstream of the river mouth. The main extraction locations were at Kakariki, the Bulls Bridge and Taylor Road (being 32 km, 22 km and 12 km upstream respectively). Figure 7 gives a summary of the volumes of extraction between 1977 and post-2004 flood.

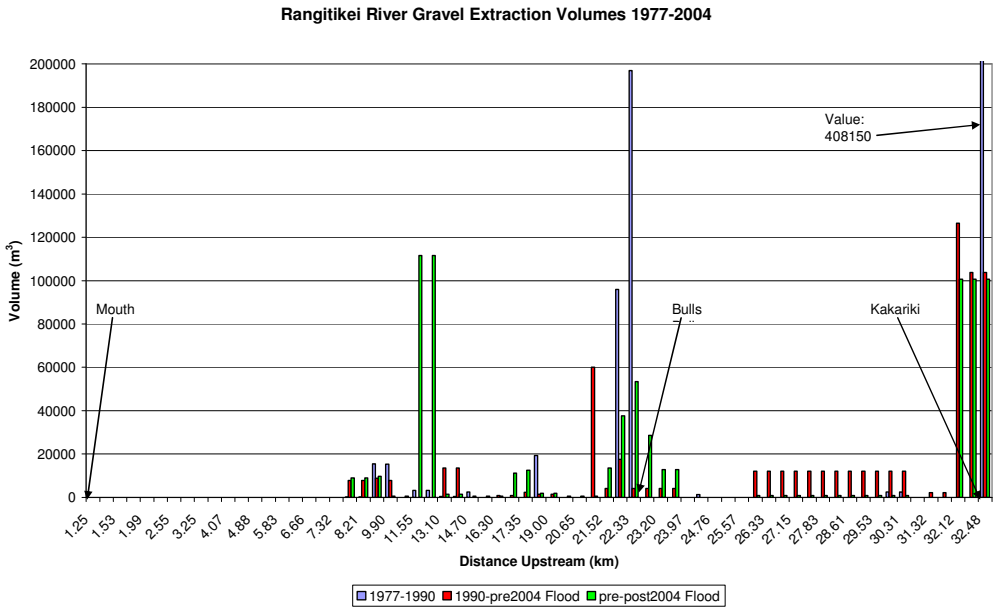

Figure 7. Rangitikei River Gravel Extraction Volumes 1977-2004

89. A further 2.3 million cubic metres of gravel was extracted above Kakariki between 1977-2004.

90. The AC Consulting report concluded that if extraction had not been undertaken then river bed levels would have risen in the order of 100 mm between 1977– 2004, rather than the degradation observed. This shows the positive impact of gravel extraction on flood mitigation. If the status quo of bed levels was to be maintained in the reach from 15 km to 32 km upstream, then the extraction volumes should be halved and extraction totally focused on locations needed for river management. However, there are a number of other factors that need to be considered, including the quality of the material, availability of access to sites and other economic factors.

Future aggradation

91. Future aggradation will consist of a combination of gravel in the bed and both silts and gravels on the berms. While the bed level build-up can be managed to some degree by extraction, there will need to be an acceptance that some aggradation will occur. This is being accommodated in the current stopbank upgrade by including provision for the forecast aggradation over the next 25 years in the stopbank design levels.

92. Aggradation of the berms will lead to difficulties in draining the areas further away from the river and may require the construction of schemes to remove flood waters by pumping.

93. Furthermore, there will be a greater potential for the river to migrate (ie. change course) rapidly during major floods.

94. The reports on erosion in the upper channel indicate that sediment supply remains constant at best; however, it may well increase in the short term due to the increased number of landslides caused by the February 2004 storm. However, a significant component of this will be silt and sand rather than gravel. Increases in the gravel supply will to a reasonable degree be smoothed out down the river as future floods transport sediment. Thus there may only be a slight or nil increase in observed deposition in the lower reaches, although a "spike" in supply is likely, as the 2004 storm was an extreme event.

Future degradation

95. The location and scale of gravel extraction in the degradational reach will need to be modified to prevent degradation. As a general approach, extraction is to be moved as far downstream as is practical. Survey results show that degradation in the reach 15 km to 32 km upstream from the river mouth can be managed to an appropriate level while still allowing significant ongoing extraction.

Review of gravel supply rate

96. Based on the information contained in Appendix 4 of the AC Consulting report, it is possible to estimate the supply rate to the lower 32 km of river. The figures include silt deposition, so an exact gravel quantity cannot be derived. However, after examining where deposition occurred it appears that the supply rate may be higher than the 1994 figure of 20-30,000 cubic metres per year. The estimated supply rates are presented in Table 1.

Table 1. Estimated Gravel Supply Rates - Rangitikei River in Lower 32 km

Period Considered	Total Supply (m^3)	Supply Rate (m^3/year)
1977-1990	803,551	61,700
1990-Pre 2004 Flood	837,259	64,400
Pre-Post 2004 Flood	751,351	-
TOTAL	**2,391,161**	**88,500**

C. Other rivers

97. The detailed information on gravel management in other rivers is contained in the report of Alistair Beveridge, attached as Appendix 2. It is my understanding that the average long-term supply estimates are reasonably close to the mark and that these rivers are not exhibiting gravel management problems. The numbers presented are an indication only and may be refined if warranted once further in-depth information becomes available.

3. EVIDENCE

Background

98. The gravel phase of the river extends from the headwaters to a point downstream where the river grade (ie. slope) is such that either the velocities are inadequate to transport the gravel further, or the small amount that is transported is effectively smothered by the deposition of silt during the later stages of floods. Generally a significant proportion of the deposition of gravel occurs in the reach of river nearing the downstream end or the sand/silt phase boundaries, often where there is a marked drop in the grade of the river. In reaches upstream of this deposition zone there may well be a fluctuation in bed levels according to the spectrum of flood flows experienced. In this reach gravel may also travel down the river in “waves”, resulting in above average bed levels for a while and average, or below average levels at other times. In the upstream reaches there is frequently a “degradational” (ie. bed lowering) trend, except following major storms. Extraction in these reaches should only occur where an “aggradational” (ie. increase in bed levels) problem is evident.

99. Indeed, streams that exit the ranges are often located on aggrading alluvial fans, where naturally substantial deposition will take place following severe storms. This fan-building process means that the streams will periodically “avulse” (ie. change course) and

management of these reaches may be required where adjacent and particularly downstream farmland, houses and communication routes are threatened. Removal of this excess gravel can be totally impracticable, due to the large volumes involved and lack of a marketable use. Therefore, planning options to avoid the risk may be a superior option.

100. In some rivers there are changes in grade from slight to steep, back to slight and then steep again, and these rivers will have complex gravel transport mechanisms.

101. The gravel bed phase is characterised by sustaining flood flows of high velocity, often associated with much turbulence in the water. There will often be much erosion of the bed and/or riverbanks during these floods, transport of the gravel and subsequent deposition. The transported gravel will be "reworked" progressively by the whole spectrum of floods. This reworking often results in the bed material being "longitudinally sorted" (ie. the particle size decreases with distance travelled down the river as larger particles settle into the river bed).

102. One of the challenges facing wise management of gravel extraction is the fact that very large proportions are carried in the major floods of say 5% (20-year) Annual Exceedance Probability (AEP) or greater. This can be at least an order of magnitude more than that carried in small floods (of say 50% or two-year AEP). Thus gravel transport is an extremely episodic process and there can be long periods when rivers carry relatively little gravel. Therefore, the supply rate per year is most definitely not constant and this has to be taken into account when optimising extraction strategy.

103. An example of the history of a stream in changeable climes is the following short case study of the Oruakeretaki Stream near Woodville. A map of this catchment is shown following (Figure 1). This stream has a catchment area of 23 square kilometres immediately above the confluence with the Otomarahu Stream, with the headwaters located in the Ruahine Range. This mountain range was severely eroded in the 1970s, exacerbated by the Cyclone Alison storm of March 1975. The largest rainfalls recorded in this storm were at Pohangina Saddle with a one-day total of 389 mm and three-day total of 612 mm. The south east Ruahine Streams transported vast quantities of gravel over the ensuing decades, resulting in large-scale aggradation in places. This led to threats of this and other streams avulsing if not managed carefully.

104. In recent years the range re-forestation has taken hold and the supply from the Ruahines diminished substantially, with occasional short-term increases following major storms.

105. The river bed on the upper floodplain at the Top Grass Road Bridge appears to be at reasonably optimal levels. There is evidence of when the bed was significantly higher, following the storm erosion of the 1970s, and no doubt this aggradation at the bridge site (and of course elsewhere) heightened the flood risk for some years. Removal of the large amount of excess gravel on the gravel fan was totally impracticable. However, currently the stream bed is above the base of the pile caps and thus just slightly higher than when the bridge was constructed many decades ago.

106. The river bed level downstream at Maharahara Road and Barrow Beach appears to be entirely within the normal range of natural river bed levels.

107. Gravel extraction has proceeded on this river and, combined with ongoing natural river processes, gradually restored bed levels to levels largely similar to the pre-1975 storm levels. Barrow Beach is the principal extraction site currently and is located at the commencement of the drop in grade (some 5 km downstream of Top Grass Road) and also where the river bed widens substantially. Approximately 10,000 m^3 was removed following the 2004 floods. Following extraction of 5,100 m^3 between November 2007 and March 2008, the bed is at the lower end of the optimum level range and thus extraction has ceased there until the supply is replenished.

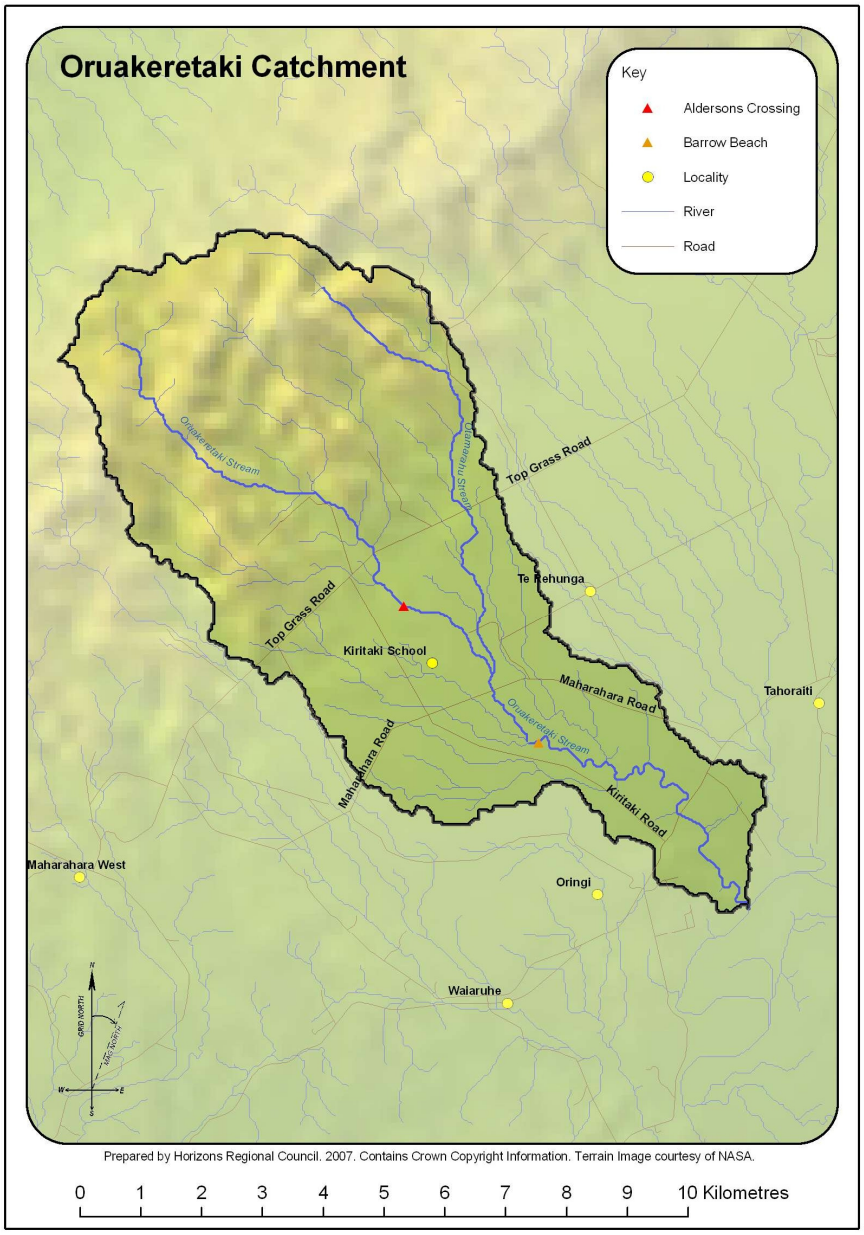

Figure 1. Oruakeretaki Catchment

Rate of gravel transport

108. The rate of gravel transport, and indeed the occurrence of any transport at all, depend on three factors:

i. The depth of the flow (once the river depth exceeds a critical amount, referred to as the "threshold of motion conditions", the gravel can no longer stay still and it starts to move. The bed as a whole continues to provide the necessary resistance,

but as the flow depth increases, the shear force applied to the river by the river bed increases, and more gravel moves.

ii. The gradient of the river (a steeper gradient transports more gravel).

iii. The size of the gravel (smaller gravel is easier to transport).

Gravel extraction policy

109. Gravel extraction policies must take full account of a number of critical factors as follows:

i. Maintaining bed levels within a desirable range.

ii. Keeping bed levels compatible with existing river protection assets.

iii. Keeping roughly in balance with natural supply rates.

iv. Maintaining good river alignments.

v. Minimising any adverse impacts on in-stream and riparian ecology.

vi. Minimising any adverse impacts on tangata whenua values; and

vii. Impacts on the gravel extraction industry.

CRITICAL FACTORS

A. Maintaining bed levels within a desirable range

110. In terms of optimum bed levels there are no set engineering criteria. Each case requires assessment on its own merits and factors these may include whether the prevailing bed level is consistent with the level of installed river protection plantings and protection works. Lowering bed levels excessively may improve flood-carrying capacity, but it can also lead to serious undermining of riverbanks, protection works and bridges. When bed levels are too low these problems are very evident.

111. On the converse side, as previously explained if a stream becomes too aggraded, then flood risks are increased or, in the case of a shingle fan, it may avulse onto a new course, with obviously serious problems resulting. An example of a badly aggraded stream is shown in the picture below of the Kumeti Bridge over State Highway 2 in the Tararua District. This stream has been slowly aggrading for several years and now the bridge has very poor flood-carrying capacity.

Photo 1. Bed aggradation at Kumeti Bridge over State Highway 2

112. While there are no set engineering criteria, there are some major themes as follows:

i. The depositional zone is obviously the appropriate place to extract gravel. If extraction does not proceed in this reach then both the flood risk in that area will be aggravated and the river may change course.

ii. Extreme care must be taken in a reach that is degrading, or is already degraded, possibly because of over-extraction in earlier times.

iii. Rapid aggradation may occur on shingle fans. Where possible, extraction can alleviate attendant flood risks generated and riverbank erosion threats). However, this problem can become almost insurmountable and wise planning of land use is also required to mitigate the hazard.

113. Refer to Figure 2: Gravel Extraction Strategy: Optimum Bed Levels.

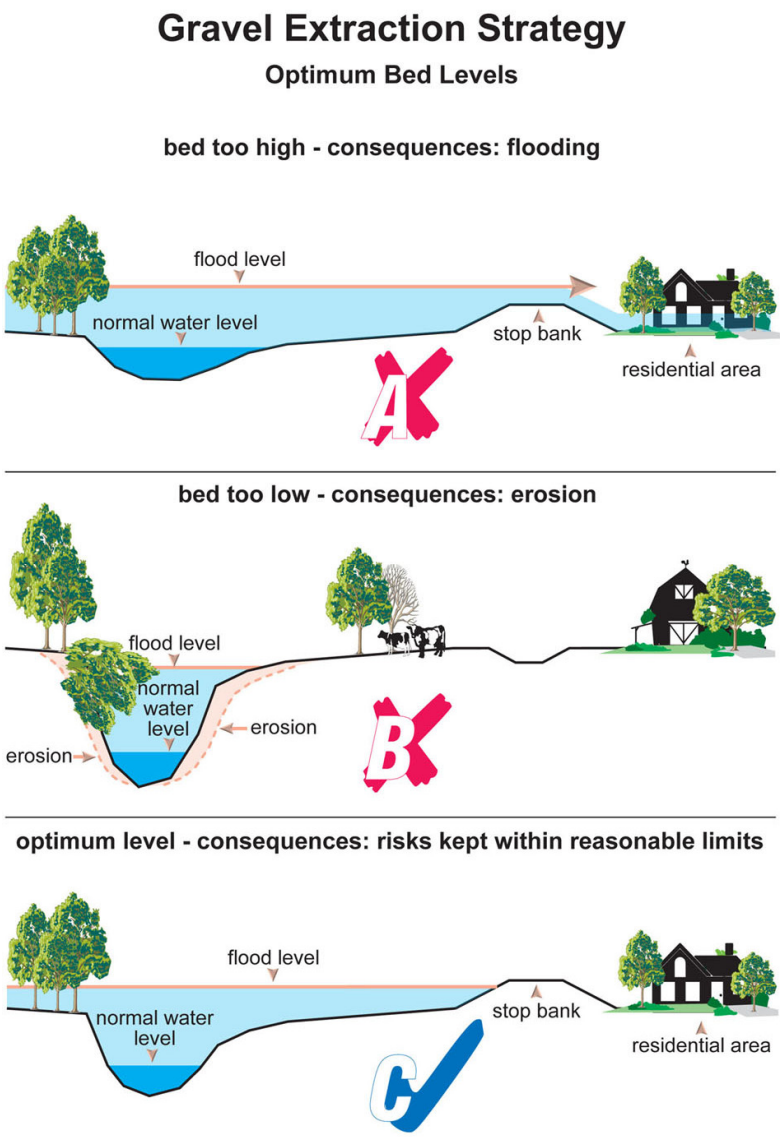

Figure 2. Gravel Extraction Strategy: Optimum Bed Levels

B. Keeping bed levels compatible with existing assets

114. In determining the optimum bed levels heed needs to be taken of the levels of other assets. In particular it is imperative that bed levels do not degrade below the prevailing levels for river protection works in the vicinity – be they rock riprap linings, groynes, protection plantings or some other works. If the bed is allowed to degrade below the levels of these works, plus their allowance for scour during floods, then the works may well collapse, resulting in significant erosion.

115. Conversely, it may well be the case that the river protection works have been installed when the river bed is slightly below the natural level. Unless there is good reason it may well be better to accept that level as part of the optimum range. The Otaki River reach extending upstream of State Highway 1 is a good example of this. For several decades there was very large-scale extraction on this river, and a substantial supply of gravel following two cyclones that damaged the Tararua Range headwaters in 1936. The bed levels dropped to slightly below the expected natural levels and over time protection works were installed commensurate with the prevailing river bed levels. Following a report from Mr Gary Williams in the late 1990s, Wellington Regional Council adopted his recommendation to retain that slightly lower level as part of the optimum range, and this also assisted in reducing flood risk to Otaki.

116. It is obviously important that the extraction of gravel does not cause the undermining of bridge foundations and the undermining or exposure of service crossings, such as gas lines or sewer lines. An example of this is where bridge foundations on the Ohutu Bridge on the Whakatane River, in Bay of Plenty, were undermined following gravel extraction combined with an aggressive period of flooding. This led to the collapse of one span of the bridge.

117. In the background short case study the levels of the river bed at the Top Grass and Maharahara Road bridges are at appropriate levels and extraction has posed no threats to the structures – although there is a series of weirs constructed to maintain bed levels below the Top Grass Road bridge. These are located to handle natural variations in river bed levels and are unrelated to previous gravel extraction.

C. Keeping roughly in balance with natural supply rates

118. In terms of a holistic overview the total gravel extracted from the river system must not exceed the total gravel supplied to the river. Failure to observe this principle is likely to see a progressive decline in river bed levels, with the attendant undermining of riverbanks and structures. It has to be recognised that the supply of gravel is episodic; therefore the match between gravel supplied and extracted will not be exact year by year. It is the long-term match that is important.

119. The supply quantities presented in Tables 6.3 and 6.4 of the Proposed One Plan as notified have been adjusted to present estimates of the long-term supply rates. They are not maximum rates, except for the Lower Manawatu River, where the rates are based on the maximums specified in the global consent for gravel extraction granted to

Horizons in 2008, for 20 years, expiring on April 2028. The supply quantities are based on several sources of information, as follows:

i. Detailed cross-sectional analyses of the mass balance between successively recorded river surveys, taking account of recorded extraction. Particularly detailed analyses have been conducted on the Lower Manawatu and Rangitikei Rivers (refer Section 2 of this report).
ii. Examination of past extraction rates and the response of river bed levels.
iii. Examination of unit supply rates per unit of headwaters catchment area.

120. In some New Zealand rivers there has been excessive extraction, partly related to an out-dated river management practice aimed at creating a "single thread channel". The aim of this practice was to confine sometimes braided rivers into a single main channel. The theory was that "entrenching" the river would reduce flood risks and reduce the river's propensity to change course. Riverbank protection works were placed on the outside of bends to maintain the channel location. Gravel extraction was utilised to assist in this aim.

121. Unfortunately, this practice often led to increased bank and bed erosion, with the river's forces focussed into a narrower channel, and both erosion and river management costs increased significantly while flooding largely decreased. Only in a few river reaches was this approach successful overall and the practice has not been applied for about 20 years.

122. Thus in some river reaches there are occasions when a suspension of extraction can be warranted, and this is an exception to matching supply and extraction.

123. A further factor of importance is to ensure that the supply of gravel to downstream reaches is not adversely reduced. Interception of gravel can cause downstream channel lowering. This is one reason why the gravel depositional reaches are prime candidates for wise extraction. The submission to the Proposed One Plan from Byford's Quarry, while having several other helpful points, states, "*In reality HRC may be better to encourage the removal of gravel from nearer the source rather than allow it to accumulate in the river system".* Unfortunately this practice will result in degradation of downstream river reaches in most cases.

124. An example of this is an assessment by OPUS International Consultants Ltd of the Manawatu River for Horizons. This assessment showed that the average rate of gravel transport at river distance 79.35 km (a few hundred metres upstream of Fitzherbert

Bridge in Palmerston North city) was 15,000 cubic metres per year. At this site there is in fact no gravel available for extraction as the transport both into and out of the reach is 15,000 cubic metres per year; thus any extraction will lower the bed either at that immediate location or in the reach downstream.

125. This shows that the total river system needs to be considered when setting extraction strategy.

D. Maintaining good river alignments

126. A common problem on river bends is the development of an asymmetrically shaped channel. The channel on the outside of the bend tends to deepen, due to the higher velocity of the river and the scouring and eddying generated as the river changes direction through the bend. As this process continues the riverbank on the outside of the bend becomes prone to erosion.

127. Conversely, on the inside of bends the river tends to deposit both gravels and silts. Beaches form and grow on the inside of the bend. The build-up on the inside of the bend pushes more of the flow to the outside of the bend. Therefore, frequently the more the asymmetry develops, the more the propensity towards asymmetry increases, although the rate of change varies for each situation.

128. Looking at the river bend in plan form (ie. “from the sky”) the bend shape begins to sharpen and a serious misalignment of the river channel may result. The result is severe turbulence and energy losses at the bend, which causes erosion and a rise in upstream flood levels.

129. A common way of arresting this process is to lower the beach on the inside of the bend, thereby both increasing the cross-sectional area and reducing the misalignment of flow. This reduces the erosive forces on the outside of the bend.

130. This application of gravel extraction thus improves the river alignment and has a very positive influence on reducing erosion. While this is sometimes only a temporary benefit, it provides an effective river management tool for usually a significant period of time.

131. When a river reach is in a degraded state, gravel extraction is not normally an appropriate tool. That is because extraction will remove gravel from the total river system resulting in a vicious cycle of degradation and further cross-section asymmetry

both locally and downstream, and also in the immediate vicinity upstream. The asymmetry becomes more pronounced, because the level of the invert (ie. base) of the river bed is significantly lower than normal relative to the level of the surrounding terrain. The beaches in this situation indeed appear high visually, but this is due to the degraded river bed levels.

132. Only in a very sharp bend and where other options (rock riprap linings etc) are cost prohibitive should extraction occur in a degraded river reach. This should be strictly limited.

133. Refer to Figure 3: Gravel Extraction Strategy: Remedying Erosion Risks at Bends.

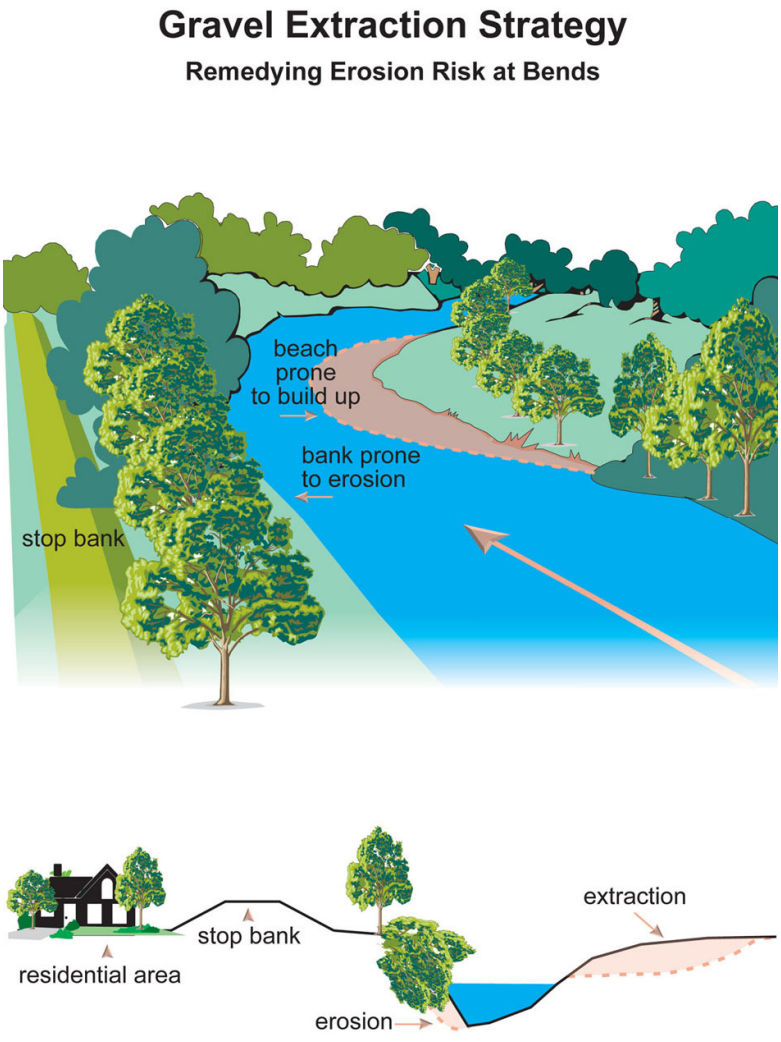

Figure 3. Gravel Extraction Strategy: Remedying Erosion Risks at Bends

E. Minimising any adverse impacts on in-stream and riparian ecology

134. Minimising any adverse impacts on in-stream and riparian ecology is covered in detail in the evidence of James Lambie.

F. Minimising any adverse impacts on tangata whenua values

135. All rivers and streams are regarded as "taonga" (highly regarded physical or spiritual treasure) by the respective tangata whenua. As such the tangata whenua expect wise environmental management of these taonga. Therefore, gravel management has to be carried out in a fashion that minimises and avoids adverse environmental effects. Any extraction that causes erosion, flood risk, siltation, pollution, and landscape or other impacts would be culturally offensive.

136. The tangata whenua, in conducting their right of "kaitiakitanga" (the ethic of stewardship and guardianship) under the Treaty of Waitangi, and pursuant to Section 7(a) of the Resource Management Act 1991 (RMA), wish to have an appropriate level of consultation in gravel extraction. In the global consent granted to Horizons in 2008 for gravel extraction in the Lower Manawatu River, condition 10 required the consent to be exercised in accordance with the provisions of the Protocol entitled Protocol between Manawatu-Wanganui Regional Council (HRC) (Operations) and Tanenuiarangi Manawatu Incorporated (TMI) dated 14 April 2008, or any approved updates of that Protocol.

137. This Protocol required the following:

i. Horizons to provide to TMI the draft annual plan of the future year's gravel management works (covering a description of the proposed activities, including locations, extraction quantities and work methodologies).
ii. Horizons to provide TMI with an annual report on completed works.
iii. An annual meeting to be held with TMI.
iv. TMI to be advised of any indigenous tree logs found in dry beach deposits.
v. TMI to conduct site visits.
vi. Horizons to abide by TMI's accidental discovery protocol.
vii. Horizons to advise TMI of the review of the five-year survey, prior to finalisation of the review.
viii. Horizons to advise TMI immediately where any other activities are proposed or occur as part of the global consent and TMI be given opportunity to comment before commencement of the activity.

138. Condition 11 of this consent required the outcomes of the annual meeting to be advised to Horizons' Environmental Compliance Manager.

139. Obviously, great care has to be taken to avoid damaging any wāhi tapu sites and gravel extraction must stay well clear of these. Should any sites be discovered then works should cease on that site and appropriate procedures followed.

G. Impacts on the gravel extraction industry

140. The role of the gravel extraction industry is obviously key to enabling gravel extraction. Therefore, this industry must receive some certainty on likely extraction quantities. The supply quantities presented in Tables 6.3 and 6.4 of the notified Proposed One Plan have been adjusted to present estimates of the long-term supply rates and will give a good guide to the gravel extraction industry on long-term gravel availability.

141. At the same time, gravel can only be taken in appropriate quantities from locations where it will provide benefit to the river system. It cannot be taken from areas where there will be no benefits and resultant damage such as undue degradation and other environmental effects.

Recommended matters of discretion

142. Based on the critical factors outlined preceding (including the detailed report of James Lambie) the following are matters of discretion that should be considered when writing any gravel extraction rule:

a. Volume of gravel extracted.
b. Location of gravel site.
c. The extent and nature of disturbance to or deposition on the bed.
d. Rate, timing and duration of extraction.
e. Location of gravel stockpile area (s).
f. Effects on aquatic habitats.
g. Overall effect on water quality.
h. Effects on riparian margins.
i. Effects on channel, bank and bed stability.
j. Erosion and flooding issues.
k. Effects on public access.
l. Procedures in the event of discovering or disturbing an archaeological site, wāhi tapu or kōiwi remains.

m. Dust management.

n. Financial contributions.

o. Duration of consent.

p. Review of consent conditions.

q. Compliance monitoring.

Specific analyses

A. Lower Manawatu River

143. Much of the following discussion relates to the recent global gravel extraction consent that Horizons Regional Council applied for on 4 October 2007. This consent was granted on 21 April 2008 and the consent decision is attached in Appendix I. A map of the Lower Manawatu River is shown following (Figure 4).

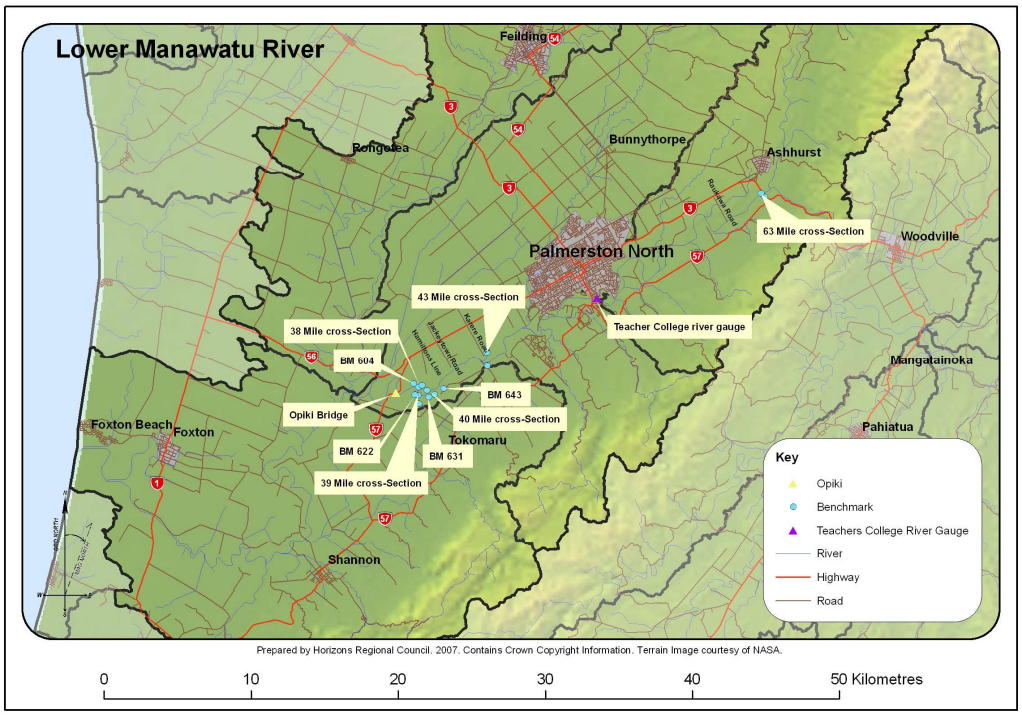

Figure 4. Lower Manawatu River

Introduction

144. The Manawatu River rises in the southern Ruahine and northern Tararua Ranges. The total catchment area is about 6,000 square kilometres, of which 60% is to the east of the

ranges. Water from the eastern part of the catchment discharges through the Manawatu Gorge. The river downstream of the Gorge is known as the "Lower Manawatu River".

145. While the Upper Manawatu River is mostly entrenched, the Lower Manawatu River is not. It flows through the fertile alluvial plain it has created, and historically used to spread its floodwaters over much of that plain quite frequently, until flood protection works were constructed.

The Lower Manawatu Flood Control Scheme

146. The first flood protection works on the Manawatu River were constructed in the 1920s. The Lower Manawatu Flood Control Scheme (LMS) was a comprehensive flood protection scheme constructed between 1959 and 1965. The LMS boundaries are legally defined, and all property owners within the boundary are required to pay rates. The rates payable are a proportion of the Capital Value (CV) of the property, and vary according to the degree of benefit received.

147. The LMS protects 280 square kilometres of pastoral, horticultural and urban land from flooding by the Manawatu River and its major tributaries between Ashhurst and the sea, relying mainly on stopbanks to contain the water. A total length of 250 km of stopbanking was constructed, with 150 km containing the Manawatu River, and a further 100 km containing the major tributaries.

148. Other works include riverbank protection in the form of riprap linings made of rock or concrete rubble, and live willow protection. The purpose of riverbank protection is to prevent the river from eroding the ground out from underneath the stopbanks.

149. The consequences of stopbank failure during a major flood are severe. In Palmerston North, thousands of houses can potentially be flooded, with damage costs amounting to hundreds of millions of dollars. In the rural areas, thousands of hectares can be flooded, with damage costs amounting to tens or hundreds of millions of dollars.

Gravel river bed

150. The Manawatu River has a gravel bed between its headwaters and a point just downstream of Hamilton's Line, near the Opiki Bridge on State Highway 56 approximately 15 km south west of Palmerston North. Most of the time the gravel remains stationery, but in times of flood the river moves gravel in the downstream

direction. In most years there are one or two floods large enough to move significant amounts of gravel. In a dry year the river moves very little gravel, but in 2004 there were six floods large enough to move significant quantities of gravel.

151. For the 30 km reach between the Manawatu Gorge and Karere Road, the river bed level has become progressively lower as time has gone by. This is largely due to commercial gravel extraction. Without gravel extraction, as the gravel migrated through the reach the bed level would fluctuate a little, but there would be no significant long-term trend for it to aggrade or degrade (ie. become progressively higher or lower). A state of dynamic equilibrium would exist, and it will in fact exist once this proposed gravel management regime is in operation.

152. Downstream of Karere Road, the river bed is aggrading. The gravel accumulates because the gradient is flat, and therefore the river flows too slowly to keep the gravel moving.

153. Historically, gravel extracted from the Manawatu River downstream of Ashhurst has been a valuable resource, used in concrete aggregates, roading works, and other construction works. The Region has gained considerable economic benefit from this readily available resource, but it has been clear for a number of years that the historic rates of gravel removal from the river are not sustainable, because they have resulted in a continuous lowering of the river bed, a process known as degradation.

Armour layers

154. A discussion of the formation and behaviour of armour layers is relevant to an understanding of gravel transport processes in the Manawatu River, and the impact of the proposed gravel management activities.

155. Large samples of gravel obtained from beaches in the Palmerston North urban reach of the river were tested, and found to have a median stone size of 20 mm. In other words, when the samples were tipped into a sieve that had a 20 mm square mesh, half of the sample by weight passed through the sieve, and half was retained by the sieve.

156. However, gravel on the surface of the river bed tends to form an “armour layer”, consisting of larger stones than found in the gravel below the surface. Gravel samples consisting of very thin layers skimmed off the surface of the beaches were found to have a median stone size that was typically about 50 mm.

157. When the Manawatu River experiences a flow larger than about 1,100 cubic metres per second (cumecs), the armour layer is disrupted, and general movement of the gravel bed occurs. Smaller flows cannot exert enough force on the gravel to cause such disruption.

158. If there is no armour layer, the median stone size on the surface of the beach would be 20 mm rather than 50 mm. A flow of about 600 cumecs would be able to mobilise that gravel. A flow of 600 cumecs is exceeded on average once every three months, compared with once every eight months for an 1,100 cumec flow.

159. The armour layer is formed by a process of "winnowing" fine material. As flood flows diminish, the force exerted on the stones diminishes and the larger stones stop moving, leaving the smaller stones to continue being transported downstream. This is a simplistic explanation, and the actual mechanism of armour layer formation is often debated in academic circles. The most important point is that armour layers are a real and observable feature of rivers with gravel beds.

160. The above flow figures at which gravel movement is initiated are averages. The actual flow that initiates gravel movement depends on the recent history of floods, or lack thereof. If there have been no recent floods large enough to move gravel, and only the occasional fresh carrying suspended sediment, the spaces between the stones will fill up with the fine sediment, and "lock" the armour layer into place. A flood rather larger than 600 or 1,100 cumecs would then be needed to cause gravel transport. If on the other hand a large flood has occurred recently, the gravel will be in a very loose state, and easily transported by smaller floods.

Impact of river bed degradation on the Lower Manawatu Scheme

161. If bed degradation continues to occur in the Manawatu River, the edge protection will eventually be undermined, and will fail. The resulting erosion of the riverbank has the potential to undermine stopbanks and the consequences of stopbank failure are likely to be severe, as already discussed.

162. Even if the stopbanks remain intact, replacement of the channel edge protection would be expensive. The most expensive rock linings in the LMS cost up to $3,000 per linear metre. If degradation continues, the riverbanks will become progressively higher, large volumes of material will collapse into the river when slumping occurs, and repairs will be increasingly costly.

163. For these reasons, gravel management aimed at avoiding bed degradation is an essential component of programmes for maintaining the integrity of our flood protection structures.

Impact of river bed aggradation on the Lower Manawatu Scheme

164. Aggradation of the river bed downstream of Karere Road has already caused a loss of flood carrying capacity, and will continue to do so unless we remove the excess gravel. During the flood of February 2004, flood levels were higher than expected, in part because of the gravel aggradation. Fortunately, freeboard was generous in the affected reach and the stopbanks were able to contain the flood in that reach. However, the risk of a stopbank failure will obviously continue to increase if no action is taken.

165. Closure of State Highway 57 at the Opiki Bridge south west of Palmerston North, due to inundation by the river now occurs more frequently than in the past. This is a result of gravel aggradation. The northern approach crosses the floodplain between the bridge and the true right stopbank, and consequently is occasionally submerged by the river, for up to three days at a time. Before February 2004 the river flow had to exceed 1,200 cumecs before the road could be flooded, whereas now a flow of 950 cumecs is sufficient to cause flooding. The average intervals between floods of this size are 14 months and six months respectively.

Consents issued in 2001

166. A report prepared by Gary Williams in 2001 confirmed that gravel extraction in the Lower Manawatu River was occurring at an unsustainable rate, and would have to be reduced. This was clearly signalled to applicants who obtained consents in 2001. The background section of gravel extraction consents issued in 2001 contained a note advising applicants that applications had been placed on hold pending further investigations, and that gravel extraction would be allowed to continue for a further five years, during which time alternatives would be investigated.

Investigations since 2001

167. After 2001 it became clear that for much of the river, the sustainable rate of gravel extraction is very low, and possibly zero. In particular, a few sub-reaches of the river were studied in response to applications for consents to extract gravel. In most of the reaches studied, it appeared that over a 10-15 year period, the volume of gravel

removed approximately equalled the volume of degradation. Thus little or no gravel could be removed on a long-term sustainable basis.

168. A comprehensive study of the gravel reach, as alluded to in the 2001 consents, was required to determine the sustainable limits to extraction on a reach by reach basis, and also the location of river reaches where any gravel removal is not sustainable. Opus International Consultants were commissioned by Horizons to carry out a study. Their completed investigation, entitled Lower Manawatu River Gravel Resource Study, confirmed that most of the LMS gravel reach could sustain little or no ongoing removal of gravel.

OPUS investigation

169. The OPUS investigation was based mainly on Horizons' archive of surveyed cross sections, and records of gravel extraction quantities. The study was limited to surveys carried out from 1991 onwards, because gravel extraction records before 1991 are unreliable or non-existent. A total of 96 sections have been surveyed, some only twice since 1991 and others as often as six times.

170. To quote from the report summary, the principal findings are as follows:

171. "The overall impression that these approximate sediment budgets give is that the volume of bed degradation in the 98 to 63 km reach (63 to 40 miles) broadly matches the total volume of losses from gravel extraction and abrasion (although the latter component is minor). This implies that, if no gravel extraction occurred in this reach, the river would be close to a natural state of equilibrium with the rate of sediment supply to the reach approximately matching the sediment transport capacity through the reach, and the bed profile remaining constant over time. In other words, the amount of sediment moving into the reach as a result of flood activity would be approximately matched by the amount of sediment being transported out."

172. Most of the Lower Manawatu gravel reach was found to have degraded, but a reach of several kilometres at the downstream end of the gravel is aggrading. This is due to the gradient flattening off, and reducing the river's ability to transport gravel.

Transition from degradation zone to aggradation zone

173. The OPUS report did not clearly locate the transition between degradation and aggradation. There are difficulties in defining the transition, because not enough cross sections have been surveyed, and also because some of the sections showed considerable lateral movement, thereby masking trends in cross-section changes.

174. The OPUS study was therefore augmented by some further investigations carried out by Horizons' staff. Aerial photographs taken over several decades were compared, and cross sections surveyed before 1991 were studied. Surveys before 1991 were not used for the OPUS study because inadequate gravel extraction records prevent meaningful conclusions from being reached over most of the gravel reach. However, it is likely that not much gravel was extracted historically from the aggradation reach, so older surveys were used to provide further information about the transition from the degradation to the aggradation reach.

175. The conclusions about the transition from degradation to aggradation are as follows:

176. Degradation has occurred between Ashhurst and Karere Road.

i. Between Karere Rd and a point a few hundred metres downstream of Jackeytown Road, there is uncertainty as to the long-term trend for aggradation or degradation. The best interim assumption is that the reach is naturally aggrading slowly, and that ongoing extraction has occurred at approximately the rate of aggradation. However, this needs to be confirmed by further monitoring.

ii. More than a few hundred metres downstream of Jackeytown Road, aggradation is occurring. The reach clearly aggrading is 5 km long, and the worst of the aggradation probably occurs in the last 2 km.

Availability of gravel between Ashhurst and Karere Road

177. In the long term there is little or no gravel available for commercial extraction from the Manawatu River between Ashhurst and Karere Road. This is because the OPUS study shows that the long-term average rate of gravel transport is almost the same at any point in the Ashhurst to Karere Road reach.

178. Bed degradation is greatest at the locations where the greatest volume of gravel has been extracted. The most pronounced degradation in the Lower Manawatu gravel reach has occurred at the right angle bend about 1 km downstream of Raukawa Road.

However, gravel has been extracted at many locations, and consequently the entire bed between Ashhurst and Karere Road has been lowered to varying degrees over time.

179. It is concluded that, for the Ashhurst to Karere Road reach, ongoing regular removal of gravel for commercial reasons must cease.

180. If a large number of sites experience gravel extraction, as has happened historically in the Lower Manawatu River, the degraded reaches will eventually overlap, resulting in a generally degraded river.

181. This is in contrast to downstream of Karere Road, where the gradient decrease becomes very pronounced and considerably reduces the river's ability to transport gravel. Hence the aggradation downstream of Karere Road.

Management of gravel between Ashhurst and Karere Road

182. Gravel often builds up on a beach, and causes flows to be concentrated against the opposite riverbank, thereby causing erosion. In the past the most frequently used way of managing these build-ups of gravel was simply to remove them from the beach. The gravel is completely removed from the river system, and used for commercial purposes. The end use means that the gravel can be removed at no cost to the Lower Manawatu Scheme.

183. However, while total removal of gravel is a short to medium term solution to the bank erosion problem, in the long term it contributes to the degradation problem, which in turn contributes to erosion problems.

184. There are four main options for removing the gravel:

i. Allow the gravel to build up, and strengthen the edge protection on the opposite bank to prevent erosion.
ii. Allow the gravel to build up, and allow erosion of the opposite bank, rather than spending money protecting it.
iii. Gravel raking, or mechanical loosening of the gravel on a beach to make it easier for the river to transport the gravel off the beach.
iv. Pick the gravel up off the beach and redistribute it elsewhere in the active channel.

185. The first two alternatives have rather limited applicability. The improved edge protection for alternative (a.) would often be very expensive. Beach build-up in a stable or

degrading reach is usually accompanied by deepening of the trough around the outside of the bend. Thus existing protection could be undermined, and new protection would have to be founded at a sufficient depth to ensure undermining did not occur.

186. Alternative (b.) is frequently not acceptable. It is essential to the integrity of the LMS that stopbanks should not be undermined, so any bend migration that could threaten a stopbank has to be prevented.

187. Even where no stopbank is under immediate threat, bank erosion can create new problems. Serious erosion changes the alignment of the river, and could potentially redirect flows in a way that causes new erosion problems elsewhere. If substantial bank erosion releases large quantities of gravel into the river, that gravel will be deposited further downstream and could also cause new erosion problems, or exacerbate existing problems. Bank erosion can also cause loss of flood carrying capacity if the quantities are large enough.

188. In future, we will be dependent mainly on alternatives (c.) and (d.), facilitating the removal of problem gravel deposits by the river, or the removal of gravel from the beach and redistribution elsewhere in the active channel. These alternatives will both disrupt the armour layer and make it easier for the river to carry the gravel.

Permissible gravel extraction between Ashhurst and Karere Road following large floods

189. There might be some occasions when there will be a need to extract gravel. Large floods temporarily alter the usual state of dynamic equilibrium, and can introduce additional gravel into the river. Such floods would probably have return periods of at least 20 years. The additional gravel would come from one of three sources:

i. Massive lateral erosion that resulted in major deposition downstream of the erosion site.

ii. Gravel introduced from the Pohangina River into the Manawatu River at Ashhurst. This would be gravel that accumulated in the Pohangina's upper tributaries in the February 2004 event, and was carried downstream by subsequent large events. This has not been quantified, but does not appear to be imminent.

iii. As a consequence of works such as the proposed river realignment at Anzac Park in Palmerston North.

190. Following a flood of 20-year return period (ie. 5% AEP) or more, a one-off removal of gravel might be required in locations and quantities that would have to be determined at the time. A total quantity of 50,000 cubic metres over the 20-year period was allowed in the consent conditions. The intention is that gravel should only be removed when flood carrying capacity has demonstrably been lost, and gravel raking or redistribution are not expected to be adequate responses.

The aggradation reach downstream of Karere Road

191. In this reach the gradient is flatter than upstream of Karere Road, and the ability of the river to transport gravel diminishes progressively downstream of Karere Road. Consequently, the natural process is for aggradation to occur. It is therefore necessary to remove gravel from the active river bed to avoid loss of flood carrying capacity.

192. It is proposed to remove enough gravel to restore the channel cross-sectional area that existed in 1993. The 1993 survey was used to calculate design levels for the LMS design upgrade approved in 1999. It has been assumed in the recent upgrade proposals that the 1993 cross-sectional area would be restored.

193. The reach can be subdivided into two sub-reaches, with somewhat different characteristics:

i. Karere Road 1 km downstream of Jackeytown Road.
ii. 1 km downstream of Jackeytown Road to 2 km upstream of Opiki Bridge.

Karere Road to 1 km downstream of Jackeytown Road

194. This 3.5 km reach has a tendency to aggrade, but the aggradation is much less severe than in the reach further downstream. The alignment is reasonably stable, which would not be the case if aggradation was severe.

195. It appears that the volume of gravel extraction in recent years has approximately equalled the volume of aggradation. Extraction volumes have varied but have usually been in the order of a few thousand cubic metres per year. It is concluded that in general the future rate of gravel extraction should equal the past rate.

196. However, there was a significant build-up of gravel in the flood of 2004, and it appears that a large one-off extraction is required to remedy this deposition episode.

197. The quantity is uncertain because survey data is sparse. However, the one-off extraction volume could be in the vicinity of 70,000 cubic metres. This is in addition to the one-off extraction consent granted to Mr. B. Whitelock in December 2005.

1 km downstream of Jackeytown Road to 2 km upstream of Opiki Bridge

198. This 5 km reach is aggrading severely, and as a result flood carrying capacity is being lost. The 2 km at the downstream end of the reach is noticeably the worst section of the reach. The situation is comparable to the Kopane reach on the Oroua River, and the Rangitikei River downstream of the Bulls Bridge.

199. A sharp transition from mild to severe aggradation at a point 1 km downstream of Jackeytown Road is made very evident when historic aerial photographs are inspected. Upstream of this point the alignment is very stable, whereas downstream the meander system migrates actively. Rapid and high build-up of gravel on beaches causes erosion of the opposite bank, and liberates further gravel that in turn deposits further downstream and exacerbates erosion problems there.

200. The sharp transition from stable to unstable alignment corresponds precisely with a marked flattening of the flood gradient, and a corresponding reduction of flood velocities.

201. It appears that in the absence of major floods, approximately 15,000 cubic metres per year needs to be extracted from the 5 km reach.

202. A large one-off extraction of perhaps as much as 200,000 cubic metres is needed as a consequence of the 2004 floods. This estimate can be refined by resurveying four more cross sections.

203. Accuracy of aggradation estimates is further limited by a reach about 1 km long, where there is major instability of alignment. Over-plots of resurveys of the four cross sections from BM 631 to BM 643 show major changes in cross-section location, shape and size. It is anticipated that adequate extraction of aggrading gravel should eventually stabilise this reach.

204. The gravel in the main aggradation reach is less attractive to commercial extractors than is gravel further upstream. The aggrading gravel contains a smaller proportion of large stones, and more sand. For many applications there are larger haul distances. Some incentives may need to be offered to ensure that sufficient gravel is removed.

Management of existing gravel consents

205. The global gravel consent granted to Horizons in 2008 for 20 years represented a fundamental shift in approach for management of gravel extraction for the Lower Manawatu River. In the main there will now be no separate consents issued to commercial extractors. The only party to extract gravel would then be Horizons, which would then select gravel extractors to remove gravel from locations that were appropriate in terms of river management.

206. Therefore essentially all the available gravel in the Lower Manawatu River has been allocated to Horizons, which has developed a Protocol with existing extractors that will implement this new approach.

207. The principal exception to this would be any necessary gravel extraction necessary to realign the river at Anzac Cliff Park in Palmerston North. This will require a separate consent application.

208. The aggradation has an impact on frequency of closure of State Highway 56 at the Opiki Bridge south west of Palmerston North. Before 2004, the road did not have to be closed unless the Manawatu River exceeded 4.9 metres at Teacher's College, which happens on average once per year. The point where the river first overflowed onto the berm before inundating the road was about 300 metres upstream of the bridge.

209. Now the point at which it first overflows onto the berm is immediately adjacent to the 38 Mile benchmark, just over 2 km upstream of the bridge. This happens if the Manawatu River exceeds about 4.3 metres at the Teacher's College monitoring station in Palmerston North, which happens on average twice per year.

210. Gravel aggradation is clearly the cause of the increased frequency of road closure at Opiki.

Management of gravel downstream of Karere Road

211. The main gravel management technique between Karere Road and the downstream end of the gravel phase will be removal of aggrading gravel. However, it is possible that at the upstream end of this reach some redistribution of gravel within the active bed will be required.

212. It will be possible to limit much of the extraction to dry areas of beaches. Most of the cross sections surveyed show build-up on beaches, but little or no build-up in the active channel. In this regard the Manawatu River is quite different from the Oroua River, where in most cases the entire cross section aggrades.

213. The main exception is at the 38 Mile cross section, which is at the last tight U-bend at the downstream end of the gravel phase. At this section the build-up between the 1993 and 2004 surveys occurs across the full width of the section, and varies between half a metre and two metres.

214. Four cross sections in the severe aggradation reach have not been surveyed since the 2004 flood. These should be resurveyed to better define the extent of the aggradation reach that has been subject to gravel build-up across the wetted low-flow channel, as well as on the dry beach areas.

215. Large-scale disturbance of the bed will be necessary to remove the gravel build-up at 38 Miles. An island develops in the channel between 10-40 metres from the right bank, which is the outside of the bend. Access is not available from the right bank because of the depth of the river, and because too much disturbance of the protection planting would be required.

216. The island will have to be removed, and the most practicable way will be to build two causeways to the island from the left bank, one to the upstream end of the island, and one to the downstream end. This would permit better circulation of machinery, and considerably reduce the duration of the activity.

217. Resurveys of cross sections not surveyed since the 2004 flood need to be carried out. They might show that there is only one location where gravel removal from the wetted low-flow channel is required, namely at 38 Miles, and that would be a convenient outcome.

218. However, they might also show the need for extraction below water in other areas. In such locations it would be desirable to lower the entire cross section to the 1993 level, but at this stage it is not clear how feasible that will be. Limitations on the machinery might make it impossible, or very expensive and prolonged to lower the entire section.

Conclusion

219. The proposed gravel management regime is essential to ensure that bed degradation upstream of Karere Road does not occur in the future and that the Lower Manawatu Scheme's expensive bank protection works are not subjected to an increased undermining risk. It is also essential to ensure that vital flood carrying capacity is not lost downstream of Karere Road.

220. The Hearing Committee for the global consent granted consent for a term of 20 years, expiring on April 2028, with the following maximum gravel extraction volumes. These volumes are consistent with the preceding information and include provision for additional gravel generated by floods during this period. The full decisions and conditions are presented in Appendix 1.

i. 700,000 m^3 from the 2 km aggrading reach between BM 604 and BM 622;
ii. 350,000 m^3 from the 2 km aggrading reach between 39 Mile to BM 643;
iii. 300,000 m^3 from the 4 km transitional reach between BM 643 to 43 Miles;
iv. 50,000 m^3 from the 32 km degrading reach upstream of 43 Miles.

B. Rangitikei River

Introduction

221. The Rangitikei River rises in the Kaimanawa and Ruahine Ranges and drains a 90 km length of the North Island Main Divide, from a point east of Rangipo to a point east of Rangiwahia. The catchment area is 4,144 square kilometres. A map of the Lower Manawatu River is shown following (Figure 5). The river carries gravel down to the lower reaches and, as the gradient flattens in the last 15 km, gravel aggrades in this reach.

222. The Rangitikei River Scheme provides erosion control from Rewa to the sea, a river distance of 63 km. No tributaries of the Rangitikei River are included in the Scheme and it does not aim to prevent all erosion. The philosophy is that the river should be allowed to follow its natural processes of migrating meander patterns, provided it does not move outside of a defined zone, which is approximately 500 metres wide, although the active channel is significantly narrower than this. The meander zone is covered in trees, which has the advantage of slowing erosion and the disadvantage of exacerbating silt deposition.

223. In the lower reaches flood protection to approximately 2,000 hectares is provided by slightly over 21 km of stopbanking. The nominal design standard is the 2% AEP (50-year) flood plus 600 mm of freeboard. The stopbanking constructed is intermittent over five locations, with the stopbanks linking into higher ground at each location, with works yet to be completed at Tangimoana.

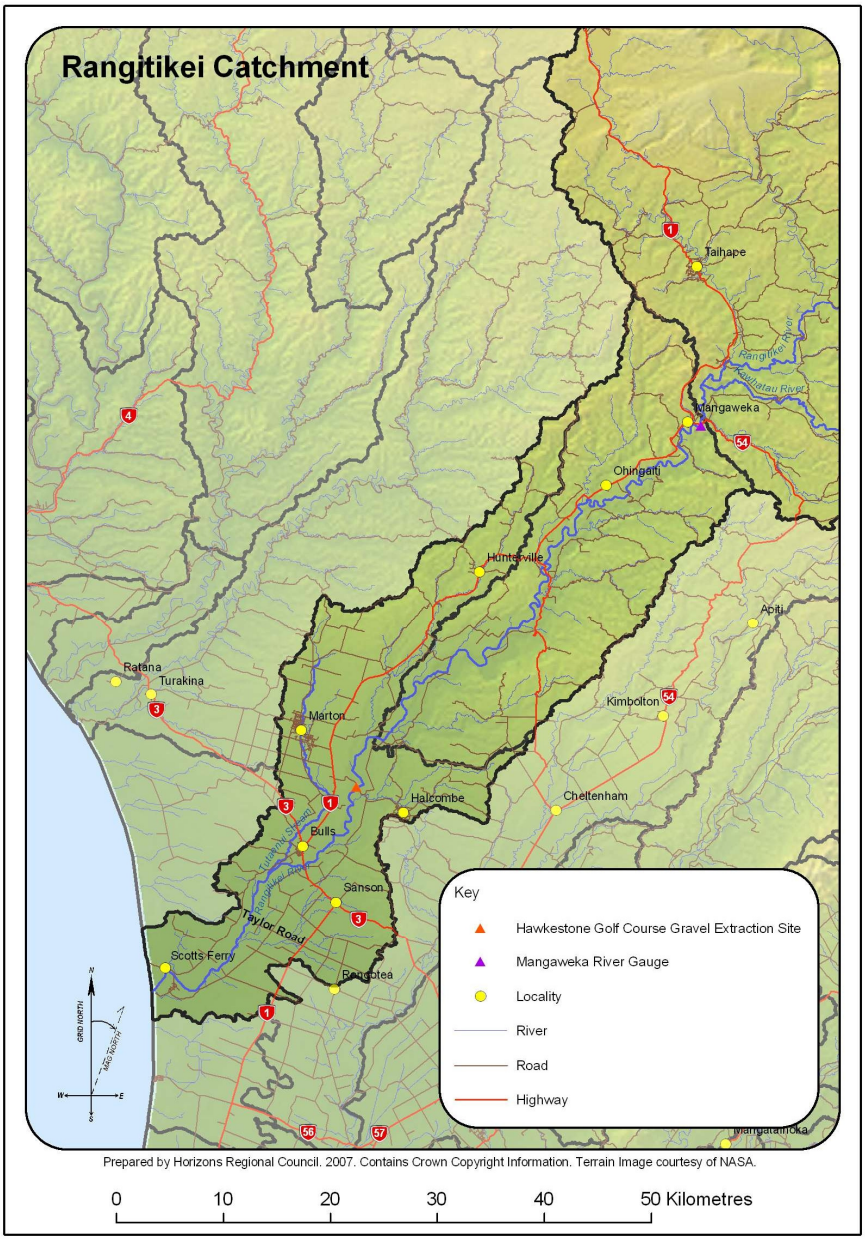

Figure 5. Rangitikei Catchment

224. The Rangitikei River Scheme has had several reviews, the last major one being in 1994. In this review problems of gravel aggradation and berm siltation were identified and a 20-year stopbank upgrade programme was recommended and adopted. The extended period for the flood protection upgrade was recommended because loss of flood carrying capacity was a gradual process and thus the financial impact could be minimised.

225. Following the major 2004 flood, a major review of the stopbank capacity was conducted by AC Consulting Ltd and they completed a full report in March 2006. The peak flow in this large flood was 1,756 cumecs at the Mangaweka gauge (approximately 2% AEP). This resulted in Horizons embarking on a major programme of stopbank upgrades.

226. The significant flood damage sustained in the recent flood of 30 July 2008 showed that a review of current channel management design and service levels is required. The peak flow in this large flood was 1,265 cumecs at the Mangaweka gauge (approximately 10% AEP). Consequently Horizons Regional Council has now embarked on a major review into the channel management of the Rangitikei River Scheme (Rangitikei River Scheme Review No. 4). This review will focus on the channel management, erosion control and gravel management. The Region is currently in a period of increased flood activity and this review needs to confirm or revise current design, with particular regard to Scheme affordability.

1994 Scheme review

227. A full review of the gravel resource was carried out in the report entitled Rangitikei River Scheme Review No. 3, July 1994, Paul Dickson, for Horizons.

228. The conclusions of this review were:

i. Most of the gravel supply to the Rangitikei River is from the Kawhatau River which delivers an estimated average annual supply of 20-30,000 m^3 per year.

ii. More than 120,000 m^3 of gravel had been removed from the Rangitikei and Kawhatau Rivers annually since 1961. This is based on the amounts reported by commercial extractors but these are believed to underestimate the total. The annual amounts exceeded 240,000 m^3 for many years.

iii. Between 1977-90, gravel extraction had caused a mean bed lowering of 0.5 metres in the 28 km reach upstream from the Tutaenui Stream (ie. from 4 km downstream of Bulls to 15 km upstream of the Kakariki Bridge).

iv. A moderate amount of gravel aggradation is occurring as a natural process in the reach from 2.5-14 km. This amounted to an average rate of 26,250 m^3 per year between 1977-89; equivalent to a bed rise of 30 mm per year.

v. The gravel deposition in the reach from 2.5-14 km is causing the main channel to become significantly narrower and shallower.

vi. In the same reach from 2.5-14 kilometres, 3 million cub metres of silt has accumulated on the river margins between 1972-1994, with the average rate of accumulation being 130-140,000 m^3 per year.

229. The review also noted that the average rates of gravel supply and transport may be greatly exceeded in rare (major) flood events; with it being probable that very large volumes of sediment are stored in upper catchments and tributaries, to be moved into storage in lower parts of the river system should a large flood occur. Thus the long-term supply may be greater than estimated.

230. This review considered many factors and recommended that the maximum amounts of gravel extracted should not exceed:

i. 40,000 m^3 per year from the Rangitikei River upstream of 15 km (this was to be from selected beaches to alleviate erosion due to bend deposits).

ii. 35,000 m^3 per year from the Kawhatau River.

iii. Up to a total of 300,000 m^3, and then not more than 25,000 m^3per year from selected beaches in the lower 15 km of the river.

231. An environmental charge of $2.50 per cubic metre has been applied to all gravel extracted from upstream of 15 km and tributaries to cover river management costs in these locations were extraction is almost unavoidable. Gravel extracted downstream of 15 km does not incur this charge.

232. Gravel extraction was to be progressively reduced to the natural supply rate in the degradation area and to a sustainable level in the Kawhatau River. Determination of the time until gravel extraction is stopped altogether in the degradation reach was deemed impractical at that time and needed to be reviewed at intervals of not more than five years. This option will be reviewed as part of the current Scheme review, but there are several factors to consider.

AC Consulting Ltd analysis

233. AC Consulting Ltd carried out a major gravel and flood flow capacity analysis in 2006. The analysis and conclusions are contained in the report entitled Rangitikei River Investigations Kakariki to Tangimoana: Preliminary Design Report, March 2006, Revision C, Graeme Campbell, AC Consulting Group Ltd.

234. The data sets used in the gravel analysis were:

i. 1976-77
ii. 1988-89
iii. 1997-2003
iv. 2004

235. Mean bed levels were calculated. Initially it was planned to carry out separate volumetric analyses for the berm and active channel areas. However, due to substantial channel migration, this separation was not possible. However, the trends identified in the analysis are still valid. The reach above Kakariki was not analysed, as the 2004 cross-section surveys had not been completed through this reach. An analysis of this reach is currently underway as part of Review No. 4.

Past trends

236. The main trend identified in the AC Consulting report is the continuation of degradation in the lower reaches from the river mouth to around 15 km upstream and degradation from 15 km upstream to the end of the study reach at Kakariki, 32 km upstream. There is a small section of degradation in the first 2 km upstream from the river mouth, and this is expected following a major flood. Some sections in the lower reach do not include survey of the berm aggradation, so this is not included in the quantities and the trend near the mouth does not give the total picture. The full area of berm aggradation has been included in the sections from 2 km upstream and the mouth area does not reflect the whole situation. The aggradation that occurred on these 1 km wide berms between 1977 and 2004 is of the order of 500 mm.

237. The average aggradation has been calculated at 25 mm per year over the whole cross-section for the lower 15 km and 20 mm per year degradation above 15 km.

238. Figure 6 gives a summary of the mean bed level changes between 1977 and 2004 for the reach of river from the mouth to Kakariki.

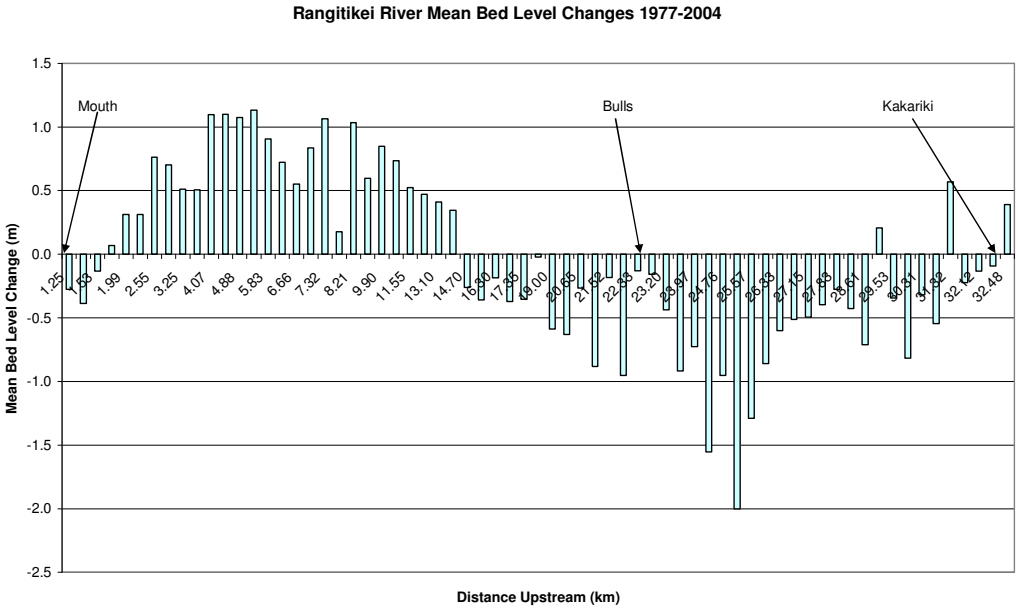

Figure 6: Rangitikei River Mean Bed Level Changes 1977-2004

Impact of the 2004 flood

239. In addition to post-flood surveys, the river was fortuitously surveyed around 2003, making possible an assessment of the impact of this large flood. These surveys have shown a continuation of the long-term trends of aggradation below 15 km and degradation above. In the reach from 3 km to 8 km the aggradation varied between 200-400 mm.

240. Within the reach above 15 km there are two areas of significant aggradation at sections at 29.85 km and 31.32 km. The aggradation at section 29.85 km is a consequence of berm erosion and deposition; that at 31.32 km appears to be the result of build-up of a gravel beach. Extraction on the inside of the bends at both locations will assist channel management, however this needs to be judicious in the long-term to avoid spiralling bed degradation.

Historic gravel extraction

241. The AC Consulting report states that it is estimated that 2.1 million cubic metres of gravel was extracted from the river channel between Kakariki and the river mouth between 1977-2004. This extraction has been undertaken in the reach between 8-32 km upstream of the river mouth. The main extraction locations were at Kakariki, the

Bulls Bridge and Taylor Road (being 32, 22 and 12 km upstream respectively). Figure 7 gives a summary of the volumes of extraction for three time periods – 1977 to 1990, 1990 to pre-2004 flood and pre-2004 flood to post-2004 flood. In some cases, the extraction volumes recorded at specific locations have been averaged over a reach of the river, as this was considered to give a better reflection of the extraction distribution. Care needs to be taken with these figures as they include both extraction from both the active channel and longer-term high beach deposits – and some land-based operations, notably the Hawkestone Golf Course gravel extraction site at Kakariki.

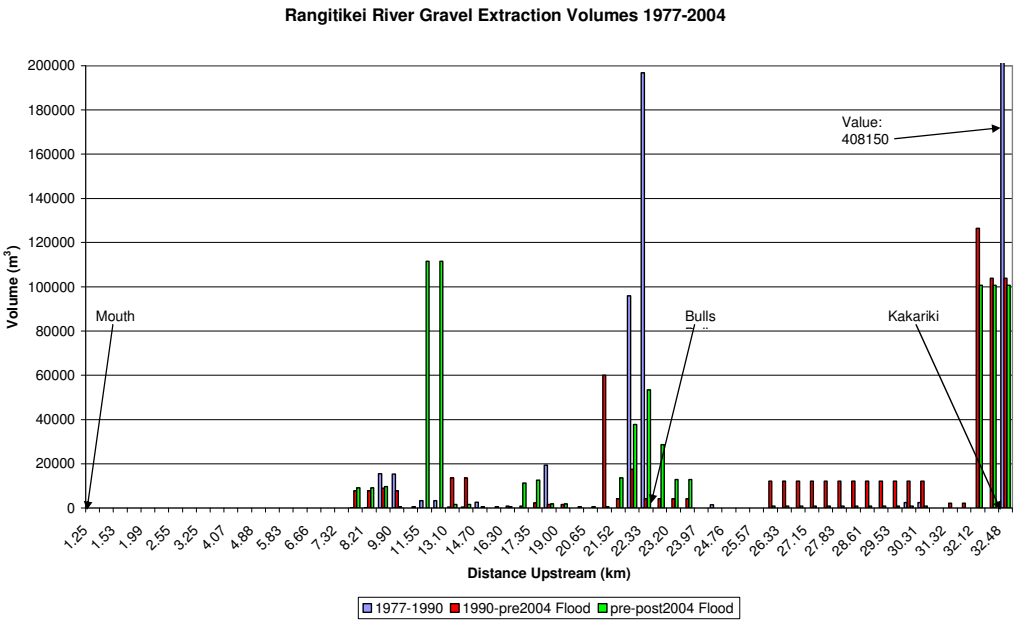

Figure 7. Rangitikei River Gravel Extraction Volumes 1977-2004

242. A further 2.3 million cubic metres of gravel was extracted above Kakariki between 1977-2004.

243. The AC Consulting report concluded that if extraction had not been undertaken then river bed levels would have risen in the order of 100 mm between 1977-2004, rather than the degradation observed. This shows the positive impact of gravel extraction on flood mitigation. If the status quo of bed levels was to be maintained in the reach from 15 km to 32 km upstream, then the extraction volumes should be halved and extraction totally focused on locations needed for river management. However, there are a number of other factors that need to be considered when directing the gravel extraction. These include the quality of the material, availability of access to sites and other economic factors.

Future aggradation & degradation trends

244. Future aggradation and degradation within the river channel is expected to follow the same trends as those of the past 30 years. There is most unlikely to be any changes in river grade, sediment size or flow regime sufficient to change these trends. Extraction will continue to be required as a tool to manage aggradation and river channel alignment. However, extraction alone is unlikely to be sufficient to prevent the aggradation in the lower 15 km or channel migration in the upper reaches.

Future aggradation

245. Future aggradation will consist of a combination of gravel in the bed and both silts and gravels on the berms. While the bed level build-up can be managed to some degree by extraction, there will need to be an acceptance that some aggradation will occur. This is being accommodated in the current stopbank upgrade by including provision for the forecast aggradation over the next 25 years in the stopbank design levels. At some locations, extraction may need to be undertaken to manage the river alignment, whether it is commercially viable or not. However, it will be most important to ensure that bed levels do not drop as a result; and thus the vicious spiral of minimising poor alignments through extraction leading to bed degradation must be tempered. In the longer term consideration may need to be given to retreating stopbanks and allowing the river to occupy a greater area of land.

246. The cross-sections in the lower river have shown a significant amount of active channel movement over the last 30 years, making it difficult to observe general trends. Where the river has been more stable, the data shows that as the active channel aggrades, so to do the berms within approximately 50 metres on either side of the channel. This is most likely a natural process whereby the river is trying to maintain bankfull flows[1] to the level of the mean annual discharge. This will lead to difficulties in draining the areas further away from the river and may require the construction of schemes to pump away flood waters for some drainage outlets, and indeed directly adjoining farmland in the lower reaches. This is another undesirable effect of aggradation.

247. Furthermore, there will be a greater potential for the river to migrate (ie. change course) rapidly during major floods, particularly once major overflows develop into the relatively low areas well back from the main channel.

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[1] These are the flows contained by the river channel immediately prior to overtopping the riverbanks.

248. The reports on erosion in the upper channel indicate that sediment supply remains constant at best; however, it may well increase in the short term due to the increased number of landslides caused by the February 2004 storm. The estimated increase in areas affected by landslides of 30 percent from that storm is indeed likely to increase sediment supply; however, a significant component of this will be silt and sand rather than gravel. Increases in the gravel supply will, to a reasonable degree, be smoothed out down the river as future floods transport sediment and thus there may only be a slight or nil increase in observed deposition in the lower reaches, although a "spike" in supply is likely, as the 2004 storm was an extreme event.

Future degradation

249. The location and scale of gravel extraction in the degradational reach will need to be modified to prevent further degradation. As a general approach, extraction is to be moved as far downstream as is practical. Survey results show that degradation in the reach 15-32 km upstream from the river mouth can be managed to an appropriate level, while still allowing significant ongoing extraction.

Review of gravel supply rate

250. Based on the information contained in Appendix 4 of the AC Consultants report, it is possible to estimate the supply rate to the lower 32 km of river. This is obtained by combining the observed volumetric changes with extractions recorded. The figures include silt deposition, so an exact gravel quantity cannot be derived. However, after examining where deposition occurred it appears that the supply rate may be higher than the 1994 figure of 20-30,000 cubic metres per year. The estimated supply rates are presented in Table 1.

Table 1. Estimated Gravel Supply Rates - Rangitikei River in Lower 32 km

Period Considered	Total Supply (m^3)	Supply Rate (m^3/year)
1977-1990	803,551	61,700
1990-Pre 2004 Flood	837,259	64,400
Pre-Post 2004 Flood	751,351	-
TOTAL	**2,391,161**	**88,500**

251. Figure 8 shows the distribution of the volumetric changes.

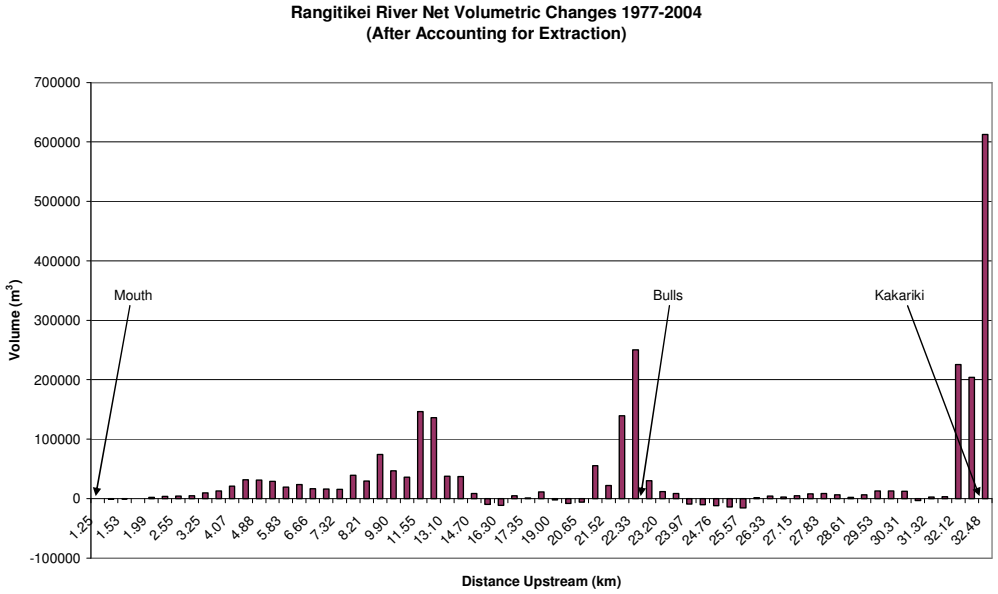

Figure 8. Rangitikei River Net Volumetric Changes 1977-2004

252. This is an interesting graph as it shows the following:

i. Aggradation in the lower reaches.

ii. Above 15 km there is generally "naturally" no net increase in volume and thus that reach cannot be extracted without inevitable bed degradation.

iii. There are two apparent areas of gravel deposition, at Bulls and Kakariki. However, the volumes at these locations are significantly influenced by large-scale extraction quantities being added to the volumetric changes. It is possible that some of this extraction occurred after the post-2004 flood surveys and thus the "mass balance" will not be exactly correct. However, at river sections 21.94 km and 22.33 km a total of only 91,106 m^3 was extracted in the 1977-2004 period, significantly short of the 389,655 m^3 gain; therefore there is definitely deposition at this site. Similarly, at river sections 32.12, 32.42 and 32.48 km, a total of only 302,145 m^3 was extracted in this period, significantly short of the 1,042,390 m^3 gain. The more likely explanation is that the very significant extractions in this vicinity are infilled by the following floods and thus gravel supply to the reach downstream is deprived.

iv. Further analysis of this trend will be conducted as part of the Rangitikei River Scheme Review No. 4. Possibly the trend reflects gravel extracted elsewhere and processed at these sites, or to a small degree land-based operations.

C. Other rivers

253. The detailed information on gravel management in other rivers is contained in the memorandum of Alistair Beveridge, attached as Appendix 2. It is my understanding that the average long-term supply estimates are reasonably close to the mark and that these rivers are not exhibiting gravel management problems. The numbers presented are an indication only and may be refined if warranted once further in-depth information becomes available.

Peter Blackwood
August 2009

APPENDIX 1

Decision of the Hearings Committee on Consent Application to

Extract and Redistribute Gravel in the Bed of the Lower Manawatu River

IN THE MATTER of the Resource Management Act 1991 (the Act)

AND

IN THE MATTER of applications for Resource Consents by Horizons Regional Council Operations Group. Land Use Consent Nos. 104194 and 104195 and Discharge Permit No. 104341 for the Lower Manawatu River.

DECISION OF THE HEARING COMMITTEE

A. APPLICATION FOR RESOURCE CONSENT

1. On 4 October 2007 Horizons Regional Council (the Council) received a resource consent application from the Operations Group of Horizons Regional Council (the Applicant) for land use consents to extract and redistribute gravel in the bed of the Lower Manawatu River.

2. On 13 February 2008 the Council received a further resource consent application from the Applicant for a discharge permit to discharge contaminants, specifically suspended sediment, to the Lower Manawatu River.

3. The Applicant sought consent durations of 20 years.

B. THE PROPOSAL

4. The Applicant wishes to undertake extraction and redistribution of gravel within the bed of the middle and lower reaches of the Manawatu River for river management purposes for a period of 20 years. The activities have been divided into those occurring with the 'Aggrading Reach' (Opiki Bridge to Benchmark 648 between Hamilton's Line and Jackeytown Road), the 'Transitional Reach' (Benchmark 648 to Karere Road) and the 'Degrading Reach' (Karere Road to Ashhurst Domain). The proposal is more fully described in the application documentation and in the Council Section 42A Officer's Reports.

C. THE HEARING COMMITTEE

5. The Hearing Committee comprised of Councillors Annette Main (Chair) and Vern Chettleburgh and Independent Hearings Commissioners Lorraine Stephenson and Rob van Voorthuysen. Under Section 34A(1) of the Act the Hearings Committee held delegated authority from the Council to hear and decide the applications.

6. The Hearing was held in Council's Boardroom in Palmerston North on Friday 14 March 2008. The Hearing was adjourned that same day and was closed for deliberations on Monday 31 March 2008. No site visit was undertaken as the members of the Hearing Committee were familiar with the relevant reach of the Manawatu River.

D. NOTIFICATION / SUBMISSIONS

7. The application was Publicly Notified on 10 November 2007 (Manawatu Evening Standard) and 11 November 2007 (The Tribune). Submissions closed on 7 October 2007.

8. In response to the public notification fifteen submissions were received within the submission period and one late submission was received. The submitters were:

i. N and B Hunt
ii. M Pedley
iii. C Davidson
iv. L Fuggle
v. B Akers and G Bevins
vi. J Waldon
vii. KMS Holdings
viii. Blackley Construction
ix. Tanenuiarangi Manawatu Limited
x. MidCentral Health
xi. Ministry of Education
xii. Manawatu District Council
xiii. Higgins Group
xiv. Palmerston North City Council
xv. Fish and Game NZ
xvi. Powerco (late submission)

9. The submissions were well summarised in Section E of Ms Manderson's Section 42A Officer's Report. We see no need to repeat that level of detail in this Decision and instead we will simply list the issues of contention raised in the submissions which were:

- Lack of consultation;
- Lack of details regarding the proposal;
- Management of existing extraction consents;
- Lack of a iwi cultural impact assessment;
- Lack of survey or monitoring information;
- Lack of a gravel allocation model;
- The sustainability of the proposal;
- The volumes of gravel to be extracted;
- Impacts on bank stability and individual riverside properties;
- Impacts of river crossings;
- Impact on trout habitat;
- Impact of sedimentation on river water quality;
- Dust management;
- Hours of operation;
- Refuelling and machinery maintenance;
- Adherence to Council's Environmental Code of Practice for River Control Works;
- Protection or existing discharge mixing zones;
- Protection of existing river access points;
- Protection of existing infrastructure; and
- Consent duration

E. EVIDENCE PRESENTED AT THE HEARING

10. At the Hearing we heard from the Applicant, Submitters and Council Officers and their consultants as follows.

11. For the Applicant we heard from Mr Peter Blackwood (Council's Manager Investigations and Design), Mr Graham Doull (Council's Senior Design Engineer) and Mr David Forrest (consultant planner).

12. The Submitters who spoke to their submissions were Mr Jonathan Proctor and Ms Hollei Gabreilsen for Rangitaane O Manawatu – Tanenuiarangi Manawatu Inc (TMI) who tabled and read written evidence, Gary Bevins and Bev Akers who made verbal submissions and tabled a brief written statement in support of their original submission, and Mr Milton Pedley and Mr Philip Pyrie (representing Leslie Fugle and Christine Davidson) who both made verbal submissions No additional issues of contention were raised.

13. Ms Manderson (Independent Consultant Planner) and Mr Williams (Independent Consultant Engineer) spoke to their Section 42A Officer's Reports. Ms McArthur (Council Environmental Scientist) was absent and so her report was taken as read. As a consequence we were unable to pose any questions regarding Ms McArthur's report.

14. The written evidence tabled and presented by these parties is held on file at the Council. We do not intend to record that material in any detail in this Decision. However, specific issues raised in the material are referred to as appropriate in the Evaluation Section of this Decision.

F. ADJOURNMENT

15. The Applicant had been consulting with TMI regarding the nature and content of a Protocol between TMI and the Applicant which would set out an agreed basis for the future involvement of TMI in the management of gravel extraction under the global consent for the Lower Manawatu River. Mr Proctor advised us that the Protocol had yet to be agreed and finalised between the parties. He appended to his evidence a copy of the Draft Protocol as it was at that time.

16. Mr Proctor advised that if the Protocol was finalised along the lines as that attached to his evidence then it was likely that it would adequately deal with all of TMI's matters of concern as set out in their submission and his evidence. In the absence of an agreed Protocol Mr Proctor advised that TMI sought the imposition of a range of consent conditions that dealt with the matters covered by the draft Protocol. Mr Proctor advised that in his view it would be preferable to finalise the Protocol as that better provided for future flexibility and adaptive management.

17. In closing the Applicant sought an Adjournment of two weeks for the purpose of attempting to finalise the Protocol with TMI. The Committee granted an adjournment until 4.00 pm on Friday 28 March 2008 and indicated to the parties that at that stage (or earlier if the Protocol was agreed and signed earlier) the Hearing would be reconvened, but that it was unlikely that the Committee would need to physically reconvene to hear further evidence or submissions.

G. RECONVENED HEARING

18. The Hearing was not reconvened as the Applicant was able to successfully negotiate the terms of Protocol with TMI. Accordingly, there was no need for us to hear further evidence on that matter.

H. EVALUATION

Statutory Considerations

19. Section 104 of the Act is the principal provision that sets out the matters that we need to have regard to when determining the application. We note that the Section 104 matters are subject to the purpose and principles of the Act as set out in Part 2.

20. We have regard to the requirements of Section 113 of the Act when preparing this Decision.

Consent Category

21. Ms Manderson included a Table on page 28 of her Officer's Report which set out what she considered to be the relevant Rules under the various Regional Plans. These were BRL [2] Rule 15 for gravel extraction (restricted discretionary activity), BRL Rule 17 for bed disturbance, namely for the deposition of gravel and ancillary activities such as machinery river crossings (Restricted Discretionary Activity), and MCWQP[3] Rule 8 for the discharge of sediment (Non-Complying Activity).

22. We note that in our view under the Proposed One Plan the application to undertake gravel extraction and redistribution would be a Permitted Activity under Rule 16-13, as that Rule encompasses excavation, disturbance and associated diversions and water and sediment discharges.

23. Mr Forrest disagreed with Ms Manderson's evaluation. He considered that there was no need to invoke Rule 8 of the MCWQP as BRL Rule 15 explicitly authorised any bed disturbance, discharge of water, and discharge of sediment associated with gravel extraction and the scheme of the BRL meant that Rule 17 (relating to bed disturbance or the deposition of gravel into the wetted channel in this case) should be interpreted as covering the same matters.

24. Unfortunately BRL Rule 17 does not explicitly refer to the associated discharge of water and sediment. In our view that is most probably an omission of drafting. We also note that the matters of discretion under Rule 17 include "*effects on water quality*", which indicates to us that under that Rule 17 we should be considering issues such as associated sediment discharges.

25. Nevertheless we find that we need to take the BRL as we find it. We also note that the MCWQP imposes additional restrictions on discharges into the Manawatu River and even if BRL Rule 17 did provide for the discharge of associated sediment the MCQWP would still need to be satisfied.

26. Under the relevant part of Rule 1 of the MCWQP at any flow level the change in horizontal visibility of the water due the activities covered by the applications over the reach from either the Coastal Marine Area to the Opiki Bridge, or over the reach from the Opiki Bridge to the Fitzherbert Street Bridge, must not change by more

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[2] Regional Plan for the Beds of Rivers and Lakes
[3] Manawatu Catchment Water Quality Regional Plan

than 30 %. Above the Fitzherbert Street Bridge the change in horizontal visibility must not change by more than 30 % after reasonable mixing.

27. Under the relevant part of Rule 2 of the MCWQP at flows below half median and after reasonable mixing has occurred the river waters shall not be rendered unsuitable for bathing due the activities covered by the applications and the horizontal visibility shall be greater than 1.6 metres.

28. We heard no specific evidence regarding whether or not the sedimentation of the river water that would occur as a result of the activities proposed by the Applicant would meet these standards. Mr Doull advised in response to questioning that in his view any sediment plume associated with gravel deposition would be the same as for riverbank rock revetment works which typically extended for "*two or three river bends*" whereas the sediment plume associated with gravel extraction in the aggrading reach would be more extensive than that.

29. In the absence of specific evidence to the contrary from the Applicant we have accepted Ms Manderson's view that the relevant standards in Rule 1 and 2 of the MCWQP will not be met. This makes the discharges of sediment associated with the applications a Non-Complying Activity under MCWQP Rule 8. This invokes Policy 2 of the MCWQP which sets out the requirements for authorising discharges which breach the Rule 1 or 2 Standards. In this case we are satisfied that Policy 2.1(c) applies in that the discharges of sediment are associated with necessary river maintenance works.

30. We note that the applications are for related activities which overlap and have consequential effects (the sediment discharges only arise from the gravel extraction and bed disturbance activities) and so they should, in our view, be bundled and assessed by the most conservative status that applies.

31. We therefore need to be satisfied that the applications will meet the requirements of Section 104D of the Act. In this case, as will be explained in the Evaluation section of this Decision, we are satisfied that the potential adverse effects of the activities (subject to the imposition of conditions) are minor and so the applications pass the threshold test of Section 104D(1)(a) of the Act.

32. We therefore find that we are able to assess the applications on their merits and we may grant or refuse them and impose conditions on them under Section 108 of the Act.

Matters of Contention

33. Section 113 of the Act requires us to focus on the principal issues of contention and to state our main findings of fact in relation to those issues. Accordingly, based on the application documents, the submissions received, the Officer's Report, and the evidence presented at the Hearing, the following principal issues that were in contention are now addressed in a sequential fashion:

- Applicant's consultation;
- Lack of details regarding the proposal;
- Management of existing extraction consents;
- Iwi cultural issues;
- Lack of survey or monitoring information;
- The sustainability of the proposal and the volumes of gravel to be extracted;
- Impacts on bank stability and individual riverside properties;
- Adherence to Council's Environmental Code of Practice for River Control Works;
- Effects in aggrading reach;
- Effects in degrading reach;
- Protection of existing discharge mixing zones;

- Impacts on natural character;
- Impacts on public access;
- Nuisance effects;
- Protection of existing infrastructure; and
- Consent duration.

Applicant's Consultation

34. Section 36A of the Act makes it clear that an Applicant for resource consent has no duty to consult with any person regarding their application.

35. Consequently, we find that the nature of the Applicant's general consultative process is of no concern to us. The application was publicly notified and any person was able to lodge a submission and have their views heard in the ensuing consent process.

36. The exception to this are the matters of concern expressed by TMI as we have explicit obligations with regard to iwi matters under Sections 6(e), 7(a) and 8 of the Act. In regard to those matters consultation undertaken by the Applicant, or in their absence by the regulatory arm of the Council, may be necessary to enable the issues raised by iwi groups such as TMI to be adequately evaluated. In this case we find that we had adequate information before us on the Section 6(e), 7(a) and 8 matters as a result of the TMI evidence tabled by Mr Proctor.

Lack of details regarding the proposal

37. Several submitters and the Council reporting officers noted that the application was lacking in detail, both in terms of the actual activities that would be undertaken and the effects that those activities would generate. We agree with that view and note that in many cases the Applicant's AEE asserted a lack of effects but provided no evidential basis for those assertions. As we noted during the Hearing it is up to an applicant to prove their case.

38. We accept that some of the activities proposed are experimental in their nature in the Manawatu River context. However, that said, our concern over the lack of detailed information has led us to find that some activities should only be authorised on a trial basis and in all cases there should be monitoring of the effects of the activities with associated regular Section 128 review opportunities.

Management of Existing Extraction Consents

39. The Applicant's proposal represents a fundamental shift in approach for the management of gravel extraction from the Lower Manawatu River. As we understand it there would be no separate consents issued to commercial extractors. The only party authorised to extract gravel would be the Applicant. The Applicant would then select commercial gravel extractors to remove gravel from locations that were appropriate in terms of river management.

40. What is not clear to us is how existing consent holders will be dealt with. There are a number of existing gravel extraction Consent Holders who have applied to renew their consents. We received various tables listing these Consent Holders during the Hearing and asked Ms Manderson to clarify the situation for us. She compiled a table which sets out the current situation. There are six applications "on hold" under Section 92 or Section 37 of the Act. There are a further nine existing extraction consents for the river. Most of these expire in 2008 although one held by the Council itself does not expire until 2010.

41. It is not clear to us, under the "first in first served" principle that underpins the consideration of competing applications under the Act, how the Applicant's global consent application was able to be dealt with before those other applications were dealt with.

42. Nevertheless we are obliged to consider the application before us. The only way that we can be assured that the issue of potential adverse cumulative adverse effects (such as would arise from granting the Applicant's global consent on the assumption that some or all of the commercial applications might also be granted or renewed at a later date) is to allocate all of the available gravel resource to the Applicant so that any other existing or subsequent applications from other parties would need to be declined.

43. We find that to be a very unsatisfactory arrangement and would have preferred it if the Regional Plans, such as the newly Proposed One Plan, had dealt with this matter from a planning perspective.

44. We appreciate that Council is developing a Protocol with existing extractors that will implement the new approach outlined above. As far as we are aware, based on the evidence of the Applicant, that Protocol is not finalised. We do not know if some or all of the extractors have formally committed to it and the Applicant was not able to inform us how gravel extraction applications would be dealt with from parties who did not sign the Protocol. In any case we note that the Protocol with extractors is a voluntary side agreement that sits outside the ambit of the Act and the application before us.

Iwi Cultural Issues

45. Under Section 6(e) of the Act we must recognise and provide for:

    The relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga.

46. Under Section 7(a) of the Act we must have particular regard to kaitiakitanga.

47. Based on the evidence of Mr Proctor we are satisfied that TMI had a historical relationship with the Manawatu River and its margins and that the River was a taonga for the iwi. We also accept that TMI has a contemporary relationship with the River and that it forms a vital part of their culture and traditions. In that regard we accept TMI as kaitiaki for the River.

48. As we have noted we granted an Adjournment so that TMI and the Applicant could progress the completion of the Protocol. We were advised by the Applicant on Friday 28 April that the Protocol had been agreed and would soon be signed by the parties. Accordingly, we determined that an additional condition should be inserted into the consent, if granted, which would refer to adherence to the terms of the Protocol.

49. We have attached the final version of the Protocol to this Decision.

50. We also consider that the Applicant should be required to report to the Manawatu-Wanganui Regional Council regarding the outcome of the annual meeting with TMI specified in Work Item 3 of the Protocol.

Lack of Survey and Monitoring Information and a Gravel Allocation Model

51. Several submitters stated that they thought the Applicant lacked sufficient survey or monitoring information to enable gravel extraction to be managed sustainably. Mr Williams considered that it would have been preferable if Council had established a design bed profile to which the River would be managed.

52. On the other hand Mr Doull considered that the Applicant had ample information including the May 2006 Opus report titled "Lower Manawatu River Gravel Resource Study", a subsequent Council analysis of aerial photographs, and 96 river cross sections which had been surveyed between two and six times each since 1991. He advised that Council was generally aiming to return the River to its 1993 bed profile.

53. We find that the Applicant has sufficient information available to it to determine its general approach to gravel management in the reach under question. Namely, that a large quantity (around 200,000 cubic metres) of gravel needs to be removed from the aggrading reach above the Opiki Bridge as a result of gravel deposition arising from the February 2004 floods and that no more gravel extraction should occur in the degrading reach from the Manawatu Gorge to around Karere Road.

54. Given that general and simple approach we see no need for a "gravel allocation model" such as might be utilised in other rivers where commercial extraction is authorised on an annual basis.

55. What was lacking in the AEE was factual information (as opposed to mere assertions) regarding the actual and potential effects of the proposed gravel management activities on water quality and aquatic habitat. We return to that matter later.

The Sustainability of the Proposal and the Volumes of Gravel to be Extracted

56. Based on the evidence before us we find that the Applicant's general approach is sustainable. The degrading reach can no longer support commercial gravel extraction. This needs to cease to avoid further bed degradation and the subsequent undermining of the riverbanks and associated bank edge protection works. We accept the need for localised gravel redistribution to occur where beaches have aggraded such that undue pressure is being placed on the opposite riverbank during flood events.

57. The accumulated gravel in the aggrading reach needs to be removed to preserve the integrity of the existing level of flood protection provided by the Lower Manawatu Flood Protection Scheme.

58. Both of those intentions are consistent with sustainable management as defined in Section 5 of the Act.

59. As discussed previously we find that in order to avoid potential adverse cumulative effects we need to allocate all of the available gravel resource to the Applicant. The exception to this would be any necessary volume of gravel required to be removed to realign the River at ANZAC Cliff Park. As noted by Mr Doull that site is to be the subject of a separate consent application by the Applicant. We also note that under both the BRL and the Proposed One Plan individuals are allowed to extract, as a Permitted Activity, 50 cubic metres of gravel for their own use in a 12 month period (see for example BRL Rule 14).

60. Mr Williams determined the maximum volumes of gravel that could be extracted from each of the three reaches of the River covered by the application. Ms Manderson translated those volumes into a recommended consent condition (Condition 3 in her Officer's Report).

61. We need to compare these volumes to what the Regional Plans allow. We are of the view that the volumes of allowable gravel extraction specified in the Proposed One Plan should be preferred to those set out in Schedule 2 of the BRL. We note that these volumes recommended by Ms Manderson are significantly greater than volumes set out in Policy 6-32 of the Proposed One Plan. Under that Policy, for a 20 year consent duration, the Applicant would be allowed to extract 800,000 cubic metres of gravel from

the aggrading reach. However, Policy 6-32(b) allows us to exceed the One Plan volumes if "*better information is available*" and we consider that to be the case here.

62. Mr Doull accepted the extraction volumes recommended by Ms Manderson but he advised us that the Applicant no longer wished there to be a specific allowance for removing "*10,000 to 20,000 cubic metres* [of gravel from the degrading reach] *for floods smaller or larger than a 20 year flood*". We are unsure about which recommended condition he was referring to as we can find no such words in Ms Manderson's recommendations.

63. We find that the volumes of extraction determined by Mr Williams and recommended by Ms Manderson are appropriate.

Impacts on Bank Stability and Individual Riverside Properties

64. Some submitters were concerned about the potential effect of the Applicant's activities on riverbank stability and on the integrity of the riverbanks fronting their properties.

65. We note that the Applicant's intention in the degrading reach (from the Gorge to Karere Road) is to preclude further commercial extraction as that would lead to further bed degradation and the potential undermining of the riverbanks, and to manage extraction from identified beaches so as to avoid erosive pressures on the opposite riverbank. These actions are hardly likely to occasion riverbank erosion, in fact they are specifically designed to minimise its occurrence.

66. We accept that in major floods there may well be riverbank erosion that occurs. The evidence before us is that there will be no plausible means of determining whether or not any such erosion can be linked to the activities of the Applicant under the consent sought. However, we are satisfied on the balance of probabilities that that would not be the case.

67. We find that the proposal will not have adverse effects on riverbank stability.

Adherence to Councils Environmental Code of Practice for River Works

68. The Applicant has produced a document titled "*Environmental Code of Practice for River Works – To meet Requirements of Rule 16-13 of the One Plan*" dated April 2007 (the Code). The document contains performance standards that the Applicant will adhere to when undertaking its river control and drainage works.

69. The Code contains generic standards including ones relating to maintaining "the current number of pools and riffles" in gravel bed rivers including the Lower Manawatu River (Sections 1.1 to 1.4 in Part One of the Code). The Code also contains specific performance standards for gravel extraction and gravel maintenance activities (Sections 3 and 4 in Part Two of the Code).

70. In our view the Code is comprehensive and its standards cover many of the matters contained in the consent conditions recommended to us by Ms Manderson. We note that neither Ms Manderson nor the Applicant had undertaken a detailed comparison of the standards in the Code with the recommended consent conditions. We consider that, should the application be granted, it would be preferable to cross-reference the relevant standards in the Code as opposed to developing consents conditions that address the same matters using slightly different wording.

Effects in the Aggrading Reach

71. The Applicant proposes large scale gravel extraction in the aggrading reach. Mr Doull advised that the entire river bed profile needed to be lowered in order to restore the

previous level of flood protection afforded by the Lower Manawatu Flood Control Scheme. We accept the need for those works and recognise the importance of protecting the community against flood risks.

72. It is inevitable that the proposed gravel extraction works will have significant unavoidable adverse effects on the water quality and ecology of the Manawatu River from Jackeytown Road to some considerable distance downstream. Mr Blackwood and Mr Doull advised us that the proposed initial 200,000 cubic metre gravel extraction would more than likely take two summer seasons to complete given its scale. While some of the extraction can occur in the dry much of it will necessarily involve extraction from the flowing channel of the River.

73. We were advised that the works would be undertaken over a continuous six week period each summer and that the Applicant would prefer to work seven days per week in order to get the work done as quickly as possible. We accept the desirability of that approach.

74. Through questioning we established that the River, on average, carries elevated flows that cause the water to naturally discolour once every two to three weeks and that the discoloured water typically remains so for around two to three days. Mr Doull thought that the River would be in a discoloured state around 20 % of the year and that in the winter it could be in a continuous discoloured state for a month or more. This then is the background environment against which the effects of the proposed gravel extraction will occur.

75. Adherence to the Performance Standards in the Code will mitigate the effects of the large scale gravel extraction activity to some extent. We also note that the Opiki Bridge marks the end of the main gravel phase of the River and below that point the River has a silty substrate. We accept that the River below Opiki Bridge has less ecological and amenity value as a result.

76. On balance, we are satisfied that the significant unavoidable adverse effects on the Manawatu River water quality and ecology that will result from the proposed large scale gravel extraction works in the aggrading and transitional reach are acceptable given the resultant benefits for the health and safety of the community.

Effects in the Degrading Reach

77. The Applicant proposes that commercial gravel extraction will cease in the degrading reach from the Manawatu Gorge to Karere Road. Gravel will be removed from specific beaches where that is necessary to avoid bank erosion on the opposite bank.

78. The Applicant proposes a hierarchy of techniques for the management of the beaches comprising beach raking, followed by gravel redistribution in the dry, followed by gravel redistribution into the flowing channel. As Mr Williams noted, and the Applicant agreed, that these techniques are experimental in the context of the Manawatu River.

79. Through questioning we established that the River, on average, carries elevated flows that cause the water to naturally discolour once every two to three weeks and that the discoloured water typically remains for around two to three days. Flood events that result in the movement of gravel in the bed of the River occur two to three times each year for a duration of up to four days. This then is the background environment against which the effects of the proposed gravel management will occur.

80. We concur with the ecological value of this reach of the River as detailed in Ms McArthur's Officer's Report. The River supports a range of migratory native fish species and a healthy macroinvertebrate community. It is also used by nesting Dotterels.

81. We are not overly concerned with the proposed beach raking and gravel redistribution in the dry for the reason that those works will not of themselves result in sedimentation of the River over and above what already occurs in flood events. However, the intended deposition of gravel into flowing channels will cause adverse effects over and above those that form part of the existing background environment.

82. Mr Doull advised that, if it occurs at all, gravel deposition in the wet would happen no more than 12 times over a five year period or around twice per year. The works would more than likely be undertaken when flows were low in the month of March. The activity would focus on the tightest bends in the River where the pressure on the opposing riverbank was the greatest.

83. Mr Doull advised that the largest volume of gravel that might need to be removed from a beach and deposited into the flowing channel would be 5,000 cubic metres. The works at a single site could occur over a continuous four day period. The area of wetted channel that would be initially directly affected by the deposited gravel would vary from 5,000 m^2 to 10,000 m^2 (namely from ½ to 1 hectare). These are large areas of riverbed and the existing macroinvertebrate ecology in those areas would be destroyed. In addition the works would result in a suspended sediment plume that would migrate some distance downstream. This would further affect amenity values and potentially smother the instream habitat and ecology.

84. We also note that the ecological and amenity values in the degrading gravel reach of the River are greater than those in the downstream silty aggrading reach.

85. The effects of concern might arise twice per annum for a period of four days on each occasion. This is not a highly significant increase in the amount of time that the River carries suspended sediment due to natural flood events but we note that the sediment plumes caused by the Applicant would occur in March during low flows, which is the worst time of the year in terms of the potential adverse effects of such a plume as the River is otherwise running clear at that time.

86. Consequently, we consider that any gravel redistribution that involves deposition into the flowing channel should occur on a trial basis initially, subject to monitoring of its effectiveness as a gravel management technique and the extent and duration of its associated sediment plume. We do not see the need for any direct monitoring of the macroinvertebrate ecology as we understand that the available literature discloses how quickly macroinvertebrate colonies recover after sedimentation events.

Protection of Existing Discharge Mixing Zones

87. Palmerston North City Council (PNCC) submitted that it held consents for a number of sewage and stormwater discharges into the River. The conditions of those consents stipulate adherence to water quality standards after reasonable mixing. The reasonable mixing relied on existing river channels to be effective and PNCC did not want the Applicant's gravel extraction activities to alter the effectiveness of those channels.

88. Mr Doull tabled a copy of an email exchange between himself and Mr Chris Pepper of the PNCC. Mr Doull had offered, on behalf of the Applicant to not relocate gravel in such a way that discharge outfalls become impeded or blocked. On that basis the PNCC withdrew their right to be heard.

89. Mr Blackwood confirmed to us that the Applicant would accept Mr Doull's email assurances being reflected in conditions of consent. We find that to be an appropriate course of action should the application be granted. However, we find that the protection to be afforded to PNCC should be extended to all authorised discharges to the Lower Manawatu River.

Impacts on Natural Character

90. Under Section 6(a) of the Act we must recognise and provide for, as a matter of national importance:

The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development

91. In previous resource consent Hearings we have found that that the margins of the Lower Manawatu River are heavily modified and the riverbed itself has been subjected to regular gravel extraction and river control activities. In our view the reach of River in question has a degraded natural character.

92. Ms McArthur was concerned about the fate of large woody debris that resided in areas that were to be subject to gravel extraction activities. That debris provides valuable aquatic habitat. Mr Blackwood confirmed that the Applicant would remove and replace any such large woody debris in extraction reaches and would also ensure that large woody debris was not smothered during gravel deposition or redistribution activities. We find that to be appropriate.

93. We find that the Applicant's proposal, subject to adherence with the standards in the Code and other consent conditions, will have no more than minor adverse effects on the natural character of the Manawatu River.

Impacts on Public Access

94. Under Section 6(d) of the Act we must recognise and provide for, as a matter of national importance:

The maintenance and enhancement of public access to and along the coastal marine area, lakes, and rivers.

95. The Applicant's activities will be confined to the bed of the River. Existing access points to the River will not be adversely affected. Public access along the River may be impeded whilst works are being undertaken, however, that is necessary to ensure the safety of the public.

96. The reach of the Manawatu River from the Gorge to at least Karere Road is readily accessible to the public. In other resource consent Hearings, such as that for the PNCC sewage discharge, we heard evidence of how the River and its margins are used for a range of passive and active recreational activities. In this case PNCC sought the protection of existing access to the beach south of the Manawatu Golf Club (accessed from Albert Street) and the second beach south of Waitoetoe Park (accessed from Maxwell's Line). PNCC sought that these beaches not be removed in their entirety and that warning signs be erected at the Waitoetoe Park beach if the water was made shallower as a result of the Applicant's works.

97. Mr Doull tabled a copy of an email exchange between himself and Mr Chris Pepper of the PNCC. Mr Doull had advised that the Applicant had no intention of removing these beaches. In addition the Applicant offered to avoid works in the degradation reach during school holidays and to erect warning signs if necessary. On that basis the PNCC withdrew their right to be heard.

98. Mr Blackwood confirmed to us that the Applicant would accept Mr Doull's email assurances being reflected in conditions of consent. We find that to be an appropriate course of action should the application be granted.

99. We find that the Applicant's proposal, subject to adherence with the standards in the Code and other consent conditions, will have no more than minor adverse effects on public access to and along the Manawatu River.

Nuisance Effects

100. As noted in Section 5.11 of the AEE the Applicant's proposal has the potential to cause nuisance effects in terms of noise, vibration and dust. We are satisfied that those nuisance effects can be minimised by adherence to reasonable working hours and the Generic Standards in the Code that deal specifically with dust suppression.

Protection of Existing Infrastructure

101. Powerco made a late submission regarding the potential adverse effects of the Applicant's proposal on Powerco's assets. We have already found that the proposal will not have adverse effects on riverbank stability. We also note that Generic Standards 21 and 22 in the Code require compliance with the New Zealand Electrical Code of Practice for Electrical Safe Distance NZECP 34:2001.

102. We have already discussed the avoidance of adverse effects on PNCC's sewage and stormwater outfalls. The Applicant's works are designed to minimise further adverse effects on existing riverbank protection works and flood control assets. Ms Manderson recommended to us a condition requiring prior notice of works proposed in close proximity to Council flow recording sites. We find that to be appropriate.

103. We find that the Applicant's proposal, subject to adherence with the standards in the Code and other consent conditions, will have no more than minor adverse effects on existing infrastructure adjacent to the Manawatu River.

Statutory Provisions

104. The relevant statutory provisions are those imposed by Sections 104, 104D, 105 and 107 of the Act and the policies and objectives of the Regional Policy Statement, the Regional Plan for Beds of Rivers and Lakes, the Manawatu Catchment Water Quality Regional Plan and the Proposed One Plan.

105. We have considered the actual and potential effects of the activity and the sensitivity of the receiving environment in the preceding Evaluation sections of this Decision. We are satisfied that there are no alternative receiving environments for the sediment discharges that will result from the gravel extraction and deposition activities. Those sediment discharges will breach the standards set in Section107 of the Act but we are satisfied that those breaches will be of a temporary nature and are associated with essential river maintenance works.

106. Ms Manderson evaluated the proposal against the relevant Objectives and Policies of the Regional Planning Instruments in some detail in her Officer's Report. Mr Forrest did the same to a lesser degree for the Applicant in the AEE. Ms Manderson concluded that the proposal would not be contrary with those Policy and Plan provisions, subject to the imposition of her recommended conditions. We note that no other party presented a qualified planning assessment of the proposal.

107. We have carefully read the planning evaluation of Ms Manderson and we concur with her view.

Duration and Review

108. The Applicant sought a consent duration of 20 years. Ms Manderson recommended a 20 year duration. We note that the Applicant has sought a global gravel extraction consent

so that gravel extraction in the Lower Manawatu River can be managed sustainably and in an integrated manner. We find that to be entirely consistent with Part 2 of the Act and are comfortable with a 20 year consent duration.

109. Ms Manderson also recommended to us a Section 128 review condition. Mr Doull opposed that recommendation. We consider that review conditions are a prudent approach and they allow for the consideration of unforeseen future effects. We note that Section 128 reviews are not mandatory and they would occur at the discretion of the Council should the need arise. We find that the consent should be subject to annual review opportunities.

Conditions

110. Conditions of consent were recommended to us by Ms Manderson, based on the technical assessments of Mr Williams and Ms McArthur. Mr Doull recommended a number of amendments to those recommended conditions.

111. We find that the intent of the recommended conditions is appropriate, however as noted previously, we think that they should be recast to refer to the standards in the Code.

I. DETERMINATION

112. Having read all of the submissions received, listened to all of the evidence presented, and considered the various requirements of the Act and regional statutory documents we are satisfied that:

a. The potential adverse effects of the Applicant's proposed activities in the degrading reach of the Lower Manawatu River from the Manawatu Gorge to Karere Road can be adequately avoided, remedied or mitigated by the imposition of conditions under Section 108 of the Act.
b. The significant unavoidable adverse effects of the Applicant's proposed activities in the aggrading reach of the Lower Manawatu River from the Karere Road to the Opiki Bridge cannot be avoided, remedied or fully mitigated but the benefits of undertaking the works in terms of providing for the ongoing health and safety of the wider community are such that the application should nevertheless be granted.
c. The effects of the activity, if undertaken in accordance with appropriate conditions of consent, will be consistent with the provisions of the Regional Policy Statement, the Regional Plan for the Beds or Rivers and lakes, the Manawatu Catchment Water quality Regional Plan and the Proposed One Plan.
d. The activity, if undertaken in accordance with appropriate conditions of consent, will be consistent with the Purpose and Principles of the Act.

113. We therefore find that we able to grant consent for applications 104194, 104195 and 104341 sought by Horizons Regional Council Operations Group subject to the imposition of the resource consent conditions attached to this Decision.

Annette Main
CHAIRPERSON
21 April 2008

Land Use Consents 104194 and 104195 and Discharge Permit 104341

The Hearing Committee, pursuant to delegated authority under Section 34 of the Act grants to Horizons Regional Council – Operations, pursuant to Sections 104C and 104D of the Act, Land Use Consents 104194 and 104195 and Discharge Permit 104341 to extract and redistribute gravel in the bed of the Lower Manawatu River from the Manawatu Gorge at Ashhurst to Riverbank Road for river (channel capacity) control and flood management purposes for a term of 20 years expiring on 18 April 2028 subject to the following conditions:

General Conditions

1. All gravel to be extracted from the bed of the Manawatu River from the Manawatu Gorge at Ashhurst to Riverbank Road (between T24:454-963 and S24:177-834) shall only be removed for river management purposes.

   ***Note**: River management purposes means as required to maintain an equilibrium in the river to avoid undesirable aggradation or degradation or an undesirable channel alignment or shape*.

2. The Consent Holder shall comply with the following provisions of the "*Environmental Code of Practice for River Works – To Meet Requirements of Rule 16-13 of the One Plan*" dated August 2007 (the Code) except as otherwise provided for in this Consent:
   a. All the Generic Standards for Good Practice set out in Part 1 of the Code;
   b. Standards for Good Practice 1 to 10 of Section 3 Gravel Extraction in Part 2 of the Code; and
   c. Standards for Good Practice 1 to 7 (excluding Standard 5) of Section 4 Gravel Management in Part 2 of the Code.

Gravel Extraction Volumes

3. The maximum total volume of material that may be excavated and removed from the Manawatu River under this Consent shall not exceed the following:
   a. 700,000 cubic metres from the 2 km aggrading reach of the Manawatu River between BM 604 and BM 622 with approximate map references S24:177-834 and S24:209-825;
   b. 350,000 cubic metres from the 2 km aggrading reach of the Manawatu River between 39 mile to BM 643 with approximate map reference S24:209-825–S24:226-830;
   c. 300,000 cubic metres from the 4 km transitional reach of the Manawatu River between BM 643 to 43 miles with approximate map references S24:226-830 – S24:256-847; and
   d. 50,000 cubic metres from the 32 km degrading reach of the Manawatu River upstream of 43 miles, between approximate map references S24:256-847–T24:448-964.

4. Prior to Gravel extraction occurring under Condition 3(d) of this Consent the Consent Holder shall submit to the Manawatu-Wanganui Regional Council's Environmental Compliance Manager a report detailing where significant reduction in flood capacity has occurred within that reach and specifying where the gravel extraction will occur.

Operational Constraints

5. The Consent Holder shall direct extractors to sites and determine how gravel will be extracted and what quantity is to be removed consistent with the Conditions of this Consent.

6. Subject to Condition 15, the Consent Holder shall adopt the following hierarchy of gravel management techniques in the reach referred to in Condition 3(d):
   a. beach raking, followed by
   b. gravel redistribution in the dry, followed by
   c. gravel redistribution into the flowing channel.

7. With regard to Condition 6, Technique (b) shall only be used if Technique (a) proves to be unsuccessful from a river management perspective. Thereafter, Technique (c) shall only be used if neither Techniques (a) nor (b) prove to be successful from a river management perspective.

8. During the period **1 December to 7 February** the gravel extraction and redistribution activities authorised by this Consent undertaken in the reach listed in Condition 3(d) of this Consent shall be restricted to the hours of 7.00 am to 5.00 pm weekdays and 7.00 am to 12 noon on Saturdays. There shall be no activities undertaken on Sundays or Statutory Public Holidays. There shall be no restriction on operating hours at other times of the year.

9. There shall be no restriction on operating hours in the reaches listed in Conditions 3(a) to 3(c) of this Consent.

Iwi Cultural Matters

10. The Consent Holder shall exercise this Consent in accordance with the provisions of the Protocol titled "*Protocol between Manawatu Wanganui Regional Council (HRC) (Operations) and Tanenuiarangi Manawatu Incorporated (TMI)*" dated 14 April 2008 or any such updated version of that Protocol where the Manawatu-Wanganui Regional Council's Environmental Compliance Manager has certified that the updated version has been approved in writing by both the Consent Holder and Tanenuiarangi Manawatu Incorporated.

11. The Consent Holder shall advise the Manawatu-Wanganui Regional Council's Environmental Compliance Manager of the outcomes of the annual meeting between the Consent Holder and Tanenuiarangi Manawatu Incorporated referred to in Work Item 3 of the Protocol listed in Condition 10.

River Habitat Protection

12. The Consent Holder shall not smother large woody debris that resides within the wetted channel during gravel redistribution activities or permanently remove such large woody debris during material extraction activities. Such large woody debris shall be temporarily removed and thereafter reinstated as near to its original location as is practicable. It is not required that woody debris be replaced if in the opinion of the Consent Holder it could cause or exacerbate river bank erosion.

13. Activities that result in discharges of suspended sediment to the Manwatu River shall not occur for more than 12 hours in any 24-hour period or for more than four consecutive days.

    Note: *For the purposes of clarity this condition authorises a discharge of suspended sediment for up to 12 hours on day one, and a discharge of sediment for up to 12 hours on days two, three and four. It* ***does not*** *authorise a consecutive discharge of sediment of 24 hours in a 48 hour period.*

14. The Consent Holder shall minimise the disturbance of nesting banded dotterels *(Charadrius Bicinctus)* and/or black fronted dotterels *(Charadrius Melanops)* during the period **1 August to 10 January** inclusive (breeding season) by:

a. starting extraction within seven days following a flood that covers the beaches where gravel extraction or redistribution will occur; or
b. continuing extraction or redistribution started prior to 1 August provided the extraction or redistribution is at the same location and is not interrupted for more than seven days; or
c. starting extraction or redistribution when an inspection of the site shows no dotterel are present.

Note: *The Department of Conservation can be contacted on 06 350 9700 for advice on dotterel nesting sites.*

Gravel Deposition into the Flowing Channel

15. The Consent Holder may initially undertake gravel redistribution into the flowing channel in the reach listed in Condition 3(d) on a trial basis subject to the following constraints:
    a. Gravel redistribution into the flowing channel shall occur on no more than three occasions during the trial period;
    b. The continuous duration of each redistribution trial shall not exceed four days;
    c. The Consent Holder shall monitor the effectiveness of the gravel redistribution trials in terms of achieving the Consent Holder's desired River Management Objectives; and
    d. The Consent Holder shall monitor how far downstream any suspended sediment plume associated with the works travels and for how long after the cessation of the works the suspended sediment plume is evident to the naked eye.

16. The Consent Holder shall advise the Manawatu-Wanganui Regional Council's Environmental Compliance Manager five working days prior to the occurrence of gravel redistribution into a flowing channel. A written report outlining the results of the monitoring specified in Condition 15 shall be provided to the Manawatu-Wanganui Regional Council's Environmental Compliance Manager within 40 working days of the cessation of each gravel redistribution trial.

17. The Consent Holder may thereafter undertake gravel redistribution into a flowing channel throughout the duration of this Consent if Manawatu-Wanganui Regional Council's Environmental Compliance Manager certifies that the redistribution works are effective in terms of achieving river management objectives and the suspended sediment plume has largely dissipated within three river bends downstream of the works and ceases to be visible within two days following the cessation of the works.

Infrastructure Protection

18. The Consent Holder shall ensure that gravel extraction and redistribution activities undertaken under this Consent do not:
    a. impede or block any stormwater or effluent outfall structures; or
    b. materially reduce the effectiveness of the of zones of reasonable mixing associated with the Palmerston North City Council discharge consents 101984 (Ashhurst Wastewater), 100358 (Aokautere Wastewater), 101829 (Palmerston North Wastewater) and Discharge Consents (102909) Fonterra, (103931) PPCS, (101732) Manawatu District Council, (103907) New Zealand Pharmaceuticals.

19. The Consent Holder shall notify the Manawatu-Wanganui Regional Council's Manager – Resource Data five working days prior to the commencement of works within 500 m upstream or 1,000 m downstream of the hydrological site at the Teachers College.

Public Access

20. The Consent Holder shall ensure that gravel extraction and redistribution activities undertaken under this Consent do not result in the total removal of the gravel beach south of the Manawatu Golf Club (accessed from Albert Street) and the second beach south of Waitoetoe Park (accessed from Maxwell's Line).

21. The Consent Holder shall erect and maintain warning signs at the Waitoetoe Park beach if the water adjacent to that beach is made shallower as a result of the Consent Holder's works.

Monitoring and Reporting

22. Every five years (**commencing in the summer of 2010-2011**), the Consent Holder shall undertake river cross-section surveying at sufficient distances, determined in consultation with the Manawatu-Wanganui Regional Council's Environmental Compliance Manager, throughout the reaches listed in Condition 3 to allow for the determination of the location of gravel deposition or build-up requiring removal.

23. By **30 September** of each year of this Consent, commencing **30 September 2008**, the Consent Holder shall prepare an annual work plan for the following 12 months (1 July to 30 June). Work plans shall include but not be limited to the type and location of works scheduled and monitoring and survey requirements. The work plan shall be provided to the Manawatu-Wanganui Regional Council's Environmental Compliance Manager.

24. By **30 October** of each year of this Consent, commencing **30 October 2009,** the Consent Holder shall prepare and submit to the Manawatu-Wanganui Regional Council's Environmental Compliance Manager an annual report that shall include but not be limited to a summary of the works undertaken during the previous year ending **30 June** and an assessment of compliance against all the conditions of this Consent.

Review and Charges

25. The Manawatu-Wanganui Regional Council may, under Section 128 of the Act, initiate a review of all conditions of these consents every year in the month of December, **commencing December 2009**. The reviews shall be for the purpose of reviewing the effectiveness of the conditions in avoiding, or mitigating any adverse effects on the environment which may arise as a result of the exercise of this Consent:
    a. reviewing the effectiveness of the standards in conditions of this Consent in meeting environmental outcomes;
    b. reviewing any refinements to monitoring or reporting required under conditions of this Consent; and
    c. deal with any significant adverse effects on the environment which may arise as a result of this Consent; and

    The review of conditions shall allow for:
    a. the deletion or amendment of any of the conditions of this Consent; or
    b. the addition of new conditions as necessary to avoid, remedy or mitigate any adverse effects on the environment.

26. Charges, set in accordance with Section 36(1)(c) of the Resource Management Act 1991 and Section 150 of the Local Government Act 2002, shall be paid to the Manawatu-Wanganui Regional Council for the carrying out of its functions in relation to the administration, monitoring and supervision of this resource consent and for the carrying out of its functions under Section 35 (duty to gather information, monitor, and keep records) of the Act.

***Note**: (Section 36(1)c of the Act provides that the Manawatu-Wanganui Regional Council may from time to time fix charges payable by holders of resource consents. The procedure for fixing administrative charges is governed by Section 36(2) of the Act and is currently carried out as part of the formulation of the Regional Council's Long Term Council Community Plan.)*

LOWER MANAWATU RIVER GLOBAL CONSENT FOR GRAVEL MANAGEMENT

PROTOCOL BETWEEN MANWATU WANGANUI REGIONAL COUNCIL (HRC) (OPERATIONS) AND TANENUIARANGI MANAWATU INCORPORATED (TMI)

Terms of Protocol

The Protocol has been prepared in relation to the Manawatu Wanganui Regional Council Global Land Use Consents (104194 and 104195) and recognises Rangitaane O Manawatu sites of significance and cultural connections to the Manawatu River and affected areas. The Protocol sets out the terms of agreement between the Manawatu Wanganui Regional Council and Tanenuiarangi Manawatu Incorporated, the mandated iwi authority for Rangitaane O Manawatu. The protocol allows for the future involvement and contribution towards management of TMI in the Manawatu River works authorised under the global consent for gravel management to the extent provided for in the scope of involvement below. [NB: The protocol will apply where consent approval is obtained.]

Scope of Involvement and Management by TMI

The following table sets out the work item and the action points:

Work Item:	Action Required:
1. Draft Annual plan of the future year's gravel management works within the River to be forwarded to TMI for comment and input prior to the annual work plan being finalised and implemented. The plan shall inter alia cover a description of proposed activities including locations, extraction quantities and work methodologies.	HRC to provide the plan of works annually to TMI 4 weeks prior to the annual meeting identified in work item 3. Where any subsequent changes in the Annual Plan are proposed, TMI is to be notified immediately and given an opportunity to comment on those proposed changes prior to implementation.
2. Annual report of completed works within the River to be provided to TMI. The annual report shall include: i. a summary of works undertaken during the previous year ended 30 June; ii. an assessment of compliance against all conditions of the Consent; and iii. a record of TMI site monitoring and outcomes.	HRC to forward the report to TMI as soon as practicable upon finalisation but in any event no later than 30 October each year.
3. Annual Meeting to be held between TMI and HRC following receipt of the Annual Plan referred to in 1 above.	HRC to arrange the meeting at a time convenient to both parties, but in any event no later than 20 September each year. TMI to identify any issues that arise from the proposed draft annual work plan at the meeting and their suggestions as to how those issues can be addressed. TMI to identify any works that impact on sites of special significance/sites of interest at the meeting. TMI is to provide details of any suggested

Work Item:	Action Required:
	mitigation measures in relation to sites of special significance/sites of interest. The sites are ranked from being of no interest, to a site of interest to being a site of special significance. TMI shall be provided with access to these sites (refer to work item 5 below.) HRC/TMI to agree at the meeting as to the changes required to the draft annual plan of future work to address impacts at the identified sites. HRC will also offer TMI the opportunity to take part in any ecological or environmental monitoring activity planned for the upcoming year.
4. HRC to advise TMI where indigenous tree logs are found in any dry beach gravel deposits.	HRC to provide written advice to TMI of the log(s) discovery and allow TMI 3 days to provide a written response indicating their interest in extracting the log. TMI shall have two weeks from the date of notice of interest to extract the log(s). Note: HRC is required to replace 'woody debris' that is encountered during excavation activities with the wetted channel.
5. TMI is enabled to conduct site visits and will provide 24 hours notice to HRC of its intention to undertake the site visits.	HRC will not unduly hinder access for TMI subject to any health and safety precautions that may apply.
6. HRC is to abide by the objectives of TMI's accidental discovery protocol at all times. [NB: A copy of the accidental discovery protocol is appended to and forms part of this protocol.]	Compliance by HRC of the accidental discovery protocol.
7. HRC to advise TMI of the review of the five yearly survey prior to finalisation of this work.	A meeting is to be arranged by HRC with TMI to discuss the aggradation/degradation trends identified by the surveys.
8. HRC will advise that where any other activities are proposed or occur as part of this global consent TMI shall be notified immediately and be given an opportunity to make comment upon before the activity occurs.	HRC will notify TMI five workings prior.

For clarity, the following are key dates referred to in this Protocol:

- HRC to provide TMI with Draft Annual Plan *(**no later than 20 August**)*;
- HRC and TMI to meet and agree any changes to Annual Plan to address impacts identified by TMI *(**no later than 20 September**)*;
- Annual Plan to be finalised by HRC and presented to HRC Compliance Manager, in accordance with consent condition/s *(**no later than 30 September**)*; and
- HRC to provide TMI with Annual Report, for previous year ended 30 June *(**no later than 30 October**)*.

Schedule of Resourcing for TMI

1. **Participation in Long-Term Monitoring and Annual Allocation Processes**

- **At five yearly intervals** – receive and review survey results, discuss aggradation/degradation trends with HRC as well as consent condition reviews.

- **Annually** - consider schedule of proposed sites for annual extraction in relation to possible sites of significance and other matters of significance to TMI and meet and discuss proposed sites and other monitoring requirements with consent holder prior to final allocations and work commencing.

Annual koha for above annual and five yearly participation, plus monitoring of one site of interest and one site of special significance, to be $2,000.

2. **Monitoring of Extraction Sites**

Where it is agreed at the annual meeting that **further** sites of interest or sites of special significance need to be visited (over the one visit to each type of site provided for in item 1 above) then the koha amount for each such additional site shall be as follow:

Degree of Interest	Actions Expected	Time Involvement	Koha
No significance	Nil	Nil	Nil
Site of interest	Meet with contractor, explain possible significance of site, do karakia, brief visit (I hour) to site on one further occasion during extraction operation	2 Hours	$170.00
Site of special significance	Meet with contractor, explain possible significance of site, do karakia, visit site (2 hours) on up to three further occasions during extraction operation	7 Hours	$595.00
Other issues relating to cultural environmental impacts	HRC to provide information and TMI to provide estimate of cost based on $85.00 per hour.	TBA	$85.00

3. **Treaty of Waitangi Claims**

3.1 This protocol is entered into in good faith and without prejudice to any rights that already exist in law or those that may arise as a consequence of TMI negotiations with the Crown to settle historical Treaty grievances. The parties agree to amend this protocol to the extent necessary to reflect any outcomes in the TMI Treaty Settlement negotiations.

3.2 In particular TMI is pursuing discussions with HRC concerning the acquisition and disposal of gravel by commercial contractors. This protocol is therefore subject to the outcome of those discussions with HRC. The parties agree to amend this protocol to the extent necessary to reflect any outcomes of those discussions.

Signed:

Allan Cook **OPERATIONS MANAGER** **MANAWATU WANGANUI REGIONAL COUNCIL**	D.P. Harris **CHIEF EXECUTIVE OFFICER** **TANENUIARANGI MANAWATU INC**
Dated:	**Dated:**

APPENDIX TWO

horizons regional council

MEMORANDUM

DATE: 12 August 2009

TO: Peter Blackwood

FROM: Alistair Beveridge

SUBJECT: A REVIEW OF THE PROPOSED ONE PLAN GRAVEL MANAGEMENT FRAMEWORK

This memo sets out my thoughts in relation to the gravel management section of the Water Chapter of the Proposed One Plan (POP). In this memo I discuss the policies, rules and the gravel allocation volume tables.

These thoughts are based upon my involvement with the region's fluvial gravel resource over the last 13 years. During this time I have been the technical report writer for resource consent applications to extract gravel, and for four years I was Horizons' " gravel scientist".

The POP contains one policy relating to gravel extraction (Policy 6-32) which in turn contains three clauses, (a) through (c). This policy is supported by Tables 6.3 and 6.4, which set out the recommended gravel allocation limits for various rivers or river reaches within the Region. There is one specific gravel rule (16-15) permitting small-scale (ie. up to 50 cubic metres of gravel and bed material) gravel extraction. The general river-based activity rule (16-20) makes large-scale gravel extraction (ie. volumes in excess of 50 cubic metres of gravel and bed material) a discretionary activity. Both of the rules make use of the provisions of Section 16.2 of the POP to manage the effect of gravel extraction on other water management values.

Background

Gravel is a key strategic resource that is used extensively in road and rail networks, construction, urban settings, and a multitude of other uses. Accordingly, it is critical that the policies and rules on gravel allocation and extraction are well crafted.

Neither the supply of gravel within a river, nor the demand for gravel is constant in space or time. Rather, it follows a "boom-bust" cycle. In general, the supply of gravel within a river is related to flood activity. Gravel is not mobilised and transported in large volumes, except in large floods (ie. floods greater than a 10-year return period). During these large floods the entire bed of a river is mobilised, and new material enters the river system from upstream and bank erosion. For this reason, there will be an excess of gravel within a river system for several years after a major flood event. During these boom times, there is usually a strong river management need to either remove or redistribute gravel.

As time progresses, the volumes of available gravel diminish. This is because the excess is either removed by extractors, the river bed stabilises, or the gravel is progressively redistributed within the river system by lesser flood events. During these "bust times", gravel availability returns to long-term gravel transport rates.

Clearly then, gravel availability follows a boom-bust cycle over a period of decades. This leads to a difficult choice in setting allocation limits and policies. Should allocation limits be based on

records of maximum extracted volume to efficiently maximise gravel removal during boom times, or be based on long-term (ie. average) extraction levels to manage through bust times?

Complicating matters is that the volumes of gravel available during boom times are typically an order of magnitude greater than the long-term average. Further, demand for gravel, which is driven by wider economic factors, rarely coincides with these boom and bust cycles of gravel availability, so that recorded maximum extracted volumes do not necessarily reflect a sustainable threshold.

Horizons' existing gravel related policies and allocation limit tables (Regional Plan for the Beds of Rivers and Lakes and Associated Activities) took the approach of providing allocation limits, in Schedule 2, that were based on long-term gravel availability averages, with the proviso that these were a guide and could be exceeded if there was a river management need or there were other extenuating circumstances (eg. one-off extractions associated with major road construction projects).

The allocation limits were based on long-term extraction records, the personal experiences and observations of long-serving staff associated with managing the gravel resource, and detailed analyses in scheme areas. While this table is not exhaustive in terms of recommending an extraction volume for each gravel-bed river and stream in the Region, it does cover those that have traditionally been used for commercial gravel extraction. It is recognised that most of the smaller gravel-bed water bodies in the Region receive some gravel extraction, but this tends to be limited in its extent, eg. farmers extracting gravel for use on farm races and tracks.

Proposed One Plan Policy
There is a single policy governing gravel extraction from the Region's rivers – Policy 6-32. This policy contains three sub-clauses setting out how the associated gravel allocation tables are to be interpreted and used.

Policy 6-32: Gravel Extraction

(a) The annual volume of gravel available for extraction from those rivers and reaches with certain allocations, listed in Table 6.3, shall be limited to the quantities stated in the table.

(b) The annual volume of gravel available for extraction from those rivers and reaches with estimated allocations, listed in Table 6.4, shall generally be limited to the quantities stated in the table, unless better information is available.

(c) In other rivers or reaches, where there is no annual extraction limit, gravel extraction shall not exceed the natural rate of replenishment except where extraction is necessary to decrease the risk of flooding or damage to structures.

The policy makes the distinction between Table 6.3, as certain allocations (inferring that the suggested allocation limits for these rivers and reaches are more precise), and Table 6.4, as estimated allocations (suggesting a lower level of accuracy or certainty about the volumes). The policy states the volumes in Table 6.3 cannot be exceeded, whereas those in Table 6.4 can be exceeded if supporting information is provided.

I am concerned that the volumes presented in the tables use long-term average figures, based on annual records, for some rivers and maximum figures, ie. records associated with river management extraction following major flood events, for others. This mix gives a false impression of the volume of gravel that is available on an ongoing (annual) basis, as implied by the title of both tables. For simplicity, I suggest the long-term average figure should be included, not maximums, as this gives gravel extractors a far more realistic impression of the volumes of gravel that will be available on an ongoing basis.

However, if Table 6.3 reflects the long-term averages, Policy 6-32(a) becomes very restrictive. One limitation is that the policy would not allow gravel extraction to exceed the allocation limits where there is a river management need (ie. after a major flood). In part, the Operations Group of Horizons have got around this issue through the use of global gravel consents for most of the major gravel-bed rivers in the Region covered by schemes, ie. South East Ruahine streams and the Mangatainoka, upper Manawatu, lower Manawatu, Pohangina, Oroua and upper Whanganui Rivers. The volumes granted as part of these consents are maximum volumes, to allow the Operations Group the freedom to remove large quantities of gravel, far in excess of the long-term transport rates, for river management purposes following major flood events. Outside of these times, gravel extraction rates will be aligned with long-term gravel transport rates. However, to provide clear guidance that this is accepted best practice, the policies should allow the recommended allocable volume to be exceeded where there is a river management need.

Another situation that would be problematic under Policy 6-32(a) are one-off major construction projects, such as major roading projects, which demand quantities of gravel well in excess of the long-term gravel transport rate. These projects happen infrequently and the gravel resource of the targeted rivers can readily handle such one-off extraction sequences in the long-term. However, the policy as it currently stands does not accommodate such activities. The policy should allow the recommended volume to be exceeded where information is presented that clearly establishes that sustainable rates of extraction are higher than the annual allocable volume.

Gravel extraction consents are typically granted for a period of five years, so it is not a major problem to adjust consent volumes up or down when they come up for renewal.

3. Annual allocable volumes

In their current form, Tables 6.3 and 6.4 are confusing. They contain a number of errors and double-ups, and most importantly contain a mixture of both long-term gravel extraction rate and maximum extraction rate figures. The figures and reaches for several of the rivers have also been changed from those depicted in Schedule 2 of the Regional Plan for the Beds of Rivers and Lakes and Associated Activities.

In the following table I explain where the proposed figures and reaches have come from, and provide some context for the recommended volumes in terms of current extraction pressure or consented volumes. The table also contains my recommendations in relation to the reaches and figures presented.

The figures presented are estimated long-term averages, except for the Lower Manawatu River which is based on the maximum limits set in the global consent. The Lower Manawatu figures are based on estimated supply rates, current river bed levels and provision for additional gravel generated by floods during the 20- year period of the global consent.

Table 6.3: Annual allocable volumes of gravel – certain volumes

River or Reach	Volume (m^3)	Comment	Recommendation
Lower Manawatu River		There is a global consent in place for the lower Manawatu River between the Ashhurst and Opiki.	The global consent set maximum amounts for gravel extraction , based on estimated supply rates, current river bed levels and provision for additional gravel generated by floods during the 20 year period of the global consent. Note: these are total amounts over the 20-year duration of the global consent.
Manawatu Gorge to Karere Road	10,000	This figure does not relate to current understanding of the availability of gravel from this reach, but instead reflects the amount set out in Horizons' global gravel consent.	50,000 cubic metres from the 32 km degrading reach upstream of the 43 Miles cross-section (Karere Road)
Karere Road to Hamilton's Line	10,000	This figure does not relate to current understanding of the availability of gravel from this reach, but instead reflects the amount set out in Horizons global gravel consent.	300,000 cubic metres from the 4 km transitional reach between B643 (Hamilton's Line) to 43 Miles.
• Hamilton's Line to Oroua confluence (Yrs 2007-09)	200,000	This figure has been included to allow increased extraction from this reach for river management purposes. After this initial volume is removed the recommended volume reduces to long-term rates.	Delete this figure as it is for river management purposes, and should default to numbers appearing in the row below.
• Hamilton's Line to Oroua confluence (Yrs 2009 onwards)	20,000	This figure does not relate to current understanding of the availability of gravel from this reach, but instead reflects the amount set out in Horizons' global gravel consent.	350,000 cubic metres from the 2 km aggrading reach between 39 Miles and BM 643. 700,000 cubic metres from the 2 km aggrading reach between BM 604 and BM 622.
Oroua River upstream of Boness Rd	5,000	This figure does not relate to any previous analysis, or the previous allowable extraction volume. The previous recommended extraction volume was 10,000m^3, which was derived from various analyses, including the 2002 Pohangina-Oroua Scheme Review and the observations of staff. Horizons' global gravel consent for the upper part of the river, above Menzies Ford, was originally up to 30,000m^3 per year, and has subsequently been increased to 50,000m^3 per year.	Change the reach boundary description for the Oroua River to better reflect the boundary between the Pohangina-Oroua Scheme and the Lower Manawatu Scheme, and increase the extraction volume to 10,000m^3/year.
Oroua River down-stream of Boness Rd	50,000	There is a global consent in place for this reach for river management purposes. This volume may be appropriate at this time due to an excess of gravel in the lower part of the Oroua River (upstream of Kopane) following flood activity in the late 1990s through to early 2000s. However, this volume may not reflect long-term sustainable rates.	Keep as is for the time being.
Makino Stream from confluence with Oroua River to the bend 800 m upstream of	3,000	The volume and reach specified are from Horizonsglobal gravel extraction consent for the Makino Stream, which allows extraction for river management purposes only. This volume is much higher than the long-term average.	Retain the listed volume, but remove the reach restriction. The volume should apply to the entire waterway.

River or Reach	Volume (m^3)	Comment	Recommendation
Reids Line			
Mangahao River confluence to Tararua Road bridge	10,000	This volume and reach is derived from the Upper Manawatu-Lower Mangahao Scheme Review 1997.	Extraction can occur along the entire reach of the Mangahao, so there is no need to specify a reach. The volume should be increased to 15,000m^3 to reflect the increased reach length.
Mangatainoka River	55,000	This figure does not relate to any previous analysis. The maximum extraction rate under Horizons' global gravel consent is 25,000m^3 per year, and the Mangatainoka Scheme Review and various other reports have put the annual gravel transport rate at between 15,000-30,000m^3.	Reduce the volume to 15,000m^3 to reflect the long-term average gravel transport rate.
South East Ruahine Streams • Mangapapa • Mangaatua • Raparapawai • Oruakeretaki • Otmarahu • Kumeti • Otamaraho • Rokaiwhana • Tamaki • Mangatewaiiti • Mangatewainui • Mangatera	 2,000 5,000 15,000 15,000 1,000 3,000 2,000 15,000 30,000 2,000 6,000 500	These figures are based upon the figures set out in Horizons' global gravel consent covering the south east Ruahine streams. Most of these streams have received no or low extraction pressure in the past, but gravel needs to be removed for river management purposes. The volumes stated are based upon the observations of staff, and the current need for extraction (following the 2004 floods). The volumes stated for some rivers are higher than long-term averages, whereas others are too low.	Amend volumes to reflect current understanding of long-term gravel transport averages in these streams (see summary of recommendations). Change spelling to 'Otamarahu'
Upper Manawatu River		The volumes presented are consistent with those presented in the Upper Manawatu-Lower Mangahao Scheme Review (1997). Horizons' global consent for the upper Manawatu River allows an annual extraction of up to 34,000m^3.	
• From 1 km upstream of Ngawapurua bridge to source	20,000		Retain as is.
• 1 km upstream to 2.5 km downstream of Ngawapurua bridge	No extraction		Retain as is.
• 2.5 km downstream of Ngawapurua Bridge to Ballance bridge	15,000		Retain as is.

Table 6.4 Annual allocable volumes of gravel – estimated allocations

River or Reach	Volume (m^3)	Comment	Recommendation
Kawhatau River	35,000	The Kawhatau River receives moderate-high gravel extraction pressure. The allowable gravel extraction figure presented here is based upon previous analyses, undertaken as part of gravel assessments of the lower Rangitikei River, and the observations of staff.	Retain as is.
Makuriiti Stream	6,000	This volume is the current extraction, which is elevated for river management purposes post-2004.	Reduce the volume to 3,000m^3 to reflect the long-term average.
Manganuioteao River • Waimarino River confluence to Whanganui River	5,000	The Manganuiateao River is not used for gravel extraction, at volumes that require a resource consent. Rules 16.2 and 16.3 make extraction a Prohibited/Non-complying activity. Including a volume here is misleading, as it suggests there is gravel available for removal.	Remove the reference to the Manganuiateao River from the table.
Mangatainoka River	55,000		Delete, as this river appears above
Ohau River • Upstream of a point 1 km above SH 1 bridge	2,000	These figures are consistent with those presented as part of the Ohau-Manakau Scheme Review of 1996. Since this review was completed, the river and scheme have experienced significant changes, resulting in an increase in available gravel. As such, the gravel volumes for the river can be amended.	Increase the volume available upstream of the SH 1 bridge to 5,000m^3 per year.
• Downstream of a point 1 km above SH 1 bridge	10,000		Retain as is.
Pohangina River	30,000	This figure is higher than the gravel transport rate presented in the 2002 Pohangina-Oroua Scheme Review and in previous gravel transport figures. This figure is consistent with the original amount allocated under Horizons' global gravel extraction consent for the Pohangina. The maximum annual extraction volume for this river has subsequently been increased to 80,000m^3.	Reduce the figure to 25,000m^3 so it is consistent with the Pohangina-Oroua Scheme Review 2002.
Rangitikei River • Makahikatoa Stream to Mangarere Road bridge	15,000	There is low-moderate extraction pressure on the upper Rangitikei River, and what extraction does occur, tends to be episodic (ie. related to roadworks). This volume is based on the observations of staff.	Retain as is.
• Mangarere Road bridge to Rewa	25,000	Traditionally there has been only moderate extraction pressure on the middle Rangitikei River, however, more recently a number of consents have been granted to allow extraction, but only where there is a demonstrable river management need. In	Retain as is.

River or Reach	Volume (m^3)	Comment	Recommendation
		these instances, gravel extraction will take place in conjunction with other river management activities eg. beach ripping and tree planting. This volume is based upon the observations of staff.	
• Rewa to 7 km downstream of SH1 bridge	50,000	This is regarded as the degradational reach of the mid-Rangitikei River. The 1994 Scheme Review recommended that the maximum amounts of gravel extracted should not exceed 40,000 m^3 per year from the Rangitikei River upstream of 15 km (this was to be from selected beaches to alleviate erosion due to bend deposits).	This figure is being reviewed as part of the Rangitikei River Scheme Review No. 4. The figure of 50,000 m^3 may be close to the mark, although some recovery of bed levels may be warranted in order to reduce river management costs and thus the figure of 40,000 m^3 is recommended for the time being.
• 7 km downstream of SH 1 bridge to mouth	100,000	This figure does not reflect current understanding of the gravel resource of the lower Rangitikei River, and is the subject of a further review by Peter Blackwood and his team.	This figure is being reviewed as part of the Rangitikei River Scheme Review No. 4. There are significant aggradation concerns and thus the figure of 100,000 m^3 is appropriate.
Turakina River	3,000	There is little or no extraction pressure on the Turakina River either now or in the past decade. This volume is based on the observations of staff.	Retain as is.
Whangaehu River	8,000	There is little extraction pressure on the Whangaehu River, except in the vicinity of Karioi, where extraction targets lahar deposits rather than extraction from the river. This volume is based on the observations of staff.	Retain as is.
Whanganui River • Whakapapa Island to Pipiriki • Pipiriki to mouth	 4,000 2,750	The bulk of the extraction on the Whanganui River is concentrated in the Taumarunui to Piriaka reach. Access to gravel downstream of Taumarunui is limited, and extraction tends to be episodic (ie. related to roadworks). As such, the river can be treated as a single reach. The volumes presented are based on an analysis of the gravel resource of the Whanganui River from 2000, and the observations of staff. Horizons' global gravel consent covering the reach from Taumarunui to Manunui allows for the extraction of up to 40,000m^3 per year, at a maximum of 17,000m^3 per year from any one beach.	Reduce the river to a single reach and combine the recommended extraction volumes.

Summary

My recommendations for changes to the gravel section of the Water rules are as follows:

a. That the existing two annual allocable volume tables be combined into one, that errors are removed, that the volumes stated are long-term averages (not maximums), and that they reflect the latest available information, as follows:

River or Reach	**Volume (m^3)**
Kawhatau River	35,000
Makino Stream	3,000
Makuriiti Stream	3,000
Manawatu River	
• From 1 km upstream of Ngawapurua bridge to source	20,000
• 1 km upstream to 2.5 km downstream of Ngawapurua bridge	No extraction
• 2.5 km downstream of Ngawapurua Bridge to Ballance bridge	15,000
• Manawatu Gorge to Karere Rd	50,000
• Karere Rd to Hamilton's Line	300,000
• Hamilton's Line to Oroua confluence [2007 to 2009]	20,000
• Hamilton's Line to Oroua confluence [2009 onwards] the 2 km aggrading reach between 39 Miles (S24 212 832) and Benchmark 643 (S24 226 830)	350,000
• Hamilton's Line to Oroua confluence [2009 onwards] . the 2 km aggrading reach between BM 604 (S24 206 833) and BM 622 (S24 207 826)	700,000
Mangahao River	15,000
Mangatainoka River	15,000
Ohau River	
• Upstream of a point 1 km above SH 1 bridge	5,000
• Downstream of a point 1 km above SH 1 bridge	10,000
Oroua River	
• Upstream of Menzies Ford	10,000
• Downstream of Menzies Ford	55,000
Pohangina River	25,000
Rangitikei River	
• Makahikatoa Stream to Mangarere Road bridge	15,000
• Mangarere Road bridge to Rewa	25,000
• Rewa to 7 km downstream of SH 1 bridge	40,000
• 7 km downstream of SH 1 bridge to mouth	100,000
South East Ruahine Streams	
• Kumeti	3,000

River or Reach	Volume (m^3)
• Mangaatua	5,000
• Mangapapa	2,000
• Mangatera	500
• Mangatewaiiti	2,000
• Mangatewainui	4,000
• Oruakeretaki	5,000
• Otamaraho	2,000
• Otamarahu	1,000
• Rokaiwhana	10,000
• Raparapawai	3,000
• Tamaki	20,000
Turakina River	3,000
Whangaehu River	8,000
Whanganui River	7,000

b. That the volumes in this new table are used as a guide, and that these recommended volumes can be exceeded for river management purposes (eg. following major flood events) or when there are extenuating circumstances (eg. major one-off construction projects).