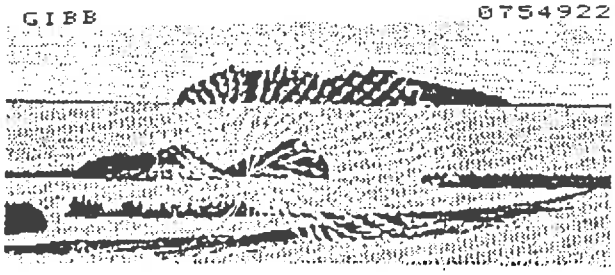

DR JEREMY G GIBB • COASTAL MANAGEMENT CONSULTANT

AUDIT AND REVIEW OF THE 1992 RIVERSDALE COASTAL HAZARD ZONE AND ASSOCIATED TECHNICAL AND PLANNING DOCUMENTS

Prepared for Mr D Treseder of Riversdale Ratepayers Association

March 1994

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AUDIT AND REVIEW OF RIVERSDALE DOCUMENTS

BACKGROUND

1. This audit and review of the Riversdale Coastal Hazard Zone, assessed in 1992 by Andrew Purves and Wayne Hastie (Wellington Regional Council), and associated technical and planning documents, was commissioned by Mr D Treseder on behalf of the Riversdale Ratepayers Association on 5 March 1994. The documents studied in the course of the review are listed in Appendix 1.

RELEVANT EXPERIENCE

2. I became formally associated with the issue of natural hazards at Riversdale in 1979 with a review of Wairarapa Catchment Board's coastal monitoring programme. Monitoring of the beach profile commenced after storm erosion in 1974 and 1978.

3. In the early 1980's I worked closely with Colin Wright, Ian Gunn and Ken Downing of the Catchment Board in carrying out extensive investigations of the Riversdale area. The Riversdale situation was investigated in the context of the coastline between Flat Point and Whareama River mouth. The investigations were subsidised by a grant from the National Water and Soil Conservation Authority (NWASCA) and amongst other matters, resulted in the establishment of a monitoring programme and 15 beach profile sites along Riversdale Beach.

4. In August 1986, I documented the results and analyses of these investigations and established a solid framework to assess a Coastal Hazard Zone (CHZ) at Riversdale Beach. The report was titled *"preliminary"* (Appendix 1) as I was firmly of the opinion at that time that further work was required to provide the basic information essential for the completion of the CHZ assessment, and to conserve the foredune complex.

5. In December 1986, I was appointed Director of Coastal Marine Directorate of the Department of conservation, establishing the directorate and its functions. In 1989 I was approached by Ian Gunn to see if I could complete the assessment of the Riversdale CHZ. Owing to my new role and demands of the position I was (most reluctantly) unable to assist.

6. In October 1993, I left the Department of Conservation and established myself as a self employed Coastal Management Consultant. A large part of my work to date has been involved in the assessment of CHZ's and reviewing techniques and standards for such assessments. These tasks have involved working closely with the Resource Management Act 1991, the Building Act 1991 and other legislation pertinent to coastal management in New Zealand. Some of the work has involved assessing the *"Coastal Environment"*, *"Natural Character"*, and criteria for *"appropriate"* as opposed to *"Inappropriate Subdivision, Use and Development"*. The work has also involved assessing *"Coastal Management Areas"* and *"Coastal Hazards Areas"*, together with formulating guidelines to manage foredune areas.

AUDIT AND REVIEW

1989 Masterton County District Scheme

7. At present the *"Masterton County District Scheme"* of May 1989 is the operative, statutory planning document. *Ordinance 7* of that Scheme defines a Coastal Hazard Zone as *"that area of land within 60m of the toe of the foredune, for the General Rural Zone and that area within 30m of the toe of the foredune in the Coastal Resort Zone"*.

8. *Clause 4* of the Scheme states that *"no subdivision shall be permitted unless the Council is satisfied that ... development within the 30m Coastal Hazard Zone (Coastal Resort Zone) or within the 60m Coastal Hazard Zone (General Rural Zone) will not occur"*. Both the settlements at Riversdale and Castlepoint are classified as *Coastal*

Resort Zones.

Comment

9. As my report assessing coastal hazards at Riversdale was completed in 1986 there is a high probability that the 30m-wide zone recommended by me was adopted. I described this zone as the *"Zone of Extreme Risk"*. The hazards identified were principally erosion and flooding by the sea during severe storms that had a high probability of occurring at least once every 5 to 10 years.

10. The 60m Coastal Hazard Zone for rural areas was not recommended by me in my 1986 report. I do not know the basis of how such a zone was assessed or adopted. However, it is not an unreasonable width.

1993 Draft Masterton District Plan

11. The Draft Masterton District Plan of December 1993 is a *"non-Statutory, draft document for informal discussion only"*. The draft document has no legal status and was open to informal feedback from the public up to Friday 25 February 1994. Following this date *"any person may still make formal submissions once the proposed District Plan is publicly notified in March"*. Masterton District Council stress that the Draft District Plan has *"not been adopted as Council policy"* and that they are *"not bound by any provision contained within the document"*.

12. In the Draft Plan, objectives and policies for mitigation of natural hazards are set out in Section 15 of the Management Strategy (p.54). Amongst other matters, this section notes the importance of Masterton District Council liaising with Wellington Regional Council with respect to *"an integrated approach to natural hazard management"*. It is important that *"a comprehensive and regularly updated, database on natural hazards is available"* and that *"risk assessment"* should be made. Where there is doubt in making such assessments, *"a precautionary approach should be taken and a relatively high level of risk assumed (such as sea-level rise for example)"*. It is noted that *"an*

essential part of avoiding or mitigating the adverse effects from natural hazards is an informed and prepared community ... through the provision of information and advice".

13. In Part B.6 of the Draft District Plan (p.59), rules are set out for hazard management. A *"Natural Hazard Area"* is defined and areas of high risk from such hazards are identified in Appendix F.2. Within a *"Natural Hazard Area"*, the *"erection of, or extension to, any building or structure"* and the *"subdivision of land"*, amongst other matters, *"shall be assessed as a discretionary activity"*. For Riversdale Beach, the *"Natural Hazard Area"* is shown in Appendix F.2.

Comment

14. The Riversdale Beach *"Natural Hazard Area"* in the Draft District Plan is adopted without modification from the report of Purves and Hastie 1992. The Coastal Hazard Zone so adopted is that shown on the 1991 photomaps supplied by Aerial Surveys Ltd., Nelson. The positioning of the landward limit of the Natural Hazard Area therefore, is with respect to the 1991 position of the toe of the foredune. As the Draft District Plan has not been adopted as Council policy, the Natural Hazard Area at Riversdale has no legal status until such time as the plan is formally adopted. This means that the Hazard Area so defined is open to public submissions.

1986 Gibb Report

15. The report provides a thorough analysis of the geology, sedimentology and tectonics of the Riversdale area. A precise analysis of historic shoreline movements for the period 1902 to 1986 is made from the most reliable survey information available, including an analysis of the coastal processes responsible for those movements. The latter analyses were based on careful field studies and measurements. Local farmers and fishermen between Flat Point and the Whareama River mouth were also consulted.

16. Based on the available information, a Coastal Hazard Zone (CHZ) was partially

assessed using a standardised technique. The standardised technique was endorsed by the Soil Conservation and Rivers Control Council in March 1981 for the National Water and Soil Conservation Authority (NWASCA), for nationwide application by both district Offices of the Ministry of Works and Development and the 20 Catchment Authorities serviced by NWASCA at that time.

17. My report was entitled *"Preliminary Assessment"* etc... because it was clearly recognised at the time that further work was essential, particularly with respect to assessing the width of the Riversdale Coastal Hazard Zone. Only a 30m-wide *"Zone of Extreme Risk"* could be reliably established at the time from available data. Further work offshore was required to establish a *"Zone of High Risk"* up to the year 2050 A.D. and a *"Zone of Moderate Risk"* for the period 2050 to 2100 A.D. Table 5 (page 44) in my report was purposefully established to focus on the gaps required to complete a comprehensive risk analysis from natural hazards for Riversdale Beach.

Comment

18. In my opinion, the *"preliminary"* report contains some of the most comprehensive data for any part of the New Zealand coast. Notwithstanding, the report fell short in not providing clear objectives and reasons for its recommendations which covered in broad terms, *monitoring, dune conservation and completion of the Riversdale CHZ*. The monitoring and dune conservation measures recommended were of direct benefit to the Riversdale Ratepayers. Any modification to the recommended programme by the Wellington Regional Council should only have occurred after full consultation with the Riversdale Ratepayers Association and with their concurrence..

19. By contrast, the Riversdale CHZ is a management tool to control subdivision, use and development in a hazard area. It is more for the benefit of the managers and planners of the area such as Masterton District Council and Wellington Regional Council. It is clearly Masterton District Council's decision as to whether the CHZ should be published in the District Plan. However, as the CHZ area directly affects the aspirations of the Riversdale Ratepayers, they should be fully consulted before the

Riversdale CHZ is incorporated into the District Plan. I do not know whether the level of public consultation was adequate.

Monitoring:

20. The recommended programme related to the 15 Beach Profile sites established by Wairarapa Catchment Board under my supervision in the early 1980s.. Data from these surveys were resolved into total volumes for the beach and foredune, together with site specific data for shoreline movements.

21. The 4 year period of beach profile record (1982-1986) reported in my 1986 report was far too short to establish any long or short-term trend. Despite this fact, the survey period covered the adverse effects of the severe onshore storm of July 1985, which had a return period of 50 to 100 years. Like other severe storms in the 1970s, this storm produced extreme deep water waves reaching and exceeding 10m in height with a return period of 5 to 10 years.

22. There were several reasons for recommending the continuation and frequency of the beach monitoring survey in my report. Most important of these was the monitoring of the erosion bight to the south which was advancing toward the Riversdale settlement at 13m/year since 1943 and the monitoring of an annual loss of sand from the Riversdale foredune at 7,000 to 8,500 m^3/year between 1982 and 1986. Both factors were recognised as having a high probability of reversing the long-term trend of accretion at Riversdale to erosion, with potential adverse effects on property and assets. It is in the Riversdale Ratepayers interest to be fully informed from high quality information as to the ongoing behaviour of both trends.

23. The monitoring of longshore drift directions and velocities at Riversdale was also important as from such observations it would be possible to determine the localised directions of sand movement along the beach. This information is essential when considering the possibilities, for example, of utilising sand stored in the low barrier across the Motuwaireka Stream for dune replenishment in front of the houses. If such sand were used and the drift was south then there would be a high probability of

causing erosion of the dunes adjacent to the store and camping ground. Equally, an oscillatory or northerly drift along the barrier could make it a useful source for sand for dune replenishment.

Dune Conservation:

24. The purpose behind these recommendations in the 1986 report is obvious. Sand trapped in the foredune in front of the houses is like *money in the bank during times of adversity*, such as during severe onshore storms. Since 1953, dune conservation works carried out by the local inhabitants in most areas have resulted in accretion of the shoreline and protection of the properties. Equally, there is evidence where these dunes have been modified the property owners have suffered from the adverse effects of storms. Special consideration needs to be given to reducing the adverse effects adjacent to stream outlets by either relocating the streams elsewhere or training the outlets out to the line of the seaward toe of the foredune and rebuilding the foredune either side of the training works.

25. In my opinion, a Riversdale Dune Management Plan needs to be defined by a suitably qualified person. The Management Plan should promote a co-operative effort between the local inhabitants and Masterton District Council and provide a practical work programme to conserve and enhance the foredune complex and control pedestrian and vehicular traffic across the complex to the beach.

Riversdale CHZ:

26. The purpose of defining a CHZ for Riversdale is to clearly identify areas at different degrees of risk from the identified natural hazards of erosion and flooding from the sea. The reason for adopting periods of 64 years (1986 to 2050) and 114 years (1986 to 2100), is that such periods encompass the *"specified intended life"* of buildings and services (see S.39 of the Building Act 1991), and accommodate the actual and potential adverse effects from natural hazards with a high probability of occurrence.

27. A CHZ so defined has an eye on both the past and the future. It provides a standardised mechanism to promote *"sustainable management"* of the coast, provide

for the *"reasonably foreseeable needs of future generations"* and contribute to the *"preservation of the natural character of the coastal environment"*. Because of this a CHZ can often be perceived as an unnecessarily restrictive imposition on existing local inhabitants and their aspirations. Under these circumstances it is helpful to remember that their children or someone else will inherit their beachfront property and assets in the future, hopefully free from the threat from coastal hazards.

28. The Coastal Hazard Zone (CHZ) assessment technique used in my 1986 report uses the standard formula at that time of;

$$CHZ = (X + R)T + S \qquad \text{[Equation 1]}$$

The formula (see paragraph 30 for definitions) has since been refined, based on developments since 1986 both in New Zealand and Australia. The refined techniques have recently been applied by myself and others to the Bay of Plenty - Coromandel coast and to the East Coast near Gisborne.

29. If I was to complete the Riversdale CHZ I would use the latest techniques and information. Since my unfinished assessment in 1986, a further 8 years have passed during which time further important information has been collected at Riversdale. Because a CHZ has a high potential impact on the aspirations of property owners it is essential that the assessment is based upon the most up-to-date, reliable information. It is also important that the information and assessment is freely made available to the public in a comprehensive report.

1992 Purves and Hastie Report

30. The Purves and Hastie report states that it *"completes the preliminary work"* undertaken by myself in 1986 using *"an accepted methodology and the best data available*. It is consistent with my work in that the authors have used Equation 1 above where; *CHZ* is the Coastal Hazard Zone width in metres, *X* is the rate of shoreline retreat caused by an accelerated sea-level rise, *R* is the long-term (historic)

rate of erosion or accretion, T is an assessment period, and S is the maximum extent of short-term shoreline movements.

31. The numerical values used by Purves and Hastie to assess a 16 to 80m-wide CHZ are set out in Table 1 of their report for each of the 15 Beach Profile sites. For Factors R and S [Equation 1], the authors have adopted the values from Tables 3 and 5 of my 1986 report. For Factor T [Equation 1], they have adopted a single period of 60 years (1990 to 2050 A.D.), based on their assessment of the *"approximate lifespan of a dwelling"*. In my 1986 report, I adopted periods of 64 years (1986 to 2050 A.D.) and 114 years (1986 - 2100 A.D.) for Factor T.

32. To compute Factor X [Equation 1], Purves and Hastie have used the *"Bruun Rule"* where:

$$X = \frac{la}{h} \qquad \text{[Equation 2]}$$

Where, X is the rate of shore retreat, l is the length of profile exchange, a is the rate of sea-level rise, and h is the maximum depth of exchange (closure depth) between nearshore and offshore sediments.

33. For Factor a [Equation 2], the authors adopted a rate of sea-level rise of 5mm/year (0.005m/year) for the period 1990 to 2050 A.D.. The rate was determined from a *"best estimate"* projection of +0.3m sea-level rise above the present level by 2050 A.D. by the Intergovernment Panel on Climate Change (IPCC) in 1990. In my 1986 report, I adopted values for sea-level rise of +0.6m above the present for 2050 A.D. and +1.45m for 2100 A.D., from the most reliable predictions available at that time. These values gave rates of sea-level rise of 9.4mm/year (0.0094m/year) for the period 1986 to 2050 A.D. and 12.7mm/year (0.0127m/year) for the period 1986 to 2100 A.D.

34. For Factor h [Equation 2], Purves and Hastie used the theoretical approaches established by Weggel in 1979 and Hallermier in 1981 to compute a closure depth of

22m. In applying these techniques it appears they utilized the 5 offshore profiles surveyed by Wairarapa Catchment Board in February 1989. For the Hallermier technique, the authors used onshore wave observations made at Lake Ferry, Palliser Bay, and offshore sediment grain sizes determined from the February 1989 survey. Based on a closure depth of 22m, the authors estimated Factor *l* [Equation 2] to average 2,000m by *"comparing the 5 profiles surveyed in 1985"*. Because no data were available at the time, I was not in a position to determine values for Factors *h* and *l* in Table 5 of my 1986 report.

35. When computing Factor *X*, Purves and Hastie have increased Factor *h* from 22m to 25m. No explanation is given. They have also increased Factor *l* from 2,000m to 20,000m. Once again no explanation is given. It appears from checking the calculation that the 20,000m value is a typographic error.

36. Purves and Hastie calculate different values for Factor *X* using the IPCC (1990) high and low sea-level projections for the year 2050 A.D. of +0.48m and +0.14m above present sea-level respectively. From these projections they calculate erosion rates of -0.64m/year and -0.2m/year respectively. For Beach Profile 1 (Table 1, p.16), they demonstrate that if these rates are used the CHZ could range from 48m-wide for the low sea-level projection up to 84m-wide for the high sea-level projection.

37 Finally, the authors recommend *"protection measures and planning standards to decrease the risk to beachfront properties"* within the Riversdale CHZ from the adverse effects of natural hazards. They recommend that the CHZ *"will be reviewed by the Wellington Regional Council every 10 years, or sooner if the WRC deems it necessary"*. The implication of this is that the 1992 Riversdale CHZ derived by Purves and Hastie would not be reviewed until the year 2002 A.D.. The role of Masterton District council in such a review is unclear.

Comments

38. Although the 1992 Purves and Hastie report states that it has completed *"the*

preliminary work undertaken by Dr Gibb" in 1986, the work has not been carried out to my satisfaction. At best the 1992 Riversdale CHZ so derived could be classified as either indicative or a first approximation. Because of the potential impacts on the beachfront property owners, it is important that a CHZ for Riversdale be derived from the *"best data available"*. The following paragraphs detail my specific criticisms of the author's report.

39. The formula used by Gibb (1986) and Purves and Hastie (1992) to determine the width of the CHZ is now outdated and has been replaced with a revised formula. Although the revised formula includes Factors ***X***, ***R***, ***T*** and ***S*** [Equation 1] other new factors are included. A possible outcome of applying the latest formula to Riversdale could be a relatively wider CHZ than that assessed by Purves and Hastie.

40. Factors ***R*** and ***S*** were derived from my 1986 Table 3. Table 3 should be updated for the period 1986 to 1994 (8 years) using the beach profile data collected by Wellington Regional Council. Factor ***R*** should be based on the period 1902 to 1994. During May to October 1992 there was significant coastal erosion along much of the east coast of the North Island. I would hope this was recorded at Riversdale by the monitoring programme. Factor ***S*** may also need to be reviewed based on the *"best data available"*.

41. For Factor ***T***, I adopted two periods in my 1986 assessment of 1986 to 2050 A.D., and 1986 to 2100 A.D.. Purves and Hastie only adopted the first period. On this basis alone they did not complete my preliminary assessment. If the *"specified intended life"* of buildings at Riversdale exceeds 50 years then the assessment of a *"Moderate Risk Zone"* covering the period 2050 to 2100 A.D. is fully justified.

42. The 1962 *"Bruun Rule"* used by Purves and Hastie [Equation 2] has since been modified to include the closure depth in metres below mean sea level (MSL) plus the height of the frontal dunes in metres above MSL. The modified *"Bruun Rule"* is still the best formula to use for beaches like Riversdale but would require the heights of the frontal dune on each of the 15 Beach Profile sites to be added to the closure depth

in a CHZ assessment.

43. The sea-level rise values [Factor *a*, Equation 2] used in my 1986 report are far too high and have since been reduced by the work of the IPCC (1990). The convention today is to adopt the *"best estimate"* projections of the IPCC of +0.3m by 2050 A.D. and +0.66m by 2100 A.D.. Purves and Hastie adopted the IPCC values but they have not adjusted them for local effects at Riversdale and New Zealand in general. These adjustments include making allowances for the historic rate of sea-level rise in New Zealand this century and tectonic uplift effects at Riversdale over the last 125,000 years. Both these factors are likely to reduce the *"global"* predictions of IPCC.

44. The closure depth [Factor *h*, Equation 2] derived by Purves and Hastie from theoretical techniques has significant limitations. They adopted wave data from Palliser Bay which is totally sheltered from seas from the North to East quadrant. Riversdale is exposed to such seas. They used the 5 offshore profiles to establish the distance to -22m water depth. These profiles as surveyed only extend to water depths of -8 to -16m below MSL. Only many of these profiles the sandy seabed became rocky after about -10m suggesting a closure depth for beach sands considerably less than -22m.. A reduction in closure depth in Equation 2 will reduce the erosion rates for *X*, thus reducing the width of the CHZ proportionately as calculated by Equation 1.

45. Purves and Hastie test the sensitivity of the CHZ to the high and low sea-level projections of the IPCC (1990) for 2050 A.D.. For Beach Profile 1, these would create a CHZ width of 60±14m (46 to 74m). Such a variation is significant in terms of the potential impacts on beachfront properties of a CHZ that could range from 46 to 74m in width. This demonstrates the importance of calculating Factor *X* from the best data available.

46. A review period for the CHZ of 10 years is suggested. In my opinion the review period should be 5 years. It is also questionable as to whether WRC should be doing this work or whether it is more correctly the function of the Masterton District

Council. I would suggest the latter option based on my understanding of the Resource Management Act 1991. This could be checked with your legal Counsel.

47. Finally, in Table 1 Purves and Hastie have departed from *"accepted methodology"* in assessing the CHZ widths for Beach profile sites 6, 9 and 10. The CHZ widths assessed are 16m, 23m and 22m respectively. They are less than the 30m-wide *"Zone of Extreme Risk"* assessed by me in 1986 and adopted by the local authorities, and Purves and Hastie. The accepted methodology is that if $(X + R)T$ [Equation 1] is positive the prediction is for a continuation of the long-term trend of accretion. This is the case for Profiles 6, 9 and 10. Under these circumstances the convention is to adopt a minimum CHZ of Factor *S*. For Riversdale the minimum CHZ-width would be 30m NOT 16m as suggested in Table 1 of the author's report.

CONCLUSIONS

48. The preliminary assessment of coastal processes and coastal hazards at Riversdale Beach by Gibb (1986) should be updated, reviewed and completed to my satisfaction. The report should include a full assessment of a CHZ for Riversdale Beach using the latest techniques and the best data available.

49. Masterton District Council should commission the completion of the 1986 Gibb report in a form suitable for dissemination to the public, especially the people of the Riversdale Beach area.

50. The 1992 Riversdale Coastal Hazard zone assessed by Purves and Hastie should be classified as either *"indicative"* or a *"first approximation"*, with the exception of the 30m-wide *"Zone of Extreme Risk"*. On this basis, it is debatable whether the 1992 CHZ should be accorded the status of inclusion in the District Plan. By contrast, the *"Zone of Extreme Risk"* is soundly based.

51. The current monitoring programme should be reviewed to ensure that the critical

processes are being adequately recorded. The Riversdale Ratepayers Association should have a say in the programme and be involved in elements of it such as the measurement of longshore drift and the monitoring of the effects of storm events and the northerly migration of the erosion bight.

52. A Dune Management Action Plan should be developed for Riversdale beach through Masterton District Council and actioned with the co-operation of the Riversdale Ratepayers Association and appropriate local authority specialist staff.

53. When a full assessment of a CHZ for Riversdale Beach has been properly assessed, including a consultative process with members of the Riversdale Ratepayers Association, due consideration should be given by Masterton District Council for the inclusion of the CHZ in their District Plan.

Dr J G Gibb

15 March 1994

APPENDIX 1

1. 1950's and 1990's. Aerial oblique photographs of Riversdale.

2. 1983 Plans. *"Coastal Resources - Riversdale Beach-Wairarapa Coast"* A.P. 1490 Sheets 1 & 2. Scale 1:2500.

3. 1985. Report by Willie Bartholomeusz (Central Laboratories MWD) 1985 entitled; *"Riversdale Coastal Hazard Survey-Sediment Analysis"*. Report M2.85/1 (Consultancy Report on sources of beach sand).

4. August 1986. Report by Jeremy Gibb (Water and Soil Directorate, Ministry of Works and Development), entitled; *"Preliminary assessment of coastal processes and coastal hazards at Riversdale Beach, Wairarapa East Coast, North Island, New Zealand"*. (Report to Wairarapa Catchment Board and Masterton County Council).

5. 1986 Plan. *"Coastal Resources-Flat Point to Whareama"*. A.P. 1740 Sheet 3 of 8 Sheets. Scale 1:5000.

6. May 1989. Masterton County District Scheme. (Operative Statutory Document).

7. July 1989. Report by Ian Gunn (Wairarapa Catchment Board) on *"Offshore survey at Riversdale Beach"*. (Internal Report on offshore investigations).

8. 1991 Plans - Aerial Surveys Ltd. Nelson. Three photomaps at 1:1000 Scale covering 'Coastal Resort Area' of Riversdale.

9. October 1992. Report by Andrew Purves and Wayne Hastie (Wellington Regional Council) entitled, *"Assessment of Coastal Processes and Coastal Hazards at Riversdale Beach, Wairarapa"*. (Assumed to be an internal report for Wellington Regional Council).

10. December 1993. Draft Masterton District Plan. (Non-Statutory Document for informal discussion only).

11. 1994. Notes from Daryl Ramsay on my 1986 Report.