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# NEW ZEALAND Engineering

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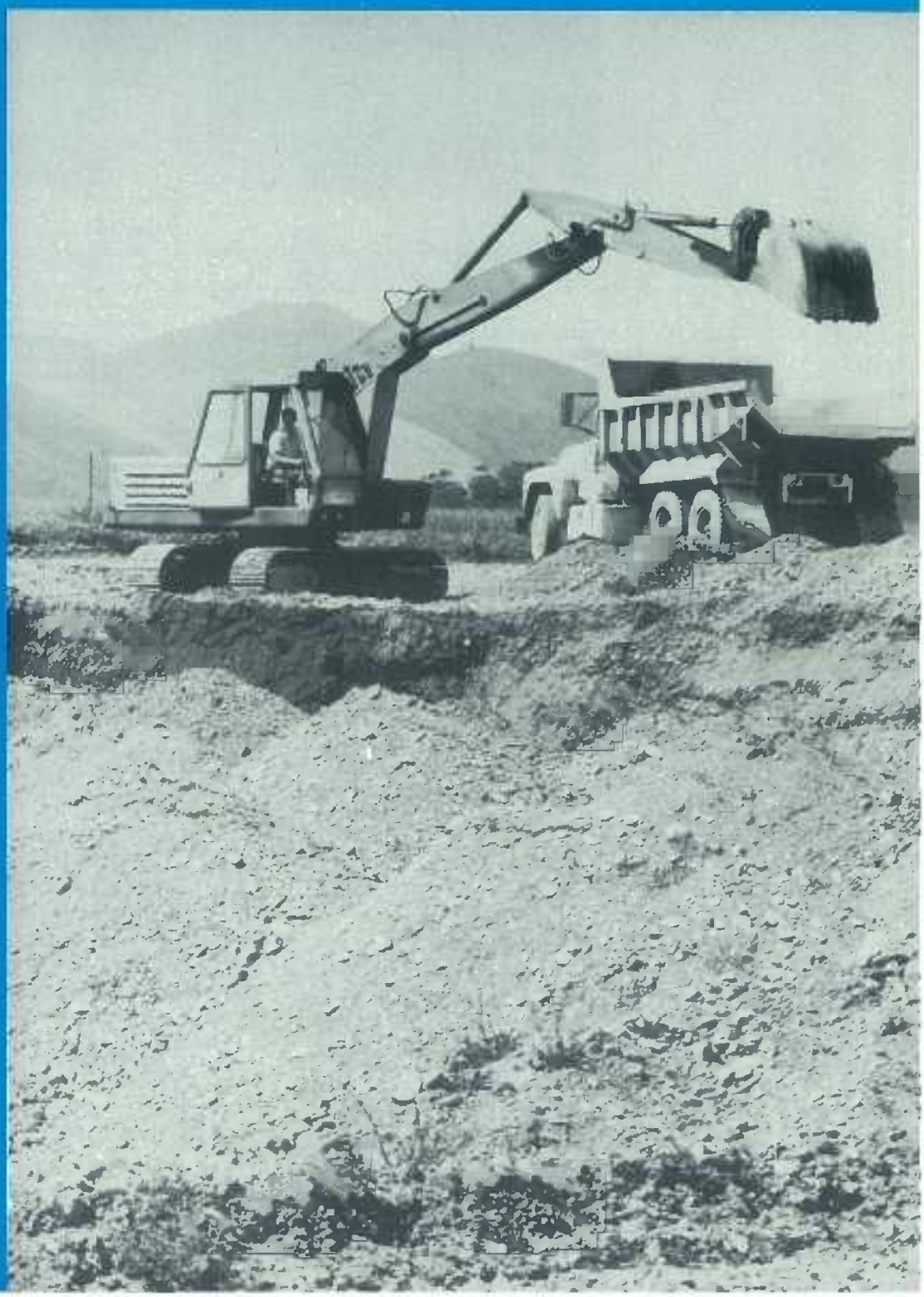

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# Engineering

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## Leading article



## Papers and articles



## General



## Cover picture

Quarrying of shingle on the Waimea plains. Management of the high quality river gravels near Nelson is described in the paper on p. 98.

NEW ZEALAND
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# Public relationship

AS well as its successful hosting of the 1979 conference, Wellington Branch mounted a splendid engineering exhibition to mark its 50th anniversary. Models, project illustrations, and instruments presented the breadth of endeavour represented in the works, the research undertakings, and the other technical contributions of engineers.

Communicating about the range, present state, and future prospects of its technology is an important facet of professional public relations. Any public discussion about technical things must be able to assume a basic level of understanding, which can be fostered by exhibitions and published information.

There are other equally important facets, as Wellington demonstrated by providing a training and information centre at the exhibition. The distinguishing mark of a profession, in comparison with a trade or commercial undertaking, is its acknowledgment of a duty to the community, in carrying forward its art and protecting the public interest. But the ways in which this duty is carried out vary for each profession, and it is something of a challenge for engineers to identify our communication needs.

Already the full range of the Institution's public relationship is wide. The branches have a key role, in the big efforts like Wellington's, and in the continuing public contact and duties of branch chairmen and committees in hosting, making considered public comment, and responding to regional policy issues. Auckland's energy policy work last year and the traffic group's contribution on the transport White Paper have been good examples from the recent past.

The Council carries on another level of the relationship, in the President's discussions with Ministers, in his representation of the Institution in various places, in the work of the public relations committee, and in the Dobson lectures. The committee for the future now adds a dimension in its responses to the New Zealand Planning Council reports, and to the work of the Commission for the Future.

"Looking outwards" is perhaps the key to it all. But whatever the Institution's organised contribution, it is, in the end, the contribution of individual members which determines whether or not the whole effort is adequate. Individuals represent the profession in many places, on the boards of companies, in local government councils, on commissions and school committees, and in personal contacts during normal work. Every meeting is an exercise in diplomacy, an opportunity to communicate engineering and represent engineers, and, above all, an opportunity to develop the profession's public relationship.

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* Unless specifically indicated, statements or opinions in *New Zealand Engineering* do not necessarily reflect the views of the Institution or the publishers. Correspondence on material published is welcomed.

# Shingle management on the Wairoa-Waimea rivers, Nelson

D. GREG PEMBERTON *
(MEMBER)

*The Wairoa-Waimea rivers are the major source of high quality river gravels for Nelson City. About 1972, severe degradation due to shingle extraction was beginning to threaten both bridge piers and bank stability. A management plan was called for. By an extensive study involving aerial photographs, river cross-section surveys and flood hydrograph analyses, it was possible, using a modified Shield's relationship, to rate large floods with shingle carrying capacity. The rate of shingle extraction by private contractors was shown to be more than six times the average annual delivery rate. A management plan was subsequently drawn up to restrict shingle extraction.*

## 1. INTRODUCTION

THE Waimea stopbanking scheme had been constructed between 1959 and 1962. Following the scheme, shingle extraction continued and was encouraged since aggradation problems were feared, particularly in the lower reaches. In 1973, the Nelson Catchment Board (N.C.B.) became alarmed at the effects of an ever-increasing rate of shingle extraction in the Waimea River as it had become great enough to cause serious degradation — serious because of associated effects of groundwater lowering, threatened instability of Appleby bridge piers, and bank erosion; but conversely usefully increasing flood capacity.

Rock work tipped on eroding banks whose height was continually increasing was becoming increasingly difficult to finance because of the larger amounts required (Fig. 1); the comment was passed that rock was going in as fast as shingle was coming out. The board, therefore, called for a plan to manage rationally the resource in the interests of promoting bank stability and an adequate floodway.

*Fig. 1: Rock protection on eroding banks of the Wairoa and Waimea rivers.*

## 2. BACKGROUND

The Wairoa-Waimea rivers are the only large source of top quality river run gravel close to Nelson City. The Wai-iti and Wairoa are both tributaries of Waimea (Fig. 2). Wai-iti material, however, is soft, being gravels from the Moutere formation and is suitable only for low grade uses such as fill. Prior to 1975, shingle operators in these rivers worked under an open-permit system administered by N.C.B. Returns upon which royalties were paid were forwarded "regularly", giving details of the quantity and site of extraction. Some returns were "ex-river", others "ex-stockpile". Beaches where shingle was to be taken were specified by staff, and were usually within the design channel width, being 140 m for the Waimea River and 100 m for the Wairoa River.

## 3. THE DEGRADATION SITUATION

River cross-section sites, with bench marks on both banks, had been established over the years since 1956. River surveys were more comprehensive in recent years (Table I).

TABLE I

*Establishment of permanent river cross-sections*

| *Year* | *Survey* | *River cross-sections, average per section* |
|---|---|---|
| 1960 | 5 | 2.5 km |
| 1965 | 5 | 2.5 km |
| 1968-9 | 13 | 1 km |
| 1971 | 13 | 1 km |
| 1973 | 18 | 640 m |
| 1975 | 18 | 640 m |
| 1978 | 24 | 480 m |

In 1960 the five established sections were between the mouth and Wairoa Brightwater bridge. By 1978 a total of 24 permanent sections at about 0.5 km spacing had been established. Shingle royalty returns are more comprehensive in recent years, so that generally the quality of information beyond 1965 is better than that before, and hence was given more emphasis in the analysis.

Figure 3 shows the changing profile of the river between 1960 and 1973, as measured by the river surveys. In the lower 6.5 km an average bed lowering of about 1.2 m occurred, but certain sites had degraded 1.8 m. Piles were visible beneath some piers on the Appleby bridge and were also visible in the low-flow channel at Brightwater Wairoa bridge (Fig. 4), about 8 km upstream of Appleby.

Figure 5 summarises shingle extraction in Wairoa-Waimea 1960-73, during which period rate of extraction tripled.

Degradation in the lower reaches of the Waimea had earlier been beneficial in several ways. It resulted in increased flood capacity such that whilst a large flood June 1962 nearly overextended the scheme a flood of larger size in August 1967 (1800 cumecs) was handled

*Formerly water resources engineer, Nelson Catchment Board, now agricultural engineering consultant to the Caribbean Development Bank, Barbados.

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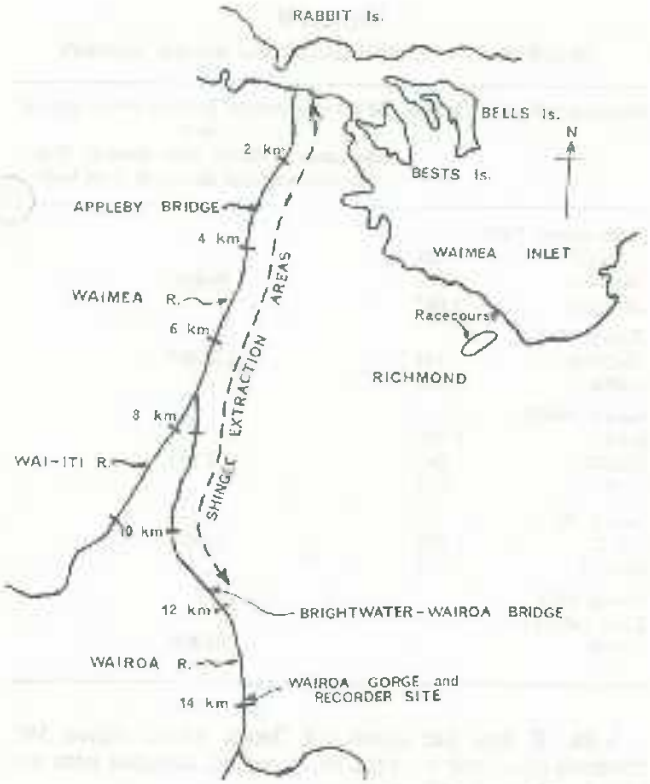


*Fig. 2: Shingle extraction areas on the Wairoa, Waimea and Wai-iti rivers.*

with adequate freeboard (in retrospect and with the benefit of flow records since the scheme was designed the original design $Q_{50}$ of 1420 cumecs is too low). The more gentle bed gradients along with supervised shingle extraction in lower 4 km of river has spread the low-flow channel ...tually across the whole bed. In floodtime, this will give more uniform scouring on all piers of the Appleby bridge, reducing severe local scouring. This bed form has made bank stability work easier, and less expensive, requiring only willow protection work with isolated rock protection. Previously, the meander pattern had the usual effect of

*Fig. 4: Wairoa bridge at Brightwater.*

causing intense pressure on small sections of the banks, and, since it migrated, all the banks at one time or another were endangered (as occurs still further upstream).

Degradation in the downstream 5 km of the Waimea has effectively and beneficially lowered the water-table by up to 1.2 m for a distance of about 1200 m either side. Areas of formerly swampy and poorly drained land are now developed. Some natural springs have dried up or diminished in flow. Two important aquifers at 12 m and 36 m are currently being studied by N.C.B. and N.Z. Geological Survey.

## 4. ANALYSIS

Some quantitative basis for the management plan was needed. Information to hand included the river surveys, many aerial photos beginning 1948, reasonable shingle extraction records, and river flow records from a Kent water-level recorder installed at Wairoa Gorge in 1952.

The length of Wairoa-Waimea crossing Waimea plains is about 13 km. Only the lower 9.2 km (that is downstream of Wairoa Brightwater bridge) had been worked for shingle; this reach was conveniently divided into four sections based on the areas where the largest shingle contractors had traditionally worked. There are three permanent crushers on the river, one having begun operations in the 1930s.

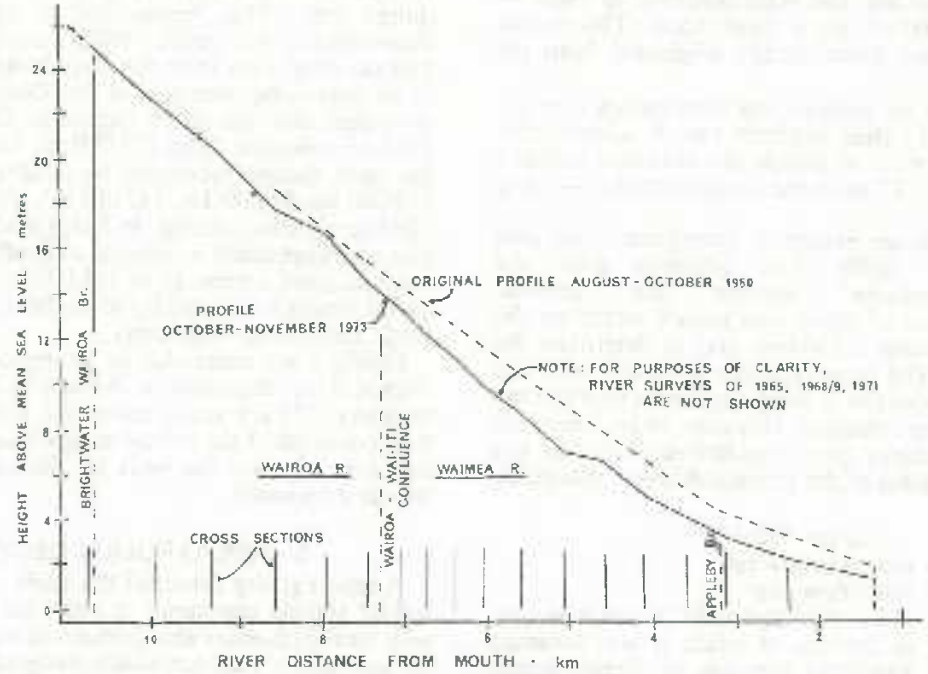


*Fig. 3: Wairoa and Waimea rivers, profiles 1960 and 1973.*