A STUDY OF THE HYDROLOGICAL AND SEDIMENTOLOGICAL CHARACTERISTICS OF TWO CATCHMENTS OF CONTRASTING LAND USE

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ERRATA: Changes on page headed ABSTRACT and pages 48 and 62 as follows:-

p. headed ABSTRACT , 4th paragraph, 3rd line to read .....

'and $\underline{1.22 \times 10^2}$ kg / ha from the Tuapaka and Ballance Catchments, respectively.'

ABSTRACT

The hydrological and sedimentological characteristics of two catchments of contrasting land use were studied for a period of one year. Both catchments were situated in the Northern Tararua Ranges, near the Manawatu Gorge, some 27 km from Palmerston North, New Zealand. The 10 ha Ballance Catchment has native forest vegetation, whereas the 180 ha Tuapaka Catchment is part of a mixed sheep and cattle farm.

The water balance estimated for the catchments indicated that a small amount of deep percolation occurred in both. Streamflow and rainfall were recorded at both catchments. During the study year approximately 26% and 14% of total rainfall was discharged as streamflow from the Tuapaka and Ballance Catchments, respectively. Throughfall and stemflow were also recorded at Ballance. The average monthly throughfall was 54% of total rainfall; the equivalent stemflow was 16% of total rainfall.

An attempt was made to identify and quantify the inputs of phosphorus (P) and nitrogen (N) forms to the two catchments. Phosphate fertilizer application, N - fixation by clovers, and rainfall, were considered as the inputs of P and N forms in the Tuapaka Catchment. In the Ballance Catchment, rainfall was assumed to be the only input of P and N forms.

The output of suspended sediment, dissolved material, and P and N forms, was measured during the study year. The output of sediment was 1.4 x 10^3 kg/ha and 1.6 x 10^2 kg/ha from the Tuapaka and Ballance Catchments, respectively. The output of dissolved material from the Tuapaka Catchment was only 13% of the sediment output. Significant quantities of P and N output were associated with suspended sediment. Of the annual loss of total P (1.6 kg/ha) from the Tuapaka Catchment, 76% was in the particulate form. At Ballance, 52% of the annual loss of total P (0.2 kg/ha) was in particulate form.

Within the bounds of error, the Ballance Catchment appeared to be slightly conservative of P and strongly conservative of N. At the Tuapuka Catchment, however, inputs of P and N balanced outputs, within the bounds of error. It is difficult, if not impossible, to determine whether a particular catchment is conservative for P and N unless adequate attention is paid to the errors involved.

The differences obtained for the output of sediment and P and N forms, from the two catchments, are interpreted in terms of the effects of agricultural activities, particularly vegetation differences, on the inputs of particulate and dissolved phases to the streams.

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SECTION 1 INTRODUCTION

Deterioration in the quality of natural waters is a problem of increasing concern in New Zealand and overseas. Interference with agricultural and recreational activities, and a reduction in the consumptive value of waters are just three of the undesirable side-effects of sediment and nutrient enrichment of waters.

Sediment is regarded by some workers as the major pollutant of surface waters (Wadleigh, 1968). Sediment originates from two sources: (i) the natural and man-accelerated processes of erosion of soils and geological materials, and (ii) the direct or indirect discharge of industrial, municipal, or agricultural wastes to watercourses. Both sources produce a variety of sediment materials. Sediments from natural and man-accelerated erosion include inert boulders, gravel, sands, silts, and colloidal materials such as clays, organics, and amorphous materials. Although sediment production is a natural process, it is suspected that most sediment results from the activities of man (Grissinger and McDowell, 1970).

Soil conservation practices can reduce the sediment loading of waters, the losses of valuable topsoil, and the flooding of downstream areas. Conservation practices by themselves, however, will not always reduce nutrient inputs, particularly dissolved components, to waters.

Nutrients, particularly phosphorus (P) and nitrogen (N), are frequently implicated as major factors in the undesirable side effects of eutrophication (Vollenweider, 1968; Ryden et al., 1973). Phosphorus and nitrogen, are frequently associated with sediment both directly and also indirectly through sorption-desorption reactions (Taylor and Kunishi, 1971; Schuman et al., 1973a, 1973b; Burwell et al., 1974).

The objectives of this study were to determine and compare the properties of two catchments of contrasting land use, and to examine the reasons for differences in their hydrological behaviour. Methods in current use or modified versions of them, were employed to measure or estimate inputs and outputs of P and N forms, and the output of sediment.

The small catchment technique (Borman and Likens, 1967) used in this study provides a means of estimating inputs and outputs, and certain interactions, at an ecosystem level. By choosing a catchment in native forest and one in pasture, comparative data can be obtained. It was hoped that such a study would provide new approaches and information, and point to directions for future research.

It is recognised that catchment studies involving water, sediment, and nutrient discharge should be conducted over reasonably long periods of time to minimise short-term effects, particularly climatic variation. Nevertheless, a short-term study, such as that reported in this thesis, gives an opportunity for the development of techniques and the collection and interpretation of comparative data. If treated with caution, useful information can be obtained for the behaviour of two catchments in the same study year.

PLATE 1. *OBLIQUE VIEW OF TUAPAKA CATCHMENT TAKEN ABOVE THE MANAWATU RIVER LOOKING S.E. TOWARD THE CATCHMENT HEAD.*

(Photo: Mr P.R. Stephens, 1975)

PLATE 2. *OBLIQUE VIEW OF BALLANCE CATCHMENT TAKEN ABOVE THE MANAWATU RIVER LOOKING WEST TOWARD CATCHMENT HEAD.*

(Photo: Mr P.R. Stephens,1975)