CURRENT RESEARCH IN HYDROLOGY IN NEW ZEALAND UNIVERSITIES

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In summarising the current studies, hydrology has been interpreted in the broader sense to include the allied fields. The information collected shows that widely varied topics are being investigated and it may be best to list these studies according to the universities.

This survey includes the Schools of Engineering and the Agricultural Colleges. It is possible that some work is also done in the Science and Mathematics Departments of the universities, but at the time no information on this is available.

UNIVERSITY OF AUCKLAND

The work is mainly in the field of sediment transport, but a few statistical studies of the available flood records on the larger New Zealand rivers have been carried out. Problems of tile drainage have been the centre of analytical studies. The sediment transport studies are all concerned with the basic mechanism of transport and can be sub-divided as follows:

(a) Momentum exchange and the associated force fields in liquid flows containing solid particles in various concentrations. This study is both theoretical and experimental and is for a Ph.D. degree.
(b) Studies into the mechanism of sediment ripple formation. Encouraging progress has been made and two publications are due to appear.
(c) Resultant lift force study on a granular bed caused by water flowing over it.
(d) Studies into the plan and cross-sectional geometry of water courses in cohesionless erodible material, including detailed and precise measurements of velocity distribution (direction and magnitude) and boundary shear distribution in a natural meander bend. Encouraging progress has been made in the development of the necessary experimental technique.
(e) A study of water turbulence effects on sediment entrainment.

Analytical work in the field of tile drains: The problem of vertical influent seepage flow to an infinite series of tile drains located in an isotropic, homogeneous, permeable continuum and underlain by an impermeable layer

has been solved for the case considering the existence of a phreatic line. Solutions are given for the drain size and depth. The limitations of the theory, awkward shaped drains and lack of straightness in the impermeable layer have been checked. More work is in progress in this field.

Enquiries for further information should be addressed to Mr. A.J. Raudkivi.

MASSEY UNIVERSITY COLLEGE OF MANAWATU

The studies at Massey are related to agricultural applications and are as follows:

(a) Mole length relative to surface gradients and soil texture.
(b) Water yield from soils with different plant cover and stock management.
(c) Suitability of various materials as sand screens in soils liable to cause silting in pipe drains.
(d) Aerial photography for detecting soil texture changes in the design of under-drainage systems.
(e) Sub-surface irrigation using established under-drainage systems.

Further details are available from Mr. Bowler.

UNIVERSITY OF CANTERBURY

Studies here are mainly in the field of flood routing and the unit hydrograph, but some work is also being carried out in the field of sediment transport.

(a) Sediment transport: Experimental studies of the mechanism of bed movement and comparison with the various physical models proposed (e.g. Einstein, Kalinske, Bagnold and others).
(b) Flood routing: A theoretical study of flood wave movement has been made, and expressions obtained for the speed and subsidence rate of a flood wave in a uniform channel. The amount of subsidence was found to be small, as was the difference between the wave speed and the "monoclinal" wave speed dQ/dA. The conclusion is that if either of these quantities is found to be appreciable in a natural channel, the fact must be ascribed either to channel irregularities having the effect of a chain of small lakes, or to infiltration losses to the surrounding country.
(c) Unit hydrograph - I. A study has been made of the algebraic processes implied in the

designer's use of the unit hydrograph to estimate a peak discharge; the aim was to determine what effect the form of the unit hydrograph has on this estimate, and hence to determine how accurately this form has to be known. It was found that the form of the unit hydrograph was almost completely immaterial, and that any simple form, e.g. the triangular, could be assumed without serious error. On the other hand the form of the rainfall intensity-time distribution was found to give estimates of peak discharge up to 20% higher than with a uniform distribution, for the same value of mean intensity and for typical climatic and infiltration relationships.

This work is due to appear in the Journal of Geophysical Research.

(d) Unit hydrograph - II. Using the method of characteristics as developed by Lighthill and Whitham, an analysis has been made of the build-up and decay of flow over a sloping impermeable surface due to rainfall of finite duration. The results are different in certain important respects from those predicted by the unit hydrograph; in particular they do not show the linear property of the unit hydrograph, i.e. peak outflow is not directly proportional to the amount of rainfall excess. However these results do not necessarily imply a serious criticism of the unit hydrograph method. Since a single impermeable surface is not necessarily a realistic model of a natural catchment, the work is being extended to cover combinations of river channels and contributing catchment slopes. It is hoped that a useful critique of the unit hydrograph theory will emerge from this work.

(e) Unit hydrograph - III. The problem considered here is the derivation of the unit hydrograph from an observed rainfall excess and outflow hydrograph. One method currently used is based on the linear equations connecting the ordinates of the unit hydrograph. The resulting system of equations is redundant and must be solved by an optimising procedure; also there are marked cyclic irregularities in the resulting unit hydrograph ordinates.

An alternative method is being developed based on a result due to J.E. Nash connecting the moments of area of the three curves being considered - rainfall excess distribution, the unit hydrograph, and the outflow hydrograph. By means of this relationship the moments of area of the unit hydrograph, up to any desired degree, may be simply obtained from the moments of area of the other two curves. From the moments of area the unit hydrograph ordinates may be obtained without any redundancy in the equations, for only those moments need be chosen having degrees up to and including the number of ordinates into which the unit hydrograph is to be divided.

Some preliminary work has been done, and results so far are promising.

Further details are available from Mr. F.M. Henderson.

LINCOLN COLLEGE

(a) Study of the effects of differences in management on the physical properties of a tussock grassland soil in the Waimakariri Catchment at Porter's Pass (altitude 3,000ft). Infiltration rates under different management are measured with double ring cylinder infiltrometers and also with a "North Fork" pattern sprinkler infiltrometer. The infiltration rate, as measured by both types of infiltrometer, was found to fall initially as wetting proceeds but later tended to rise.

(b) Collaboration with the North Canterbury Catchment Board in analysis of run-off and precipitation data from two small adjacent catchments.

Further details are available from Mr. B. Douglass.

It is seen that there is a healthy spread of the topics and it is hoped that this will persist. An increase in liaison between the "men in the field" with their problems, and the more theoretical work in the universities would be of general benefit for both parties and every endeavour should be made to encourage it.