GROUNDWATER TRANSMISSIVITIES IN NORTH CANTERBURY (NOTE)

M. C. Day* and B. W. Hunt†

Recent efforts have been made to calculate groundwater transmissivities in North Canterbury by Hunt and Wilson (1974) and Hunt 1976 a). These calculated transmissivities have been used by Hunt 1976 a, b) to construct regional numerical models for use as predictive tools in groundwater management. The following note contains some similar results that have been caclulated for the region between the Selwyn and Waimakariri Rivers by the first writer, under the guidance of the second writer, as part of a M.E. project (Day, 1976). The methods used in the calculations are virtually identical with those used by Hunt (1976 a) and will not be discussed in detail in this note.

The piezometric contours that were used for this study were drawn by the North Canterbury Catchment Board from data which they obtained in December, 1974. These contours are shown in Fig. 1. along with the resulting streamlines and corresponding values of the stream function, , upon each streamline. The numerical difference between the values of upon any two streamlines give an estimate for the flow rate, in cumecs, between the streamlines.

This study differed from previous studies in that well withdrawals in the Christchurch area and spring outflows along spring-fed rivers were included in the transmissivity calculations. Average annual well withdrawals were obtained from all local bodies in the Christchurch area. There were, however, no comparable records available for wells controlled by industries in the region, and these were ignored. Well withdrawals are small compared to total flow rates in the aquifer. They also tend to be an order of magnitude smaller than many of the spring outflows, so that errors introduced by neglecting industrial withdrawals were believed to be insignificant.

* Lyttelton Harbour Board
† Department of Civil Engineering, University of Canterbury

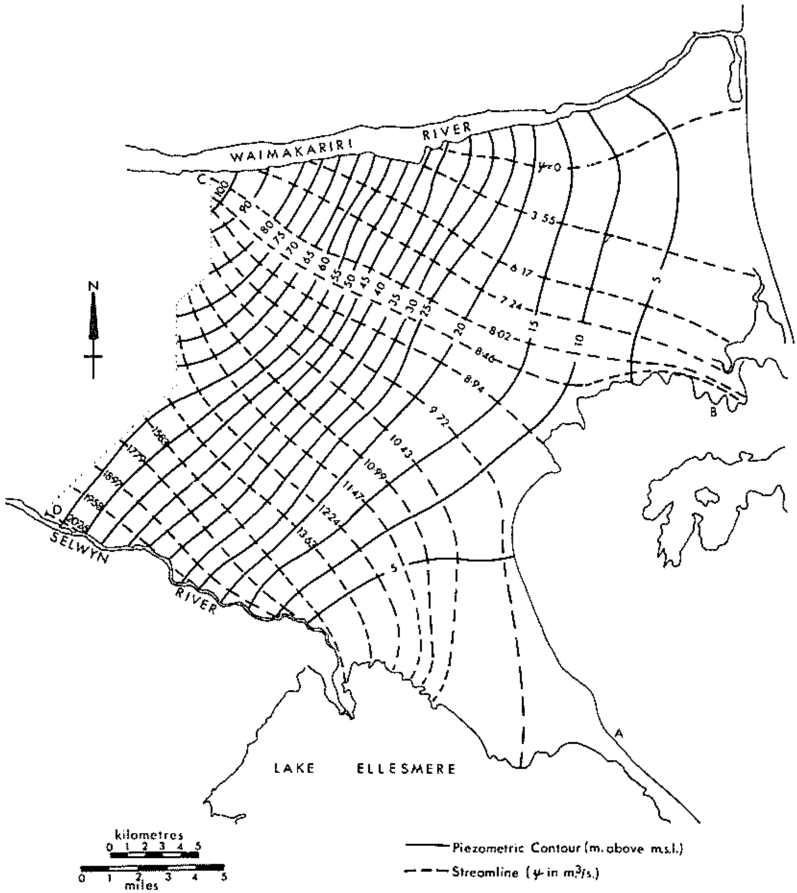

FIG.1 – Piezometric contours and streamlines for a portion of the Canterbury Plains.

The distribution of spring outflows was determined by simultaneous gaugings along spring-fed rivers within the region. These gaugings were made by the North Canterbury Catchment Board after a dry spell in the summer of 1975–76, so there should have been no rainfall run–off influencing the flows. Thus, the increase in flow from one section to the next of any river was assumed to come solely from groundwater, and losses due to evaporation and evapo–transpiration were believed to be relatively small and were ignored. The location of well withdrawals and spring outflows that were used in this study are shown in Fig. 2.

Transmissivities were calculated by setting the difference in flow rates between any two cross sections along the same stream tube equal to the sum of well withdrawals and spring outflows occurring between the two cross sections. The result of these calculations is shown in Fig. 3, in the form of a transmissivity contour map. The most notable features of this map include a general transmissivity increase in moving eastward toward the sea and relatively large transmissivities along lower portions of both the Selwyn and Waimakariri

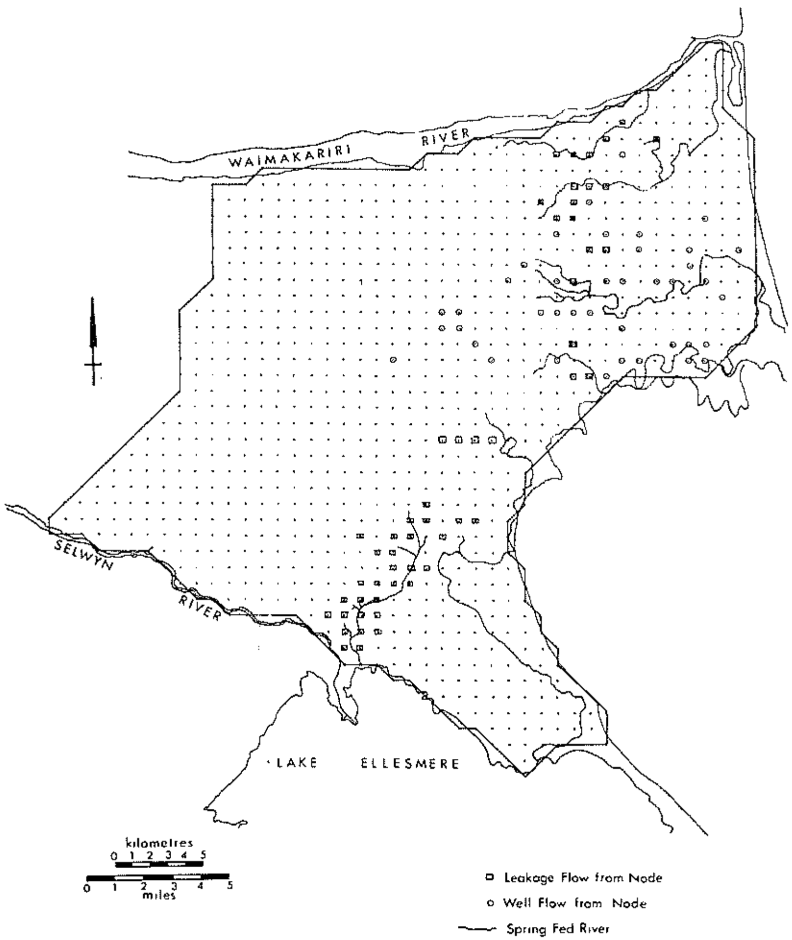

FIG.2 — A finite-difference grid used in the study showing the location of spring and well outflows.

Rivers. High transmissivities shown along the western edge of Fig. 3, may be a result of inaccuracies in the original piezometric contour map since observation wells are relatively scarce in this area and this is not known to be a particularly high yield area for wells.

A partial check upon the accuracy of the transmissivity calculations was made by using the calculated transmissivities in a numerical, finite-difference model in an attempt to regenerate the piezometric contours shown in Fig. 1. The calculated and measured contours are compared in Fig. 4, and the writers believe that this comparison is good enough to suggest that the calculations have been done accurately. Further evidence for this conclusion is also shown in Fig. 5, where the calculated piezo-metric contours are compared with contours obtained by; (1) neglecting well and spring outflows and, (2) using a constant transmissivity with zero well and spring outflows. The rather substantial differences that occur in each case suggest; (1) that well and spring outflows are too important to be neglected for calculations in this area and, (2) that the calculated transmissivity variation is a definite improvement over the assumption of a constant, average transmissivity for the entire region.

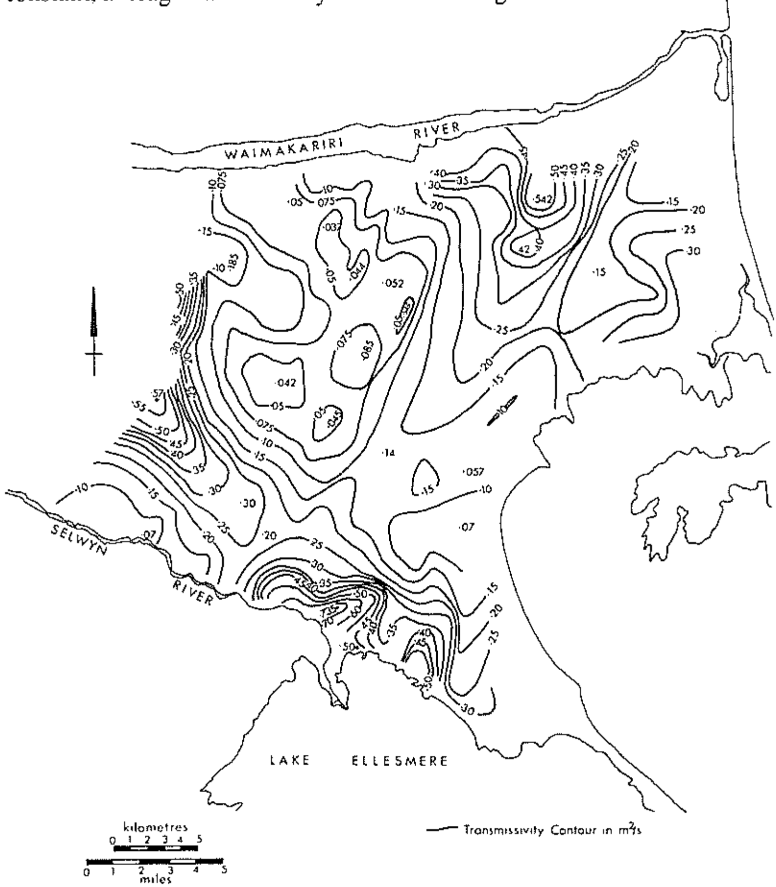

FIG.3 – Transmissivity contours for the region shown in Fig.1.

ACKNOWLEDGEMENTS

The writers would like to thank the North Canterbury Catchment Board for supplying the piezometric contour map, obtaining the municipal well withdrawals, gauging and surveying spring-fed rivers and reducing and tracing the figures contained in this note. The writers would also like to thank Mr L. J. Brown and Mr D. D. Wilson, both of the Christchurch Branch of the N.Z. Geological Survey, for supplying and helping to interpret well records and for their valuable advice on geological considerations.

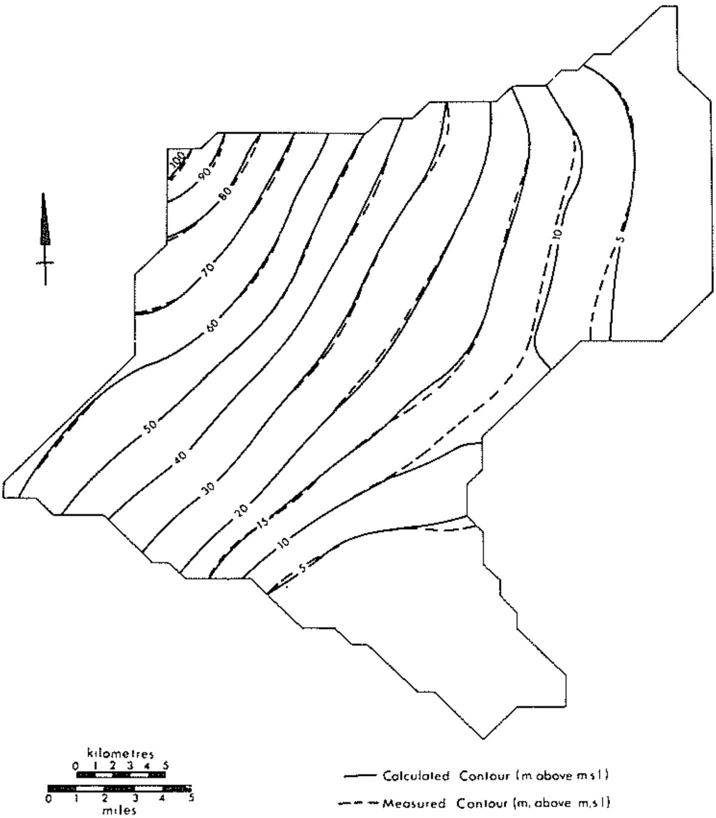

FIG.4 – Piezometric contours calculated from the transmissivities shown in Fig.3.

REFERENCES

Day, M. C. 1976: A Model For Steady Groundwater Flow in North Canterbury. M.E. report, University of Canterbury, Christchurch, N.Z.

Hunt, B. W. 1976a: An Aquifer Simulation Study in Northern Canterbury. *New Zealand Journal of Science, 19:* 265-276.

Hunt, B. W. 1976b: Some Computer Models for Groundwater Flow. *University of Canterbury. Civil Engineering Report 76-11,* Christchurch, N.Z.

Hunt, B. W. and Wilson, D. D. 1974: Graphical Calculation of Aquifer Transmissivities in Northern Canterbury, New Zealand. *Journal of Hydrology (N.Z.) 13 (2):* 66-80

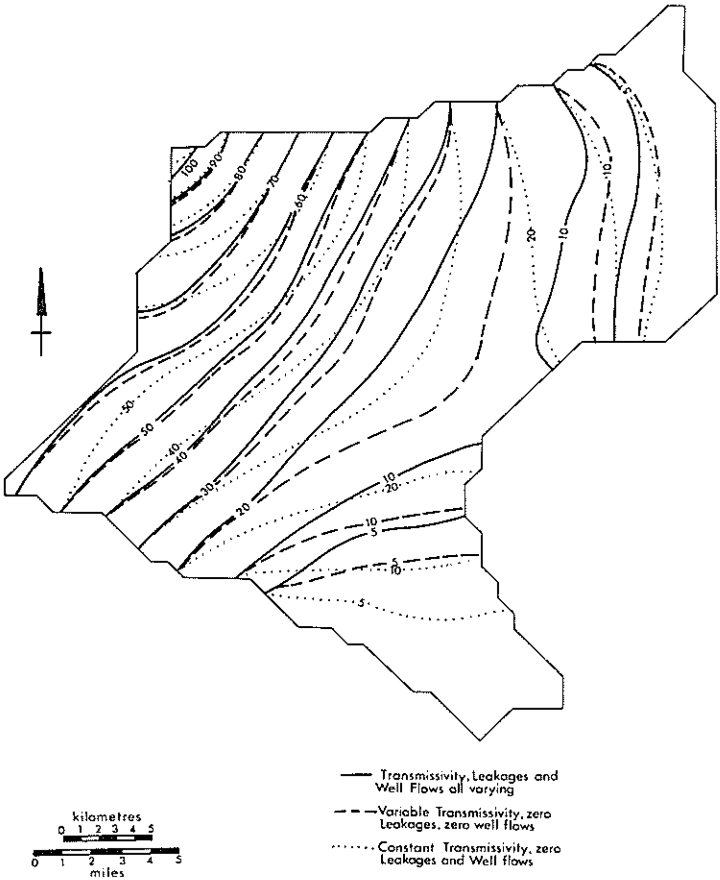

FIG.5 – Piezometric contours calculated for several different assumed distributions of transmissivities and well and spring outflows.