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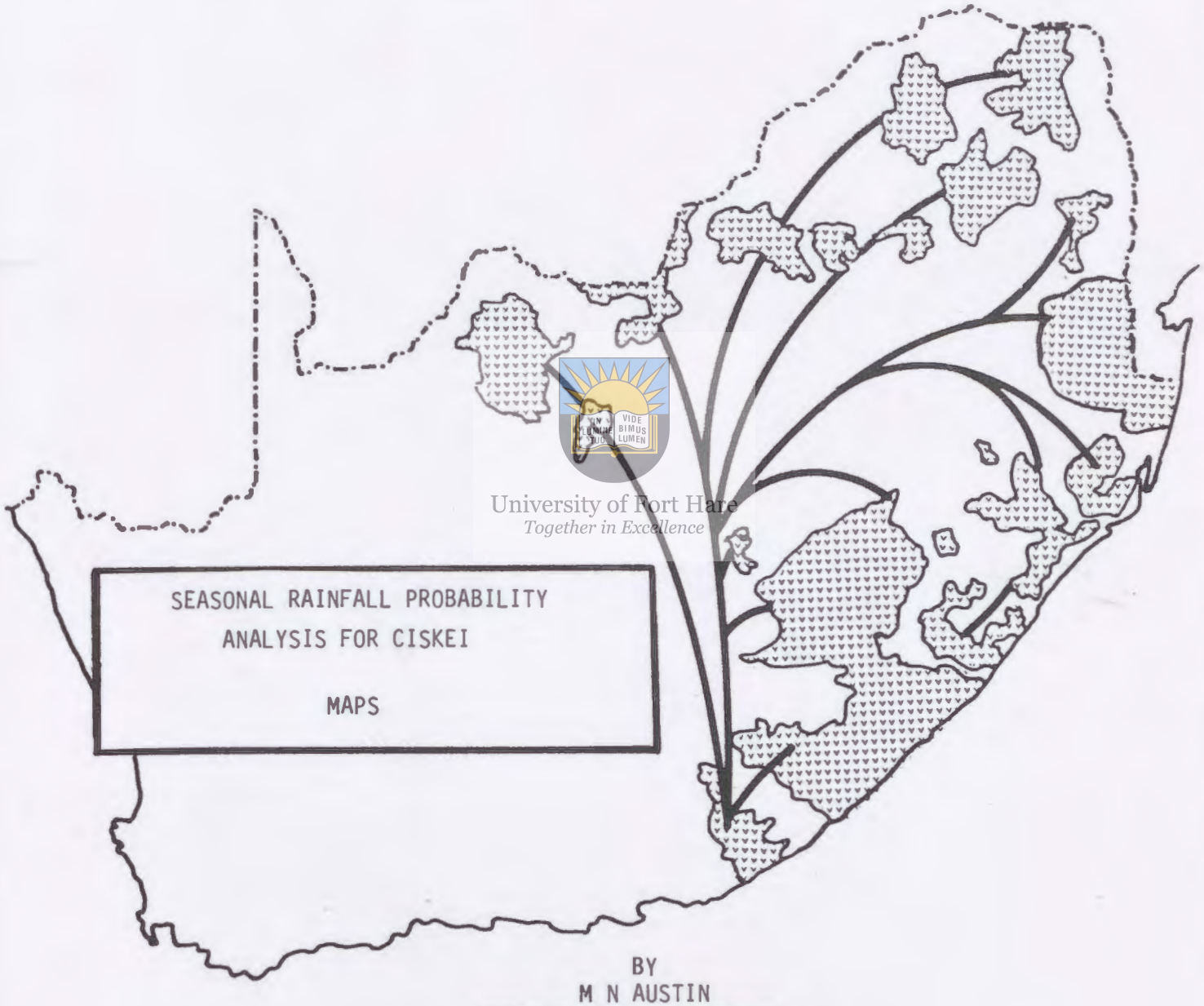

SEASONAL RAINFALL PROBABILITY ANALYSIS FOR CISKEI

MAPS

BY
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REPUBLIC OF CISKEI

1989

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AGRICULTURAL AND RURAL DEVELOPMENT RESEARCH INSTITUTE (ARDRI)
UNIVERSITY OF FORT HARE

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INTRODUCTION

The agricultural production potential of an area is determined by the physical and socio-economic factors which pertain to that area. The physical factors are climate, topography and soil. Rainfall, especially in drier areas such as Ciskei, is the most important climatic factor determining agricultural production. Mean annual rainfall is the first estimate of the quantity of water which is available in a region in the long-term. It determines the broad agricultural potential of a region if the other factors of climate, topography and soil are not limiting to growth. It is, then, a reference point from which to start assessing a region's agricultural potential, but it does not provide information on the seasonal distribution of rainfall. Therefore, monthly rainfall, which is a convenient if not entirely balanced division of the year into twelve segments, is often used for describing seasonal distribution of rainfall. For agricultural production planning on a regional or smaller scale, one also needs to know the variability and the spatial distribution of monthly rainfall. Such an analysis for the Ciskei area has been completed (Austin, 1988 and 1989a).

Rainfall is, though, only one of many factors which influence growth, and agriculturalists are ultimately interested in the spatial production potential for a particular crop within a region. Many crop yield or crop growth models are based on daily or monthly rainfall inputs. However, a number of models, particularly those which deal with perennial crops, use growing season rainfall as an 2input. If mean growing season rainfall is required, this can easily be derived from the monthly data. However, in drier areas mean annual rainfall can often be very misleading because the mean does not occur with sufficient frequency to be used as a statistic for planning purposes. When rainfall is not normally distributed, as in Ciskei where rainfall has a skew probability distribution, quantities equal to or exceeding the mean are received less than

half the time. As a result, estimates of expected growing season rainfall at various probabilities are required.

PROCEDURE

In the process of a seasonal rainfall probability analysis, all rainfall data for Ciskei region were collected, checked and verified, (Austin, 1988). Rainfall for several alternative growing seasons at each station were first summed, since the expected rainfall at a given probability level for a particular season cannot be simply derived as the addition of the respective individual monthly expectations. Even growing season rainfall in the comparatively wet summer months in Ciskei has a positively skew distribution. A gamma distribution function was fitted to the seasonal data of all stations in Ciskei and surrounds as described by Austin (1990).

The minimum expected rainfall for 10 possible growing seasons was then obtained for the 75% and 50% levels of probability. The growing seasons were chosen in such a way that they covered most of the potential growing seasons for major crops in the Ciskei region. Unfortunately, it was not possible to include all potential growing seasons and, should a particular growing season be required which is not described a useful estimate can often be obtained from two or more of the seasons which have been presented.

The following (inclusive) growing seasons were analysed:

August to November	April to October
August to December	May to October
January to April	June to November
October to February	July to November
November to March	February to May

Since the data are measured at irregularly fixed points and, for planning purposes, information is required for localities for which no measured values are available, an interpolation technique was used to generate values for intermediate grid points which preserved the original data (Austin, 1989a). The grid point data so derived are available in a data base with a retrieval program (Austin, 1989b). The data base was then used to produce the maps presented in this bulletin.

RESULTS AND DISCUSSION

Figures 1 to 10 show the minimum rainfall that can be expected at the 75% level of probability for each of the 10 seasons. These are the maps of most use to agricultural production planners who generally plan on the basis of predictions which are realised in three out of four years.

A possible growing season for maize in much of Ciskei is October to February and Figure 4 shows the minimum rainfall which can be expected for this growing season. Van Averbeke & Marais (1989) determined that the minimum rainfall required from October to February to obtain one ton of maize grain/ha was 200 mm, other growing conditions being optimal. Figure 4 can then be used to determine the areas of Ciskei which would not achieve a one ton yield of maize three out of four years, i.e. those areas in Figure 4 with less than 200 mm.

Given a particular location in Ciskei, one can use a series of maps to determine the optimum growing season for maize based on expected growing season rainfall at a specified probability level. The potential growing seasons for maize may be August to December (Figure 2), October to February (Figure 4), or November to March (Figure 5). By referring to the same location on each map, the

growing season with the highest expected rainfall at the 75% probability level can be selected for that location.

There are numerous other factors which affect the selection of an optimum growing season. For example, frost occurrence is very likely during February to June; the occurrence of drought at a very sensitive stage such as tasselling is likely in the October to February period for much of Ciskei. The occurrence of drought would necessitate using these maps in conjunction with the maps of each month's expected rainfall at the 75% level of probability (Austin, 1989a). However, for most of country, the rainfall received is the most important factor determining yield. For planning purposes, the expected rainfall is the most important factor determining levels of inputs such as fertilizer and plant population. Expected rainfall thus determines to a great extent the target yield (i.e. that yield the farmer should attempt to achieve).

Since, for certain applications rainfall other than at the 75% level of probability may be required, for example, to monitor the current season, the minimum rainfall that can be expected at the 50% levels of probability are presented for each of the 10 growth periods in Figures 11 to 20. The decision that must first be made is: how often is it necessary to correctly predict growing season rainfall. For low input crops which are drought tolerant, the 50% levels of probability may be sufficient. This means that the rainfall would be less than that expected at this probability level 50% of the time. On the other hand, for high input crops such as potatoes, risks should be low and probability levels higher than 75% may be appropriate. However, low risk implies a reduction in area where high probability criteria are satisfied.

The maps presented in this bulletin have many uses and the information contained in them is presently being applied in

different areas of research and planning.

REFERENCES

AUSTIN, M.N., 1988. Monthly and annual rainfall probability analysis for Ciskei I Data. ARDRI Bulletin 4/88 University of Fort Hare, Alice. 75p.

AUSTIN, M.N., 1989a. Monthly and annual rainfall probability analysis for Ciskei II Maps. ARDRI Bulletin 1/89 University of Fort Hare, Alice. 8p + 13 colour + 82 b & w maps.

AUSTIN, M.N., 1989b. Using CIRADA: Ciskei rainfall data base ARDRI Bulletin 3/89 University of Fort Hare, Alice. 11p.

AUSTIN, M.N., 1990. Predicting expected rainfall at given probability by fitting a gamma distribution function. Fort Hare Papers: 10 (in press).

VAN AVERBEKE, W. & MARAIS, J. N., 1989. The effect of plant density on water use efficiency by maize. Paper presented to the Combined Congress of the South African Societies of Crop Production and Soil Science, Wild Coast Sun, Transkei, January.

Fig.1 RAINFALL EXPECTED AT 75% LEVEL OF PROBABILITY (mm)

FOR THE PERIOD AUGUST TO NOVEMBER INCLUSIVE

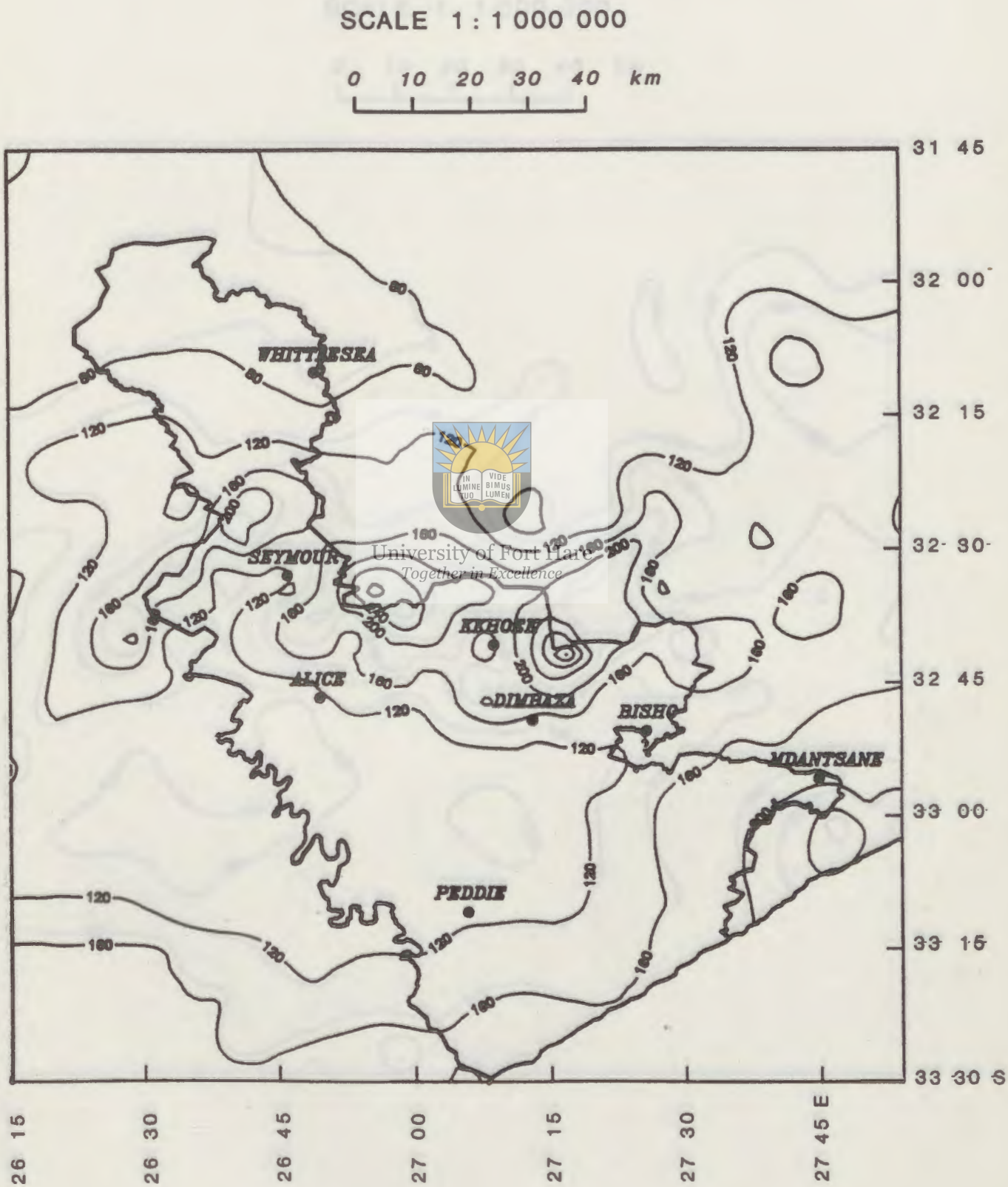

Fig.2 RAINFALL EXPECTED AT 75% LEVEL OF PROBABILITY (mm)

FOR THE PERIOD AUGUST TO DECEMBER INCLUSIVE

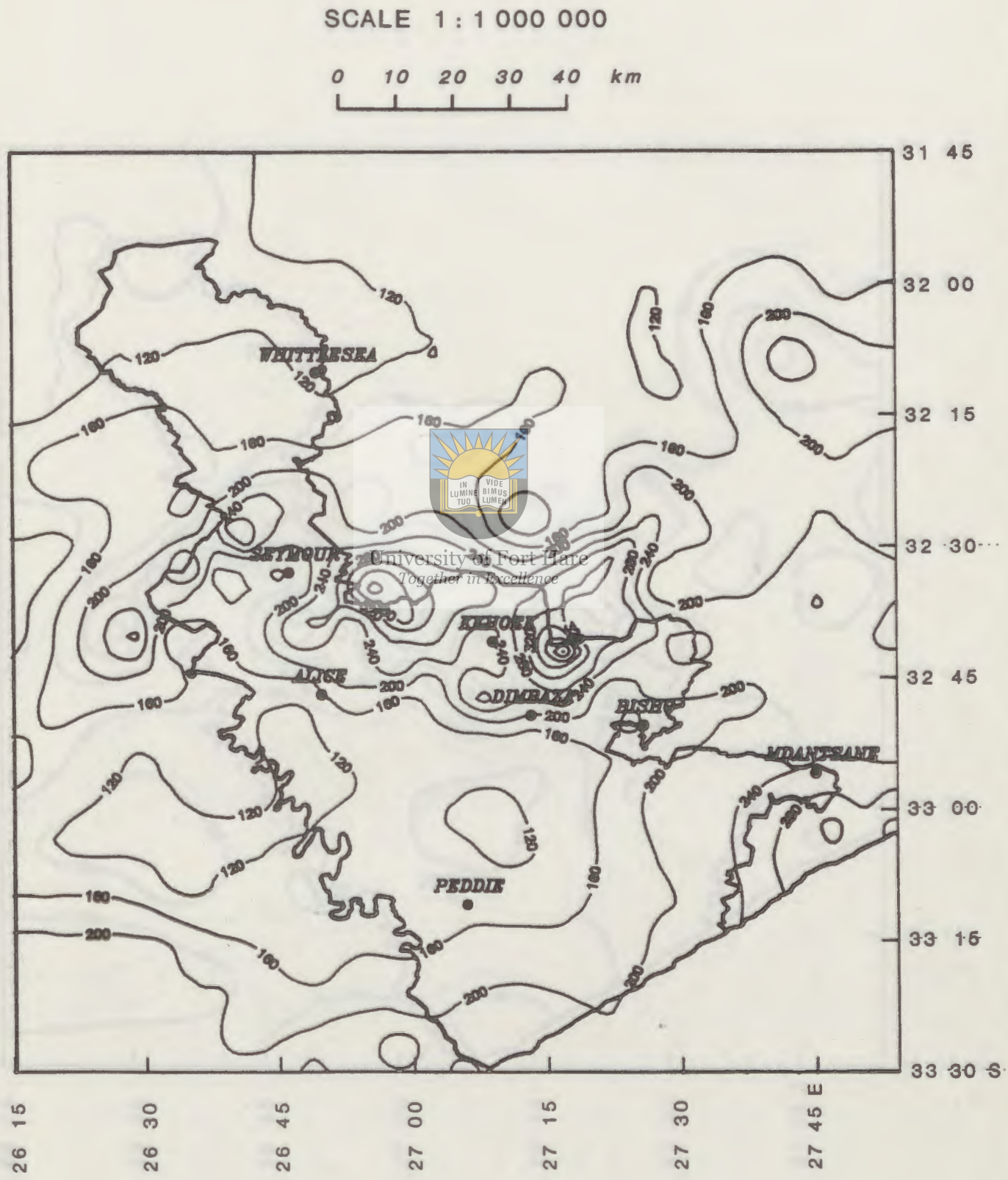

Fig.3 RAINFALL EXPECTED AT 75% LEVEL OF PROBABILITY (mm) FOR THE PERIOD JANUARY TO APRIL INCLUSIVE

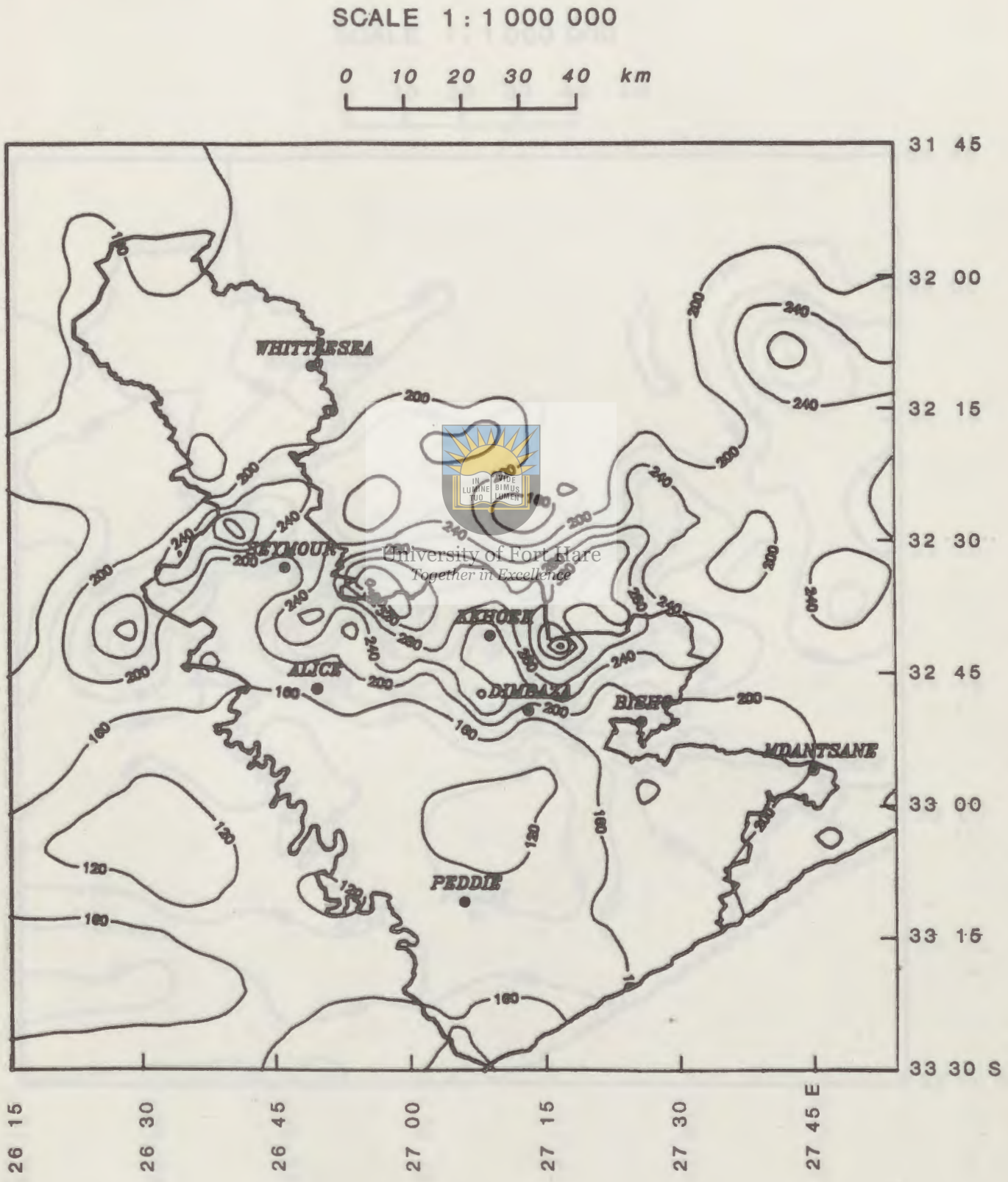

Fig.4 RAINFALL EXPECTED AT 75% LEVEL OF PROBABILITY (mm)

FOR THE PERIOD OCTOBER TO FEBRUARY INCLUSIVE

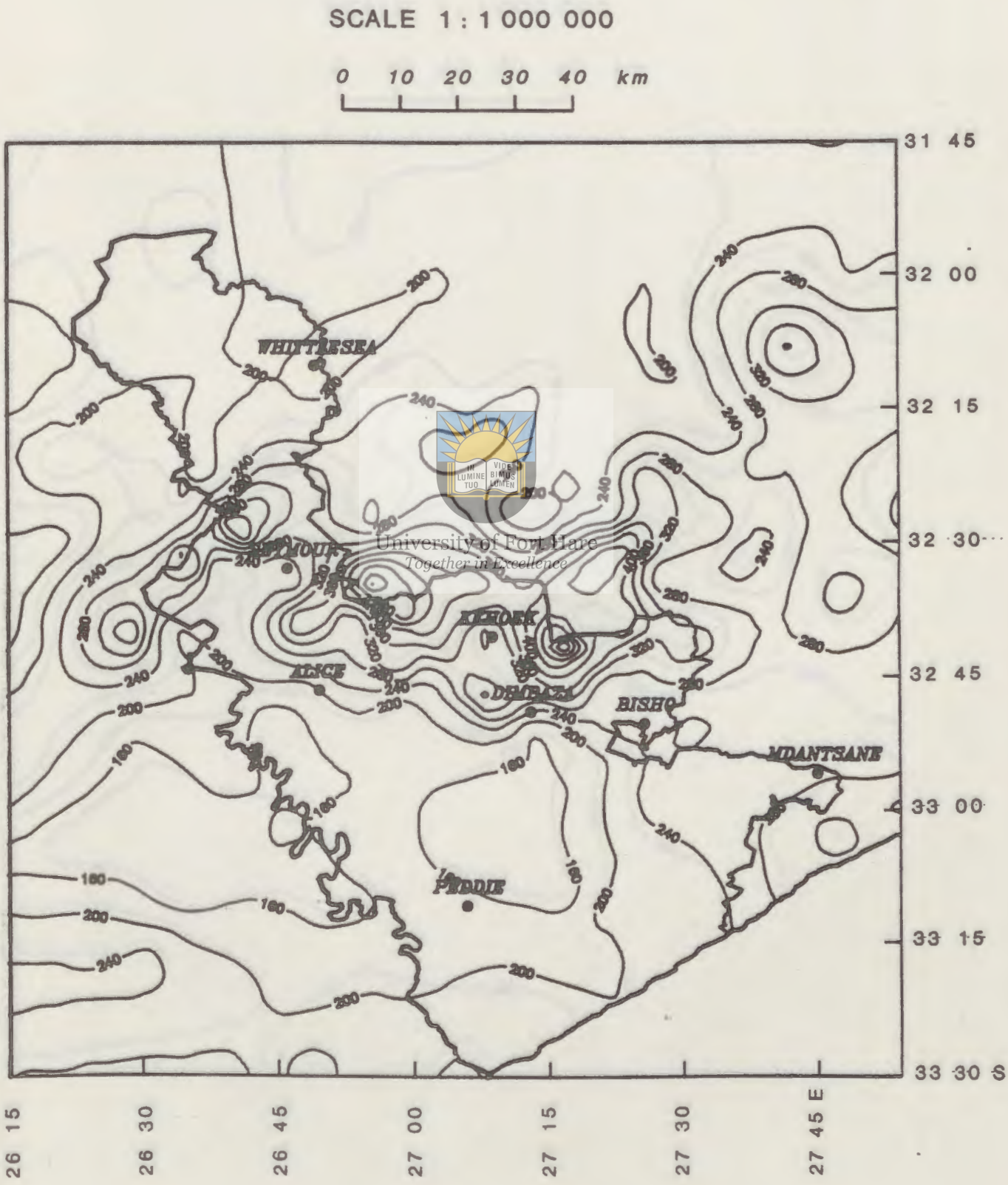

Fig.5 RAINFALL EXPECTED AT 75% LEVEL OF PROBABILITY (mm)

FOR THE PERIOD NOVEMBER TO MARCH INCLUSIVE

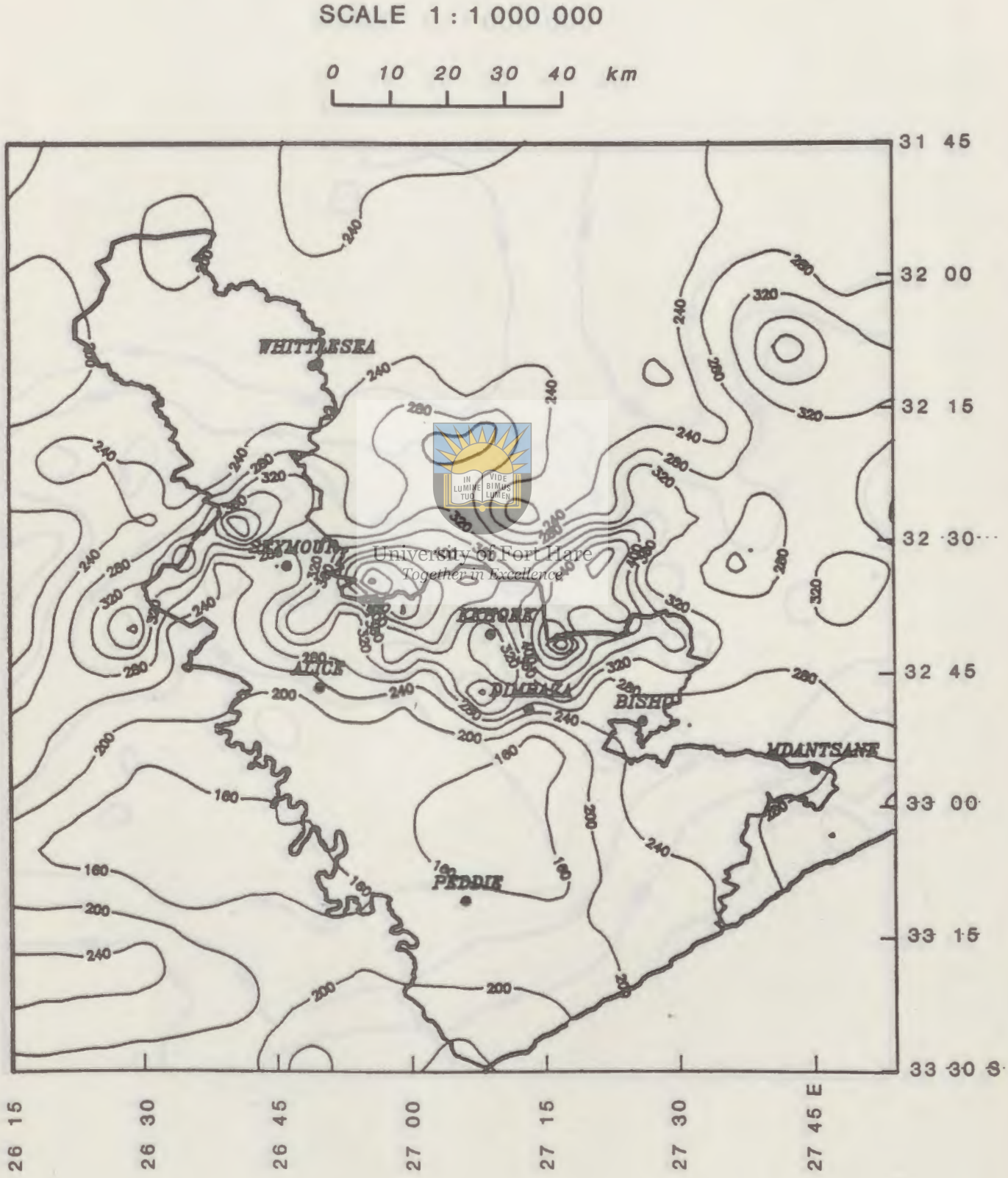

Fig.6 RAINFALL EXPECTED AT 75% LEVEL OF PROBABILITY (mm)

FOR THE PERIOD APRIL TO OCTOBER INCLUSIVE

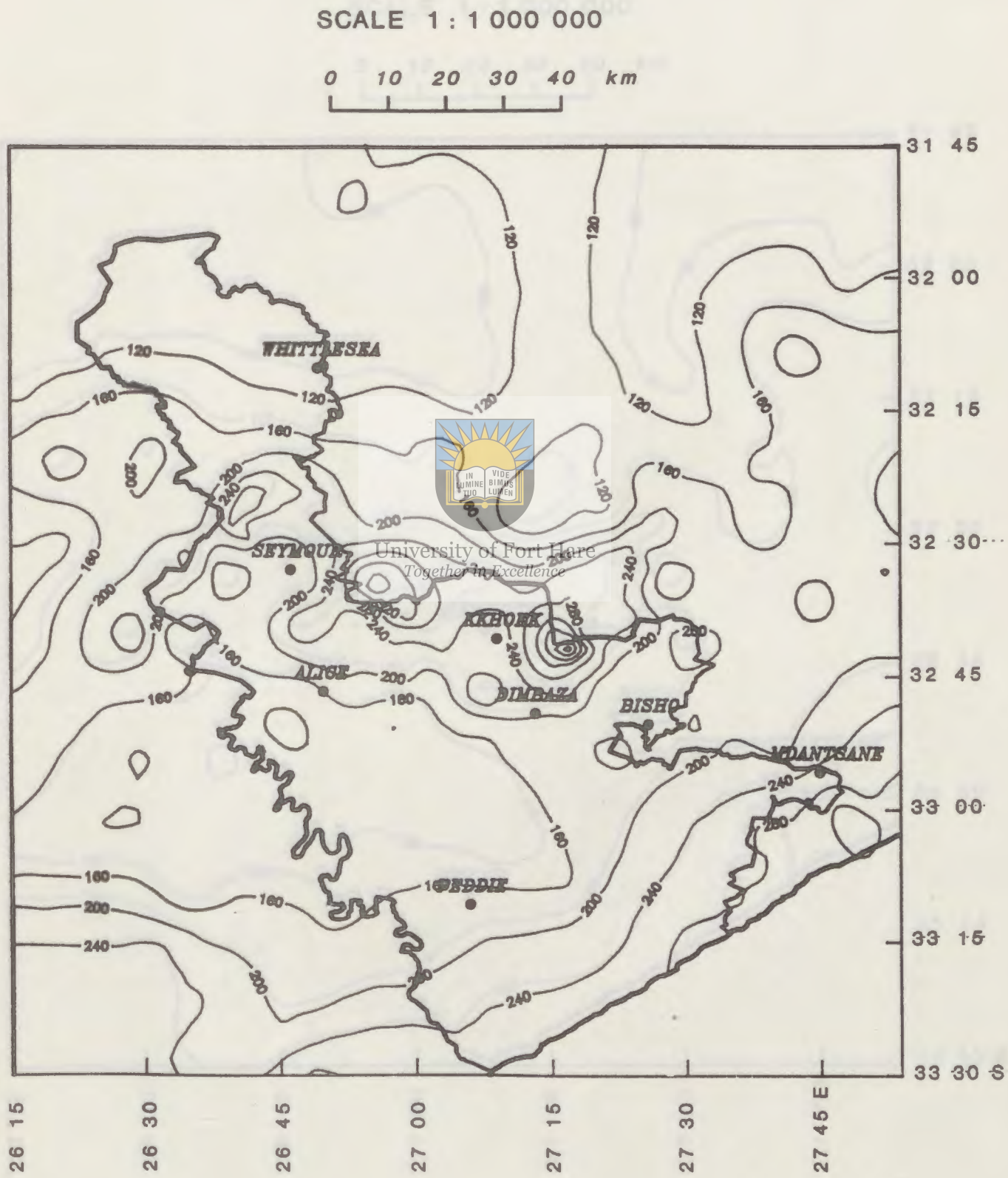

Fig.7 RAINFALL EXPECTED AT 75% LEVEL OF PROBABILITY (mm)

FOR THE PERIOD MAY TO OCTOBER INCLUSIVE

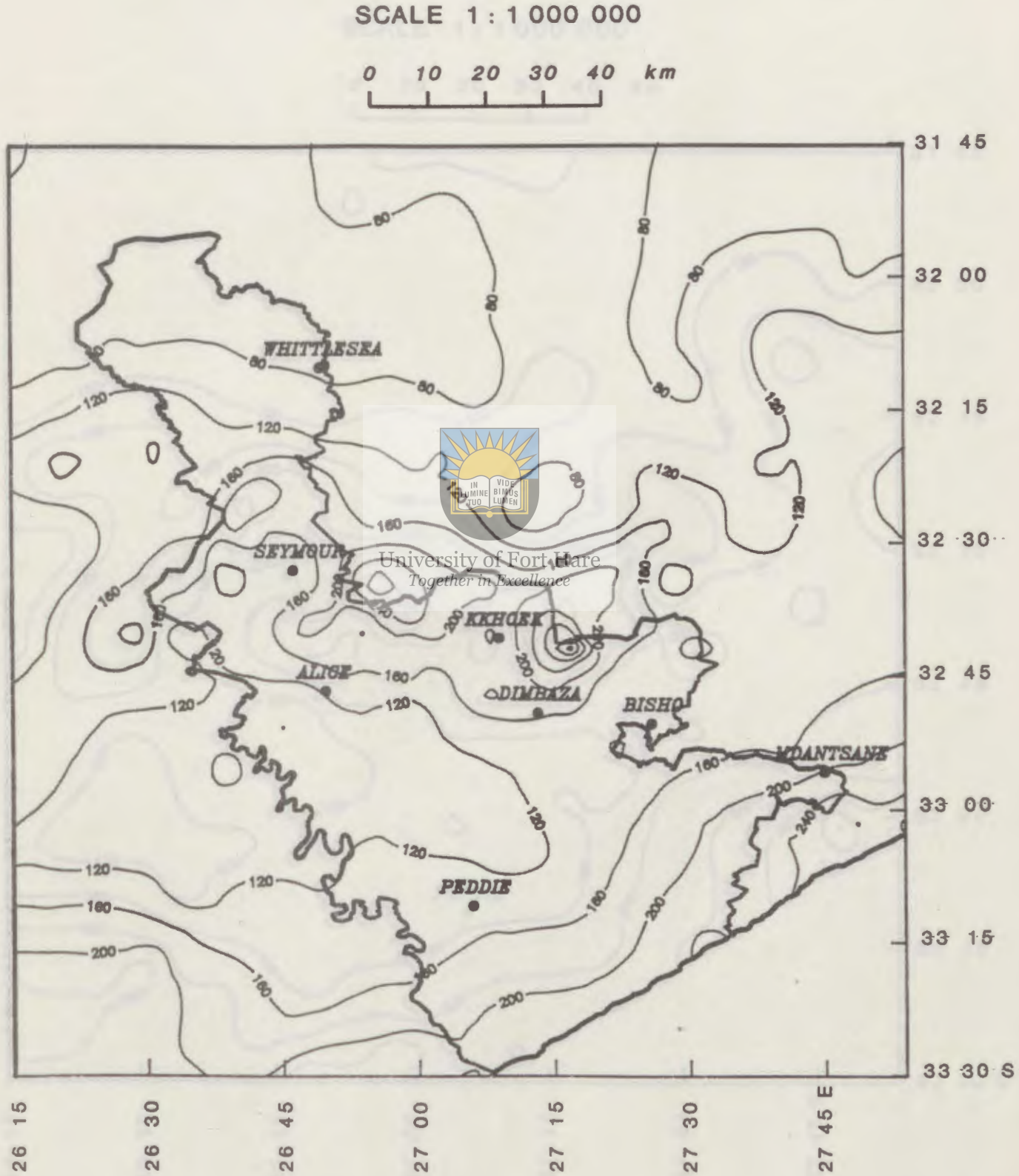

Fig.8 RAINFALL EXPECTED AT 75% LEVEL OF PROBABILITY (mm)

FOR THE PERIOD JUNE TO NOVEMBER INCLUSIVE

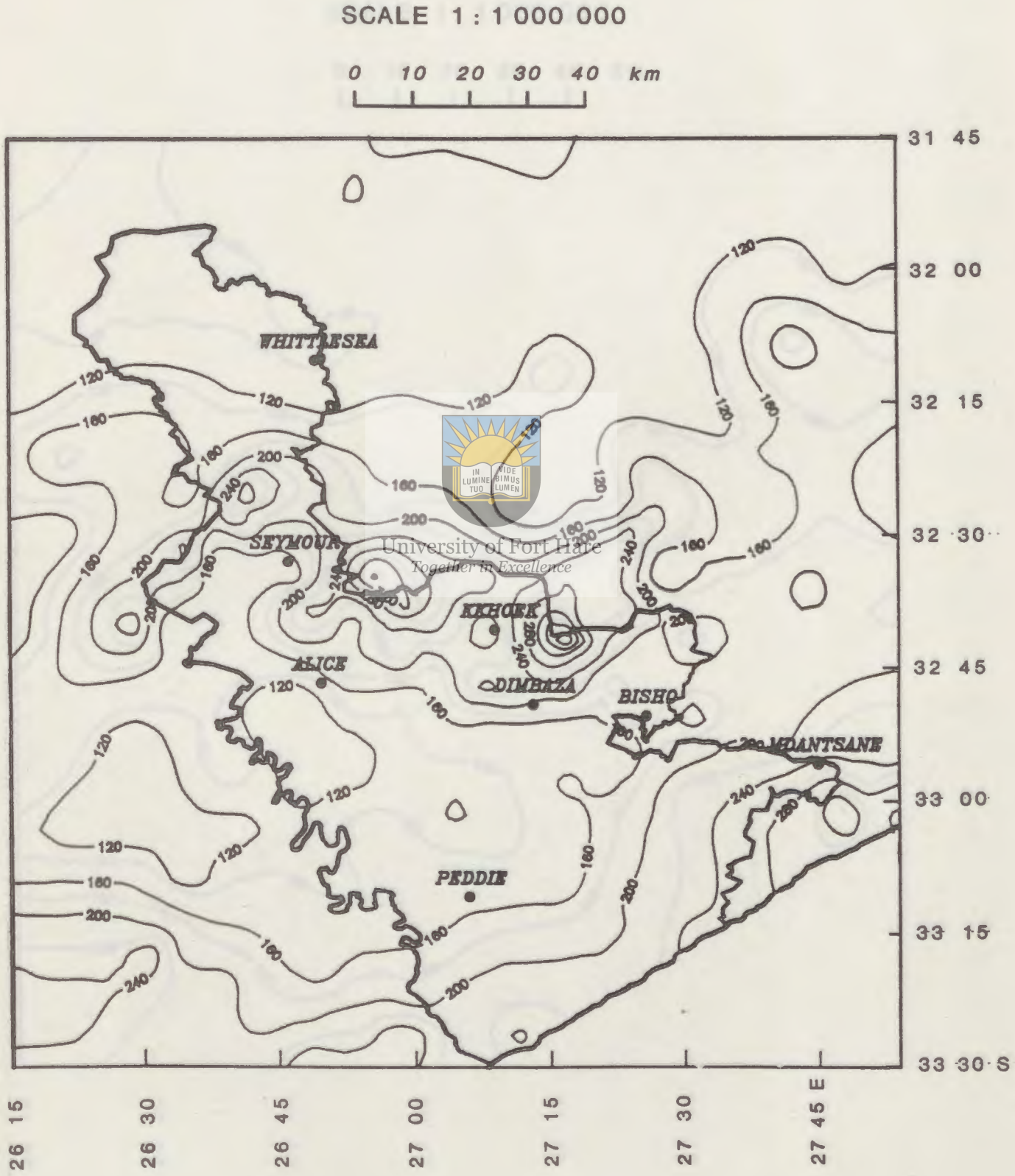

Fig.9 RAINFALL EXPECTED AT 75% LEVEL OF PROBABILITY (mm)

FOR THE PERIOD JULY TO NOVEMBER INCLUSIVE

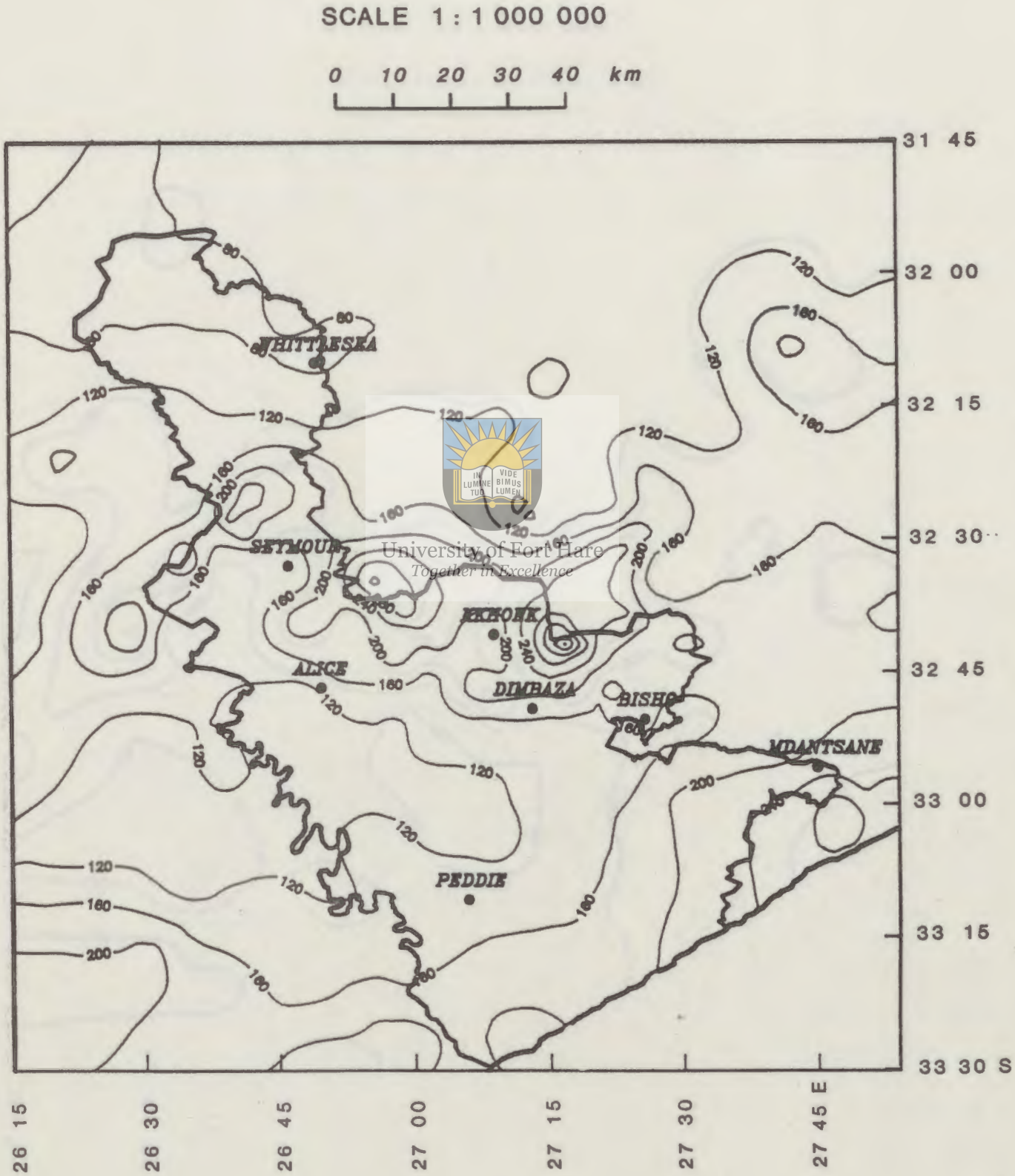

Fig.10 RAINFALL EXPECTED AT 75% LEVEL OF PROBABILITY (mm) FOR THE PERIOD FEBRUARY TO MAY INCLUSIVE

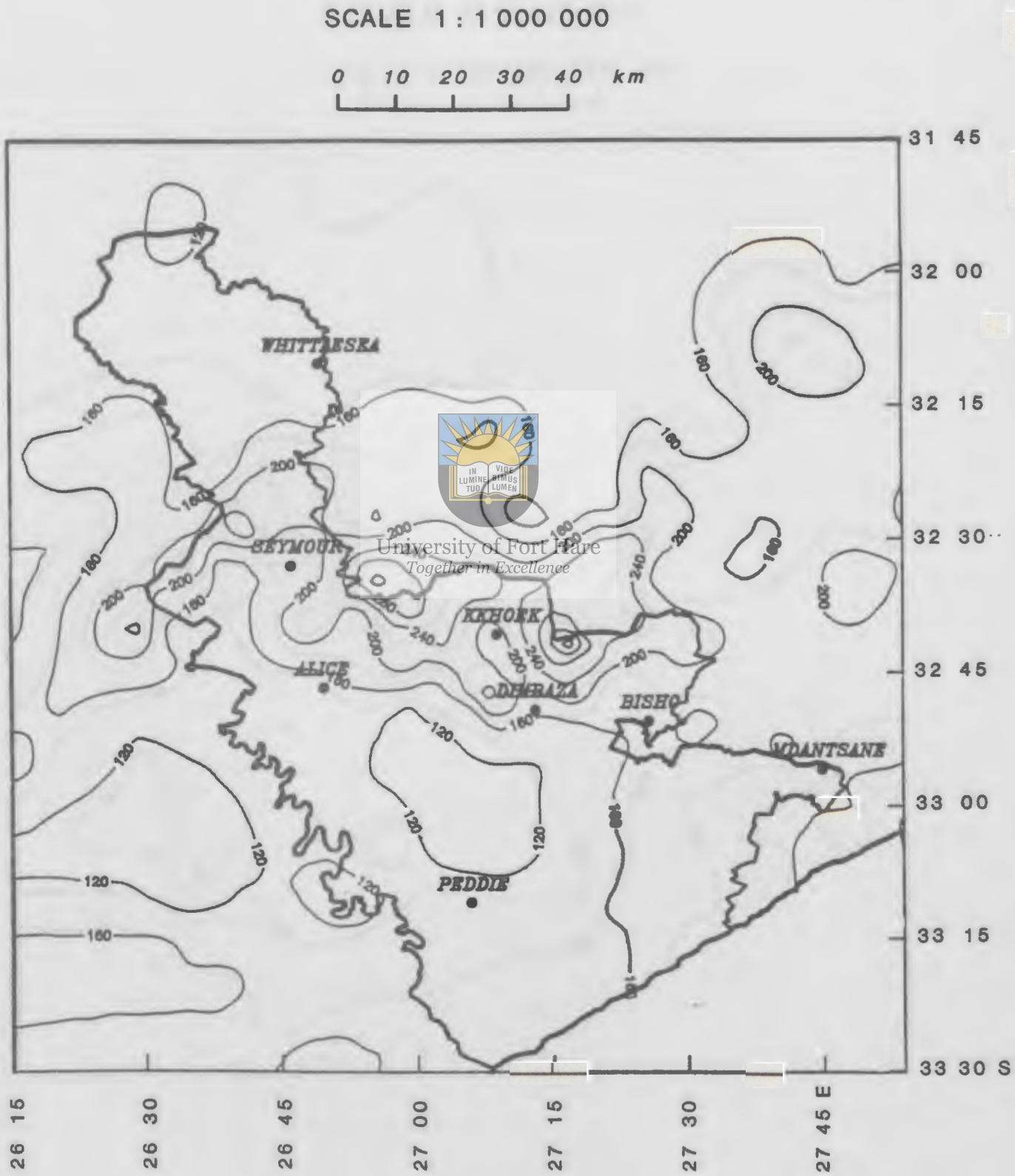

Fig.11 RAINFALL EXPECTED AT 50% LEVEL OF PROBABILITY (mm)

FOR THE PERIOD AUGUST TO NOVEMBER INCLUSIVE

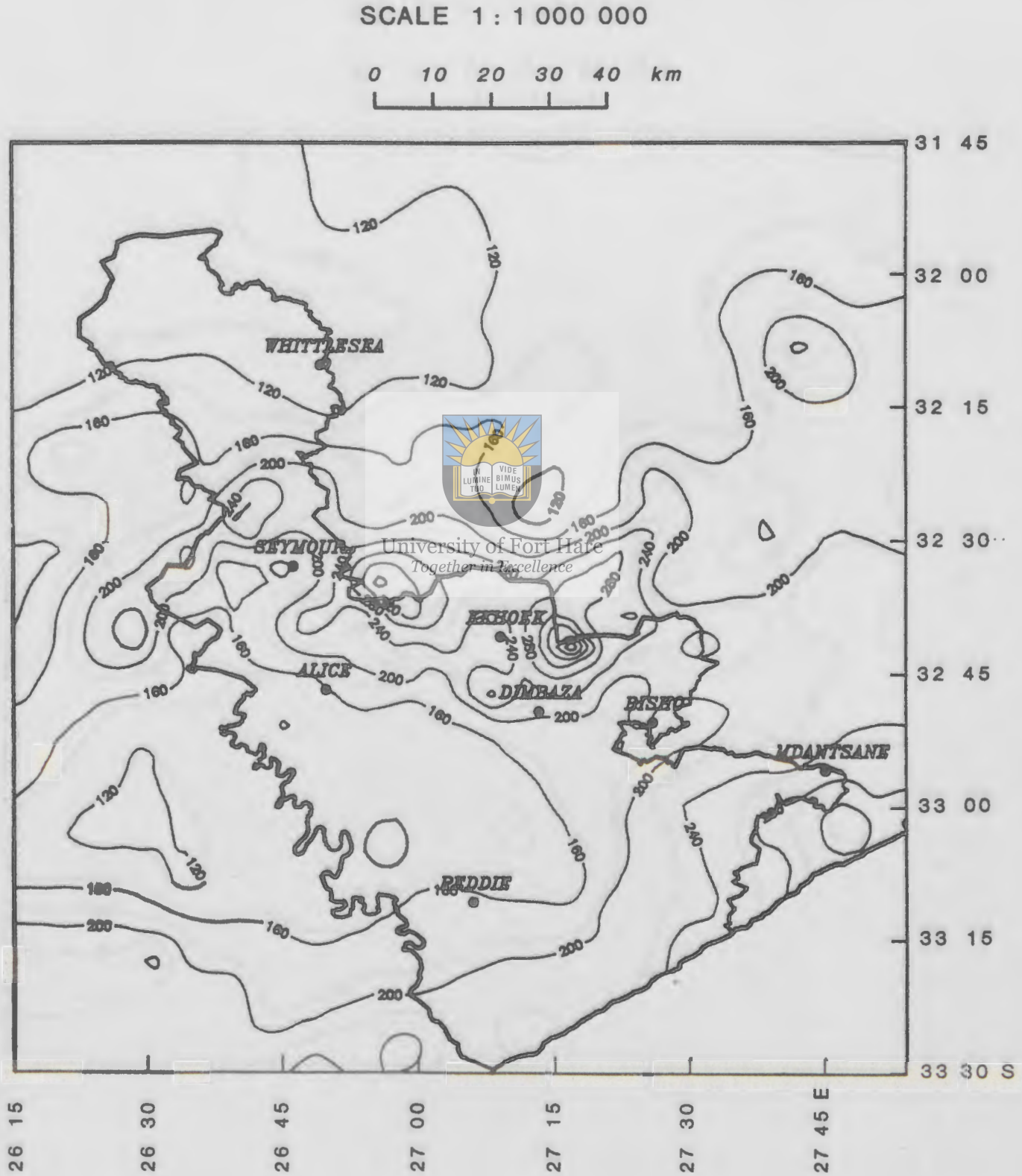

Fig.12 RAINFALL EXPECTED AT 50% LEVEL OF PROBABILITY (mm)

FOR THE PERIOD AUGUST TO DECEMBER INCLUSIVE

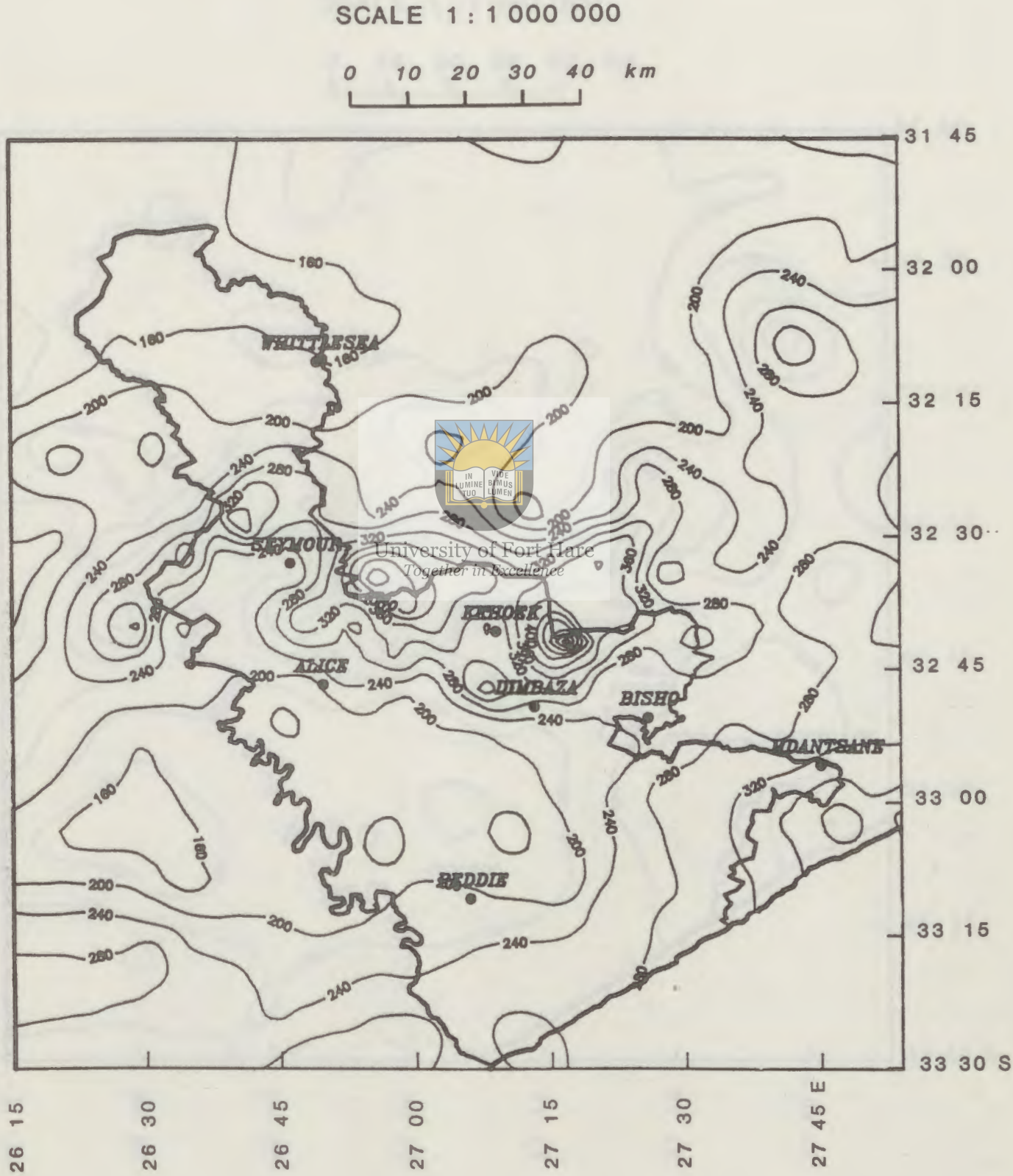

Fig.13 RAINFALL EXPECTED AT 50% LEVEL OF PROBABILITY (mm)

FOR THE PERIOD JANUARY TO APRIL INCLUSIVE

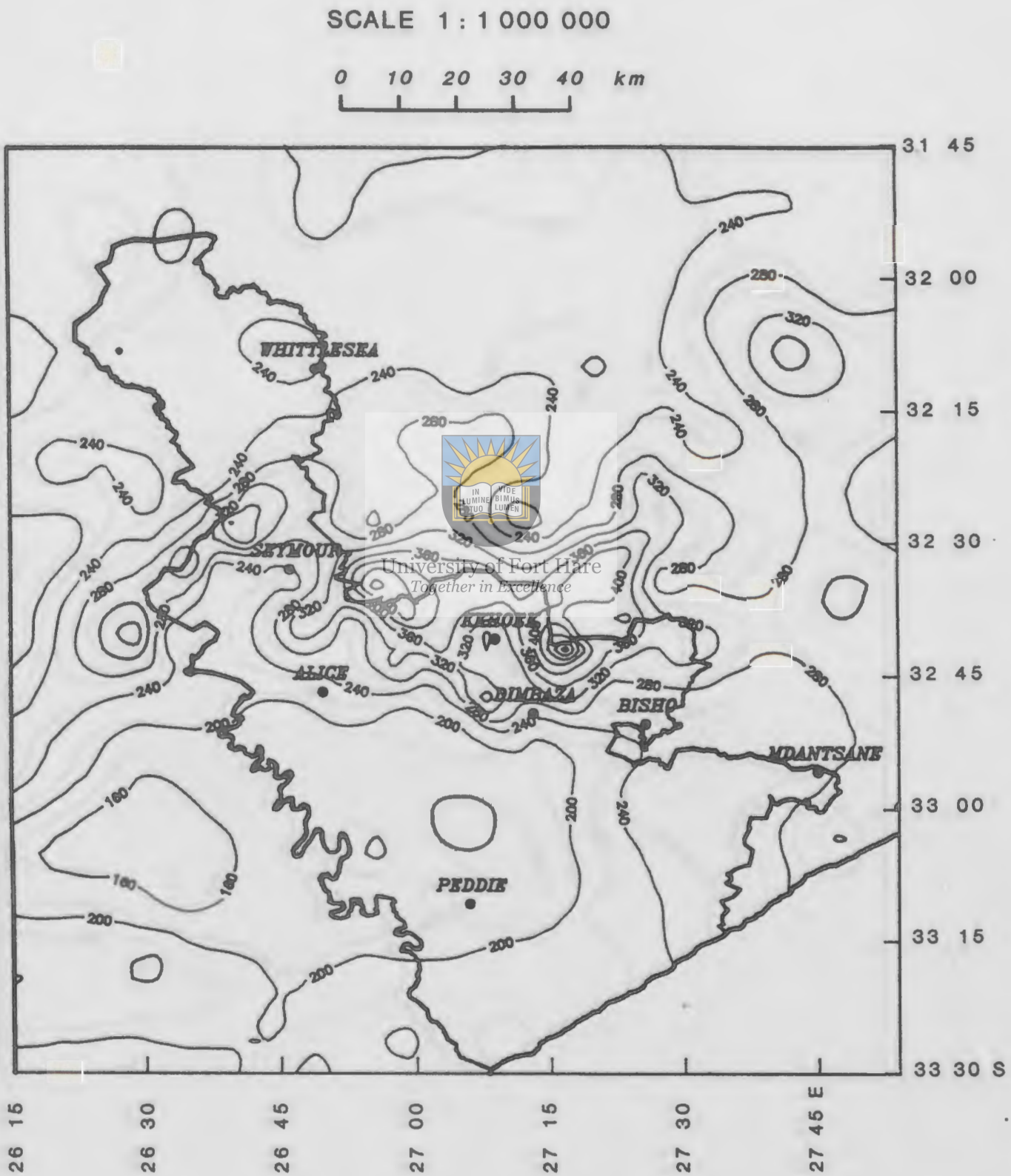

Fig.14 RAINFALL EXPECTED AT 50% LEVEL OF PROBABILITY (mm)

FOR THE PERIOD OCTOBER TO FEBRUARY INCLUSIVE

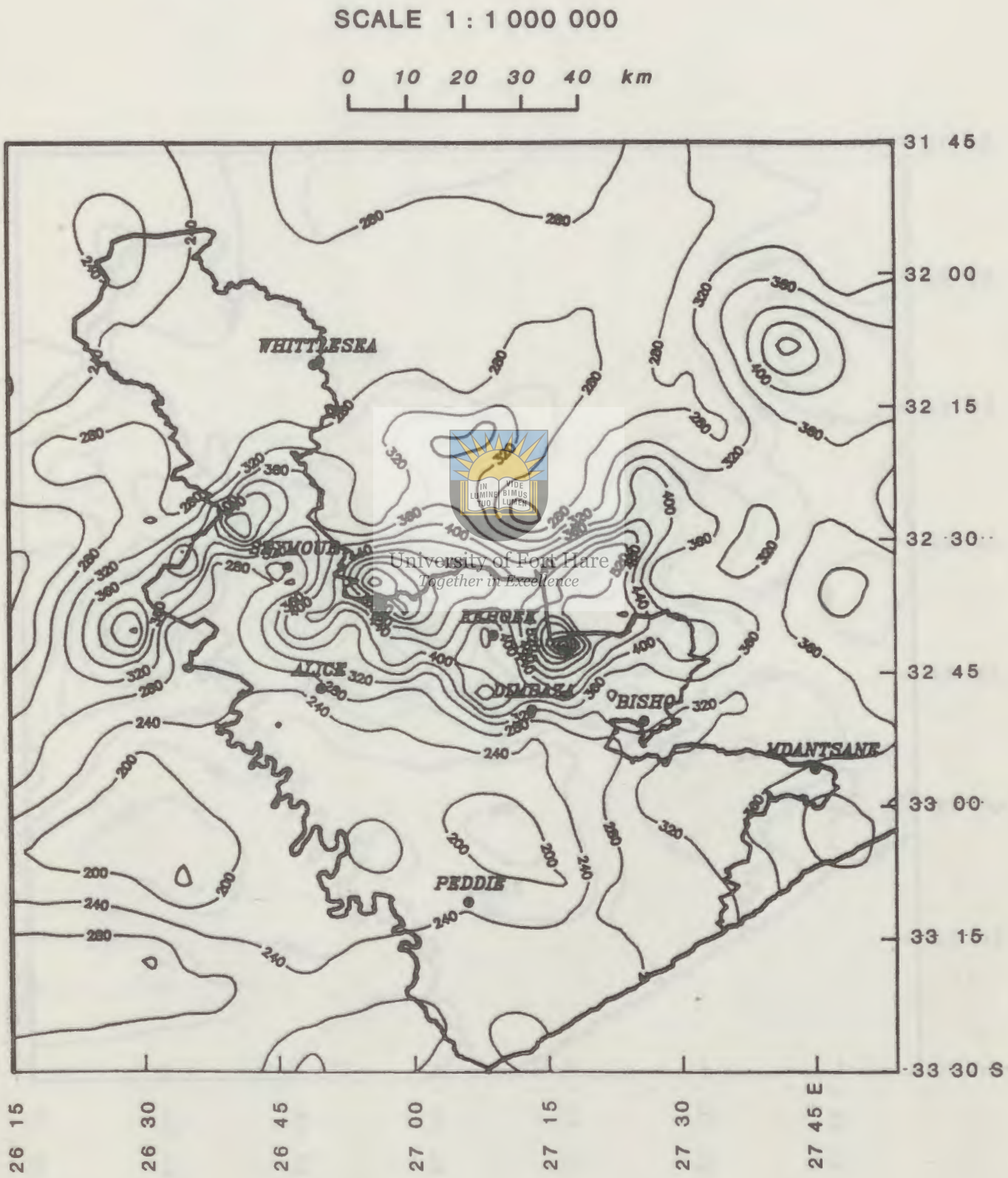

Fig.15 RAINFALL EXPECTED AT 50% LEVEL OF PROBABILITY (mm)

FOR THE PERIOD NOVEMBER TO MARCH INCLUSIVE

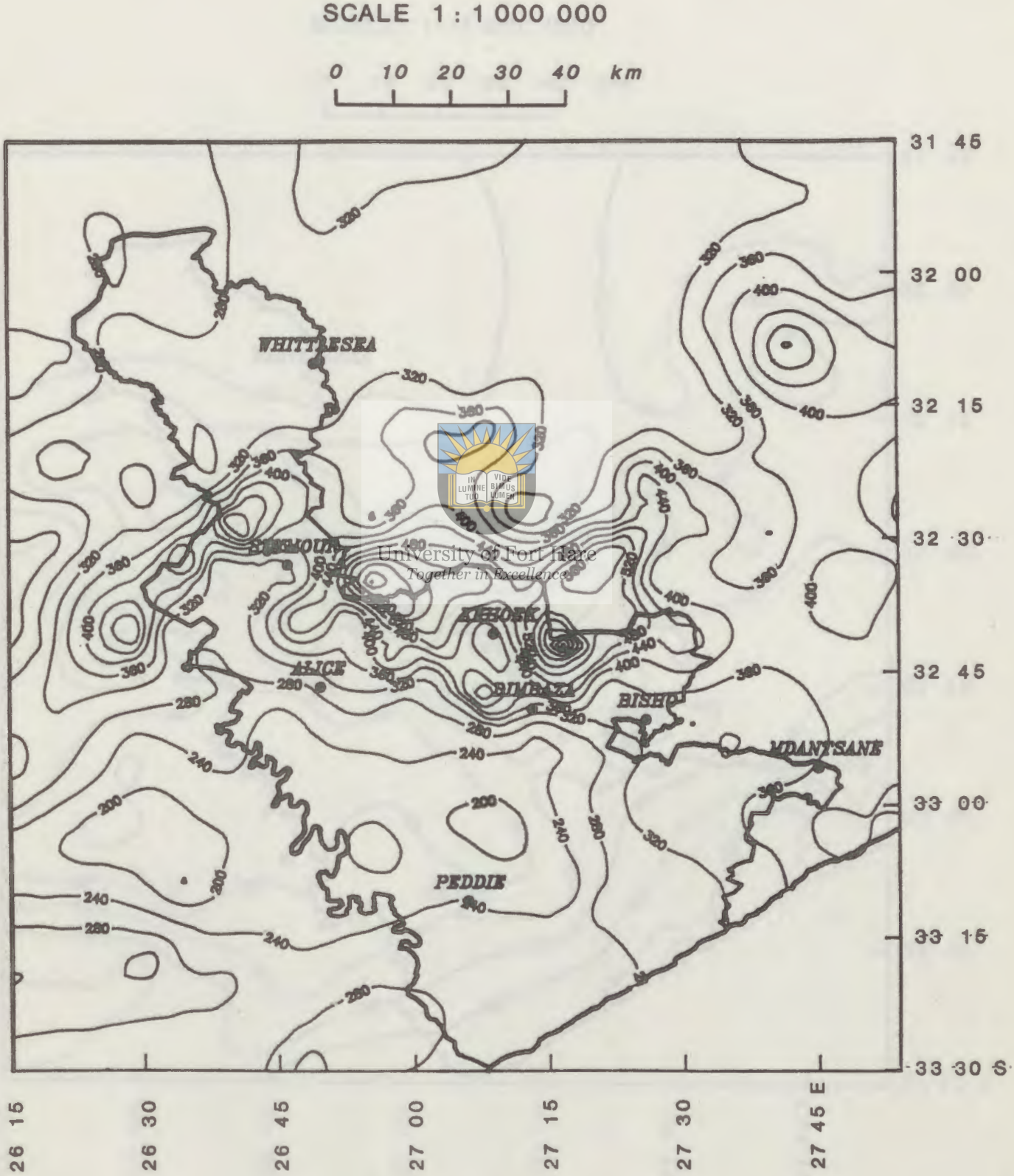

Fig.16 RAINFALL EXPECTED AT 50% LEVEL OF PROBABILITY (mm)

FOR THE PERIOD APRIL TO OCTOBER INCLUSIVE

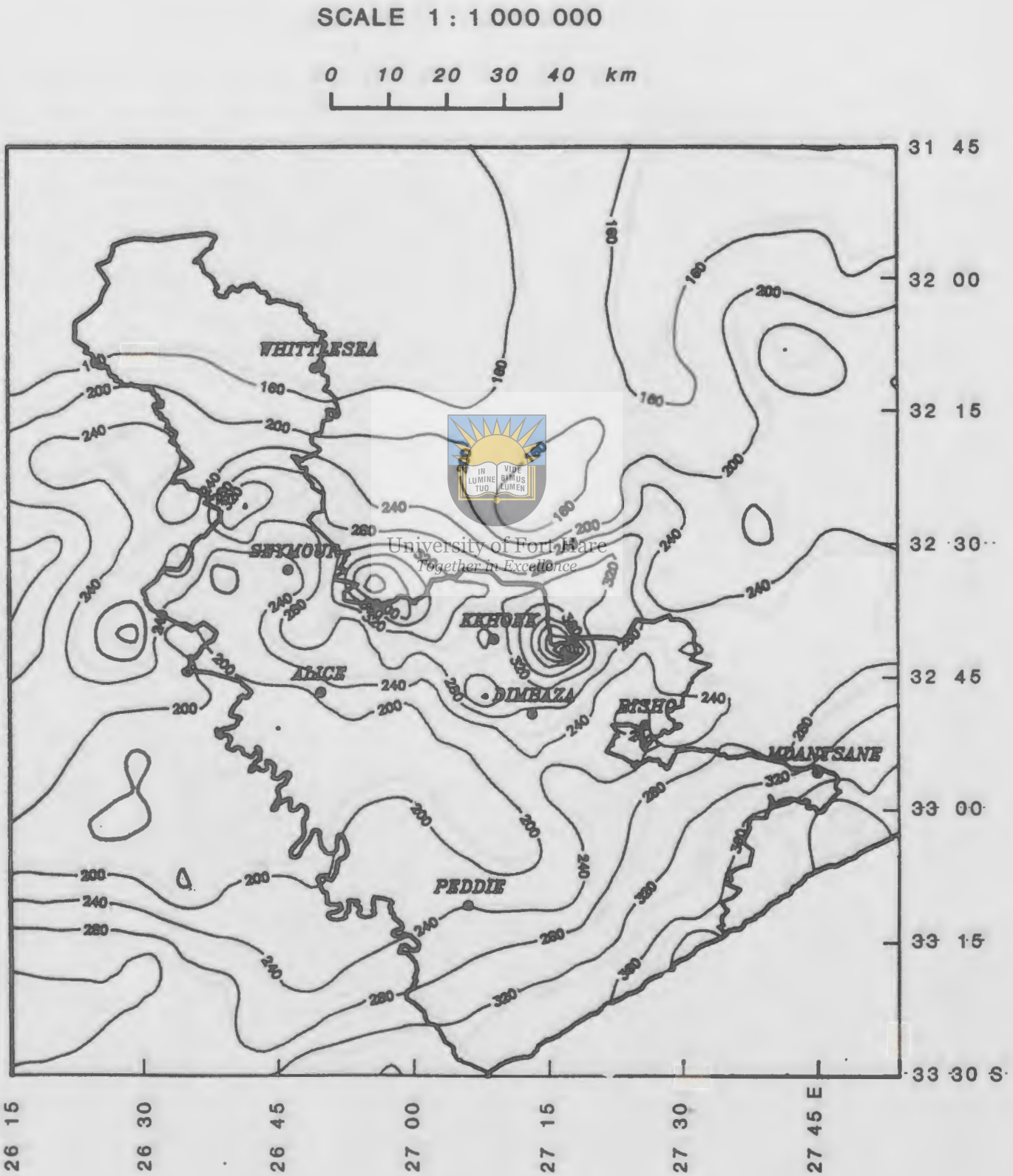

Fig.17 RAINFALL EXPECTED AT 50% LEVEL OF PROBABILITY (mm)

FOR THE PERIOD MAY TO OCTOBER INCLUSIVE

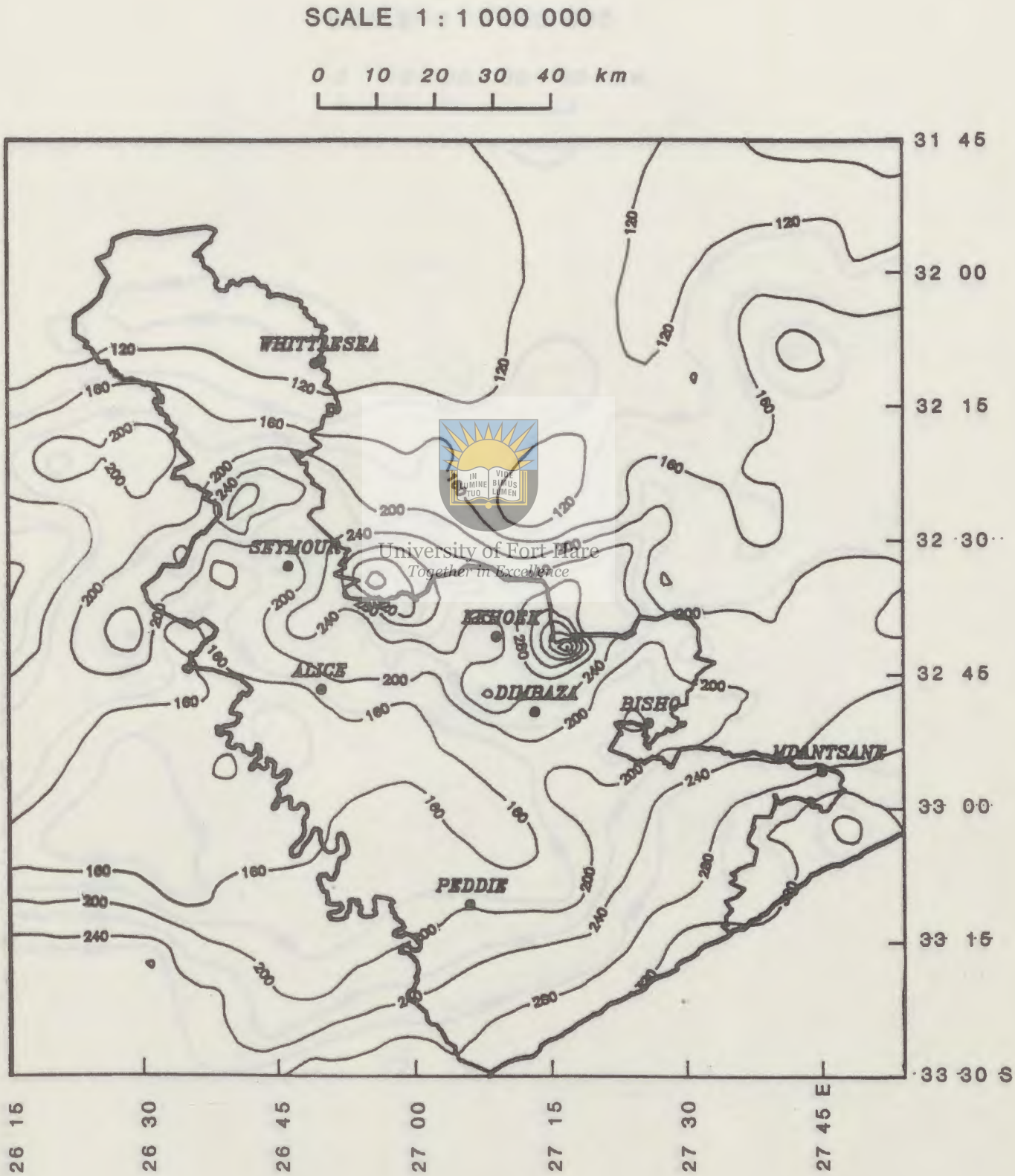

Fig.18 RAINFALL EXPECTED AT 50% LEVEL OF PROBABILITY (mm)

FOR THE PERIOD JUNE TO NOVEMBER INCLUSIVE

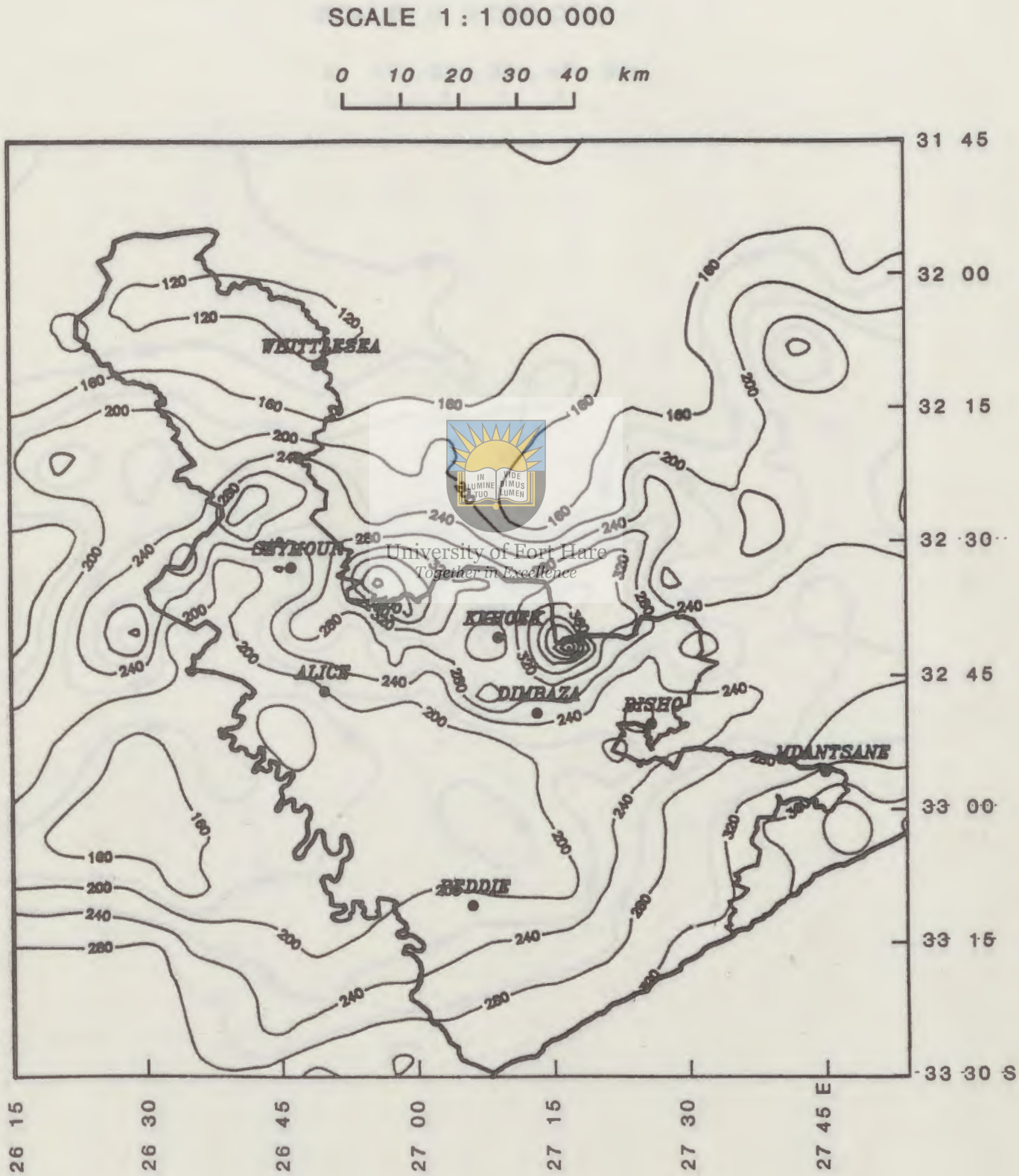

Fig.19 RAINFALL EXPECTED AT 50% LEVEL OF PROBABILITY (mm)

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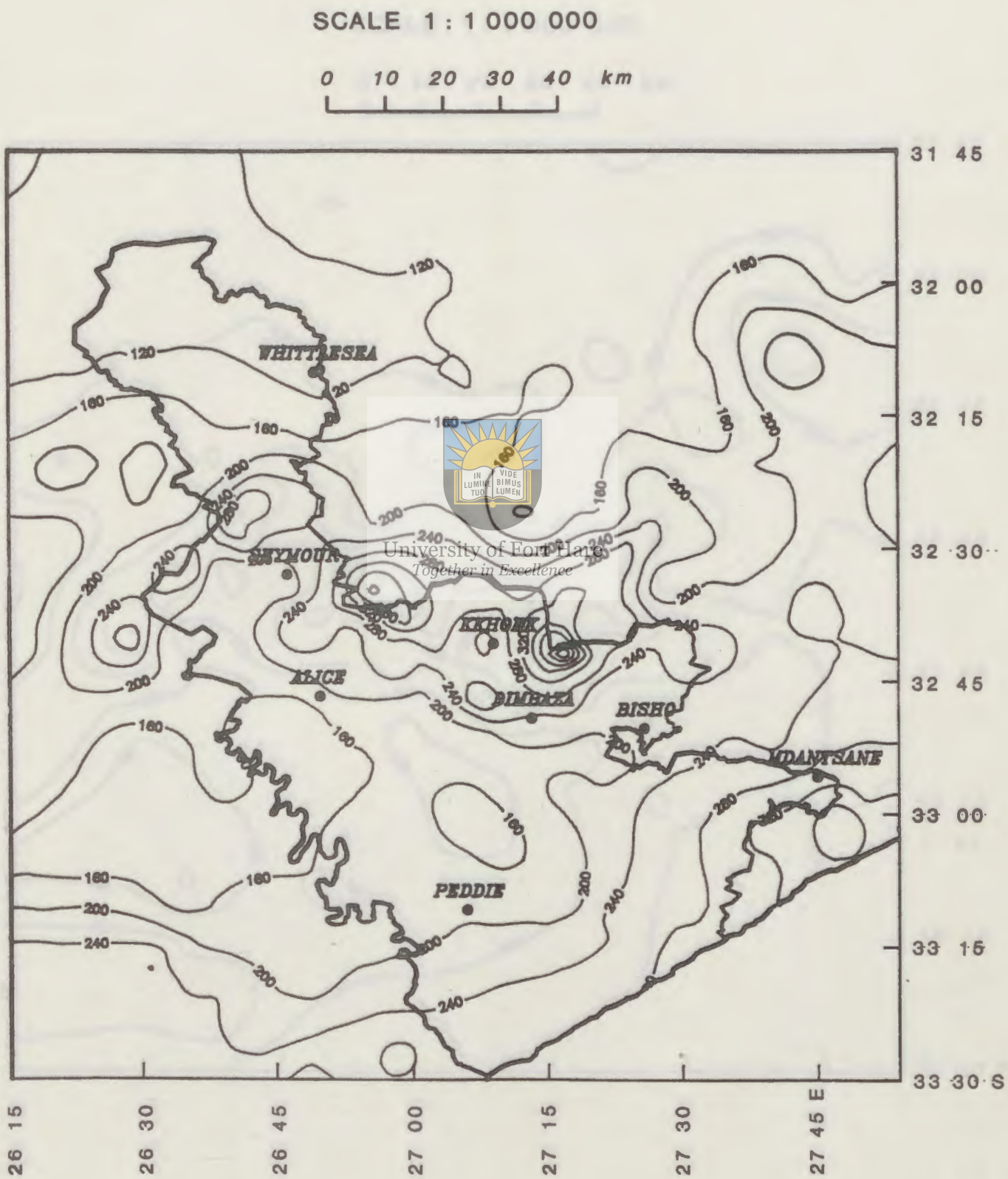

Fig.20 RAINFALL EXPECTED AT 50% LEVEL OF PROBABILITY (mm)

FOR THE PERIOD FEBRUARY TO MAY INCLUSIVE