### *APPENDIX 1: Soil Erosion Consideration*

Since 1930, engineers and soil scientists in the United States of America have studied the individual contributions made to total soil loss from a slope by several important variables (Wischmeier and Smith, 1972). They came up with an empirical formula, called the Universal Soil Loss Equation, which is quoted below:

$$A = R\,K\,L\,S\,C\,P$$

Where *A* is the computed soil loss per unit area

*R* the rainfall factor, is the number of erosion index units in a normal annual rainfall. The erosion index is a measure of the erosive force of specific rainfall

*K* the soil erodibility factor, is the erosion rate per unit of erosion index for a specific soil in cultivated continuous fallow, on a 9 per cent slope 72.6 feet long. (The reasons for selection of these conditions as unit values are explained in the detailed discussion of this factor in the Handbook, No. 282, Wischmeier and Smith (USDA))

*L* the slope length factor, is the ratio of soil loss from the field slope length to that from a 72.6 length on the same soil type and gradient

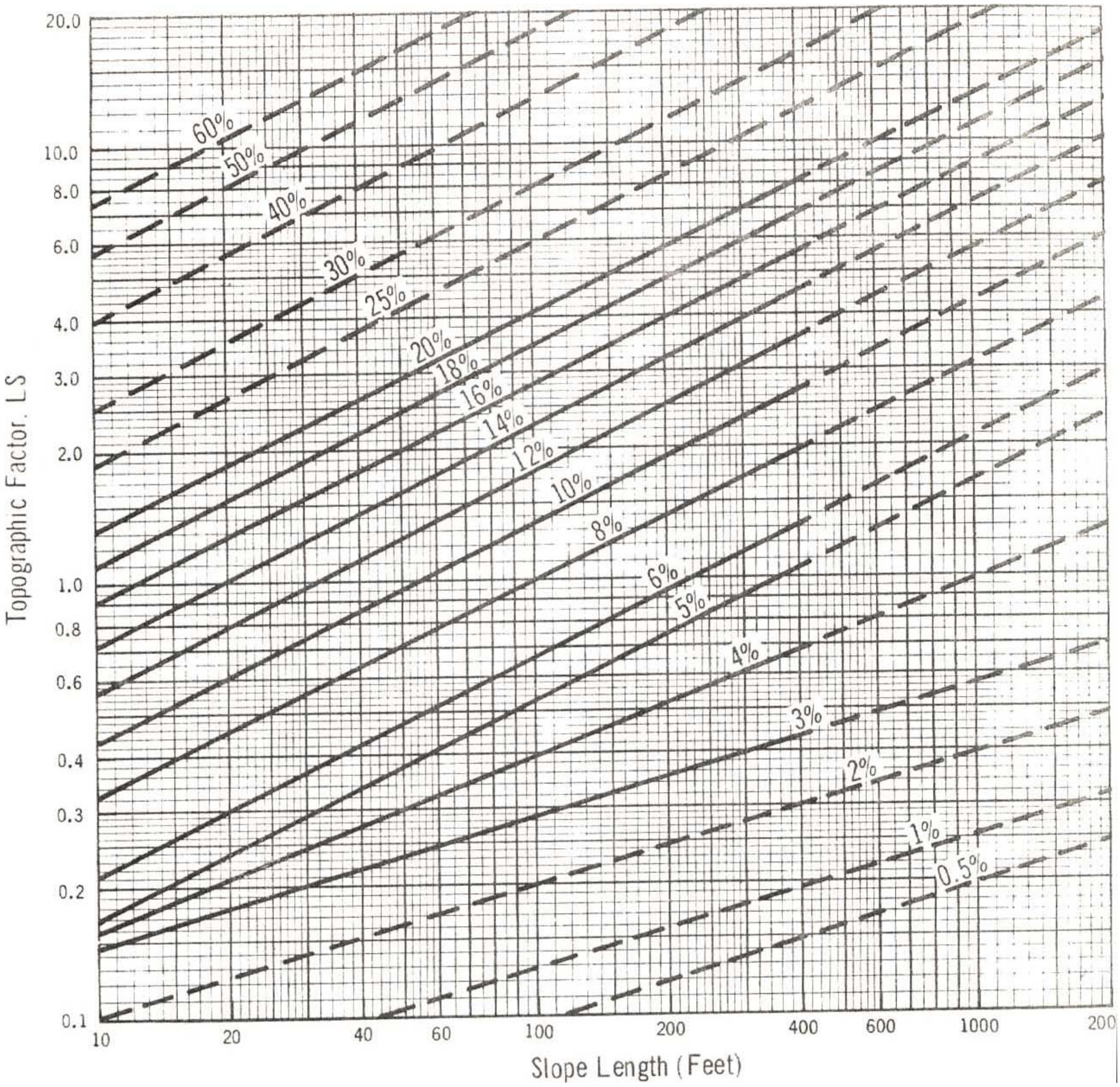
*S* the slope gradient factor, is the ratio of soil loss from the field gradient to that from a 9 per cent slope

*C* the cropping management factor, is the ratio of soil loss from a field with specified cropping and management to that from the fallow condition on which the factor K is evaluated

*P* the erosion control practice factor is the ratio of soil loss with contouring, strip cropping, or terracing to that with straight-row farming, up-and-down slope.

In the UDA, numerical values for each of the six factors have been determined from countless controlled experiments under greatly varying climatic, soil and management conditions. In Victoria, work is going on at present (Soil Conservation Authority) to determine numerical values for the equation, specifically for K, which will vary depending on the soil type. The factors L and S for Victoria will have similar values to those of the USA. The effect of slope length and gradient is well illustrated in the graph (Figure 33) reproduced from a recent publication (Holeman et al., 1975). The graph and the equation on which the curves are based show that, for a doubling of slope length, the soil loss by erosion increased by $(2)^m$, which works out at a factor of 1.4 when slopes exceed 5 percent ($m = ½$), Therefore, it was important in the mapping land systems to differentiate between low hills, high hills and mountains, even if the slope gradient would be the same. Clearly there is generally a much greater unbroken length of slope subject to erosion, after removal or disturbance of the vegetation on mountains, than on low hills.

***Figure 33 – Slope Effect Chart***
(Topographic Factor, LS)*




* The dashed lines represent estimates for slope dimensions beyond the range of lengths and steepness for which data are available. The curves were derived by the formula:

$$LS = \left(\frac{\lambda}{72.6}\right)^{m} \left(\frac{430x^{2} + 30x + 0.43}{6.57415}\right)$$

Taken from "Procedure for Computing Sheet and Rill Erosion on Project Areas".

US Department of Agriculture
Soil Conservation Service
Engineering Division
Plan Science Division.

Technical Release No. 51 (Rev.)
Geology
January 1975

The effects on potential soil loss of an increase in slope gradient is magnified by the fact that soil loss is proportional to the square of the sine of the slope angle. Reference to the graph show that a slope of 20 per cent would suffer approximately three times as much soil erosion losses as a slope of 10 per cent, all other things being equal. As soil is an irreplaceable resource, slope gradients have also been considered in the mapping of land systems. Slope steepness and slope length must be considered in the evaluation of land capability and in working out safe land management procedures.