The purpose of the present study was to extend a previous analysis of heat exchange during competitive distance running that found exceptions to the efficacy of the WBGT Index for estimation of competitive endurance running performance and potential risk of heat injury. Through a simple computer model based on a modification of the classic heat balance equation, we have demonstrated a more versatile and accurate description of the heat stress experienced by competitive distance runners. The computer model took the form of: $E_{req} = M \pm C \pm R \pm W - E_{res}$ where $M$ is metabolic heat production, $C$ the convective heat exchange, $R$ the radiant heat exchange, $W$ the work performed, $E_{res}$ the heat exchange via the respiratory system, and $E_{req}$ the required evaporative cooling to maintain thermal equilibrium. Comparisons of the WBGT Index and the computer model showed that the WBGT Index 1) underestimates the heat stress ($E_{req}$) experienced when wet bulb temperature is moderate, while dry bulb temperature is warm with very high black globe temperatures; and 2) overestimates heat stress ($E_{req}$) in warm, very humid conditions with low black globe temperatures. The advantage of the computer model in predicting performance decrement more precisely appears to lie in its identification of the evaporative requirements of the athlete competing in any set of environmental conditions, as well as in its ability to assess the environmental potential for evaporative cooling ($E_{req}/E_{max}$). Clear identification of certain environments in which either the $E_{req}$ or the $E_{req}/E_{max}$ ratio is too high is possible. Neither is possible with the use of the WBGT Index.