CLIMATE

Climate varies greatly within the catchment, chiefly because of steepness and changes in elevation. However, there is a dearth of data. Some stations provide reliable records of rainfall but no regular records of temperature and other climatic data are available.

Precipitation

Rainfall records have been kept at only a few sites for many years, and no measurements of the snowfall is available. The only station in the higher rainfall area is at Woods Point and there are none in areas of heavy snow. In an attempt to provide more detailed information on the water resources of the catchment, a precipitation map (Figure 1) has been prepared on the basis of vegetative types, with the station records being used as guides.

The distribution of the vegetative types is clearly dominated by climate, the major variable being precipitation. Be correlating the local vegetation with the rainfall at known points, and taking note of other variable, particularly aspect, and the temperature as estimated from the altitude, it is possible to interpolate the precipitation pattern from a map of the dominant vegetation.

Thus a detailed map of vegetation was prepared in the field by representing each dominant species or species group by a spot symbol. The map provided the basis for the sketching of isohyets and delineation of snow bearing areas. The patterns illustrated by this means are presumably accurate, but not the actual values assigned to the isohyets.

The pattern of precipitation is considered to result from two main influences, the topography and the general westerly origin of the rain-bearing winds. Heavy precipitation as snow, hail and rain results from adiabatic cooling processes brought about by the ascent of the air mass. Of several most important in this catchment are large scale convective movements, which result in separate storms; the regional uplift associated with cyclonic depressions which result in general areas of rain; and the forcing aloft of air by the convergency of two dissimilar air masses, as occurs along the a front, which produces lines of associated storms and a band of heavy rain. All these mechanisms are assisted locally where wind is deflected upwards by a large topographic mass. Conversely, where the air descends behind a range, precipitation is at a minimum.

The loss of moisture from the sir mass during uplift reduces the precipitation available for areas behind the range. Over the short distance involved, and considering the scale of the sir movements, this effect is not significant for regional uplift, which produces general rain over all the areas enclosed by the ranges. However, it is important within the catchment for individual convective storms, each of which originates in front of some particular range. Consequently, the series of high ranges forms a corresponding series of regions of high precipitation. Because the air bringing moisture to the north-south across the direction of prevailing winds show the sharpest effect on the precipitation pattern, provided that they are far enough apart. These features are conspicuous in the southern portion of the catchment, where the valleys of the Big and Upper Goulburn Rivers contain marked rain shadow areas east of the main ranges, and the pattern is repeated in the next major north-south valley, which is part of the Glenmaggie catchment, on the other side of the Great Divide. The valleys of the Jamieson, Howqua and Delatite Rivers which all face west, show smaller effect on precipitation.

A conspicuous feature is the pronounced low rainfall area around Mansfield. This corresponds to the low altitude and to the rain shadow from the generally higher dissected plateau country to the west. The combination, of low altitude and rain shadow, produces very steep gradients of precipitation at the edge of the higher country. Thus steep gradients exist on the southern face of the Strathbogie Ranges and the continuation of this trend is seen in the slopes north of the Broken River, rising to the Tolmie highlands, which are outside the catchment.

The two areas with the highest gradient of rainfall are in the Dry Creek Basin, immediately north of Mount Torbreck, and in the Delatite areas east of Merrijig. In these areas, the topographic patterns of vegetation change rapidly and ecological regions, elsewhere several miles wide, may be represented by a band a few hundred metres wide around one kilometre, to west sclerophyll forest containing commercial grade timber stands of messmate and gum with narrowleaved peppermint. This indicates a gradient of about 240 mm/per annum per kilometre.

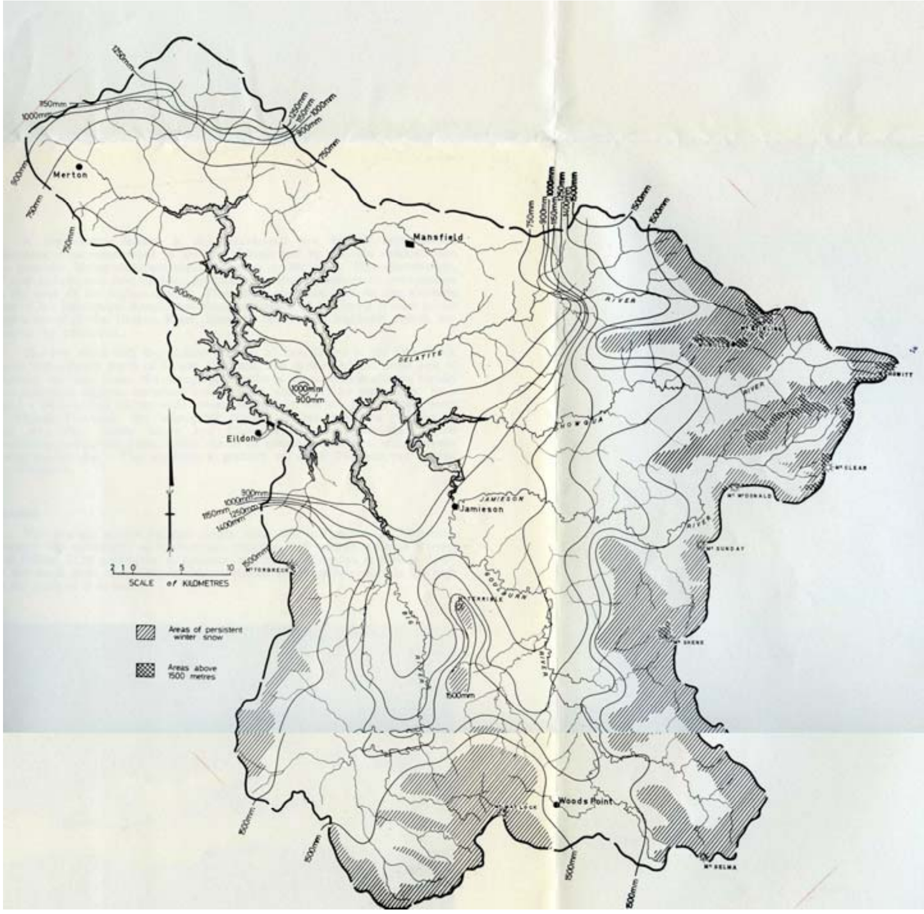

Figure 1 – Inferred Precipitation

Rainfall

The average annual rainfall ranges from 690 millimetres at Mansfield. This corresponds to the low altitude and to the rain shadow from the generally higher dissected plateau country to the west. This combination, of low altitude and rain shadow, produces very steep gradients of precipitation at the edge of the higher country. Thus steep gradients exist on the southern face north of the Broken River, rising to the Tolmie highlands, which are outside the catchment.

Clouds forming over The Bluff in the eastern part of the Eildon catchment

Seasonal Rainfall

Seasonal distribution of rainfall follows a similar general pattern over most of the catchment, as shown by average monthly rainfall at Woods Point, Jamieson and Mansfield (Figure 2). The pattern is one of pronounced winter rain and summer drought. February is the driest month; June and August the two wettest in that order. Apart from the difference in total falls, the most marked difference between stations is in the proportion of total rain falling in the six cooler months. This proportion is highest at Woods Point (eighty per cent), slightly less at Jamieson, and still less at Mansfield, where the distribution shows a summer drought from November to February, rather than a winter peak.

Effective Rainfall

Data indicating the probability of receiving rain equal to, or greater than, certain specified amounts for each month, quarter and season is available for Jamieson and Mansfield (Commonwealth Meteorological Bureau 1951). Effective rainfall is defined as the amount of rain necessary to start germination and to maintain growth.

From May to October the chances of receiving sufficient rainfall for plant growth are very high, but only thirty per cent in January and February at Mansfield. The values for these two months at Jamieson are forty-three and forty-four per cent respectively.

The chance of receiving effective rain increases with altitude. Moisture stress is therefore likely to be rare in the alpine areas.

Snowfall

Snow is an important source of water in the higher proportions of the catchment. Filed observations showed that most of the snow in the catchment falls on the forested country dominated by alpine ash (*Eucalyptus delegatensis*). It is not restricted to snowgum woodland and alpine grassland, although these high areas receive the heaviest and most persistent falls.

Persistent snow during winter begins a little below 1200 metres, depending on aspect. Snowfalls are quite frequent at 900 metres during winter, as on the Strathbogie Ranges, but the snow lies for only a week or so. It may fall at any time of the year on the high peaks, but rarely during summer, and no mountain in the catchment carries persistent summer snow. The snow season, adequate for winter sports, last from about May to October, but seasons are variable.

Mist, Dew and Frost

Observations lead to the conclusions that interception of mist by vegetation could be a significant source of precipitation in higher areas of the catchment. Mist occurs mainly above 1000 metres, where cloud cover is common (Costin and Wimbush 1961). On a mountain top, the efficient collectors appear to be trees with fine foliage, shrubs, or land grass, for example the long, fine tussock snow grass found in ungrazed areas. Ice accumulation on obstructions in super-cooled cloud is more noticeable than mist water collection at very high elevations, and the snow under trees usually contains layers of clear ice which has been shed by the foliage.

Temperature

There are no temperature records for stations in the catchment. Data from nearby Alexandra and from Healesville may be taken to represent the lower forested hill country (Figure 3). The only available records for nearby high areas are those for Mount Hotham, which experiences more severe condition than most of the mountain tops in the Eildon catchment, and for Mount Buffalo which, at just over 1200 metres, can be assumed to be comparable with Eildon catchment areas.

In Figure 3, the mean and extreme monthly figures for there four localities are given as graphs.

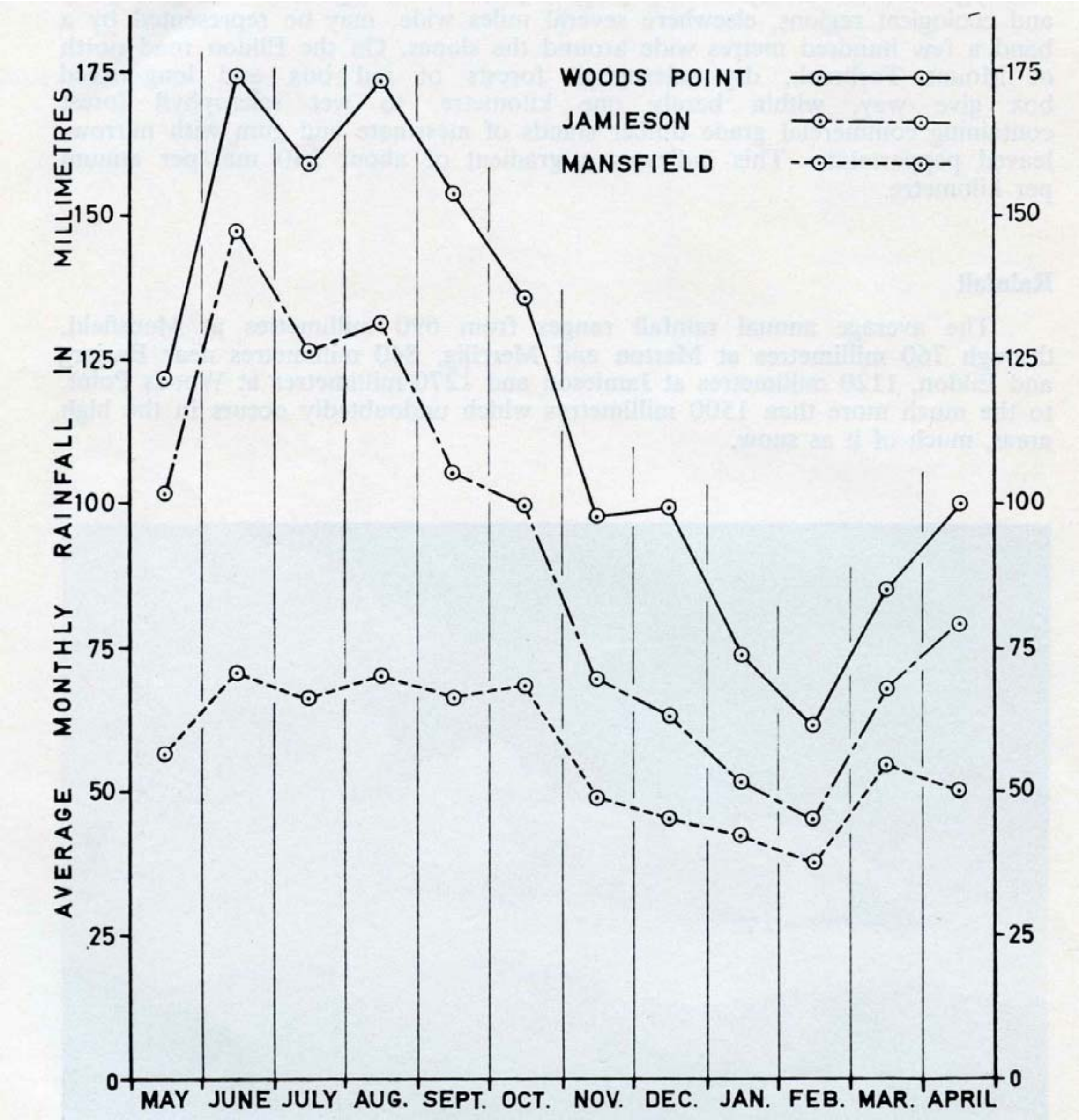

Figure 2 – Seasonal Rainfall

Average mean monthly and annual temperatures may be estimated from regressions based on the various temperature stations in north-eastern Victoria. Such a set of relationships has been calculated by Rowe (1976) and has been used to provide the data presented in Table 2. And the basis for calculating the estimates of potential evapotranspiration presented later. The predicted values are generally within 0.5°C of observed values at available check stations, except where local topographic influences are present. The slope of the regression line is 0.6°C per 100 metres in July, increasing to 0.7°C per 100 metres in January. Mean annual temperatures change by about 0.6°C per 100.

Table 2 – Predicted Mean Monthly Temperatures. (°C)

Altitude	Jan	Feb	Mar	Apr	May	June	July	Aug.	Sept.	Oct	Nov.	Dec.	Annual
305	21.6	21.6	19.4	15	11.6	8.3	7.2	8.3	11.1	13.8	17.1	20.0	14.4
610	19.4	19.4	17.1	12.8	9.4	6.6	5.5	6.6	8.8	12.2	15.5	17.7	12.2
914	17.1	17.1	15.5	10.5	7.2	4.5	3.7	5.0	7.2	10.0	13.3	15.5	10.5
1220	15.0	15.0	13.3	8.8	5.5	2.7	1.7	2.7	5.0	8.3	11.1	13.8	8.8
1524	13.3	13.3	11.1	6.6	3.7	0.5	0	1.1	3.3	6.1	9.4	11.6	6.6

Low temperatures limit plant growth during much of the year ad lack of water in midsummer further curtails the growing period in the lower rainfall areas, where there are two growing periods – one in late spring, the other in early autumn. For many plants, growth is very slow at temperatures of 4°C and below, and the onset of these conditions marks the effective end of the growing season. In the lower areas of the catchment, represented by the figures for Alexandra, the first light frosts (2°C screen temperatures) may be expected in early April, while at 600 metres, the first frost occurs in January or February. The first severe frosts, recorded as screen temperatures of 0°C or under, occur in April at 300 metres, as early as February in higher area. These temperatures refer to a point 1.5 metres above the ground, and grass temperatures are several degrees lower.

At 300 metres, the last severe frost may be expected in late September or early October, and during November in the higher country. Light frosts persist until November at low levels in the catchment, but the highlands may experience frosts in December. From twenty five to fifty frosts per year will occur in the lower area of the catchment, depending on local situation, and up to one hundred per year in the highland valleys.

The drainage of cold air, chilled by radiation to clear night skies, from slopes to the valleys, is an important feature in the upper parts of the catchment. The drainage is a regular occurrence on clear, calm nights throughout the year. It produces night wind, which reaches the lower valleys shortly before dawn. The air movement is responsible for the regular valley fogs, which form at night under high humidities, to dissipate about mid-morning under the influence of heat convection caused by the sun. These fogs contribute a significant amount of water to the valley vegetation. In cooler weather, and when there is little wind, the drainage may cause severe frosts along the lower valley sides and floors. Where the valley is obstructed by overlapping spurs, and in small, open area of river flats between forest, ponds of cold air may form, and severe local frost patches will result. These local temperature inversion effects explain some peculiar changes in vegetation, in particular the localised patches of snow gum at quite low altitudes along the valley floors, as at Bindaree, and the Fry area, on the Howqua.

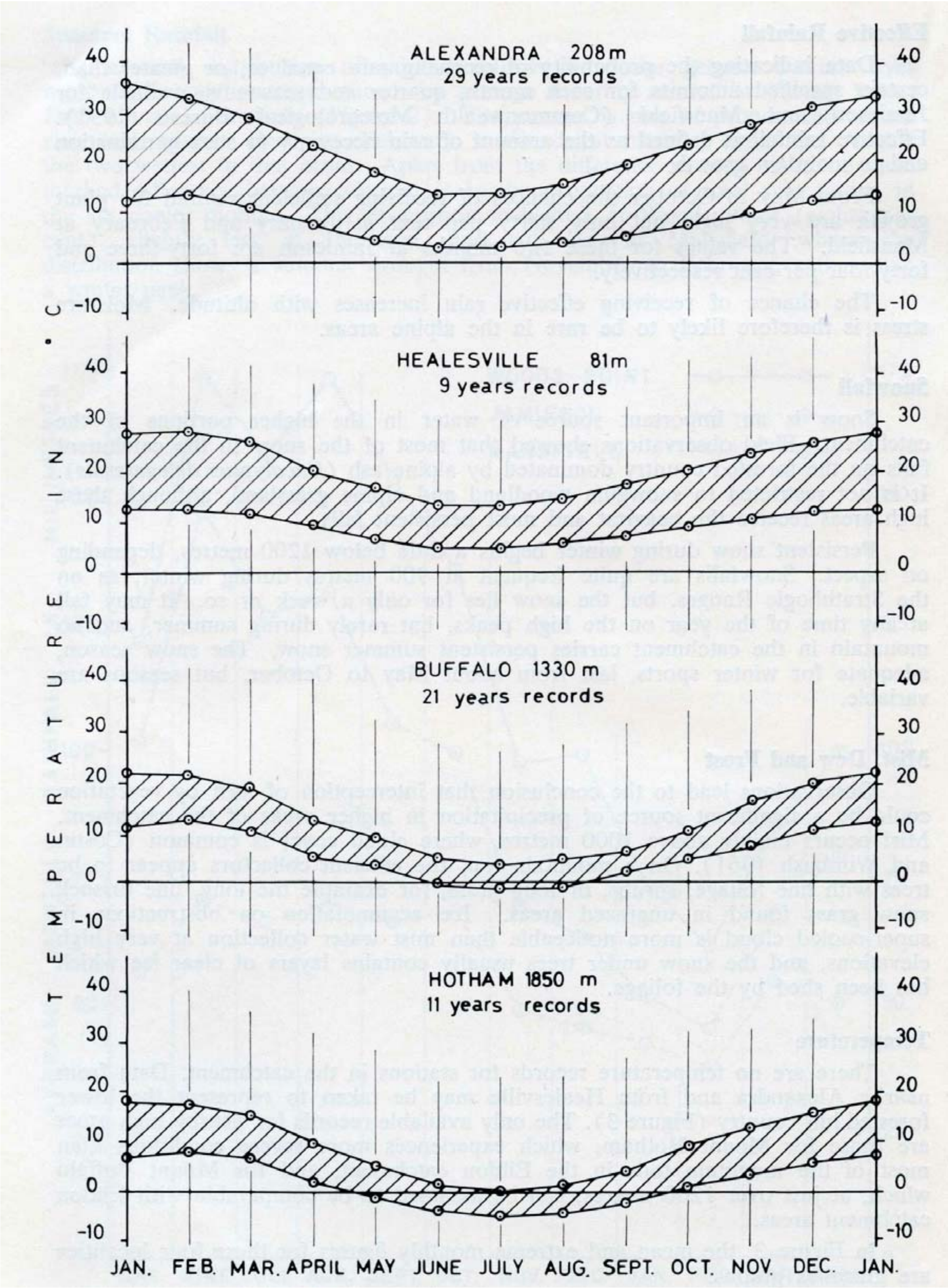

Figure 3 – Seasonal Temperature

Humidity; Evaporation; Transpiration

There are no direct measurements of evaporation in or near the catchment and the only estimates are based on saturation deficit measurements for stations well outside the catchment. On this basis, the annual average evaporation in the lowlands, e.g. Mansfield, is estimated to be one thousand and twenty millimetres, with the monthly values ranging from twenty-five millimetres in winter to one hundred and eighty millimetres in summer. Comparable estimates for the highlands at 900 metres are six hundred and ninety millimetres and eighteen millimetres to one hundred and thirty millimetres.

The potential loss of soil water through vegetation has been estimated by Thronthwaite’s method, which is based on mean monthly and annual temperatures. By the use of the relationships between temperature and altitude, a set of curves can be constructed. These relate predicted potential evapotranspiration losses with altitude for each month (Figure 4).

Average monthly values for rainfall, potential evapotranspiration, and soil water storages can be used to construct a water budget for deep-rooted perennial vegetation (Figure 5).

Wind; Thunderstorms; Fire Danger Weather

There have been no regular observations of wind direction or speed in the study area. It appears that strong winds are predominantly from the west. A study of the mean monthly synoptic charts indicates that the gradient winds have a more northerly component during summer and a more southerly component during winter, corresponding to the latitudinal shift of the depression tracks. Much of the weather consists of frontal and stream conditions, with the typical pattern of clear weather, then increasing high cloud, followed by a shift of wind to the south-west, with rain. In summer, it often takes the form of a storm line only, followed by cumulus clouds, gradually clearing with the wind returning slowly to the north-west.

Wind direction and strength on the ground appear to be influenced by local topography. The channeling effect of ridge and valley lines causes wind to blow along the valleys. Lee effects give rise to strong down draughts behind obstructions, and reverse flow across the valleys at low levels. These lee effects often take the form of a system of standing waves downstream from the obstructions, reaching to great heights. Clouds formed in these systems are a feature of the sky over the area. The general pattern of vertical movements probably has a considerable influence on the weather and climate in the area.

Summer thunderstorms are common. Most of them are thermal, that is, associated with convection induced by solar heating of the land. These are isolated but some occur in line squalls.

“Dry” storms occur in a dry air mass, typically in north-westerly winds, so that the cloud base is very high. Rain falling from these clouds into the dry air below evaporates rapidly, so that little or none reaches the ground. Summer lightening under these conditions is a serious fire hazard. It also causes much interference to radio reception, on some days limiting fire control communications severely.

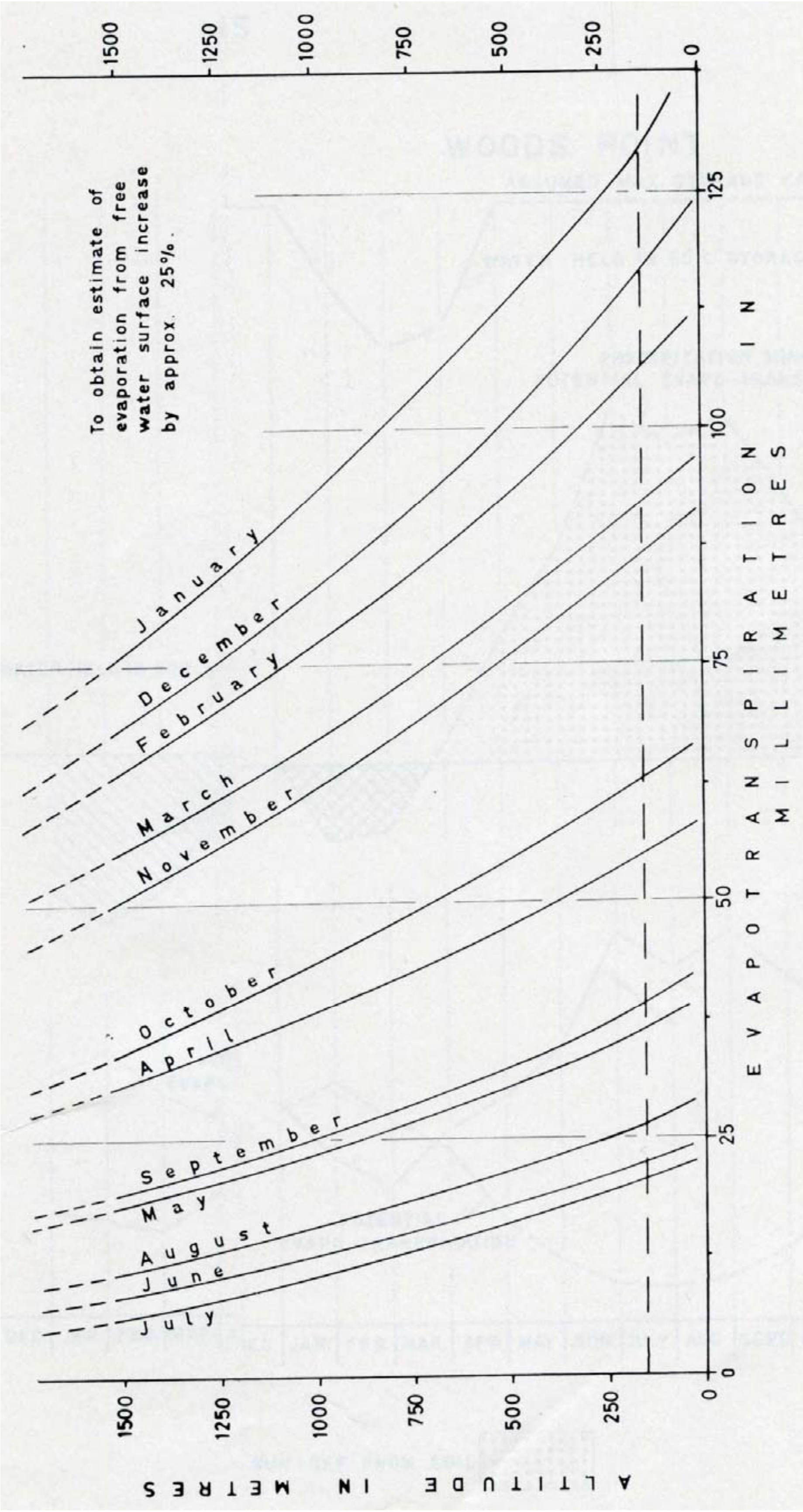

Figure 4. Calculated Seasonal Evapotranspiration at Various Altitudes.

Figure 4 – Calculated Seasonal Evapotranspiration at Various Altitudes

AVERAGE MONTHLY WATER BUDGET AT THREE RAINFALL STATIONS

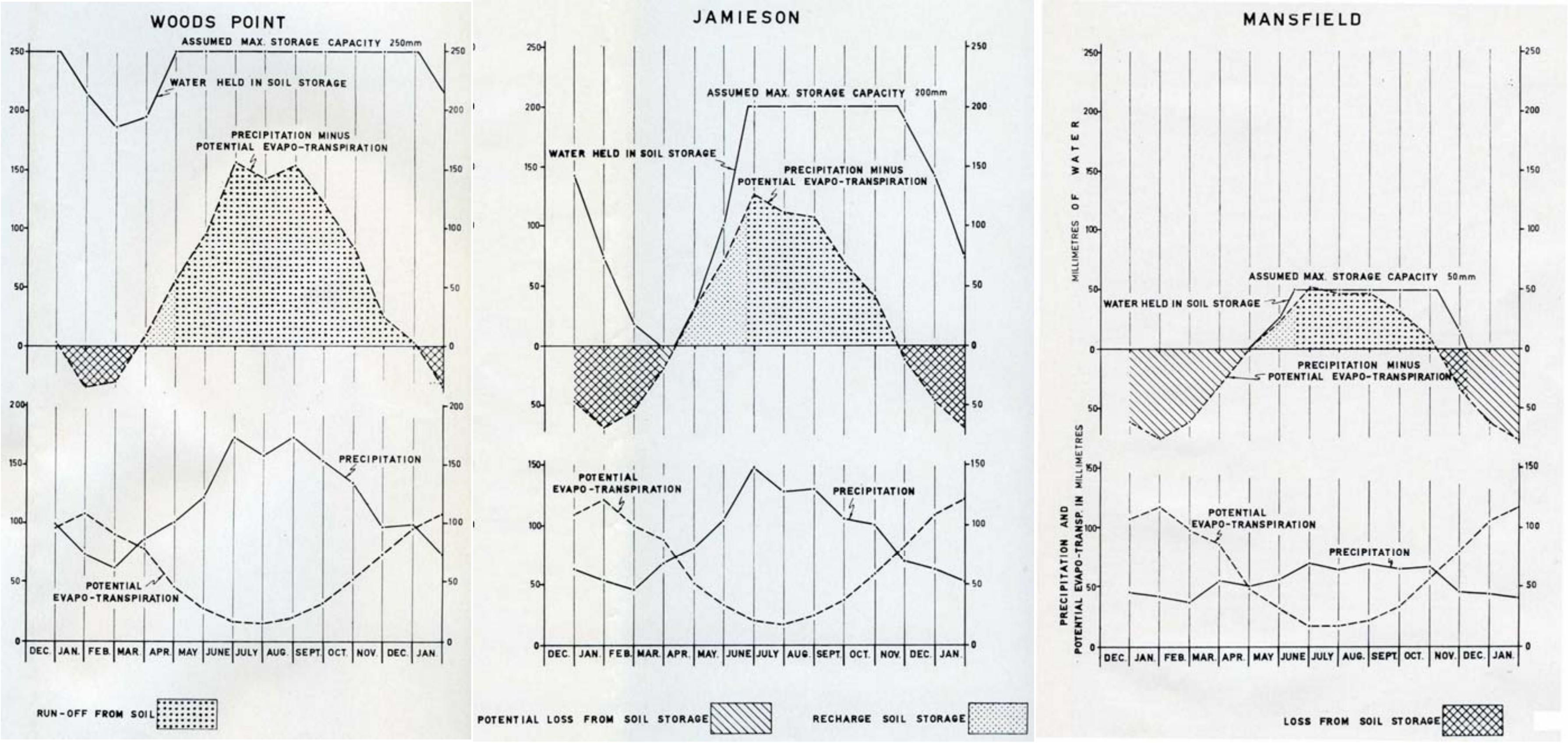

Figure 5 – Seasonal Water Budget at Mansfield, Jamieson and Woods Point

Table 3 – Soil Classification

Soil Group	Probable Relationship to Other Classifications			Typical Profile Features
	Stace et. al 1968	Northcote 1971	Soil Survey Staff (USDA) 1960	
Solodic Soils	Solodic Soils	Db2.41-2, may be also Dy	Orthic Albaqualfs, Natraqualfic Typudalfs, Albaqualfic Typudalfs, possibly Albaqualfic Typustalfs	Massive pale coloured loamy surface soil abruptly overlying a coarsely structured yellowish brown, frequently mottled clay subsoil. The subsoil is often easily dispersible. Medium acid to neutral.
Black Earths: (a) Chernozemic Soils	Black Earths	Ug5, perhaps also Uf	Vertisols	Weakly differentiated very dark to black heavy soils with blocky structure. Neutral to mildly alkaline
(b) Prairie Soils	Prairie Soils	Uf and Um	Aquolls and Udolls	Dark friable loams and clay loams grading over a short distance into very dark to black, sometimes mottled, fine blocky clay subsoil. Medium to slightly acid.
Brown Earths	Chocolate Soil or Brown Earth? (Stony phase)	Um 1.2 or Um 1.4	Hapludents or Ochrepts	Acid friable reddish brown clay loam and clay soils with moderate degree fine structure and little profile differentiation.
Red and Yellow Podsolic Soils	Red and Yellow Podosolic Soils	Dr2.4 or DR4.4	Ochrultic Typudalfs and Typochrults	Massive pale coloured sandy to silty loam topsoil, grading relatively rapidly into a blocky structured reddish or yellowish brown clay subsoil. Acid.
Leptopodsols: (a) Pallid Variant	Red and Yellow Podsolic Soils	Gn2.34 or Gn2.74, multi-storey	Ochrultic Typudalfs: intergrade to Ochrultic Typustalfs?	Moderately deep to shallow, pale sandy loam to clay loam over a clay loam or light clay subsoil. Poorly structured or massive. A2-horizon is bleached. May occur as a younger soil over older, buried soil material. Medium acid to neutral.
(b) Red Variant		Gn3.1 and/or Gn4.1		
Amphipodsols	Red Podsolic Soils	Gn 4.14	Orthic Typochrults, possibly some Ultustalfs and Orchrultic Typudalfs	Dark greyish brown massive or weakly structured loamy surface soils grading through slightly bleached A2-horizon into reddish brown or yellowish red well structured loamy to clayey subsoils. Medium Acid.
Cryptopodsols	Brown Podsolic Soils	Gn 4.34	Typumbrults	Moderately deep to shallow brown to yellowish brown loam to clay loam, often somewhat lithosoloc. A2-horizon not bleached. Subsoils moderately structured. Surface. Surface soil high in organic matter. Acid
Meadow soils	Wiesenboden	Um, several Principal Profile Forms may be possible	Haplaquents, Aquic Hapludents, Umbraqueptic and Aquic Dystrochrepts, Ochraquepts	Dark to greyish brown loams or clay loams, with moderate structure and rusty staining along root channels in the surface horizon, grading to massive, grey mottled loamy subsoils.
Skeletal Soils	Lithosols	Um4 most likely	Hapludents, some intergrades to Orthustent	Very stony soils with more or less undifferentiated profiles
Krasnozems	Krasnozems or Intergrades to Euchrozems	Gn4.11 or Gn3.11	Rhodustalfs, Ultustalfs, perhaps Rhodochrults	Deep red, strongly structured clays or clay loams, medium to slightly acid. Subsoils firm to weakly friable.

Soil Group	Probable Relationship to Other Classifications			Typical Profile Features
	Stace et. al 1968	Northcote 1971	Soil Survey Staff (USDA) 1960	
Regosols: (a) Coarse Gritty Siliceous Sands	Deep Sands	Uc 1.21	Orthopsamments	Deep pale coloured rather uniform sandy deposits.
(b) Alluvial Soils	Alluvial Soils	Uc, Um	Hapludents	More or less unaltered sandy and loamy alluvial deposits.
Peats	Acid Peats	0 acid	Hostosols	Black, fairly porous, water saturated organic deposits, generally well decomposed and sticky, but often fibrous brown loamy soils.
Acid Brown Earths	Brown Earths	Um 6.12 and/or Um 6.13	(orthic?) Dystrochrepts	Well weathered, strongly acid yellowish brown to reddish brown loamy soils.
Transitional Alpine Humus Soils	Brown Earths	Gn 4.31	Dystrochrepts and/or Haplumbrepts	Well weathered, strongly acid soil, mostly about 1 m deep. Highly organic in the top 15-20 cms grading into brown mineral soil. Textures often become somewhat heavier with depths.
Alpine Humus Soils	Alpine Humus Soils	Um 7.11 and/or Um 7.12	Haplumbrepts, possibly in part Cryumbrepts	Very friable, dark, highly organic loam grading, rapidly through brown loam into weathering rock. Strongly acid.