INVENTORY OF HYDROLOGICAL RESEARCH IN HYDROLOGY SECTION

By

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CONTENTS

Appendices

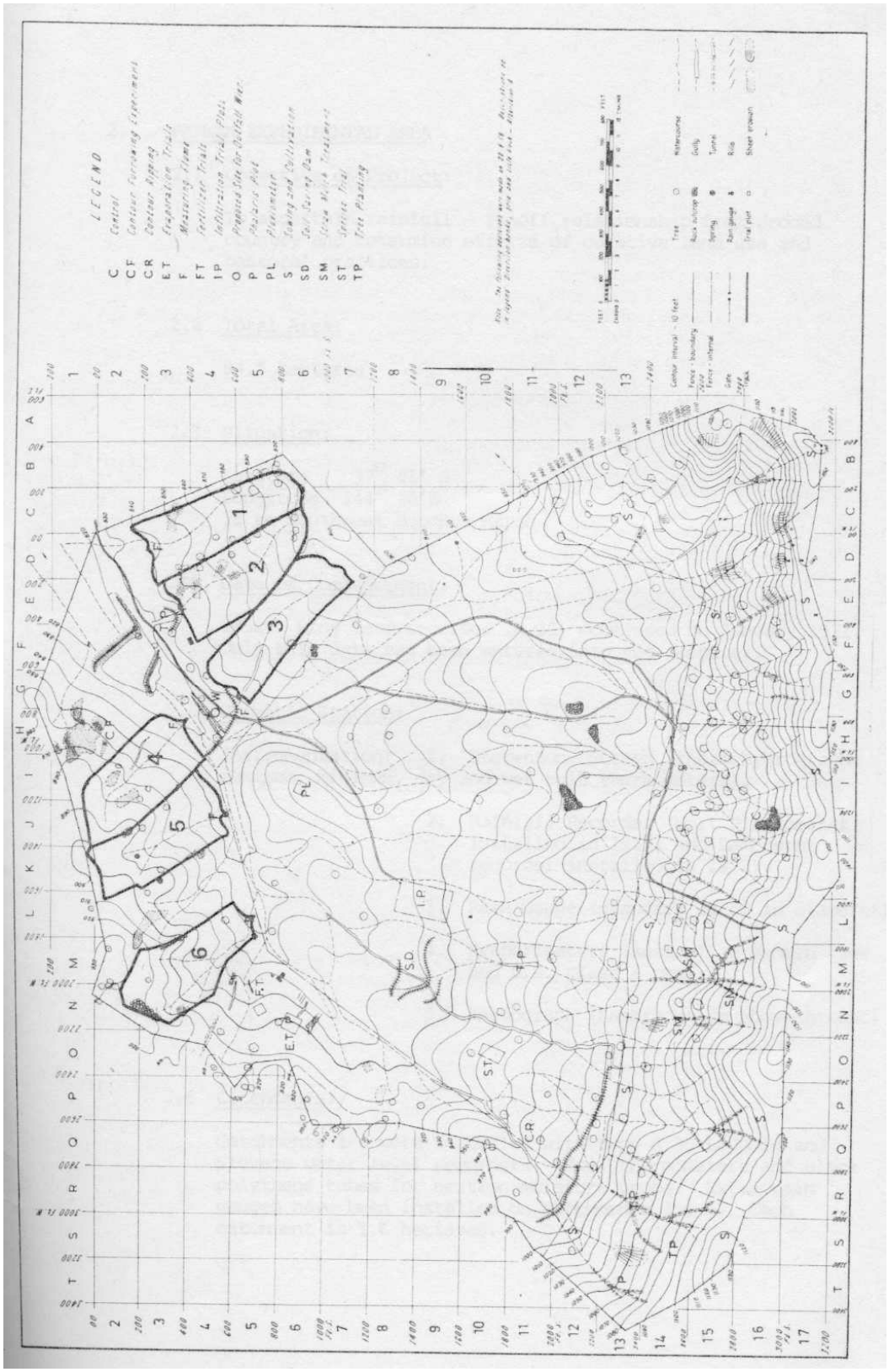
1 Introduction

The purpose of the Authority's hydrological studies is to determine and to understand the relationships of land, landuse and water regime. The studies of this section are a long term research on the effect of landuse and land management on the water regime, in particular types of land. This is in order to predict the effect of future landuse changes on water flow and quality.

Australia is the world's driest continent and its continued growth and developed are dependent on the skilful utilisation of its extremely limited water resources: care of the quantity and quality of water resources is therefore of great significance. Hydrology is fundamental science to water resources, planning and development. Also, the conservation of the soil resource requires a knowledge of the effects of changes on landuse and land management on water flow, which is a major agent of soil erosion.

The Soil Conservation Authority operates four sets of Hydrological Experimental Areas, comprising nineteen catchments. These experimental areas span a wide range of Victorian land-types; they are located at Parwan (near Bacchus Marsh), Stewarts Creek (near Daylesford), Reefton (Upper Yarra), Long Corner Creek (near Myrtleford). At each catchment continuous records of rainfall and runoff are obtained. At some catchments data on water quality is collected also. From these, data models are being tested or developed for the prediction of the effect of landuse changes on water flow.

In operating these four Hydrological Experimental Areas, the Authority relies heavily on the advice and guidance of an Experimental Catchment Consultative Committee which consists of representatives of Forest Commission of Victoria, State Rivers and Water Supply Commission, Melbourne Metropolitan Board of Works and Soil Conservation Authority.



Plan showing the six small catchments being studies within the Parwan Experimental Area

2 Parwan Experimental Area

2.1 Objective of Project

To ascertain rainfall – runoff relationship from eroded country and determine effects of curative land use and pastoral practices.

Total Area

94.5 hectares

2.3 Situation

Latitude 37^{o} 41' S
Longitude 144^{o} 20' E
16km southwest of Bacchus Marsh

2.4 Date of Commencement

1954. Long term recorder (A.35) commenced on January 1971. Only this data has been entered into the computer.

Climatic Station

Instrumentation:

1. Stevenson Screen (thermohygrogaph), maximum, minimum, dry and wet bulb thermometers).
2. Rainfall Recorder (Mort Pluviometer installed in 1957, and Lambrecht recorder installed in 1972).
3. Rain Gauge (standard 20 cm in diameter)
4. Evaporimeters (Australian sunken tank and U.S. Class A pan)
5. Anemograph (Lambrecht 2 m above ground).

Catchments

Catchments 1-6 were installed with type A.35 Leupold and Stevens water level recorders. Soil thermometers and black polythene tubes for neutron moisture probe. Extra rain gauges have been installed on catchments 3 and 6. Each catchment is 1.6 hectares.

A Northerly Aspect

Catchment 1. Succession back to woodland and native pastures common to the area. Sheet erosion in this catchment is to be controlled.

Catchment 2. First cycle of improved pasture of Wimmera ryegrass has been completed and second cycle improved pasture has been started in 1979, top dressed annually with 75 kg/0.4 ha (1½ cwt/acre) of superphosphate. The pasture species are *Phalaris tuberosa*, *Currie cocksfoot*, *Woogenellup Sub-clover* and *Crimson clover*. Grazing is to be restricted to reduction of excess growth.

The pasture at catchments 2 and 5 still has not yet developed due to dry weather conditions.

Catchment 3. Control – This catchment is to be left in its natural state. Erosion control measures are to be implemented on this catchment when necessary. Regrowth of Wattles to be controlled. Grazing is to be restricted to reduction of excess growth.

B Southern Aspect

Catchment 4 – Southerly aspect replica of catchment 1. Management practices identical to catchment 1.

Catchment 5 – Improved pasture – Southerly aspect replica of catchment 2. Management practices identical to catchment 2.

Catchment 6 – Control – Southerly aspect replica of catchment 3. Management practices identical to catchment 3.

All the manually operated equipment are read and serviced by officers from hydrology section of the Soil Conservation Authority and maintenance work is carried out in summer every year.

C. Main Channel Catchment

The area is 84.9 ha with a concrete V notch of 120^{o} and type A.35 Leupold and Stevens water level recorder was installed. A steel blade V with the same degree was imbedded in the concrete notch in December 1979 in order to improve the accuracy.

The vegetation is natural pasture with isolated occurrences of trees and shrubs. The dominant tree species are *Eucalyptus melliodora* (yellow box), *E. hemiphloia* (grey box) and *E. leucoxylon* (yellow gum). Smaller trees and shrubs are *Acacia mollissima* (black wattle), *Acacia acinacea* (gold dust wattle) *Bursaria spinosa* (sweet bursaria) and *Hymenanthera dentata* (tree violet).

2.7 Soils

Shallower A horizons occur more on the northerly aspects than on the southerly, and also there is a sharper boundary between A and B Horizons on the northerly aspect. Although the A1 horizon has a comparatively light texture, surface compaction which followed the removal of vegetation and raindrop action has converted these soil surfaces to a hard impervious crust in many places. The A2 horizon has a very poor structure, and when wet it quickly loses stability. These characteristics are partly responsible for the widespread occurrence of tunnel erosion.

2.8 Summary of Results

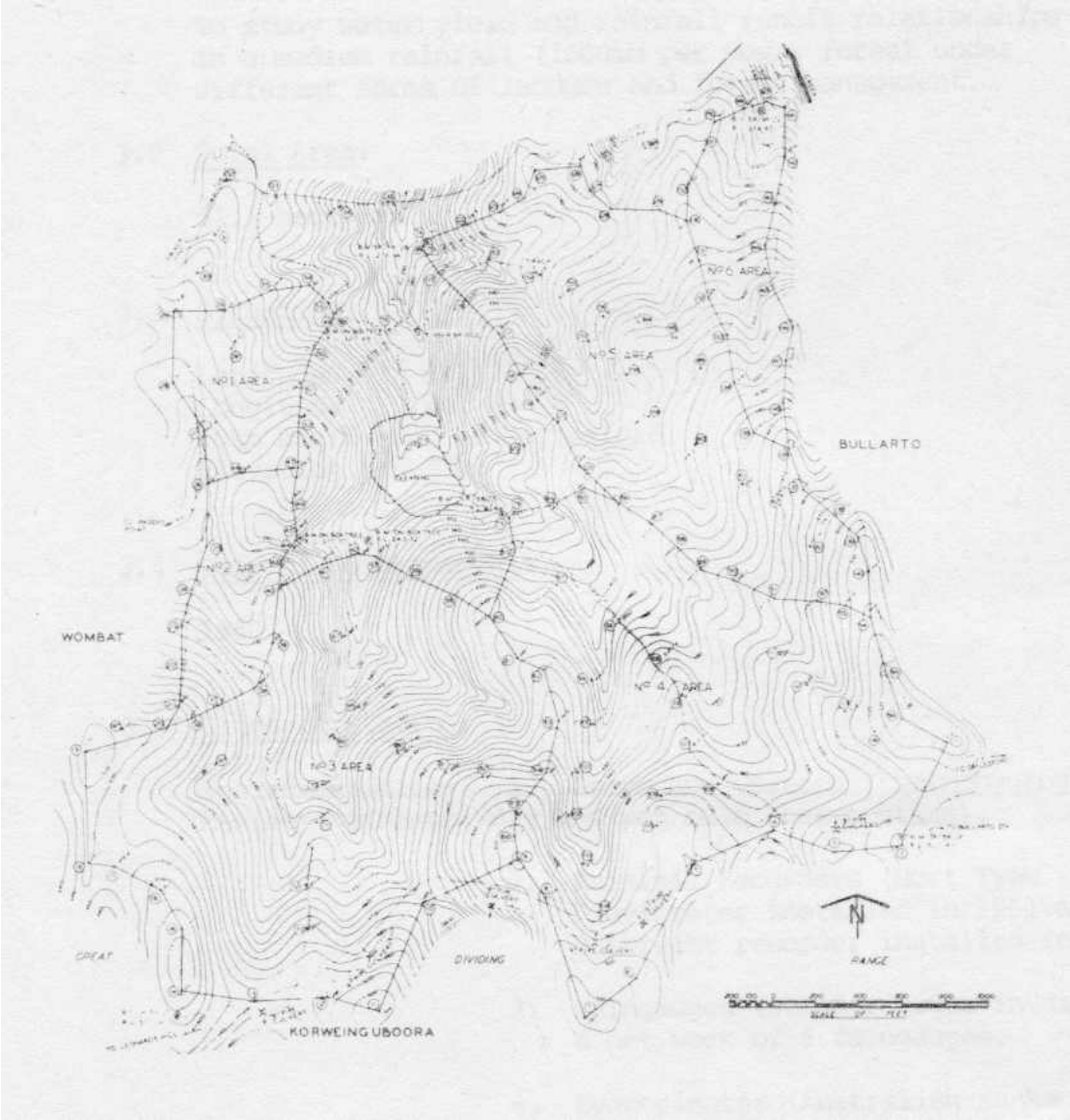
The maximum temperature in the summer is 39^{o} and minimum in the winter is -1^{o} C. The average annual amount of rainfall is 530 mm while the average annual amount of evaporation is 1,539 mm. The deficit is over 1,000 mm.

The amount of runoff from those with a northerly aspect is always greater than from comparable catchments with southerly aspect, and the amount of soil moisture content on the northerly aspects is always less than at southerly aspects. Hence, the vegetation growth on southerly aspects is always denser and better than on northerly aspects. The denser vegetation provides increased resistance to water and soil movement. The net results are reduced surface runoff and reduced soil erosion. The general comment is if SCA ceases operation in the Parwan Valley, then Melton Reservoir would fill with silt within 10 years.

2.9 Further Studies

The next phase of this study is to investigate these physical relationships, and attempt to predict them – in particular to use the research results for ungauged catchments. Preliminary examinations have been made on a number of existing hydrological models mainly developed from USA hydrological data. Unfortunately none of these seem to meet Victorian conditions adequately, thus it is necessary to collect more local data and to use them in developing models to suit the local situation.

In addition the Experimental Area serves as part of a secondary school education on the subject of soil erosion. Numerous secondary schools have arranged to visit the area as part of their school curriculum. It is expected that this activity will be continued at least for the next ten years.



Stewart’s Creek Experimental Area

3. Stewart's Creek Experimental Area

3.1 Objective of Project

To study water yield and rainfall runoff relationships in a medium rainfall (1,000 mm per year) forest under different forms of landuse and forest management.

3.2 Total Area

51.1 hectares

3.3 Situation

Latitude 37^{o} 21' S
Longitude 144^{o} 09' E
10 km south-east of Daylesford
Elevation 685 – 770 m

3.4 Date of Commencement

1960

3.5 Climatic Station

Instrumentation:

1. Stevenson Screen thermohygrographs, maximum, minimum, dry and wet bulb thermometers.
2. Rainfall Recorders (Mort Type Pluviometer installed in 1961 and Lambrecht recorder installed in 1972).
3. Rain gauges (standard 20 cm in diameter) a net work of 6 rain gauges.
4. Evaporimeter (Australian sunken tank and US Class A pan).
5. Anemograph (Lambrecht 2 m above ground).
6. Trough gauges.
7. Rain gauge for water sample analyses.
8. One black polythene tube of neutron moisture probe.

3.6 Catchments

Initially, the vegetation of all the catchment areas was approximately uniform, consisting of *Eucalyptus*, particularly *E. obliqua*, *E. dives* and *E. radiata*. It is typical

of large areas of Central Highland forest. The area was divided into five catchments and catchment No. 3 was not in operation because of leakage in the base rock. The water from this area contributes to the Loddon River, and subsequently becomes the source of water supply to Daylesford township. Type A.35 Leupold and Stevens water level recorders and U.S. H type flumes were installed in all catchments.

Catchment No. 1

The area of this catchment is 4.3 hectares. 6 standard rain gauges were installed randomly around this area with 1 black polythene tube for neutron moisture probe. This is a control catchment in relation to catchment 2 and the vegetation is still Eucalypt forest up to date. No change is proposed.

Catchment No. 2

The area of this catchment is 4.0 hectares. There are two standard rain gauges and 2 black polythene tubes for neutron moisture probe. The vegetation was similar to catchment No. 1 until 1969, then a land use change was implemented. At present, the area is covered by pasture with restricted cattle grazing.

Catchment No. 4

The area of this catchment is 25.2 hectares. There is a network of 16 standard rain gauges, 2 trough gauges and 2 black polythene tubes for neutron moisture probe. Ten stem flow gauges for measuring stem flow from Eucalypt trees were also installed in this area. This is a control catchment in relation to catchment 5 and the vegetation is still natural Eucalypt forest. No change is proposed.

Catchment No. 5

The area of this catchment is 17.6 hectares. The vegetation was natural Eucalyptus similar to catchment No. 4 until 1969, than a landuse change was carried out. Now the vegetation is *Pinus radiata*. There is a network of 7 standard rain gauges, 1 trough gauge and 9 black polythene tubes for neutron moisture probe. One gauge for measuring stem flow from the pine trees was installed in February 1981.

All the manual gauges are read and serviced weekly by officers from hydrology section based at Kew, and maintenance work is carried out in summer every year.

3.7 Soils

Soils of the catchment areas belong to yellow and red GN type with sporadically bleached dark A horizon. This horizon is met with in the eucalypt forest relatively often, in pine forests seldom, and in pasture very seldom. Subsoils are brown silty clays.

3.8 Summary of Results

The maximum temperature in summer is 36.6^{o}C, while the minimum in winter is -5^{o}C. The average wind speed is 4.0 km/hr.

Average annual amount of evaporation is 947 mm and average annual rainfall is 1,080 mm. The amount of soil moisture varies from 0.4 to 0.5 g/cm^{3} at a depth of 4.87 metres (16 ft) and 0.3 to 0.5 g/cm^{3} at a depth of 1.83 metres (6 ft). The upper layers of soil usually contain more moisture than the lower layers. The soil is normally saturated during winter months, loses moisture progressively from about November until about May and then regains it during a six to eight week period in May and June.

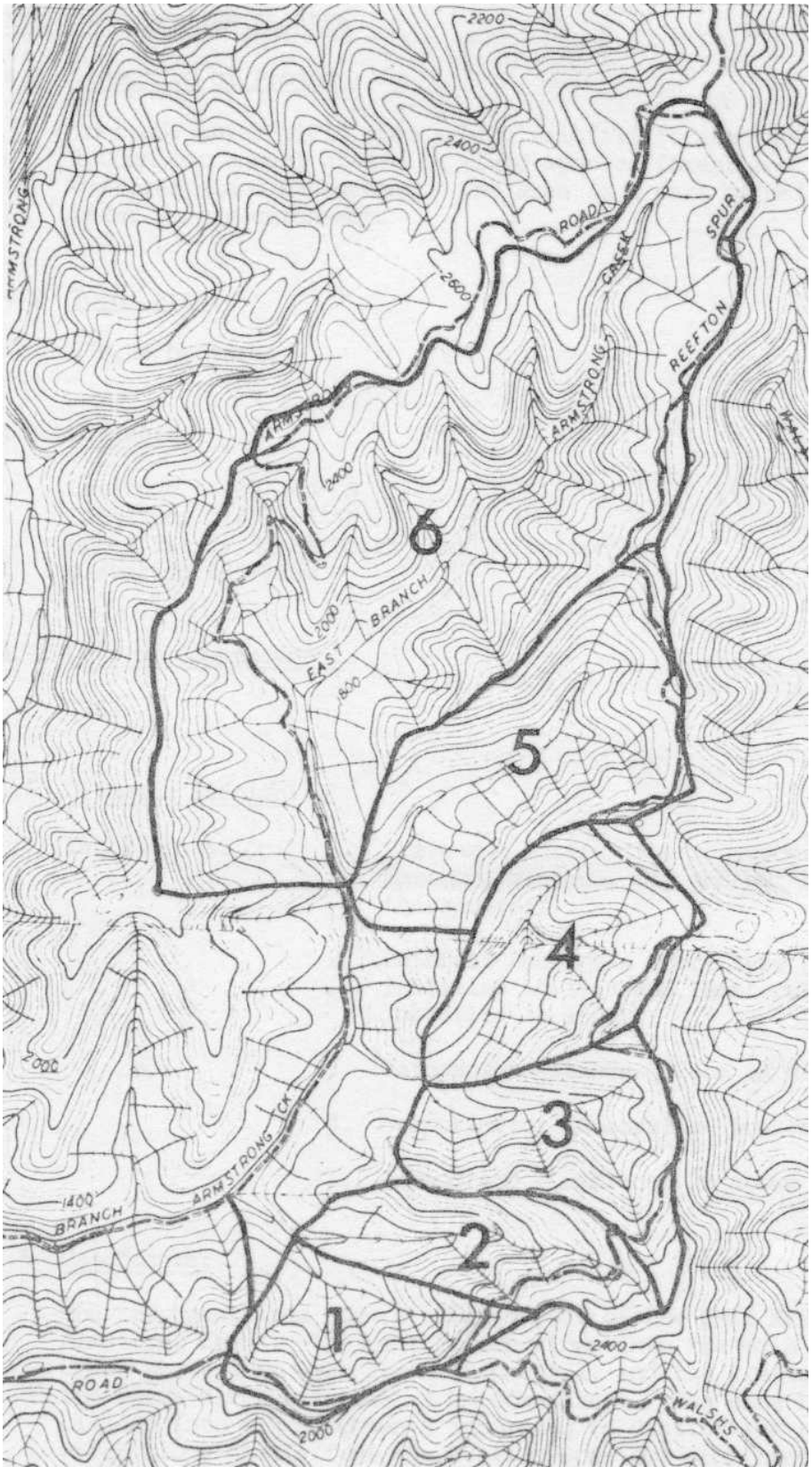
The average interception in this type forest is about 9-18% while the stem flow is about 2-10% various according to tree species and rainfall amount. Before the implementation of the treatments, the amount of runoff of the catchment concerned was about 10-20% of rainfall. After the treatments the amount of runoff is nearly doubled. Whether this phenomenon is permanent or not still remains to be investigated.

3.9 Further Studies

The results of increasing runoff are complex. There is a number of contributing factors, such as damage to soil porosity, development of pasture and its age, different rates of evaportranspiration between pasture and eucalyptus trees and rainfall intensities. All these factors require investigation. Furthermore the pine trees are still at a young stage; the long term effect still remains to be investigated.

Owing to the public opinion changes in the last decade, water samples are also included in the data collection.

The water samples are taken weekly to the laboratory for specific conductivity test and also tests for Potassium (K+), Sodium (Na+), Magnesium (Mg++), Calcium (Ca++), Chloride (Cl-), Bicarbonate (HCO_3-) and Sulphate (SO4=).



Reefton Experimental Area

4. Reefton Experiment Area

4.1 Objectives of the Project

To study water yield from a high rainfall forest (above 1,000 mm per annum) area with mixed species forest and different land management. The are is a part of Melbourne's water supply catchment.

4.2 Total Area

970.44 hectares

4.3 Situation

Latitude 37^{o} 40' S
Longitude 145^{o} 55' E
Upper Yarra, 32 km North East Warburton
Elevation 430 – 820 m

4.4 Date of Commencement

1963

4.5 Climatic Station

Instrumentation

1. Stevenson Screen (thermohygrograph), maximum, minimum, dry and wet bulb thermometers).
2. Rainfall Recorders (Mort type Pluviometer installed in 1963 and Lambrecht recorder installed in 1976).
3. Rain gauges (standard 20 cm in diameter).
4. Evaporimeter (Australian sunken tank).
5. Anemograph (Lambrecht 2 m above ground).

4.6 Catchments

The catchment area covers a large part of the East Branch of the Armstong Creek. The East Branch flows into the main Armstrong Creek about 2 km west from Catchment 1, and the Armstrong meets the Yarra River a further 4 km downstream. The area has been divided into six catchments according to distinctive ridges which slope gently from the Reefton Spur but drop steeply towards the weirs on the main creek.

The vegetation is eucalypt dominant open forest. There is a wide range in height, density and species composition with a range in height, density and species composition with a marked difference between the sparse vegetation on the drier sites at low elevations in the southern catchments to tall dense forest on wetter sites at higher elevation in the catchment headwaters. The southern catchments contain mixed species with the main overstorey species being *E. radiata*, *E. sieberi* and *E. dives*. At higher elevation the dominant species are *E. obliqua*, *E. regnans* and *E. cypellocarpa*.

Catchment No. 1

The area of this catchment is 70.42 hectares. It is a gently sloping catchment by comparison with the other catchments. 72% of the area has a slope less than 18^o and only 6% of it is greater than 30^o. The dominant forest species are *E. baxteri*, *E. sieberi* and *E. radiata*. Only one rain gauge was installed in this catchment. This catchment will be treated with fuel reduction burn, road construction and integrated logging in the near future.

Catchment No. 2

The area of this catchment is 55.85 hectares and it is the only rectangular shape catchment. 62% of the area has a slope less than 18^o and 8% of catchment is greater than 30^o. The dominant forest species are *E. obliqua, E. sieberi* and *E. baxteri.* Two standard rain gauges were installed in this catchment. This catchment will be treated with fuel reduction burn, road construction and rehabilitation in the near future.

Catchment No. 3

The are of this catchment is 95.1 hectares. It is the steepest catchment among the six. 23% of the area has a slope greater than 30^o and only 50% is less than 18^o. The dominant forest species are *E. obliqua, E. baxteri* and *E. sieberi*. In order to study the topographic effects on rainfall, five rain gauges and five trough gauges have been installed between 1966 and 1937.

Because of the shortage of manpower in this section, the data collection on this study ceased in November 1980. Analysis of the data is in progress. This catchment will be treated with fuel reduction burn and road construction in the near future.

Catchment No. 4

The area of this catchment is 107.24 hectares. 59% of the area has a slope less than 10^o and 16% is more than 30^o. The dominant forest species are *E. baxteri, E. obliqua*, *E. sieberi* and *E. regnans*. Only one rain gauge was installed in this catchment. No treatment is planned for this catchment and it is intended to use this area as a control catchment.

Catchment No. 5

The area of this catchment is 156.21 hectares. 62% of the areas has a slope less than 18^o and 9% is more than 30^o.

The dominant forest species are *E. regnans, E. Baxteri* and *E. sieberi* but more than 30% of the area are covered by *E. regnans* (Mountain Ash).

Two rain gauges were installed in this catchment. Calibration is still in progress; no immediate treatment is planned.

Catchment No. 6

The area of this catchment is 485.62 hectares. This is the largest catchment among the six. 65% of the area is less than 18^o and only 6% is more than 30^o. The dominant forest species are *E. regnans* and *E. obliqua*. Because of the size of the catchment, five rain gauges have been installed in the area.

No calibration analysis is possible for the immediate future because of shortage of man power in this section. This catchment has been examined by Assessment Section of the Forest Commission. It is suggested that this catchment, because of its size and the timber content can be used to examine the effects of logging operations, carried out in successive years on hydrologic properties in the future.

All the manual gauges were read by officers from the Forest Commission up to November 1980. Now all the gauges are read and serviced by officers from the Soil Conservation Authority. All the maintenance work is carried out by officers from hydrology section of SCA.

4.7 Soils

No soil survey work has been carried out in this experimental area. Under the recommendation of the Experimental Catchment Consultative Committee, a soil survey must be carried out prior to any treatment.

Summary of Results

The maximum temperature in summer is 39^o while the minimum in winter is -5^oC. The average wind speed is 1.92 km/hr.

The average annual rainfall for the area if 1,298 mm and the average amount of annual evaporation is 721.7 mm. The amount of soil moisture varies from 23.5% in the summer to 42% during the winter.

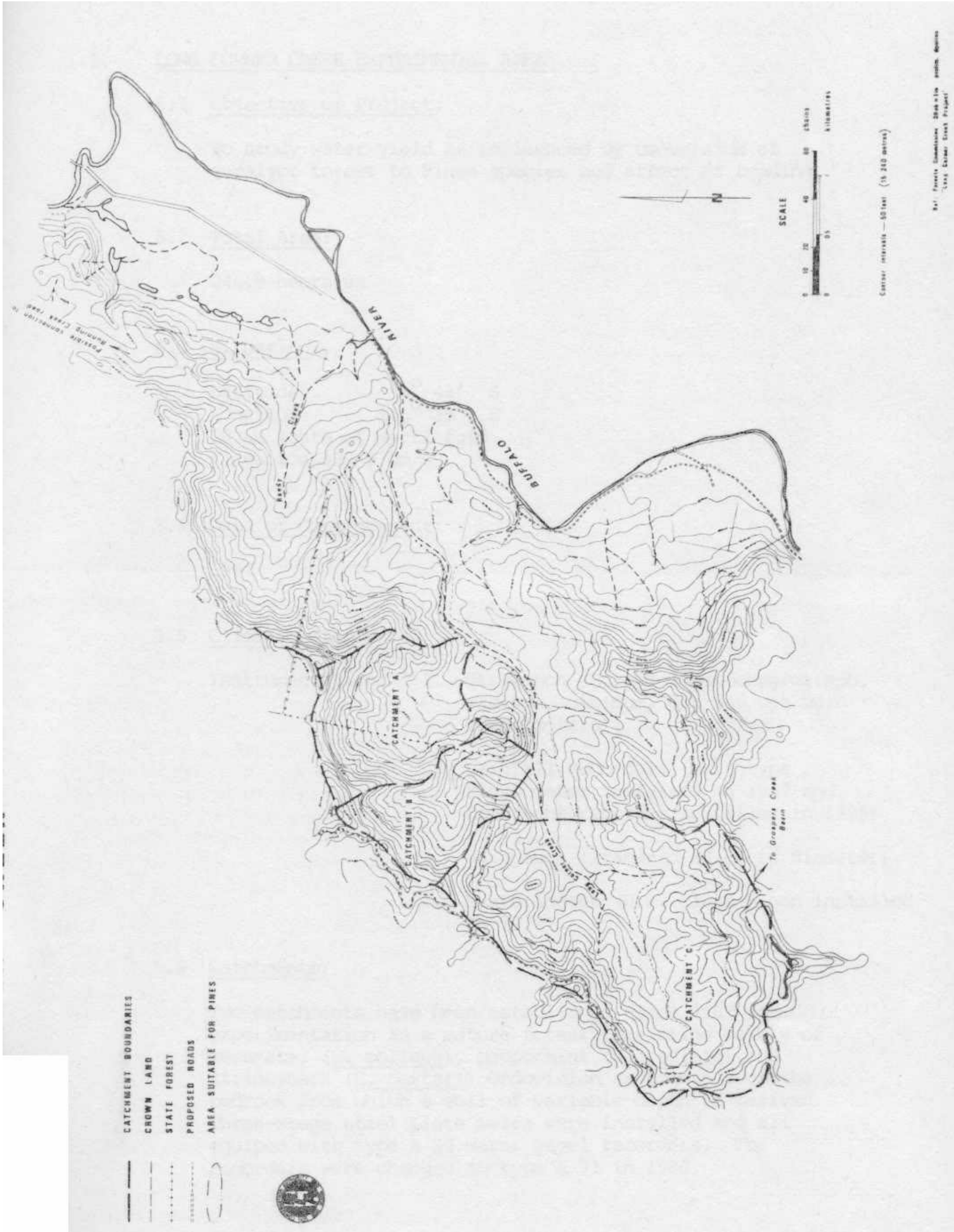
The amount of runoff varies from catchment to catchment. The amount of annual mean at catchment 1 is 187 mm while catchment 2 is 266 mm and catchment 3 and 4 are in between. Several characteristics related to runoff have been determined. They indicate that there is no single typical catchment and no major leakage from any of the four catchments. Runoff between the catchment is highly correlated. Correlation coefficients are above 0.98 for annual data, and above 0.97 for monthly data. A post-treatment change in annual runoff of 17% is detectable. Initial findings from a mathematical water balance model indicate that there are major difference in the hydrology of Mountain Ash and mixed species forests.

Further Studies

Reefton experimental area is typical of mixed species forest which constitutes approximately 45% of Melbourne water supply catchment, and which supplies approximately 20% of the water for Melbourne. It s the only experimental catchment in mixed species forests in the Melbourne water supply area; this project continues to provide basis information unavailable elsewhere. It is possible to impose treatments on the catchments 1, 2 and 3 as discussed in the catchments section. However, hydrology is only part of the catchment management. It is essential to have soil data before treatment in order to get a proper understanding of the mechanisms involved. In addition, it is important to impose the treatments without delay to minimize the cost of the project.

The Experimental Catchment Consultative Committee recommends that the following treatment strategy be adopted and implemented according to the time schedule given.

Catchment 1 – Fuel reduction burn in autumn 1982.
Catchment 2 – Roading and logging in summer 1982 or 1983.
Catchment 3 – Road construction in summer 1982 or 1983. It will be done at the same year as Catchment 2.
Catchment 4 – Control
Catchment 5 – Road construction in summer 1983 or 1984. Logging in summer 1984 or 1985.
Catchment 6 – No treatment proposed.



Long Corner Creek Project

5. Long Corner Creek Experimental Area

5.1 Objective of Project

To study water yield as influenced by conversion of eucalypt forest to Pinus species and effect of roading.

Total area

246.9 hectares

Situation

Latitude 36^{o} 41' S
Longitude 146^{o} 39' E
20 km south of Myrtleford
Elevation 330 – 670 m.

5.4 Date of Commencement

1967

5.5 Climatic Station

Instrumentation:

1. Stevenson Screen (thermohygrograph, maximum, minimum, dry and wet bulb thermometers).
2. Rainfall Recorders (Mort type Pluviometer installed in 1967 and Lambrecht recorder installed in 1975).
3. Rain gauge (standard 20 cm in diameter).
4. Evaporimeter (U.S. class A pan installed in 1979).

5.6 Catchments

Two catchments have been established since 1967 for experimentation in a mature forest consisting mainly of messmate, (E. obliqua), peppermint (E. radiata) and stringybark (E. baxteri). Ordovician sediments form the bedrock from which a soil of variable dept is derived. Three-stage steel plate weirs were installed and all equipped with type A.35 water level recorders. The recorders were changed to type A.71 in 1980.

Catchment A

The area of this catchment is 145.7 hectares. The streamflow is perennial. One rain gauge was installed in this area. Preliminary studies showed that the catchment yields a lot of sediment during the winter flow and the weir has to be cleaned every year during summer season while the flow is low.

Catchment B

The area of this catchment is 101.2 hectares. The streamflow is very low during the summer season and occasionally it ceases to flow. It is not physically noticeable whether any leak exists in this catchment. Sediment yield is very low therefore the weir can be cleaned once in every five years. Climatic station is near to this station.

All the manual gauges are read by officers from the Forest Commission at Myrtleford office and the maintenance of the equipment and weirs are carried out by officers from the hydrology section of the Soil Conservation Authority.

5.7 Soils

A preliminary soil survey was carried out in April 1981 by Mr D Hough. A report is expected soon.

5.8 Summary of Results

The maximum temperature in summer is 40^{o} C while the minimum in winter is -4^{o} C. The average temperature for the year is 13.5^{o} C. The hottest month falls in January with monthly average temperatures of 20.8^{o} C and the coldest month falls in July with monthly average temperature of 7.1^{o} C. The mean annual rainfall for the area if 1,232 mm and the average amount of annual evaporation is 826 mm.

Preliminary studies have shown that catchment A yields 50% more water than catchment B. The annual amount of runoff in 13 years average is 279.2 mm for catchment A and 175.1 mm for catchment B. The two catchments on runoffs are highly correlated to each other with a correlation coefficient equal to 0.95 for monthly data.

5.9 Further Studies

A joint field inspection had been made on the 4^{th} March 1981 with representatives from Forest Commission of Victoria and the Soil Conservation Authority.

It was agreed that either catchment would be suitable for conversion to pine trees. If every requirement, including the re-zoning of the area by Land Conservation Council, is fulfilled by the end of 1981, then the conversion can be carried out during the summer of 1982-83 or 1983-84. This depends on detailed recommendation to the Soil Conservation Authority made by Experimental Catchment Consultative Committee.

6. Contracts

In order to operation property the four sets of instrumented experimental catchments, - comprising nineteen catchments in all – about five professional officers and six non-professional officers are required, with access to computing and programming. Currently, only two professional officers and two non-professional officers are available, with only limited programming assistance. As a result, alternative arrangements have been made to carry out hydrological research on an ad hoc basis.

The following contracts were initiated by the hydrology section and approved by the Authority.

6.1 Rainfall – Runoff Model for the Parwan Experimental Area

This contract was entered with Caulfield Institute of Technology to employ a postgraduate student to carry out the project. USDA – SCS Curve Numbers Model was validated on Parwan Experimental data. This project was completed in June 1978. Further development on this model is required.

6.2 Some Hydrologic Effects of Land Use Changes at Stewarts Creek Experimental Area

This contract was entered with Monash University, Department of Civil Engineering. Initially the contract was paid by the Soil Conservation Authority. After the first progress report the Environmental Study Division of the Ministry for Conservation assisted the contract by providing some funds to Monash University. Owing to the difficulty in finding a comparable replacement for Dr E Tsykin (who took a permanent job in Western Australia in June 1980), this project has been temporarily discontinued. A report has been issued on this project.

6.3 Soil Survey for Long Corner Creek Experimental Area

This contract was entered with a private consultant – Dr D Hough. The objective is to obtain a soil survey to relate the characteristics of the experimental catchments to the measured hydrology before and after landuse change. A report is expected soon.

7. Research Project

7.1 Radiation Balance and Evapotranspiration in a Forest Area

This project was carried out by Dr Anthony Y. K. Wu. Funds were provided by Water Research Foundation of Australia. This project was completed and published in 1976.

7.2 The Soil Moisture characteristics of the Reefton Experimental Area and their hydrological significance

This project was carried out by Ms R. Belin as part of the requirements of Bachelor of Agriculture Science (Hons.) at LaTrobe University. Thesis published in 1978.

7.3 Sediment Relationship to Water Quantity at Reefton Experimental Area

This project is currently carried out by Ms A Spurritt as part of the requirements of Bachelor of Science (Hons.) at University of Melbourne. Thesis is expected to be completed by March 1982.

7.4 Understorey Vegetation of the Catchments and its relationship to the Tree Stratum and Site Characteristics

This project is currently carried out by Mr K Lavis a final year B. Agr. Sci. student at Latrobe University.

Appendix I – Publications

F X Dunin (1969) The infiltration component of a pastoral experimental catchment: Part 1.
J. Hydrol 7 1969 p. 121

F X Dunin (1969) The evapotranspiration component of a pastoral experimental catchment:
J. Hydrol 7 1969 p. 147

F X Dunin (1969) The infiltration component of a pastoral experimental catchment: Part 11
J. Hydrol 7 1969 p. 134

F X Dunin (1969) A model for rainfall during initial abstraction
J. Hydrol 9 1969 p. 57

F X Dunin (1970) Changes in water balance components with pasture management in south-eastern Australia
J. Hydrol 10 1970 p. 90

A Y K Wu (1971) An estimation of the amount of run-off by using precipitation and soil moisture data
Australian Soil Conservation Conferences, Melbourne, May 1971 pp. 19-22

A Y K Wu (1971) The effect of Covering an Evaporation Pan with Wire Netting
Weather Vo. 26 No. 1 1971

Soil Erosion and Conservation the Parwan Creek Catchment.
SCA Publication 1976 23 pp

A Y K Wu (1976) Radiation Balance and Evapotranspiration in a Forest Area
Report presented to Water Research Foundation of Australia (Project No. 70/187) 77 pp 1976.

J A Crane (1977) A Rainfall – Runoff Model for the Parwan Experimental Area
M.Sc. Thesis 144 pp
Caulfield Institute of Technology

R Belin (1978) The Soil Moisture Characteristics of the Reefton Experimental Area and their Hydrological significance
B.Sc.(Hons) Thesis 72 pp LaTrobe University

S Zallar, (1978) Some Effect of Grazing on the Hydrological properties of an
A Y K Wu Improved Pasture
The Institution of Engineers Australia Bational Conference Publication 78/8 p. 121-126.

Soil Erosion and Conservation in the Parwan Creek Catchment (Revised) 1979 24 pp
SCA Publication

Stewarts Creek Experimental Area
SCA Publication 1979 13 pp

A Y K Wu (1979) Wonderful Water Scan NO. 213, 1979, pp 35-40.

M P Papworth (1979) Rating Tables for Reefton Weirs Preliminary Report

E Tsykin (1979) Stewarts Creek Project for Soil Conservation Authority
Dept. of Civil Engineering Monash University, 1979, 20 pp

A Y K Wu (1979) Experimental Work in Catchment Hydrology
Victoria's Resources Vol. 21, No. 4, 1979, pp 12-13

A Y K Wu (1980) Parwan Hydrological Experimental Area
SCA Publication 1980, 23 pp.

MP Papworth (1980) Hydrology Report – Reefton Experimental Area November 1971 event

E Tsykin and EM Laurenson (1980) Some Hydrologic Effects of Landuse Changes at Stewarts Creek Experimental Area
Research Report Monash University 1980, 46 pp

A Y K Wu and MP Papworth (1981) Reefton Experimental Area First Progress Report (Pretreatment Calibration) 1981 21 pp.

D Hough (1981) Long Corner Creek Hydrologic Project Aspects of the Geology Physiograph
In Press

The Hydrological Experimental projects are listed in the Inventory of Water Resources Research in Australia and also listed in the Inventory of MAB field projects (Phase II) UESCCO as requested by those organizations.

Appendix II

Clients – to date

SCA – Farm Water Supply Catchment Section
SCA and Farmers
SCA – Catchment Section
Soil Conservation Service throughout Australia
Dandenong Valley Authority
Melbourne and Metropolitan Board of Works
State Rivers and Water Supply Commission
Forests Commission of Victoria
Commonwealth Bureau of Meteorology

Monash University	-	Mech. Engineering Dept
		Civil Engineering Dept
University of Melbourne	-	Geography Dept
		Agricultural Engineering
		School of Botany
		Forestry

La Trobe University
Caulfield Institute of Technology
Timber Mills in Victoria
CSIRO Plant Industry Canberra
Irrigation Research Institute
The Ballarat Water Commission
State Electricity of Victoria
Water Research Foundation of Australia

Australia Water Resource Council (Hydrological Research projects are on the list in the Inventory of Water Resources Research in Australia).

UNESCO (Hydrological Research projects are on the list in the Inventory of Man and Biosphere).

Schools throughout Victoria use Parwan Experimental Area as an educational areas.

The Creswick Forestry School.