WATER RESOURCES

OF THE

HASTINGS VALLEY

INCLUDING THE

STEWARTS AND CAMDEN HAVEN VALLEYS

SURVEY OF THIRTY N. S. W. RIVER VALLEYS

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WATER RESOURCES OF THE HASTINGS RIVER VALLEY

PREFACE

BY THE HON. J.G. BEALE, M.E., A.S.T.C. Mech. Eng.,

M.I.E. Aust. M.ASCE., M.A.S.M.E., M.A.S.A.E., M.L.A.

MINISTER FOR CONSERVATION

NEW SOUTH WALES

In accordance with the policy of the New South Wales Liberal-Country Party Government announced prior to its election to office at the May, 1965 State Elections, I directed the Water Conservation and Irrigation Commission to undertake a survey of the State's water resources on an individual valley basis to enable the formulation of a balanced and soundly based programme of water conservation.

The survey, which is the largest and most comprehensive study of its type ever undertaken in Australia, has recently been expanded to cover the Murray and Darling Basins in their entirety. It involves the preparation of twenty seven reports covering thirty two major river valleys in the State.

In the survey, studies are being made of the physiography, climate, groundwater potential and surface water resources of each valley. In addition to reviewing current water requirements, assessments are being undertaken of possible future water development.

Reports are being prepared progressively and those issued to date have covered sixteen major valleys and a number of minor valleys. This report on the water resources of the Hastings River Valley is the thirteenth to be issued.

JACK G. BEALE. M.L.A.

November, 1968.

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WATER RESOURCES OF THE HASTINGS RIVER VALLEY (INCLUDING THE STEWARTS AND CAMDEN HAVEN VALLEYS)

1. INTRODUCTION

A modern civilization makes huge demands on water for domestic, agricultural and industrial purposes. When it is realised that an average of about 300 tons of water is used in the production of a ton of steel and an average of 1,000 tons of water is required to produce a ton of food, it is apparent that water resources are a major factor influencing the development of any country.

Although there is an abundance of water on Earth, totalling more than 320 million cubic miles, only a very small proportion of it is in a form and location suitable or readily available for consumptive use.

By far the greatest part of this resource, 99.2 percent, is contained either in the oceans where it is too saline for use without expensive treatment or as ice in the polar regions where it is too remote from populated areas to be of any benefit. Underground water comprises over 99.5 percent of the remaining 0.8 percent and therefore the surface water contained in rivers and lakes, which is the most convenient source of supply for man's needs, amounts to only about 0.004 percent of the Earth's total water resources.

The gross water resources available are normally considered to be the amounts of rainfall and snow which fall on the land. Surface water resources represent the portions of rainfall and snow which eventually appear as streamflow and are therefore considerably less than the gross water resources.

Many countries are fortunate to have relatively abundant water resources. However Australia is the world's driest continent having an average rainfall of only about 1½ feet in comparison with averages of almost 4½ feet for South America and about 2 feet for North America, Africa, Asia and Europe.

Furthermore as none of the streams on the Australian mainland are permanently snow fed and as over about 70 percent of the Australian continent the average rainfall does not exceed the potential evaporation loss in any month of the year, the comparison of surface water resources is even more unfavourable.

The average annual surface water resources of the Australian mainland have been assessed at about 240 million acre feet which is equivalent to less than 2 inches of rainfall occurring without loss over the entire continent. The

corresponding average annual values for other continents are South America 19 inches, North America 11 inches, Asia and Europe 9 inches each and Africa 7 inches.

Australian rivers exhibit marked variability in flow with occasional flood flows and extended periods of very low flows. Records of streamflow in New South Wales indicate that most of the State's major streams have at some time either completely ceased flowing or else have been reduced to a small trickle. Consequently the conservation of surface water resources in New South Wales is a task of prime importance.

The average annual rainfall of the Hastings Valley, including the Stewarts and Camden Haven Valleys, is approximately 57 inches and the average annual surface water resources have been assessed at about 1,000,000 acre feet. On the basis of available water per square mile of catchment area, these resources are considerably greater than the averages for both Australia and New South Wales. However in common with the rest of the continent the surface water resources of the valley vary considerably from year to year.

2. PHYSIOGRAPHIC FEATURES.

For the purpose of this report the Hastings River Valley has been assumed to include the Stewarts and Camden Haven catchments which adjoin the south eastern section of the Hastings River catchment. The principal features and generalised land slopes of the valley are shown at Figures 1 and 2 respectively.

The valley embraces a total area of about 1,750 square miles of which about 300 square miles are drained by the Stewarts and Camden Haven Rivers (including the minor streams entering coastal lakes between Port Macquarie and Laurieton). It extends westward from the coast for a distance of about sixty miles to the eastern fringe of the New England Tablelands.

On the northern side of the valley, a well defined ridge which commences at Mount Beranghi, about three miles from the coast, separates the Hastings Valley from the adjoining Macleay Valley. Although Mount Beranghi is over 700 feet in elevation, the two valleys are connected near the coast, in the vicinity of Crescent Head, by a low lying coastal swamp which permits an exchange of water between the valleys during flood periods. This flow between the valleys may occur in either direction, depending on the relative flood levels in the two rivers.

Westward from Mount Beranghi, the northern boundary of the valley remains at a relatively low level for some miles. However in the vicinity of the headwaters of the Wilson River it commences to rise and at Mount Banda Banda and Spokes Hill the elevation is over 4,000 feet. The northern section of the valley has been deeply dissected by the northern tributaries of the Hastings River including the Wilson River, Pappinbarra Creek, and the Forbes River. Slopes are generally rugged (greater than 15 degrees) and the area is heavily forested.

The western boundary of the valley ranges in elevation from over 3,000 feet in the north, to about 2,000 feet in the south. Peaks rise above the general ridge level, the highest being Mount Rushbrook, at more than 3,900 feet. The western section of the valley has been deeply dissected by Fenwicks Creek Tobin's Creek and Doyles River and is characterised by steep ridges extending towards the coast. Mount Seaview, at an elevation of over 3,500 feet, is situated on one such ridge.

The southern boundary of the valley from near Mount Kaoaraoa to Mount Gibraltar is generally at about 2,000 feet above sea level, with isolated peaks rising to about 3,000 feet. In the vicinity of Comboyne and the headwaters of the Ellenborough River, plateau areas with fertile basaltic soils have been largely cleared of their original rain forest vegetation and are now used extensively for dairying.

The southern boundary of the valley, between Mount Gibraltar and South Brother divides the Camden Haven watershed from the Manning River tributaries and varies in elevation from about 500 to about 2,000 feet. East of South Brother, which has an elevation of about 1,600 feet, the boundary becomes ill defined in a complex of swamps and lagoons connecting the lower reaches of the Camden Haven system and the Manning.

The headwaters of the Stewarts and Camden Haven Rivers rise near Mount Gibraltar and are separated from the Thone River, a southern tributary of the Hastings River, by Broken Bago Range. This range varies in elevation from about 2,000 feet near the southern boundary of the valley to only about 300 feet above sea level a few miles south of Wauchope. Between Wauchope and the coast the Hastings River catchment is separated from the catchments of the Stewarts and Camden Haven Rivers and several minor streams draining into coastal lakes, by a ridge which is generally less than 500 feet above sea level.

Along the coastal section of the valley, south of the mouth of the Hastings River at Port Macquarie, there are several relatively large coastal lakes. It is into Watson Taylor's Lake near the southern boundary of the valley that the Stewarts and Camden Haven Rivers drain, this lake being connected to the South Pacific Ocean near Laurieton about 15 miles south of Port Macquarie.

The other coastal lakes in the area are Queen's Lake, Cathie Lake and Lake Innes. Queen's Lake, into which Heron's Creek drains, has the largest catchment area of the three lakes, extending west from the coast a distance of about 14 miles.

Low lying swampy terrain characterises much of the coastal fringe of the Hastings Valley being backed at intervals by extensive alluvial flats flanking the tidal sections of the rivers. Along the Hastings River itself, the flats extend upstream to about Wauchope, and are used mainly for intensive dairying. The Hastings River is tidal to about 3 miles above Wauchope, the Wilson River to about 4 miles above Telegraph Point, and the Camden Haven River to about 2 miles above Kendall.

Upstream of the alluvial flats the country can generally be grouped into two topographic zones which are transitional between the coastal plain and the tablelands. The first is the ridge and valley zone, which, on the Hastings, extends upstream to the vicinity of Long Flat. In this zone, the valley floors become progressively narrower and the separating ridges progressively steeper. The river flats are generally intensively farmed, with dairying the predominant industry while the ridges are used as a source of timber and for beef cattle grazing.

The second transitional zone, that of dissected uplands and escarpments, is characterised by steep or rugged slopes, with little alluvium along the stream channels. This zone is sparsely populated, and the only industries are beef cattle grazing and timber getting.

Table 1 gives a classification of land slopes in the Hastings Valley. Separate details are given for the Wilson and Camden Haven-Stewarts Rivers systems.

TABLE 1

Section of Valley	Land Slope Classification			
	Mostly Flat Slopes less than 3 degrees	Undulating to Hilly - Slopes from 3 to 8 degrees	Hilly to Steep Slopes from 8 to 15 degrees	Rugged or Mountainous Slopes Greater than 15 degrees
Wilson River	28%	25%	12%	35%
Camden Haven - Stewarts Rivers	28%	36%	26%	10%
Hastings River excluding Wilson and Camden Haven-Stewarts Systems	16%	19%	14%	51%
Total Hastings Valley	18%	20%	14%	48%

The original vegetation of the Hastings Valley has been largely cleared from the good quality flat and undulating land, which is now used for either cultivation or grazing. However, most of the steep areas are still forested, as also are the poorer soils. Timber getting is a major industry in the valley and much good quality hardwood and, to a lesser extent, softwood cabinet timber, is milled in the area.

Along the coastal strip, paper bark is the dominant species in the swampy areas and waterlogged sandy soils, while banksias, bloodwood, smooth bark apple, blackbutt, scribbly gum and other varieties occur on the sand dunes, and mangrove colonies line the estuaries. Further inland, river oak or flooded gum are found along the streams whilst in some higher areas rainforests have developed.

Eucalypt hardwood forest covers large areas of the undulating and rugged country, particularly on the soils derived from granites or sedimentary rocks. Sub-tropical rainforest originally covered most of the basalt derived soils and the protected areas with a southerly aspect.

3. CLIMATIC FEATURES

Rainfall

The drainage area of the Hastings River Valley is well watered. Annual median rainfalls over the valley exceed 45 inches with the exception of a minor area near Telegraph Point. (The median is that rainfall equalled or exceeded on 50 percent of occasions).

The highest annual rainfall occurs over the high ground in the southern section of the valley near Comboyne, where the annual median exceeds 65 inches. A relatively low rainfall area occurs over the western part of the coastal plain between Kempsey and Telegraph Point, where the annual median is less than 45 inches.

The distribution of annual median rainfalls over the Hastings Valley is shown at Figure 3, whilst the distributions of monthly median rainfalls are shown at Figures 4 to 15 inclusive.

The five months from December to April are relatively wet, receiving about 55 percent of the annual rainfall. On the coastal fringe the wet period generally extends until June. Monthly median rainfalls for the months December to April are greater than 5 inches per month over the higher rainfall areas. At some stations the median rainfalls are greater than 8 inches per month in this period.

The months July to November, which receive about 30 percent of the annual rainfall, are relatively dry; however monthly median rainfalls usually exceed 2 inches per month over most of the drainage area, and are greater than 4 inches over the higher rainfall areas in some of these months. August is usually the driest month when less than 4 percent of the annual rainfall is received on the average.

Monthly and annual rainfalls recorded at Comboyne, Kempsey West, Kendall, Laurieton, Moorland, Port Macquarie, Stewarts River, Telegraph Point, Wauchope and Wingham are given in Appendices 1 to 10 inclusive.

Very heavy rain may occur over the area usually when depressions are located off the northern New South Wales coast. Under these conditions totals of 8 inches in 24 hours are not uncommon. The highest total recorded in the catchment in a 24 hour period ending 9 a.m. is 17.65 inches on 29th April 1963 at Laurieton.

Very high monthly totals can occur at stations in the drainage area in any month of the year. Even in the drier months totals exceeding 10 inches have been recorded, while in the wetter months totals greater than 40 inches have been recorded at some stations. The highest monthly total on record for a station in the catchment is 48.55 inches at Comboyne in February 1929.

The tables at Appendix 11 show on a monthly and annual basis for Comboyne, Kempsey West, Kendall, Laurieton, Moorland, Port Macquarie,

Stewarts River, Telegraph Point, Wauchope and Wingham, the following data:

(i) the maximum and minimum rainfalls;

(ii) the 10th, 30th, 50th, 70th and 90th percentiles. (A rainfall observation less than the 10th percentile can be expected once in ten years on the average. Similarly a rainfall observation less than the 70th percentile can be expected on an average of seven times in ten years, or alternatively a rainfall observation greater than the 70th percentile can be expected on an average of three years in ten).

Although individual months may record very low totals on occasions, it is unusual for dry spells to persist for more than a few months particularly on the coast. In the five relatively dry months, July to November, at least 5½ inches are received on 90 percent of occasions. In the wet months December to April, at least 15 inches are received on 90 percent of occasions. The corresponding median values for the above periods are approximately 16 inches and 30 inches respectively.

Minimum recorded rainfalls at Comboyne, Kempsey West, Laurieton, Port Macquarie, Stewarts River and Wauchope are shown in the tables at Appendix 12. These tables indicate the minimum cumulative rainfalls, commencing in any month of the year, and continuing for up to twelve months, which have occurred at the selected stations.

Temperature

The temperature regime of the lower reaches of the Hastings Valley is adequately defined by records from Port Macquarie and Laurieton, shown in Tables 2 and 3, which are representative of locations on the seaboard. Inland, however, on the eastern slopes of the New England Tablelands, no temperature records are available.

Temperatures over the inland areas of the valley may be estimated by decreasing the averages shown for Laurieton by about 3°F for every thousand feet the areas are above sea level.

TABLE 2.

PORT MACQUARIE (Elevation 44 feet)

Average Temperature (°F) Based on 30 Years of Record

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Average Maximum	78.6	78.7	77.1	73.2	68.8	64.9	64.0	65.8	68.5	71.2	74.0	76.4	71.8
Average Minimum	64.4	64.3	61.8	56.8	50.8	46.3	44.8	45.4	49.2	54.8	59.8	62.5	55.0
Average Daily	71.5	71.5	69.4	65.0	59.8	55.6	54.4	55.6	58.9	63.0	66.5	69.4	63.4
Highest on Record 105.8						Lowest on Record 30.5							

TABLE 3.

LAURIETON (Elevation 25 feet)

Average Temperature (°F) Based on 16 Years of Record

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Average Maximum	77.8	77.8	75.6	72.0	66.1	62.3	61.1	63.1	67.0	71.6	74.4	76.2	70.4
Average Minimum	61.7	62.0	59.5	54.6	47.8	43.5	42.0	43.2	47.1	51.9	57.0	58.8	52.4
Average Daily	69.7	69.9	67.1	63.3	56.9	52.9	51.5	53.1	57.1	61.7	65.7	67.5	61.4
Highest on Record 100.0						Lowest on Record 22.0							

Warm to hot weather is experienced over the valley from October to April, with average maxima from the mid seventies to the mid eighties over the lower parts of the catchment away from the sea. Cooler conditions are experienced over the higher parts of the catchment and also on the coast where sea breezes occur. During the remainder of the year conditions are mainly cool to mild.

In the summer months very hot conditions can occur throughout the region when north westerly winds bring hot dry air from Central Australia. Temperatures exceeding 90°F occur frequently while temperatures exceeding 100°F occur on an average of about 3 days per year over the lower parts of the catchment, away from the coast.

Average winter minima are about 18 degrees cooler than the summer values. On occasions of clear skies and light winds very low overnight temperatures occur. Extreme minima as low as 22°F have been recorded away from the coast and it is expected that extreme temperatures lower than 18°F would occur over the higher parts of the tablelands forming the western boundary of the region.

Frosts.

Frosts on the coastal fringe are rare. However, inland from the coast over the lower parts of the region about four frosts per year are experienced on the average in the months of June, July and August. Although no information is available it is expected that about 40 frosts per year would be experienced over the higher parts of the ranges in the west of the region, in a season extending from April to October.

Sunshine.

Estimates of the average duration of bright sunshine in hours per day for the region are shown in Table 4. These estimates are based on cloud observations.

TABLE 4.

Average Duration of Sunshine in Hours per Day

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
8.9	7.9	7.3	6.8	6.4	6.3	6.8	7.4	8.0	8.1	8.3	8.7	7.6

Evaporation.

Estimates of average monthly and annual evaporation, from a sunken pan, together with estimates of the standard deviations are shown in Table 5 for the Hastings Valley.

TABLE 5.

Estimated Average Monthly and Annual Evaporation. in Inches for the Hastings Valley.

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Evaporation	5.3	3.4	3.3	2.4	2.4	1.7	1.4	2.4	3.0	4.3	4.8	5.5	39.9
Standard Deviation	0.6	0.6	0.6	0.4	0.4	0.4	0.4	0.4	0.5	0.6	0.9	0.8	3.6

Wind.

Strong winds occur over the Hastings Valley on occasions, in association with one of the following meteorological conditions:

(i) Strong east to south east winds associated with deep depressions off the northern New South Wales coast. These depressions often originate as tropical cyclones and may still be of cyclonic intensity when they affect the region. Wind speeds under these conditions may exceed 60 miles per hour on the coast but are somewhat less inland.

(ii) Violent squalls associated with severe local storms such as thunderstorms or frontal squalls. Gusts under these conditions can be of the order of 100 miles per hour.

Table 6 gives the extreme wind gusts likely to be experienced at a point in the catchment for various return periods.

TABLE 6.

Estimated Extreme Wind Gusts to be Expected with Given Return Periods.

Return Period (Years)	10	20	50	100
Wind Gust Equalled or Exceeded (Miles per hour)	90	95	105	110

4. GROUNDWATER POTENTIAL.

The geological formations in the Hastings Valley as indicated by available information are shown at Figure 16.

Silurian metamorphic rocks occupy the western part of the valley, where they outcrop in a meridional belt which forms the boundary between the Hastings and the adjoining Macleay and Manning Valleys to the west. These strata also outcrop to the west and south-west of Port Macquarie, where they are associated with intrusions of serpentine. The most common rock types are slates, phyllites, quartzites and greywackes.

Devonian strata, which are largely undifferentiated, form an east-west zone on the southern side of the Hastings River, whilst conglomerates, tuffs, sandstones and mudstones of Carboniferous age outcrop over the greater part of the valley. Overlying this marine sequence is a similar group of rocks of Permian age, the main outcrop of which occupies a meridionally disposed zone between Mooraback Creek and the Forbes River. Like the Carboniferous sediments, the Permian rocks contain boulders called "erratics" as well as striated and faceted pebbles which indicate a fluvio-glacial origin for some of the beds.

Some minor granitic intrusions occur in the Carboniferous strata north of the main river, and at the junction of the Devonian and Silurian systems. The age of these intrusions is believed to be late Permian, and they are regarded as offshoots of the main New England Batholith.

To the south of Wauchope there is an extensive area which is underlain by Triassic strata which include a coarse basalt conglomerate and a sequence of sandstones and shales. These sediments which are believed to be of fresh water continental origin, occupy most of the catchments of the Camden Haven and Stewarts Rivers.

Widespread flows of Tertiary basalt overlie the Triassic strata in the vicinity of Kendall and Laurieton. The Comboyne Plateau is underlain by basalt, and there are extensive cappings on the northern boundary where the Wilson River has its source, and in the elevated western part of the valley.

The upstream sections of the Hastings River and its tributaries, the Wilson, Camden Haven and Stewarts Rivers are in an active state of erosion whilst the rivers coming from the south off the Comboyne Plateau are characterised by high waterfalls and flow mostly on the country rock although a bed load of basaltic gravels and boulders is common.

In contrast, the streams rising in the north have relatively gentle gradients, the development of occasional small pockets of alluvium comprised of a variety of rock types reflecting the greater diversity of strata in their catchments.

Fluviatile alluvium occurs as narrow discontinuous flats along the middle reaches of some of the streams and forms quite extensive terraces from a point about a mile upstream of Wauchope to the southern end of Rawdon Island, where an outcrop of Carboniferous tuffs forms a rock barrier across the valley.

Downstream of the barrier, the flood plain broadens and the alluvial material is essentially of estuarine origin, consisting of silts, muds and clays in contrast to the silts, sands and gravels of the fluviatile deposits.

Whilst the Hastings River now flows into the sea at Port Macquarie, there is evidence suggesting that in geologically recent times its mouth was further north near Big Hill. Most of the area between the present river course and the Maria River and the coast, is comprised of peaty low-lying swamps, raised beaches and wind blown dune sands.

It is convenient to discuss the groundwater potential of this valley under three main classifications based on the mode of occurrence of the groundwater and the nature of the strata in which it is stored. These classifications are: Jointed Rocks, which although themselves impervious, may contain water in cracks, joints and partings; Porous Rocks, usually

sandstones, which contain water in the openings between the cemented sand grains and Unconsolidated Deposits, in which water may be held in sands or gravels associated with alluvial material, or in accumulations of aeolian and beach sands near the coastline.

In the Hastings Valley groundwater is utilised fairly extensively for watering stock, whilst near Wauchope some 300 acres are being irrigated from wells in the alluvium. However, there are fewer than 50 licensed bores and wells in the area, and the demand for underground supplies is limited because of the permanence of most streams.

Jointed Rocks.

The rocks in this group include all those belonging to the Silurian, Devonian, Carboniferous and Permian systems as well as the igneous rocks. The rock types vary from metamorphics such as slates and quartzites, through slightly altered and indurated sediments to granites, basalts and tuffs.

The water bearing potential of this group is very variable and depends on many factors, including rock type, the elevation and relief at the bore site, the amount and distribution of rainfall and the ability of the rain to percolate downwards through the varying soils which the local environment has produced.

The oldest and most altered rocks in the valley are the Silurian metamorphics and volcanics which include slates, greywackes, quartzites, sandstones, tuffs and interbedded volcanics. Typically, the more competent of these strata are heavily jointed, and the best groundwater potential can be expected from such rocks as quartzites, greywackes, tuffs and the interbedded volcanics.

There are no records of bores in these strata, but it is expected that small but useful supplies for stock would be obtainable within a depth of 100 feet from bores sited to take advantage of local conditions. Water quality is likely to be similar to that reported from other areas underlain by similar strata and have a Total Salinity of less than 100 parts per hundred thousand, with a Hardness in excess of 10 parts per hundred thousand.

Available information indicates that the Devonian strata, which are essentially of marine origin, are also untested. However it is anticipated that although supplies similar to those from the Silurian rocks could well be available, the salinity of any groundwater would be higher than 100 parts per

hundred thousand generally and even considerably higher in some instances.

Neither the Carboniferous nor the Permian strata are expected to provide other than stock supplies except in occasional specially favourable conditions. Although both groups of rocks include sandstones, most of these would be strongly cemented and often indurated, and there is little prospect of them retaining their original porosity or permeability.

The outcrops of granite are of relatively small extent and, based on past experience, boring in them would be speculative, and supplies in excess of 150 to 200 gallons per hour would be unlikely.

The most reliable water bearing rocks in this subdivision are the Tertiary basalts. Their capacity to receive and store water results from variations within the various igneous flows, both as regards the actual lava type and the surface conditions at the time of each extrusion. There is evidence to show that not only were there a number of widespread extrusions of basalt, but in some instances there was sufficient time between successive flows to permit weathering of the basalt into soil. Variations in the lava types include columnar and vesicular (honeycomb) basalt, and where the areal extent and thickness of the basalts are large, they may provide significant underground reservoir capacity.

Local conditions influence the depth at which useful supplies of water may be obtained from basalts. Sources include springs large enough to maintain the flow in creeks such as occur at the edge of the Comboyne Plateau; wells capable of yielding valuable supplies for stock, domestic and garden use from depths as small as 5 or 6 feet; and bores, sometimes more than 200 feet deep, which may yield more than 1,000 gallons per hour.

The water obtained from basalts is characteristically hard, but the saline content is usually well below 100 parts per hundred thousand. Softening is usually necessary if the water is to be used domestically in hot water systems or for washing.

Porous Rocks.

Little is known of the nature of the Triassic strata which underlie most of the catchments of the headwater streams in the Camden Haven and Stewarts River Valleys. However it seems reasonable to expect some degree of porosity and permeability in the sandstone strata, and therefore bores are likely to produce sufficient water for stock and domestic use. Because of their terrestrial origin,

the salinity of any groundwater obtained from these strata is expected to be low, probably less than 100 parts per hundred thousand.

Unconsolidated Deposits.

The Hastings River and most of its tributaries have steep gradients over the greater part of their courses with the result that there has not been any significant accumulations of alluvium in their upper and middle reaches. Over most of their courses the streams appear to be actively eroding their valleys and to be still in a youthful stage of development. There are some bed-load sands and gravels present in the beds of the tributaries and the main stream and it is not unusual for landholders with licenses to irrigate from the streams by pumping from excavations in the highly permeable bed-load, rather than from the actual streams.

Some three miles upstream of Wauchope the occasional narrow, discontinuous alluvial terrace gives way to a broad continuous area of fluviatile alluvium extending downstream to the rock barrier of Carboniferous tuffs on Rawdon Island, which appears to mark the limit of deposition of shallow fluviatile sands and gravels.

The surface of this fluviatile alluvial material is generally flat, but it is intersected by a number of flood channels, and there are some low lying swampy areas near the extremities of the flats. There appears to be a relationship between the relatively minor variations in surface level and the nature of the underlying material and its capacity to yield useful supplies of groundwater. The best sands and gravels are encountered in the higher areas whilst beneath the swampy areas only fine sands, silts and clays have been penetrated by test borings. The more permeable deposits have apparently been laid down during periods of high flooding in the form of broad natural levees, as is the case in other coastal valleys.

Test bores at Wauchope in connection with construction of the railway bridge, established the presence of coarse gravels from 20 to 42 feet. The greatest depth to bedrock was 50 feet, but it is of interest that the deeper gravels and boulders are described as being "cemented" with hard clay, whilst the upper 10 or 20 feet appear to be relatively free from clay. It is from these shallower gravels and boulders that the best yields of groundwater are obtained.

Throughout this area there are numerous wells producing stock and domestic supplies, and in the vicinity of Wauchope and for several miles upstream and downstream of the town, wells yielding useful irrigation supplies are quite common. Yields of 6,000 to 10,000 gallons per hour are usual, the best recorded yield being 16,000 gallons per hour. Most wells are between 20 and 30 feet deep and, provided they are continued through the first 2 or 3 feet of gravel (which is often unstable because of the presence of fine sand) into the coarser material beneath, reliable supplies are usually obtainable.

The quality of the water from the high yielding wells is consistently good, a typical analysis being; Total Salinity 28 parts per hundred thousand; Total Alkalinity (as sodium carbonate) 9 parts per hundred thousand; Hardness (as calcium carbonate) 13 parts per hundred thousand; Chlorides (as sodium chloride) 18 parts per hundred thousand and pH 6.6.

In the swampy areas and near the side slopes there is a noticeable deterioration in the water quality. However the salinity is rarely too high for the water to be used on plant life, although the yields are inadequate for irrigation.

Downstream of Wauchope there is a gradual decrease in the thickness and areal distribution of the shallow gravels, and there is evidence, in the form of black muds and shelly layers, that estuarine conditions have prevailed from time to time. The prospects of obtaining supplies of groundwater suitable for irrigation decline with the onset of the estuarine environment.

From the rock barrier at Rawdon Island to the coast no shallow gravels have been recorded. The country is low lying, often swampy and usually poorly drained, much of it being only a few feet above sea level. As a result of this environment connate salt is present in most of the sediments, and it is not surprising that virtually all groundwater occurring at depths greater than 25 feet or thereabouts is too saline for even stock watering. Lenses of better quality water have been developed at shallow depths in some areas as a result of either direct infiltration of rainfall, concentration of run-off from local catchments on the side slopes, or flooding.

The best supplies of groundwater are obtained from the levees, which have been built up by floodwaters spilling over the flats and depositing sand and silt under virtually freshwater conditions. Wells and spearpoints located on the levees normally yield useful supplies of good quality water from depths

less than 25 feet. Yields of several hundred gallons per hour are usual, but some wells have produced as much as 2,000 gallons per hour. However as these wells may be located quite close to the banks of streams which are normally brackish, depletion of the rather limited underground storages during dry periods may result in the intrusion of poorer quality waters from the river or from the underlying estuarine alluvium. The possibility of this occurrence is supported by the recorded variation in static water levels in some wells in the levees, in keeping with the periodicity of the tides.

Profiles of test bores which have been constructed with a view to determining the nature of the alluvium and the depth to bedrock for both railway and road bridges have recorded partially consolidated gravels and boulders or "conglomerate" in the deeper bores, immediately above bedrock even though they are spread over a wide area. Alluvial strata in the shallower parts of the profiles were of estuarine or fluviatile origin as would be expected from surface conditions, but the consistent reporting of a semi-consolidated deposit of gravels and boulders suggests either the presence of conglomerates marking an ancient shore line or more likely, the presence of remnants of Tertiary fluviatile beds.

Behind the beaches forming the present coastline there are extensive sand beds, which extend from the mouth of the Hastings River, northwards to Crescent Head. Considerable areas of these sandbeds are low lying and swampy and are inundated during big tides. As there are also many tidal inlets in which the water is nearly always brackish or salty, the combined effect is to break up the otherwise quite extensive area underlain by the sands into small pockets where conditions favour the storage of good quality groundwater. Because of the small size of these favourable areas the potential of these supplies is limited by the likelihood of intrusion of brackish or saline waters from the adjacent low-lying areas.

Although it is possible to extract useful supplies from localised areas, the overall potential of the coastal sandbeds in the Hastings Valley is considered to be much poorer than those associated with other major coastal rivers.

The distribution of Unconsolidated Deposits in the Stewarts and Camden Haven River catchments is similar although somewhat reduced in scale, to that described for the Hastings River catchment. However, because of the somewhat

low gradients in the middle reaches of these streams there is a relatively greater development of narrow alluvial flats of fluviatile origin. The flats are not large enough to provide significant areas with good groundwater potential, but it should be possible to obtain useful stock and domestic supplies, and possibly limited irrigation supplies, from suitably located wells.

Conditions in the flood plains and in the areas of beach sands in the Stewarts and Camden Haven River Valleys are essentially the same as those on the larger coastal rivers, and although supplies of local importance may be obtained from the beach sands, these sands do not represent a major potential source of good quality groundwater.

5. STREAM GAUGING STATIONS

Streamflow is the residual of precipitation which appears in stream channels after losses due to evaporation, transpiration and deep seepage have occurred. It is generally the major consideration in both the engineering and economic aspects of schemes concerned with irrigation, hydro-electric power generation or town or commercial water supply.

Despite intensive research, no reliable method has yet been devised to estimate streamflows from rainfall and other meteorological data in the absence of any streamflow information although various approximate methods are used to extend streamflow records using concurrent streamflow and rainfall information. Streamflow measurement is therefore the most essential element for the proper appraisal of proposals to utilize surface water resources.

Records of streamflow are obtained by establishing gauging stations, where stream heights are recorded either periodically by visual observation of the water level on a staff gauge, or continuously by an automatic recording instrument.

A number of gaugings or actual measurements of flow, are necessary to calibrate a gauging station. These gaugings involve measurement of the waterway area of the stream and flow velocities at a number of points across the channel. When sufficient gaugings have been obtained, a calibration for the station can be derived, and the flow corresponding to any gauge height estimated. As the regimen of most streams is subject to occasional variation, it is generally necessary to continue gauging measurements throughout the period

of operation of the gauging station. Using the recorded stream heights and a calibration between stream height and streamflow, continuous records of the flow at the gauging station are derived.

The units commonly used in the measurement of streamflows are cusec and acre foot. "Cusec" is an abbreviation of "cubic foot per second", and is a unit of measurement of the rate of flow. One cusec is approximately equal to 374 gallons per minute. "Acre foot" is a unit of measurement of volume. One acre foot of water is the volume which would cover an area of one acre to a uniform depth of one foot, and is approximately 270,000 gallons. A flow of one cusec discharges a volume of approximately two acre feet in a period of twenty four hours.

The first stream gauging station in the Hastings River Valley was installed in 1918 on the Ellenborough River at Elands for the purpose of assessing the hydro-electric power generation potential of the Ellenborough Falls. However the station was discontinued in the depression year of 1931 due to lack of funds for its operation. In 1936 two new stations, Ellenborough River at Glenwarren and Big Creek at Elands, were established in replacement of the original station on the Ellenborough River at Elands and were operated until 1961 when it was decided that adequate data had been obtained.

The next station to be installed was at Ellenborough (originally named Kindee Bridge) on the Hastings River, in 1945. Additional stations have since been established, and at the present time three stations, all equipped with pressure actuated recorders, are being operated in the valley. Details of current and discontinued gauging stations in the valley are given at Table 7 whilst their locations are shown at Figure 17.

TABLE 7.

Stream	Station	Catchment Area in Square Miles	Type of Gauge	Period of Operation
Hastings River	Yarras*	230	Staff gauge	1955 to 1961
Forbes River	Birdwood	140	Pressure recorder	1955 to date
Ellenborough River	Glenwarren*	27	Pressure recorder	1936 to 1961
Big Creek	Elands*	3.5	Pressure recorder	1936 to 1961
Ellenborough River	Elands*	31	Staff gauge	1918 to 1931
Ellenborough River	Ellenborough	205	Pressure recorder	1964 to date
Hastings River	Ellenborough	620	Pressure recorder	1945 to date

* Discontinued station.

The density of the present gauging station network in the valley is 1.7 stations per thousand square miles which may be compared with the present approximate densities of 0.5 stations per thousand square miles for Australia and less than 3 stations per thousand square miles for the United States of America.

The stations at present installed measure the runoff from over 600 square miles, or about one third of the whole valley. Recent field surveys have shown that it would be possible to instal additional gauging stations to measure the runoff from about three quarters of the valley, but in the remainder of the valley where streams are subject to tidal influence some difficulty would arise in the accurate measurement of streamflow on a continuing basis.

It is currently proposed to expand the existing stream gauging network in the valley by the installation of an additional seven gauging stations, of which two would be on the Camden Haven - Stewarts Rivers system and five would be on the Hastings River and its tributaries. In addition, it is intended to improve the standard of recording at two key stations in the valley by the installation of long term automatic recorders and plans for this work should be completed in the near future.

The ultimate coverage to be provided will result in a network density of nearly 6 stations per 1,000 square miles and should provide sufficient data for the appraisal of future water conservation or utilisation schemes in the valley.

6. CATCHMENT YIELDS.

The water yield of a catchment is related to many factors the main ones being precipitation, vegetation, topography, geology and area of catchment. As the relationship between these factors and water yield is extremely complex, it is the continuous measurement of streamflow at stream gauging stations which provides the basic information for determination of water yield within a valley.

Relatively long periods of streamflow records are available for several stream gauging stations in the Hastings Valley. Those for which more than fifteen complete years of records have been obtained are the now discontinued stations on Big Creek at Elands and the Ellenborough River at Glenwarren (each 24 years) and the currently operated station on the Hastings River at Ellenborough (18 years).

The yields at selected existing and discontinued stream gauging stations in the Hastings Valley, in terms of average flow over the complete years of computed record are shown at Table 8 together with the number of years on which the averages are based. Stations for which averages are not given are those where either the period of record is too short for the averages to have any significance, or where insufficient information is available concerning stream heights.

TABLE 8.

Stream	Station	Catchment Area (Square Miles)	Complete Years of Computed Record	Average Yield over Period of Complete Years of Computed Record		
				Acre Feet per Annum	Cusecs	Gallons per Minute
Forbes River	Birdwood	140	11	180,000	247	92,000
Ellenborough River	Glenwarren*	27	24	40,800	56	21,000
Big Creek	Elands*	3.5	24	7,700	11	4,100
Ellenborough River	Elands*	31	11	90,000	123	46,000
Hastings River	Ellenborough	620	21	647,000	886	331,000

* Discontinued Station

Details of maximum, minimum and mean discharge for each month of record for the stations listed in Table 8 are given at Appendices 13 to 17 inclusive.

7. AVERAGE ANNUAL RUNOFF.

In order to derive an estimate of the long term average annual runoff of the Hastings Valley, streamflow records at the gauging stations in the valley have been correlated with streamflow records in the Clarence River Valley which are available from 1909. On this basis, the long term average annual runoff of the Hastings Valley including the Camden Haven and Stewarts Valleys has been assessed as being of the order of 1,000,000 acre feet, which is equivalent to a continuous rate of flow of about 1,370 cusecs or 510,000 gallons per minute.

On a square mile of catchment area basis, these surface water resources are about one and a half times the average for Coastal New South Wales and almost six times the average for Australia.

The volume of average annual runoff of the valley represents approximately 19 percent of its average annual rainfall. In Table 9, a dissection is given of the long term average annual runoff into the averages for the Hastings River catchment and for the Stewarts - Camden Haven Rivers system (including the minor coastal catchments between Laurieton and Port Macquarie). A comparison is also made with the adjacent Macleay Valley.

TABLE 9.

Catchment	Area in Square Miles	Long Term Average Annual Runoff		
		Acre Feet	Acre Feet Per Square Mile	Percentage Runoff
Hastings River	1,450	850,000	590	19%
Stewarts-Camden Haven Rivers (including minor coastal streams)	300	150,000	500	16%
Hastings Valley (including Stewarts and Camden Haven Rivers and minor coastal streams)	1,750	1,000,000	570	19%
Macleay Valley	4,340	1,500,000	350	17%

Although the Hastings and Macleay Valleys have a similar percentage runoff, the Hastings Valley has considerably higher runoff per square mile than the larger Macleay Valley. This result can be attributed to the higher rainfall of the Hastings Valley and the fact that runoffs per square mile usually decrease with an increase in catchment area.

8. VARIABILITY OF STREAMFLOWS.

Records of streamflow in the Hastings Valley indicate a high degree of variability in the valley's surface water resources. Furthermore, as the longest period of record at any of the stream gauging stations in the valley is only 26 years, it is likely that the variability will become more marked as the period of available data increases.

Over a period of 21 complete years of record the annual flow of the Hastings River at Ellenborough has varied from about 16 percent to about 260 percent of the average of 647,000 acre feet per annum. The variation of the recorded annual flows at this gauging station is shown at Figure 18.

Even greater variations in annual flow have been recorded at the gauging stations on the tributary streams. At Birdwood on the Forbes River the variation in recorded annual flow has ranged from about 12 percent to about 290 percent of the average of 180,000 acre feet per annum.

On a monthly basis the variability is more marked. The monthly flow of the Hastings River at Ellenborough has varied from about one hundredth to almost ten times the monthly average while a variation of from about one fiftieth to about twelve times the monthly average has been recorded at the gauging station on the Forbes River at Birdwood.

A comparison of the monthly streamflow variations of the stream gauging stations on the Hastings River at Ellenborough and the Forbes River at Birdwood is shown at Figure 19 whilst the monthly streamflow variations for the stations on the Ellenborough River at Glenwarren and Big Creek at Elands are shown at Figure 20. These Figures illustrate the high degree of variability, both in magnitude and sequence, of streamflows in the valley and do not indicate any regular periodic cycles of runoff.

The valley generally experiences its lowest monthly rainfall in either August or September and its highest monthly rainfall in February. A comparison of the average monthly rainfalls at Comboyne and Port Macquarie is shown at Figure 21.

The distribution of average monthly streamflows is similar to the distribution of average monthly rainfall over the valley, being generally lowest in September and October. The average monthly streamflows recorded at the gauging station on the Hastings River at Ellenborough over the period since 1945 is shown at Figure 22.

At the station on the Hastings River at Ellenborough the highest average monthly flow occurs in March whilst the lowest occurs in October, the ratio of the maximum to minimum mean monthly flow being about six to one. Whilst the records indicate that the average discharge for the month of February tends to be lower than expected from the rainfall pattern, this minor variation is attributed to the relatively short period of streamflow records in relation to rainfall records.

As mean monthly discharges are computed by averaging daily and instantaneous flows over the month, the variability of instantaneous flows is always greater than the variability of monthly flows. An indication of the extreme variability of instantaneous flows in the valley may be obtained from the following Table 10, which shows the recorded maximum, minimum and mean flows at selected gauging stations.

TABLE 10

Stream	Station	Period of Record	Recorded Flows		
			Maximum Instantaneous	Minimum Instantaneous	Mean Daily
Forbes River	Birdwood	July 1955 to date	23,000 cusecs (8,600,000 gpm)	1.6 cusecs (600 gpm)	247 cusecs (92,000 gpm)
Ellenborough River	Glenwarren	September 1936 to September 1961	12,300 cusecs (4,610,000 gpm)	2.8 cusecs (1,050 gpm)	56 cusecs (21,000 gpm)
Big Creek	Elands	September 1936 to September 1961	4,900 cusecs (1,840,000 gpm)	0.2 cusecs (75 gpm)	11 cusecs (4,100 gpm)
Ellenborough River	Elands	May 1918 to August 1931	8,600 cusecs (3,230,000 gpm)	0.8 cusecs (300 gpm)	123 cusecs (46,000 gpm)
Hastings River	Ellenborough	October 1945 to date	170,000 cusecs (63,600,000 gpm)	6 cusecs (2,250 gpm)	886 cusecs (331,000 gpm)

9. PERSISTENCE OF STREAMFLOWS

Records for the existing and discontinued stream gauging stations in the Hastings Valley indicate that the valley has a relatively high groundwater flow which is able to sustain flow in the stream channels for extended periods of time after the cessation of rainfall.

An indication of the persistence of dry weather flows in the valley may be gained from the flow duration graphs at Figures 23 to 25 inclusive for the gauging stations on the Forbes River at Birdwood, Hastings River at Ellenborough and Big Creek at Elands respectively. These graphs indicate that although flows at the stations have on occasions been reduced to very low values, flow has not ceased at any stage during the periods of record.

A summary of the flow duration characteristics at the three stations is given in Table 11.

TABLE 11

Percent of Time Flow Equalled or Exceeded	Corresponding Flows					
	Hastings River at Ellenborough		Forbes River at Birdwood		Big Creek at Elands	
	Cusecs	Gallons/ Minute	Cusecs	Gallons/ Minute	Cusecs	Gallons/ Minute
10%	1,520	569,000	500	187,000	16	6,000
30%	530	198,000	140	52,500	5	1,900
50%	240	90,000	65	24,300	3	1,120
70%	120	45,000	33	12,400	2	750
90%	55	20,600	13	4,900	1	375
95%	20	7,500	9	3,400		
99%	10	3,700	2	750		
100%	6	2,250	1.6	600	0.2	75

Whilst the flow duration curves shown at Figures 23 to 25 inclusive indicate the frequency of various flows at the particular stations, they do not readily permit comparisons to be made of the relative flow duration characteristics of the various sub-catchments in the valley.

To enable these comparisons to be made, the flow duration curves for the three stations have been replotted in the form of flow per square mile of catchment area and are shown at Figure 26. The curves at Figure 26 indicate that of the three stations considered, Big Creek at Elands has the best low flow persistence characteristics.

10. OCCURRENCE OF FLOODING

In the Hastings Valley the major damage arising from flooding is generally restricted to the section of the valley eastward from Wauchope. In this area the major centres of population in the valley are situated and extensive areas of low lying land occur. Elsewhere in the valley flood damage is mainly confined to roads, communications and fencing.

The most downstream location on the Hastings River for which reasonably long records of flood heights or flood flows are available, is the gauging station at Ellenborough near Kindee Bridge. This station which was established in September 1945 is situated about 1½ miles downstream of the junction of the Hastings and Ellenborough Rivers.

From 1945 to January 1968 a total of twenty five floods reaching peak discharges equal to or greater than 20,000 cusecs have been recorded at Ellenborough. In this period floods have occurred more frequently in March than in any other month of the year whilst no floods have been recorded as occurring in the spring months of September and October. The monthly distribution of recorded floods with peak discharges equal to or in excess of 20,000 cusecs in the Hastings River at Ellenborough since 1945 is shown in Table 12.

TABLE 12

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
3	3	5	2	2	4	1	3	0	0	1	1	25

A diagram indicating the magnitude and occurrence of floods in the Hastings River at Ellenborough with peak discharges equal to or greater than 20,000 cusecs over the period of computed records since September 1945 is given at Figure 27.

The highest flood on the Hastings River at Ellenborough since 1945 occurred in January 1968. The peak flow at Ellenborough in this flood has tentatively been estimated at about 170,000 cusecs.

The next highest flood flow recorded at the gauging station on the Hastings River at Ellenborough occurred in April 1962 when the peak flow was estimated at 69,000 cusecs. Other major floods recorded at this station occurred in February 1954 and April 1963 when the peak flows were estimated at 65,500 cusecs and 61,000 cusecs respectively.

Details of the highest recorded flood flows at selected gauging stations in the valley are given in Table 13.

TABLE 13

Stream	Station	Catchment Area (Square Miles)	Highest Recorded Flood Flow		
			Date of Occurrence	Estimated Peak Flow	
				Cusecs	Cusecs Per Square Mile
Forbes River	Birdwood	140	January 1968	23,000	164
Ellenborough River	Glenwarren *	27	February 1956	12,300	450
Big Creek	Elands *	3.5	February 1956	4,900	1,400
Hastings River	Ellenborough	620	January 1968	170,000	274

* Discontinued stations

Table 13 indicates that the gauging station on Big Creek at Elands, which has a catchment area considerably less than any of the other three stations, has recorded the highest runoff per square mile.

Substantial rises occurred in all streams between the Hastings and Tweed Valleys in June 1967 as a result of heavy rain associated with a tropical depression. In the Hastings Valley, flooding was of a relatively minor nature with the Hastings River at Ellenborough reaching a peak flow of 38,500 cusecs on 13th June 1967. Records show that this flow has been exceeded on about ten occasions since 1945.

The January 1968 Flood

In January 1968 parts of southern Queensland and the northern regions of New South Wales experienced extremely high rainfalls as a result of the intrusion and intensification of a trough of low pressure air over southern Queensland.

In the Hastings Valley, the flood rains were heaviest in the south eastern section of the valley. At Comboyne the monthly total of more than 25 inches is the second highest recorded January rainfall since commencement of records in 1906, being exceeded only in 1951 when more than 27 inches were registered.

The heaviest rainfalls occurred during the two day period 12th and 13th January, Comboyne receiving in excess of 12 inches in the 24 hour period to 9.00 a.m. on 13th January. As a result of the general heavy rainfalls, substantial rises in river levels occurred in all streams in the Hastings Valley.

At Ellenborough, the Hastings River reached its peak level on 13th January when a height of 41ft. 3ins. was recorded. This is the highest flood level which has been recorded at this station since the commencement of records in September 1945 and the peak discharge of about 170,000 cusecs is equivalent to about 274 cusecs per square mile of catchment area.

The peak flows of the Forbes River at Birdwood and the Ellenborough River at Ellenborough were also the highest on record since the establishment of the stations in July 1955 and August 1964 respectively.

At Birdwood the peak discharge of 23,000 cusecs was about 2,800 cusecs higher than the previous maximum of 20,200 cusecs which occurred in November 1959 and represents a flow of 164 cusecs per square mile of catchment area. On the Ellenborough River at Ellenborough, the peak flow was about 70,000 cusecs or about 292 cusecs per square mile of catchment area.

11. DROUGHT PERIODS

The term "drought" is often used to describe a period when soil moisture is inadequate for the requirements of most pastures and crops and there is a shortage of supply for domestic, industrial or stock watering purposes. Below average precipitation and a diminished or exhausted rate of streamflow are normally the prime indicators of drought conditions in a valley.

The annual rainfalls recorded at Port Macquarie and Kempsey and at Comboyne and Kendall are shown at Figures 28 and 29 respectively. These diagrams indicate that the valley received particularly low annual rainfalls in the years 1902 1915 and 1940. In the southern section of the valley at Comboyne and Kendall the driest year occurred in 1940 with recorded totals of 42.00 inches and 29.40 inches respectively. However in the northern areas along the coastal section of the valley, 1915 was the driest year. At Port Macquarie the rainfall of 28.90 inches in 1915 was about 7 inches less than that recorded in 1940.

Many areas in the southern and central sections of the valley experienced their lowest recorded twelve monthly rainfall during the 1964-1966 drought. At Comboyne the total rainfall of 27.47 inches for the twelve months period from June 1964 to May 1965 was more than four inches lower than the previous twelve monthly minimum of 31.91 inches which was recorded from September 1908 to August 1909 inclusive.

The northern section of the valley also experienced particularly low rainfall during the 1964-1966 drought. At Port Macquarie the total rainfall of

30.12 inches for the twelve months period from April 1964 to March 1965 inclusive was only about one inch higher than the lowest recorded twelve monthly total of 28.90 inches from January to December 1915.

The lowest streamflows which have been recorded in the valley over a twelve month period since the establishment of the gauging station on the Hastings River at Ellenborough in 1945, occurred in the 1964-1966 drought. In the period from July 1964 to June 1965 inclusive, the total flow of the Hastings River at Ellenborough was only about 70,000 acre feet or eleven percent of the average annual flow. However the headwater stations on the Ellenborough River at Glenwarren and Big Creek at Elands, which were operated over the period from 1936 to 1961, recorded their lowest flows over a twelve monthly period during the 1939-1940 drought.

In the following Table 14 details are given of the minimum recorded twelve monthly flow at selected gauging stations in the valley.

TABLE 14

Stream	Station	Minimum Recorded Twelve Monthly Flow		
		Period of Occurrence	Total Volume (Acre Feet)	Percent of Average
Forbes River	Birdwood	July 1964 to June 1965	17,400	9.7%
Ellenborough River River	Glenwarren	December 1939 to November 1940	5,230	12.8%
Big Creek	Elands	December 1939 to November 1940	810	10.5%
Hastings River	Ellenborough	July 1964 to June 1965	70,000	11.2%

None of the gauging stations in the valley have recorded zero flow during their period of operation. However for a period of 4 days in December 1957, Big Creek at Elands had a flow of only 0.2 cusecs (75 gallons per minute).

The lowest recorded flow of the Hastings River at Ellenborough since establishment of the gauging station in 1945 has been 6 cusecs occurring for a period of 5 consecutive days in December 1953. A flow of 8 cusecs was recorded on two consecutive days in December 1957 whilst in the 1964-1966 drought the flow did not fall below 25 cusecs.

The gauging station on the Forbes River at Birdwood was not established until 1955 and consequently no record is available of flows during earlier droughts. However the lowest recorded flow of 1.6 cusecs on 28th November 1965 is less than half the minimum flow in December 1957 of 4 cusecs.

The lowest recorded flows at gauging stations on Big Creek at Elands and Ellenborough River at Glenwarren are 0.2 cusecs (December 1957) and 2.8 cusecs

(January 1947) respectively. However as these stations were operated over the period from 1936 to 1961 there is no record of the minimum flows during 1965 or other drought periods.

12. THE 1964-1966 DROUGHT

In common with many areas of the State the Hastings Valley experienced a period of very low rainfall during the years from 1964 to 1966. In the Hastings Valley, the most critical period began in about May 1964 and continued until about February 1966, being relieved temporarily by above average falls at some locations in June, July, October and December 1965. Since February 1966 there have been intermittent months of slightly below average rainfall, however these were relieved by above average falls particularly in January, April, June 1967 whilst major flooding occurred in January 1968. The recorded monthly rainfalls at Port Macquarie and Comboyne for the period from April 1964 to September 1968 are given in Table 15 on Page 30.

In some areas of the valley, the rainfall during the period from June 1964 to May 1965 was the lowest twelve monthly total ever recorded. At Comboyne in the southern section of the valley, the total of 27.47 inches in this period was the lowest twelve monthly total ever recorded. Prior to the 1964-1966 drought the lowest twelve monthly total at Comboyne was 31.91 inches in the period from September 1908 to August 1909.

As a result streamflows in the valley diminished rapidly during the latter half of 1964 and with the exception of some minor fluctuations, this trend continued until July 1965 when heavy rainfall in the central-southern section of the valley resulted in a peak flow of about 13,500 cusecs occurring in the Hastings River at Ellenborough. Further minor rises also occurred in September 1965 but by November 1965 many streams were flowing at their lowest rates since the commencement of the 1964-1966 drought. At the gauging station located on the Forbes River at Birdwood the minimum flow in this month of 1.6 cusecs is the lowest flow recorded at the station since its establishment in 1955.

Following above average rainfalls over the valley, rises occurred in most streams in December 1965 and again in February, March and April 1966. Although there were several relatively short periods of low flow during the latter half of 1966, flows did not reach the critical levels recorded in November 1965.

TABLE 15

Month		Rainfall (Points)	
		Port Macquarie	Comboyne
April	1964	519	760
May	1964	192	108
June	1964	483	320
July	1964	139	129
August	1964	450	258
September	1964	92	68
October	1964	231	209
November	1964	230	206
December	1964	125	257
January	1965	247	298
February	1965	266	475
March	1965	38	47
April	1965	769	378
May	1965	293	102
June	1965	566	343
July	1965	237	1,344
August	1965	173	181
September	1965	355	159
October	1965	740	269
November	1965	461	343
December	1965	940	972
January	1966	203	230
February	1966	832	1,016
March	1966	361	442
April	1966	439	902
May	1966	327	162
June	1966	673	261
July	1966	244	12
August	1966	336	251
September	1966	245	204
October	1966	228	473
November	1966	759	696
December	1966	130	316
January	1967	919	1,003
February	1967	574	1,393
March	1967	838	1,279
April	1967	1,031	750
May	1967	312	297
June	1967	1,864	2,345
July	1967	150	181
August	1967	646	884
September	1967	209	349
October	1967	803	1,650
November	1967	182	342
December	1967	555	483
January	1968	747	2,536
February	1968	313	424
March	1968	342	712
April	1968	98	166
May	1968	232	356
June	1968	58	60
July	1968	262	248
August	1968	570	893
September	1968	120	134
Minimum Twelve Monthly Total During Period		3,012 (April 1964 to March 1965)	2,747 (June 1964 to May 1965)

Computed records and streamflow measurements indicate that substantial improvements in the flows of most streams in the valley occurred between June 1967 and the major flood in January 1968. Since January 1968, flows

in the various streams in the valley have generally been below average although a minor fresh occurred in August 1968.

Recent streamflow measurements at selected gauging stations are given in Table 16.

TABLE 16

Stream	Station	Flow Measurements		
		Date	Cusecs	Gallons per Minute
Hastings River	Ellenborough	14.10.68	74	27,600
Forbes River	Birdwood	14.10.68	17	6,350

The extended period of below average rainfall in the valley since 1964 resulted in the occurrence of extended periods of low streamflows. The minimum total flows recorded during this period for 30 days, 3 months and 12 months at the gauging stations on the Hastings and Forbes Rivers are given in Table 17.

TABLE 17

Stream	Station	Minimum Flow During 1964-1966 Drought (Acre Feet)		
		30 Days	3 Months	12 Months
Hastings River	Ellenborough	1,610	7,220	70,000
Forbes River	Birdwood	410	1,890	17,400

Lower flows over periods of up to six months have been recorded in earlier droughts. Details of the minimum 30 day and 3 monthly flows recorded in the 1953-1954, 1957-1958 and 1964-1966 droughts at the gauging stations on the Hastings River at Ellenborough and the Forbes River at Birdwood are given in Table 18.

TABLE 18

Stream	Station	Minimum Flows (Acre Feet)					
		30 Days			3 Months		
		1953-54	1957-58	1964-66	1953-54	1957-58	1964-66
Hastings River	Ellenborough	730	1,160	1,610	6,550	6,610	7,220
Forbes River	Birdwood	No Record	280	410	No Record	1,190	1,890

13. WATER REQUIREMENTS FOR CURRENT DEVELOPMENT.

The agricultural activities in a valley are mainly influenced by climate, topography and soil types. In the Hastings Valley the variety in agricultural pursuits is not great, the main rural activities being dairying, beef cattle grazing and the growing of fodder crops.

The rugged topography which characterises much of the valley renders large areas unsuitable for irrigation, whilst in other sections the average annual rainfall is sufficiently high to encourage dry farming methods. Consequently in the Hastings Valley the demand on streamflow for irrigation is not great.

The graph at Figure 30 shows the growth in both the number of licenses for irrigation and the total area licensed for irrigation in the Hastings Valley at 30th June of each year in the period from 1944 to 1968. As indicated at Figure 30 the area authorised for irrigation by license under the Water Act has increased from nil in 1944 to 2,745 acres at 30th June 1968. Over the same period the number of licenses for irrigation has increased from nil to 184.

A marked increase in the rate of growth of licensed irrigation in the valley occurred in 1954 and 1959, mainly as a result of prevailing drought conditions. Although seasonal variations have influenced the rate of growth since 1954, increases since June 1965 have been substantial.

At the 30th June 1968 the average area applicable to each license for irrigation was about 15 acres. This average is similar to corresponding average areas for other valleys on the coast of New South Wales such as the Clarence (15 acres per license), Macleay (17 acres per license) and Lower Hunter (14 acres per license).

In addition to irrigation, streamflow is also used for various town, industrial and stock water supply purposes. At 30th June, 1968 there were 21 licenses issued for water supply purposes with a total capacity of about 6,700 gallons per minute (18 cusecs). These water supply licenses include schemes for the diversions for domestic supply from the Hastings River to the towns of Wauchope and Port Macquarie and from the Camden Haven River to the town of Laurieton.

The estimated maximum demands as at 30th June 1968 on streamflow for irrigation, water supply and riparian usage (excluding transmission losses) in the Hastings and Camden Haven - Stewarts River Systems are given in Table 19. In preparing Table 19 the minor streams draining into coastal lakes between these two systems have been included in the Camden Haven - Stewarts Rivers system.

TABLE 19

Type of Requirement	Estimated Maximum Requirements under Present Conditions					
	Hastings River System		Camden Haven and Stewarts Rivers Systems		Total	
	Cusecs	Gallons per Minute	Cusecs	Gallons per Minute	Cusecs	Gallons per Minute
Irrigation (2.0 feet for an 8 Months Irrigation Season)	9.0	3,350	3.0	1,100	12.0	4,450
Town, Industrial and Stock Water Supply	13.3	4,950	4.7	1,750	18.0	6,700
Riparian Usage	8.9	3,350	1.1	400	10.0	3,750
Totals	31.2	11,650	8.8	3,250	40.0	14,900

It should be noted that the estimated total maximum demand at 30th June 1968, of 40 cusecs, is exclusive of transmission losses within the Hastings Valley. These transmission losses, which occur as a result of evaporation from the water surface and seepage into the banks and bed of each channel are directly related to groundwater conditions and the magnitude of discharges in the various streams in the valley. Therefore these losses can be expected to vary widely depending on streamflows and antecedent meteorological conditions.

The distribution of estimated total maximum demands, exclusive of transmission losses, for various streams in the Hastings River Valley is given at Table 20. Reference to Table 20 shows that although the highest demand occurs along the Hastings River, significant demands also occur on the Maria and Camden Haven Rivers and their tributaries.

TABLE 20.

	Area Authorised for Irrigation at 30th June 1968 (Acres)	Estimated Total Maximum Demand	
		Cusecs	Gallons per Minute
Hastings River	653	16.1	5,960
Ralfe's Rivulet	0	0.1	40
Forbes River	56	0.9	330
Ellenborough River and tributaries	56	1.4	520
Kindee Brook	98	0.5	180
Thone River and tributaries	280	2.4	890
Pappinbarra Creek and tributaries	206	2.0	750
Colonel Grays Creek	15	0.3	110
Morton's Creek and tributaries	193	1.3	480
Kings River and tributaries	40	0.2	70
Stoney Creek	54	0.3	110
Maria River and tributaries	379	5.2	1,950
Kooloonbung Creek and tributaries	54	0.3	110
Heron's Creek	15	0.4	150
Camden Haven River and tributaries	265	6.0	2,220
Stewarts River and tributaries	234	2.0	730
Miscellaneous	147	0.8	300
Totals	2,745	40.0	14,900

14. POSSIBLE IRRIGATION DEVELOPMENT

It is considered that the provision of an assured water supply would not result in any great departure from the present form of irrigation development. Increases in areas under irrigated pastures and fodder crops for dairy cattle and stock fattening can be expected and some increase in vegetable production under irrigation may be anticipated.

Due to the generally steep topography of the valley, satisfactory sites for the construction of farm dams are limited and therefore the development of these works as a source of supplemental irrigation supplies has been negligible. However where suitable soil types and satisfactory sites exist, the temporal rainfall pattern is such as to make farm water storages economically feasible and it is expected that limited water supplies for future development will be provided by these works.

An assessment of areas which appear suitable for irrigation has been made with the assistance of aerial photographic interpretation. The extent of suitable areas is summarised in Table 21.

TABLE 21.

Location	Possible Irrigable Area (Acres)
Hastings River Valley.	
Hastings River above the Forbes River Junction	200
Hastings River between Forbes River Junction and the upstream limit of tidal influence	2,300
Tributaries of Hastings River entering above tidal influence	6,000
Hastings River within tidal influence	9,300
Wilson River and Tributaries	5,700
Maria River and Tributaries (excluding Wilson River)	6,000
Other Tributaries of Hastings River entering within tidal influence	1,500
Total - Hastings River catchment	31,000
Camden Haven - Stewarts River Valleys	
Camden Haven River above tidal influence	2,500
Camden Haven River within tidal influence	1,200
Tributaries of the Camden Haven River	900
Stewarts River above tidal influence	2,300
Stewarts River within tidal influence	1,000
Tributaries of the Stewarts River	500
Other streams	1,600
Total - Camden Haven and Stewarts Catchments	10,000
Total - Hastings, Camden Haven and Stewarts River Catchments	41,000

Almost one half of the total area of 41,000 acres which has been assessed as suitable for irrigation lies adjacent to sections of streams within tidal influence. In the case of the Hastings River the limit of tidal influence occurs in the vicinity of Cameron Falls about 3 miles above Wauchope.

Factors which could limit the degree of irrigation development ultimately attained include the liability of downstream areas to flooding, the quality of water supply as governed by the extent of upstream penetration of tidal saline water and the possibility of major element deficiencies in some of the soil types.

15. INVESTIGATION OF STORAGE PROPOSALS.

A general survey of the Hastings River for dam sites was commenced in 1944 with a view to evaluating multi-purpose water conservation proposals as possible post-war projects. Four possible dam sites were finally selected as being the most promising. Two of the selected dam sites were located on the Hastings River whilst the other two were located on the Forbes and Wilson Rivers. The locations of these sites are shown at Figure 31.

It was estimated that the dam site on the Hastings River below the junction of the Ellenborough River could provide a storage volume of 600,000 acre feet, the height of the dam being of the order of 200 feet and in view of the 670 square mile catchment it was thought that the hydro-electric potential at this site was promising. However, having regard to the large area of river flats which would be inundated both on the Hastings and Ellenborough Rivers following the construction of such a dam it was decided not to proceed further with investigations at this site. The remaining three sites were not attractive as hydro-electric projects and because of their location were not considered to be suitable for town water supply purposes. As the irrigation demand in the valley at that time did not warrant storages of the types envisaged it was subsequently decided to suspend any further consideration of these sites.

Because of the likely increase in irrigation development in the two valleys the Commission's long term programme envisages construction of storages for irrigation and stock and domestic purposes on the Hastings, Forbes, Wilson and Stewarts Rivers.

To date only a cursory study of storage proposals on the Stewarts River has been undertaken. However preliminary examination indicates the existence of three possible dam sites, the location of these sites being shown at Figure 31. Selection of the actual storage sites has not yet been made by the Commission. Before this is possible, a complete field examination of the river valley will be essential following which detailed investigation of potential storage sites will be undertaken.

16. ACKNOWLEDGMENT.

The Water Conservation and Irrigation Commission gratefully acknowledges the assistance provided by the Director, Bureau of Meteorology, in supplying the section on Climatic Features, the Rainfall Statistical Data and the Median Rainfall Maps for inclusion in this report and by the Department of Public Works and the Forestry Commission for providing the information on town water supply schemes and timber resources respectively.

Appendix 1
Sheet 1

COMBOYNE RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1906	309	284	1316	579	615	76	53	1253	597	250	418	385	6135
1907	1081	560	1104	290	227	601	69	48	40	80	575	639	5314
1908	161	2576	1220	595	130	51	440	988	274	56	534	514	7539
1909	100	266	358	367	124	314	89	195	601	161	805	888	4268
1910	1128	204	1939	621	387	545	43	110	227	312	295	800	6611
1911	1722	1487	891	215	402	50	611	995	241	190	631	233	7668
1912	373	1815	914	256	104	305	815	308	0	130	371	494	5885
1913	469	669	215	2095	1909	1068	88	15	436	175	185	296	7620
1914	181	730	1178	130	394	1597	193	326	1660	1742	652	935	9718
1915	164	595	179	448	1610	80	133	276	57	168	58	531	4299
1916	352	731	470	1421	1179	125	80	139	128	504	322	947	6398
1917	558	548	641	273	171	176	30	65	508	200	1787	343	5300
1918	699	881	594	380	160	50	440	196	443	273	169	280	4565
1919	546	561	862	817	1485	168	348	36	137	434	479	340	6213
1920	876	614	478	276	165	159	407	29	471	384	585	524	4968
1921	1426	589	706	653	1384	760	1684	84	456	690	294	870	9596
1922	605	1446	187	195	563	313	1040	1010	1147	71	68	500	7145

Appendix 1
Sheet 2

COMBOYNE RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1923	382	118	620	1321	65	287	195	535	215	145	119	392	4394
1924	685	396	510	508	195	578	807	55	141	251	932	904	5962
1925	497	642	952	469	1087	1166	56	339	115	186	801	815	7125
1926	432	196	929	389	882	596	860	192	170	85	24	1462	6217
1927	923	529	542	1309	175	137	4	30	267	469	870	898	6153
1928	1006	1471	614	751	229	318	318	74	22	191	181	133	5308
1929	634	4855	1521	896	202	768	434	258	682	1498	425	150	12323
1930	417	673	1290	1068	473	3147	141	160	85	491	113	463	8521
1931	414	925	681	2682	268	186	136	156	173	199	573	1007	7400
1932	430	423	468	467	832	226	730	291	1068	312	505	129	5881
1933	1055	134	487	1181	144	1817	1683	83	1033	717	707	686	9727
1934	404	1612	1097	1057	502	86	1578	379	1302	291	337	1117	9762
1935	634	1486	871	241	112	58	628	44	785	183	172	732	5946
1936	836	588	1085	965	377	179	91	30	220	189	101	1781	6442
1937	814	938	1287	564	86	1593	309	285	63	643	1596	288	8466
1938	1513	1127	524	1488	997	82	220	304	311	223	353	62	7204
1939	982	23	2756	627	331	97	145	267	542	829	162	318	7079

Appendix 1
Sheet 3

COMBOYNE RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1940	322	175	689	397	212	102	92	352	301	347	274	937	4200
1941	1014	1219	418	348	234	214	300	131	28	244	343	137	4630
1942	213	1175	1891	92	37	537	473	36	54	2436	543	774	8261
1943	814	193	465	233	1866	69	44	631	418	303	1304	870	7210
1944	1014	597	548	224	168	168	490	1079	242	248	106	237	5121
1945	525	602	222	354	481	2098	742	109	160	195	931	414	6833
1946	263	878	1719	904	112	250	5	41	650	298	260	503	5883
1947	801	2091	820	951	506	265	33	51	117	297	824	1875	8631
1948	838	313	1135	165	1176	1627	123	154	849	34	234	304	6952
1949	744	1010	1745	457	259	370	1130	2227	538	401	528	283	9692
1950	1497	1205	511	1037	281	4034	1841	930	280	590	1350	1045	14601
1951	2777	475	1163	207	173	1985	28	154	178	214	76	120	7550
1952	356	1297	659	235	255	377	455	1451	42	584	241	368	6320
1953	880	1975	1475	443	532	7	126	285	163	153	223	169	6431
1954	975	2278	276	371	591	231	769	493	1598	1165	599	1078	10424
1955	1661	2454	1987	1073	796	252	189	0	288	622	371	1013	10706
1956	1711	3269	2420	241	933	1104	73	341	177	452	98	674	11493

Appendix 1
Sheet 4

COMBOYNE RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1957	378	2654	482	192	11	134	407	919	24	259	178	236	5874
1958	789	928	374	945	121	1217	53	509	431	213	53	869	6502
1959	2345	931	1596	476	215	579	537	698	302	909	1967	620	11175
1960	773	812	831	395	481	408	137	118	199	407	394	639	5594
1961	1000	1355	472	386	347	1201	118	284	438	799	628	679	7707
1962	1652	423	637	2406	821	44	904	296	232	279	228	1827	9749
1963	664	543	2376	1983	1923	726	169	312	1177	699	602	917	12091
1964	538	685	1046	760	108	320	129	258	68	209	206	257	4584
1965	298	475	47	378	102	343	1344	181	159	269	343	972	4911
1966	230	1016	442	902	162	261	12	251	204	473	696	316	4965

Appendix 2
Sheet 1

KEMPSEY WEST RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1882	130	661	173	260	239	592	154	125	8	745	327	369	3783
1883	763	927	183	504	800	0	186	201	203	252	309	225	4553
1884	134	192	153	350	462	225	746	78	246	270	316	263	3435
1885	780	310	67	407	132	329	216	11	138	125	94	901	3510
1886	558	106	74	191	145	359	677	139	357	291	372	316	3595
1887	500	1112	910	868	570	230	346	1189	52	42	262	1295	7376
1888							NO RECORDS						
1889	440	167	297	642	613	47	761	1253	662	118	351	257	5608
1890	1530	2382	1587	310	386	291	492	130	215	238	291	852	8704
1891	699	499	574	208	474	592	135	183	478	60	525	801	5228
1892	402	1069	891	1483	202	224	132	261	175	769	434	622	6664
1893	310	1290	1860	274	231	1178	60	313	118	836	228	91	6789
1894	726	721	2431	471	198	159	11	52	247	518	122	308	5964
1895	2264	493	159	120	5	0	2	4	210	132	516	601	4506
1896	202	551	284	15	212	169	102	170	70	113	1163	326	3345
1897	100	98	400	134	298	695	431	203	47	26	41	1229	3702
1898	516	451	423	85	843	1825	105	346	524	68	34	385	5605
1899	400	269	249	121	327	317	799	1473	872	350	185	313	5675

Appendix 2
Sheet 2

KEMPSEY WEST RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1900	30	175	131	129	755	481	834	2	76	22	262	94	2991
1901	260	169	476	147	238	179	109	256	72	516	172	136	2730
1902	127	56	257	94	6	45	44	98	116	422	374	318	1957
1903	222	199	522	182	377	817	634	340	364	207	270	464	4598
1904	191	262	330	1176	283	10	781	170	86	326	301	62	3978
1905	313	663	197	767	347	36	5	35	23	144	197	372	3099
1906	83	204	630	403	322	19	1	1245	770	210	293	181	4361
1907	574	425	606	17	278	389	9	20	0	167	182	240	2907
1908	42	1176	526	293	101	20	222	575	77	17	402	222	3673
1909	95	195	233	242	150	126	51	57	197	201	486	407	2440
1910	726	205	1225	763	100	490	3	35	25	287	159	427	4445
1911	959	964	464	93	203	20	448	632	113	231	290	138	4555
1912	187	678	474	48	65	286	910	143	52	169	316	464	3792
1913	341	437	89	817	1289	990	103	18	351	285	139	217	5076
1914	120	431	1226	25	460	864	122	131	1193	1719	535	494	7320
1915	227	402	55	187	667	44	76	113	58	37	35	309	2210
1916	267	342	279	1135	699	67	31	209	116	177	345	582	4249
1917	344	253	452	160	303	148	44	112	362	302	1228	418	4126

Appendix 2
Sheet 3

KEMPSEY WEST RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1918	662	414	325	371	367	22	87	114	179	122	97	226	2986
1919	250	232	763	225	771	157	109	0	14	236	239	326	3322
1920	855	278	195	306	184	199	500	41	292	282	419	273	3824
1921	984	187	290	477	1549	669	1174	72	265	319	138	447	6571
1922	397	1594	34	98	342	292	1137	450	630	155	130	203	5462
1923	270	188	326	1380	11	122	428	414	230	167	41	605	4182
1924	504	219	245	500	181	270	655	179	164	231	597	324	4069
1925	284	385	769	248	794	493	6	411	9	136	849	650	5034
1926	357	390	407	222	290	376	536	97	64	34	5	656	3434
1927	1008	325	325	623	2	113	19	5	77	380	894	448	4219
1928	1165	907	370	628	245	942	218	29	0	369	178	154	5205
1929	272	3474	629	686	185	341	310	240	443	1061	162	41	7844
1930	411	475	786	1049	564	985	272	136	13	148	67	241	5147
1931	116	403	470	1543	220	87	186	46	65	19	328	881	4364
1932	214	236	190	479	282	58	276	34	1181	329	385	105	3769
1933	802	10	178	1108	43	1650	1072	73	1012	587	396	710	7641
1934	235	1173	851	1624	587	23	764	196	693	169	200	338	6853
1935	531	939	594	166	56	2	382	54	841	200	102	444	4311

KEMPSEY WEST RAINFALL STATISTICS

(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1936	523	492	731	286	146	126	29	37	173	245	35	846	3669
1937	607	561	893	343	36	567	209	268	39	340	817	252	4932
1938	904	746	149	503	590	58	116	229	124	274	221	37	3951
1939	295	0	1332	311	101	100	35	277	277	481	337	250	3796
1940	336	123	783	257	15	89	36	161	52	248	111	573	2784
1941	659	364	449	209	255	155	238	26	10	161	204	104	2834
1942	118	998	511	132	82	372	233	28	54	999	435	424	4386
1943	512	111	206	127	990	22	21	369	295	204	1116	765	4738
1944	1001	100	168	54	52	205	464	840	98	121	229	233	3565
1945	583	422	61	299	313	1294	591	151	68	215	1065	270	5332
1946	505	387	1328	755	108	9	6	20	198	213	200	222	3951
1947	371	1137	594	627	242	23	11	101	119	174	527	1339	5265
1948	375	112	982	162	704	1188	106	26	237	21	315	265	4493
1949	1079	678	699	333	164	158	577	1479	375	299	378	271	6490
1950	390	793	502	390	130	2186	1732	866	262	387	1183	460	9281
1951	1155	449	928	118	142	882	0	143	32	129	49	103	4130
1952	125	665	468	282	209	517	342	1306	122	429	80	234	4779
1953	702	1259	565	326	400	0	45	182	36	274	87	90	3966

KEMPSEY WEST RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1954	251	1924	184	320	427	243	348	309			NO RECORDS		
1955						NO RECORDS							
1956		NO RECORDS					40	85	101	NO RECORDS	36	281	
1957	136	897	688	143	0	45	280	533	2	216	38	121	3099
1958	346	609	518	653	53	593	6	609	185	99	54	1098	4823
1959	1057	694	829	172	75	366	392	249	529	285	1132	477	6257
1960	689	676	642	211	201	220	30	52	66	134	269	70	3260
1961	314	879	529	228	293	673	95	115	76	700	296	374	4572
1962	1178	136	704	1891	841	24	1070	510	250	132	259	893	7888
1963	522	228	1842	2282	1684	421	29	198	325	248	362	720	8861
1964	563	728	1081	836	100	179	57	262	96	159	96	133	4290
1965	107	170	175	311	159	302	422	144	63	312	132	712	3009
1966	107	614	445	413	NO RECORDS			186	95	292	749	66	

Appendix 3
Sheet 1

KENDALL RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1899				NO RECORDS					750	451	329	312	
1900	223	403	116	269	1191	923	999	23	162	37	460	345	5151
1901	461	263	513	175	451	311	306	178	75	528	245	183	3689
1902	321	103	1075	725	130	75	72	178	185	663	307	112	3946
1903	317	427	641	111	380	820	535	586	467	651	569	586	6090
1904	291	581	590	1694	239	0	871	162	63	275	120	175	5061
1905	108	530	260	1102	376	116	43	85	84	138	362	871	4075
1906	164	255	781	390	335	67	10	1143	653	161	555	287	4801
1907	584	453	815	253	477	682	38	54	23	74	308	459	4220
1908	83	2169	862	513	102	34	492	839	249	68	788	301	6500
1909	174	209	317	392	147	286	98	166	324	119	590	660	3482
1910	744	123	1382	424	183	420	24	93	63	411	201	498	4566
1911	1057	698	908	267	344	22	693	803	328	207	548	179	6054
1912	324	1364	847	384	67	295	1203	105	67	110	682	513	5961
1913	76	519	119	1277	1580	980	163	12	497	123	90	150	5586
1914	152	284	1019	242	405	837	147	279	1215	1354	329	897	7160
1915	298	312	106	494	1078	75	144	190	78	174	16	418	3383
1916	372	285	612	1329	743	110	67	183	138	308	221	818	5186

Appendix 3
Sheet 2

KENDALL RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1917	434	388	425	314	145	151	46	65	336	311	1176	292	4083
1918	697	703	385	502	185	75	506	168	303	133	107	234	3998
1919	570	385	565	494	1359	250	244	13	119	350	235	225	4809
1920	547	474	438	176	195	205	433	36	213	221	391	656	3985
1921	1367	209	372	905	892	538	744	50	379	566	224	1074	7320
1922	358	1182	84	279	811	314	1331	963	1015	135	52	415	6939
1923	460	174	460	1592	53	344	344	518	225	86	104	360	4720
1924	897	411	515	540	263	283	560	200	264	185	760	407	5285
1925	358	350	786	469	1294	609	65	394	59	256	453	524	5617
1926	128	265	704	229	500	468	703	180	130	134	6	758	4205
1927	512	310	617	2254	155	436	12	18	232	263	780	630	6219
1928	1045	878	487	385	240	1329	388	26	23	330	166	143	5440
1929	340	3620	760	740	275	492	556	247	482	1222	442	55	9231
1930	268	911	1114	1219	641	2517	169	58	217	348	49	329	7840
1931	181	553	757	2410	160	110	272	18	157	59	539	691	5907
1932	529	378	321	401	516	156	760	110	744	267	539	122	4843
1933	686	18	323	1335	0	1420	1018	27	720	507	354	344	6752
1934	190	1015	416	1615	376	61	1340	440	760	198	262	625	7298

Appendix 3
Sheet 3

KENDALL RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1935	335	775	912	116	70	29	388	119	655	154	101	398	4052
1936	532	418	494	504	216	144	72	23	143	273	22	1157	3998
1937	892	363	972	373	17	676	272	207	6	240	1051	261	5330
1938	1046	1108	216	552	768	18	220	349	100	215	140	51	4783
1939	443	0	1281	411	121	69	54	303	355	534	225	140	3936
1940	249	76	647	262	68	21	27	138	179	367	173	733	2940
1941	410	570	279	412	221	111	305	78	10	258	271	18	2943
1942	51	669	732	95	87	408	498	49	12	1387	564	353	4905
1943	526	98	275	81	1543	0	20	689	467	312	833	818	5662
1944	657	372	220	175	76	203	452	796	40	208	196	121	3516
1945	415	333	153	207	317	1509	673	102	1	109	779	207	4805
1946	150	579	1151	847	65	24	3	8	216	232	225	356	3856
1947	318	1041	512	703	509	185	0	27	84	158	580	1343	5460
1948	599	160	966	64	544	931	70	85	563	114	68	205	4369
1949	736	1231	850	335	193	608	785	910	414	264	409	123	6858
1950	586	1060	401	752	384	2405	1969	813	244	434	1344	628	11020
1951	1505	189	985	97	414	1169	5	77	77	144	50	136	4848
1952	236	1167	462	405	285	438	463	807	31	414	118	190	5016

Appendix 3
Sheet 4

KENDALL RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1953	414	1229	758	207	526	0	126	277	98	73	129	147	3984
1954	513	1959	191	476	519	252	412	525	1284	476	251	361	7219
1955	1052	1043	979	891	846	194	88	0	388	676	263	960	7380
1956	697	2209	1086	213	626	1036	64	318	122	372	80	580	7403
1957	118	1489	548	76	45	119	325	900	33	59	75	78	3865
1958	371	750	591	757	204	910	65	333	315	194	137	661	5288
1959	1369	1001	1398	350	156	410	640	241	417	742	1185	520	8429
1960	538	651	736	285	215	449	51	34	96	406	383	480	4324
1961	492	1056	410	329	373	870	88	143	163	507	449	392	5272
1962	1486	660	352	2260	1074	35	863	314	113	265	408	841	8671
1963	696	336	3085	2528	1396	806	121	199	526	521	536	711	11461
1964	397	770	1326	433	45	387	92	413	50	174	158	143	4388
1965	263	179	132	416	201	486	538	139	52	452	176	700	3728
1966	160	641	362	585	125	391	16	212	201	258	480	105	3536

Appendix 4
Sheet 1

LAURIETON RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1885	273	501	213	1311	221	404	720	19	249	206	20	788	4925
1886	455	35	204	353	395	308	658	114	344	140	671	253	3930
1887	264	1920	1508	1224	615	341	282	925	103	115	1022	1370	9689
1888	270	1481	211	220	28	202	188	86	494	519	72	668	4439
1889	94	205	349	401	152	91	559	951	1092	264	485	213	4856
1890	1515	1990	1458	591	590	334	758	165	476	186	317	509	8889
1891	1518	763	525	609	657	800	186	313	750	18	404	1024	7567
1892	755	1709	1438	933	586	274	204	298	197	727	611	631	8363
1893	347	994	716	378	132	906	226	335	225	712	492	194	5657
1894	539	408	1737	230	306	158	48	151	567	586	0	365	5095
1895	3736	924	274	164	230	43	10	2	320	93	1096	942	7834
1896	219	631	417	54	443	227	153	133	116	132	795	251	3571
1897	155	176	619	514	943	1823	291	199	274	29	103	1170	6296
1898	707	628	400	140	879	1377	371	656	1103	170	98	523	7052
1899	185	415	186	241	769	491	744	3746	944	496	274	157	8648
1900	328	388	135	172	1340	895	1831	12	83	54	686	527	6451
1901	427	121	342	169	637	280	497	149	62	528	221	197	3630
1902	211	139	394	741	341	102	132	187	150	642	195	194	3428

Appendix 4
Sheet 2

LAURIETON RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1903	423	161	496	132	287	670	868	663	386	535	575	777	5973
1904	464	580	673	890	277	0	925	292	74	271	120	139	4705
1905	213	382	208	936	319	74	32	89	114	200	475	207	3249
1906	186	263	675	329	312	87	34	1217	905	127	267	455	4857
1907	784	792	782	200	485	643	34	8	0	38	358	365	4489
1908	38	1927	756	755	177	37	429	766	228	67	405	231	5816
1909	57	246	618	489	196	260	69	157	508	157	546	753	4056
1910	612	85	1043	461	239	294	26	68	25	385	186	549	3973
1911	1141	475	1013	381	414	46	633	418	237	262	361	200	5581
1912	340	1128	1125	624	131	611	1640	93	74	263	577	603	7209
1913	196	501	155	1281	1727	1007	389	6	755	141	77	122	6357
1914	144	339	1830	175	804	768	325	437	967	1147	319	935	8190
1915	145	154	183	144	1048	71	211	273	65	182	26	445	2947
1916	288	401	888	1516	975	176	68	262	178	372	430	598	6152
1917	253	672	508	853	328	204	43	75	376	325	1091	339	5067
1918	816	678	381	590	267	51	410	213	365	185	235	438	4629
1919	560	572	674	680	1309	380	335	32	119	532	345	230	5768
1920	561	454	392	237	314	165	475	38	126	225	380	629	3996

Appendix 4
Sheet 3

LAURIETON RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1921	1874	203	324	648	936	554	747	132	391	626	133	572	7140
1922	497	854	82	346	912	357	1332	943	654	174	24	396	6571
1923	327	188	378	1539	66	233	337	560	233	75	141	431	4508
1924	567	412	646	550	420	136	524	175	210	244	848	425	5157
1925	443	363	807	525	1887	423	55	422	94	249	333	501	6102
1926	76	185	896	190	404	471	736	196	129	51	5	808	4147
1927	505	487	780	2056	162	414	0	84	206	624	1216	610	7144
1928	1287	1124	514	430	468	1210	409	206	5	243	392	80	6368
1929	501	4677	822	920	514	622	480	295	419	1327	498	19	11094
1930	347	941	1440	1312	710	3052	302	345	75	377	129	324	9354
1931	254	557	663	1806	174	190	430	46	130	161	578	812	5801
1932	839	527	414	683	986	198	885	118	787	269	271	169	6146
1933	784	122	402	1180	41	1360	769	25	784	752	530	270	7019
1934	184	1243	317	1512	513	105	1302	600	901	197	613	596	8083
1935	493	799	844	180	137	87	301	780	764	265	89	467	5206
1936	539	663	578	386	288	198	93	29	219	419	88	975	4475
1937	1017	457	1146	904	48	1418	461	353	118	370	1300	206	7798
1938	1012	1064	316	505	1490	96	458	627	279	490	206	154	6697

LAURIETON RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1939	107	11	1377	644	291	80	168	500	399	572	276	245	4670
1940	534	137	968	440	202	68	117	223	247	550	283	1185	4954
1941	902	773	566	590	555	267	565	215	34	440	352	69	5328
1942	160	918	1086	225	139	627	784	105	61	1874	688	478	7145
1943	549	161	483	203	1868	15	45	1062	862	489	1153	1128	8018
1944	1123	528	454	263	153	575	722	1030	206	305	199	321	5879
1945	495	538	251	555	758	1496	850	390	66	179	718	327	6623
1946	175	713	1356	1826	84	33	5	8	386	271	383	547	5787
1947	663	1131	412	1028	873	279	8	110	151	277	765	1435	7132
1948	836	235	1036	155	528	814	202	180	639	33	138	215	5011
1949	811	1188	760	427	212	645	695	895	700	316	500	193	7342
1950	420	1079	386	1069	458	1769	2167	868	222	514	1539	882	11373
1951	1018	246	806	189	266	1133	20	94	102	141	110	163	4288
1952	228	1258	469	481	560	570	487	717	104	665	177	186	5902
1953	409	1540	1331	462	921	12	233	360	104	117	104	141	5734
1954	411	1 632	430	750	632	291	332	958	1385	857	637	434	8 749
1955	540	857	1476	1032	1137	480	127	10	480	676	282	1308	8405
1956	1028	1984	895	345	763	1165	57	329	104	325	111	514	7620

Appendix 4
Sheet 5

LAURIETON RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1957	138	1796	532	321	60	175	440	1173	55	31	65	107	4893
1958	496	514	636	848	97	1084	74	422	298	314	151	617	5551
1959	1743	575	1339	521	357	540	606	239	349	1029	1195	517	9010
1960	931	1049	539	162	228	958	70	59	123	277	435	570	5401
1961	616	993	531	456	763	1063	110	251	142	416	381	335	6057
1962	2014	223	632	2011	1080	32	965	480	175	376	273	707	8968
1963	354	343	3146	2966	1669	1322	77	354	547	671	826	502	12777
1964	437	767	1182	674	110	640	79	410	55	146	139	186	4825
1965	328	297	124	507	126	611	327	158	100	464	493	762	4297
1966	88	645	327	443	281	372	38	364	258	208	557	234	3815

Appendix 5
Sheet 1

MOORLAND RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1885						NO RECORDS					82	1005	
1886	498	108	250	401	438	366	899	122	328	109	402	503	4424
1887	299	1323	2225	1272	584	358	219	787	163	74	905	1267	9476
1888	203	1742	325	245	25	391	183	55	577	405	110	721	4982
1889	254	360	651	293	1011	63	894	787	1074	710	428	650	7175
1890							NO RECORDS						
1891	1518	763	525	609	469	933	347	313	750	231	556	760	7774
1892	419	1873	1404	1146	376	122	161	371	313	501	961	1459	9106
1893	494	1092	1274	376	145	1056	438	379	215	1160	391	533	7553
1894	617	736	2049	207	333	134	94	175	501	553	28	405	5832
1895	4023	1088	322	242	221	24	18	13	242	73	996	909	8171
1896	269	743	380	55	291	337	181	152	46	130	687	339	3610
1897	29	82	471	286	798	1684	305	376	87	33	71	1623	5845
1898	769	444	519	168	1224	1559	291	651	1138	386	109	528	7786
1899	304	308	153	447	721	426	1273	3738	812	547	261	341	9331
1900	331	538	153	312	628	1054	1119	15	118	83	378	304	5033
1901	454	211	420	250	589	473	477	135	112	386	357	205	4069
1902	256	157	535	1088	310	84	82	125	185	695	298	140	3955

Appendix 5
Sheet 2

MOORLAND RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1903	231	301	564	126	452	620	558	6812	516	792	553	477	5871
1904	422	633	904	1445	264	9	827	175	63	237	112	397	5488
1905	171	532	205	1318	391	88	46	74	76	142	655	752	4450
1906	285	220	580	381	278	54	16	1164	491	200	584	288	4541
1907	810	404	1222	231	389	779	63	41	13	60	595	494	5101
1908	72	2243	826	595	118	43	685	686	290	84	775	365	6782
1909	110	339	235	474	251	396	86	212	572	161	622	804	4262
1910	582	202	1474	666	298	392	22	45	171	465	187	608	5112
1911	1335	835	940	591	363	43	822	718	348	210	719	175	7099
1912	391	954	733	286	183	287	1433	319	127	173	319	388	5593
1913	103	719	198	1343	1956	830	233	17	493	131	205	138	6366
1914	256	346	1195	129	471	1009	262	314	1153	1477	352	617	7581
1915	374	382	217	546	737	96	126	240	57	121	11	465	3372
1916	277	414	399	1119	955	152	107	205	131	304	302	746	5111
1917	577	412	567	508	209	213	42	57	493	307	1364	123	4872
1918	738	602	427	608	286	100	489	197	300	144	122	214	4227
1919	488	264	581	677	1605	266	300	31	234	284	199	222	5151
1920	845	454	339	226	354	182	475	27	176	287	429	746	4540

Appendix 5
Sheet 3

MOORLAND RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1921	1512	300	482	1070	799	625	756	95	470	619	171	876	7775
1922	541	1196	88	278	779	419	1383	893	906	181	60	219	6943
1923	272	33	258	1332	57	275	315	502	204	127	128	647	4150
1924	800	482	320	590	404	385	656	232	289	236	657	449	5500
1925	492	331	830	324	1311	625	74	539	80	274	607	304	5791
1926	377	287	919	346	589	565	1041	304	138	96	14	1146	5822
1927	507	310	849	2900	230	374	10	62	244	307	934	611	7338
1928	743	629	582	498	359	1193	459	162	1	248	227	138	5239
1929	528	3371	954	821	383	512	564	286	366	973	403	100	9261
1930	330	824	1167	1171	495	2423	194	122	41	455	75	352	7649
1931	405	447	674	2185	223	178	257	44	153	94	525	772	5957
1932	693	587	295	433	776	206	766	211	789	334	459	166	5715
1933	509	81	158	1452	70	891	1001	3	632	869	560	326	6552
1934	234	1235	353	1593	411	87	830	651	892	188	303	546	7323
1935	433	730	633	171	116	83	388	193	753	231	54	460	4245
1936	620	411	668	600	237	150	87	24	160	265	25	1003	4250
1937	765	194	1341	810	54	1767	335	288	24	407	921	216	7122
1938	1184	771	99	287	842	116	300	420	141	346	155	182	4843

Appendix 5
Sheet 4

MOORLAND RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1939	727	0	1514	513	182	76	115	272	303	493	123	320	4638
1940	317	69	305	390	103	46	111	293	207	472	190	1001	3504
1941	702	638	242	360	293	211	314	160	33	339	204	N.R.	
1942	0	588	1020	358	65	498	725	136	26	1468	602	191	5677
1943	0	576	441	263	745	30	36	858	782	398	891	750	5770
1944	N.R.	149	251	505	142	264	633	333	396	102	491	33	
1945	N.R.	405	375	514	376	1293	N.R.	90	13	189	516	N.R.	
1946	85	736	1314	1080	58	64	5	4	372	202	772	N.R.	
1947	465	2388	276	1620	652	394	74	39	141	N.R.	760	N.R.	
1948	0	754	515	182	1044	512	103	232	502	65	96	N.R.	
1949	N.R.	1331	1182	462	185	912	552	971	432	212	NO RECORDS		
1950	N.R.	94	104	714	309	1762	1427	720	176	514	998	433	
1951	2320	201	701	91	164	1181	7	109	233	275	71	148	5501
1952	220	1323	650	507	403	389	317	573	52	489	94	255	5272
1953	468	1145	865	293	370	4	116	310	59	97	92	160	3979
1954	552	1407	376	363	449	257	323	623	1053	667	278	267	6615
1955	737	1067	788	926	781	287	73	6	479	452	324	712	6632
1956	978	1597	1069	180	682	835	71	304	83	418	91	483	6791

MOORLAND RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1957	148	1329	383	121	134	114	351	927	47	46	46	140	3786
1958	417	842	411	506	135	937	10	334	336	204	126	651	4909
1959	1189	669	1087	419	217	520	627	388	418	805	1041	377	7757
1960	694	617	648	290	266	707	69	97	178	235	296	677	4774
1961	643	870	388	190	328	1228	154	293	160	453	463	443	5613
1962	992	357	588	1503	1159	41	422	195	165	243	111	550	6326
1963	406	368	2117	2182	1074	928	152	243	442	287	477	503	9179
1964	463	549	786	405	25	438	47	358	30	132	137	77	3447
1965	213	294	5	308	244	505	211	92	144	328	201	486	3031
1966	119	724	275	224	212	385	26	237	162	328	570	204	3466

Appendix 6
Sheet 1

PORT MACQUARIE RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1840				NO RECORDS				35	275	230	375	830	
1841	1295	262	1145	143	893	316	192	115	0	75	365	72	4873
1842	401	848	1943	905	391	33	1270	398	265	105	47	679	7285
1843	102	1700	345	496	736	571	511	1557	527	37	150	107	6839
1844	2099	728	95	114	534	300	538	819	243	69	399	525	6463
1845	104	213	272	1269	446	25	70	38	375	281	252	1172	4517
1846	186	205	472	546	76	252	351	333	552	111	716	348	4148
1847	740	1279	658	498	718	50	60	10	243	286	205	32	4779
1848	5463	870	1473	663	90	921	579	228	112	NR	106	461	
1849	75	233	225	427	1222	238	330	200	313	802	253	385	4703
1850	422	280	469	1316	272	1229	768	518	1023	1036	419	351	8103
1851	525	2017	725	1498	700	1230	358	465	NR	802	304	NR	
1852	969	340	1216	1667	3608	285	180	674	368	878	NO RECORDS		
1853 to 1869							NO RECORDS						
1870					NO RECORDS					838	858	498	
1871	1433	512	553	654	620	874	43	8	42	384	342	297	5762
1872	411	762	590	330	47	68	51	144	684	448	535	654	4724
1873	967	1901	718	754	190	771	547	360	170	174	631	2507	9690

Appendix 6
Sheet 2

PORT MACQUARIE RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1874	891	513	351	575	71	247	636	313	144	322	318	127	4508
1875	193	1256	1207	584	1128	271	894	97	479	166	392	307	6974
1876	518	625	331	1969	1993	906	739	82	400	253	280	293	8389
1877	345	77	946	317	442	64	608	209	119	343	191	675	4336
1878	893	1881	446	746	181	296	89	247	425	171	199	676	6250
1879	232	860	553	397	1720	668	96	1512	788	64	242	805	7937
1880	257	909	786	789	132	76	171	0	1173	390	666	140	5489
1881	924	533	314	259	151	439	416	594	1283	760	322	109	6104
1882	22	549	181	146	315	939	335	133	43	730	420	1175	4988
1883	528	952	473	719	1211	73	502	305	250	433	209	211	5866
1884	43	311	100	803	310	208	1421	131	368	365	431	258	4749
1885	302	485	263	764	316	387	672	23	256	209	93	1607	5377
1886	757	52	338	703	394	879	940	193	529	364	277	113	5539
1887	574	1750	1461	1647	1119	512	190	1068	181	91	1819	2127	12539
1888	108	1092	306	222	44	265	273	105	877	488	149	1157	5086
1889	263	202	646	683	528	78	690	747	938	292	553	238	5858
1890	2168	1809	1447	913	681	314	635	247	265	175	643	822	10119
1891	725	1020	608	515	792	600	544	374	733	156	503	875	7445

Appendix 6
Sheet 3

PORT MACQUARIE RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1892	652	1138	1410	1170	476	361	175	369	346	727	632	631	8087
1893	428	1025	1070	450	246	1128	261	340	128	753	370	183	6382
1894	464	521	1644	363	407	247	59	885	679	628	147	507	5751
1895	3294	1259	534	277	233	41	47	67	303	96	767	970	7888
1896	310	704	441	56	404	290	127	177	114	150	763	224	3760
1897	142	198	456	346	939	1753	337	256	114	68	124	1195	5928
1898	737	583	417	291	772	1657	400	293	1055	161	157	659	7182
1899	209	502	601	226	800	540	876	3053	731	583	497	251	8869
1900	195	161	173	297	1801	857	1075	17	92	63	527	465	5723
1901	455	411	289	418	865	413	725	217	117	637	161	131	4839
1902	412	198	425	490	157	137	72	303	185	686	329	212	3606
1903	448	251	671	152	517	775	698	760	458	487	457	981	6655
1904	765	632	725	1544	331	13	931	275	61	245	107	60	5689
1905	406	719	311	1232	808	83	23	59	50	137	209	219	4256
1906	234	274	699	589	432	141	27	903	867	151	292	540	5149
1907	953	675	644	112	591	862	41	43	3	134	243	397	4698
1908	138	1762	807	455	165	57	494	746	198	52	513	178	5565
1909	95	374	673	510	218	327	199	143	521	146	628	621	4455

Appendix 6
Sheet 4

PORT MACQUARIE RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1910	840	248	1125	659	257	403	2	75	34	353	163	469	4628
1911	956	1052	1071	234	502	60	592	735	312	255	514	235	6518
1912	274	836	571	328	186	387	1409	132	57	169	326	334	5009
1913	239	507	72	1263	1690	1369	365	32	519	220	79	110	6465
1914	91	539	1361	175	849	1075	266	329	1170	1652	349	484	8340
1915	179	173	151	274	1044	96	131	208	56	138	24	416	2890
1916	224	446	849	1355	965	144	102	308	172	257	352	661	5835
1917	337	694	663	602	399	168	41	157	402	335	932	338	5068
1918	735	599	555	693	272	27	396	228	378	210	112	284	4489
1919	461	681	590	512	1110	393	289	13	72	511	183	237	5052
1920	672	438	471	314	442	245	427	36	259	325	531	395	4555
1921	1019	233	364	587	981	749	815	102	583	488	117	789	6827
1922	485	1610	70	283	779	412	1001	742	798	118	112	347	6757
1923	526	374	260	1254	124	141	459	570	291	168	114	602	4883
1924	413	342	622	560	422	207	471	227	132	244	737	388	4765
1925	375	270	822	762	1373	509	42	529	70	173	404	478	5807
1926	105	62	639	182	452	631	624	250	146	43	6	698	3838
1927	974	627	612	1870	53	411	4	100	307	598	736	406	6698

Appendix 6
Sheet 5

PORT MACQUARIE RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1928	969	990	328	511	441	1234	349	123	7	183	199	145	5479
1929	375	3325	697	877	522	603	363	293	458	1126	296	40	8975
1930	453	960	1317	1546	906	2565	326	165	55	340	147	318	9098
1931	212	317	446	1988	203	254	278	77	86	106	410	814	5191
1932	243	319	291	347	593	137	547	62	671	470	183	194	4057
1933	840	128	270	1385	27	1598	1205	76	1041	740	335	249	7894
1934	163	939	621	1236	557	44	989	487	1003	161	320	537	7057
1935	454	760	1062	158	352	102	269	646	739	153	88	451	5234
1936	447	557	918	336	261	226	96	54	281	474	41	903	4594
1937	1033	740	1723	907	51	1135	475	177	73	259	1563	239	8375
1938	839	851	176	420	1231	118	436	448	167	327	163	76	5252
1939	399	7	966	444	360	105	157	424	177	441	128	118	3726
1940	177	61	800	715	151	86	122	182	161	338	148	661	3602
1941	794	489	448	607	226	219	422	84	48	307	291	64	3999
1942	84	1030	777	103	54	425	532	65	59	976	492	618	5215
1943	495	68	235	191	1370	20	34	609	377	439	845	886	5569
1944	501	278	306	118	64	439	579	570	101	143	129	227	3455
1945	248	198	121	444	510	1359	506	132	53	229	737	265	4802

PORT MACQUARIE RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1946	352	576	911	1240	62	27	3	8	208	221	259	536	4403
1947	566	847	481	725	495	203	13	83	166	217	637	1306	5739
1948	484	247	1164	205	482	848	90	107	537	66	183	218	4631
1949	667	774	849	515	323	682	874	860	643	302	421	292	7202
1950	451	1177	575	842	724	1640	3048	1063	395	515	1295	887	12612
1951	902	497	905	205	453	1195	17	174	73	169	54	98	4742
1952	166	862	590	474	619	434	560	1223	135	720	162	111	6056
1953	439	1316	920	560	734	23	164	350	63	302	97	133	5101
1954	372	1626	539	324	704	230	300	891	1401	454	297	271	7409
1955	401	1028	973	823	1175	294	149	11	408	384	183	845	6674
1956	1119	1589	666	274	703	919	78	371	95	220	69	372	6475
1957	137	1314	654	259	69	168	489	1015	61	149	47	152	4514
1958	702	379	917	1207	113	674	52	513	376	251	59	564	5807
1959	1582	669	949	609	318	579	593	350	316	1094	871	677	8607

PORT MACQUARIE RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1960	941	723	529	402	259	570	142	57	157	211	279	530	4800
1961	792	1216	501	718	422	898	100	204	148	667	639	266	6571
1962	2170	474	1058	1915	1082	26	708	567	211	332	272	818	9633
1963	612	373	1603	2438	1505	1037	61	391	291	384	720	746	10161
1964	323	665	752	519	192	483	139	450	92	231	230	125	4201
1965	247	266	38	769	293	566	237	173	355	740	461	940	5085
1966	203	832	361	439	327	673	244	336	245	228	759	130	4777

Appendix 7
Sheet 1

STEWARTS RIVER RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1900	NO RECORDS	532	147	345	1009	1151	1162	7	185	65	534	367	
1901	470	174	570	372	424	416	441	160	125	514	384	213	4263
1902	268	182	826	853	264	187	96	164	113	669	297	214	4133
1903	240	459	703	130	483	834	690	711	353	664	638	614	6519
1904	343	684	952	1570	138	9	827	175	63	237	112	397	5507
1905	171	453	200	1187	350	72	50	54	94	131	552	848	4162
1906	118	280	733	403	360	57	10	1475	614	74	503	284	4911
1907	788	409	1134	239	422	670	25	52	30	53	500	500	4822
1908	95	1952	835	483	23	0	501	729	95	0	906	29	5648
1909	103	125	150	350	90	335	0	135	373	270	345	661	2937
1910	602	75	1365	575	66	479	0	104	118	330	102	451	4267
1911	1529	613	748	413	120	29	456	723	218	285	300	85	5519
1912	123	1477	454	330	148	312	1266	377	45	114	437	315	5398
1913	230	716	145	1495	2000	770	90	0	495	130	180	178	6429
1914	210	430	920	165	410	1240	232	272	1529	1983	550	988	8929
1915	320	468	192	602	800	100	135	315	85	205	40	603	3865
1916	295	390	535	1485	1090	340	235	225	155	370	352	665	6137
1917	285	341	590	429	219	228	35	56	462	270	1452	159	4526

Appendix 7
Sheet 2

STEWARTS RIVER RAINFALL STATISTICS

(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1918	766	616	294	446	228	65	412	136	314	156	116	208	3357
1919	516	314	575	658	1532	214	242	22	190	303	219	132	4917
1920	744	457	339	226	354	182	475	27	176	287	429	746	4442
1921	1608	287	478	929	861	583	946	62	409	594	226	964	7947
1922	509	1578	89	325	786	350	1316	956	1057	208	28	193	7395
1923	3911	40	319	1437	43	259	273	431	151	105	89	537	4075
1924	609	343	338	610	246	376	571	193	247	243	603	506	4885
1925	348	452	707	254	1353	688	83	408	58	227	621	395	5594
1926	199	459	939	371	605	544	663	230	147	45	19	919	5140
1927	486	241	704	2546	245	269	9	116	136	322	872	597	6543
1928	863	627	345	525	262	1330	403	121	0	212	163	101	4952
1929	744	4130	1012	837	293	552	622	285	471	1459	385	48	10838
1930	416	1052	1235	1407	640	2619	208	115	36	459	73	322	8582
1931	406	556	1166	2335	234	147	222	33	147	97	592	673	6608
1932	662	562	221	356	639	151	652	146	716	323	528	158	5114
1933	729	68	292	1597	50	1463	1061	5	729	924	430	438	7786
1934	294	1483	415	1734	395	80	1399	473	883	209	238	628	8231
1935	490	1037	859	205	115	36	461	137	939	91	57	452	4879

STEWARTS RIVER RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1936	490	521	734	717	237	178	65	18	188	245	17	1377	4787
1937	1048	347	1468	613	42	1708	329	180	0	195	1286	329	7545
1938	1396	1277	280	569	988	103	235	440	141	336	172	118	6055
1939	923	0	1549	549	162	87	88	360	368	612	152	323	5173
1940	260	122	593	348	85	51	103	232	194	428	177	1112	3705
1941	720	853	215	275	390	156	256	140	43	292	292	61	3693
1942	139	655	1137	196	33	456	606	104	21	1809	518	350	6024
1943	503	139	460	180	1858	22	28	710	577	425	858	779	6539
1944	981	256	425	138	133	202	538	850	142	81	236	216	4198
1945	596	369	221	310	612	1651	596	109	5	129	653	249	5500
1946	195	710	1531	895	47	40	2	0	206	264	344	453	4687
1947	398	1788	401	957	608	328	41	37	118	240	694	1282	6892
1948	726	225	1253	153	780	886	115	287	545	18	75	229	5292
1949	1143	1322	1134	433	200	1236	776	1036	548	279	639	152	8898
1950	768	1474	452	915	333	2496	1962	847	333	490	1414	880	12364
1951	1798	282	910	86	243	1412	11	81	74	201	55	123	5276
1952	213	1103	615	447	414	564	475	879	58	592	124	259	5743
1953	590	1547	819	349	436	3	101	295	55	82	78	187	4542

STEWARTS RIVER RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1954	669	2110	447	463	446	264	438	627	1295	744	249	363	8115
1955	1022	1236	1217	1088	869	229	143	0	527	603	303	956	8193
1956	900	2170	1536	349	1127	961	78	347	96	405	106	514	8589
1957	167	1638	672	143	34	112	353	897	34	46	58	160	4314
1958	369	810	527	1058	210	1192	47	377	319	171	121	623	5824
1959	1518	782	1031	406	173	490	647	409	357	806	1431	303	8353
1960	781	748	767	313	221	603	56	85	131	209	372	730	5016
1961	641	1084	361	240	447	1060	93	194	197	505	466	406	5694
1962	1556	364	581	2232	1467	45	667	291	232	290	158	873	8756
1963	576	542	3061	2413	1415	1054	132	210	675	349	584	668	11679
1964	487	732	1343	585	52	470	62	388	36	171	146	77	4549
1965	212	278	10	361	163	468	540	116	84	377	270	414	3293
1966	115	740	324	485	140	439	13	214	162	441	587	174	3834

Appendix 8
Sheet 1

TELEGRAPH POINT RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1910	NO RECORDS		1624	630	114	337	0	0	16	215	443	351	
1911	1071	556	586	70	251	0	591	781	225	116	409	260	4916
1912	206	1088	422	140	0	272	818	150	0	170	243	205	3714
1913	0	274	45	996	1250	840	98	0	417	140	60	106	4226
1914	48	202	841	0	150	537	80	65	1628	1439	347	296	5633
1915	0	218	0	192	775	24	132	133	26	82	103	370	2055
1916	112	316	333	1107	700	NO RECORDS		171	160	177	269	597	
1917	333	502	252	285	170	123	0	20	345	338	1440	150	3958
1918	935	538	426	366	191	0	262	60	224	221	89	200	3512
1919	327	283	780	426	1062	149	154	0	48	190	184	143	3746
1920	607	394	127	129	212	130	302	0	212	283	318	341	3055
1921	766	195	303	495	1538	637	1010	57	392	394	84	757	6628
1922	336	1300	0	111	524	220	1237	582	724	102	49	224	5409
1923	428	367	193	1181	32	127	334	335	262	177	46	580	4062
1924	413	404	218	701	197	158	590	163	115	191	596	227	3973
1925	342	363	912	514	1252	362	0	378	35	116	423	582	5279
1926	278	184	579	159	436	632	572	84	71	98	0	1029	4122
1927	961	218	291	1320	0	27	0	17	223	536	946	360	4899

Appendix 8
Sheet 2

TELEGRAPH POINT RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1928	602	782	427	409	200	948	359	16	0	311	103	96	4253
1929	306	3938	537	699	153	396	419	171	472	986	181	0	8258
1930	477	756	1117	1207	444	1891	267	65	25	238	27	187	6701
1931	215	465	614	2093	238	81	170	51	72	32	443	644	5118
1932	201	235	227	335	351	107	406	46	488	230	593	215	3434
1933	1056	0	252	885	31	1852	1063	52	954	524	212	298	7179
1934	88	920	688	1350	502	0	1044	453	800	194	163	423	6625
1935	336	847	922	129	44	5	366	20	928	108	94	532	4331
1936	381	454	591	382	105	126	37	0	208	191	14	1107	3596
1937	710	747	1068	427	18	755	224	174	33	298	972	243	5669
1938	879	704	155	576	710	5	105	294	60	252	133	20	3893
1939	381	0	1104	437	132	82	25	256	256	433	205	277	3588
1940	330	39	733	289	62	35	27	98	90	149	120	794	2766
1941	521	584	317	246	173	139	299	0	14	190	320	39	2842
1942	63	801	604	38	40	301	314	72	41	1126	485	565	4450
1943	519	61	179	181	145	9	37	524	393	253	797	728	5096
1944	683	163	242	7	32	176	483	854	69	50	236	148	3143
1945	211	266	118	194	322	1201	575	119	44	92	872	313	4327

TELEGRAPH POINT RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1946	371	560	1383	788	49	4	0	0	76	143	230	653	4257
1947	360	815	364	604	503	37	15	31	124	123	606	1539	5121
1948	349	108	1062	93	759	740	91	67	261	71	152	262	4015
1949	566	893	705	360	428	491	754	1203	308	235	767	359	7069
1950	497	1127	458	469	236	2106	2048	959	346	526	1659	544	10975
1951	1049	230	865	62	209	963	0	136	61	154	NO RECORDS	79	
1952	219	1015	297	358	348	556	319	1330	61	397	113	119	5132
1953	534	1265	864	224	561	0	61	268	28	179	87	266	4337
1954	277	2435	196	210	437	225	410	381	1101	975	374	243	7264
1955	740	993	986	702	846	111	53	2	365	341	164	998	6301
1956	1102	1792	1076	180	591	1061	NO RECORDS		95	199	14	579	
1957	136	1000	1015	88	0	70	320	535	0	117	96	198	3575
1958	312	807	378	920	89	841	3	588	255	136	18	769	5116
1959	1565	810	1258	230	104	403	625	298	603	713	1094	624	8327

TELEGRAPH POINT RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1960	728	571	831	246	361	329	65	53	162	273	372	262	4253
1961	366	1230	507	299	455	916	78	101	94	657	443	396	5542
1962	1552	213	870	2432	1046	9	513	337	142	196	197	1105	8612
1963	628	219	1616	2759	1639	697	31	262	459	271	614	586	9781
1964	432	884	1075	663	43	265	109	441	88	176	220	182	4578
1965	169	474	11	363	88	388	591	154	114	246	232	931	3761
1966	96	882	387	539	42	275	NR	229	118	194	731	106	

Appendix 9
Sheet 1

WAUCHOPE RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1891	651	799	586	196	364	868	195	284	506	85	285	687	5506
1892	514	1210	1503	1200	488	131	186	654	285	573	556	896	8196
1893	460	1290	1562	396	129	1258	150	398	126	892	266	90	7017
1894	693	542	1922	436	107	107	19	71	204	655	37	296	5089
1895	2454	848	277	156	58	9	10	18	283	40	1262	1104	6519
1896	477	876	289	22	389	348	91	132	193	138	730	331	4016
1897	226	150	377	165	503	863	357	175	0	40	41	1065	3962
1898	815	583	498	135	885	1670	238	278	1027	219	153	335	6836
1899	282	288	457	195	448	385	1023	2418	632	493	307	189	7117
1900	313	101	92	205	1156	714	775	20	83	37	235	621	4352
1901	553	161	408	207	595	292	152	152	32	589	220	155	3516
1902	288	182	552	377	49	65	41	110	141	592	215	232	2844
1903	170	181	854	97	322	961	533	433	375	465	438	677	5506
1904	393	398	357	1173	252	4	833	104	61	235	134	108	4052
1905	178	559	275	1027	383	78	33	42	9	129	297	550	3560
1906	188	110	823	453	378	61	3	889	318	437	322	89	4071
1907	495	432	475	55	304	402	8	36	0	97	329	321	2954
1908	86	1792	639	251	57	31	167	654	160	34	408	271	4550

Appendix 9
Sheet 2

WAUCHOPE RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1909	98	309	289	340	54	252	65	80	266	136	526	619	3034
1910	901	106	1317	586	178	344	0	13	27	323	188	441	4424
1911	1103	1181	506	139	226	0	661	721	263	272	644	218	5934
1912	161	1382	550	173	45	264	906	158	50	135	387	462	4673
1913	162	370	93	1127	1195	714	120	42	452	208	78	176	4737
1914	186	346	1212	125	358	784	170	177	1443	1684	337	417	7239
1915	251	197	72	239	1256	38	124	152	34	115	22	430	2930
1916	185	364	418	1375	668	76	10	207	86	313	169	865	4736
1917	290	279	283	211	307	154	28	61	369	319	1007	181	3489
1918	621	768	310	263	229	59	348	148	171	185	80	304	3486
1919	331	309	717	504	1193	236	120	3	72	262	131	160	4038
1920	652	416	357	131	149	236	256	30	162	247	462	393	3491
1921	1402	179	444	672	1225	598	864	72	387	505	114	783	7245
1922	425	1212	38	81	499	234	1219	746	681	167	95	327	5724
1923	246	181	289	1195	29	264	302	412	226	91	84	350	3669
1924	718	460	270	492	317	251	505	112	138	250	627	305	4445
1925	425	432	692	382	1221	650	18	298	30	182	544	610	5484
1926	207	147	639	112	482	382	557	158	46	47	5	828	3610

Appendix 9
Sheet 3

WAUCHOPE RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1927	811	253	244	1451	50	106	10	15	175	595	887	505	5102
1928	923	584	413	369	192	1273	288	84	0	417	205	104	4852
1929	373	4575	678	647	295	504	321	106	592	1131	161	49	9432
1930	393	802	956	1115	469	2370	189	140	134	264	65	265	7162
1931	196	418	668	2083	221	112	189	42	90	35	573	684	5311
1932	339	226	386	340	368	108	574	83	662	311	694	123	4214
1933	1525	44	281	1191	27	1834	1289	27	901	614	239	381	8353
1934	130	1216	425	1537	525	19	1168	504	795	183	198	459	7159
1935	431	1065	817	107	51	13	456	79	801	166	101	481	4568
1936	475	615	782	391	166	109	80	15	194	111	16	1320	4274
1937	652	487	1033	333	14	832	242	133	7	290	1294	171	5488
1938	1191	905	196	701	784	32	158	370	112	158	188	49	4844
1939	604	0	1101	330	94	90	68	266	346	533	166	139	3737
1940	224	96	639	210	52	55	24	159	148	320	268	883	3078
1941	437	544	294	151	116	112	312	39	24	182	339	28	2578
1942	23	651	698	104	50	347	292	34	31	1428	524	575	4757
1943	660	70	224	119	1897	9	34	547	424	216	860	705	5765
1944	853	202	215	59	86	146	586	731	84	70	217	141	3390
1945	323	304	181	190	414	1273	585	119	179	154	850	268	4840

WAUCHOPE RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1946	241	477	1369	843	52	10	3	7	178	266	180	426	4052
1947	367	1071	471	740	518	80	26	44	93	139	617	1528	5694
1948	465	151	1227	113	645	814	71	97	425	52	170	274	4504
1949	569	1130	806	289	278	462	753	1105	372	333	481	317	6895
1950	974	868	306	675	176	1929	1875	999	277	521	1357	516	10473
1951	1249	313	884	128	265	1155	9	119	75	148	56	315	4716
1952	245	1088	595	153	266	524	424	1329	42	381	109	148	5304
1953	650	1408	653	147	538	4	98	249	29	111	142	106	4135
1954	286	1793	292	264	356	217	335	305	1050	716	657	552	6823
1955	726	864	823	887	717	74	36	0	199	447	154	1046	5973
1956	753	2175	1039	348	545	922	31	167	63	185	53	548	6829
1957	272	1040	428	104	2	55	213	493	13	112	75	123	2930
1958	406	569	727	722	91	958	3	421	285	138	33	373	4726
1959	1282	744	1300	248	166	287	554	306	408	730	1256	533	7814

Appendix 9
Sheet 5

WAUCHOPE RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1960	561	557	506	299	279	417	77	59	138	211	341	258	3703
1961	269	993	333	396	304	804	75	105	76	811	275	289	4730
1962	1290	388	438	2150	1061	9	720	288	92	258	282	958	7934
1963	409	190	1744	2532	1324	743	53	237	476	302	531	594	9135
1964	440	699	782	464	39	316	98	329	62	216	201	173	3819
1965	93	317	8	192	141	338	301	137	50	812	191	609	3189
1966	217	538	365	678	78	256	9	193	157	289	639	78	3497

Appendix 10
Sheet 1

WINGHAM RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1889	171	173	824	139	884	21	1067	552	411	406	428	650	5726
1890	1107	2272	1506	293	453	72	864	38	221	97	521	228	7672
1891	539	880	549	382	248	1249	88	558	758	41	743	348	6383
1892	656	1110	1158	1058	278	74	35	233	210	571	652	931	6966
1893	486	1045	975	193	91	828	268	272	145	611	148	184	5246
1894	638	448	1717	252	125	83	30	52	259	713	26	184	4527
1895	2729	493	226	43	77	0	0	10	168	22	617	605	4990
1896	269	533	197	65	227	178	91	61	132	198	602	187	2740
1897	63	37	139	215	287	527	225	141	60	20	15	1538	3267
1898	387	321	267	134	279	1022	226	340	913	240	18	211	4358
1899	470	221	220	463	359	180	648	1312	502	186	97	160	4818
1900	160	242	178	231	539	535	566	0	150	38	244	241	3124
1901	225	44	273	242	301	158	198	108	44	318	212	173	2296
1902	227	186	85	420	19	4	89	37	238	565	262	183	2315
1903	110	282	413	150	227	414	337	487	217	532	425	253	3847
1904	65	303	447	633	132	45	544	38	27	146	166	193	2739
1905	60	322	341	958	164	33	11	48	62	73	203	564	2839
1906	57	66	431	160	166	7	0	950	337	248	452	149	3023

Appendix 10
Sheet 2

WINGHAM RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1907	616	276	846	122	151	277	22	10	0	41	350	460	3171
1908	72	1824	801	239	58	45	400	417	94	49	154	292	4445
1909	127	200	98	200	49	345	35	119	497	223	462	763	3118
1910	712	116	965	198	225	233	0	52	61	211	84	641	3498
1911	1271	561	611	328	325	2	569	738	171	261	517	118	5472
1912	122	682	682	145	115	183	452	72	81	50	172	496	3252
1913	155	624	125	1072	1251	926	158	0	328	194	63	105	5001
1914	137	229	934	90	162	597	143	117	990	1078	367	523	5367
1915	177	283	165	270	1040	45	152	115	61	0	24	429	2761
1916	178	406	274	887	780	143	82	104	161	320	372	728	4435
1917	429	310	363	294	176	118	28	35	650	239	696	257	3595
1918	690	422	205	371	126	51	220	156	414	70	98	145	2968
1919	368	182	413	304	1071	23	210	15	184	284	213	294	3561
1920	622	399	250	138	176	113	372	8	174	117	381	532	3282
1921	910	137	504	711	883	803	945	71	315	499	228	746	6752
1922	334	1077	7	148	414	156	809	528	669	205	32	230	4609
1923	235	58	115	825	20	201	259	362	117	139	155	270	2756
1924	733	442	271	379	110	366	564	130	242	174	691	602	4704

Appendix 10
Sheet 3

WINGHAM RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1925	404	270	465	350	432	521	32	371	24	203	616	593	4281
1926	149	18	855	394	497	261	365	137	56	76	18	607	3433
1927	462	138	396	1437	165	206	5	47	82	218	695	482	4333
1928	619	447	715	353	86	1051	258	44	0	109	291	183	4156
1929	343	3199	239	516	143	256	368	255	517	978	401	186	7401
1930	192	476	1252	569	364	2081	152	15	25	347	158	416	6047
1931	333	369	635	1796	264	79	147	13	134	61	464	509	4804
1932	263	389	393	380	233	153	551	157	644	362	410	151	4086
1933	798	22	216	623	50	474	1012	0	428	774	342	483	5222
1934	190	659	175	1106	442	30	1008	437	817	228	272	496	5860
1935	466	597	541	80	45	9	413	85	459	158	90	332	3275
1936	444	265	444	205	151	103	56	24	136	92	24	583	2527
1937	495	181	653	248	26	733	130	176	0	307	499	358	3806
1938	1215	383	332	400	716	23	71	370	170	256	237	107	4280
1939	1121	0	949	326	80	81	34	160	250	567	448	112	4128
1940	257	72	581	278	32	31	65	245	176	334	129	753	2953
1941	599	650	384	356	81	183	154	140	9	245	154	113	3068
1942	66	500	826	55	42	218	486	6	36	965	411	364	3975

WINGHAM RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1943	403	130	360	157	1465	70	49	477	342	336	522	501	4812
1944	808	309	127	53	85	108	346	657	89	56	134	139	2911
1945	259	467	56	265	220	1278	693	20	28	227	NO RECORDS		
1946	132	238	787	674	28	59	0	4	59	118	301	296	2696
1947	487	1381	320	420	295	139	32	51	120	181	239	1419	5084
1948	476	135	1012	100	716	611	52	137	366	0	90	261	3956
1949	667	615	662	311	146	619	762	664	468	307	433	164	5818
1950	485	906	87	499	142	1764	861	591	199	354	662	35	6585
1951	2126	237	793	126	123	996	14	105	120	120	16	76	4852
1952	231	1055	600	263	142	258	257	818	7	507	136	158	4432
1953	483	981	611	143	333	13	59	233	34	83	84	164	3221
1954	324	1184	311	172	309	234	313	289	548	592	414	477	5167

WINGHAM RAINFALL STATISTICS
(Points)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1955	750	1279	755	1116	187	116	56	3	121	260	346	410	5399
1956	779	1365	1333	268	468	511	45	180	99	233	49	220	5550
1957	102	784	638	166	32	62	201	433	12	11	81	154	2676
1958	294	736	436	268	131	590	21	319	312	214	107	817	4245
1959	821	936	914	145	82	308	313	303	241	657	737	695	6152
1960	576	363	557	142	192	302	97	96	143	292	234	448	3442
1961	393	578	266	204	166	533	85	144	236	560	431	652	4248
1962	796	213	400	1518	980	8	459	144	99	218	110	998	5943
1963	462	113	2820	1583	1020	539	114	209	479	341	316	708	8704
1964	207	291	433	303	44	271	42	189	33	94	271	122	2300
1965	74	88	89	184	218	288	488	95	127	209	91	508	2459
1966	319	881	365	617	128	251	5	161	126	264	578	182	3877

STATISTICAL RAINFALL DATA
(Points)

Station	Rainfall Statistic	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Comboyne (Period 59 Years)	Minimum	100	23	179	92	11	7	4	0	0	34	24	62	4200
	10%	263	196	358	207	108	58	43	36	42	130	98	150	4584
	30%	432	560	524	354	175	168	118	110	163	199	223	340	5946
	50%	699	730	820	469	331	305	195	258	267	279	371	531	6833
	70%	975	1205	1135	896	563	596	473	339	456	452	585	870	7707
	90%	1652	2278	1891	1421	1384	1627	1040	995	1068	829	932	1078	10706
	Maximum	2777	4855	2756	2682	1923	4034	1841	2227	1660	2436	1967	1875	14601
Kempsey West (Period 65 Years)	Minimum	30	0	34	15	2	0	0	0	0	17	5	37	1957
	10%	117	112	155	90	40	20	6	20	19	36	46	99	2878
	30%	266	235	289	165	161	83	50	56	70	160	170	234	3795
	50%	390	414	468	293	245	179	135	143	124	215	270	313	4361
	70%	588	663	629	483	369	483	434	257	267	305	387	450	5159
	90%	1004	1174	1225	1119	761	1065	813	850	724	546	867	779	6815
	Maximum	2264	3474	2431	1624	1549	2186	1732	1479	1193	1719	1228	1339	9281
Kendall (Period 65 Years)	Minimum	51	0	84	64	0	0	0	0	1	37	6	18	2940
	10%	141	145	206	114	66	23	22	21	28	81	62	122	3789
	30%	318	335	415	277	178	115	72	78	94	160	164	207	4303
	50%	434	519	591	411	317	295	272	178	185	258	271	361	5061
	70%	584	796	821	707	510	552	500	315	340	368	475	594	5980
	90%	1048	1284	1129	1601	1123	1089	922	809	681	656	783	853	7578
	Maximum	1505	3620	3085	2528	1580	2517	1969	1143	1284	1387	1344	1343	11461

STATISTICAL RAINFALL DATA
(Points)

Station	Rainfall Statistic	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Laurieton (Period 80 Years)	Minimum	38	11	82	54	28	0	0	2	0	18	0	19	2947
	10%	146	155	211	169	112	46	34	25	62	68	78	154	4002
	30%	277	384	413	345	247	180	128	122	120	183	189	235	4971
	50%	478	564	618	517	417	337	333	245	226	274	348	441	5890
	70%	649	900	837	753	694	636	548	421	397	490	521	597	7138
	90%	1139	1623	1432	1492	1131	1311	883	941	854	708	1005	972	8875
	Maximum	3736	4677	3146	2966	1887	3052	2167	3746	1385	1874	1539	1435	12777
Moorland (Period 70 Years)	Minimum	0	0	88	55	25	4	7	3	1	33	11	77	3372
	10%	150	161	206	172	104	43	37	27	46	85	61	141	3988
	30%	308	349	384	291	241	139	112	128	139	183	131	293	4883
	50%	465	543	580	440	373	370	295	241	233	279	311	454	5645
	70%	636	769	829	649	587	603	476	367	462	442	545	638	6737
	90%	1165	1328	1334	1435	1005	1168	898	780	810	784	904	906	7785
	Maximum	4023	3371	2225	2900	1956	2423	1433	3738	1153	1477	1364	1623	9476
Port Macquarie (Period 84 Years)	Minimum	22	7	70	56	27	13	2	8	3	43	6	40	2890
	10%	138	186	208	179	91	51	38	49	56	112	84	112	4028
	30%	306	374	447	326	291	186	141	127	116	174	162	236	4821
	50%	452	580	617	514	447	390	343	238	231	276	292	392	5567
	70%	687	849	815	722	714	617	538	408	399	440	475	620	6545
	90%	972	1315	1241	1370	1147	1215	936	810	872	729	750	937	8738
	Maximum	3294	3325	1723	2438	1801	2565	3048	3053	1401	1652	1819	2127	12612

STATISTICAL RAINFALL DATA
(Points)

Station	Rainfall Statistic	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Stewarts River (Period 64 Years)	Minimum	95	0	89	86	23	0	0	0	0	0	17	29	2937
	10%	169	132	218	173	49	38	18	25	35	78	58	110	4104
	30%	332	356	436	349	205	154	92	116	105	198	155	215	4851
	50%	506	549	644	455	342	332	239	202	182	270	302	396	5504
	70%	737	832	915	845	544	593	488	377	363	388	511	619	6541
	90%	1270	1608	1354	1584	1240	1371	887	849	723	707	865	938	8673
	Maximum	1798	4130	3061	2546	2000	2619	1962	1475	1529	1983	1452	1377	12364
Telegraph Point (Period 51 Years)	Minimum	0	0	0	0	0	0	0	0	0	32	0	0	2055
	10%	98	119	133	89	31	4	5	0	25	93	47	109	3201
	30%	321	271	295	218	121	82	79	53	70	147	117	220	3998
	50%	381	556	537	366	238	176	267	119	208	196	220	298	4450
	70%	580	812	835	628	474	509	414	313	345	303	431	571	5462
	90%	956	1209	1098	1297	1212	942	972	742	785	702	931	957	8059
	Maximum	1565	3938	1616	2759	1639	2106	2048	1330	1628	1439	1659	1539	10975

STATISTICAL RAINFALL DATA
(Points)

Station	Rainfall Statistic	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Wauchope (Period 74 Years)	Minimum	23	0	38	22	2	0	0	0	0	34	5	28	2578
	10%	174	129	220	106	50	12	10	19	26	61	55	107	3234
	30%	284	296	345	182	158	98	70	80	80	151	158	245	4052
	50%	428	482	502	332	304	258	178	150	167	241	253	343	4733
	70%	651	825	722	545	485	561	353	293	302	357	450	549	5709
	90%	1147	1253	1264	1198	1175	1207	849	726	672	686	855	890	7530
	Maximum	2454	4575	1922	2532	1897	2370	1875	2418	1443	1684	1357	1528	10473
Wingham (Period 75 Years)	Minimum	57	0	7	43	19	0	0	0	0	0	15	35	2296
	10%	107	70	134	113	43	18	18	9	25	41	30	120	2740
	30%	227	235	274	189	125	78	58	52	93	120	146	186	3273
	50%	404	369	436	278	176	183	154	140	170	223	262	332	4248
	70%	602	601	666	395	312	376	350	275	313	323	416	512	4992
	90%	857	1140	990	1064	883	867	781	571	586	600	631	749	6244
	Maximum	2729	3199	2820	1796	1465	2081	1067	1312	990	1078	743	1538	8704

MINIMUM RAINFALL RECORDED IN PERIODS OF UP TO TWELVE MONTHS COMMENCING IN THE MONTH INDICATED
(Points)

Station	Number of Months	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Comboyne	1	100	23	179	92	11	7	4	0	0	34	24	62
	2	366	621	382	129	145	113	34	88	120	109	196	350
	3	724	891	685	337	316	171	157	168	279	410	552	815
	4	1091	1115	819	650	346	438	237	468	527	766	977	1238
	5	1215	1429	1226	715	613	709	631	601	944	1139	1666	1605
	6	1529	1518	1356	1223	1065	772	770	1096	1744	1759	2046	1729
	7	1618	1713	1673	1355	1187	1126	1126	2018	2102	2195	2263	2043
	8	1813	2314	1917	1842	1466	1610	2106	2643	2469	2319	2377	2132
	9	2414	2475	2260	1979	1844	2386	2776	3289	2593	2633	2469	2327
	10	2575	2941	2397	2192	3019	2856	3317	3544	2907	2722	2821	2928
	11	3263	3616	2610	3367	3544	3943	3572	3895	2996	2917	3122	3089
	12	4200	3829	3785	4136	4052	4072	3949	3984	3191	3518	3469	3581
Kempsey West	1	30	0	34	15	2	0	0	0	0	17	5	37
	2	183	188	132	100	5	2	6	14	73	39	152	222
	3	336	322	274	125	7	6	29	100	103	281	277	319
	4	465	374	284	127	11	99	196	200	313	406	491	576
	5	540	458	286	131	216	243	319	456	438	807	748	670
	6	585	502	290	341	353	363	456	581	883	1164	842	676
	7	629	600	500	473	712	672	581	885	1241	1313	848	721
	8	727	716	632	969	976	895	1063	1361	1430	1364	893	765
	9	843	1125	1148	1302	1242	1099	1516	1500	1436	1409	937	863
	10	1265	1512	1581	1344	1446	1560	1795	1692	1481	1453	1035	979
	11	1639	1830	1848	1938	2076	1974	1801	1737	1525	1551	1151	1401
	12	1957	2052	2190	2265	2212	1980	1846	1781	1623	1667	1573	1775

MINIMUM RAINFALL RECORDED IN PERIODS OF UP TO TWELVE MONTHS COMMENCING IN THE MONTH INDICATED
(Points)

Station	Number of Months	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Laurieton	1	38	11	82	54	28	0	0	2	0	18	0	19
	2	118	239	307	248	117	38	12	8	38	56	172	229
	3	482	481	459	404	122	46	42	46	151	203	343	272
	4	626	987	661	447	130	309	80	381	258	484	478	941
	5	1201	1198	721	449	516	468	438	610	744	823	1062	1180
	6	1292	1645	723	769	698	828	630	807	1199	1333	1454	1693
	7	1851	1647	1043	862	1170	1071	841	1491	1407	1818	1888	1960
	8	2092	1967	1136	1684	1510	1377	1566	1699	2310	2309	2032	2093
	9	2294	2060	2020	2131	1696	1640	2241	2329	2537	2551	2423	2323
	10	2476	2357	2648	2169	1959	2315	2570	2724	2736	2638	2512	2506
	11	2502	2802	2782	2635	2634	2644	2882	2937	2768	2783	2626	2706
	12	2947	3090	2987	3125	2963	2956	2969	2971	2857	2897	2826	3181
Port Macquarie	1	22	7	70	56	27	13	2	8	3	43	6	40
	2	167	303	327	157	89	30	11	46	137	49	152	131
	3	454	494	488	496	92	38	87	172	195	321	280	356
	4	777	766	837	598	100	215	221	423	394	487	484	665
	5	1213	1205	1110	665	308	352	464	568	560	925	874	1007
	6	1706	1479	1199	968	529	561	585	734	1046	1066	1329	1322
	7	1891	1782	1502	1064	788	780	751	1182	1167	1510	1644	1950
	8	2194	1967	1598	1769	1324	1014	1205	1737	1611	2020	2111	2022
	9	2312	2271	2122	2268	1745	1288	1904	2181	2121	2628	2183	2325
	10	2450	2295	2538	2352	2096	1987	2493	2691	2854	2799	2486	2510
	11	2474	2711	2762	2592	2795	2576	2925	3043	2937	2981	2671	2911
	12	2890	2935	3086	2937	3263	3008	3066	3070	3158	3142	3039	2958

MINIMUM RAINFALL RECORDED IN PERIODS OF UP TO TWELVE MONTHS COMMENCING IN THE MONTH INDICATED
(Points)

Station	Number of Months	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Stewarts River	1	95	0	89	86	23	0	0	0	0	0	17	29
	2	228	275	414	177	23	42	2	82	80	64	178	132
	3	378	625	590	289	89	42	107	135	138	264	391	257
	4	728	715	898	587	89	248	160	411	298	592	652	407
	5	818	1050	925	819	295	401	422	534	666	860	971	757
	6	1153	1050	1060	1013	559	614	545	747	1258	1179	1663	847
	7	1153	1185	1433	1321	903	801	758	1608	1408	1663	1753	1182
	8	1288	1558	1703	1399	1237	1379	1713	1808	1758	1753	1934	1182
	9	1661	1828	2048	1586	1754	2034	2476	2487	1848	2088	2037	1317
	10	1931	2173	2120	2044	2424	2638	2798	2577	2183	2088	2223	1690
	11	2276	2834	2259	2699	2661	2988	3078	2912	2183	2223	2463	1960
	12	2937	3112	2914	3144	3011	3078	3362	2912	2318	2596	2866	2305
Wauchope	1	23	0	38	22	2	0	0	0	0	34	5	28
	2	298	193	119	106	57	13	10	36	40	52	198	51
	3	506	398	360	161	65	20	40	133	81	310	390	459
	4	711	562	500	233	72	162	141	256	323	572	625	695
	5	1090	708	510	251	250	291	407	612	596	994	1002	900
	6	1276	1076	528	534	418	485	722	635	1111	1236	1207	1360
	7	1300	1235	811	574	691	739	877	1286	1320	1426	1526	1415
	8	1459	1383	851	1067	1086	1025	1358	1654	1510	1803	1581	1439
	9	1607	1699	1495	1190	1175	1436	1844	2088	1924	2055	1605	1598
	10	1889	1971	1597	1326	1796	1882	2304	2138	2215	2120	1764	1746
	11	2195	2141	1620	1977	2478	2512	2450	2485	2280	2200	1912	2066
	12	2578	2164	2271	2675	2628	2562	2689	2702	2360	2445	2232	2334

FORBES RIVER AT BIRDWOOD

LOCATION OF GAUGE:	Latitude 31°24'S Longitude 152°19'E
PERIOD OF ESTABLISHMENT:	July 1955 to date
COMPLETE YEARS OF COMPUTED RECORDS:	11
ZERO OF GAUGE:	R.L. 42.32 Assumed Datum. Approximately 600 feet above mean sea level.
CATCHMENT AREA:	140 square miles
CONTROL:	Rock
EQUIPMENT:	Automatic recorder (pressure type) installed February 1961. Staff gauge, range 0 to 25 feet.
CURRENT METER OBSERVATIONS:	(a) Number obtained : 80
	(b) Maximum observation in cusecs : 1247
	(c) Minimum observation in cusecs : 1
MAXIMUM ESTIMATED DISCHARGE DURING PERIODS OF RECORDS:	20,200 cusecs
MEAN DISCHARGE FOR 11 YEARS:	247 cusecs
MEAN ANNUAL DISCHARGE FOR 11 YEARS:	180,000 acre feet.
REMARKS:	Streamflow records for this station are shown to June 1967 and the maximum estimated discharge of 20,200 cusecs indicated above occurred prior to that date. However, in January 1968 this station experienced the highest flood since the commencement of records in 1955, the estimated peak discharge being 23,000 cusecs.

FORBES RIVER AT BIRDWOOD

Year 1955

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	..	..	..	..
Feb.	..	..	..	..
Mar.	..	..	..	..
Apr.	..	..	..	..
May	..	..	..	..
June	..	..	..	..
July	..	..	..	..
Aug.	75	64	68	4,190
Sept.	75	51	58	3,502
Oct.	No Records			
Nov.	No Records			
Dec.	No Records			
Total	..	..	..	..

Year 1956

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	1360	45	251	15,534
Feb.	14700	420	2837	164,520
Mar.	11700	770	2967	183,980
Apr.	2840	58	798	47,876
May	3400	314	527	32,668
June	1540	254	530	31,772
July	1360	87	512	31,722
Aug.	105	51	67	4,124
Sept.	58	39	47	2,844
Oct.	45	29	35	2,154
Nov.	24	19	22	1,302
Dec.	29	14	19	1,154
Total	..	..	..	519,650

Year 1957

Jan.	34	7	16.7	1,030
Feb.	No Records			23,000*
Mar.	No Records			18,000*
Apr.	95	55	73	4,372
May	55	20	35	2,142
June	41	20	25	1,472
July	27	11	16.5	1,024
Aug.	226	11	42	2,604
Sept.	87	5.5	21	1,252
Oct.	20	5.5	8	496
Nov.	11	4	6.4	386
Dec.	6.5	4	4.9	304
Total	..	..	..	56,082*

Year 1958

Jan.	20	5.5	11.7	726
Feb.	138	5.5	32	1,794
Mar.	348	5.5	83	5,130
Apr.	226	71	102	6,112
May	71	9.3	28	1,754
June	2600	9.3	901	54,088
July	105	13.0	37	2,272
Aug.	120	6.3	35	2,186
Sept.	83	9.3	33	2,008
Oct.	67	9.3	27	1,674
Nov.	22	4.7	13.1	784
Dec.	201	4.7	36	2,242
Total	..	..	..	80,770

* Estimated

FORBES RIVER AT BIRDWOOD

Year 1959					Year 1960				
Month	Discharge in Cusecs			Discharge for Month Acre Feet	Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean			Max.	Min.	Mean	
Jan.	13200	44	1146	71,078	Jan.	390	82	177	10,956
Feb.	4310	105	558	31,232	Feb.	1585	142	389	22,586
Mar.	1405	105	769	47,658	Mar.	3560	220	1055	65,392
Apr.	No Records			20,000*	Apr.	620	118	214	12,864
May	No Records			6,000*	May	390	76	130	8,030
June	No Records			5,000*	June	230	88	113	6,800
July	620	51	183	11,346	July	94	55	71	4,388
Aug.	118	51	83	5,136	Aug.	55	36	45	2,798
Sept.	810	94	197	11,848	Sept.	43	31	35	2,082
Oct.	335	60	133	8,228	Oct.	186	24	36	2,250
Nov.	20180	194	1288	77,310	Nov.	31	20	23	1,400
Dec.	310	106	193	11,978	Dec.	60	24	32	1,984
Total	..	..	..	306,814*	Total	..	..	..	141,530

Year 1961					Year 1962				
Jan.	260	24	89	5,528	Jan.	2910	154	510	31,600
Feb.	4400	54	291	16,294	Feb.	620	118	211	11,830
Mar.	126	63	95	5,904	Mar.	1122	118	331	20,500
Apr.	113	38	65	3,872	Apr.	19120	170	1435	86,100
May	63	38	49	3,044	May	3050	118	347	21,500
June	1900	100	321	19,232	June	154	84	111	6,650
July	100	45	58	3,616	July	11700	84	563	34,900
Aug.	74	29	45	2,760	Aug.	203	84	130	8,050
Sept.	54	29	36	2,148	Sept.	84	58	71	4,230
Oct.	420	23	117	7,264	Oct.	130	52	60	3,720
Nov.	118	38	63	3,800	Nov.	94	34	46	2,760
Dec.	203	75	104	6,440	Dec.	4640	28	354	21,900
Total	..	..	..	79,902	Total	..	..	..	253,740

* Estimated

FORBES RIVER AT BIRDWOOD

Year 1963

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	5940	106	526	32,600
Feb.	335	75	161	9,030
Mar.	2540	154	733	45,500
Apr.	15420	154	900	54,000
May	18450	310	1967	122,000
June	1540	154	298	17,900
July	420	118	206	12,800
Aug.	106	75	95	5,910
Sept.	2600	52	238	14,300
Oct.	585	130	261	16,200
Nov.	1675	124	295	17,700
Dec.	1450	170	469	29,100
Total	..	..	..	377,040

Year 1964

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	1675	106	204	12,640
Feb.	975	75	164	9,498
Mar.	7200	154	525	32,600
Apr.	3190	94	347	20,600
May	220	94	139	8,600
June	130	66	84	5,050
July	66	46	51	3,140
Aug.	118	28	41	2,520
Sept.	34	28	32	1,920
Oct.	34	23	27	1,654
Nov.	34	11	17	1,024
Dec.	40	5.5	14.5	897
Total	..	..	..	100,143

Year 1965

Jan.	58	18	31	1,916
Feb.	40	18	29	1,606
Mar.	40	8	13	786
Apr.	34	5.5	12	740
May	14	8	11	694
June	11	5.5	7.6	457
July	6300	8	195	12,100
Aug.	40	23	27	1,682
Sept.	310	15	24	1,424
Oct.	31	11	18	1,112
Nov.	360	1.6	12.2	732
Dec.	2480	75	356	22,100
Total	..	..	..	45,349

Year 1966

Jan.	66	20	34	2,086
Feb.	No Records			4,200*
Mar.	No Records			2,000*
Apr.	203	20	42	2,494
May	44	25	35.5	2,202
June	75	20	35	2,074
July	20	11	17	1,056
Aug.	15	11	13	778
Sept.	37	15	18	1,066
Oct.	15	8	13	812
Nov.	655	11	40	2,418
Dec.	15	11	14	842
Total	..	..	..	22,028*

* Estimated

FORBES RIVER AT BIRDWOOD

Year 1967

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	1100	11	109	6,730
Feb.	1100	51	203	11,400
Mar.	2240	154	604	37,500
Apr.	1810	130	422	25,300
May	130	58	83	5,170
June	14050	51	1773	106,000
July				
Aug.				
Sept.				
Oct.				
Nov.				
Dec.				
Total				

ELLENBOROUGH RIVER AT GLENWARREN

LOCATION OF GAUGE:	Latitude 31°37'S Longitude 152°17'E
PERIOD OF ESTABLISHMENT:	September 1936 to September 1961
COMPLETE YEARS OF COMPUTED RECORDS:	24
ZERO OF GAUGE:	R.L. 22.84 Assumed Datum Approximately 2,500 feet above mean sea level.
CATCHMENT AREA:	27 square miles.
CONTROL:	Rock.
EQUIPMENT:	Automatic recorder (Pressure type) installed February 1956. Staff gauge range 0-15 feet.
CURRENT METER OBSERVATIONS:	(a) Number obtained : 72
	(b) Maximum observation in cusecs : 165
	(c) Minimum observation in cusecs : 3
MAXIMUM ESTIMATED DISCHARGE DURING PERIOD OF RECORDS:	12,300 cusecs
MEAN DISCHARGE FOR 24 YEARS:	56 cusecs
MEAN ANNUAL DISCHARGE FOR 24 YEARS:	40,800 acre feet

ELLENBOROUGH RIVER AT GLENWARREN

Year 1937

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	415	16	60	3,730
Feb.	585	14	57	3,206
Mar.	2450	48	192	11,890
Apr.	58	39	49	2,946
May	44	14	26	1,624
June	920	14	91	5,478
July	94	31	54	3,326
Aug.	31	18	21	1,290
Sept.	18	14	15	880
Oct.	48	14	19	1,160
Nov.	1280	18	183	11,000
Dec.	39	18	23	1,450
Total	..	..	..	47,980

Year 1938

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	2020	14	130	8,084
Feb.	160	24	57	3,200
Mar.	24	14	17	1,112
Apr.	5960	14	484	23,216
May	700	16	61	3,798
June	16	7	9	560
July	8.5	6	7	438
Aug.	12	7	8	518
Sept.	12	8.5	9	549
Oct.	10	7	8	506
Nov.	22	7	11	690
Dec.	7	5.5	6	382
Total	..	..	..	43,053

Year 1939

Jan.	152	5	13	819
Feb.	16	5.5	7	404
Mar.	6500	5	421	26,123
Apr.	156	34	77	4,604
May	34	27	32	1,960
June	27	12	17	990
July	12	9	10	582
Aug.	16	5.5	7	404
Sept.	970	5.5	29	1,754
Oct.	300	14	45	2,772
Nov.	48	14	23	1,380
Dec.	39	14	18	1,132
Total	..	..	..	42,924

Year 1940

Jan.	18	7.5	11	680
Feb.	7.5	6	7	406
Mar.	250	6	21	1,314
Apr.	9	4	6	376
May	5	4	5	302
June	5	4	4	268
July	5	4	5	298
Aug.	9	4	6	360
Sept.	5	4	4	242
Oct.	12	4	6	342
Nov.	4	3	4	258
Dec.	104	5	20	1,264
Total	..	..	..	6,110

ELLENBOROUGH RIVER AT GLENWARREN

Year 1941

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	156	5	24	1,510
Feb.	1390	18	107	6,004
Mar.	24	11	17	1,080
Apr.	39	11	14	854
May	11	7.5	8	520
June	9	6	7	448
July	9	6	7	408
Aug.	7.5	6	6	378
Sept.	6	4.5	6	342
Oct.	7.5	6	6	387
Nov.	14	6	8	483
Dec.	7.5	4	6	375
Total	..	..	..	12,789

Year 1942

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	7.5	4.5	6	398
Feb.	31	7.5	11	639
Mar.	620	7.5	52	3,251
Apr.	21	7	12	720
May	34	5	8	488
June	12	5	6	380
July	63	4	11	702
Aug.	9	4	5	302
Sept.	5	4	4	242
Oct.	4210	5	421	26,094
Nov.	415	39	76	4,584
Dec.	700	31	66	4,104
Total	..	..	..	41,904

Year 1943

Jan.	970	24	94	5,814
Feb.	48	14	20	1,138
Mar.	58	11	18	1,084
Apr.	31	11	15	922
May	1820	7.5	146	9,060
June	108	14	32	1,932
July	18	14	17	1,068
Aug.	124	11	25	1,578
Sept.	39	18	22	1,310
Oct.	48	18	25	1,532
Nov.	415	18	93	5,604
Dec.	480	31	96	5,946
Total	..	..	..	36,988

Year 1944

Jan.	7940	48	210	13,004
Feb.	160	31	55	3,192
Mar.	58	18	26	1,610
Apr.	31	14	18	1,102
May	18	14	15	940
June	24	18	19	1,128
July	69	18	27	1,652
Aug.	1390	18	110	6,834
Sept.	30	8.5	12	731
Oct.	69	7	12	714
Nov.	12	7	9	549
Dec.	7	5.5	6	371
Total	..	..	..	31,827

ELLENBOROUGH RIVER AT GLENWARREN

Year 1945

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	40	5.5	9	567
Feb.	40	5.5	10	539
Mar.	12	5.5	6	392
Apr.	107	5.5	10	620
May	40	5.5	9	563
June	5690	8.5	289	17,348
July	1630	8.5	85	5,299
Aug.	16	5.5	9	524
Sept.	5.5	4.5	5	294
Oct.	4.5	3.5	4	251
Nov.	325	3.5	39	2,313
Dec.	63	16	20	1,232
Total	..	..	..	29,942

Year 1946

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	16	9	12	766
Feb.	63	6	16	910
Mar.	10640	9	366	22,706
Apr.	1280	27	122	7,300
May	42	12	20	1,236
June	16	9	12	710
July	12	9	10	600
Aug.	12	9	10	610
Sept.	11	9	10	562
Oct.	9	3.4	6	356
Nov.	8	4	5.3	318
Dec.	8	4	5.3	328
Total	..	..	..	36,402

Year 1947

Jan.	69	2.8	7.2	448
Feb.	1630	4	142	7,952
Mar.	1630	26	88	5,448
Apr.	300	32	98	5,926
May	40	21	24	1,460
June	152	21	29	1,744
July	21	12	15	946
Aug.	12	7.5	10	612
Sept.	7.5	7.5	7.5	450
Oct.	9.5	7.5	8	497
Nov.	40	7.5	13	790
Dec.	5420	16	249	15,488
Total	..	..	..	41,761

Year 1948

Jan.	69	39	46	2,880
Feb.	39	24	32	1,876
Mar.	180	18	42	2,596
Apr.	39	31	34	2,020
May	335	18	53	3,296
June	5420	14	315	18,810
July	48	18	29	1,804
Aug.	24	18	19	1,152
Sept.	160	18	43	2,574
Oct.	48	18	24	1,484
Nov.	18	11	15	928
Dec.	14	11	12	742
Total	..	..	..	40,162

ELLENBOROUGH RIVER AT GLENWARREN

Year 1949

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	24	11	14	842
Feb.	300	11	40	2,256
Mar.	480	48	114	7,074
Apr.	225	58	96	5,740
May	160	31	59	3,632
June	160	18	34	2,036
July	4380	14	235	14,544
Aug.	5420	24	318	19,694
Sept.	582	41	74	4,446
Oct.	63	24	38	2,348
Nov.	217	24	42	2,504
Dec.	48	16	27	1,656
Total	..	..	..	66,772

Year 1950

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	836	16	70	4,366
Feb.	836	20	112	6,260
Mar.	63	29	34	2,120
Apr.	156	29	55	3,344
May	41	20	31	1,890
June	5070	20	527	31,646
July	582	41	174	10,776
Aug.	2360	35	147	9,092
Sept.	48	29	35	2,116
Oct.	108	29	47	2,920
Nov.	931	29	135	8,108
Dec.	108	35	55	3,416
Total	..	..	..	86,054

Year 1951

Jan.	3690	55	401	24,852
Feb.	217	48	87	4,898
Mar.	836	41	94	5,820
Apr.	63	29	41	2,434
May	29	20	25	1,554
June	5960	20	232	13,942
July	41	24	33	2,042
Aug.	24	20	22	1,384
Sept.	20	16	18	1,104
Oct.	16	13	15	938
Nov.	13	10	13	762
Dec.	13	10	11	674
Total	..	..	..	60,404

Year 1952

Jan.	24	10	14	886
Feb.	217	8	26	1,480
Mar.	72	16	32	1,990
Apr.	29	16	20	1,210
May	24	13	16	966
June	55	13	18	1,096
July	63	10	17	1,028
Aug.	2360	24	226	14,032
Sept.	35	20	24	1,466
Oct.	29	16	23	1,406
Nov.	20	13	14	812
Dec.	24	10	13	832
Total	..	..	..	27,204

ELLENBOROUGH RIVER AT GLENWARREN

Year 1953

Month	Discharge for Month			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	35	7	14	894
Feb.	582	13	89	4,976
Mar.	4640	29	144	8,900
Apr.	82	29	45	2,676
May	82	24	35	2,144
June	24	16	18	1,096
July	16	13	14	884
Aug.	13	10	11	680
Sept.	10	8	9	544
Oct.	8	6.5	7	440
Nov.	8	4.5	6	353
Dec.	13	4	5	324
Total	..	..	..	23,911

Year 1954

Month	Discharge for Month			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	55	5	17	1,031
Feb.	7060	6.5	303	16,957
Mar.	41	16	25	1,572
Apr.	16	10	13	786
May	13	8	9	580
June	48	10	14	866
July	41	8	18	1,100
Aug.	16	13	14	836
Sept.	1900	13	110	6,594
Oct.	2520	20	109	6,772
Nov.	139	29	50	3,016
Dec.	94	16	26	1,610
Total	..	..	..	41,720

Year 1955

Jan.	241	16	33	2,076
Feb.	2850	29	242	13,556
Mar.	1760	82	195	12,116
Apr.	1130	63	227	13,614
May	156	41	65	4,056
June	48	24	32	1,932
July	24	24	24	1,488
Aug.	24	16	18	1,104
Sept.	17	13	14	820
Oct.	300	13	24	1,506
Nov.	37	10	14	868
Dec.	No Records			3,600*
Total	..	..	..	56,756*

Year 1956

Jan.	330	13	38	2,372
Feb.	12300	72	593	34,370
Mar.	6870	135	455	28,240
Apr.	770	43	102	6,106
May	2600	34	94	5,844
June	1690	28	77	4,630
July	55	26	34	2,108
Aug.	43	21	27	1,702
Sept.	26	17	21	1,254
Oct.	26	17	20	1,244
Nov.	23	10	14	868
Dec.	No Records			700*
Total	..	..	..	89,438*

* Estimated.

ELLENBOROUGH RIVER AT GLENWARREN

Year 1957

Month	Discharge for Month			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	37	8	11	660
Feb.	3100	10	190	10,648
Mar.	585	31	61	3,802
Apr.	31	17	20	1,196
May	17	13	15	902
June	13	10	11	656
July	10	9	10	596
Aug.	450	8	27	1,678
Sept.	26	10	15	904
Oct.	17	8	9	572
Nov.	37	5	8	478
Dec.	10	5	6	390
Total	..	..	..	22,482

Year 1958

Month	Discharge for Month			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	37	5	9	542
Feb.	51	7	12	672
Mar.	13	6.5	7.4	456
Apr.	72	6	14	860
May	13	9	10	600
June	480	9	43	2,594
July	37	15	21	1,306
Aug.	60	13	18	1,136
Sept.	17	10	14	820
Oct.	13	10	12	722
Nov.	10	6	8	480
Dec.	250	8	15	932
Total	..	..	..	11,120

Year 1959

Jan.	1900	13	133	8,272
Feb.	1300	31	98	5,496
Mar.	435	31	91	5,634
Apr.	420	43	64	3,868
May	40	22	30	1,868
June	655	16	29	1,768
July	360	20	41	2,560
Aug.	115	20	36	2,244
Sept.	115	25	36	2,130
Oct.	1180	25	45	2,782
Nov.	4120	25	222	13,300
Dec.	135	25	41	2,528
Total	..	..	..	52,450

Year 1960

Jan.	175	25	32	1,982
Feb.	2440	16	80	4,624
Mar.	3860	31	200	12,374
Apr.	43	25	32	1,920
May	25	16	22	1,368
June	43	20	22	1,318
July	25	16	19	1,190
Aug.	20	16	17	1,072
Sept.	16	10	12	708
Oct.	37	9	12	752
Nov.	9	6.5	8	476
Dec.	20	6.5	9.7	600
Total	..	..	..	28,384

ELLENBOROUGH RIVER AT GLENWARREN

Year 1961

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	690	9	32	1,982
Feb.	1080	9	52	3,032
Mar.	22	14	18	1,112
Apr.	14	12	13	772
May	31	6.5	9.7	604
June	1300	12	88	5,298
July	31	14	20	1,262
Aug.	115	12	19	1,178
Sept.	115	12	20	1,254
Oct.				
Nov.				
Dec.				
Total	..	..	..	..

BIG CREEK AT ELANDS

LOCATION OF GAUGE:	Latitude 31°37'S Longitude 152°17'E.
PERIOD OF ESTABLISHMENT:	September, 1936 to September, 1961.
COMPLETE YEARS OF COMPUTED RECORDS:	24
ZERO OF GAUGE:	R.L. 28.02 Assumed Datum. Approximately 2,500 feet above mean sea level.
CATCHMENT AREA:	3.5 square miles.
CONTROL:	Rock.
EQUIPMENT:	Automatic recorder (pressure type) installed February, 1956. Staff gauge range 0-15 feet.
CURRENT METER OBSERVATIONS:	(a) Number obtained : 75 (b) Maximum observation in cusecs : 38 (c) Minimum observation in cusecs : 0.3
MAXIMUM ESTIMATED DISCHARGE DURING PERIOD OF RECORDS:	4,900 cusecs.
MEAN DISCHARGE FOR 24 YEARS:	11 cusecs.
MEAN ANNUAL DISCHARGE FOR 24 YEARS:	7,700 acre feet.

BIG CREEK AT ELANDS

Year 1937					Year 1938				
Month	Discharge in Cusecs			Discharge for Month Acre Feet	Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean			Max.	Min.	Mean	
Jan.	117	1.2	16	961	Jan.	158	3	14	877
Feb.	61	3	12	677	Feb.	16	45	8.8	492
Mar.	211	6.5	18	1105	Mar.	5.5	3	3.9	241
Apr.	8.5	3	5	307	Apr.	620	3	40	2,374
May	4.5	1.2	3.4	209	May	85	3	9	572
June	158	3	21	1,243	June	11	3.7	5.9	352
July	10.5	4.5	7.8	481	July	4.5	2.5	3.1	193
Aug.	4.5	3	3	198	Aug.	4.5	2	3.1	190
Sept.	3	2.5	2.9	171	Sept.	4.5	2.5	3.2	200
Oct.	3	2	2.7	170	Oct.	3	2	2.7	168
Nov.	158	3.7	25	1,522	Nov.	8.5	2	3.5	211
Dec.	11	3	4.9	302	Dec.	2	1.2	1.5	95
Total	..	..	..	7,346	Total	..	..	..	5,965

Year 1939					Year 1940				
Jan.	34	1.2	4.4	270	Jan.	4.3	2	2.4	151
Feb.	11	2	3.6	201	Feb.	2.7	0.4	1.4	80
Mar.	280	2	31	1,889	Mar.	4.5	0.8	1.8	111
Apr.	22	5	8.9	534	Apr.	2	0.5	0.8	49
May	7	2.7	4.4	273	May	1.1	0.5	0.7	44
June	2.8	2	2.4	147	June	0.6	0.5	0.5	31
July	2	1	1.7	104	July	0.6	0.4	0.5	28
Aug.	3.5	1	2	123	Aug.	0.8	0.5	0.6	37
Sept.	90	1	4.9	292	Sept.	0.8	0.4	0.5	31
Oct.	60	3.5	10	638	Oct.	2.5	0.5	1	59
Nov.	9	2	4.7	280	Nov.	19	0.5	1.2	72
Dec.	2.7	1	1.9	120	Dec.	123	1.3	9.4	585
Total	..	..	..	4,871	Total	..	..	..	1,278

BIG CREEK AT ELANDS

Year 1941

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	25	2	6.5	403
Feb.	211	2	12	663
Mar.	4.5	2	2.4	149
Apr.	2.5	1.3	1.7	101
May	1.3	0.8	1.2	74
June	1.7	0.8	1.3	80
July	2.5	0.8	1	82
Aug.	1.3	0.8	0.9	57
Sept.	0.8	0.5	0.6	34
Oct.	3	0.5	2.2	135
Nov.	3.7	1.2	2.2	131
Dec.	2	0.9	1.2	75
Total	..	..	..	1,984

Year 1942

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	3.8	0.6	1.3	79
Feb.	11	2	4.6	278
Mar.	58	3	12	734
Apr.	11	3.5	5.6	346
May	3.5	2	2.5	157
June	4.2	2	2.5	148
July	5	1	2.8	174
Aug.	2.8	0.4	1.8	110
Sept.	1	0.4	0.8	47
Oct.	1410	0.4	90	5,557
Nov.	25	1.3	5.4	326
Dec.	11	0.8	4.3	270
Total	..	..	..	8,226

Year 1943

Jan.	64	3	10	640
Feb.	4.5	1.3	2.8	158
Mar.	6	0.5	1.1	72
Apr.	4.5	0.8	1.1	67
May	420	0.8	24	1,460
June	16	0.8	4.1	243
July	0.8	0.5	0.6	40
Aug.	16	0.5	2.7	170
Sept.	13	0.8	1.5	93
Oct.	13	2	4.6	286
Nov.	29	3	14	818
Dec.	64	4	15	936
Total	..	..	..	4,983

Year 1944

Jan.	2800	8	79	4,892
Feb.	2420	4.5	50	2,914
Mar.	11	4	5	334
Apr.	5	2	3	202
May	2	1.3	2	105
June	1.3	1	1.2	74
July	4.5	1	2	116
Aug.	184	1.3	15	920
Sept.	8	2	5	276
Oct.	2	2	2	124
Nov.	2	1.3	1.4	86
Dec.	2	1.3	1.3	82
Total	..	..	..	10,125

BIG CREEK AT ELANDS

Year 1945

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	29	1.3	3	172
Feb.	8	1.3	3	145
Mar.	8	1.3	3	175
Apr.	8	1.3	2	140
May	8	2	2.4	150
June	2060	3	108	6,487
July	600	5.2	35	2,147
Aug.	5.2	2	2.8	172
Sept.	2	1	1.4	86
Oct.	2	1	1.1	70
Nov.	70	1	6.8	412
Dec.	7.2	1	2.4	154
Total	..	..	..	10,310

Year 1946

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	3.5	1	1.4	86
Feb.	17	1	2.3	127
Mar.	3600	2	109	6,782
Apr.	64	7	13	803
May	9.4	3.5	5.2	320
June	3.5	2	2.5	153
July	2	1	1.2	74
Aug.	1	0.5	0.7	45
Sept.	1	0.5	0.5	33
Oct.	1	0.5	0.6	38
Nov.	0.5	0.3	0.4	23
Dec.	9.4	0.5	1.2	74
Total	..	..	..	8,558

Year 1947

Jan.	20	0.3	1.1	71
Feb.	92	2	23	1,281
Mar.	166	7.2	16	1,021
Apr.	25	7.2	12	748
May	22	5.2	8	458
June	17	3.5	7	393
July	3.5	2	3	181
Aug.	2	1	1.8	114
Sept.	2	1	1	64
Oct.	3.5	0.5	0.8	48
Nov.	12	0.5	2.9	173
Dec.	1120	5	35	2,146
Total	..	..	..	6,698

Year 1948

Jan.	25	5.2	8.4	522
Feb.	5.2	2	3.4	199
Mar.	39	3.5	11	668
Apr.	9.4	3.2	6.1	363
May	58	3.5	8.7	540
June	1770	2	49	2,930
July	7.2	3.5	4.6	285
Aug.	3.5	2	2.7	169
Sept.	39	2	7.3	440
Oct.	7.2	2	3.7	229
Nov.	2	1	1.7	104
Dec.	5.2	0.5	0.9	58
Total	..	..	..	6,507

BIG CREEK AT ELANDS

Year 1949

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	3.5	1	1.1	73
Feb.	48	1	7	395
Mar.	166	14.2	38	2,356
Apr.	22	9.4	11.6	696
May	9.4	7.2	7.8	486
June	14	5.2	6.1	366
July	990	3.5	42	2,572
Aug.	1360	5.2	94	5,844
Sept.	19	8	11	638
Oct.	13	4.5	6	392
Nov.	13	3	5	320
Dec.	8	1.3	4	234
Total	..	..	..	14,372

Year 1950

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	58	1.3	5	298
Feb.	70	1.3	12	698
Mar.	4.5	2	2	149
Apr.	52	2	9	552
May	6	2	3.3	204
June	420	2	57	3,422
July	92	10.3	29	1,818
Aug.	125	5.5	17	1,049
Sept.	7.7	3.7	4.3	256
Oct.	37	5.5	8.2	507
Nov.	134	3.7	30	1,782
Dec.	168	3.7	36	2,248
Total	..	..	..	12,983

Year 1951

Jan.	195	13.5	72	4,480
Feb.	53	5.5	17.4	974
Mar.	78	3.7	11	684
Apr.	7.7	3.7	4.5	270
May	3.7	1.5	2.7	170
June	92	1.5	22	1,342
July	7.7	2.5	4.4	270
Aug.	3.7	2.5	2.5	158
Sept.	2.5	1.1	1.5	89
Oct.	1.2	0.8	1	64
Nov.	0.8	0.4	0.7	44
Dec.	0.4	0.4	0.4	25
Total	..	..	..	8,570

Year 1952

Jan.	1.5	0.4	0.7	45
Feb.	108	0.4	21	1,199
Mar.	92	3.7	36	2,252
Apr.	3.7	1.5	2.7	160
May	3.7	1.5	2	123
June	17	1.5	3.4	206
July	7.7	0.8	2.2	134
Aug.	144	2.5	33	2,036
Sept.	5.5	2.5	3.8	226
Oct.	17	2.5	5.2	324
Nov.	3.7	0.8	1.7	102
Dec.	0.8	0.8	0.8	50
Total	..	..	..	6,857

BIG CREEK AT ELANDS

Year 1953

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	13.5	0.8	2.1	132
Feb.	181	0.8	24	1,336
Mar.	1720	7.7	48	2,850
Apr.	78	3.7	36	2,137
May	17	3.7	6.4	396
June	3.7	2.5	2	181
July	2.5	1.5	1.6	97
Aug.	2.5	1.5	1.6	99
Sept.	1.5	0.4	1.1	67
Oct.	0.4	0.4	0.4	25
Nov.	0.4	0.4	0.4	24
Dec.	1.5	0.4	0.5	33
Total	..	..	..	7,377

Year 1954

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	7.7	0.8	2	123
Feb.	1660	1.5	117	6,532
Mar.	10.3	3.7	5.2	320
Apr.	3.7	1.5	2.5	148
May	5.5	1.5	2.9	182
June	3.7	1.5	2.9	176
July	21	1.5	6.5	400
Aug.	13.5	3.7	4.8	296
Sept.	168	2.5	16.1	964
Oct.	60	7.7	17.4	1,077
Nov.	21	5.5	12.9	772
Dec.	17	3.7	8.4	519
Total	..	..	..	11,509

Year 1955

Jan.	134	2.5	11.8	730
Feb.	144	7.7	46	2,561
Mar.	134	20.5	48	2,994
Apr.	156	21	49	2,908
May	32	5.5	13	806
June	10.3	3.7	5.4	322
July	3.7	2.5	3.1	193
Aug.	2.5	1.5	1.9	117
Sept.	1.8	1.8	1.8	110
Oct.	16	0.9	2.4	146
Nov.	3.3	1.3	1.8	107
Dec.	32	1.3	12.8	791
Total	..	..	..	11,785

Year 1956

Jan.	58	3.3	9.9	616
Feb.	4900	13	123	7,108
Mar.	1560	16	54	3,374
Apr.	870	5	16	972
May	870	3.3	34	2,127
June	64	3.3	8.3	500
July	9.7	3.3	5.2	324
Aug.	3.3	2	2.9	178
Sept.	2	1.5	1.9	113
Oct.	27	1.3	2.2	139
Nov.	1.3	0.9	1.1	67
Dec.	7.2	0.9	1.7	100
Total	..	..	..	15,618

BIG CREEK AT ELANDS.

Year 1957

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	1.3	0.9	1.1	68
Feb.	930	0.9	41	2,287
Mar.	85	3.3	9.8	605
Apr.	3.3	1.3	2.4	145
May	1.3	1.3	1.3	80
June	1.1	0.9	1	62
July	13	0.9	1.1	67
Aug.	116	0.5	3.8	238
Sept.	4.2	1.1	2.2	129
Oct.	1.1	0.5	0.9	57
Nov.	1.7	0.5	0.9	54
Dec.	0.5	0.2	0.5	29
Total	..	..	..	3,821

Year 1958

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	2.6	0.5	0.7	44
Feb.	3.3	0.5	1.3	73
Mar.	2	0.5	0.9	56
Apr.	45	0.5	2.9	174
May	3.3	1.3	2.1	128
June	139	1.3	10	600
July	7.2	2	3.8	239
Aug.	7.2	2	2.5	153
Sept.	2	1.6	1.8	110
Oct.	2	1.3	1.6	100
Nov.	1.6	0.9	1.2	73
Dec.	300	1.1	5.2	323
Total	..	..	..	2,073

Year 1959

Jan.	1030	3.3	35	2,154
Feb.	670	7.2	24.5	1,373
Mar.	450	5	16.5	1,023
Apr.	20	4.6	9.3	556
May	4.6	2	3.2	196
June	420	1.2	4.6	276
July	78	3.3	6.6	410
Aug.	23	3.3	4.5	278
Sept.	27	2	5	301
Oct.	195	2	7.6	473
Nov.	1460	7.2	47	2,803
Dec.	34	3.3	6.2	383
Total	..	..	..	10,226

Year 1960

Jan.	40	2	4.1	255
Feb.	250	2	7.5	437
Mar.	420	7.2	19	1,189
Apr.	7.2	2.6	4	242
May	5	2	2.3	140
June	7.2	2	3.1	187
July	3	1.6	1.9	119
Aug.	1.6	0.8	1	62
Sept.	0.8	0.8	0.8	48
Oct.	58	0.4	5	299
Nov.	0.8	0.4	0.5	31
Dec.	5.9	0.4	1.3	83
Total	..	..	..	3,092

BIG CREEK AT ELANDS

Year 1961

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	181	1.6	7.2	452
Feb.	450	0.8	14.2	812
Mar.	7	2.3	4.2	262
Apr.	5.8	1.2	2.2	137
May	32	1.2	2.3	143
June	640	2.3	23	1,408
July	3.8	1.2	2.3	142
Aug.	40	0.8	2.1	130
Sept.	36	0.8	2.8	165
Oct.				
Nov.				
Dec.				
Total	..	..	..	..

ELLENBOROUGH RIVER AT ELANDS

LOCATION OF GAUGE:	Latitude 31°36'S. Longitude 152°20'E.
PERIOD OF ESTABLISHMENT:	May 1918 to August 1931
COMPLETE YEARS OF COMPUTED RECORDS:	11
ZERO OF GAUGE:	R.L. 91.42 Assumed Datum. Approximately 2,000 feet above mean sea level.
CATCHMENT AREA:	31 square miles.
CONTROL:	Rock
EQUIPMENT:	Staff gauge range 0 to 10 feet
CURRENT METER OBSERVATIONS:	(a) Number obtained : 17
	(b) Maximum observation in cusecs : 411
	(c) Minimum observation in cusecs : 4.7
MAXIMUM ESTIMATED DISCHARGE DURING PERIOD OF RECORDS:	8,600 cusecs
MEAN DISCHARGE FOR 11 YEARS:	123 cusecs
MEAN ANNUAL DISCHARGE FOR 11 YEARS:	90,000 acre feet

ELLENBOROUGH RIVER AT ELANDS

Year 1918

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	..	..	..	..
Feb.	..	..	..	..
Mar.	..	..	..	..
Apr.	..	..	..	..
May	49	17	29	1,794
June	58	17	28	1,692
July	175	17	44	2,730
Aug.	89	17	39	2,404
Sept.	115	14	35	2,090
Oct.	89	21	38	2,376
Nov.	21	14	17	1,016
Dec.	49	10	18	1,104
Total	..	..	..	..

Year 1919

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	58	9	24	1,512
Feb.	12	6	10	540
Mar.	320	7	21	1,324
Apr.	208	12	26	1,600
May	1440	17	426	26,438
June	205	5	15	896
July	11	4	7	456
Aug.	9	5	7	424
Sept.	14	5	7	446
Oct.	7	5	6	358
Nov.	9	5	8	470
Dec.	9	4	6	372
Total	..	..	..	34,836

Year 1920

Jan.	24	7	16	964
Feb.	18	7	11	632
Mar.	18	9	13	828
Apr.	24	8	14	826
May	11	7	9	544
June	14	7	10	576
July	167	7	50	3,106
Aug.	167	5	36	2,248
Sept.	24	2	8	472
Oct.	9	2	5	302
Nov.	72	5	43	2,580
Dec.	14	5	9	544
Total	..	..	..	13,622

Year 1921

Jan.	2240	5	966	59,916
Feb.	1440	16	565	31,648
Mar.	795	16	284	17,608
Apr.	286	16	111	6,654
May	2690	16	441	27,356
June	4280	9	413	24,792
July	8570	5	891	55,268
Aug.	167	5	10	640
Sept.	5	5	5	300
Oct.	24	5	7	412
Nov.	29	5	18	1,052
Dec.	3180	2	406	25,144
Total	..	..	..	250,790

ELLENBOROUGH RIVER AT ELANDS

Year 1922					Year 1923				
Month	Discharge in Cusecs			Discharge for Month Acre Feet	Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean			Max.	Min.	Mean	
Jan.	205	5	35	2,192	Jan.	29	7	14	882
Feb.	3990	6	1269	71,054	Feb.	6	4	5	258
Mar.	720	5	101	6,236	Mar.	7	3	4	274
Apr.	72	27	36	2,148	Apr.	167	4	48	2,904
May	72	7	19	1,170	May	375	24	172	10,640
June	445	5	69	4,154	June	1080	24	119	7,110
July	4890	21	1269	78,666	July	19	4	6	346
Aug.	3710	9	424	26,276	Aug.	31	3	7	439
Sept.	1860	5	257	15,414	Sept.	6	0.8	2	145
Oct.	29	5	10	618	Oct.	4	0.8	2	137
Nov.	86	2	23	1,380	Nov.	6	2	5	278
Dec.	86	11	33	2,064	Dec.	58	4	9	576
Total	..	..	..	211,372	Total	..	..	..	23,989

Year 1924					Year 1925				
Jan.	750	6	73	4,526	Jan.	208	14	36	2,216
Feb.	49	9	16	912	Feb.	450	14	65	3,650
Mar.	208	9	22	1,340	Mar.	208	17	60	3,742
Apr.	360	12	74	4,438	Apr.	750	12	69	4,126
May	27	10	15	954	May	1830	27	178	11,060
June	450	10	68	4,066	June	2240	9	305	18,322
July	450	12	63	3,888	July	208	12	56	3,474
Aug.	21	9	13	804	Aug.	49	10	24	1,514
Sept.	17	10	12	730	Sept.	49	12	19	1,138
Oct.	49	7	12	740	Oct.	27	12	15	924
Nov.	208	14	78	4,650	Nov.	450	21	97	5,800
Dec.	1080	17	136	8,446	Dec.	1080	12	62	3,822
Total	..	..	..	35,494	Total	..	..	..	59,788

ELLENBOROUGH RIVER AT ELANDS

Year 1926

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	750	12	97	6,030
Feb.	12	10	11	618
Mar.	49	7	21	1,284
Apr.	243	27	95	5,644
May	1690	12	166	10,280
June	650	14	108	6,480
July	1080	12	165	10,234
Aug.	21	9	12	720
Sept.	No Records			
Oct.	12	7	6	580
Nov.	8	5	6	364
Dec.	2100	5	96	5,974
Total	..	..	..	..

Year 1927

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	700	36	142	8,780
Feb.	115	14	49	2,720
Mar.	17	7	10	604
Apr.	1320	49	250	15,020
May	67	9	25	1,538
June	17	7	11	660
July	14	9	11	670
Aug.	17	7	10	642
Sept.	12	9	10	616
Oct.	21	10	12	758
Nov.	750	10	64	3,868
Dec.	850	67	315	19,528
Total	..	..	..	55,404

Year 1928

Jan.	750	9	131	8,128
Feb.	1830	115	467	27,062
Mar.	144	27	66	4,088
Apr.	144	36	68	4,082
May	49	10	25	1,540
June	2240	6	312	18,722
July	208	12	54	3,330
Aug.	17	7	10	608
Sept.	14	7	10	570
Oct.	20	6	11	704
Nov.	17	9	12	738
Dec.	49	12	18	1,132
Total	..	..	..	70,704

Year 1929

Jan.	208	10	107	6,654
Feb.	4280	89	649	36,334
Mar.	750	27	324	20,094
Apr.	175	12	59	3,556
May	12	6	9	538
June	450	7	26	1,554
July	450	9	64	3,948
Aug.	450	10	51	3,184
Sept.	1830	12	264	15,824
Oct.	1400	12	206	12,792
Nov.	208	12	75	4,488
Dec.	17	6	11	650
Total	..	..	..	109,616

ELLENBOROUGH RIVER AT ELANDS

Year 1930					Year 1931				
Month	Discharge in Cusecs			Discharge for Month Acre Feet	Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean			Max.	Min.	Mean	
Jan.	14	7	11	660	Jan.	115	7	17	1,066
Feb.	27	10	15	812	Feb.	450	10	142	7,932
Mar.	450	12	156	9,676	Mar.	700	14	121	7,478
Apr.	750	27	246	14,762	Apr.	2250	27	301	18,048
May	360	49	124	7,706	May	280	49	102	6,344
June	5760	27	1026	61,560	June	49	12	18	1,082
July	450	67	154	9,568	July	21	12	15	932
Aug.	49	17	25	1,550	Aug.	12	9	11	648
Sept.	36	12	17	1,008	Sept.				
Oct.	450	21	186	11,552	Oct.				
Nov.	144	27	69	4,110	Nov.				
Dec.	49	12	16	1,012	Dec.				
Total	..	..	..	123,976	Total	..	..	..	..

HASTINGS RIVER AT ELLENBOROUGH

LOCATION OF NO. 3 GAUGE:	Latitude 31°27'S. Longitude 152°27'E.
PERIOD OF ESTABLISHMENT:	September 1945 to date
COMPLETE YEARS OF COMPUTED RECORDS:	21
ZERO OF NO. 3 GAUGE:	R.L. 49.54 Assumed Datum
CATCHMENT AREA:	620 square miles
CONTROL:	Gravel
EQUIPMENT:	Automatic recorder (pressure type) installed June, 1964. Staff gauge, range 0-40 feet.
CURRENT METER OBSERVATIONS:	(a) Number obtained : 153
	(b) Maximum observation in cusecs : 42,500
	(c) Minimum observation in cusecs : 19
MAXIMUM ESTIMATED DISCHARGE DURING PERIOD OF RECORDS:	69,000 cusecs
MEAN DISCHARGE FOR 21 YEARS:	886 cusecs
MEAN ANNUAL DISCHARGE FOR 21 YEARS:	647,000 acre feet
REMARKS:	No. 1 Station was located 1 mile U/S of present site and was discontinued in April, 1961.
	No. 2 Station was located ½ mile U/S of No. 1 Station and was discontinued in June, 1964.
	No. 3 Station was established in June 1964 and is located 1½ mile D/S of No. 2 Station.
	Streamflow records for this station are shown to June 1967, and the maximum estimated discharge of 69,000 cusecs indicated above occurred prior to that date. However in January 1968 this station experienced the highest flood since commencement of records in 1945, the estimated peak discharge being 170,000 cusecs.

HASTINGS RIVER AT ELLENBOROUGH

Year 1945

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	..	..	..	..
Feb.	..	..	..	..
Mar.	..	..	..	..
Apr.	..	..	..	..
May	..	..	..	..
June	..	..	..	..
July	..	..	..	..
Aug.	..	..	..	..
Sept.	..	..	..	..
Oct.	150	50	83	5,130
Nov.	2800	40	270	16,220
Dec.	1000	80	231	14,370
Total	..	..	..	..

Year 1946

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	515	60	108	6,720
Feb.	1870	50	296	16,580
Mar.	47000	105	2260	140,112
Apr.	5860	550	1498	89,860
May	515	185	297	18,420
June	185	127	144	8,692
July	127	80	97	5,984
Aug.	66	55	61	3,762
Sept.	80	38	51	3,078
Oct.	110	20	39	2,394
Nov.	55	15	30	1,790
Dec.	110	25	61	3,802
Total	..	..	..	301,194

Year 1947

Jan.	375	25	84	5,210
Feb.	12300	80	2335	130,732
Mar.	7900	515	1569	97,290
Apr.	4420	480	1365	81,910
May	660	315	427	26,490
June	1200	190	394	23,660
July	190	135	156	9,690
Aug.	135	80	107	6,620
Sept.	120	60	75	4,500
Oct.	60	50	58	3,600
Nov.	290	20	99	5,930
Dec.	19300	240	1956	121,290
Total	..	..	..	516,922

Year 1948

Jan.	2300	265	597	37,020
Feb.	450	135	176	10,220
Mar.	5020	105	897	55,640
Apr.	515	80	169	10,110
May	15800	150	1184	73,394
June	22700	135	2469	148,116
July	No Records			26,000*
Aug.	No Records			13,000*
Sept.	No Records			39,000*
Oct.	No Records			20,000*
Nov.	No Records			10,000*
Dec.	No Records			7,500*
Total	..	..	..	450,000*

* Estimated.

HASTINGS RIVER AT ELLENBOROUGH

Year 1949

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	No Records			8,200*
Feb.	6220	85	665	37,248
Mar.	22300	560	4138	256,550
Apr.	2300	220	837	50,192
May	761	302	423	26,222
June	12100	203	1954	117,268
July	33500	186	2673	165,732
Aug.	43300	420	3784	234,630
Sept.	1510	725	1165	69,928
Oct.	1400	347	672	41,658
Nov.	2220	220	644	38,644
Dec.	761	371	541	33,568
Total	..	..	..	1,079,840*

Year 1950

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	15200	220	1122	69,550
Feb.	12600	347	2299	128,720
Mar.	8260	657	1155	71,630
Apr.	10100	657	1534	92,064
May	872	371	601	37,278
June	54000	324	8281	496,848
July	No Records			254,000*
Aug.	No Records			195,000*
Sept.	No Records			37,500*
Oct.	1450	560	878	54,438
Nov.	7300	530	1607	96,444
Dec.	3820	473	1003	62,172
Total	..	..	..	1,595,644*

Year 1951

Jan.	15000	657	3951	244,982
Feb.	5020	910	1775	99,420
Mar.	9160	690	2422	150,194
Apr.	1100	395	709	42,564
May	395	239	291	18,064
June	24500	259	2735	164,092
July	835	347	500	30,982
Aug.	446	220	306	18,988
Sept.	239	165	189	11,320
Oct.	148	101	131	8,098
Nov.	101	60	75	4,474
Dec.	148	36	61	3,808
Total	..	..	..	796,986

Year 1952

Jan.	148	21	65	4,004
Feb.	7900	18	581	33,690
Mar.	1870	210	623	38,650
Apr.	395	132	243	14,596
May	280	88	146	9,040
June	2300	76	265	15,870
July	1100	76	188	11,646
Aug.	36000	473	3946	244,660
Sept.	500	174	318	19,092
Oct.	470	192	268	16,636
Nov.	192	124	154	9,220
Dec.	335	70	111	6,858
Total	..	..	..	423,962

* Estimated.

HASTINGS RIVER AT ELLENBOROUGH

Year 1953

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	183	101	130	8,074
Feb.	15200	132	2170	121,524
Mar.	21000	345	1975	122,426
Apr.	3400	432	845	50,712
May	964	287	541	33,566
June	300	181	227	13,616
July	192	122	161	10,008
Aug.	300	46	123	7,598
Sept.	203	52	116	6,960
Oct.	131	40	68	4,202
Nov.	40	6	27	1,590
Dec.	30	6	12	758
Total	..	..	..	381,034

Year 1954

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	660	9	200	12,372
Feb.	65500	14	2208	123,642
Mar.	750	100	419	25,964
Apr.	397	100	228	13,662
May	511	151	262	16,230
June	1480	116	404	24,212
July	7180	100	844	52,356
Aug.	1000	205	510	31,610
Sept.	18900	116	1471	88,242
Oct.	19900	217	1502	93,110
Nov.	8640	511	1546	92,758
Dec.	1410	456	772	47,874
Total	..	..	..	622,032

Year 1955

Jan.	3500	250	532	33,000
Feb.	28000	482	3879	217,228
Mar.	21900	1400	4975	308,470
Apr.	15800	1610	3379	202,752
May	19300	700	1552	96,254
June	800	357	517	31,000
July	357	357	357	22,134
Aug.	357	138	251	15,534
Sept.	228	47	106	6,378
Oct.	594	69	146	9,052
Nov.	208	69	121	7,280
Dec.	1630	90	487	30,168
Total	..	..	..	979,250

Year 1956

Jan.	4060	140	561	34,806
Feb.	51200	932	6431	362,980
Mar.	45400	1830	5944	368,530
Apr.	5680	1020	2003	120,200
May	20600	581	1470	91,140
June	7880	360	986	59,158
July	542	241	348	21,582
Aug.	387	176	254	15,722
Sept.	360	100	152	9,106
Oct.	No Records			8,560*
Nov.	No Records			6,000*
Dec.	No Records			7,740*
Total	..	..	..	1,105,524*

* Estimated.

HASTINGS RIVER AT ELLENBOROUGH

Year 1957

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	219	24	64	3,944
Feb.	15100	48	1353	75,776
Mar.	5320	287	955	59,218
Apr.	287	156	235	14,122
May	156	96	119	7,382
June	No Records			6,050*
July	176	59	139	8,612
Aug.	No Records			11,200*
Sept.	219	59	113	6,774
Oct.	59	39	50	3,092
Nov.	71	14	30	1,828
Dec.	No Records			1,690*
Total	..	..	..	199,688*

Year 1958

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	287	19	93	5,742
Feb.	1480	71	182	10,214
Mar.	2400	31	301	18,672
Apr.	No Records			16,800*
May	219	100	157	9,748
June	6460	84	1118	67,084
July	770	156	326	20,224
Aug.	1120	136	290	17,962
Sept.	156	117	132	7,928
Oct.	126	39	71	4,418
Nov.	39	35	38	2,308
Dec.	No Records			20,000*
Total	..	..	..	201,100*

Year 1959

Jan.	21400	219	2548	157,980
Feb.	13700	280	1841	103,114
Mar.	No Records			150,000*
Apr.	2490	375	1141	68,474
May	425	220	328	20,312
June	1690	163	308	18,452
July	3600	200	596	36,954
Aug.	1160	220	416	25,820
Sept.	No Records			40,000*
Oct.	1980	275	544	33,726
Nov.	47100	750	5230	313,820
Dec.	2490	155	593	36,784
Total	..	..	..	1,005,426*

Year 1960

Jan.	No Records			40,000*
Feb.	No Records			80,000*
Mar.	11000	450	2456	152,300
Apr.	1480	195	660	39,610
May	1100	60	379	23,474
June	No Records			25,000*
July	No Records			15,000*
Aug.	No Records			10,000*
Sept.	No Records			7,000*
Oct.	No Records			8,000*
Nov.	135	60	82	4,948
Dec.	175	60	107	6,616
Total	..	..	..	411,948*

* Estimated.

HASTINGS RIVER AT ELLENBOROUGH

Year 1961

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	1350	90	287	17,800
Feb.	10200	135	788	44,100
Mar.	480	170	287	17,800
Apr.	305	170	221	13,300
May	270	120	173	10,700
June	7360	120	900	54,000
July	305	140	188	11,600
Aug.	390	140	200	12,400
Sept.	305	100	156	9,350
Oct.	1300	100	587	36,400
Nov.	440	160	221	13,300
Dec.	690	180	326	20,200
Total	..	..	..	260,950

Year 1962

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	18800	690	2353	146,000
Feb.	No Records			40,000*
Mar.	3080	345	945	58,600
Apr.	69000	500	6487	389,000
May	18600	700	1740	108,000
June	760	410	537	32,200
July	No Records			115,000*
Aug.	580	275	409	25,400
Sept.	275	170	235	14,100
Oct.	218	145	162	10,000
Nov.	145	100	115	6,870
Dec.	20000	90	1445	89,600
Total	..	..	..	1,034,770*

Year 1963

Jan.	20000	600	2350	146,000
Feb.	1870	350	671	37,600
Mar.	14800	425	3320	206,000
Apr.	61000	600	4568	274,000
May	No Records			450,000*
June	No Records			70,000*
July	No Records			50,000*
Aug.	No Records			20,000*
Sept.	No Records			55,000*
Oct.	No Records			60,000*
Nov.	No Records			70,000*
Dec.	No Records			100,000*
Total	..	..	..	1,538,600

Year 1964

Jan.	No Records			50,000*
Feb.	No Records			35,000*
Mar.	No Records			120,000*
Apr.	No Records			75,000*
May	No Records			30,000*
June	No Records			18,000*
July	300	195	255	15,800
Aug.	855	101	183	11,300
Sept.	180	122	141	8,460
Oct.	140	90	113	7,020
Nov.	No Records			4,000*
Dec.	122	40	64	3,990
Total	..	..	..	378,570*

* Estimated

HASTINGS RIVER AT ELLENBOROUGH

Year 1965

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	98	40	68	4,210
Feb.	98	35	71	3,950
Mar.	No Records			3,000*
Apr.	131	26	47	2,800
May	51	28	36	2,250
June	122	25	36	2,170
July	19950	30	1138	70,600
Aug.	485	90	166	10,300
Sept.	1000	45	122	7,300
Oct.	66	41	54	3,370
Nov.	700	25	45	2,680
Dec.	8600	260	1278	79,200
Total	..	..	..	191,830*

Year 1966

Month	Discharge in Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	170	57	95	5,880
Feb.	2600	57	418	23,400
Mar.	1820	70	206	12,800
Apr.	2820	70	232	13,900
May	215	90	132	8,210
June	400	70	115	6,910
July	70	40	63	3,932
Aug.	70	40	47	2,924
Sept.	130	32	55	3,300
Oct.	190	32	80	4,932
Nov.	2600	52	240	14,000
Dec.	103	40	63	3,908
Total	..	..	..	104,096

Year 1967

Month	Discharge In Cusecs			Discharge for Month Acre Feet
	Max.	Min.	Mean	
Jan.	2000	40	256	15,800
Feb.	14450	205	1140	64,100
Mar.	13800	800	2370	147,000
Apr.	6400	410	1590	95,200
May	410	186	274	17,000
June	38500	168	7850	471,000
July				
Aug.				
Sept.				
Oct.				
Nov.				
Dec.				
Total				

* Estimated.

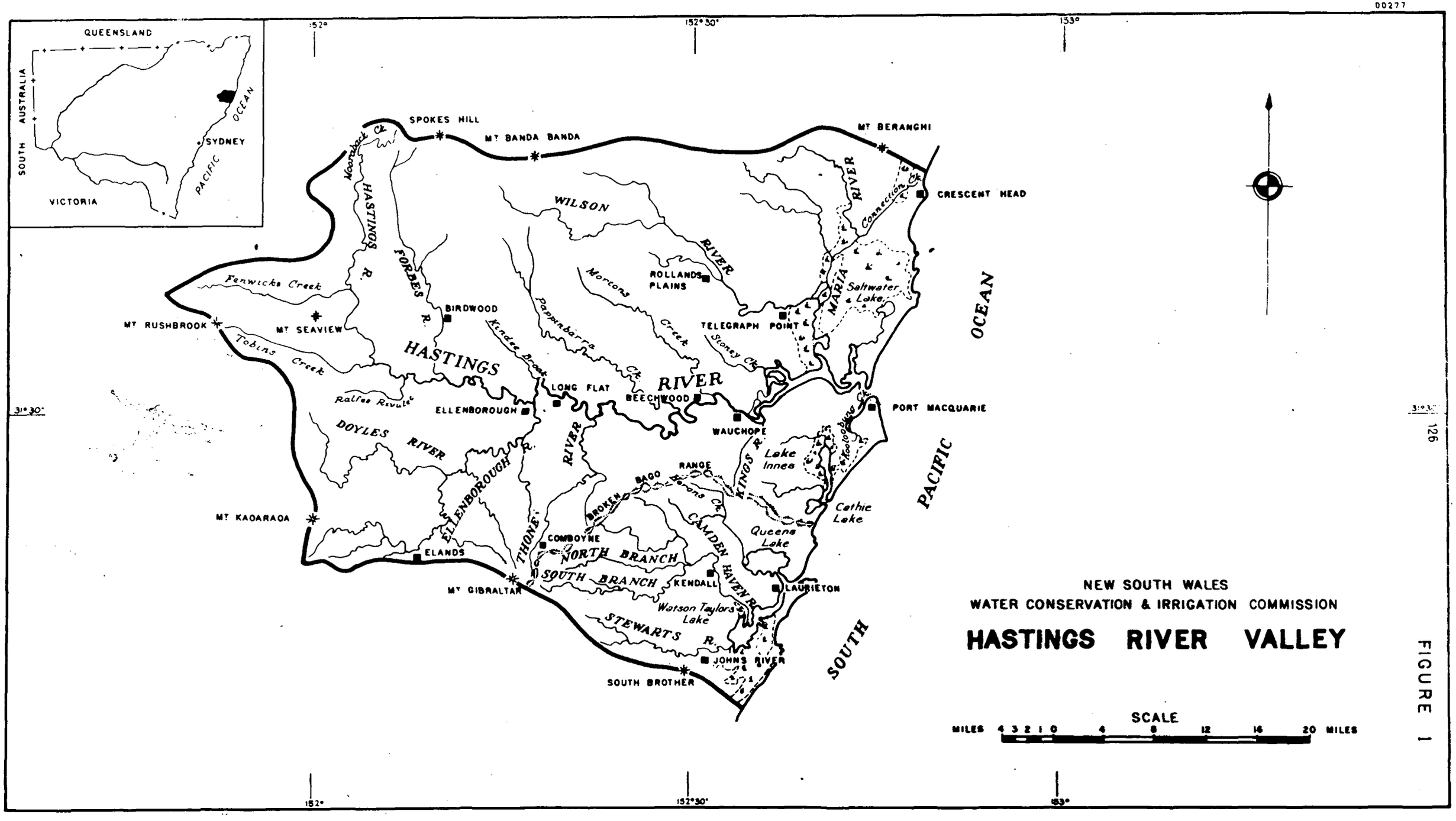

QUEENSLAND
SOUTH AUSTRALIA
VICTORIA
SYDNEY
PACIFIC OCEAN
152°
152°30'
153°
31°30'
SPOKES HILL
MT BANDA BANDA
MT BERANGHI
CRESCENT HEAD
Connection Ck
MARIA RIVER
Saltwater Lake
WILSON RIVER
ROLLANDS PLAINS
Morcons Creek
Pappinbarra Ck
Stoney Ck
TELEGRAPH POINT
OCEAN
Woolbrook Ck
HASTINGS R.
FORBES R.
Fenwicks Creek
MT RUSHBROOK
MT SEAVIEW
BIRDWOOD
Kindee Brook
Tobins Creek
HASTINGS RIVER
LONG FLAT
BEECHWOOD
WAUCHOPE
PORT MACQUARIE
Ralfes Rivulet
ELLENBOROUGH
DOYLES RIVER
ELLENBOROUGH R.
THONE RIVER
KINGS R.
Lake Innes
Moolbong Ck
RANGE
BAGO
BROKEN
Barons Ck
CAMDEN HAVEN R.
Cathie Lake
Queens Lake
PACIFIC
MT KAOARAOA
COMBOYNE
NORTH BRANCH
SOUTH BRANCH
ELANDS
KENDALL
LAURIETON
MT GIBRALTAR
Watson Taylors Lake
STEWARTS R.
JOHNS RIVER
SOUTH BROTHER
SOUTH
NEW SOUTH WALES
WATER CONSERVATION & IRRIGATION COMMISSION
HASTINGS RIVER VALLEY
SCALE
MILES 4 3 2 1 0 4 8 12 16 20 MILES

FIGURE 1

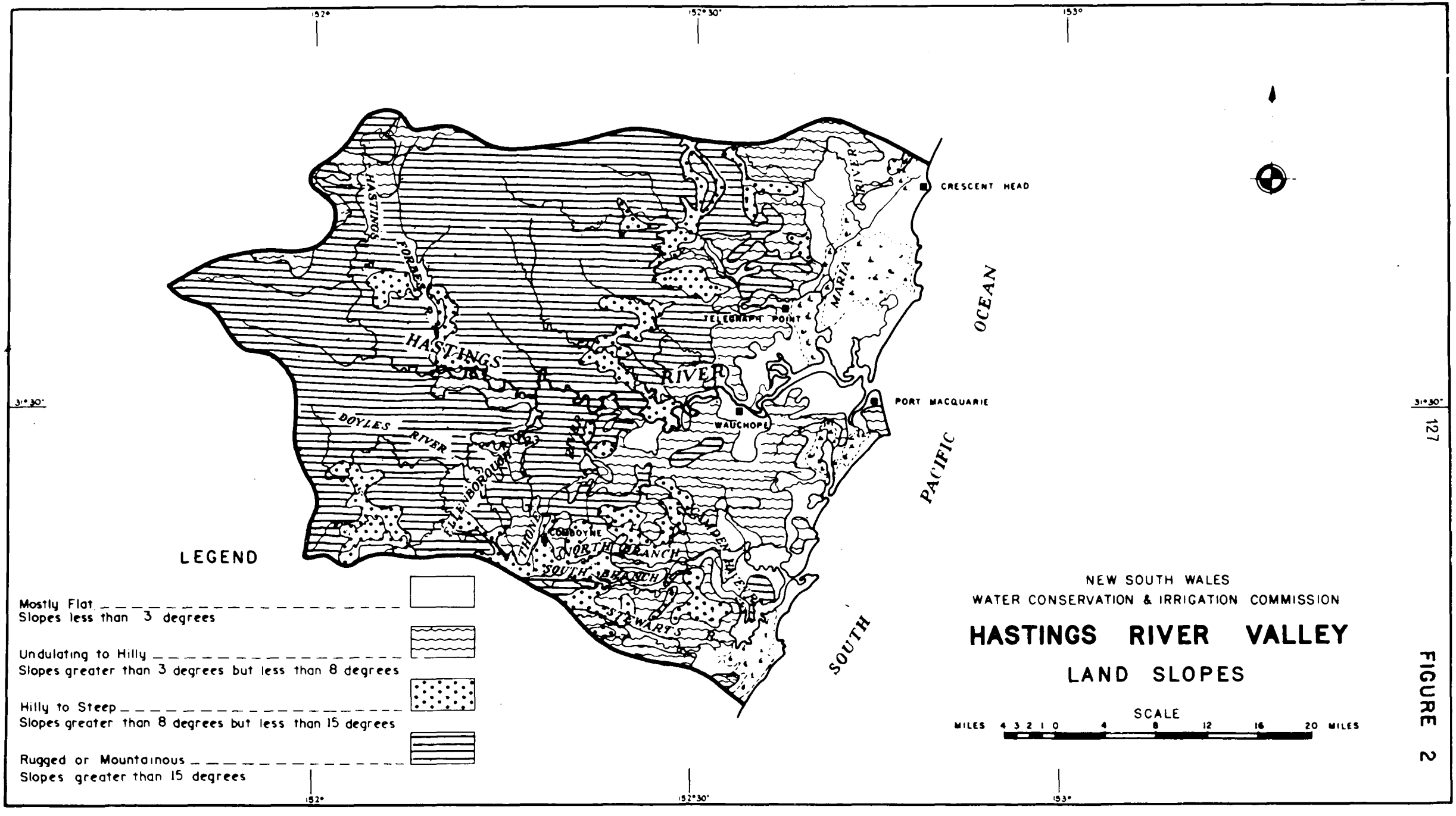
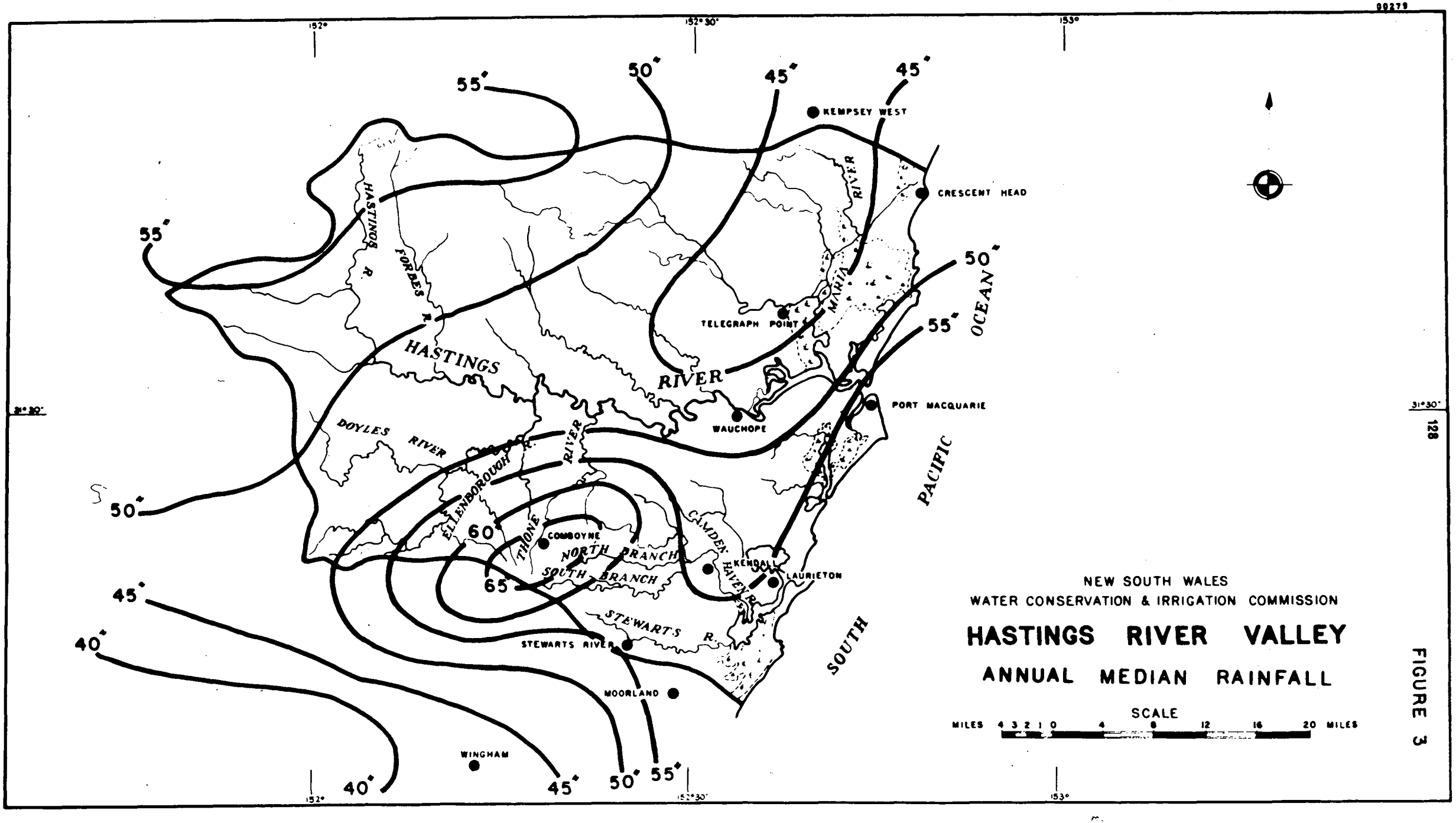

152°
152° 30'
153°
31° 30'
HASTINGS
FORBES
HASTINGS
RIVER
DOYLES RIVER
ELLENBOROUGH
THONE
COMBOYNE
NORTH BRANCH
SOUTH BRANCH
STEWARTS
GARDEN HAVEN
WAUCHOPE
TELEGRAPH POINT
MARIA
RIVER
CRESCENT HEAD
PORT MACQUARIE
SOUTH
PACIFIC
OCEAN
LEGEND
Mostly Flat
Slopes less than 3 degrees
Undulating to Hilly
Slopes greater than 3 degrees but less than 8 degrees
Hilly to Steep
Slopes greater than 8 degrees but less than 15 degrees
Rugged or Mountainous
Slopes greater than 15 degrees
NEW SOUTH WALES
WATER CONSERVATION & IRRIGATION COMMISSION
HASTINGS RIVER VALLEY
LAND SLOPES
SCALE
MILES 4 3 2 1 0 4 8 12 16 20 MILES

FIGURE 2


NEW SOUTH WALES
WATER CONSERVATION & IRRIGATION COMMISSION
HASTINGS RIVER VALLEY
ANNUAL MEDIAN RAINFALL
SCALE
MILES 4 3 2 1 0 4 8 12 16 20 MILES
FIGURE 3
128
KEMPSEY WEST
CRESCENT HEAD
TELEGRAPH POINT
PORT MACQUARIE
WAUCHOPE
COMBOYNE
KENDALL
LAURIETON
STEWARTS RIVER
MOORLAND
WINGHAM
HASTINGS RIVER
BONILLS R.
FORBES R.
MARIA RIVER
DOYLES RIVER
ELLENBOROUGH R.
THONE RIVER
NORTH BRANCH
SOUTH BRANCH
CAMDEN HAVEN R.
STEWARTS R.
SOUTH PACIFIC OCEAN
55°
50°
45°
40°
60°
65°
152°
152°30'
153°
31°30'

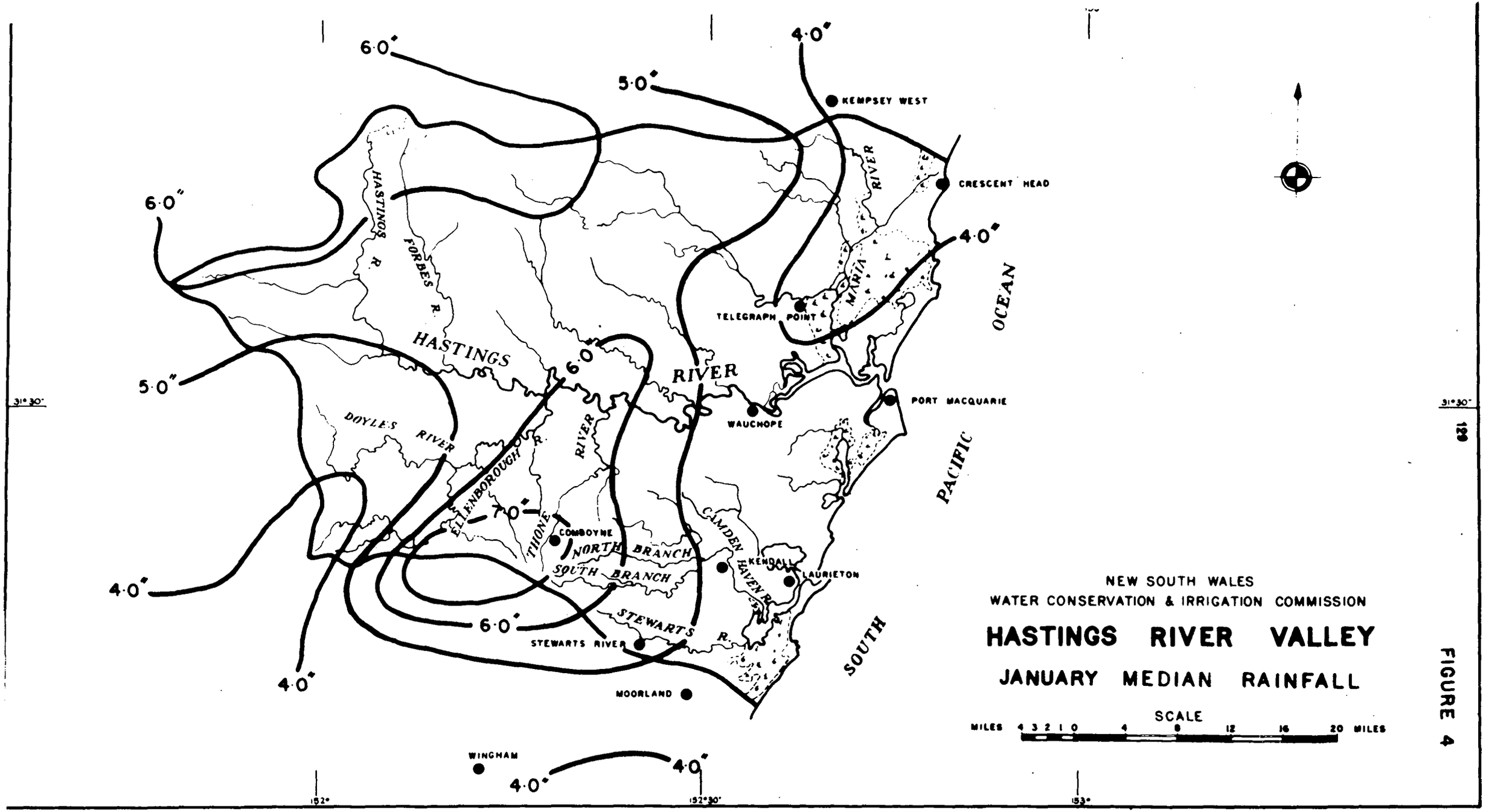
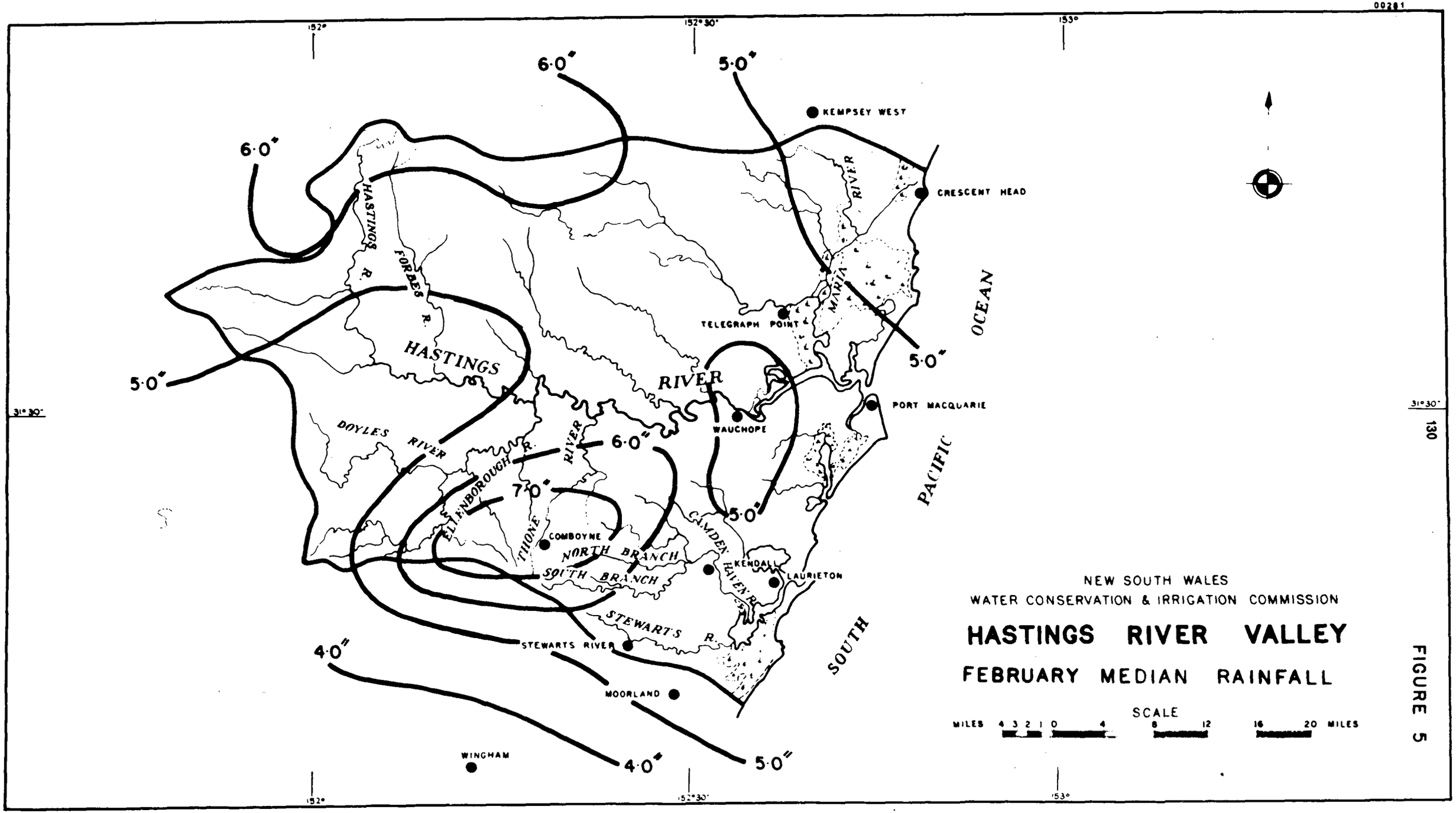

6·0"
5·0"
4·0"
KEMPSEY WEST
CRESCENT HEAD
HASTINGS R.
FORBES R.
HASTINGS
RIVER
MAKIA RIVER
TELEGRAPH POINT
OCEAN
PACIFIC
SOUTH
PORT MACQUARIE
WAUCHOPE
DOYLES RIVER
ELLENBOROUGH R.
THONE RIVER
COMBOYNE
NORTH BRANCH
SOUTH BRANCH
CAMDEN HAVEN R.
KENDALL
LAURIETON
STEWARTS R.
STEWARTS RIVER
MOORLAND
WINGHAM
31°30'
152°
152°30'
153°
NEW SOUTH WALES
WATER CONSERVATION & IRRIGATION COMMISSION
HASTINGS RIVER VALLEY
JANUARY MEDIAN RAINFALL
SCALE
MILES 4 3 2 1 0 4 8 12 16 20 MILES

FIGURE 4



NEW SOUTH WALES
WATER CONSERVATION & IRRIGATION COMMISSION

HASTINGS RIVER VALLEY

FEBRUARY MEDIAN RAINFALL

SCALE
MILES 4 3 2 1 0 4 8 12 16 20 MILES

FIGURE 5

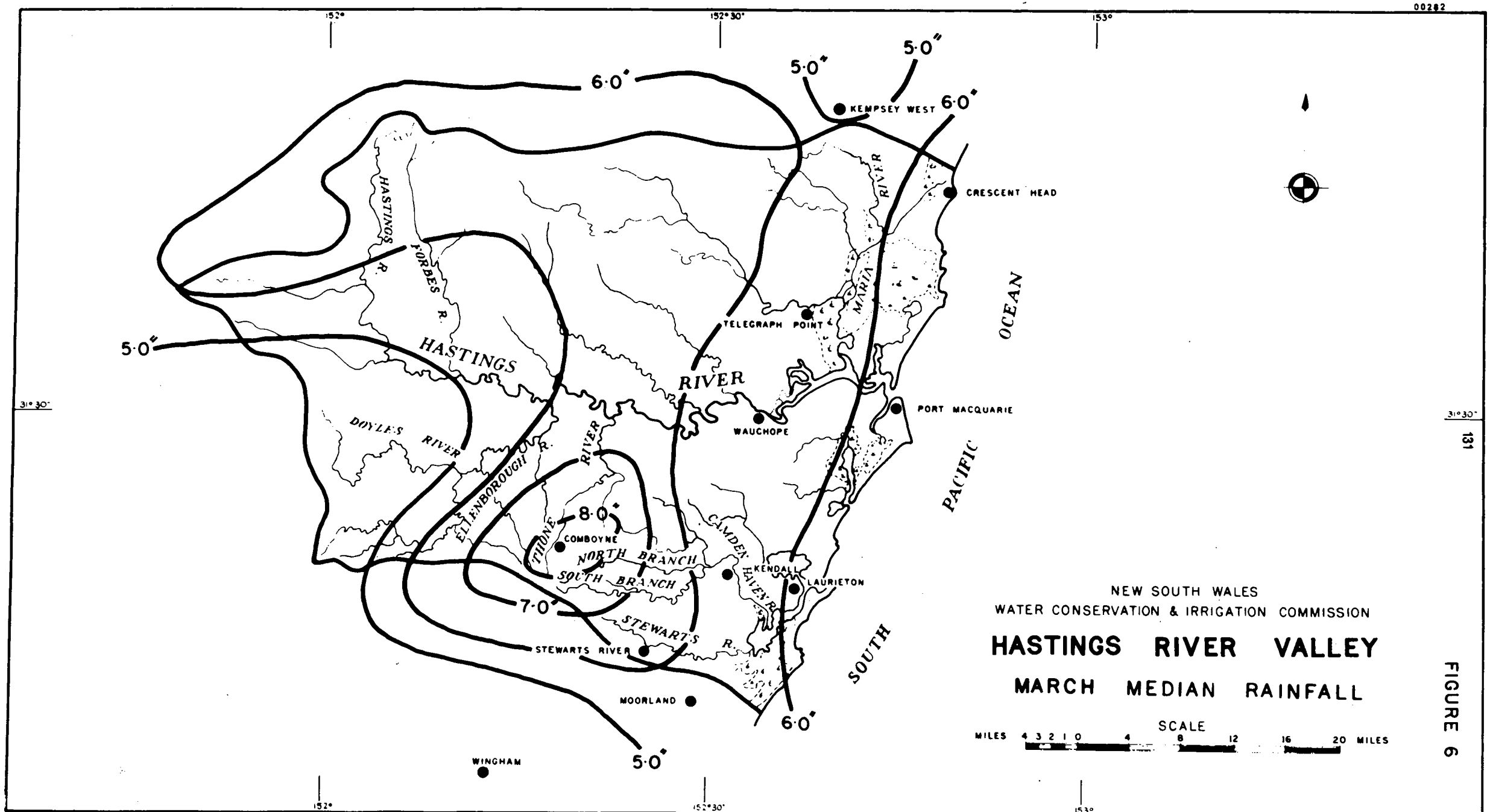

152°
152°30'
153°
31°30'
6·0"
5·0"
5·0"
5·0"
6·0"
5·0"
8·0"
7·0"
6·0"
5·0"
KEMPSEY WEST
CRESCENT HEAD
TELEGRAPH POINT
PORT MACQUARIE
WAUCHOPE
COMBOYNE
KENDALL
LAURIETON
STEWARTS RIVER
MOORLAND
WINGHAM
HASTINGS R.
FORBES R.
HASTINGS
RIVER
DOYLES RIVER
ELLENBOROUGH R.
THONE
RIVER
NORTH BRANCH
SOUTH BRANCH
STEWARTS R.
CAMDEN HAVEN R.
MARIA RIVER
PACIFIC
OCEAN
SOUTH
NEW SOUTH WALES
WATER CONSERVATION & IRRIGATION COMMISSION
HASTINGS RIVER VALLEY
MARCH MEDIAN RAINFALL
SCALE
MILES 4 3 2 1 0 4 8 12 16 20 MILES

FIGURE 6

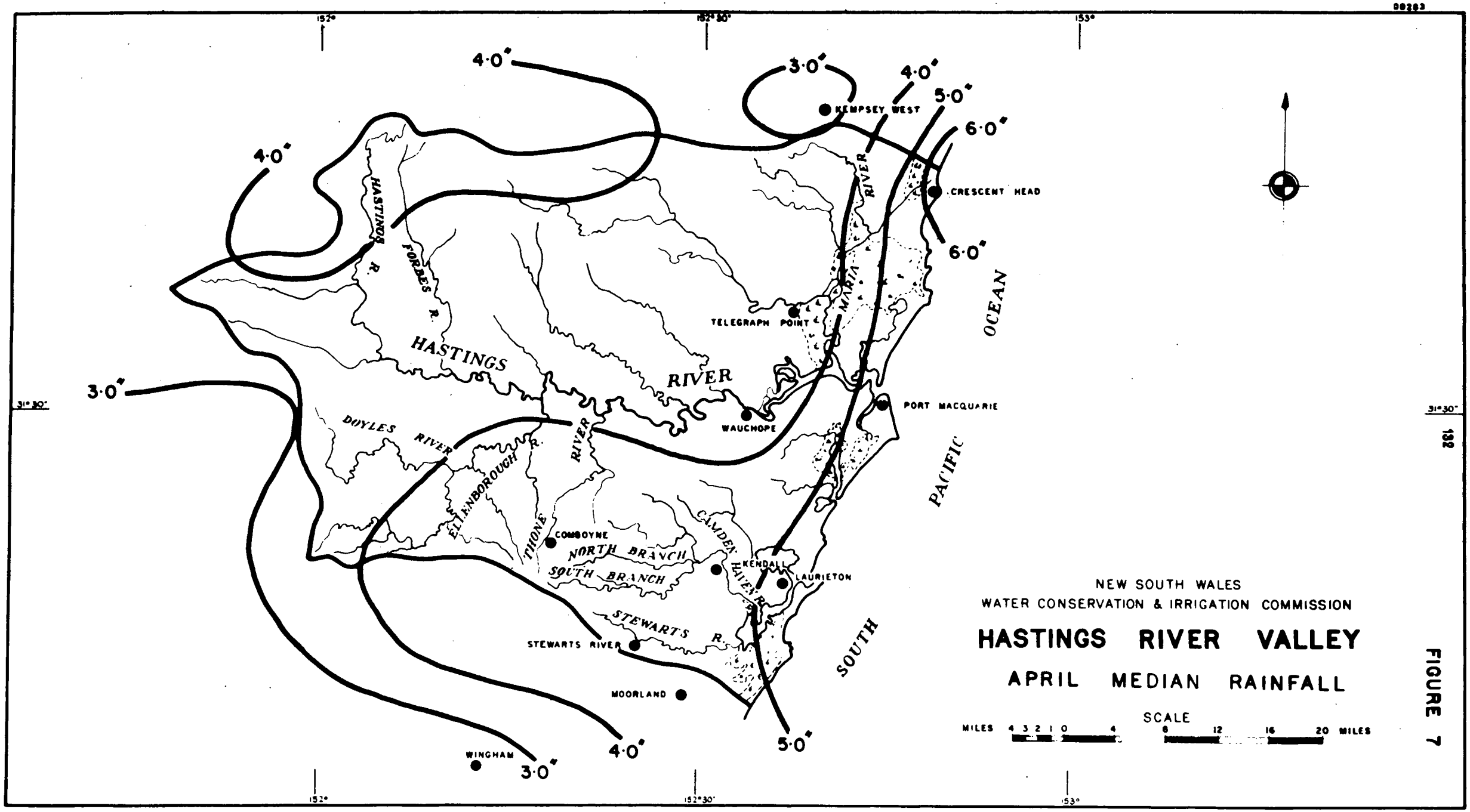

152°
152°30'
153°
31°30'
4·0"
3·0"
5·0"
6·0"
KEMPSEY WEST
CRESCENT HEAD
TELEGRAPH POINT
PORT MACQUARIE
WAUCHOPE
COMBOYNE
KENDALL
LAURIETON
STEWARTS RIVER
MOORLAND
WINGHAM
HASTINGS R.
FORBES R.
HASTINGS
RIVER
MARIA
RIVER
OCEAN
PACIFIC
SOUTH
DOYLES RIVER
ELLENBOROUGH R.
RIVER
THONE
NORTH BRANCH
SOUTH BRANCH
CAMDEN HAVEN R.
STEWARTS R.
NEW SOUTH WALES
WATER CONSERVATION & IRRIGATION COMMISSION
HASTINGS RIVER VALLEY
APRIL MEDIAN RAINFALL
SCALE
MILES 4 3 2 1 0 4 8 12 16 20 MILES

FIGURE 7

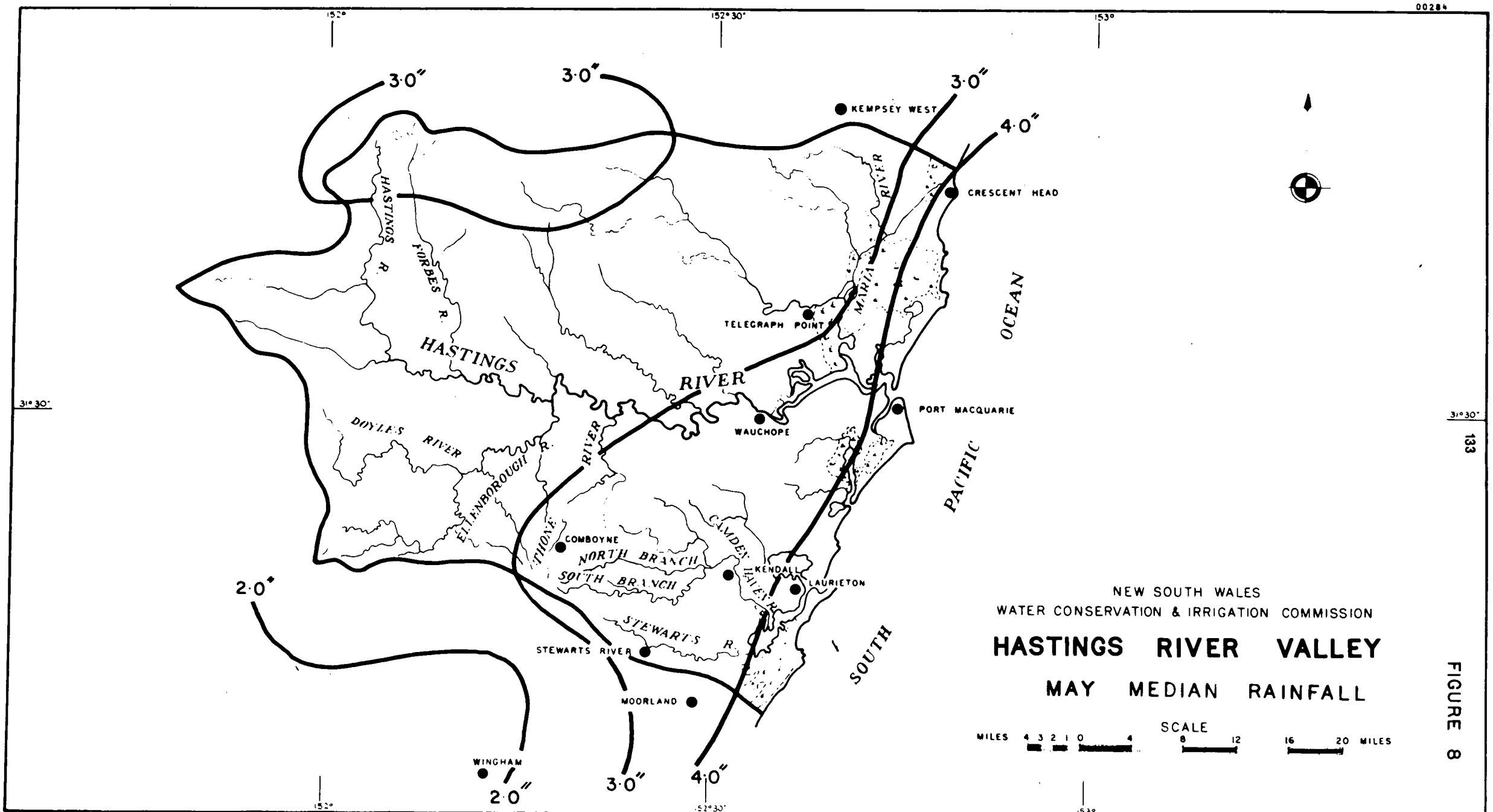

152°
152°30'
153°
31°30'
3·0"
3·0"
3·0"
4·0"
2·0"
2·0"
3·0"
4·0"
KEMPSEY WEST
CRESCENT HEAD
HASTINGS R.
FORBES R.
HASTINGS
RIVER
MARIA RIVER
TELEGRAPH POINT
OCEAN
PACIFIC
SOUTH
PORT MACQUARIE
WAUCHOPE
DOYLES RIVER
ELLENBOROUGH R.
RIVER
COMBOYNE
NORTH BRANCH
SOUTH BRANCH
CAMDEN HAVEN R.
KENDALL
LAURIETON
STEWARTS R.
STEWARTS RIVER
MOORLAND
WINGHAM
NEW SOUTH WALES
WATER CONSERVATION & IRRIGATION COMMISSION
HASTINGS RIVER VALLEY
MAY MEDIAN RAINFALL
SCALE
MILES 4 3 2 1 0 4 8 12 16 20 MILES

FIGURE 8

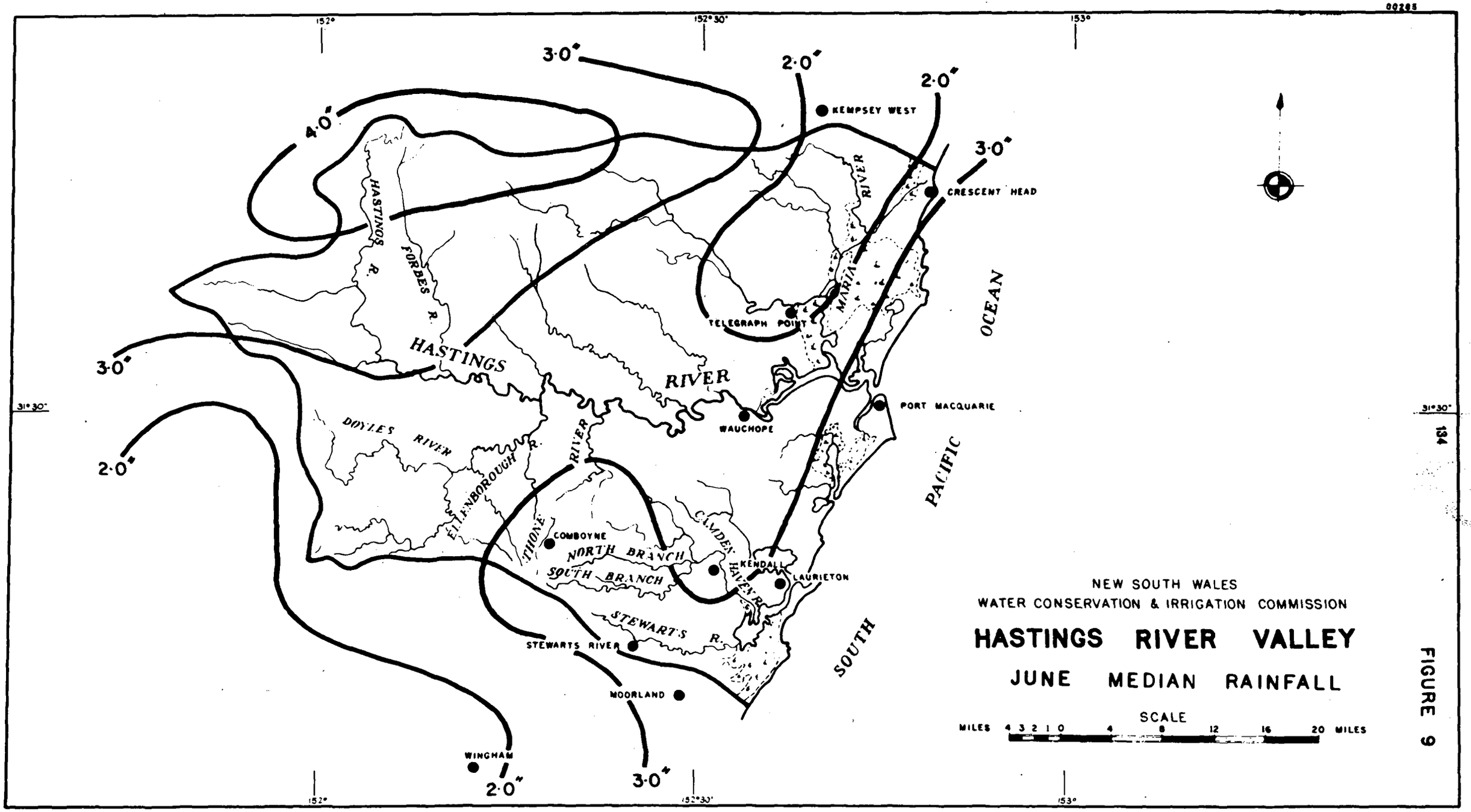

152°
152°30'
153°
31°30'
4·0"
3·0"
2·0"
KEMPSEY WEST
CRESCENT HEAD
TELEGRAPH POINT
PORT MACQUARIE
WAUCHOPE
COMBOYNE
KENDALL
LAURIETON
STEWARTS RIVER
MOORLAND
WINGHAM
HASTINGS R.
FORBES R.
HASTINGS
RIVER
MARIA
RIVER
DOYLES RIVER
ELLENBOROUGH R.
THONE
RIVER
NORTH BRANCH
SOUTH BRANCH
CAMDEN HAVEN R.
STEWARTS R.
SOUTH
PACIFIC
OCEAN
NEW SOUTH WALES
WATER CONSERVATION & IRRIGATION COMMISSION
HASTINGS RIVER VALLEY
JUNE MEDIAN RAINFALL
SCALE
MILES 4 3 2 1 0 4 8 12 16 20 MILES

FIGURE 9

134

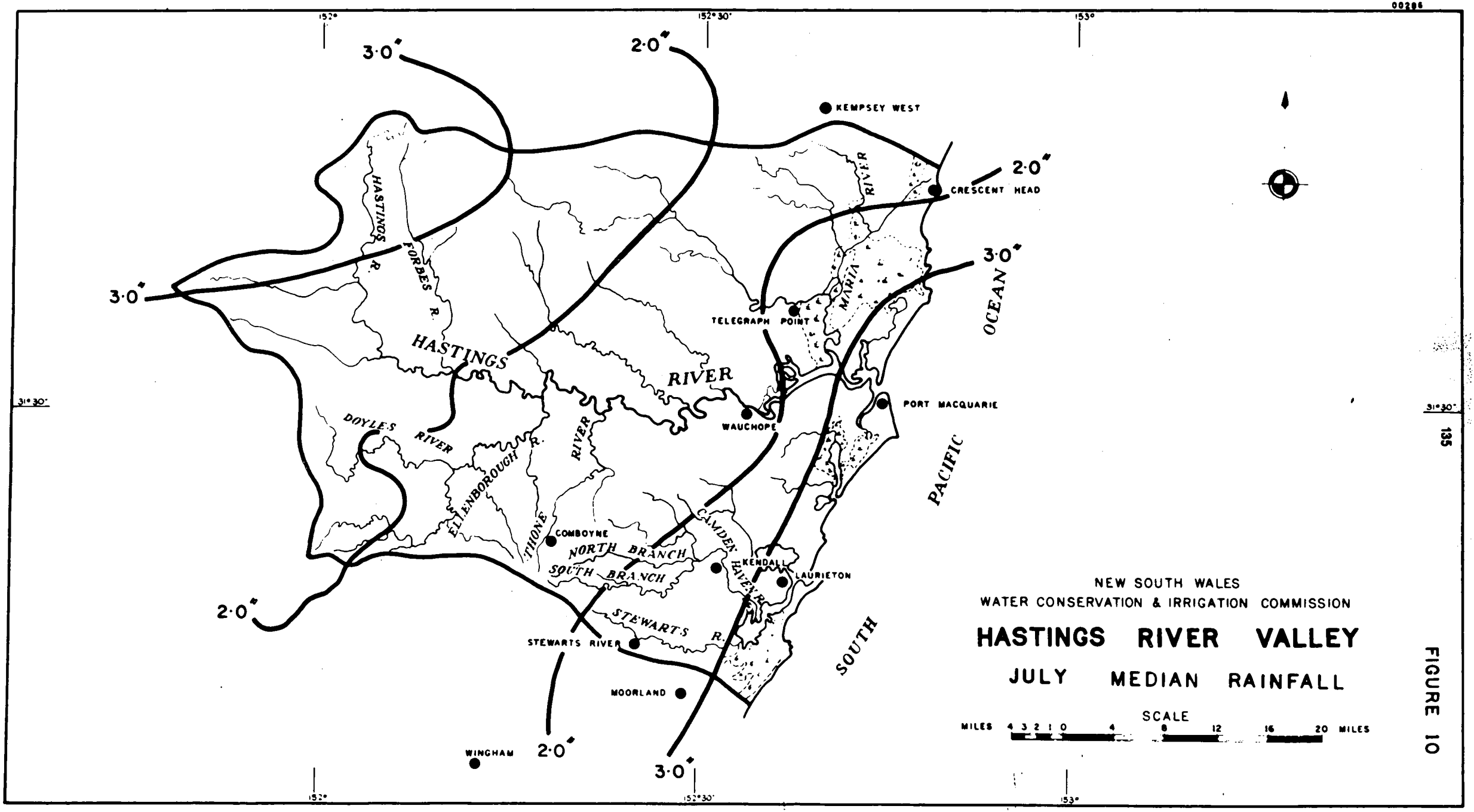

152°
152°30'
153°
31°30'
3·0"
2·0"
KEMPSEY WEST
CRESCENT HEAD
TELEGRAPH POINT
PORT MACQUARIE
WAUCHOPE
HASTINGS R.
FORBES R.
HASTINGS
RIVER
MARIA RIVER
OCEAN
PACIFIC
SOUTH
DOYLES RIVER
ELLENBOROUGH R.
THONE RIVER
COMBOYNE
NORTH BRANCH
SOUTH BRANCH
CAMDEN HAVEN R.
KENDALL
LAURIETON
STEWARTS R.
STEWARTS RIVER
MOORLAND
WINGHAM
NEW SOUTH WALES
WATER CONSERVATION & IRRIGATION COMMISSION
HASTINGS RIVER VALLEY
JULY MEDIAN RAINFALL
SCALE
MILES 4 3 2 1 0 4 8 12 16 20 MILES

FIGURE 10

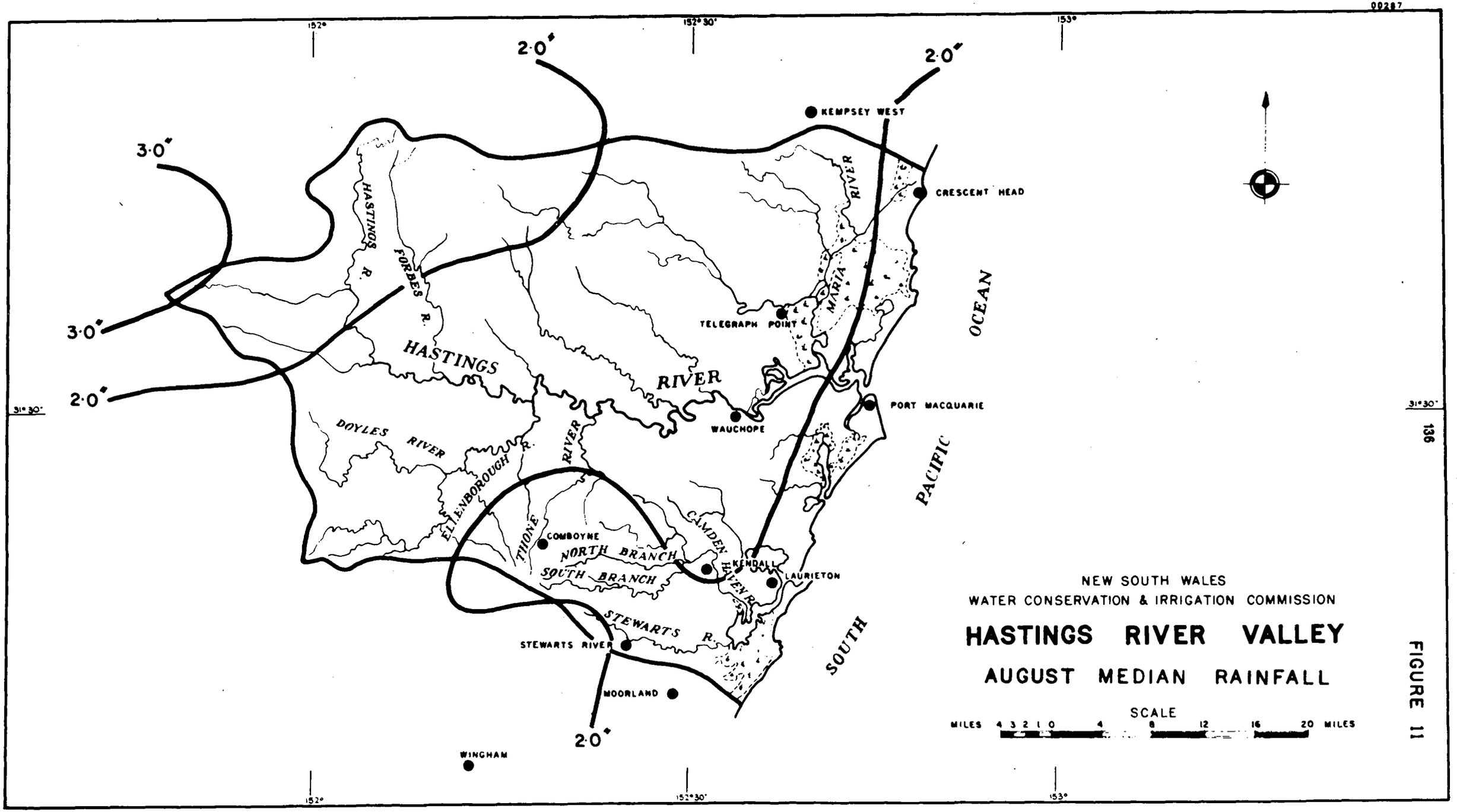

152°
152°30'
153°
31°30'
3·0"
2·0"
KEMPSEY WEST
CRESCENT HEAD
TELEGRAPH POINT
PORT MACQUARIE
WAUCHOPE
COMBOYNE
KENDALL
LAURIETON
STEWARTS RIVER
MOORLAND
WINGHAM
HASTINGS R.
FORBES R.
HASTINGS
RIVER
MARIA
RIVER
DOYLES RIVER
ELLENBOROUGH R.
THONE
RIVER
NORTH BRANCH
SOUTH BRANCH
CAMDEN HAVEN R.
STEWARTS R.
PACIFIC
OCEAN
SOUTH
NEW SOUTH WALES
WATER CONSERVATION & IRRIGATION COMMISSION
HASTINGS RIVER VALLEY
AUGUST MEDIAN RAINFALL
SCALE
MILES 4 3 2 1 0 4 8 12 16 20 MILES

FIGURE 11

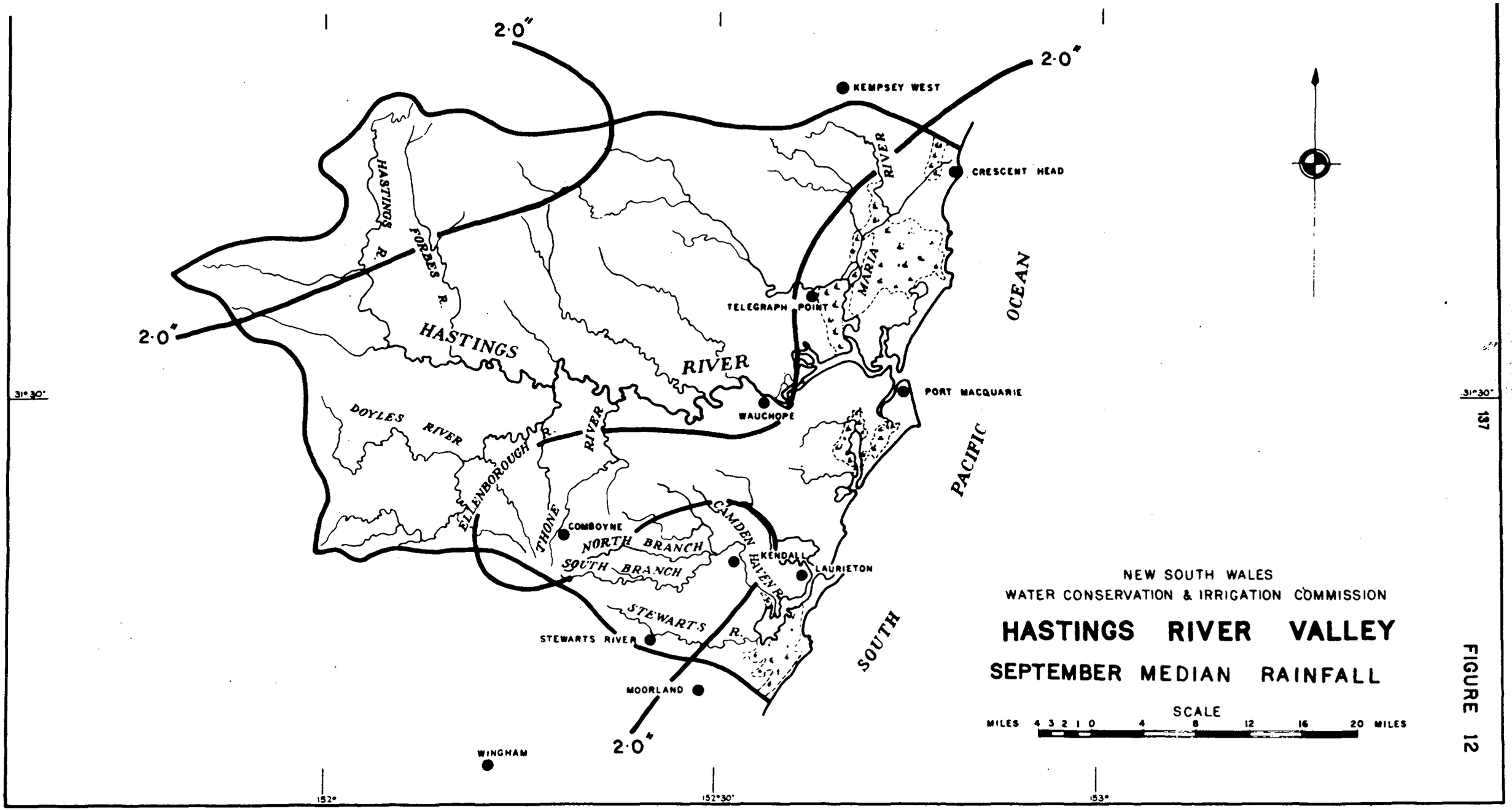

2·0"
2·0"
2·0"
2·0"
KEMPSEY WEST
CRESCENT HEAD
HASTINGS R.
FORBES R.
HASTINGS
RIVER
MARIA RIVER
TELEGRAPH POINT
OCEAN
PACIFIC
SOUTH
PORT MACQUARIE
WAUCHOPE
DOYLES RIVER
ELLENBOROUGH R.
THONE RIVER
COMBOYNE
NORTH BRANCH
SOUTH BRANCH
CAMDEN HAVEN R.
KENDALL
LAURIETON
STEWARTS R.
STEWARTS RIVER
MOORLAND
WINGHAM
31°30'
31°30'
152°
152°30'
153°
NEW SOUTH WALES
WATER CONSERVATION & IRRIGATION COMMISSION
HASTINGS RIVER VALLEY
SEPTEMBER MEDIAN RAINFALL
SCALE
MILES 4 3 2 1 0 4 8 12 16 20 MILES

FIGURE 12

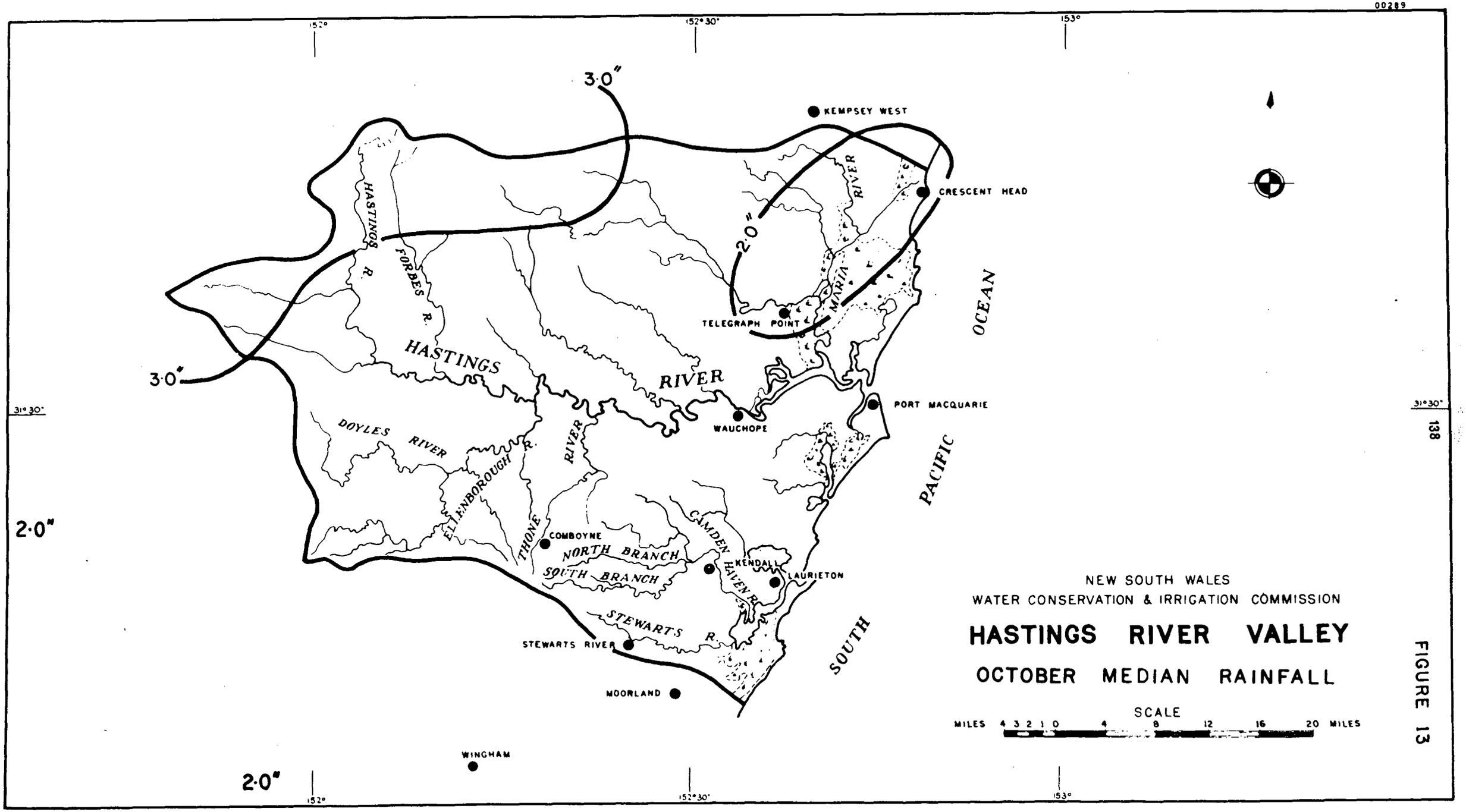

152°
152°30'
153°
31°30'
3·0"
2·0"
KEMPSEY WEST
CRESCENT HEAD
TELEGRAPH POINT
PORT MACQUARIE
WAUCHOPE
COMBOYNE
KENDALL
LAURIETON
STEWARTS RIVER
MOORLAND
WINGHAM
HASTINGS R.
FORBES R.
HASTINGS
RIVER
MARIA
RIVER
DOYLES
RIVER
ELLENBOROUGH R.
THONE
RIVER
NORTH BRANCH
SOUTH BRANCH
CAMDEN HAVEN R.
STEWARTS R.
SOUTH
PACIFIC
OCEAN
NEW SOUTH WALES
WATER CONSERVATION & IRRIGATION COMMISSION
HASTINGS RIVER VALLEY
OCTOBER MEDIAN RAINFALL
SCALE
MILES 4 3 2 1 0 4 8 12 16 20 MILES

FIGURE 13

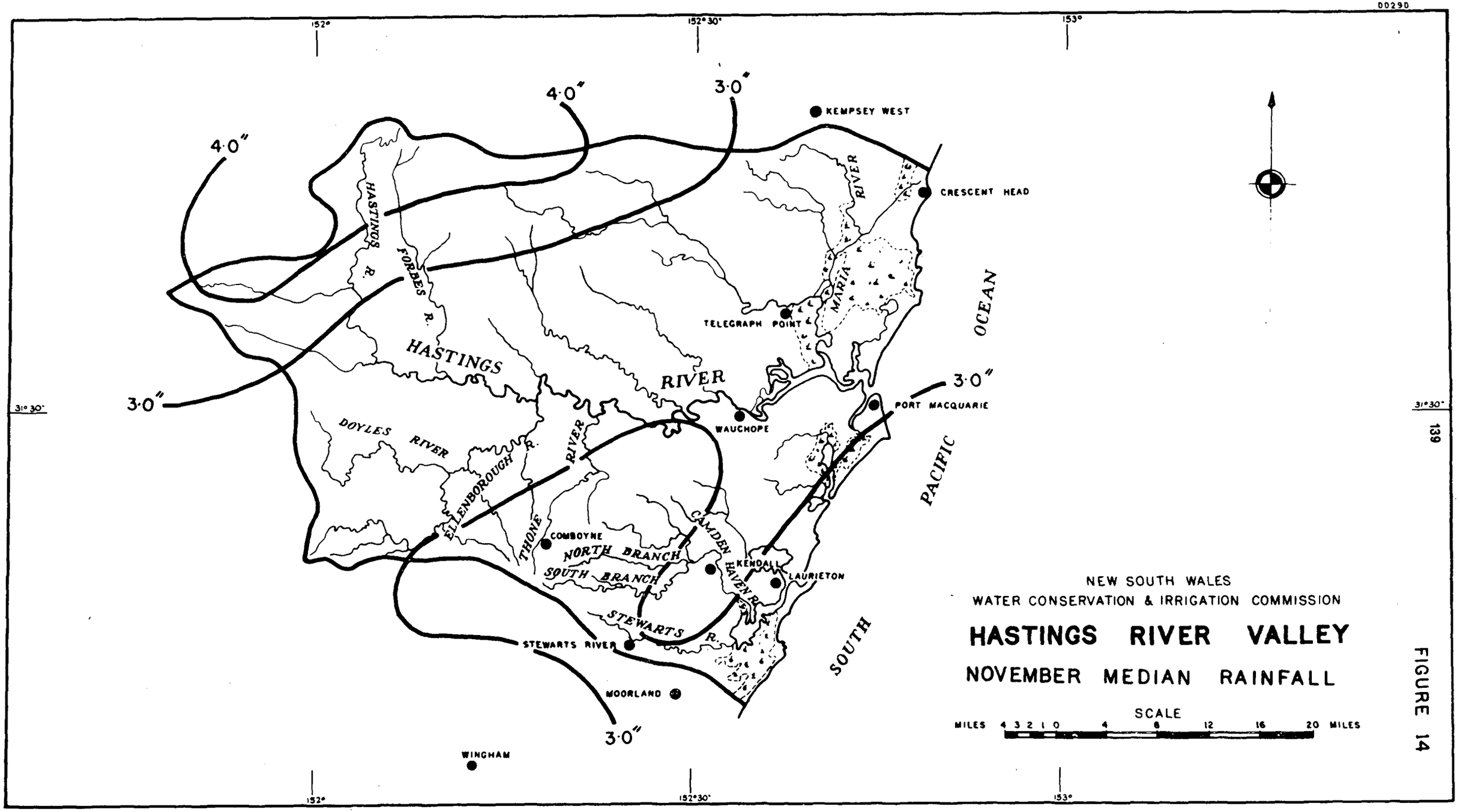

152°
152°30'
153°
31°30'
4·0"
3·0"
KEMPSEY WEST
CRESCENT HEAD
HASTINGS R.
FORBES R.
MARIA RIVER
TELEGRAPH POINT
HASTINGS RIVER
OCEAN
PACIFIC
PORT MACQUARIE
WAUCHOPE
DOYLES RIVER
ELLENBOROUGH R.
THONE RIVER
COMBOYNE
NORTH BRANCH
SOUTH BRANCH
CAMDEN HAVEN R.
KENDALL
LAURIETON
STEWARTS R.
STEWARTS RIVER
MOORLAND
WINGHAM
SOUTH
NEW SOUTH WALES
WATER CONSERVATION & IRRIGATION COMMISSION
HASTINGS RIVER VALLEY
NOVEMBER MEDIAN RAINFALL
SCALE
MILES 4 3 2 1 0 4 8 12 16 20 MILES

FIGURE 14

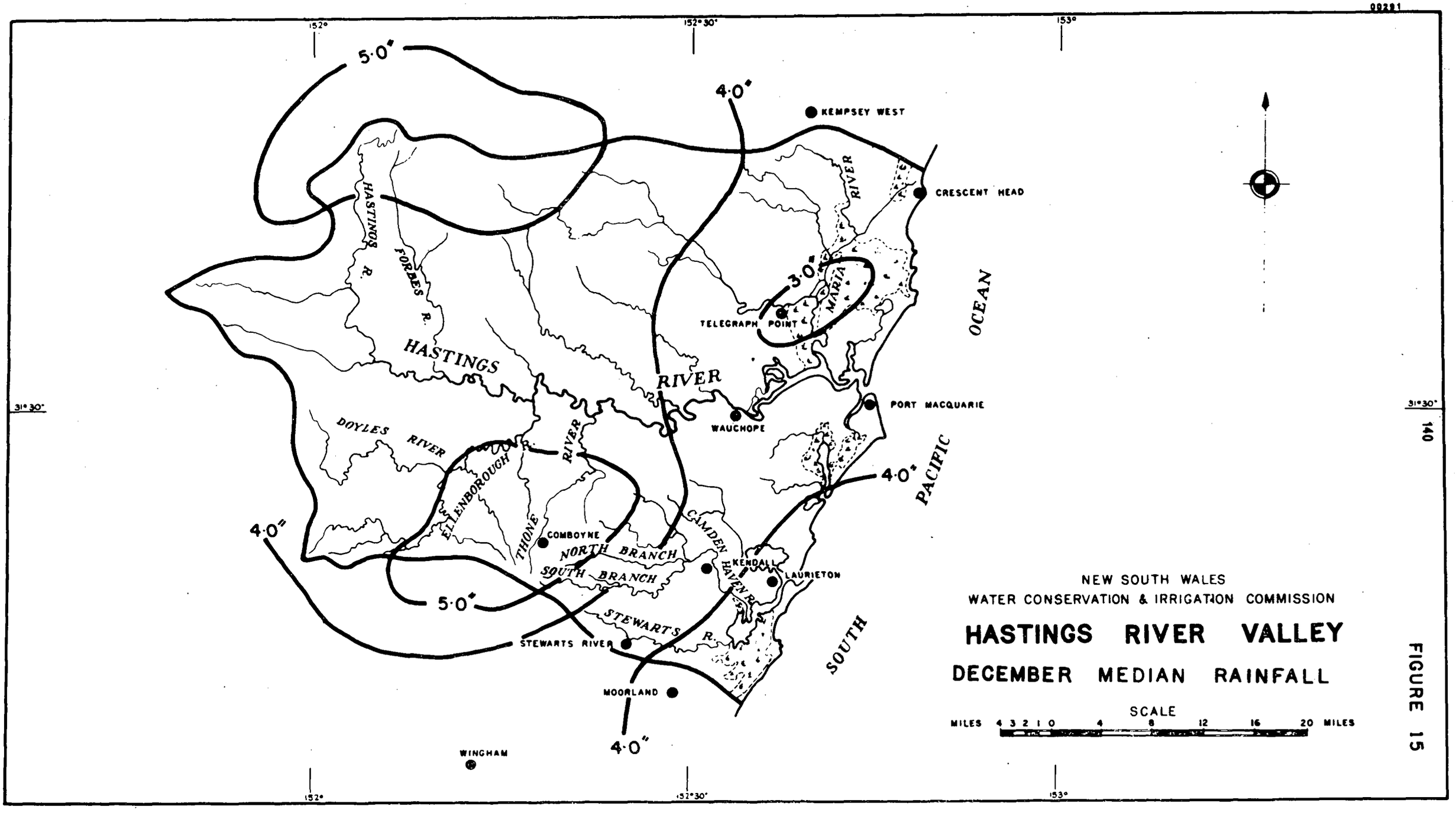
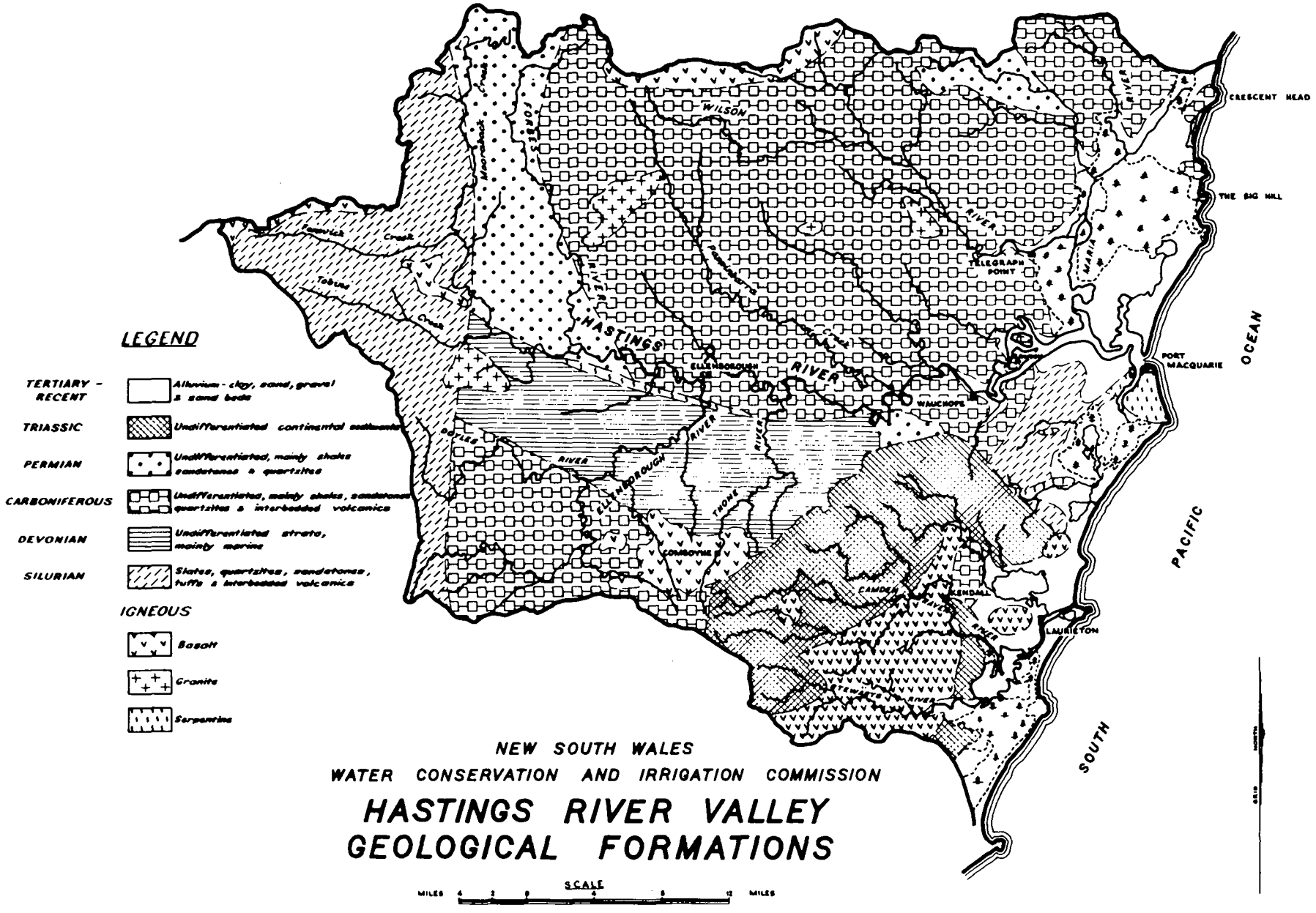


FIGURE 15

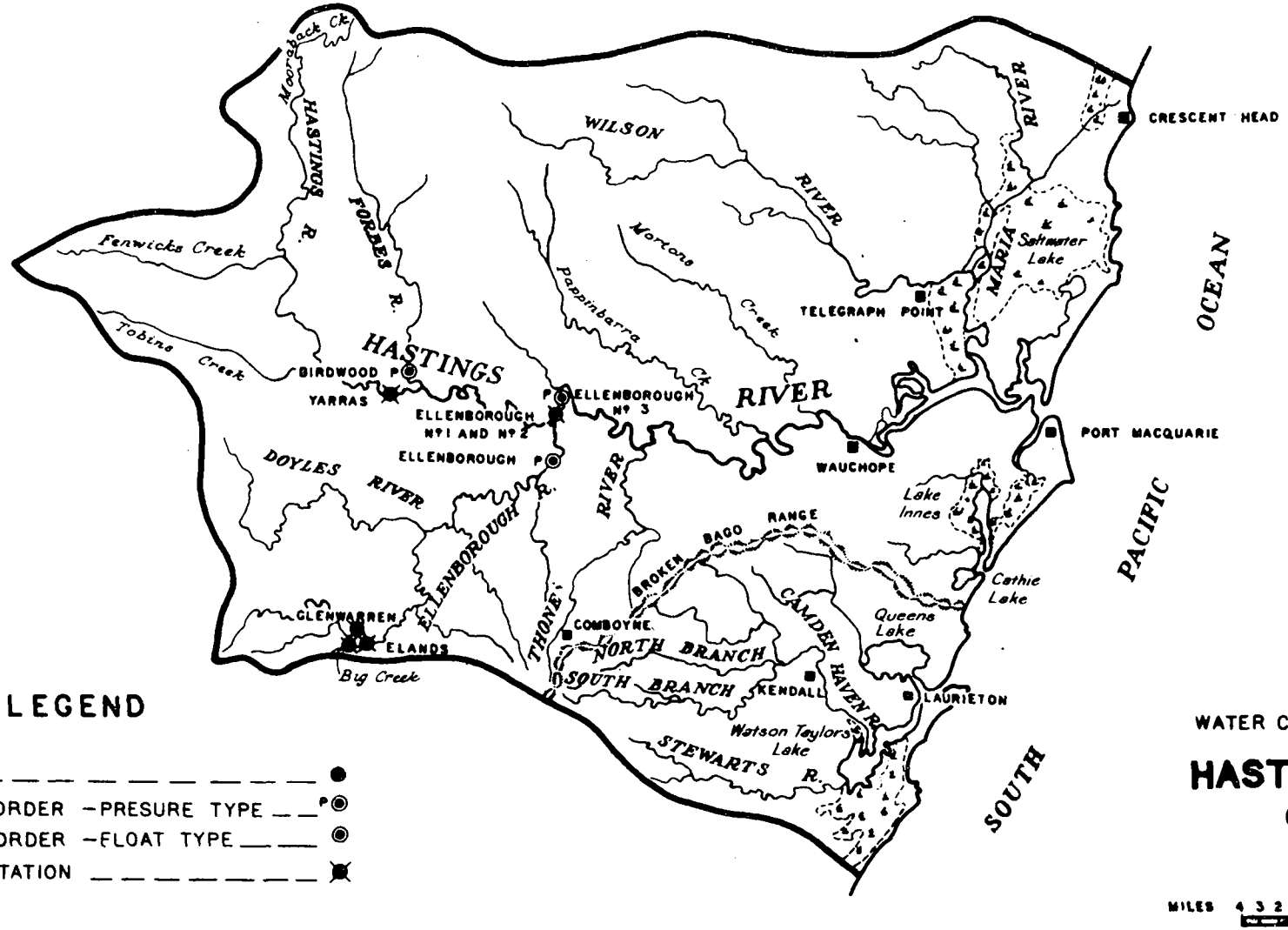
140



NEW SOUTH WALES
WATER CONSERVATION AND IRRIGATION COMMISSION

HASTINGS RIVER VALLEY GEOLOGICAL FORMATIONS

FIGURE 16



LEGEND

STAFF GAUGE
AUTOMATIC RECORDER – PRESURE TYPE
AUTOMATIC RECORDER – FLOAT TYPE
DISCONTINUED STATION

NEW SOUTH WALES
WATER CONSERVATION & IRRIGATION COMMISSION

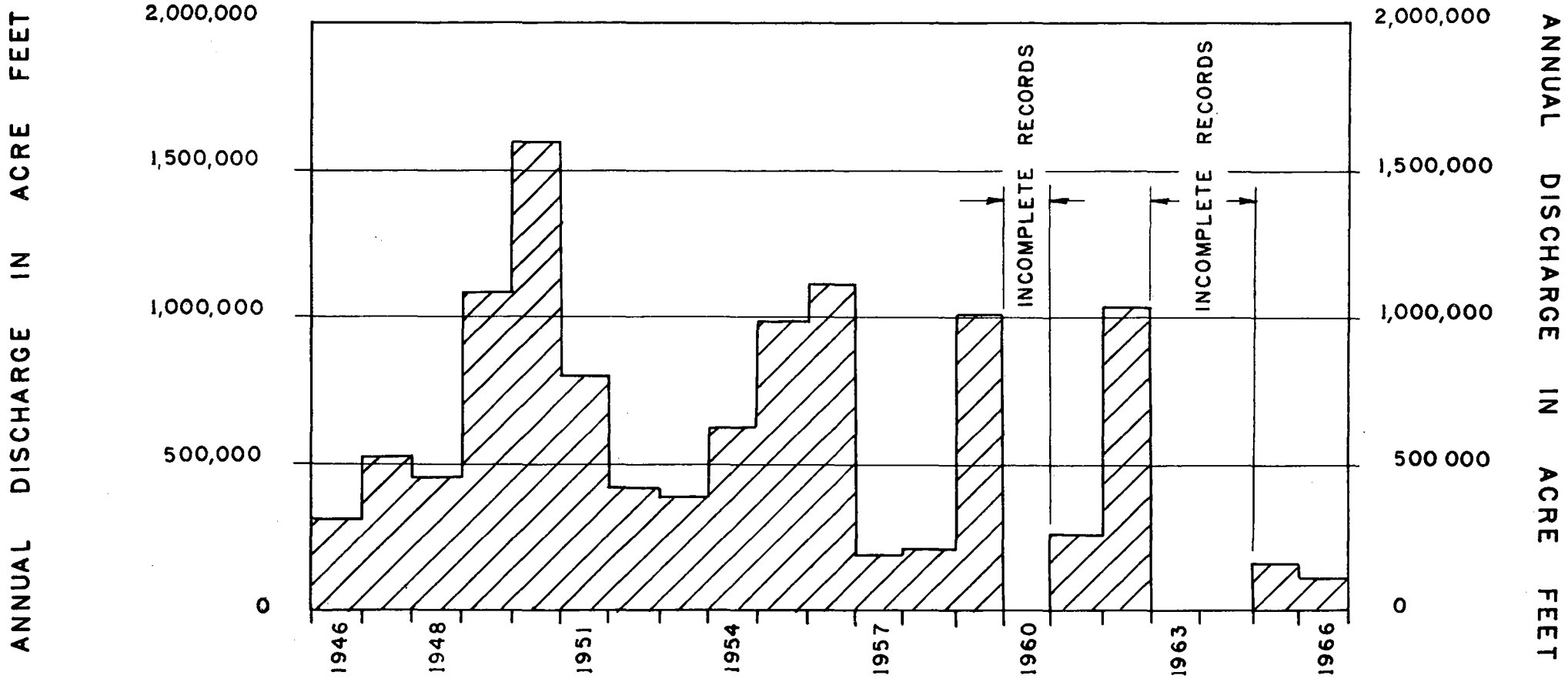
HASTINGS RIVER VALLEY
GAUGING STATIONS

31st. DECEMBER 1966

SCALE

MILES 4 3 2 1 0 4 8 12 16 20 MILES

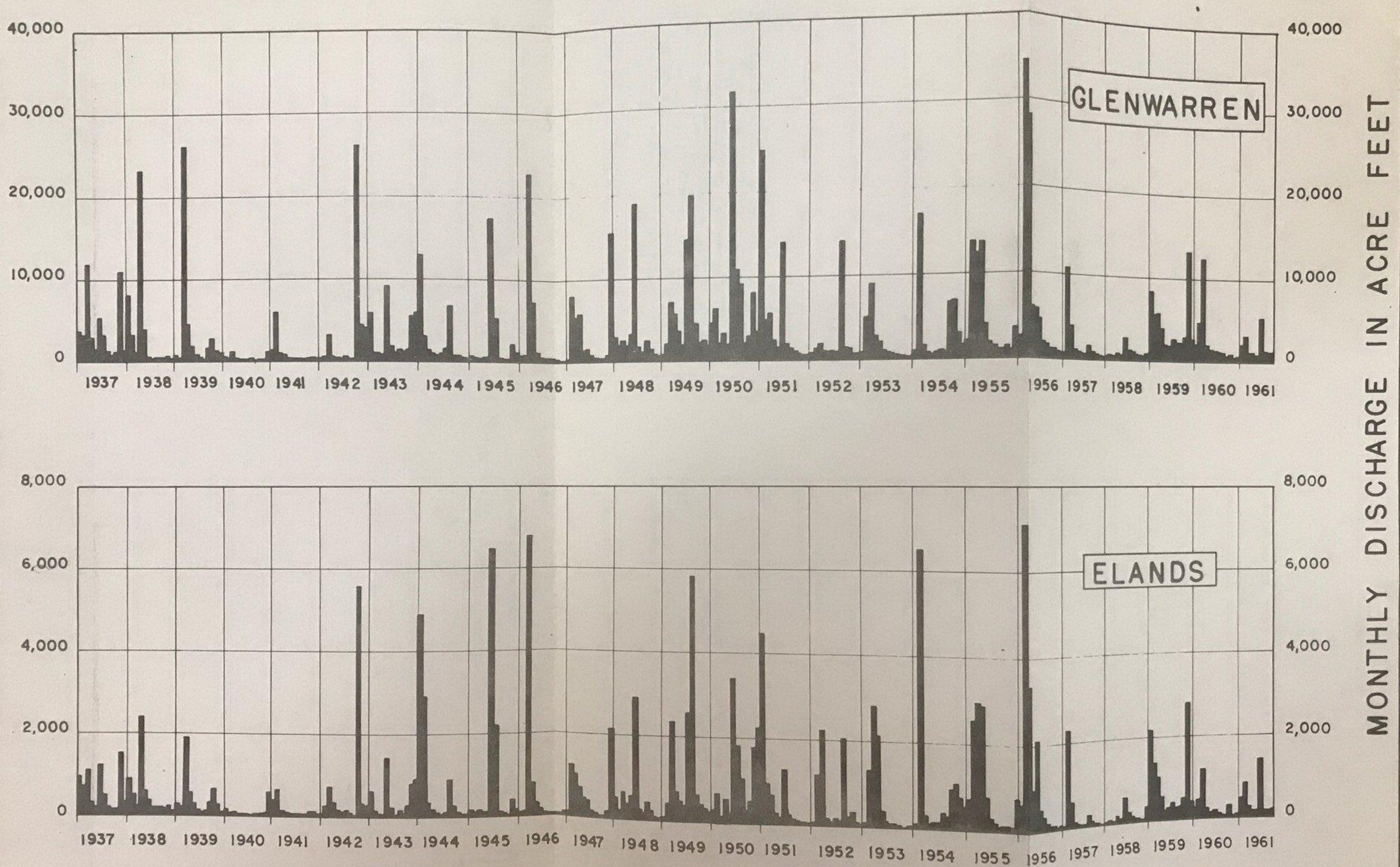
FIGURE 17



ANNUAL DISCHARGE OF HASTINGS RIVER AT ELLENBOROUGH

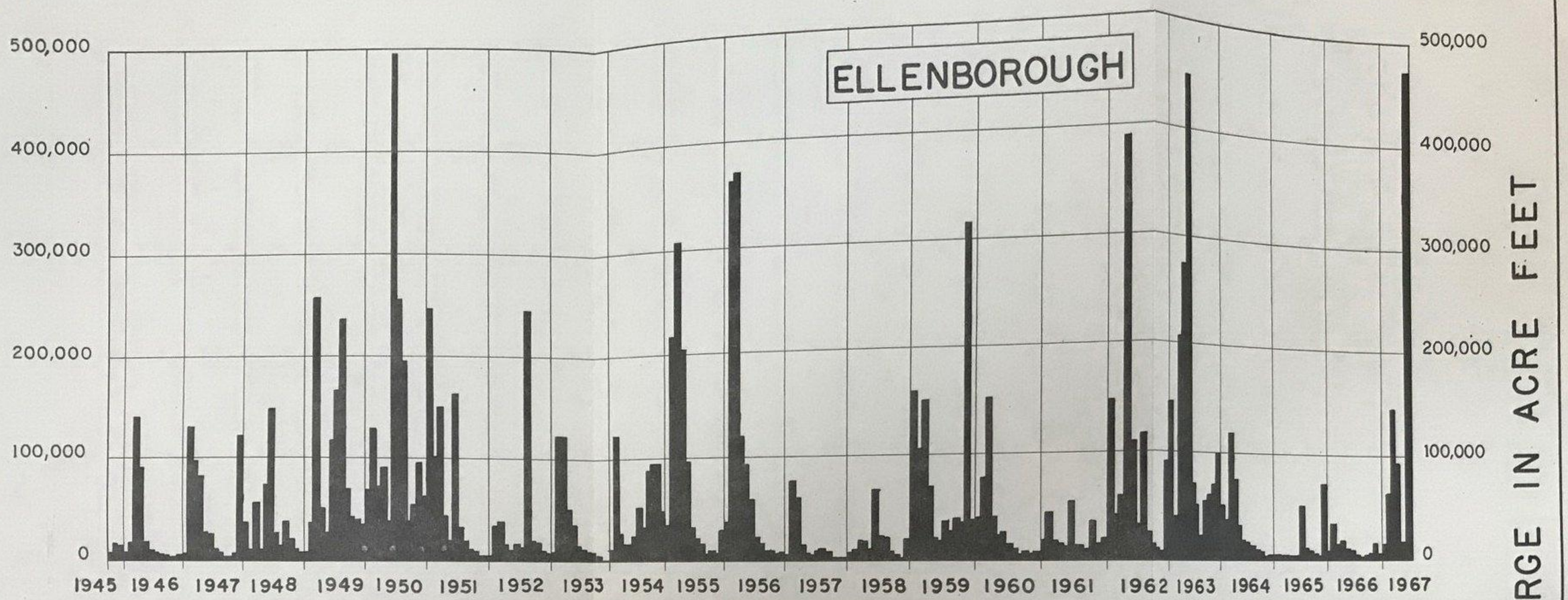
FIGURE 18

FIGURE 20



HYDROGRAPHS OF MONTHLY DISCHARGE FOR ELLENBOROUGH RIVER AT GLENWARREN AND BIG CREEK AT ELANDS

FIGURE 19



HYDROGRAPHS OF MONTHLY DISCHARGE FOR HASTINGS RIVER AT ELLENBOROUGH AND FORBES RIVER AT BIRDWOOD

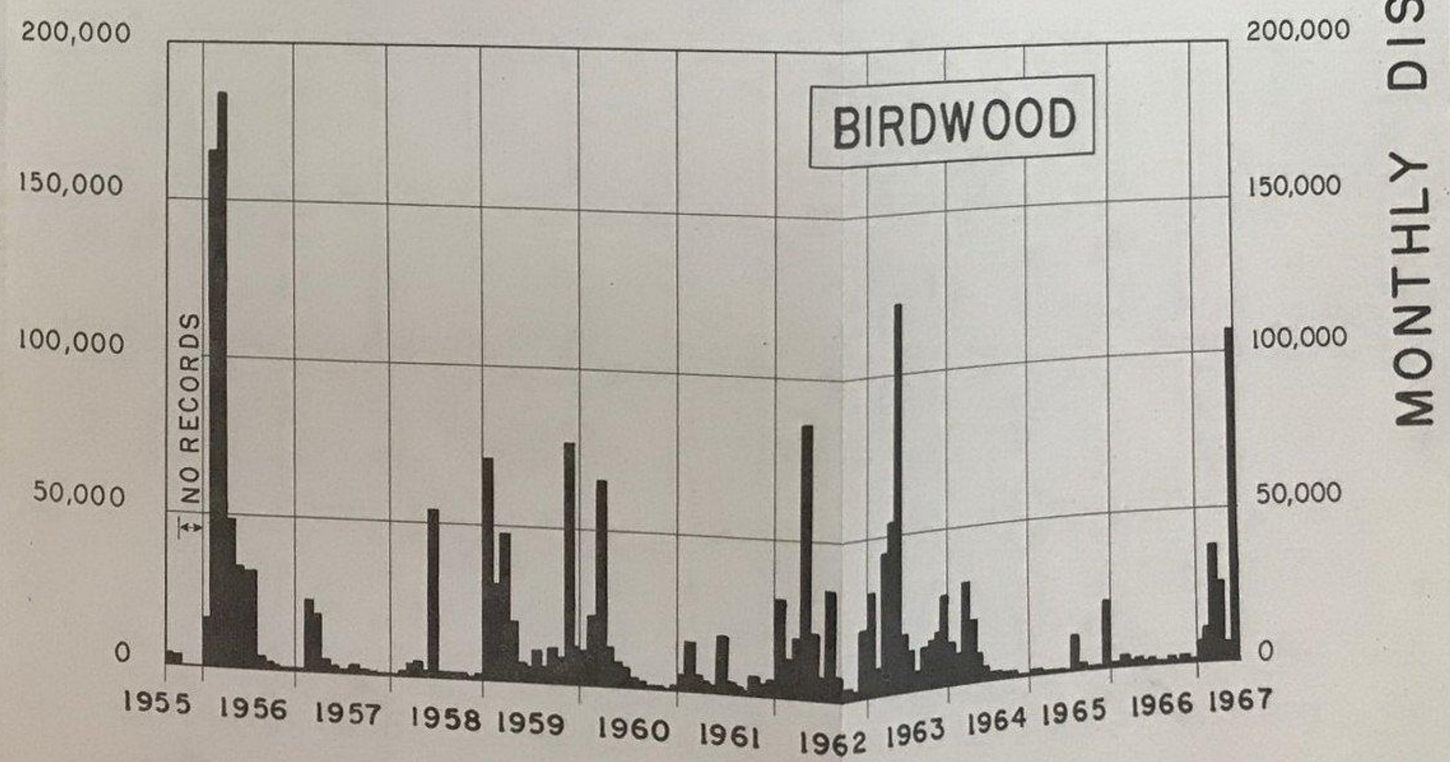
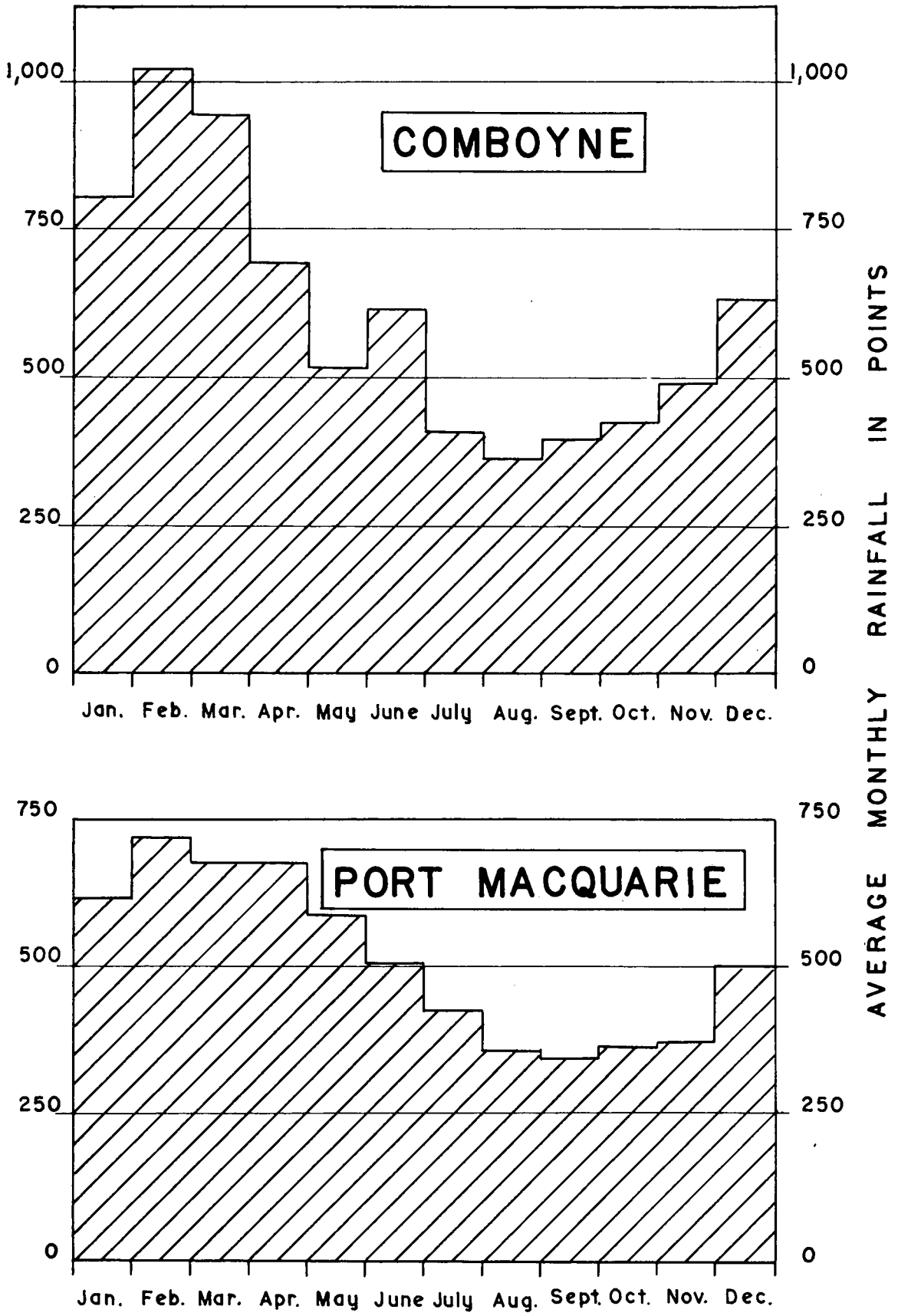
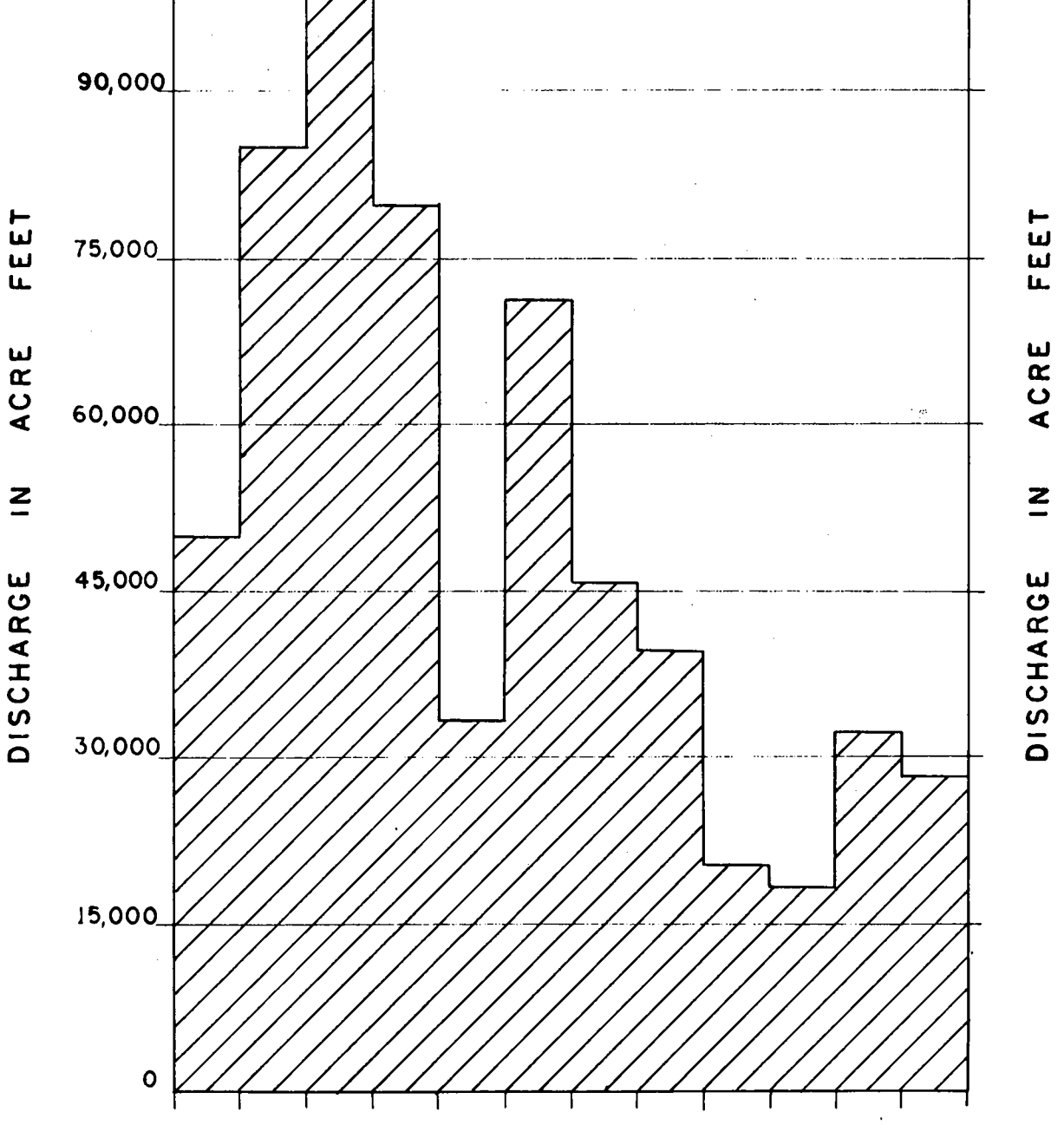


FIGURE 21



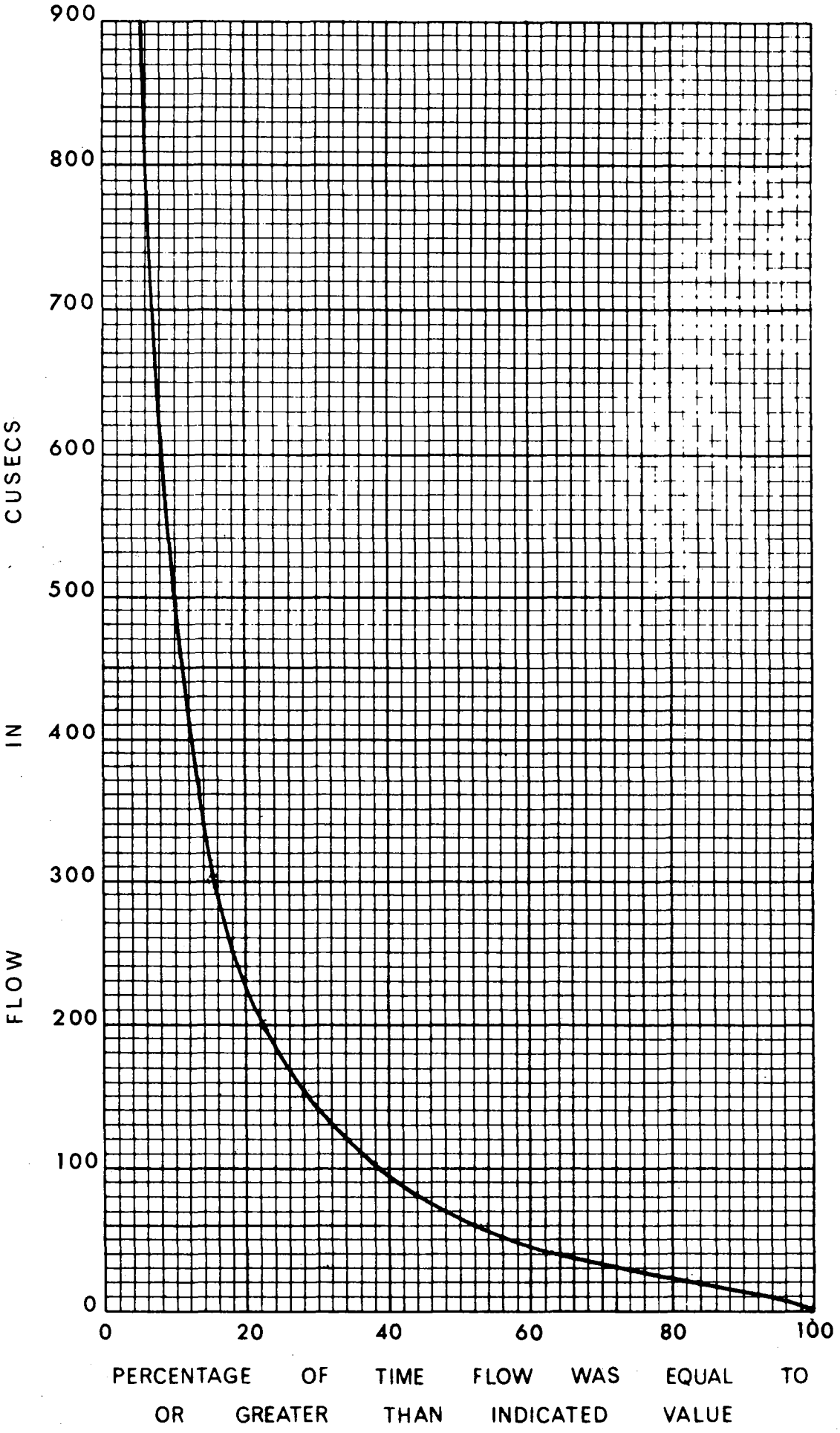
AVERAGE MONTHLY RAINFALLS
AT
COMBOYNE AND PORT MACQUARIE

FIGURE 22



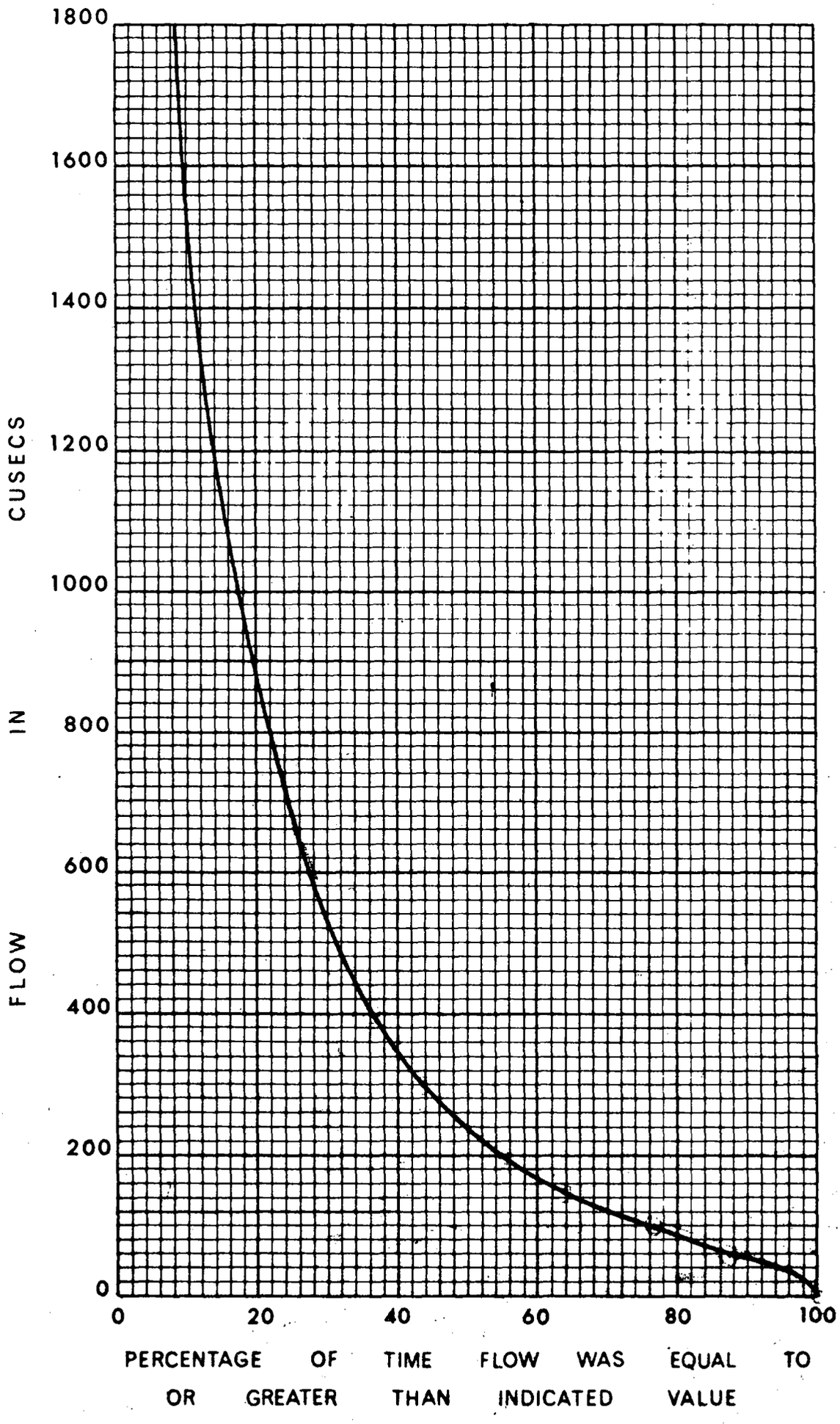
AVERAGE MONTHLY DISCHARGE FOR HASTINGS RIVER AT ELLENBOROUGH

FIGURE 23



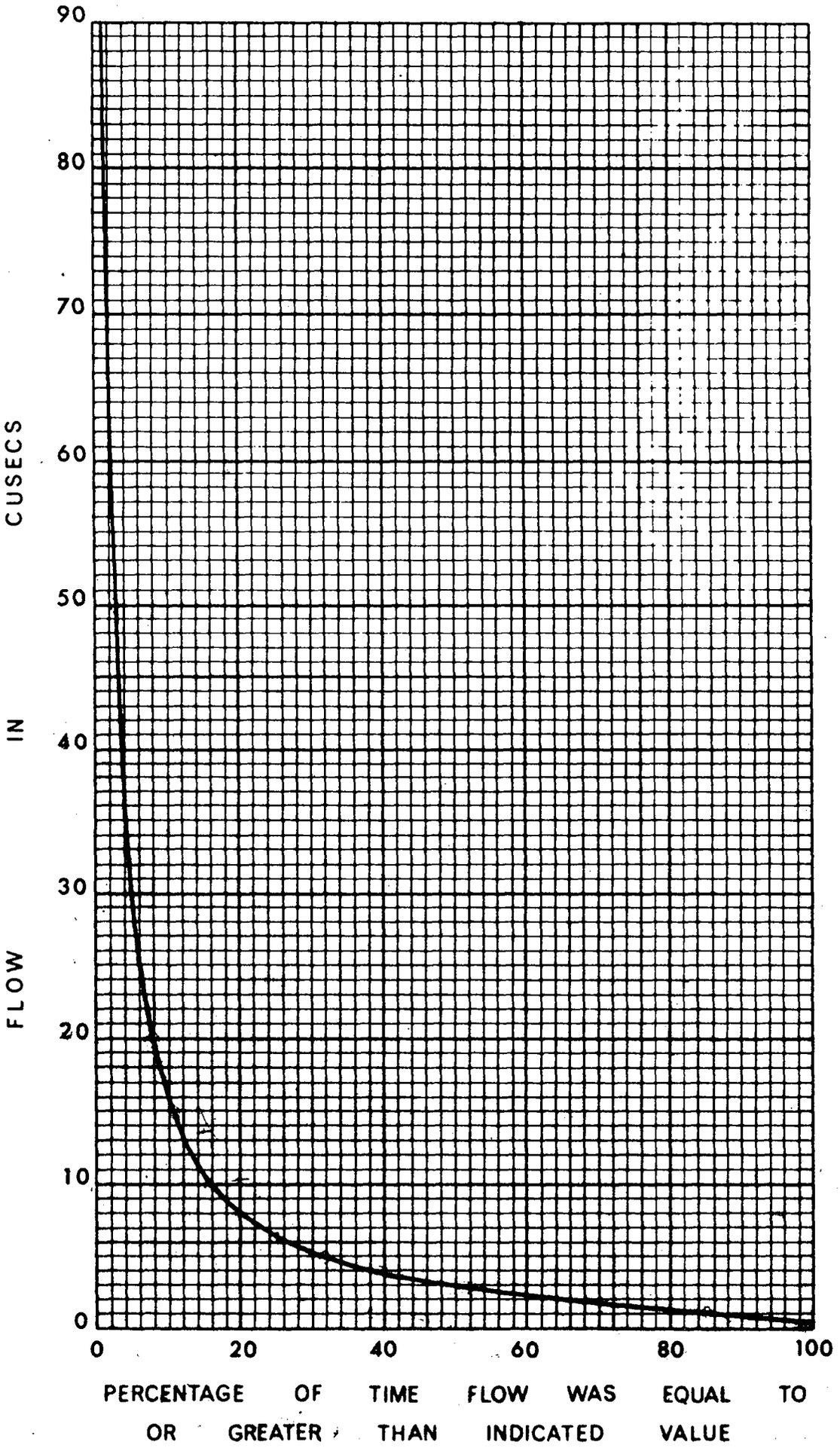
FLOW DURATION CURVE FOR FORBES RIVER AT BIRDWOOD

FIGURE 24



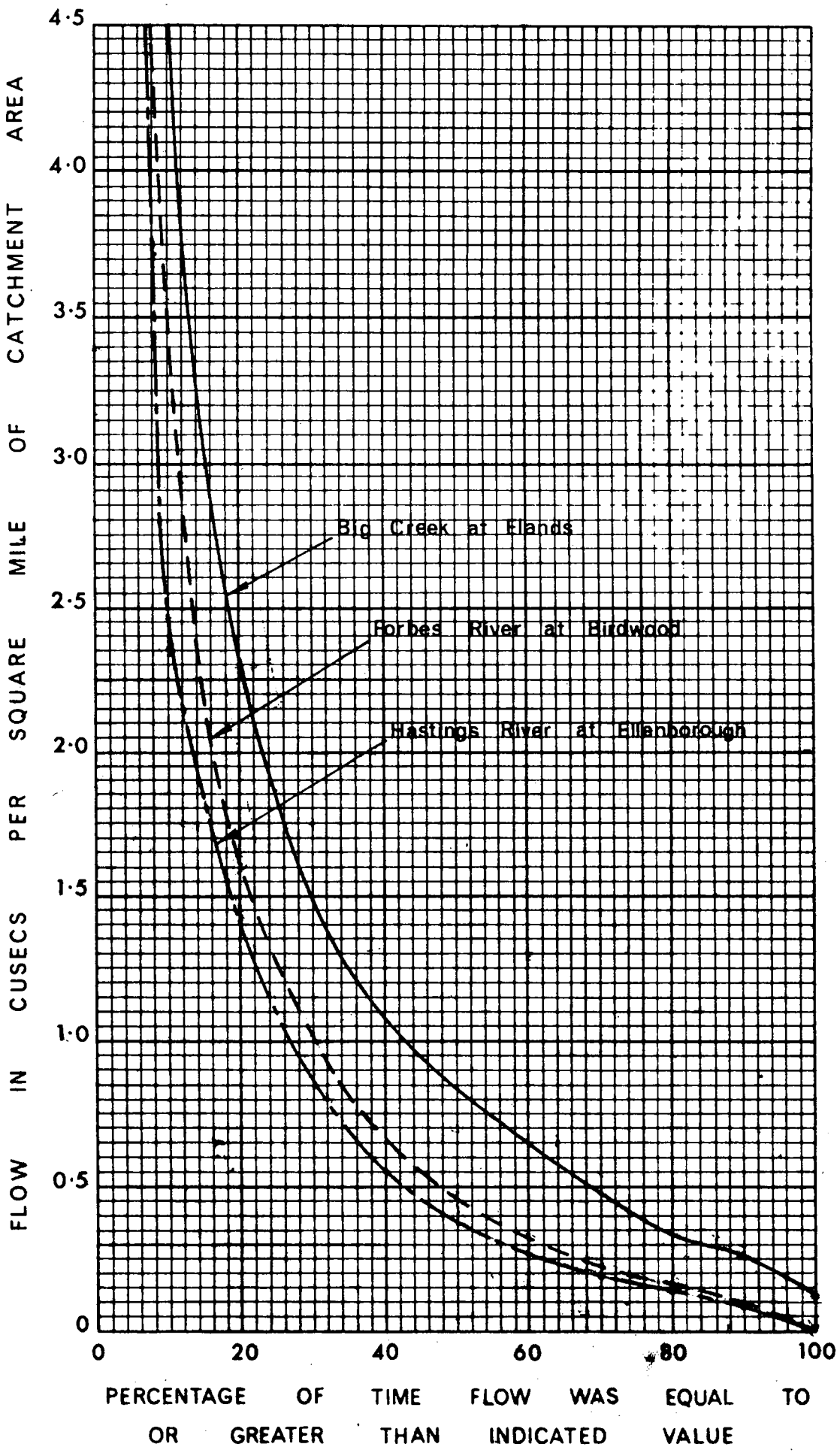
FLOW DURATION CURVE FOR HASTINGS RIVER AT ELLENBOROUGH

FIGURE 25



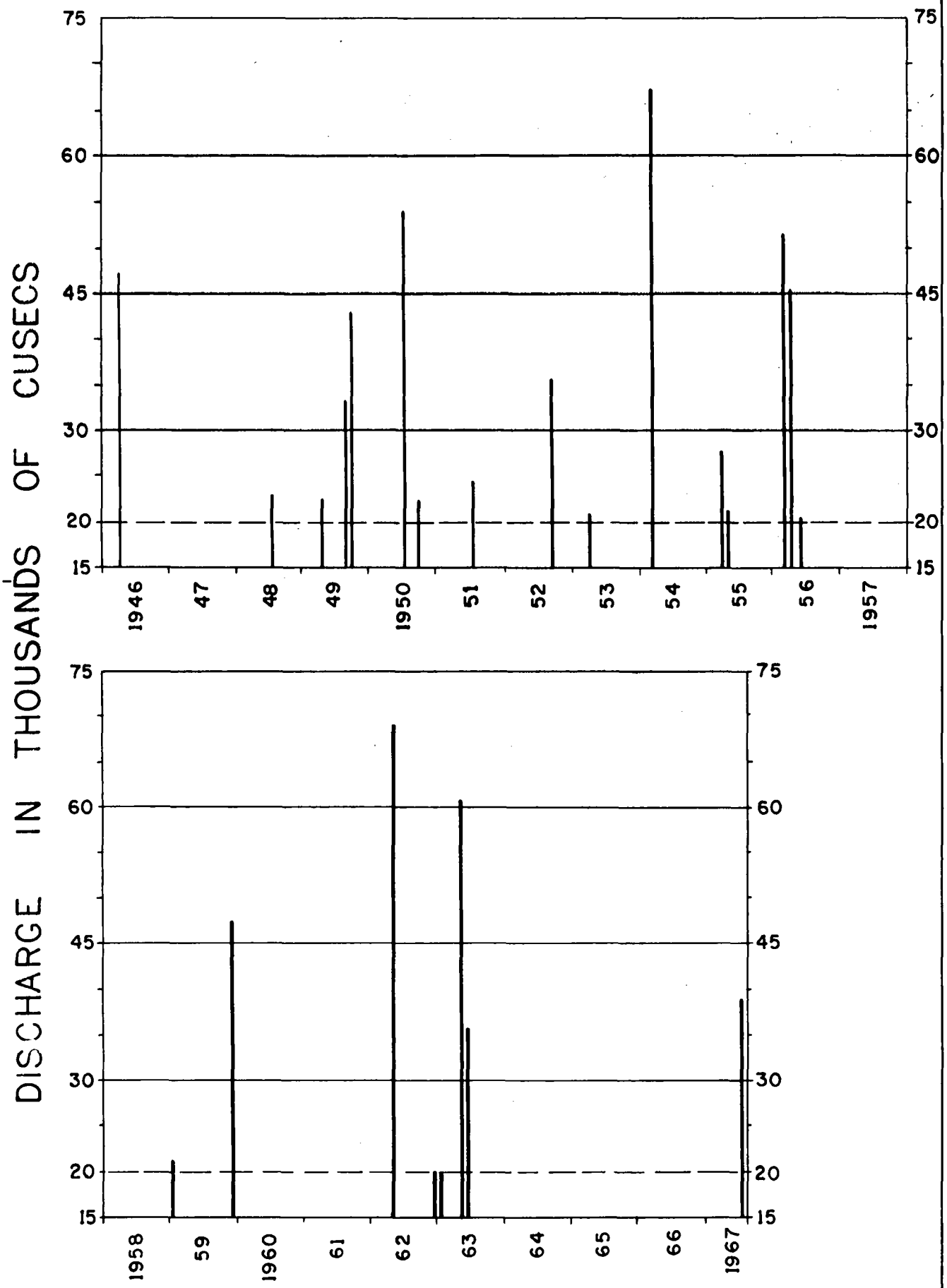
FLOW DURATION CURVE FOR BIG CREEK AT ELANDS

FIGURE 26



FLOW DURATION CURVES FOR THE HASTINGS VALLEY

FIGURE 27



DETAILS OF FLOOD DISCHARGES
ABOVE 20,000 CUSECS
HASTINGS RIVER AT ELLENBOROUGH

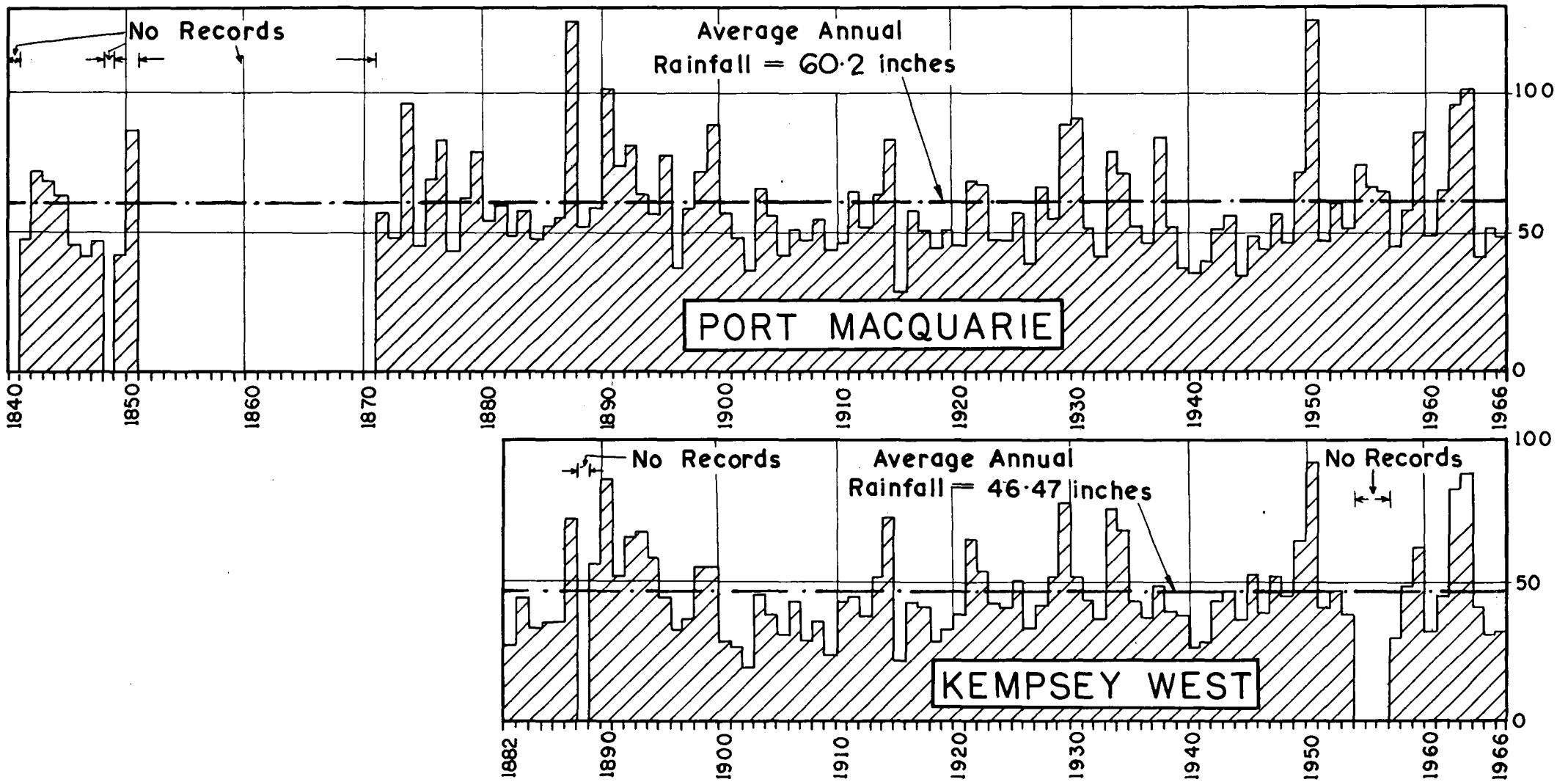
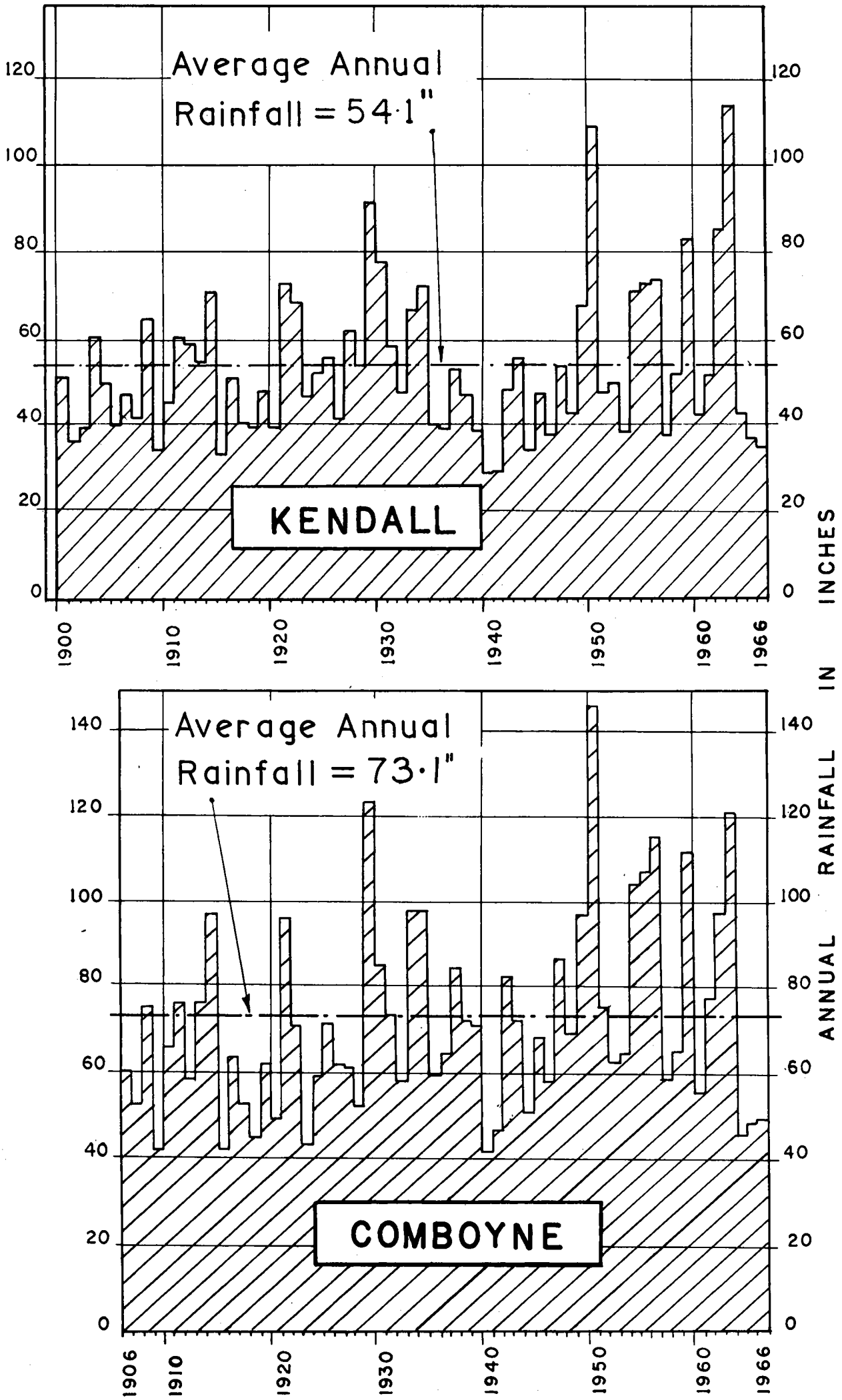


FIGURE 28

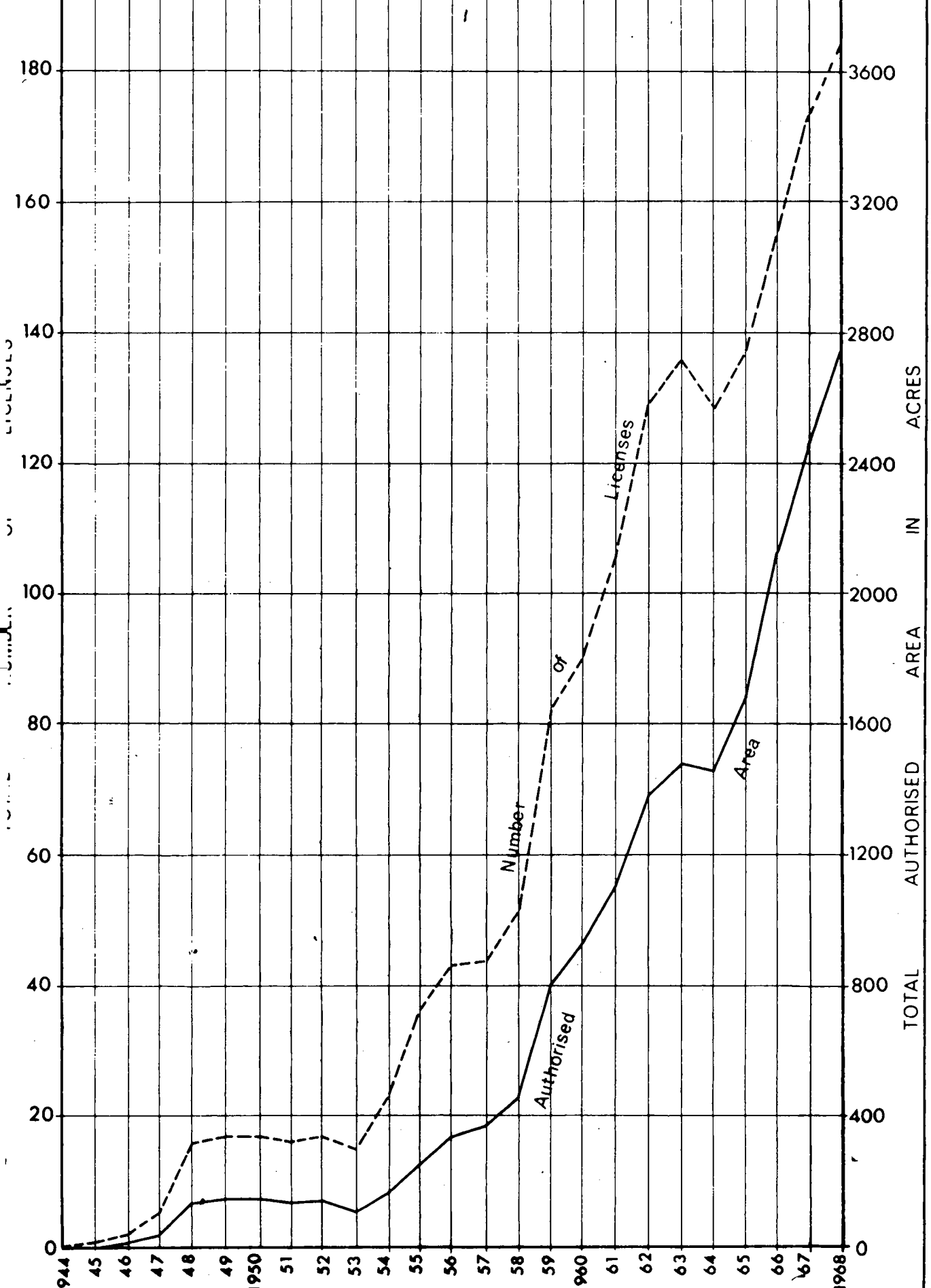
ANNUAL RAINFALLS AT PORT MACQUARIE AND KEMPSEY WEST

FIGURE 29

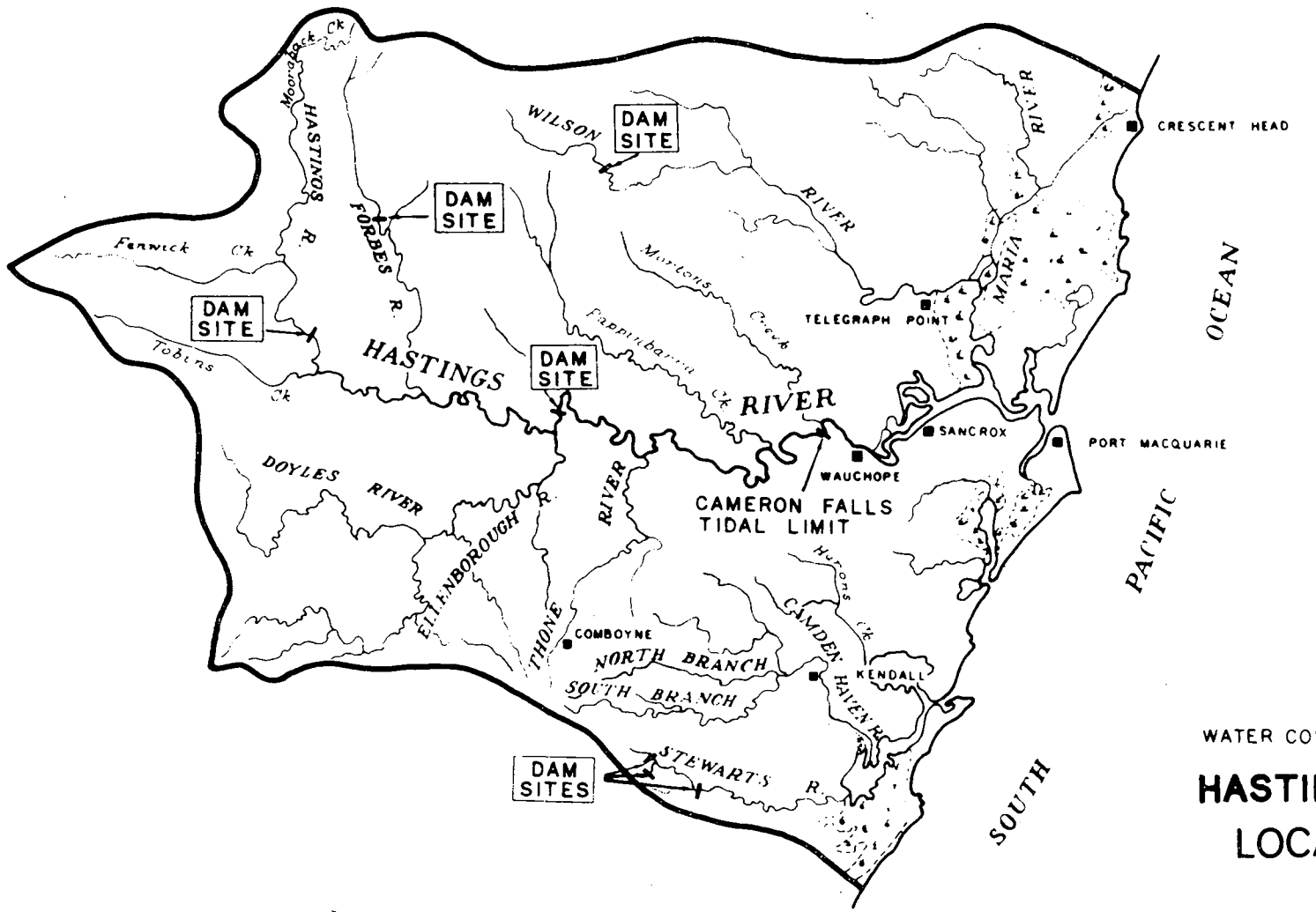


ANNUAL RAINFALLS AT COMBOYNE AND KENDALL

FIGURE 30



HASTINGS RIVER VALLEY
AREA AUTHORISED FOR IRRIGATION & TOTAL NUMBER OF LICENSES AT 30th JUNE FOR EACH YEAR INDICATED



NEW SOUTH WALES
WATER CONSERVATION & IRRIGATION COMMISSION

HASTINGS RIVER VALLEY
LOCATION OF DAM SITES

SCALE
MILES 4 3 2 1 0 4 8 12 16 20 MILES

FIGURE 31