

THE WATER POWER POTENTIAL OF SOUTH-WESTERN TASMANIA

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ABSTRACT

The potential average energy obtainable from the major rivers of South-West Tasmania is about 25% of the total hydro-electric potential of the State. Water power is the only indigenous source of energy of any significance in Tasmania. It is a non polluting and self renewing source of energy.

The Hydro-Electric Commission is a statutory authority created by the Parliament of Tasmania for the investigation, design and construction of power schemes and for the generation, transmission, distribution and sale of electrical energy within the State.

Engineering investigations in progress in South-West Tasmania will enable the feasibility and relative economics of alternative methods of developing the potential of the Gordon, King and Franklin Rivers to be assessed.

Geomorphological, pedological and biological surveys are being carried out in the lower Gordon drainage system for possible use in the preparation of environmental impact statements should the Commission decide at some future time to recommend to Parliament that a power scheme be constructed in this area. Investigations already indicate strongly that the damming of the lower Gordon River will not result in any adverse effect upon downstream vegetation.

INTRODUCTION

The major rivers of south-western Tasmania - the lower Gordon, King and Franklin - contain within their catchments the last major water power resources of the State. The potential average energy output from this area represents nearly 25% of the total hydro potential of the State. This potential is over twice that of the Gordon River Power Development Stage I works at present under construction.

Water power is the only indigenous source of energy of any significant magnitude available in Tasmania. No commercially viable oil or gas reserves have as yet been proved, and reserves of coal appear to be quite small. For example, "indicated" coal reserves in Tasmania are put at present at about 21 million tonnes. However, it would be necessary to prove the availability of 40 million tonnes in order to justify the installation of two 120 MW thermal generating sets using local coal as fuel. Alternatively "indicated" coal reserves are equivalent to the energy that could be obtained from hydro developments on the lower Gordon, King and Franklin Rivers in less than 20 years. Such hydro schemes could be regarded as having an indefinite life.

At present approximately 45% of the energy requirements of the State is derived from oil, 45% is obtained from electricity and about 10% from other sources - primarily coal. It is clear therefore that the State is at present heavily dependent upon imported oil. In view of the limited life of the world's oil reserves it is necessary to give consideration to ways and means of replacing oil as a source of energy as well as meeting the growing needs of industry, commerce and the domestic consumer. Imported coal and nuclear generating plant offer alternatives but at high cost and with pollution penalties. Solar energy and wind power offer some contribution to energy requirements but present indications are that energy available from these sources would be

quite small and expensive. On the other hand the water power resources of the South-West offer a pollution free method of energy generation for which development techniques are fully developed and for which design and construction expertise is available.

It is for these reasons that the Hydro-Electric Commission is engaged on the assessment of the feasibility of the water power resources of western and south-western Tasmania.

HYDRO-ELECTRIC COMMISSION AUTHORITY TO UNDERTAKE THE INVESTIGATION AND DEVELOPMENT OF WATER POWER

Before proceeding to a description of the possible power developments on the lower Gordon, King and Franklin Rivers at present under consideration by the Hydro-Electric Commission it is important that the authority of the Commission in these matters be fully understood.

The Hydro-Electric Commission is a statutory authority formed by the Parliament of Tasmania for the construction of power developments and for the generation, transmission, distribution and sale of electrical energy within the State. The powers and responsibilities of the Commission are set out in the Hydro-Electric Commission Act 1944.

Section 73 of the Hydro-Electric Commission Act 1944 provides:-

"The Commission may cause a systematic hydro-metric and waterpower survey to be carried out in respect of all waters of the State from which it may be reasonably anticipated that power may be obtained economically and the cost thereof shall be met out of the revenues of the Commission."

It is under this authority that the Commission is carrying out an assessment of the feasibility and economics of developing the water power potential of the lower Gordon, King and Franklin Rivers.

Section 16 of the Hydro-Electric Commission Act 1944 provides that no new power development shall be undertaken or constructed by the Commission unless and until a report on any proposed new power development has been submitted to the Minister and the proposed works have been authorised by both Houses of Parliament.

It will be some time before the engineering and environmental studies in the west and south-west are sufficiently advanced to enable the Commission to decide whether or not a report should be prepared for the Minister recommending the construction of hydro-electric power generating works on any of these rivers.

CLIMATE AND HYDROLOGY OF THE SOUTH-WEST

The climate of the south-western and western Tasmania is generally classified as temperate maritime. On the coast the average daily temperature range is 5.5°C rising to 11°C in areas away from the coast thus exhibiting a slightly more continental effect.

Temperature

The mean maximum temperature occurs in January or February and varies from about 18°C in the exposed coastal areas to 22°C in the more sheltered areas away from the coast. The mean minimum temperature occurs in July or August and varies from 7°C on the coast to 1.5°C inland from the coast. Extremes of temperature (14 percentile level) vary from Max 21.8°C Min 4.6°C on the coast to Max 28.9°C Min 1.7°C at inland locations.

Rainfall

The average annual rainfall varies from 1600 mm on the coast to 3400 mm on mountain barriers exposed to the westerlies. As demonstrated by Searle (1976) there is

a strong gradation from west to east with topography playing a major role. The seasonal rainfall varies from a minimum during January, February, March to a maximum during July, August, September. Two-thirds of the annual rainfall occurs during the six months May to October. The rainfall is highly reliable and although periods of deficiency occur they are relatively less severe than elsewhere in the State. On the average, rain occurs on 66 per cent of the days in the year.

Humidity

The mean relative humidity both at 9.00 a.m. and 3.00 p.m. rarely falls below 60 per cent at all stations in all months of the year. The mean relative humidity at 9.00 a.m. for all locations is about 80 per cent.

Evaporation

The mean annual open water (pan) evaporation varies from about 804 mm on the coast to 870 mm inland from the coast.

Sunshine

The region has the least sunshine in Australia due to the high incidence of cloud cover. The average number of hours of sunshine a year is about 1500 hours ranging from 7.7 hours per day in January to 1.7 hours per day in June.

Water Balance

As shown in table 10 the mean annual evapotranspiration (total moisture loss to the atmosphere) ranges from 507 mm to 864 mm per year with an average value of 680 mm per year, or 8 per cent of the open water (pan) evaporation. This factor of 0.81 has been the subject of a great deal of discussion in the literature and Aitken, Ribeny and Brown (1972) adopted a value of 0.8 for the conversion of pan evaporation to potential evapotranspiration for Papua and New Guinea. This would support the concept of the evapotranspiration occurring at the potential rate for most of the time, due to high rainfall with low variability maintaining optimum catchment soil moisture conditions most of the year.

In general terms the mean annual rainfall over the region is about 2450 mm of which approximately 1740 mm (71 per cent) runs off into the sea with the remaining 710 mm (29 per cent) returning to the atmosphere through the process of evapotranspiration.

Table 9

Queenstown

Mean Monthly Evaporation. (mm)

Jan	127.0	Apr	42.5	Jul	26.1	Oct	75.7
Feb	113.0	May	30.4	Aug	36.4	Nov	88.3
Mar	82.1	Jun	25.8	Sept	47.2	Dec	107.1
Total for year - 803.6							

POSSIBLE POWER DEVELOPMENTS

Stage I of the Gordon River Power Development, which is nearing completion, will exploit a substantial part of the useful head of the Gordon River. However, from the junction of the Serpentine River, near the outlet of the present power station, the Gordon falls more than 110 metres before it reaches the sea. On its way it collects additional water from its major tributaries such as the Denison, Olga, Sprent and Franklin Rivers and more than trebles in volume by the time it discharges into Macquarie Harbour. For convenience this stretch of river is referred to as the lower Gordon River and its power potential, already enhanced by the major water storages created by the Gordon Stage I Development, can be realised in several ways.

Water Power Potential

Table 10

Water Balance - West Coast Catchments

Catchment	Area	Mean Annual Rainfall	Mean Annual Runoff	Mean Annual Evapotranspiration
	(km ²)	(mm)	(mm)	(mm)
Davey below Crossing	686	2724	1957	767
Gordon below Huntley	458	2096	1589	507
Gordon at Knob	1280	2175	1505	670
Gordon above Franklin	2981	2443	1671	772
Franklin at Fincham	757	2583	2018	565
Franklin below Jane	1590	2703	1988	715
Huon at Scotts Peak	258	2105	1591	514
Huon at Frying Pan Creek	2090	2103	1371	732
Jane below Punt Hill	415	2612	1748	864
King at Crotty	449	3039	2380	659
King at Tofft	541	3042	2223	819
Serpentine above Gordon	457	2496	1929	567

Closely linked with the investigations of the lower Gordon River is the possibility of power generation from the King and Franklin River systems. The Franklin River is the main tributary of the Gordon and its mode of development could be influenced by the selection of a scheme on the lower Gordon. Accordingly because of their interdependence, the lower Gordon and King-Franklin investigations are being carried out concurrently and are being treated as a single regional study.

The various possibilities for the development of the power potential of the lower Gordon, King and Franklin Rivers can be reduced to two main alternatives. One scheme is to integrate the King, Franklin and Gordon catchments and direct their total flow via the Gordon River. The other is to develop the combined flow of the Franklin and King Rivers via the King River with a separate and independent scheme on the lower Gordon.

Integrated Development

In this arrangement (figure 13) the King River would be diverted into the Franklin River basin by a dam at Tofft near Crotty. The combined flows of the King and Franklin Rivers would then be developed through a dam and power station on the Franklin River just below the junction of the Andrew River to produce an average of about 1170 million kilowatt hours of electricity per annum.

On the Gordon River, a lower Gordon dam, constructed a short distance downstream of the Franklin River junction, would back up the combined waters of the Gordon and Franklin Rivers to an elevation of about 76 metres. The power station at this dam would be capable of generating almost 1800 million kilowatt hours annually from the total flows of the King, Franklin and Gordon Rivers.

Further increments of power that would be possible with this arrangement include the construction of a small dam and power station at Albert Rapids, below the junction

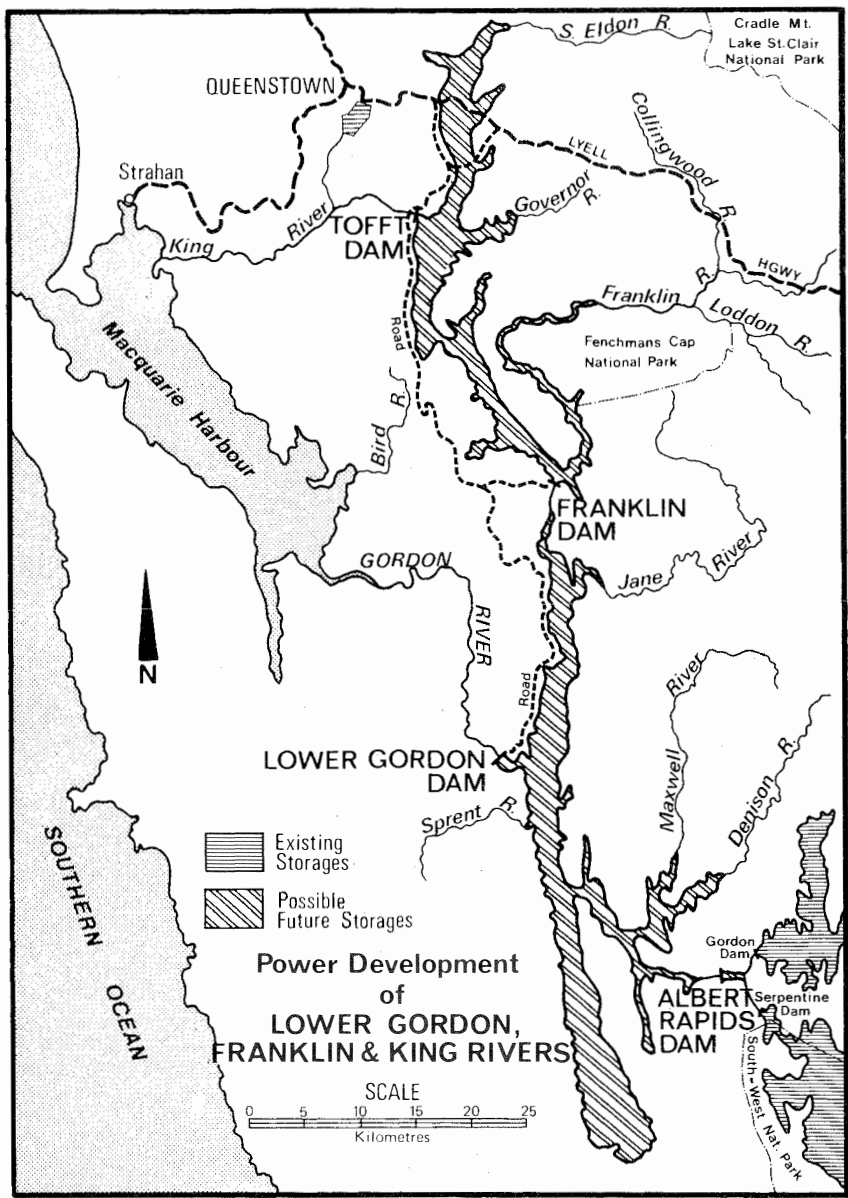


FIGURE 13

Water Power Potential

of the Serpentine and Gordon Rivers and the diversion of the Davey River into the lower Gordon via the Olga-Hardwood Saddle. Albert Rapids scheme would harness a 24 metre difference in elevation between the Gordon Stage I scheme and the lower Gordon dam to produce an average output of 245 million kilowatts per annum. The Davey diversion could add 236 million kilowatts to the average annual output of the lower Gordon station.

Separate Development

The alternative form of development (figure 14) would be to divert the Franklin River into the King River valley and generate power on the King River. The height of the Franklin dam would remain virtually unchanged, but the combined flow of the Franklin and King River catchments would now be discharged into Macquarie Harbour via the King River. Electricity would be generated at a dam and power station on the King River near Mt. Huxley and at a second dam and power station further downstream at Sailor Jack Creek. The combined average annual outputs would be about 1740 million kilowatt hours.

On the lower Gordon River a dam and power station just upstream of the Olga River junction would back the water right up to the Gordon Stage I power station and thereby dispense with the need for an intermediate scheme at Albert Rapids. The annual output of the Olga power station would be almost 1070 million kilowatt hours.

An alternative form of separate development of the lower Gordon River would be to move the scheme further upstream and replace the single dam at Gordon above Olga with a dam across the Gordon River at Splits just upstream of the Denison River junction and a dam and power station on the Denison River. The water would be returned to the Gordon by way of the Denison River. The output by this arrangement would be reduced to an average of 895 million kilowatt hours per annum.

It would not be economically feasible to develop the remaining head in the Gordon River below the Gordon River at Splits or the Gordon above Olga dams.

Under this arrangement the diversion of the Davey River to the Gordon River would no longer be of value. However, the potential of the Davey River could be developed by the construction of a dam and power station on the lower Davey River.

PROGRESS WITH INVESTIGATIONS

The major engineering investigation activities to date have included topographical mapping, the collection of basic data such as river flow and climatological data, and the study of the feasibility of alternative power development proposals. The feasibility studies have necessitated extensive geological mapping supported by geophysical surveys and diamond drilling. These studies have been directed primarily at the examination of potential damsites and at the establishment of the water tightness of proposed storages. Work carried out to date has enabled the Commission to conclude that the storages under consideration would be water tight and this view has been supported by appropriate consultants. Most of the present activities are being concentrated on the examination of alternative damsites on the Gordon River below the Franklin River junction, the Franklin below Andrew damsite and the Gordon above Olga damsite.

The field work which forms the basis for all the studies is a step-by-step process starting with broad regional investigations that progressively narrow the limits of choice. Every resource allocation at each stage of the investigation is weighed carefully against the value of the information sought. This is essential in a region where the country is rugged, the climate harsh and where working conditions require a special enthusiasm and motivation.

Base camps have been established at all the main centres of activity including

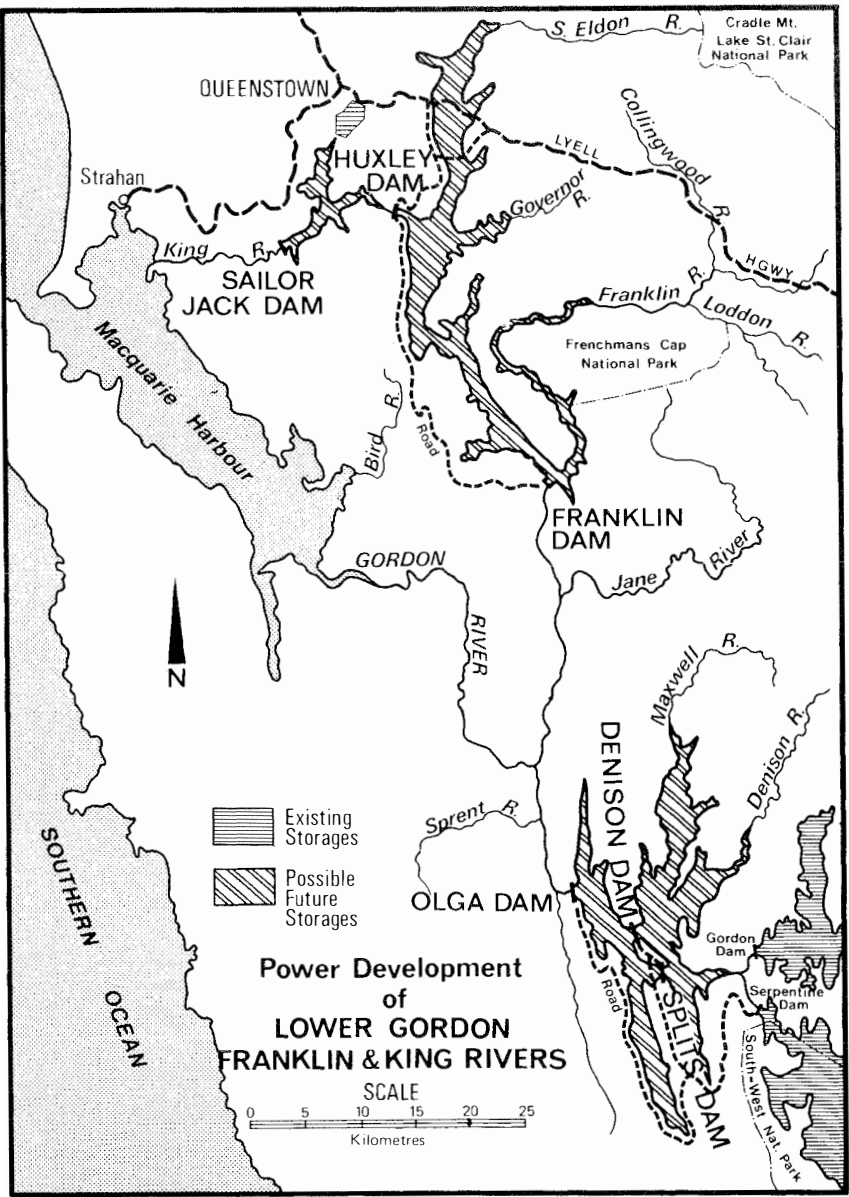


FIGURE 14

Denison, Olga and Sir John Falls on the Gordon River, near Mt. McCall on the Franklin River and at Rinadeena on the King River. They vary in size but are generally equipped for a cook plus six to twenty men. From these camps working parties, carrying their equipment, get to their sites by foot-track and boat. At Olga damsite, access is assisted by an overhead cableway, and at Franklin an inclined surface haulage has been constructed to transport men and equipment down into the gorge.

Except for Rinadeena, which is reasonably close to Queenstown, and Franklin which is remote but accessible by car from the Lyell Highway all the camps are isolated. Sir John Falls camp, located just upstream from Butler Island, can be reached by boat, helicopter and amphibious aircraft, but all other camps on the lower Gordon depend on helicopters for supplies and movement of personnel. This limitation restricts investigations in the region to a short summer period usually from December to April. During the rest of the year the weather in the west makes helicopter access unreliable and unproductive.

Nevertheless, throughout the winter small parties continue the work of data collection, water measurement and water sampling using small boats and leg power to cover the long distances between gauging sites.

The Hydro-Electric Commission is also undertaking environmental studies in the south-western area. On the recommendation of the Commission's scientific adviser, Mr. C.S. Christian, a scientific survey of the lower Gordon and King-Franklin regions has been commenced. The survey will initially consist of a fact finding study of the flora and fauna within the area that could be directly or indirectly affected by hydro-electric power developments. This information would be used ultimately in the preparation of an environmental impact statement should the Commission decide to recommend the construction of a power development. Because of the very rugged nature of the terrain and the very dense vegetation covering most of the area it has not been possible to proceed with a biological survey along conventional lines. The approach suggested by Mr. Christian is to prepare a broad land form and land type map based primarily upon solid geology and geomorphology together with vegetation drainage and climate. This data is then used for the identification of different physical environments. Section lines or transect lines are then selected to intersect a number of representative environments and these transects roughly cleared to form walking tracks and surveyed. These lines traverse not only the river valleys but also areas well above proposed storage levels and areas downstream from possible developments. Suitable parties then move in to sample soils and aquatic and terrestrial flora and fauna. Finally an attempt is made to correlate the flora and fauna with land type and vegetation so that the findings can be projected to other areas and streams.

Because of the novelty and difficulty of the survey the proposed activities were instituted on a step-by-step basis leaving considerable flexibility for the modification of the programme according to developments. In the first instance discussions were held with interested Government Departments and instrumentalities and the proposals were discussed with a number of the scientific staff of the University of Tasmania. In order to test the feasibility of proposals pilot studies were carried out in the field by a small group of volunteer scientists and Commission experts in February 1975. Following the successful completion of the pilot studies a broad scientific survey was organised for the summer of 1975-76 covering 7 transect lines (total length of 16 km).

The survey was under the general direction of the Hydro-Electric Commission's scientific advisers, Mr. Christian and Dr. Gilbert, and personnel engaged included ten senior University staff on a part time basis, Hydro-Electric Commission geologists, hydrologists and engineers, nine skilled field assistants (usually experienced post-graduate students) together with Inland Fisheries Commission staff and volunteer specialists. The Hydro-Electric Commission cleared and surveyed the transect lines

for this work, provided camp accommodation and meals and provided helicopter transport as necessary.

Reports on the 1975-76 investigations are encouraging and it appears that a great deal of scientific data has been collected by the parties involved. In fact the investigation is providing an opportunity for scientific study that would not otherwise have been possible in such remote and difficult country. A programme for a continuation of these studies during 1976-77 is now being prepared.

The Commission is also carrying out investigations of salinity in the lower Gordon River and for this purpose has carried a number of salinity surveys along the lower reaches of the river under different river flow conditions. These studies show that quite high saline concentration levels occur well upstream from Butler Island under normal river flow conditions. Other investigations have shown that ground water in the banks adjacent to the river is free of salt. The studies to date indicate that vegetation along the river is not likely to suffer as a result of the reduction of river flows to exceptionally low levels. In any case it would be a relatively simple matter to provide for release from any lower Gordon River Dam both during and after storage filling in order to overcome any possible adverse effects upon the vegetation along the river. The studies in hand will enable the level of release required for this purpose, if any, to be determined.

The Commission as part of its long term studies is also collecting data to enable any effects of proposals on the entrance to Macquarie Harbour to be assessed. Obviously in any report a number of other matters such as tourism will need to be discussed.

CONCLUSION

The investigations of the King-Franklin and lower Gordon areas are far from complete and it is envisaged that several more years will elapse before conclusions can be drawn. The long term plans outlined here are still in a very preliminary stage and are subject to considerable change after engineering and environmental studies have been completed.

REFERENCES

- Aitken, A.P., Ribeny, F.M.J. and Brown, J.A.H., 1972: The estimation of mean annual rainfall and runoff over the territory of Papua New Guinea. *Civil Eng. Trans. I.E. Aust.*
- Searle, I.L., 1976: The estimation of mean annual rainfall in south west Tasmania. *Hydro-Electric Commission Report.*



PLATE 20. - The invasion of the works of man into rainforest
at Rosebery.