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Changing Approaches to River Management in the Tasmanian Hydro Electricity System

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SUMMARY: The development of the Tasmanian hydro-electricity generating system has had a profound impact on the natural waterways of Tasmania. This paper examines the extent of hydro-induced modification and impacts to Tasmania's natural watercourses, the environmental management issues which arise with system operations, and institutional responses to these river and lake management issues. Particular emphasis is given to the changing nature of the Hydro-Electric Corporation's response to waterway management issues; i.e., historical versus current response, and the drivers behind this change. The Hydro has had to undergo an institutional shift from an era focussing on dam building (resource development), to a new era as an electricity generator with a strong corporate vision as energy and water managers (resource management). The Hydro is increasingly evaluating and seeking to understand its impacts on the aquatic environment. The challenge is now to find practical solutions which enable sustainable energy generation while improving lake and downstream river environments.

- The operations of the Hydro-Electric Corporation have a major influence on a large percentage of Tasmania's lakes and rivers.
- The Hydro is redefining its vision as a business and taking on more responsibility for the environmental quality of the lakes and rivers on which it impacts.
- A number of factors both external and internal to the Hydro have influenced this instiutional shift, including COAG reforms to the electricity and water industries, end of the dam building era, structural changes to the business, and expansion of internal environmental expertise.

1. INTRODUCTION

What has made the Hydro-Electric Corporation (the Hydro), after being involved in litigious and highly publicised environmental disputes during the 1970s and early '80s, embrace more fully the role of custodian and manager of a large percentage of Tasmania's waterways? What has caused community interactions with the Hydro to move from the environmental battlegrounds of the 1970s and '80s to round-the-table consultations and integrated catchment studies, alongside community members and stakeholders, trying to find consensus in the management of individual waterbodies?

This shift is in fact occurring, and the factors leading to this change are presented in this paper. This paper broadly reviews the extent of the impacts of the hydro system on Tasmania's natural river systems, and how the Hydro-Electric Corporation (formerly Commission) has historically and is presently dealing with these impacts.

Section 2 of this paper provides some background on Tasmania's water resources, and factors which make Tasmanian lakes and rivers differ from the mainland. Section 3 reviews the impacts of flow regulation and extent of modification of Tasmania's natural lakes and rivers for the purposes of hydro development. Section 4 examines the aquatic environment issues which arise with operation of the hydro-electric scheme, and how these issues have changed over time. Section 5 looks at the institutional changes which have occurred and which are changing the way the Hydro approaches water management, and Section 6 summarises the current Hydro actions which reflect this shift.

2. TASMANIA'S WATER RESOURCES

Tasmania, with 3% of the population and less than 1% of the land area of Australia, is bestowed with 12% of the country's freshwater resources (SEAC 1996). Average annual surface run-off is 53 million megalitres (ML). The largest water user in the State by far is the Hydro-Electric Corporation, using 13.5 million ML a year for electricity generation, although in most cases this is a 'non-consumptive' use. Uses other than electricity generation consume less than 1% of the total, 480,000 ML, and include, in order of volume used, irrigation, mining, industry and domestic uses.

Despite the abundance of water in Tasmania, the geographic distribution of these water resources is highly uneven, reflecting climatic patterns and regional geomorphology. Tasmania is situated on the northern edge of westerly winds known as the 'Roaring Forties', which bring cloudy wet conditions to the south and west of the State. This moisture-laden westerly airflow is forced to rise over the western, central and southern highlands, where it cools and releases much of its moisture. Hence the west coast can get six times the

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average annual run-off of the lower elevation Tasmanian midlands. Factors such as relatively high evaporation rates and ground permeability on the east coast also mean that run-off in the southeast of the State is only 10-15% of the annual rainfall, compared to 80-90% in the west. In general, the west coast experiences less variable run-off between both seasons and years than does the east coast (SDAC 1996).

Unlike many regions of mainland Australia, Tasmania's extremely variable terrain reflects a history of dynamic geologic processes involving volcanism, folding, faulting, uplift, intrusion and glaciation. Rocks from all geologic time periods are represented in Tasmania (Burrett and Martin, 1989). The State's hydro schemes are largely situated to take advantage of areas which combine high topographic relief and high precipitation, and so to a large degree utilise the Central Highland and western catchments.

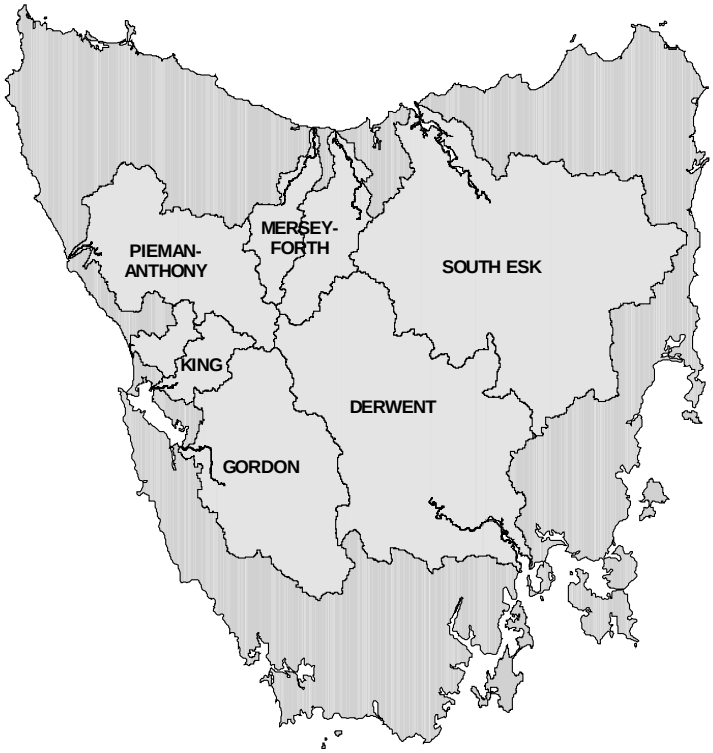
Stream patterns are variable throughout the State and are largely influenced by the geology, reflecting interactions of different rock types and joint or fault patterns. Tasmania's major rivers generally fall into two categories, those which have been largely superimposed (e.g. the Gordon, King, Pieman and Mersey Rivers), and those which are largely graben-controlled. (e.g. the Derwent and Tamar) (Scanlon et al. 1990). Tasmanian streams are often young, high gradient and actively eroding (SDAC 1996), with many reaches which are steep, relatively fast flowing, carrying cobbles and boulders, and in places structurally constrained right down to the estuary. These characteristics make them different from many mainland Australian streams. The six major river systems mentioned above have all been modified for hydro-electric power generation, and the unique characteristics of each catchment create different management issues for each one.

Tasmania is also rich in freshwater lake resources, with thousands of natural and modified lakes. The Tasmanian Central Plateau is the only place in Australia where a large number of permanent freshwater lakes occur (SEAC 1996), many of them created by glaciation. Tasmania has Australia's deepest permanent freshwater lake (Lake St. Clair), as well as the largest (Great Lake) (SDAC 1996); both of these have been modified for hydro-electric power generation.

3. IMPACTS OF FLOW REGULATION

The development of the Tasmanian hydro-electricity generating system has had an impact on a large proportion of the natural waterways of Tasmania, as can be seen in Map 1. The generating system was developed largely post-World War II, alongside a massive nationwide dam-building program to drought-proof Australia and ensure adequate water supplies. On average, one reservoir was built or expanded in Tasmania each year between the late 1940s to mid-1980s, to a point where Tasmanian storages for hydro-electric power generation can hold over 25 million ML of water (SDAC 1996). The purpose of all this development is for the average annual generation of 1,100-1,150 MW-yrs (10,000 GWh) of electricity, which meets 100% of mainland Tasmania's demand. In 1996 Tasmania generated almost 60% of Australia's hydro-electric power (ESAA 1997).

At present there are 27 power stations and 52 storages grouped into six major hydro schemes in Tasmania as shown in Map 1.



MAP 1 - HYDRO CATCHMENTS IN TASMANIA

More than 1,100 km^2 of river valleys, wetlands and pre-existing lakes have been inundated for hydro development. The catchment area feeding into Hydro storages takes up 21,500 km^2, or 35% of the mainland Tasmania land area. 107 dams and weirs have been constructed which affect 21 creeks, 25 rivers, and ultimately 7 estuaries. At least 1,200 km of natural creeks and rivers are affected by hydro operations by way of diversion or addition of water, and alteration of flow regimes. The generating system includes a further 212 km of purpose-built water conduits including pipelines, tunnels and canals, which are often instrumental in moving water out of natural catchments into selected hydro storages.

Fundamental hydrological changes brought on by these developments include:

- loss of natural river and wetlands, and creation of new wetlands;
- decreases or increases in volume of discharge in streams due to interbasin transfers;
- changes and sometimes reversals in seasonal discharge patterns in streams;
- unnatural pulses of water released into streams;
- changes in flow variability and rates of rise and fall in water levels; and
- changes to the magnitude, frequency and form of flood events (Petts 1984).

Major interbasin transfers occur in almost all hydro catchments:

- The headwaters of the Mersey River are diverted at Parangana Dam into the Forth River on Tasmania's north coast.
- The upper reaches of the Huon River are diverted into the Gordon River, via Lakes Pedder and Gordon and the Gordon Power Station.
- The whole Great Lake catchment naturally drains via the Ouse and Shannon Rivers into the Derwent river system in the south of the State. It has been diverted northwards over the Great Western Tiers through the Poatina Power Station, into the Macquarie-South Esk river system and out into the Tamar Estuary in the north of the State. The Great Lake developments have involved four successive stages of dam construction and/or dam wall raising. Great Lake is a significant wetland with over a dozen invertebrate species listed as rare, vulnerable or having a significantly restricted range.
- Significant reaches of the Derwent, Dee and Nive rivers are frequently left dry due to diversions of water in the upper Derwent scheme.
- The headwaters of the Henty River are diverted into the Pieman River scheme.
- Additionally there are numerous small diversions, for example three small tributary streams of the Franklin River are redirected into Lake King William.

The hydro-electric generating system is huge, complex, and poorly understood by most people. Because each catchment is unique and the dams and power stations play different roles in the system, and hence have different discharge and lake level patterns, it is difficult to generalise about environmental impacts. The hydrological changes have implications for sediment movement, stream channel form and maintenance, instream biota, riparian habitats, and water quality.

4. AQUATIC ENVIRONMENT ISSUES

Early aquatic environment issues for the Hydro revolved around conflicts with the proposed developments. Considerable media attention has been given to the heated environmental battles attempting to constrain the hydro dam-building drive in Tasmania, most notably the Lake Pedder and Franklin River campaigns. Other less publicised conflicts existed between agriculturalists and the Hydro, particularly over how much water the Hydro made available in agricultural catchments. In several instances, legislation was passed ensuring the Hydro releases "reasonable quantities" of water for downstream irrigation purposes (e.g. the Shannon, Ouse and Lake Rivers), a requirement which has proven to be very poorly defined.

During the late 1980s and early 1990s, aquatic environment issues for the Hydro revolved around particular high-profile problems. The Lagoon of Islands suffered a major algal bloom between 1989-91, a product of high sediment and phosphorous loads eroding out of the unstable banks of the Ripple Creek Diversion Canal combined with changing water level patterns in the lagoon (Sanger 1992). A major fish kill downstream of the Reece Power Station in the Pieman River scheme in 1990 highlighted a total absence of environmental information on the Pieman River. The fish kill was found to be due to gas supersaturation out of the power station caused by a combination of factors (Koehnken 1992). Hydrogen sulfide and de-oxygenated water was being discharged out of the John Butters Power Station into the King River soon after the power station was commissioned in 1992; this was due to stratification of Lake Burbury and a deep intake (Sanger 1993).

In response to some of these major problem issues, a consultancy arrangement was set up in 1991 with the Inland Fisheries Commission. The IFC supplied biological consultancy services to the Hydro to address aquatic environment issues, and this arrangement is ongoing. The main role of this consultancy has been to conduct routine water quality monitoring of Hydro lakes, more detailed water quality monitoring of some 'problem' lakes, to respond to other aquatic issues as they arise, and to provide a link with the trout fishing community which is a major user of Hydro waterways. Note that the IFC deals with native and commercial fish issues as well as trout, and the potential for conflicts of values in these areas is something both the IFC and Hydro have to deal with.

Ongoing issues tend to reflect regional characteristics. The west coast is a mountainous and heavily forested region with small mining towns and the fishing/tourist village of Strahan. The Hydro's west coast schemes capture water falling on the west coast range, a highly metalliferous belt with numerous mines recovering copper, silver, lead, zinc and gold. Issues on the west coast often relate to the interactions of the hydro schemes with the mining discharges. Examples are high heavy metal loads in run-off draining into impoundments of the Pieman River system (Koehnken 1992), and tailings and acid mine drainage in the King River system (Koehnken 1997).

The Central Highlands are characterised by sparse alpine vegetation, numerous lakes of varying sizes, small permanent populations and lots of shacks. Trout fishing is one of the major uses of the region. Issues in the Central Highlands often relate to fish and water quality. High turbidity and nutrient levels are problems in a number of the Hydro lakes (as well as non-Hydro lakes) in the southeast part of the Central Highlands (e.g. Shannon Lagoon, Penstock Lagoon, Lagoon of Islands, Woods Lake).

The Derwent, Mersey and South Esk catchments are more densely populated with a mix of rural and urban populations, and higher proportions of the land have been cleared for grazing. Aquatic environment issues often relate to water quantity, bank erosion and condition of the riparian zone (e.g. willows).

During the 1990s, the consultancy arrangement with the IFC resulted in a number of positive environmental actions on the part of the Hydro. Lake level agreements were made for several lakes to enhance water quality, protect threatened native galaxiid fish species, and optimise the trout fishery (e.g. Woods Lake, Lagoon of Islands). A current velocity barrier to prevent the spread of exotic red fin perch from Lake Gordon into Lake Pedder was established, to reduce the threat to the native Pedder galaxiid. An outlet was installed in Penstock Lagoon to improve water circulation and hence water quality. An elver ladder was put in place at Trevallyn Dam in Launceston to enable upstream passage of elvers and reduce their mortality rates. A barrier to fish migration is being constructed on Liawenee Canal to prevent the upstream migration of red fin perch into sensitive World Heritage Area lakes.

In general, the IFC consultancy arrangement has made the Hydro much more aware of the environmental issues surrounding their operational decisions, and shown them mechanisms to improve these issues. However, as long as an external agency was dealing with these issues, the Hydro was not taking full responsibility for anticipating and understanding their aquatic environmental impacts. Nor was the Hydro required to be strategic and long-term in their thinking on these issues.

5. INSTITUTIONAL CHANGES

The Hydro has historically viewed itself first and foremost an electricity business, with a mission to increase the electricity generating capacity of the State via dam-building. There is limited mention of water management in any of the Hydro's annual reports prior to 1997. The historical response of the Hydro to aquatic environment issues was largely reactive, responding when issues arose with a mad scramble to get some information where none had been collected before, and putting in place sometimes expensive solutions which were preferably (in the eyes of the Hydro) low-maintenance.

Changes to the Hydro during the 1990s have been rapid and profound. The last hydro dam in Tasmania was built in 1993, ending the development of two-thirds of the potential hydro-electric resources in Tasmania (the remainder of these resources are within or near World Heritage Areas or National Parks). The Hydro in the mid-1990s was focussed largely on staff reductions and internal changes marking the end of the dam building era. Staff numbers were cut from around 5,000 to less than 2,000, construction villages were closed and sold, and the business totally restructured. In 1996, comprehensive electricity reform legislation was passed by the Tasmanian parliament, the Hydro was corporatised in 1996, and in 1998 the Hydro was split into three separate businesses.

The Hydro ceased building dams in 1994 because supply and demand were in balance, and a decreased load growth was projected. It would be many years before a new supply was needed. When this situation arises, the new supply is unlikely to be another major hydro-electric dam for two reasons: 1) the remaining dam options are either uneconomic or are located in environmentally sensitive areas such as World Heritage Areas; and 2) the Hydro would prefer a more diverse folio of energy generation sources than just hydro-electricity. The end of the dam building era does not mean the end of expansion of energy generation; rather, the Hydro is more likely to develop sources such as wind, gas or mini-Hydro schemes.

The business split created two new businesses in addition to the Hydro. Aurora Energy Pty. Ltd. is focussed on management of the electricity distribution assets and retail, and Transend Networks Pty. Ltd. is focussed on management of the transmission assets. The third business, what is left of the Hydro-Electric Corporation, now has a staff of 650. This 'new Hydro' has a focus on operation and maintenance of the generation assets (power stations, dams and associated infrastructure and property) and system control.

The end of the dam building era required the Hydro to shift from a primarily resource development to a resource management era. The business split has clearly separated the electricity transmission, distribution and retail sides of the business from the aspects of the

business which relate to water. The 1997 Hydro Annual Report is the first annual report which refers to water management as an essential function of the Hydro business.

Alongside this setting of new business directions have been two other very significant changes, one external and one internal to the Hydro.

External to the Hydro, the Council of Australian Government's 1995 decision to require reforms to the water industry has led to a review of the *Water Act* 1957 in Tasmania. The new water management legislation is almost certainly going to require a water licence or licences for the Hydro. Associated with this legislation and the development of State policies is the setting of environmental values for Tasmanian waterways. This will require a review of the Hydro's water management practices, including consideration of environmental flows.

The Hydro is keen to be as proactive and involved as possible in the setting of environmental flows and the development of water and catchment management plans. The sooner these are set the sooner the Hydro has more certainty for its business. The Hydro has looked at the experiences of New Zealand, BC Hydro and Snowy Mountains hydro authorities, and concluded that as a business the Hydro needs to be involved early in any environmental flow setting process and to involve the community and stakeholders as much as possible.

Internal to the Hydro has been the gradual growth since 1993-94 of an Environmental Services section. Significant achievements of this section have been the development and refinement of an environmental policy for the Hydro, and the development of an ISO-14001 certified Environmental Management System (EMS). The EMS is a management system with defined policies, procedures and work instructions. It includes management of environmental risk, measurement and reporting of performance, and independent external audits. This system has been instrumental in the setting of environmental objectives for the business, and systematically evaluating the Hydro's environmental performance against these objectives.

The last five years has seen a growth in the Environmental Services section to a staff numbering 17, comprising scientists from a range of disciplines, and including zoologists, aquatic ecologists and fish biologists. The significance of this development is that the Hydro is increasingly internalising environmental responsibilities rather than counting on external consultants to tell them what to do. By taking this responsibility, the Hydro is changing its management of the aquatic environment from reactive to much more proactive and strategic.

6. CURRENT HYDRO ACTIONS

An outcome of these institutional shifts in approach to water management has been the development of a comprehensive aquatic environment program for Hydro waterways. This program includes:

- development of an aquatic environment policy for the Hydro;
- written reviews of the range of aquatic environment issues in Hydro catchments, to be updated every few years to provide benchmarks and chart progress;
- environmental risk assessments for Hydro catchments;
- development of strategies, priorities and long-term programs for issues such as environmental flows, fish migration and threatened species;
- commencement of a broad-based multi-disciplinary water monitoring program of Hydro-impacted lakes and rivers involving physico-chemical, biological and physical habitat monitoring;
- increased liaison with the community, university research and other government and research agencies; and
- setting up of and active involvement in catchment management studies.

An example of this new approach and the positive outcomes which can be achieved is the Mersey River Experimental Study. Details and results of this study are presented in this volume by Sonia Anderson.

There are several aims which the Hydro's aquatic environment program would like to achieve. "Excellence in water management", a stated aim of the Hydro business, includes excellence in the management of environmental issues associated with the Hydro waterways, and this is the overarching aim of the Hydro's aquatic environment program.

Further aims are:

- To address aquatic environmental issues in a comprehensive, proactive and strategic manner, aiming for long-term outcomes;
- To respond in a committed fashion to legislative, policy and community-driven developments relating to environmental management of the Hydro's waterways; and
- To work co-operatively with other government agencies and members of the community to find the best practicable solutions to water management conflicts and problems.

7. CONCLUSIONS AND FUTURE CHALLENGES

This paper has documented a shift in the corporate vision of a major water management institution. The Hydro has had a major impact on the natural waterways of Tasmania, and it controls the flows and lake levels in many of Tasmania's major rivers and lakes. The Hydro

has always had a significant role as a water manager in Tasmania, but this role has concentrated on power generation and has not embraced all facets of water management until recently.

Many factors have influenced this shift in corporate vision. COAG reforms to the electricity and water industry, end of the dam-building era, structural changes to the business, and expansion of internal environmental expertise have all been instrumental. This combination of factors has created a situation in which the Hydro has become much more involved in aquatic environment issues related to its waterway management.

A number of initiatives contained in the Hydro's aquatic environment program reflect this expansion in its role as water manager. The aquatic environment program and the Hydro's Environmental Management System will ensure environmental goal setting, and measurement of performance against these goals. The Hydro is evaluating and seeking to understand its impacts on the aquatic environment, and to find practical solutions which will improve the lake and downstream river environments.

The challenge now is to see if these practical solutions can be found, given the at times competing needs of running an energy generation business and minimising the environmental impacts of that business. The fact is, they must be found for the business to be sustainable. Although the Hydro has considerable powers under the current Tasmanian water legislation to make decisions on water management, it needs to reach long-term sustainable outcomes on water management issues to provide certainty to the business. These outcomes must be environmentally sustainable, be acceptable to the community, retain a certain measure of generating flexibility, and maximise energy generation within these constraints. The drivers for the business to achieve these outcomes are not only business certainty and demonstrated sustainability, but also a demonstrated compliance with its own environmental policy statements, and qualification as a Green Energy source.

The Hydro is about to launch a major program of systematically reviewing its water management practices in the State on a catchment-by-catchment basis. This long-term program will be funded by the Hydro, but will closely involve other government agencies, local councils, interest groups, stakeholders and the community. A starting point will be the establishment of a Steering Committees in each catchment, to be headed by either a State government or local council representative. Each catchment Steering Committee will employ a facilitator to develop a process of dispute resolution which satisfies the individual catchment stakeholders. Community and specialist perceptions of water management issues will be canvassed, and a program of issue investigation designed and implemented. The outcomes will ultimately mean changes in Hydro operations, and the Hydro will put in the time and resources required to ensure the best decisions are made in each catchment. The end goal is a sustainable business with community acceptance of its use and management of the State's water resources.

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