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PATEA HYDRO SCHEME CASE HISTORY ENVIRONMENTAL PREDICTIONS AND THE OUTCOME (*)

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1. INTRODUCTION

The Patea Hydro Electric Scheme was the first of the local authority hydro electric schemes to be subjected to full environmental scrutiny. Many environmental planning techniques which are now standard practice were developed during the approval processes for the Patea Scheme. This paper examines the procedures which were followed, the predictions which were made on scheme behaviour, and compares these with the present situation 6 years after the lake has been filled.

In the 1970's the world economy was severely affected by disruption in oil supply from middle east states. A potential world energy crisis was seen which would affect New Zealand badly. A Government policy was formulated encouraging local authority Electric Power Boards to develop hydro resources within their area. Favourable Government finance was offered. Local energy resources were examined, including environmentally sensitive rivers. The Egmont Electric Power Board, a local power supply authority, responded by investigating hydro resources within its own region. Consultants were appointed, with Beca Carter Hollings & Ferner Ltd as lead consultant, and the author as Project Manager. The Patea River was chosen as having the potential to supply a large proportion of the Board's electricity demand.

The chosen scheme had a dam in a remote section of the Patea River 42 km upstream from the mouth. The dam would raise the water level by

(*) *Aménagement hydroélectrique de Patea. Prévisions des effets sur l'environnement et résultats.*

60 m creating a narrow sinuous lake which extended 47 km back through remote bush covered gorges. The power station output of 30 MW would generate directly into the Egmont Electric Power Board supply network. Fig. 1 shows the dam location and catchment area.

2. ENVIRONMENTAL PROCEDURES

Concern for the environment is high in New Zealand, with many major water resource projects not proceeding because of environmental opposition. In 1977-78, construction of dams across major rivers required approvals from the area Water Board (Taranaki Catchment Board), local Authorities, and preparation of an Environmental Impact Report.

The Egmont Electric Power Board adopted a very open and frank policy in its proposals for hydro electric development. The public was kept fully informed at all stages and the local press was provided with information and opportunities to be involved in site visits. This open attitude encouraged public participation and a feeling of community involvement. Comment was encouraged, and the scheme was designed recognising the public need. People affected by the scheme were provided with alternative arrangements. Key aspects in the environmental procedures are described below.

2.1. SCHEME DESCRIPTION AND REQUEST FOR COMMENTS

At a very early stage in the definition of the scheme before the final dam site was selected the Egmont Electric Power Board prepared a description of the scheme with its likely impact. This document was only eight pages long but contained the elements of the scheme to allow the public to appreciate what was proposed. The scheme description was circulated widely in 1977 with a request for comments in writing. Response was excellent with many useful comments and expressions of interest.

2.2. ENVIRONMENTAL IMPACT REPORT

An Environmental Impact report was prepared in 1977 by the Egmont Electric Power Board with close involvement of the consultants. The Environmental Impact report "set the scene", dealing with alternatives, investigations carried out, the proposed development, a summary of the responses to the scheme description, a description of the existing environment, the likely changes to this environment, the economics of the scheme and the statutory procedures which would be required through to the completion of the scheme. The impact report was audited by the Commission for the Environment.

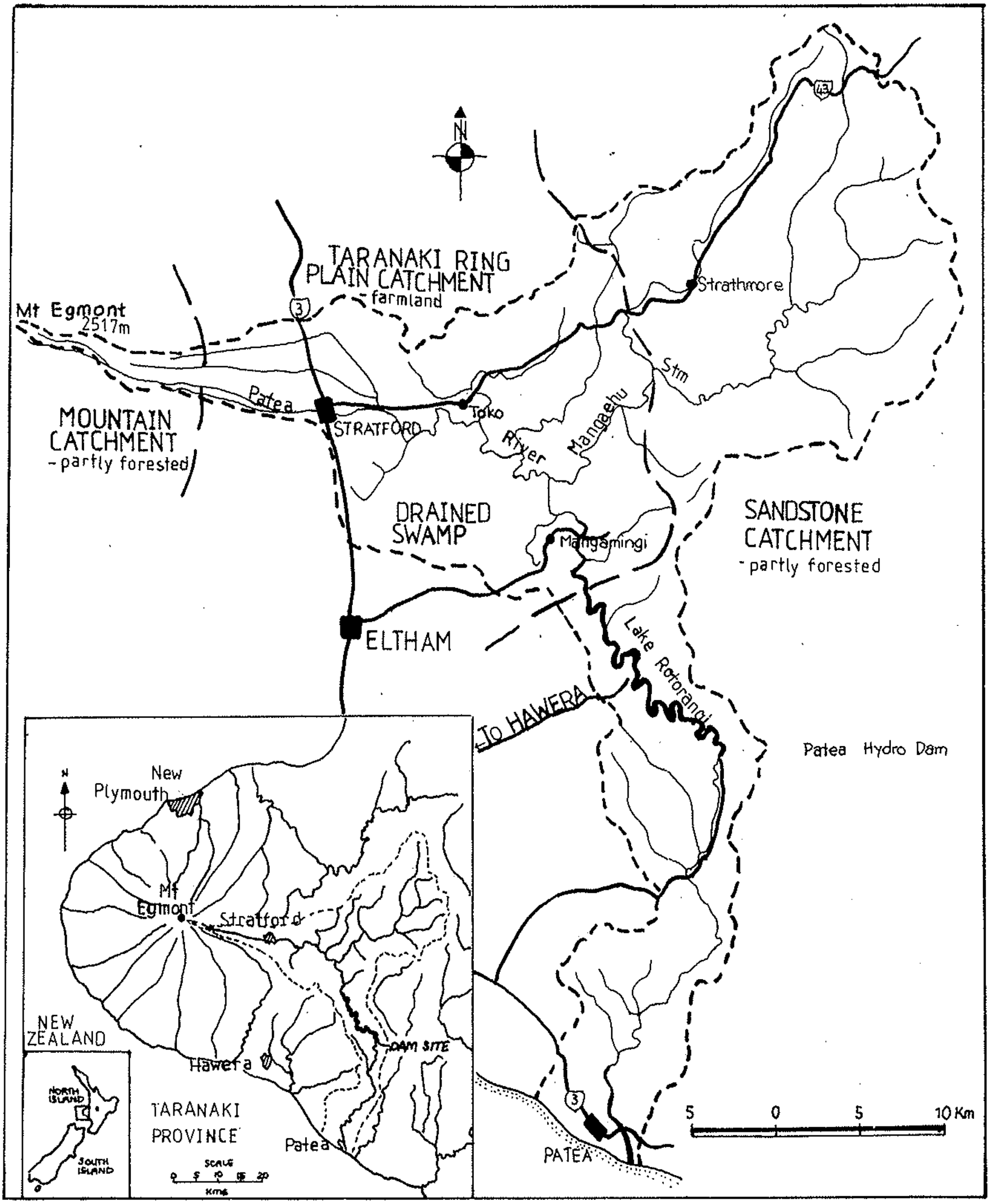

Fig. 1

Lake Rotorangi location and catchment physical features

Emplacement du lac Rotorangi et caractéristiques physiques du bassin versant

2.3. Water right

Water Rights control how the river resource may be used. The only objections to the scheme, later withdrawn, were from discharges of waste into the river who were concerned at possible costs in upgrading their effluent quality. The water right was granted in four parts with conditions.

2.4. Town & country planning approval

Planning approval is necessary for changes in land use, and is only granted after a public hearing. This hearing gives affected members of the public the opportunity to state their case. For the Patea Scheme, a joint hearing was held before a committee involving the three local Authorities which were affected by the scheme. This hearing had a large involvement from the public and was held in Hawera, the town most affected by the scheme. The joint committee made recommendations to the Power Board on conditions which should apply to the development, principally related to the lake shore and reserves, and to inundated bridges and farm tracks which had to be replaced. These recommendations were adopted.

2.5. Need for early assessment of environmental issues

These approval procedures took 20 months to complete, and when approvals were certain, a Feasibility Study into the scheme was initiated.

A policy decision to carry out Environmental Studies before the Feasibility Study was made after careful consideration by the Egmont Electric Power Board. Had the Feasibility Study proved negative, the obtaining of environmental approval would have been largely wasted. However, there is a similar chance that the environmental approval procedure could have stopped the construction of the scheme as has happened on many other similar proposals.

It is important to recognise this potential environmental constraint on construction. Environmental considerations may well be more important than engineering ~~of~~ or economic factors.

3. PREDICTED EFFECTS OF SCHEME, AND COMPARISON WITH THE OUTCOME FIVE YEARS AFTER FILLING

The following aspects of the Patea Hydro Scheme were discussed at length in the Environmental Impact reporting procedures and provisions were made for expected outcomes. A prime purpose of this paper is to describe these predictions, how they were monitored, and compare the outcome. Fig. 2 shows features of the lake.

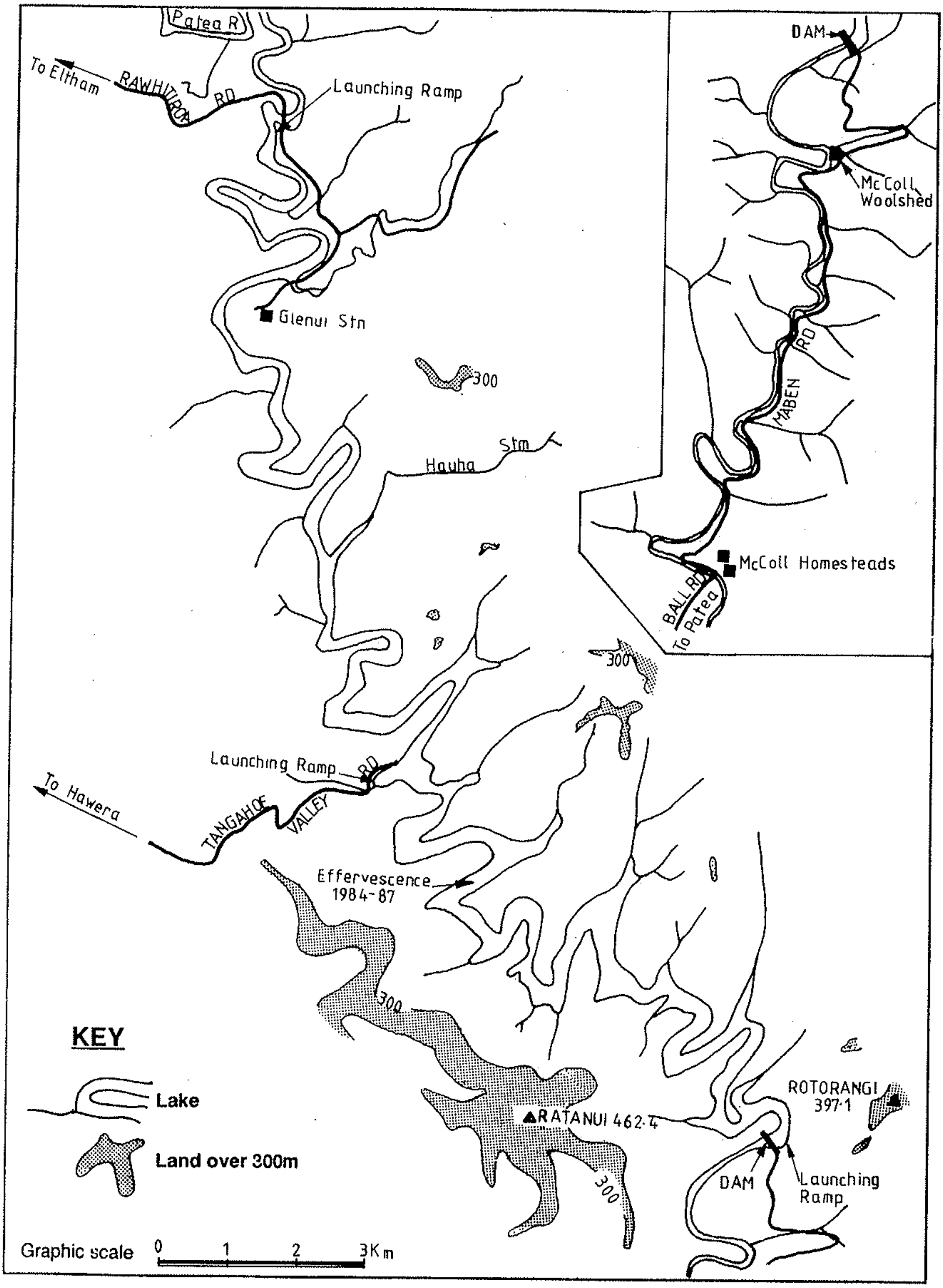

Fig. 2

Lake Rotorangi — access and features

Lac Rotorangi — accès et caractéristiques

3.1. LAKE ROTORANGI WATER QUALITY

The Patea River from Mangamingi downstream was brown and silty with muddy banks; a typical river from an erodible weak rock catchment. The lake was expected to be also brown and silty. The lake was predicted to be eutrophic with plankton blooms from high phosphorus and nitrogen levels.

Reallocation of water resource between the hydro scheme as potential user, and other existing users who were releasing waste into the river resulted in more rigorous control by the Catchment Board. This reduced nutrient levels markedly before construction commenced and subsequently so that the lake is now only midly eutrophic or mesotrophic. No plankton blooms have occurred.

A very pleasant outcome of the scheme was the surprisingly clear dark water over most of the lake. The dark water is highly reflective and very attractive especially where native bush comes down to the water's edge over the lower third of the lake.

Predictions on lake behaviour indicated that thermal stratification might occur on the lake due to the sheltered location. Cold winter and spring inflows will have a marked temperature differential to surface warmed water. In practice a strong thermocline develops with warm (15° - 19°) surface waters of 10 - 20 m depth overlying cold (9° - 12°) deoxygenated water. The thermocline becomes apparent between August and October as the lake surface warms up.

The lake "overturns" intermittently at the beginning of winter between May and July. No dramatic change occurs, and resident fish do not appear to be affected. At the powerhouse the smell at overturn was particularly apparent for the first two years, presumably due to rotting vegetation. Odour has now decreased, but the colour remains dark brown following overturn. No other adverse effects have been observed. Catchment Board monitoring is increasing the understanding of this phenomenon. Fig. 3 shows the winter flow regime schematically. In summer, warmer inflows pass straight along the surface.

An intriguing phenomena in the lake were several areas of effervescence — often along a line. Some of these persisted for 3 years. Speculation on a natural gas seep was disproved by sampling, which indicated normal air. Escaping air from submerged gravel terraces was thought to be the source of the bubbles.

3.2. FLOOD FLOW EFFECTS

3.2.1. Design Floods

The design annual flood of the Patea River is 430 m³/s. The Patea Dam was designed with an automatically controlled gated spillway of 1 000 m³/s

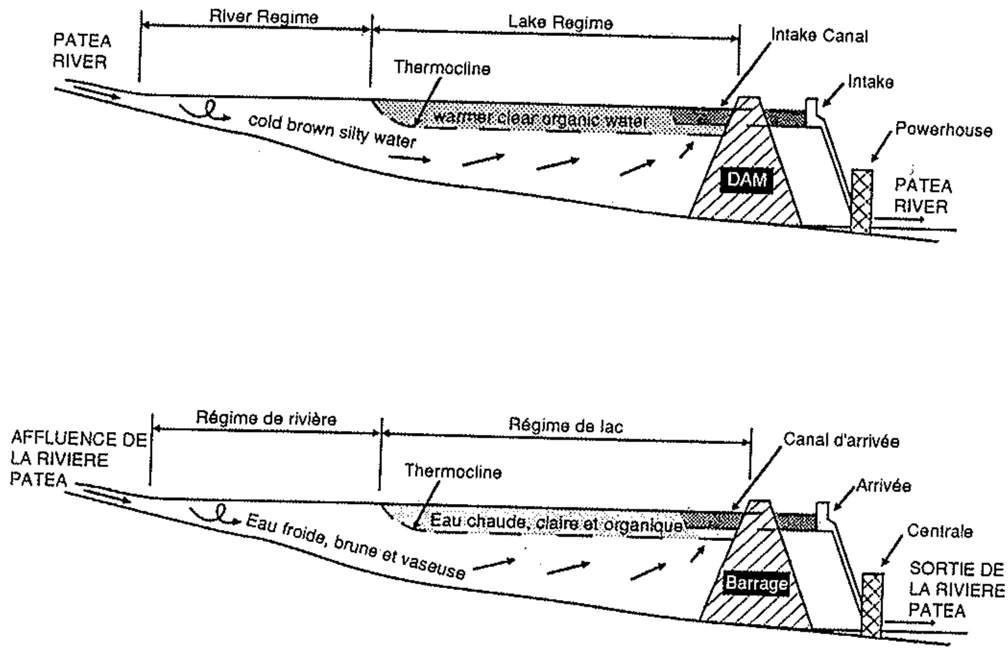

Fig. 3

Lake Rotorangi winter flow profile
Suggested transition from silty river to clear lake water

Lac Rotorangi — Schéma de l'écoulement des eaux en hiver
Passage de l'eau silteuse de la rivière à l'eau claire du lac

capacity for the 100 year flood. Excess flows up to 1 500 m^3/s (1 000 year return period) would be taken by an Auxiliary overflow spillway, with the Maximum Probable Flood of 2 800 m^3/s triggering a "Fuse Plug" spillway. The Auxiliary spillway and the Fuse Plug spillway both discharge to a tributary stream which rejoins the Patea River downstream of the spillway plunge pool. Erosion damage is expected if these extreme event spillways discharge.

Major floods were predicted to have significant effects on the lake water quality and sedimentation with appreciable velocities down the narrow lake creating rolling currents which would overturn the lake waters. Flood flows to the lake were small from lake fill in 1984 until 1989, less than the annual flood.

3.2.2. *Recorded Floods*

On 6th February 1989 the largest flood inflow to the lake occurred, with a 325 m^3/s inflow of warm (18° C) water. This was still less than the predicted annual flood. The Taranaki Catchment Board closely monitored the progress of this flood through the reservoir. The warm less dense floodwaters remained above the thermocline, flowing directly through to the power station with silty water apparent to the dam. The entire flow was contained within the reservoir, and no spill occurred.

Saturday 15th July 1989 produced the largest flood recorded on the Patea

River since recording commenced in 1974. Inflows were assessed from upstream gauging stations at 660 m^3/s with total outflows from generation and spilling of 515 m^3/s. A flood warning was then received for anticipated further heavy rain. Flows were thought likely to exceed 1 000 m^3/s. Spillway gates were changed to manual control and the gate opening increased. Outflows from the dam were matched to inflows at the upriver gauging stations to help broaden the flood peak and discharge the inflow before it reached the reservoir, creating a storage "hole" in the reservoir. By this means peak flows would be reduced, decreasing the likelihood of spill down the auxiliary spillway channel which could cause damage to the auxiliary spillway channel and road access. The predicted rainfall did not eventuate, and the spillway gate control was progressively reverted to lake level control.

No inspections of the reservoir were made during the flood, but it appears that the whole of the lake was mixed by the flow down the reservoir. Lake surface waters remained silty for six weeks after the flood, until further rain flushed the silty water out, and re-established the regime shown on Fig. 3.

An exceptional flood occurred on 10th March 1990 heavy regional rain. Estimated peak inflow was about 1 100 m^3/s corresponding to just over a 100 year return period. Once again flow measurements upstream allowed the gates to be opened early to reduce peak flows down river. The spillway discharged 830 m^3/s continuously for 14 hours, with the spillway continuing to discharge for four further days. The volume of the flood was more than the entire reservoir volume and was equivalent to 1 month average summer flow volume.

The reservoir condition changed from thermally stratified to mixed over its full length in the flood. Rolling currents appear to have developed on bends in the reservoir. A large amount of silt laden water flowed through the reservoir and on down the river. The heavy rains caused slipping and erosion in the catchment greatly increasing the silt load in the river. Reservoir water was still discoloured 4 months after the event. The effects of this flood are being studied, with several years siltation possible in this one event.

Below the dam, minor damage resulted from scour and wave action around the stilling basin. Some slumping also occurred down the river, similar to what would have occurred in an unregulated flood. The reduction in spillway discharge was carefully controlled to avoid sudden drawdown effects downstream.

The passage of these three floods demonstrates the regulating effect of reservoir operation on downstream flows. Flow volumes are high in relation to reservoir storage, but with inflows measured well up stream on tributaries, storage management is possible to reduce downstream flood effects and retain flows for generation. Reduction in water quality during floods was less than had been envisaged, with the flood volume diluting anaerobic water displaced from the bottom of the lake.

3.3. Lake shoreline

Lake Rotorangi is 47 km long, and the shoreline with its many arms up small tributaries is approximately 130 km in length. Full shoreline clearing over a 10 m height was proposed with the exception of some tributary gullies to be left as wildlife preserves. Around the reservoir margins only minor slumping of the surface clays due to saturation was expected. Wave action from boats was expected to have the potential to cause erosion and speed restrictions were envisaged in certain areas.

In practice the lake margin clearing was very successful with trees felled well ahead of the lake fill and allowed to partly rot and be overgrown by regrowth. Burning was not attempted because of the potential to damage or destroy native bush above the water line. Floating trees were collected at the dam over the first few years but were never a major problem. The slips that have occurred to date have been small in size and relate to either wave erosion of redeposited silts and sands or sloughing of residual soils sliding off relatively steep slopes in heavy rain. These sloughing slides are not caused by the raising of the lake but by natural runoff. Most of the slips which were triggered by the lake have now stabilised and vegetation cover has gradually healed the scars.

3.4. Hydrology

At the initiation of the scheme only a short period of river flow records was available. Predictions were made at the time of the Environmental Impact report and updated in the Feasibility Study of August 1978 with a predicted mean flow of 27.8 m^3/s.

Since commissioning the annual average flows through the scheme vary from 22.7 m^3/s to 32.7 m^3 s. The average flow of 27.3 m^3/s is close to predicted value. The average generation of 110.1 GWh equals the predicted value even though generation flows are lower than predicted, due to an efficient design and optimisation of generation potential by the owner. A long term flow comparison has not been done. Flow variations may be due to lower than average rainfalls, or to increased afforestation in the catchment. The Table below summarises flows.

Table of power generated, average and flood flows, compared with predictions

Financial Year	Average Generation Flow (m³/s)	Units Generated GWh	Percentage Spill	Total Average Flow (m³/s)	Maximum Outflow (m³/s)
1984/85	—	(part) 78.4	—	(part) 26.1	212
1985/86	24.9	107.8	7.8	26.8	245
1986/87	24.6	107.9	5.6	26.0	230
1987/88	21.3	93.6	6.6	22.7	207
1988/89	26.8	119.1	5.0	28.1	325 (Inflow figure)
1989/90	26.7	122.0	18.5	32.7	840
Average	24.90	110.1	8.7	27.3	387
Prediction	26.4 m³/s	110.1 GWh	5 %	27.8 m³/s	430 m³/s

3.5. Sedimentation

The Taranaki sandstone hill country rivers run through Tertiary sandstones and siltstones which are highly erodible — See Fig. 1. Streams are characteristically brown at high flow and carry obvious heavy silt loads with minor gravel bed load. Silt builds up on the river banks to a point where it slumps back into the river carrying vegetation with it.

The predicted sediment load from sampling carried out prior to the feasibility study was 430 000 tonnes per annum, based on measurements of sediment concentration during floods in 1977. Silt deposition was considered likely to occur some distance down the reservoir because of the current velocity in the narrow confined valled shape. A service life of at least 400 years was predicted.

The Catchment Board has carried out monitoring since lake filling to check sediment deposition. The upper lake behaves as a river with the channel swept clear of sediment. Deposition occurs on the shallow lake shores at the upper end of the lake. Silt is deposited on the bottom of the lake from about one third of the way down the lake. Suspended sediment sampling at normal flows shows low concentrations. More comprehensive sampling of flood sediment loads is intended in future, particularly on the first "dirty" flood of winter. On the basis of the first 5 years observation, sediment inflows appeared less than predicted. This may be due to changes in the catchment, for example better control of erosion and improved pasture management. The effect of recent floods is being evaluated.

3.6. Biology

The Patea River gorge supported hardwood — podocarp — beech forests. In many areas these had been cleared and slopes have now largely reverted to scrub. Animal populations include introduced wild goats, pigs, and small animals.

In the river, native fish species formed a resident population, with occasional introduced brown trout. The frequent silty floods made the habitat extremely variable in terms of water quality.

The lake has shown a steady growth in biological life since it was filled. Plytoplankton or floating microscopic algae form the basis for a food chain being eaten by zooplankton which are in turn eaten by small and then large fish. Fish populations in the lake have grown with stocking of rainbow trout by the local angling society. In the early years of the lake, trout condition and quality was excellent. The value of the recreational trout fishery has declined recently, possibly due to increased competition with perch. Perch may in time dominate the lake fishery.

Land locked fish populations now appear to be establishing, with brown and rainbow trout, perch, the common bully, and possibly kaoro. An elver pass was installed over the dam to assist in the passage of eels from the lower Patea River into the lake. Up to 150 elvers per hour have been observed traversing the pass and entering the lake. The upper Patea eel fishery is expected to be unaffected by the dam. Other migratory fish which rely on salt water and fresh water to complete their life cycle are expected to die out. This will include the lamprey, red finned bully, torrentfish, banded kokopu, giant kokopu, and the inanga.

Lake weeds are progressively spreading down the lake from infested upper catchments. The steep lake shores inhibit growth and lake weed is not a problem at present. A watch is being kept for noxious free floating macrophytes, for example, water hyacinth and salvinia.

3.7. Effects down river

Prior to the construction of the Patea Scheme the lower Patea River was a sluggish stream of low gradient. Tangled masses of logs and timber debris became evident at low river levels and gravel bars deposited at the mouths of tributary streams. Periodic silt build up on banks followed by slumping was a feature as floods deposited their silt above normal river levels. River improvements were carried out for 5 km downstream of the dam with gravel bars removed to increase the head available for generation at the dam.

Since completion of the scheme river flows have been regulated by discharge from the power station. A dominant power station discharge of 15 m^3/s has caused a channel adjustment to this flow. Silt which formerly passed into the lower river is now being retained by the lake. Minor degradation has been observed for up to 3 km below the dam but there is very little change downstream of this section.

The main deleterious effect on the river was during commissioning of the dam when a release of 500 m^3/s to test the spillway capability at greater than the predicted annual flood caused slumping of long sections of the river bank as downstream river levels dropped after the test. As a result of this experience, spillway releases are now closed off very slowly to minimise river bank slumping.

Construction of the dam is also thought to have had a deleterious effect on riverbed organisms with silt from road construction affecting the river. Riverbed organisms have now partly recovered but the general biological value of the river remains low.

3.8. Transmission line

A separate Environmental Impact Assessment was undertaken for the transmission line required to transmit the generated electricity to the Power Board's network. Three separate possible routes were analysed and comment was invited from all affected parties including the landowners.

The final route chosen was the direct route of 25 km passing over bush covered land belonging to the Crown as well as hill country farm land, and some high productivity rolling farm land. The towers were sited away from the ridge tops to be visually unobtrusive. During construction through the native bush area, strict controls were placed on tracking access and on benching of tower locations. As a consequence helicopters and hand excavation were used extensively.

3.9. Dam performance

The Patea Dam is 82 m high from the bottom of the foundations to the dam crest. It is the fifth highest dam in New Zealand. The dam is constructed of compacted siltstone with a central vertical chimney drain and downstream drainage blanket. It is the first major dam in New Zealand constructed of Tertiary siltstone.

Dam performance has been good. The monitoring programme carried out since filling shows a dam crest settlement of 90 mm, with downstream movement of 118 mm. This is less than predicted.

Three months after lake filling a leak developed from the reservoir to the downstream end of one of the diversion tunnels. Two months of intensive work culminated in the successful repair of this leak. Groundwater pressures have been carefully monitored and a steady seepage gradient now exists through the diversion tunnel ridge, in agreement with predictions.

The dam site area has been drastically modified by construction. The site has been attractively landscaped, in accordance with plans prepared by a Landscape Architect. Landscaping has covered construction scars, apart from small roadside slips and a large slip adjacent to one of the dam borrow areas. The slip, which was caused by high groundwater in the redeposited thick alluvium found above the local siltstone presents no risk to any of the scheme elements. As it is uneconomic to provide effective stabilisation measures, the slip has been left to come to rest of its own accord assisted by some minor drainage work and revegetation.

3.10. Monitoring

3.10.1. Dam Site Monitoring

Detailed surveillance monitoring of the dam site is carried out to a prepared schedule, with comparison of results with "alarm" levels.

3.10.2. Lake Rotorangi

The Taranaki Catchment Board has carried out a reservoir monitoring programme required as a condition of the water right. All aspect of the reservoir water quality, flora and fauna are covered, and reported annually.

The lake shore is inspected at intervals by the Egmont Electric Power Board staff and in detail annually by the surveillance team. Each year photographic records are made of slips on or near the lake shore, comments are given regarding their severity, and recommendations made for remedial works if required.

3.10.3. Benefits of Monitoring

The results of all monitoring undertaken have been very beneficial for lake management. The understanding gained of lake behaviour will be useful for future management decisions eg. on lake waste discharges; and will greatly aid the prediction of the effect of any future similar lakes.

Dam surveillance monitoring has given assurances of continuing satisfactory dam performance, and has allowed the detection and treatment of areas of higher pressures and seepage downstream of the dam.

3.11. Recreation

The prospect of the extensive areas of recreational water of Lake Rotorangi accessible from three separate access routes was welcomed in the region as a major potential recreational asset. Recreational waters in Taranaki are restricted with the coastline often hostile with heavy wave action and dangerous swimming and boating conditions. The plans for the lake had support from local activity and youth groups.

In practice the recreational use of the lake has exceeded expectations. Three public launching ramps have been constructed and are well used. The fishing has been good and canoe trips with wilderness camping are popular. Three areas have been set aside as permissible water skiing locations and are well used in sumer by organised clubs and individuals. House boats are operating on the lake providing secluded and safe boating from those who want to get away from the rest of civilisation while still living in comfort.

3.12. Access

The lower Patea Valley had access at only one point prior to scheme construction. Two major landowners carried stores to their homes across a wire swing bridge from the road end. Construction of the scheme changed this with a concrete bridge across the river, and a 13 km road up the river, giving all weather access. The road has local amenity value giving access to the very attractive lower reservoir; and to bush walks in the forest around the dam.

3.13. Financial

The scheme was not as successful from a financial aspect. The envisaged cost in March 1979 was $24.3 million in costs of the day excluding any interest during construction. Inflation was at that time climbing to record levels of about 19 % and continued through the construction of the scheme. During construction the costs increased due to unexpected difficulties in the riverbed with large limestone boulders, increased excavation quantities, increased dam fill volumes as a result, and higher than expected costs of land acquisition and reinstatement in the reservoir. Repairs to the diversion tunnels following lake filling also added extra costs. The final cost was $69 million. The decision of the Government to apply interest during construction and to increase the interest rate on the Government loans to build the scheme added a heavy cost burden to the Power Board. These costs added a further $17 million. The result was a large debt burden to the Power Board in common with many other Power Boards which embarked on the construction of hydro schemes at this same time. In March 1989 in return for releasing Government totally from its loan commitment to the scheme, the excess debt was written down to a level that was bankable in the private sector. Although incurring some loss for 2 or 3 years, the future financial position is sustainable.

The cost of landscaping and provision of public facilities increased from 0.2 % of envisaged scheme cost, to 0.5 % of final scheme cost due to increased awareness of benefits of facilities for the public.

3.14. Social impacts

Social impacts were expected to be relatively small with no great influx of population apart from supervisory staff. Hawera has a population of 10 000 people and with the surrounding towns of Eltham and Patea, no problems were envisaged in accommodating the construction staff of 100.

This proved to be the case and the predictions were close to reality. The additional incomes of construction workers had beneficial effects on the local community.

3.15. Administration

A Lake Rotorangi Reserves Committee was formed by the Egmont Electric Power Board as future owner in 1981 with input from local Authorities bordering the lake. From this beginning a Lake Rotorangi Joint Committee was formed in 1985 with specific responsibilities for recreational management of the lake and surrounding reserve land. The committee represents the three affected territorial local Authorities and the Power Board together with expert input from Government Departments, the Taranaki Catchment Board, and recreational users. Lake management is in accordance with the Egmont Electric Power Board policy of involving the public in the decision making process wherever possible.

A draft Water Management Plan has been prepared by the Taranaki Catchment Board which addresses many of the management issues pertaining to water quality in the catchment particularly in the zone draining to the lake.

4. CONCLUSION

The construction of the Patea Hydro Electric Scheme has created a power resource which has helped stabilise power supplies in the region. The cost of construction of the scheme has created some difficulties for the local Power Board due to changes in Governement policy and unexpected difficulties during construction.

Water quality has been much better than expected, with relatively clear highly reflective lake water encouraging fish, fishing, and boating activities.

The lake created by the dam has been a major asset to the surrounding community and has opened up a variety of recreational activities not formerly possible. There has been some loss of a canoeable river but this has been replaced by a lake with a more gentle experience available to a wider range of people without the fear of white water hazards.

The Egmont Electric Power Board policy of involving the public in the decision making process was a major reason for the acceptance of the scheme. Local residents supported the scheme, affected people were treated fairly, and no major objections to the scheme were heard.

ACKNOWLEDGEMENTS

We acknowledge the permission of the Egmont Electric Power Board to publish this paper and thank them for their enthusiasm, co-operation and assistance through the 16 years from 1974 to the present.

We also gratefully thank Mr F McLay of the Taranaki Catchment Board for his comments and most useful data on the reservoir monitoring.

REFERENCES

[1] RILEY PB, 1984 "Patea Scheme Has Produced New Zealand's Longest Man-Made Lake" New Zealand Engineering, July Journal of IPENZ.

[2] RILEY PB, CARTER RP and DAVIS AR 1989 "Patea Hydro Scheme Environmental Impact — The Prediction and the Reality". Proceedings IPENZ Annual Conference, Wellington, New Zealand.

SUMMARY

An earthfill dam on the Patea River in South Taranaki raises the river level by 60 m creating the head necessary for a 30 MW power scheme. The principal environmental impact of the scheme is the creation of a 47 km long lake flooding an existing steep sided valley. Other impacts are the modification of river flows downstream of the dam by power generation, road access up the valley to the scheme, and a transmission line constructed over a forested area.

The reservoir was filled in 1984 and has been monitored over the 6 years since that time. Results of this monitoring are compared with the predictions made before the scheme was constructed. Changes from river to lake had consequent effects on water quality, land use, access, recreational use, and river flows downstream. Construction of the scheme had positive effects on power supply, and created recreational amenities. The effects of these changes were predicted in the Environmental Impact Report prepared in 1977 prior to scheme design. Significant differences in expected performance occurred in water quality, and with recreational use. Both had a better outcome than expected. These and other changes are discussed.

The importance of full public disclosure at earliest possible stage is demonstrated. Media involvement informs the public, and requests for comments involve the public in shaping the scheme. This local involvement resulted in strong support for the scheme, with no major objections.

RÉSUMÉ

Un barrage en terre construit sur la rivière Patea dans le sud de la province de Taranaki a élevé le niveau de la rivière de 60 m, créant ainsi une chute pour une usine hydro-électrique de 30 MW. L'impact principal de ce projet sur l'environnement a été la création d'un lac de 47 km de long, submergeant une vallée aux pentes escarpées. Les autres impacts ont été le changement du cours de la rivière à l'aval du barrage, entraîné par la production d'électricité, l'accès par la route le long de la vallée jusqu'au site du barrage,

et la construction d'une ligne électrique à haute tension au-dessus d'une zone boisée.

Le reservoir fut rempli en 1984 et a été surveillé en permanence depuis cette date. Les résultats de cette surveillance sont comparés avec les prédictions faites avant le début des travaux. Le passage du régime de rivière au régime de lac a eu des conséquences sur la qualité de l'eau, l'utilisation des terres, l'accès, les usages à but de loisirs et l'écoulement de la rivière en aval. La construction du barrage a eu des effets positifs sur l'alimentation en électricité et a créé des installations de loisirs. Les effets de ces changements avaient été prévus dans le Rapport d'Impact sur l'Environnement préparé en 1971 avant la conception du projet. Des différences notables dans les prévisions ont été constatées en ce qui concerne la qualité de l'eau et les usages à but de loisirs. Dans les deux cas, les résultats ont été meilleurs que les prévisions. Le rapport discute de ces changements et d'autres modifications.

On souligne que le public doit être informé aussi tôt que possible et de façon complète. La promotion à travers les médias informe le public qui, par ses réactions et commentaires, participe ainsi à la conception du projet. Cette participation locale s'est traduite par un fort soutien au projet, aucune objection majeure n'étant émise.