Heritage waterwheel, Pukekura Park.

Historical.
J W Goodwin was appointed to take charge of the Park in 1949 when it had declined largely as a consequence of unavoidable neglect during World War 11. His brief was 'to attract visitors back into the Park'. He drafted a very comprehensive and forward thinking proposal which amongst many other suggestions, emphasised maximum exploitation of water. Features suggested were a fountain, a waterfall, a waterwheel a windmill and a water ram. By the time he retired in 1977 he had overseen the introduction and unveiling of the first three in the years 1955, 1970 and 1976.

Mr Goodwin was very heavily involved personally with the design and installation of the fountain commemorating the visit of Queen Elizabeth in January, 1954 but he delegated the design and construction of the waterfall to the late Ian McDowell and myself. This set the scene for a great working relationship to flourish and upon its successful completion, we were on the lookout for a waterwheel as our next challenge. The breakthrough came in the form of a pure accident in Feb. 1973 when, in visiting a son engaged in holiday work at the Omata Dairy Factory, there was an electricity cut. I turned the conversation with staff to the pre-electricity era and it was revealed that relics of the waterwheel which originally provided power were still present beside the factory. I was shown the remnants of a wheel that had not turned for about forty years. It was no less than 12ft.(3.64m) in diameter by 6ft.(1.82m) wide. Twelve feet was the head of water entering the dell near Gilbert St, making it the perfect site for such a waterwheel!

Although all the woodwork was in an advanced state of decay, the bearing housings, axle, hubs and a mass of cast-iron gearing were still in great condition. Having gained

acceptance of the prospect that there was a good chance that the wheel would be restored if the relics were donated to the Park, I arranged for Fitzroy Engineering to carry out an inspection. They gave a strong thumbs-up and later would not only transport the prize but also clean all the ironwork and paint it where appropriate.

Meanwhile, permission had to be gained from the Council to carry out the work. With a stroke of customary genius, Mr Goodwin proposed that the wheel be restored and installed in the Park as a centennial (1976) project and even got the Taranaki County Council to assist with a $500 donation.

Ian had been involved with the negotiations from the outset and given this clearance, set about preparing scale drawings of the wheel before anything was removed. Based on these drawings, the joinery firm of Jones & Sandford reconstructed the wooden components and the Taranaki Harbours Board donated the two large hardwood bearing beams.

Preparation of the site was a massive undertaking because Ian and I had agreed to carry out the work with our respective teams and there weren't even access paths down into the area. In order to fully exploit viewing potential and provide the unique opportunity of being able to actually pass behind the wheel we laid a pathway which encompassed the entire rim overlooking the site then completed the almost parallel loop at the level of the wheel.

Excavating down to solid ground upon which to establish foundations for walkway and wheel was very laborious manual work. Ian's team concentrated on the solid stonework required behind and to the side of the wheel, using in the lower courses large blocks hewn by prisoners originally for the vault of the old New Plymouth Post Office and for kerbstones.

We were very anxious to preserve the integrity and character of the mostly native trees growing around the rim. At that time there were no mobile cranes available with telescoping derricks strong enough to be able to thread the bulky almost tonne load of the wheel between the trees so we opted to have each rim divided into two halves then carried the four components down, plus the axle assembly etc and assembled the wheel on site.

I located the wheel in 1973. Work started on the site in the summer of 1974. Assembly of the wheel started in 1975. It was commissioned to commemorate the centennial of Pukekura Park on 29th May 1976. The Festival of Lights in the summer of 1976/77 was centred around the Fountain Lake, Children's Playground area so that the waterwheel could be featured for the first time and it was certainly an unforgettable spectacle.

The stream is renowned for quickly rising into a raging torrent after rainfall, particularly through the narrow ravine just above the wheel. Had this eventuated at any stage during our prolonged activities preparing the site and assembling the wheel, the consequences would have been disastrous because the flow of the stream was carried over the site in nothing more than a flimsy ramshackle aqueduct constructed of bent sheets of corrugated iron! We were exceptionally lucky.

We were elated when upon completion and after final trimming to a tolerance of 25mm both laterally and in throw, a 10 lt (10 kg) bucket of water was all that was required to get it to turn.

Over the years it has given great pleasure to an enormous number of visitors and provided a reason for many to reflect on our past and ponder over the impressive size of the machinery once required to generate the amount of power that would now be supplied by a relatively small motor. In so-doing, it has earned a significant place in the history of the Park. In support of this and before elaborating on its retirement, I feel that I should record some special features that my researches have disclosed.

Mechanical details.
The wheel is of 'overshot' design. That means that in order to function it requires a 'head' (height) of water greater than its diameter (12 ft (3.64m)) delivered just over top dead centre. In most situations this would involve the construction of a water-race (headrace) a sufficient distance upstream to gain the head but the problem was resolved in rather an ingenious way by the Omata Dairy Company. The factory was sited on the lower side of a long spur of land around the end of which the natural flow of a stream extended. All that was required was to dig a relatively short tunnel through the ridge for the headrace to intercept the stream at its higher level and the required head was readily gained. The required volume of water was regulated with a control gate and after use was returned to the stream via a tailrace.

I suspect that in the case of most waterwheels, the power would have been taken off to the machinery at rotational speed by means of a pulley mounted directly on an extension of the wheel's axle (axial pto) but this model has a very different method of power take-off. Around the radius of one rim is bolted a very heavy duty cast-iron inward-facing ring gear (radial pto). In the working site this meshed with a 1 ft diameter (30cm) cog wheel mounted on what is called the counter-shaft. This meant that the power was delivered not at the rotational speed of the wheel but geared-up x12. This I find rather strange because the major load at Omata, the massive butter churns would have rotated at only a very slow speed, therefore gearing down would have been necessary for that particular task although other machinery would have operated at higher rotational speeds. I suspect that this feature makes the wheel somewhat unique, designed perhaps more to power a sawmill where high rotational speed is critical.

The power output of the wheel was calculated at about 4.5 horsepower (3.5kw). The butter churns were like large wooden vats turned on their side, rotating on a horizontal axis like a drum on its side. Once the cream had been added each was sealed. Around the inner surface of the churn wall was mounted a series of paddles through which the cream surged in agitation as the churn rolled. While it was still in fluid form the burden of rotation was even and therefore relatively light but as the agitation of the paddles transformed it into butter that all changed because as a solid it was scooped up by the paddles and for a critical short period the loading became very uneven and taxed the power of the waterwheel to its limit. The manager revealed that a critical skill was to be able to anticipate this stage at a point just before it happened, disengage the wheel, allow it to rev up unladen then re-engage it whereupon the momentum gained from its spinning tonne weight would generate just enough power to jolt the churn into completing the process.

Most waterwheels, to my knowledge are evenly balanced, both in vertical as well as horizontal plane; i.e. a line taken through the centre in both plan or side elevation will produce mirror images. Not so with this wheel because in plan the massive weight of the cast iron radial gearing on only one rim results in major structural imbalance. Add to this the heavy unbalanced load stress imposed by the operation described above and it is no surprise that such wheels were of such rugged construction.

There is another significant difference between the two rims. It relates to the fixture of the hub of each to the axle. With all the structural drama that has occurred since installation in the Park, both have been radically modified. That on the power take-off side was a snug fit on the axle and keyed rigidly to it in conventional manner but the other had several millimetres of tolerance, the slack of which was 'taken up' by tapping in a series of thin wedges and sheet-metal shims, some of them piggy-backed.

The significance of this was explained to me by the Manager. Being aware of the inherent imbalance of the wheel and the fact that the late stages of butter churning imposed extreme unbalanced loading on the same side, it is very easy to understand that the wheel would become stressed out of shape (trim). To counter this, when it was idle and as required, someone would enter the wheel with a hammer and tap back into place any dislodged wedges or shims and replace any that had vibrated out and been lost. This maintenance procedure would have been used to restore the trim on a regular basis but because the wheel would never be laden in its new site, we foresaw no reason to make provision for the procedure.

When we had the faithfully restored wheel installed in the Park we did not couple the counter-shaft because of constraints of space, sound and safety. Another modification was to replace the grease-cup bearing lubrication with two copper high pressure hydraulic lines for remote servicing with a greasegun. Locked access was provided to both sides but because the wheel would never be laden, somewhat naively as it has transpired, we presumed that it would turn 'forever' with very little need for servicing. It quickly shattered our dream. The incessant turning of the unbalanced tonne mass at idling speed 24 hours per day over a prolonged period without regular attention was sufficient to gradually work the authentic shims and wedges loose and upset the trim. We just could not keep up with the demand for attention and at one stage replaced the steel shims and wedges with wedges of puriri hardwood but they were also chomped up.

There ensued a period of years during which numerous very clever and generous well-wishers offered 'the perfect solution' to the point where the original hub assembly is no longer recognisable having had spacers, brackets and flanges of various types welded in for stability. However, the relentless movement continued to impose stress on weaker components resulting in breakage of diagonal wooden braces and wear around the seat of steel tie-rods etc., progressively destroying equilibrium.

With the advent of mobile cranes with telescoping derricks the wheel was removed for 'repair and strengthening' between Sept. and Dec. 1989 and yet again in the 1990s but it has continued to relentlessly self-destruct into what is now a very unsafe condition. This, coupled with the fact that with the benefit of hind-sight it is obvious that it was unwise to locate it in direct line with the ravine upstream which converts high flows into an uncontrollable raging torrent of immense destructive power means that its removal

and replacement with a wheel of simpler, balanced design is the logical action to take. I understand that such a project is now well advanced.

In the foregoing I have endeavoured to record the historical background of the wheel but perhaps of greater importance, I have gone to some length to emphasise what I consider to be the great mechanical and heritage significance that it embodies. My purpose has been to impress that this is no ordinary waterwheel and therefore in retirement, still justifies a high level of recognition.

Retirement and preservation.

A suggestion has been made that it may be possible to tuck it into some corner of the Park and provide surroundings of marginal authenticity. In considering this option it must be remembered that this wheel is 3.64m in diameter and 1.82m wide. Once lifted out of its present site, in relationship to the human form it is **massive**, with the average person able to walk beneath the level of its axle or snuggle in and sleep in its buckets!

The only site that I can visualise with suitable scale and surroundings would be at the southern end of the Hatchery Lawn. For me this would be grossly incongruous and it would also be positively misleading duplication to visitors in search of **the** waterwheel located in a site already tricky to find without additional complications. Furthermore, I believe very strongly that this wounded relic of a by-gone era thoroughly justifies preservation in a covered structure and with a successor occupying its present site, I do not see retention within the Park as an appropriate solution for a number of reasons.

Establishment of a 'Waterpower Museum'.

The need to 'do something' with the retired waterwheel could be the catalyst for initiating the development of a project to pay homage to the significance of water in the establishment of our city. Within coooeee of the Central Business District there is a perfect archaeological site desperately in need of respect and attention. The sign has long-since fallen into the weeds but below the intersection of Carrington St and Pendarves St beside the Huatoki Stream and under a luxuriant groundcover lay the relics of 'Alpha', the first flourmill to meet the needs of European settlers. Its source of power was a waterwheel probably comparable to that from the Park as evidenced from the surviving stonework. It seems to be a very appropriate location.

My casual observations indicate that there is space on this site to construct a covered but open-sided structure in which to safely house the wheel and provide access to it via a sloping path down from Carrington St. In addition to the potential for meaningful restoration of the historic mill site and the 'return home' of the forlorn Alpha millstones currently bedded so unsympathetically in concrete in Queen St there are already several other features of historical interest within sight of this location which justify upgrading to tourist attraction status. If the waterwheel was featured here, it would be the nucleus for expansion into the display of other forms of waterpower and accessories that were so important in the history of the city.

Setting aside three parking spaces with specified time-limit beside the access point on Carrington St would encourage visitor interest and if in the future a second pedestrian bridge was constructed across the stream a very interesting heritage loop walk could be established starting from the Wind Wand, following up the Huatoki, across to the mill site, up to the present bridge to recross the stream, on up to Marsland Hill and/or St

Mary's and back to the foreshore. Even without the second bridge, having to re-cross the existing one adds only a couple of hundred metres to the route.

George Fuller. Extracts from a summary dated Sept. 2004.