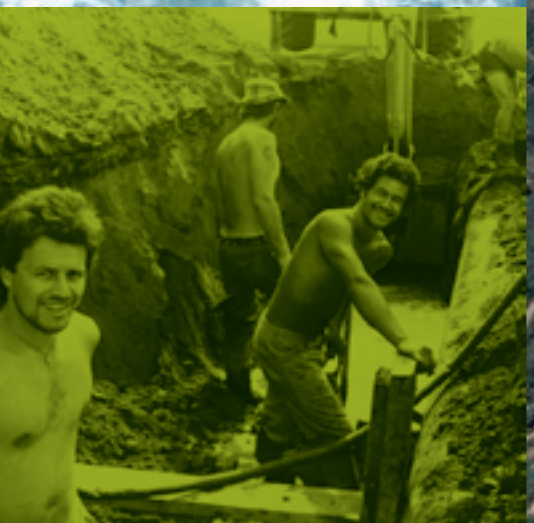


1970s-2000s

Greater Wellington water

Te Marua water treatment plant (foreground) and the Stuart Macaskill storage lakes, 1999

Regional Water Board

The Kaitoke scheme was the first to address the region's water sources and needs in a truly integrated way. It was conceived to supply many municipalities, and set the scene for collaborative thinking on water, which has characterised every decade since.

A Wellington city engineer once said that "as time progresses considerations of mutual interest in regard to water supply will inevitably draw the authorities within these areas into closer relationship".[212] That was after the 1930 schism: in 1959 his equivalent went even further, recommending that "all sources of water supply within the region should be controlled by one authority".[213] In the same year, the Hutt Valley Underground Water Authority (HVUWA) was set up to safeguard the Hutt aquifer by controlling "the tapping, use and pollution of underground water".[214] Control of water at this time was by three bodies: the HVUWA, the Water Supply Board, and the Hutt River Board. Importantly, the HVUWA argued that a "single regional [water] authority was essential".[215]

Reform was afoot in Britain, where 'water wars' saw 1,226 water boards amalgamated to around 350. The Commission of Enquiry into Reorganisation of Local Government in the Hutt Valley in 1963 noted this, and advocated integrating all water supplies under a single authority. The biggest user, WCC, agreed.[216]

By 1963, the Wellington City and Suburban Water Supply Board owned the Kaitoke scheme and controlled catchments totalling 52,500 hectares, but not being a rating body it had no independent income and did not represent Lower Hutt and Petone. Not until 1967 did reform kick in, with the Water and Soil Conservation Act. This Act established "control of all water resources in the country", and anticipated eight water boards (in reality augmented catchment boards) as its local agents.

With the Act passed, regional water boards started forming.[217] Legislation establishing the Wellington Regional Water Board (WRWB) was passed on 1 December 1972. The WRWB absorbed the old Water Supply Board, HVUWA and Hutt River Board, moving into the latter's premises in Lower Hutt. Its operational area extended from Waikanae in the north and the Orongorongo range in the east, and included 10 local authorities and 340,000 people in 1,550 square kilometres. The WRWB began operations on 1 March 1973, taking over Wellington Waterworks Division staff on 1 September 1974.[218] At the same time WCC contracted the WRWB to run its retail operation and maintain its reticulation on an agency basis (this arrangement continued with Wellington Regional Council from 1980 until November 2001).[219]

The road tunnel project to link Wainuiomata with the Hutt Valley was abandoned in the 1930s (shown here), but produced dividends when in 1981 it was finished in a smaller bore for water pipes. (Alexander Turnbull Library, Wellington, NZ. Reference F-65767-1/2)

As well as bulk water supply, the WRWB was responsible for forestry, water resources management, soil conservation, rivers control, and recreation. It adopted a major WCC report from 1971, by JS Roberts, which identified the need to rehabilitate large sections of the existing system, increase the quality of water and introduce new sources for a rapidly expanding population. The board's chief engineer Ron Bishop also recommended (in 1974) expanding the Kaitoke scheme and providing new storage at Te Marua.

The board set about a major programme of system renewal and expansion works, but its existence was to be fairly short-lived (1973-1980). The functions of the WRWB and the Wellington Regional Planning Authority were combined under the Wellington Regional Council (WRC), a new local authority created in 1980.

The regional council (restyled Greater Wellington in 2003) continues to operate a 'wholesale' water supply under the WRWB Act 1972. It supplies water to four retailing councils: Wellington, Porirua, Hutt City and Upper Hutt, levying each for its share of the total supply.

Renewal

From 1973 the first major task for the newly established water board was renewing old pipes – but doing so in a way that significantly upgraded their capacity. With each project the engineers had to keep the water flowing: "It is a '24/7, 365 business'," design engineer John Morrison says. "We don't have the opportunity to take it offline".[220] The 90-year-old 600-millimetre cast-iron mains from Wainuiomata came first. The plan was to replace 15.5 kilometres of the main, from the Waiwhetu tunnel to Thorndon, with a 1,050-millimetre steel pipe. This took four years from 1975. The original pipe had been laid along the Hutt Road following the old coastline, and knowledge of its exact route was vague (in the 1930s a water diviner had even failed to locate it).[221] The new pipe had to cross the old 26 times, requiring deviations and a tunnel under Rocky Point. The traffic issue was best handled by doing much of the work at night. The project was commissioned with a ceremony at Thorndon pumping station on 12 June 1979.[222]

Next was replacement of the increasingly leaky 750-millimetre pipe through the Waiwhetu hill. The original 1880s brick-lined pipe tunnel was too small for a replacement pipe. A logical alternative presented itself in the form of the part-finished road tunnel from Tunnel Grove just a few hundred metres south. It had been started in January 1932 by the Wainuiomata Development Company, but was killed off by the Depression. About a third of it had been driven (from the Hutt side), and its only function had been to store explosives during World War Two. The WRWB bought the tunnel in 1975 with plans to complete it with a smaller drive. Codelfa Construction New Zealand Ltd broke through to Waiu Street in September 1980. A 1,100-millimetre steel pipe was laid through the tunnel. Such was the excitement in Wainuiomata over the original road tunnel that, when it was completed for water only, *Valley News* cried "alas".[223]

While these two sections of original Wainuiomata-Wellington pipeline were replaced, the 750-millimetre-diameter century-old pipeline running through Wainuiomata itself was deemed to be still usable, so was cleaned and concrete-lined in 1987-1989. From Moores Valley Road to the dam, both the 1902-1903 750-millimetre and the 1926 525-millimetre O-K main were replaced with a 1,050-millimetre pipe in 1992-1993.

Another big renewal job was the O-K main between the Orongorongo intake and Wainuiomata water treatment plant, which was replaced between 1997 and 2004. The pipe through the 3.2-kilometre tunnel was replaced first. In parts the tunnel wall had to be shaved to allow both the new pipe and replacement rail tracks to fit. The pipe from the Orongorongo weir to the tunnel's eastern portal was replaced two years later. The terrain made access and pipe-laying as challenging as it had been in the 1920s, but this time lightweight pipes and materials were flown in by helicopter. The final stage was the western-portal-to-Wainuiomata treatment plant, completed in 2004.

In further refurbishment of the O-K main, the section from Moores Valley to the eastern portal of the Waiwhetu hill tunnel was lined in concrete in 1995. In 2000-2001 the Thorndon-to-Karori section was concrete-lined, and the Randwick-to-Rahui section

The 'ten-fifty' project in the late 1970s greatly increased the supply capacity of the pipeline from Wainuiomata to Wellington.

The signboard at Ngauranga warning motorists of possible disruption during the laying of the new water main along the Hutt Road. (Dominion Post Collection, Alexander Turnbull Library, Wellington, NZ. Reference EP/1978/0031/10A)

– now part of a dedicated supply from Waterloo to Petone – rehabilitated by inserting an inner polyethylene pipe of smaller diameter.[224]

The work of maintaining Wellington's distribution system involved much renewal of old pipes, as well as laying trunk, feeder and rider mains and service connections to new subdivisions. The serious condition of much of the Wellington's early reticulation piping had been reported as early as 1945. At that time there were still over 11 kilometres of original piping (seven decades old) and 290 kilometres of cast-iron mains that needed concrete lining.[225] The weakness of 19th-century pipes was emphasised in May 1985 when an 1884 200-millimetre main burst spectacularly at the intersection of Lambton Quay, Featherston and Hunter Streets. A major development for Wellington was laying a new trunk main from Thorndon to a reservoir planned for the south of the city. While an 800-millimetre main was being laid from 1983, Macalister Park was chosen as the reservoir site, with work under way there in 1990. Finished in 1993, the 20-million-litre reservoir acts as a control point for water from Waterloo and Wainuiomata; it is effectively an extension of the bulk supply system.

Expansion

The reports of Roberts (1971) and Bishop (1974) set the scene for expanding the water network, but did so based on population growth estimates that proved to be too high. In 1967 the Wellington Regional Planning Authority published growth predictions based on the 1966 Census. These saw Wellington's population of 286,000 increase to 917,000 by 2001. Water consumption was also predicted by JS Roberts to double in the 20 years from 1971. Dry summers in 1969-1971 saw the first restrictions imposed on water use since Kaitoke had been commissioned. Although the population predictions were scaled down by 1980, they were still higher than Wellington's actual growth, and led to ambitious plans for new water sources over the next quarter century, most of which were not required.

Some expansion, however, was needed. The Hutt Park pumping station was upgraded by the Regional Water Board after 1975. The Gear Island plant was reconstructed in 1976-1977, with three new wells in the Shandon Golf Course to replace its open 'flowing' wells, which posed a contamination risk. Variable-speed pumps were also installed to better manage supply pressure to Wellington along the now-fragile, 600-millimetre, cast-iron main. Aeration and chemical treatment were introduced to remove acidity, while water from this source was fluoridated for the first time.

Studies of the aquifer (by Donaldson & Campbell) suggested much more water could be drawn if the wells were placed further up the valley where there was less risk of saltwater intrusion. This led to the biggest development yet of the source. After encouraging findings from test wells in the Waterloo area, land was bought from New Zealand Railways, and a major storage, treatment and distribution plant was begun in 1977 next to the Waterloo station. Six service wells were sunk along Knights Road, rising mains were laid to Naenae and Gracefield reservoirs and a connection made to the Wainuiomata-Wellington system at Randwick. The plant opened in 1981, after which the Hutt Park pumping station was decommissioned. Two further wells were sunk in 1988, coming into use the following year. In October 1999, closure of the Buick Street plant (Petone) and limiting Gear Island's use further concentrated abstraction from the aquifer away from Petone foreshore. Pumping capacity to Wellington was subsequently shifted from the flood-prone Randwick site to Waterloo. Waterloo is now a major part of the supply system, delivering about 40 percent of the region's water.[226]

The major development of the system in the last quarter century has been in terms of storage. Morton Dam and the upper Karori dam were increasingly considered at risk of failing in a large earthquake. Morton Dam was also silted up. The drawback of the

Waterloo water treatment plant and pumping station – next to the Waterloo railway station in Lower Hutt – became the main point of water abstraction from the Lower Hutt aquifer when opened in 1981 (photo December 1986).

The smaller of Te Marua's twin lakes ready for filling. The radiating inlet pipes at the base of the tower help circulate the stored water.

intake systems at Kaitoke and Orongorongo was that there was no storage, so they had to be shut off if the water was too turbid or coloured (happening on average about two days a month). Rather than build another dam, two lakes were planned 'off-river' at Te Marua to be fed by gravity from the Kaitoke intake.[227] Treatment and a pumping station would follow.

In 1974, the WRWB negotiated with housing developers Te Marua Ltd to buy its whole property for the lakes. Upper Hutt stood to lose rates income from this and "saw it as a land grab", according to its former representative Stuart Macaskill. The issue of recreation on the proposed lakes was also divisive; some nearby residents wanting boating and swimming access while the Ministry of Health and Commission for the Environment said that water quality demanded none.[228]

After these issues were settled, work started in October 1980 on the two lakes, to hold 3,220 million litres – equivalent to about three weeks' average supply. The consulting engineers were Tonkin & Taylor Ltd, for whom contractors Green & McCahill worked. The project was hit by ballooning inflation in the 1980s, when costs estimated in 1974, for instance, had to be multiplied by 361 percent.[229] Water from Lake 2 flowed first to consumers in January 1986. However, leakiness seemed to dominate public perception of the lakes and led to five years of remedial work. The contractor was paid for this considerable extra work by the engineers' insurers, but only on the steps of the High Court.[230] The lakes were named after Stuart Macaskill in 2002, honouring the long-term water board member and regional council chairman.[231]

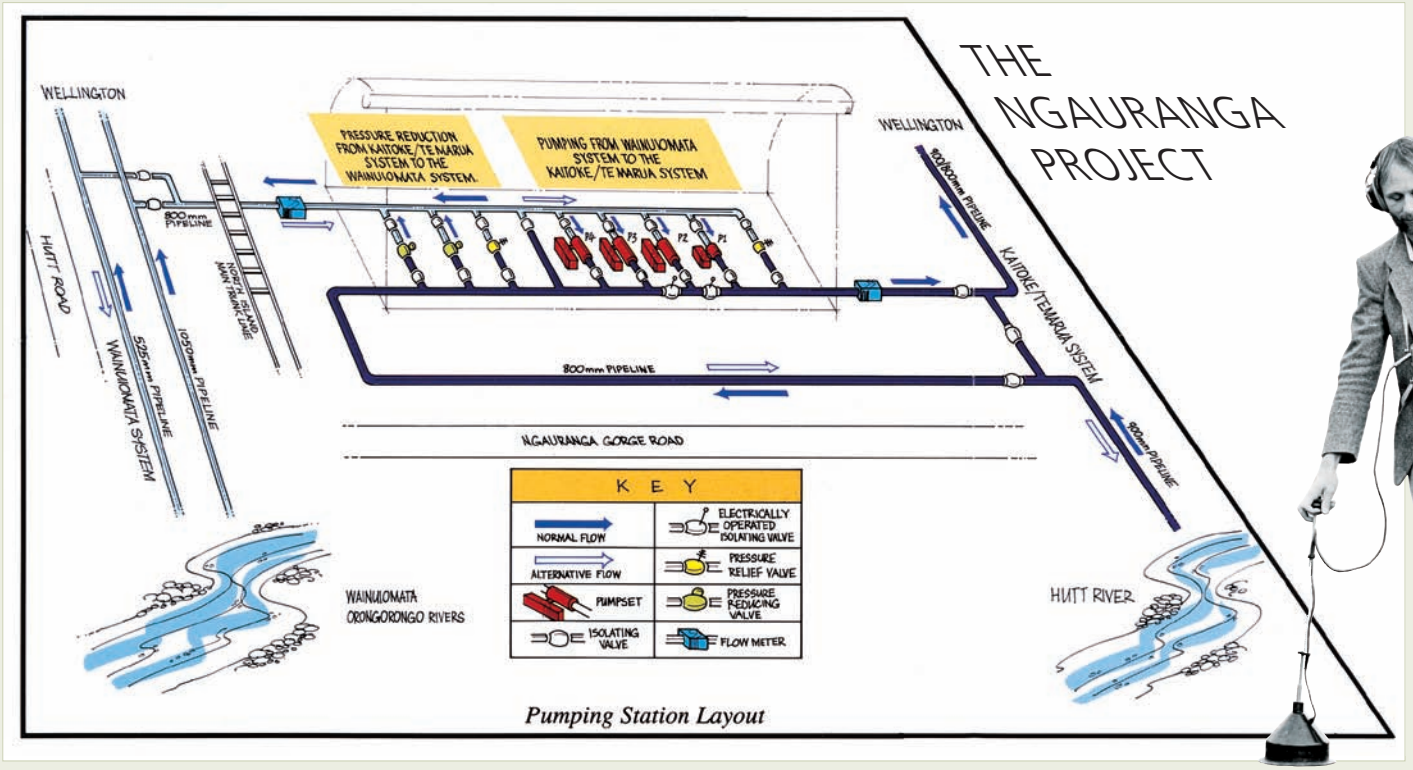
Before the lakes were completed, work began on a pumping station at Te Marua. This housed 10 pumps, to move water from lake to treatment plant or between the lakes, or boost the gravity flow of treated water from Te Marua to Karori. It was commissioned in December 1985. The Te Marua water storage and treatment project was completed in 1987 with commissioning of the treatment plant.

The 'moonscape' of the Te Marua twin lakes construction site, September 1983.

A major systemic enhancement has involved interconnecting parts of the system. As originally built, the Wainuiomata and Orongorongo systems were not linked. An interlinking of sorts, of Orongorongo/Gear Island and Wainuiomata waters, came in 1953 with a 450-millimetre pipe connecting the O-K main in Glenmore Street with the Bell Road feeder on The Terrace. A fuller interlinking was introduced in 1981-1982 with the reconstruction of the Thorndon pumping station. Unused for many years, this station's new equipment was able to pump water from the 1,050-millimetre pipe up to

the lower reservoir at Karori (useful during back-pumping up the Kaitoke main). At about the same time the newly completed Waterloo pumping station and associated distribution changes allowed cross-connection at Randwick, in either direction between the Hutt aquifer and the Wainuiomata systems.

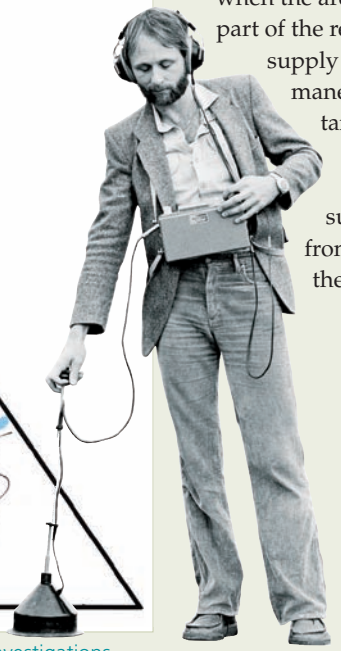
The most significant interconnection was the Ngauranga project – a pumping station, 20-million-litre covered reservoir and pipeline down Ngauranga Gorge – which linked the Wainui/Waterloo and Hutt supply systems. This project developed because of growing concern about the water quality and earthquake safety of the open storage at Karori, and allowed those reservoirs to be decommissioned. The Ngauranga pumps replaced those at Karori for back-pumping towards Upper Hutt, while the reservoir compensated for the loss of storage at Karori. Ngauranga had to balance different pressures from the two systems and be able to pump in several directions. It was opened on 23 June 1992.



The Ngauranga pumping station and pipeline (opened June 1992) allowed water to be passed between the 'Kaitoki-to-Karori' and 'Wainui-to-Wellington' pipelines, which provided a major improvement to the security of regional water supply

Around the region

Horowhenua and Hutt county councils formed a joint committee in 1971 to solve Kapiti's water problem, and designed a treatment plant at Waikanae. The WRWB oversaw construction from June 1975. Drawing water from an intake on the Waikanae River, the plant also piped water to Otaihanga and Paraparaumu. The plant was opened on 20 March 1977 while reticulation was finalised.[232] Kapiti took over management of the plant on 1 April 1982, when the area was not included as part of the regional council's water supply role. The prospect of a permanent water supply (as against tanker loads) might have led Pukerua Bay to join Porirua City in April 1973, but a supply (of Kaitoke water, from Paremata) was extended there only in mid-1980.[233]



Gary O'Meara – pipe location investigations.
(Dominion Post collection, Alexander Turnbull Library, Wellington, NZ. Ref: ep/1980/1702/12. Detail)

Quality and safety

With water, quality is everything. The earliest approach to quality was simply to choose a clean source. The Kaiwharawhara Stream served this purpose until deemed "not satisfactory" in 1929, when a chlorination plant was begun at Karori.[234] While considered better in quality, the high-country catchments brought lots of twigs and leaves, especially after storms. A coarse strainer was built at Morton Dam in 1952, though this did nothing to stop discoloured water reaching consumers.[235] Shared use of catchment land in the early years of water supply, for activities such as farming, gold-mining and deer-breeding, became taboo by 1900.[236]

The Boxing Day flood in 1962 had an unexpected effect on quality management. Heavy rains in the Wainuiomata and Orongorongo valleys damaged the intake weirs and carried mud and silt into the city before the valve was shut. As a result a chlorination plant was built for both supplies in 1963, with strainers installed on the O-K main in 1967 and the Wainuiomata pipe in 1968.[237]

Modern medical thinking sees water as an avenue for augmenting health. Fluoridation is a good but controversial example. A commission of inquiry in 1957 endorsed fluoride for improving dental health, after which Lower Hutt added it to the Hutt Park supply. Petone, however, preferred to draw water perceived as more pure from the Buick Street pumping station. Fluoridation and chlorination of the Kaitoke supply began in March 1965, with the Water Supply Board favouring fluoridation for all. When the Buick Street pumping station was finally retired in 1999, the WRC moved to provide Petone with a fluoridated supply from Wainuiomata. There was such an outcry from residents that the supply of aquifer water was restored and fluoride was discontinued again for Petone – the plants at Waterloo and Gear Island modified to allow for the aberration.[238] For the regional council this was about public health and efficient use of resources, but for the residents of Petone it was all about democracy.

Construction of the region's biggest water treatment plant, at Te Marua, was started after the lakes were finished, on a hill to the north. This introduced a chemical coagulation process and filtration of Hutt River water, "a major step forward in the maintenance of water quality standards and the removal of bacteria".[239] Two clarifiers and six filters enabled turbid raw water to be treated, while chlorination and fluoridation were transferred from Kaitoke. With a rated capacity of 140-million-litres a day, Te Marua was fully commissioned in 1990.[240]

The final chapter in treatment came with the plant next to Morton Dam at Wainuiomata, with a rated capacity of 60 million litres, which was completed in 1993.

Wellington City Council Laboratory staff take water from Karori's lower dam for testing, December 1952. Water from all sources was tested once a week. (New Zealand Free Lance Collection, Alexander Turnbull Library, Wellington, NZ. Reference F-92870-1/2)

The Boxing Day flood in 1962 resulted in muddy water being supplied to Wellington before the pipe could be shut off.

This treats water from both the Wainuiomata and Orongorongo catchments using the dissolved air flotation process, in which the 'colour', sediment and microorganisms in the water are coagulated with chemicals, lifted by millions of tiny air bubbles to the top of the filters and floated off. With the supply pressure from the Orongorongo intakes now reduced by treating the water at Wainui, the pipeline over the Waiwhetu hill was abandoned, with water from both catchments coming through the Wainui tunnel.

Automation has allowed manually-operated mechanical systems to be retired. At first a telephone system let the Karori custodian dial up automatic level indicators for each reservoir. Now, computer control systems are integral to the management of water treatment and supply, and laptops and wireless technology can be used to remotely monitor and control key points in the system.

The water custodian at Karori checks water levels at his other reservoirs, circa 1952. Computer technology has since revolutionised management and control of water supply. (New Zealand Free Lance Collection, Alexander Turnbull Library, Wellington, NZ. Reference PAColl-8983-26)

Standards expected of water quality have also risen. New Zealand adopted World Health Organisation standards for drinking water in 1960, but formal Drinking Water Standards for New Zealand were introduced only in 1984. These have been revised every five years since 1995, providing increasingly demanding standards for managing the health risks associated with water supplies.[241]

Microscope slide of a creature taken from tap water in Karori in 1951, prior to water treatment.

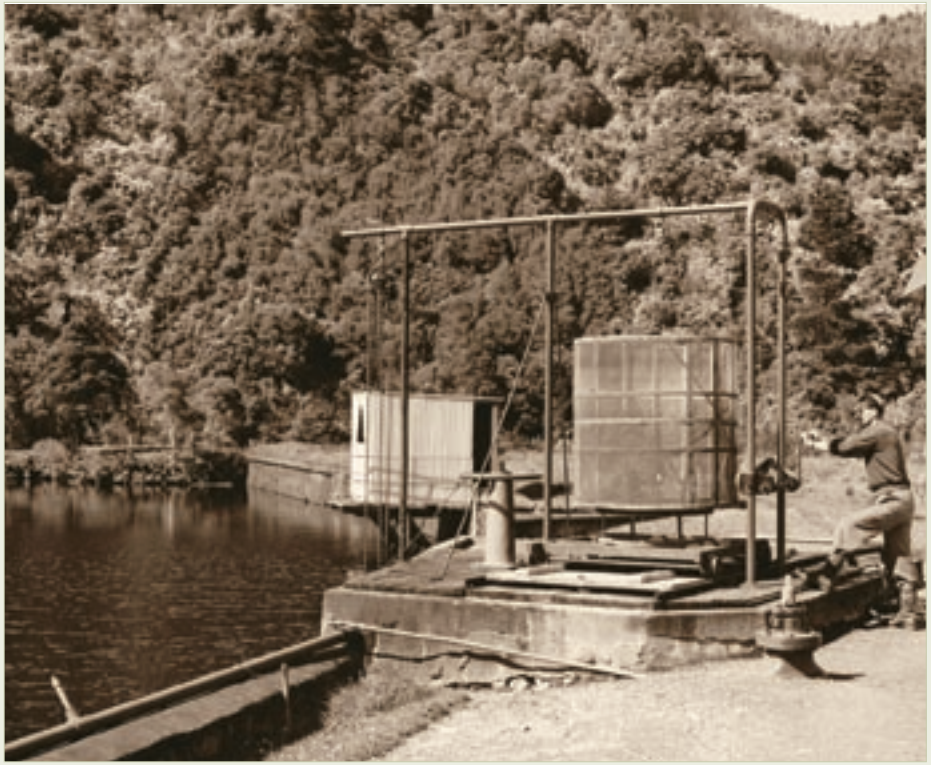
Wellington's water rates very highly. Its surface water collection areas have long been set aside exclusively for that purpose, to lower the risk of contamination. More recently, improved water treatment and catchment management processes have allowed some controlled public access into these areas without jeopardising water quality.

The Waiwhetu aquifer beneath Lower Hutt is also of high value to the region. The aquifer is sealed from surface contamination in the lower Hutt Valley by an impermeable layer of clay and the water takes over 12 months to 'flow' underground to the wells at Waterloo, making it secure from microbiological contamination. Occasional scares have served to confirm how fortunate the region is and how well its water is managed. A pollution alert in January 1991, when high coliforms were detected from the Waterloo treatment plant, had residents boiling their water for three weeks. The source (a seagull had died in a tank at the plant) illustrated the vulnerability of water supplies if they were not chlorinated. A Giardia alert in August 1998 closed the Wainuiomata treatment plant for several weeks, but only a single cyst was found and no cases of illness were reported.[242]

Mitigating the effects of natural hazards has also received greater attention in recent times. The Te Marua lakes were built very close to the Wellington fault line so, at the time of construction, seismic monitoring devices were buried deep to measure movement. Ongoing seismic mitigation includes moving services near fault lines to more solid ground and strengthening or duplicating critical assets. Even so, Greater Wellington has joined with the region's city councils to encourage preparedness in every home, because a big shake could cut all water supplies for several days.[243]

Morton Dam had been assessed as being at risk of failing in an earthquake and silt build-up had substantially reduced its value as a storage reservoir. It was decommissioned on 29 October 1988. Two new intake weirs were built, on the Wainuiomata River and lower George Creek, to retain supplies from the Wainuiomata catchment.[244]

In 1979 consultants suggested the upper Karori dam could also fail in an earthquake, taking out the lower dam by domino effect. With resulting headlines like 'Karori Dam Ready to Spew Disaster – Little Can Be Done', mitigation work followed in the streets below, including the purchase of four houses on Curtis Street to remove them.[245] Fear of the Karori dams bursting had earlier led the national emergency management headquarters in the Beehive basement to be bunded against floodwaters. With the Ngauranga scheme in operation, the chief engineer recommended both Karori dams be decommissioned, which they were in 1997. After 124 years of doing so, 'the Kaiwarra' ceased to supply water to Wellington. Now no longer the heart of Wellington's water system, the Karori waterworks reserve was gifted back to WCC for the wildlife sanctuary in July 2004.[246]



Cleaning the mesh filter at Wainuiomata lower dam, circa 1952. (New Zealand Free Lance Collection, Alexander Turnbull Library, Wellington, NZ. Reference PAColl-8983-27)

Future water

On the future organisation of water, the WRC in the late 1990s suggested full integration of bulk supply and reticulation for Hutt City, Porirua, Upper Hutt and Wellington on a trust model, but the time was not right for pooled ownership of municipal assets. WCC and HCC advanced this model for integration by forming a non-profit management company, Capacity, to retail water and manage their two water and drainage infrastructures.[247] While tensions continue between local and regional government, there is a mood apparent for sustainable management of urban waters, with potable and waste being seen holistically as part of one cycle.[248]

With modelled growth in water use set to surpass the present system's sustainable yield within a few years, options for new sources are again being considered, including storage dams that could supply approximately 60,000 additional residents (at present levels of use). A new dam is not a certainty: smaller-scale source options and demand management may defer new storage for years, by which time some other solution, such as desalination, may be affordable and acceptable.[249]

The amount of water on our planet is finite. Water has become a commodity and wars have been fought over it. In the Chinese city of Harbin, three million people had their water shut off for five days in November 2005 after a chemical plant exploded upstream. New Zealand has considered exporting water from Deep Cove and, when this was looked at in 1985, the Government identified the Hutt aquifer as a potential export source, if piped to tankers from Point Howard. While it did "not have the market image of 'pure Fiordland mountain water' its quality was certainly acceptable."[250]

To bring Wellington's urban population its water, engineers have tapped into sources progressively further afield and harnessed increasingly sophisticated technology, until today, on average, around 150 million litres of water a day are supplied to 370,000 people from up to 55 kilometres away through some very difficult country and several thousand kilometres of service pipes. We can take for granted neither this engineering feat nor the product delivered.

The Wainuiomata water treatment plant, with its state-of-the-art treatment process, was opened in 1993. The decommissioned Morton Dam can be seen in the foreground.