BUILDING A MODERN WATER SYSTEM

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By George F. Nellist

Editorial Note: The first two chapters of this work, "An Early History of Honolulu's Water System," and "The Discovery and Development of Artesian Water," published in the 13th and 14th biennial reports of the Board of Water Supply, brought the record down to the creation of the Honolulu Sewer and Water Commission in 1925. This chapter, concluding the series, covers the period from 1925 to 1955.

Members of the original Honolulu Sewer and Water Commission, appointed by Governor W. R. Farrington on April 29, 1925 for a term of six years, were G. Stanley McKenzie, Chairman; Charles J. McCarthy, representing the City and County of Honolulu; Lyman H. Bigelow, Superintendent of Public Works, Territory of Hawaii; Frank O. Boyer and George Fred Wright.

Mr. Boyer resigned February 15, 1926 and was succeeded by Fred T. Williams. On February 3, 1927 Mr. McCarthy retired and was succeeded as the representative of the City and County by member Wright. The created vacancy was filled by the appointment of C. Campbell Crozier on April 27, 1927.

First meeting of the Commission was held May 14, 1925 and the organization was completed on July 1 with the appointment of Frederick Ohrt as Chief Engineer.

The Commission lost no time in undertaking its obligation "to expedite and complete the sewer and water system, and to insure its adequacy and to safeguard the watersheds and artesian basins of Honolulu."

By the dawn of 1929 bond issues and premiums had made available almost $6½ million, about 60 per cent of which was earmarked for the water system and 40 per cent for the sewer system, and a broad program for the extension and modernization of the then dual systems had been planned.

However, as this work is a history of the water system we shall hereafter confine ourselves to activities relating to that utility.

Without attempting to review in detail all of the far-reaching construction and improvement program carried through in the four-year period, 1925-29, it should be mentioned that during these years, in 1927-28, the three important steam pumping plants, Kaimuki, Beretania and Kalihi, collectively representing the heart of the water system, were entirely reconstructed. New buildings were erected and modern pumps were installed.

Also, in 1926 three new artesian wells had been drilled at the Beretania station, three were added to the Kalihi station and a year later two additional wells were drilled at Kalihi, greatly increasing water production.

Proving the value of water for fire protection, in 1928 the installation of 24-inch low pressure header mains connecting the three pumping stations and, in effect, unifying them for supplying water to all sections of the city, resulted in a 25 per cent reduction in insurance rates.

That the Sewer and Water Commission fully realized the magnitude of the task ahead is shown by this statement in its report dated December 31, 1926:

"The city is supplied with water through antiquated equipment which is by no means a system, but an unplanned patchwork of unrelated units. There are frequent water shortages in many parts of the city, there is an ever present fire menace, growth is hampered, and, in general, the water system has lagged far behind the needs of the city. This is the condition which we have found and which we are correcting as rapidly as possible."

At that time Honolulu was only 25 per cent metered and over-all consumption of water was 500 gallons per person per day, far above the figures for Mainland cities whose per capita consumption averaged about 150 gallons a day.

It was quite apparent that there was a great wastage of water. Some of the old artesian wells were overflowing or leaking badly, and the six principal reservoirs were leaking about one million gallons a day. Sealing of the defective
wells was undertaken and by December, 1930 the city was 100 per cent metered. In that year the daily per capita consumption had fallen to 159 gallons and at this writing it is 166 gallons.

In 1928 "unaccounted for" water in Honolulu amounted to 39 per cent of the total production, or 9.6 million gallons a day. The conservation program reduced this loss to 17 per cent in 1935 and the figure now is 3.5 million gallons, or 9.5 per cent of the total.

It should be noted here that the 1931-32 report of the Board of Water Supply announced that in the period from 1926 to 1932 the conservation of 12 million gallons of water a day in the city’s consumption had been effected. The policy, "Conserve Water," had already paid big dividends.

Long-range planning entered the water picture in the early years of the Sewer and Water Commission and it began overhauling and improving the distribution system under plans extending over a 30-year period.

It is interesting to note that in the 1926 report, the Commission made the prediction that by 1930 Honolulu would have a population of 124,000 and a daily consumption of 22 million gallons, and that by 1955 the population would be 275,000 and consumption 48 million gallons, a very accurate forecast when the military and naval populations are included.

As recounted in the second chapter of this history the first suggestion that "the control of Honolulu’s water supply should be placed in the hands of a commission of able and clear-headed men appointed for a long term of years . . ." was made by Arthur C. Alexander in 1915.

As we have seen, this idea was not translated into action until 1925, with the creation of the Sewer and Water Commission.

The splendid results in water service improvements obtained from the early activities of this Commission solidified public opinion behind the suggestion that management of the system should be entrusted to an autonomous, non-political organization.

Further support came from Carl Ewald Grunsky, distinguished consulting engineer, who in a report to the Hawaii Bureau of Governmental Research dated January 10, 1929, wrote:

"Water works management should be removed from political control—The management of the water works is subject to change with every change of the municipal administration. This is a very undesirable situation which should be remedied. It would be desirable to bring the water studies and the new construction and the operations and maintenance of the water works all into one branch of the government.

"This would preferably take the form of a Commission with five members with overlapping terms of five years so that only one member of the Commission would go out of office each year. This would . . . result in increased efficiency."

The Honolulu Sewer and Water Commission fully supported this argument. It had learned the hard way about the many problems involved in the maintenance and operation of the water system and in its 1929 report to the Legislature it recommended that the lawmakers "authorize by legislation the consolidation under one body of any and all phases of the water problem, including investigations and development, conservation measures, construction, supply distribution, equipment and finances. Such a body, we believe, should be charged with definite responsibility for solving the Honolulu water problem and should be clothed by the Legislature with full authority to do so."

In his report to the Commission, included in the same report, Chief Engineer Ohrt added this observation:

". . . the first duty of whomever may be held responsible for correct solution of the water problem is to insist upon an aggressive policy of conservation and reasonable use of Honolulu’s most valuable resource. Most valuable, because the measure of value is necessity; and the growth of every city is rigidly conditioned by its water supply."

Also in the 1929 report Mr. Ohrt sounded this note of warning: "... of the two major problems assigned to this Commission—sewers and water—by far
the most important facing Honolulu is the water problem; and particularly that phase of it concerning supply. Unless an aggressive policy of conservation is clearly enunciated, insisted upon and carried out, there is no good reason why the situation, despite what already has been accomplished, may not nevertheless become critical . . . ."

Furthermore, also in 1929, the Commission earmarked $50,000 for "sealing defective and useless artesian wells."

The Legislature of that same year, 1929, lost no time in creating the Board of Water Supply, giving it virtually full control over the system.

The legislative act provided that the Board would be composed of seven members, five to be appointed by the Mayor of Honolulu, with the approval of the Supervisors, to serve staggered terms of five years, with two members to serve in ex-officio capacity, the Superintendent of Public Works of the Territory of Hawaii and the Chief Engineer of the Department of Public Works, City and County of Honolulu. All members were to serve without compensation.

Chief responsibility of the Board was fixed by the Legislature in these words: "... whose duty it shall be to manage, control and operate the water systems and properties of the City and County for the supplying of water to the public within the district of Honolulu."

The Board was invested with broad powers and authority. It was empowered to issue and sell bonds and to fix and adjust water rates "so that the revenues derived therefrom shall be sufficient to make the water works self-supporting ..." The system was to receive nothing from general tax funds.

Provision was made by the Legislature "to have determined by the courts of this Territory the liability, if any, of the City and County for water or water service furnished or to be furnished for fire protection . . . ." This moot problem has not yet been forced to a solution.

It might be observed here that, as related in the first chapter, the first fire hydrants in Honolulu, five in number, were installed on Nuuanu Avenue in 1851. At the present writing, Honolulu has 3,614 hydrants, maintained, serviced and financed by the water board, and on its books showing a total investment of $1,525,312.

Members of the first Board of Water Supply, appointed by Governor Farrington on July 1, 1929 (the first Board was appointed by the governor), were G. Stanley McKenzie, Chairman; C. Campbell Crozier, Alexander G. Budge, Ernest W. Greene, Herbert E. Gregory, Lyman H. Bigelow and Louis M. Whitehouse, the last two ex officio. They immediately appointed Mr. Ohrt manager and chief engineer.

However, the Mayor and Supervisors challenged the constitutionality of the legislative act creating the Board and it was not until February 1, 1930, following a favorable decision by the Supreme Court, that it assumed control of the water system.

In January, 1932 all sewer plans and records were turned over to the Department of Public Works of the City and County and the sewer and water systems were completely divorced.

Under its organizational, assured continuity of management and autonomous setup, the new Board of Water Supply was enabled to carry on the long-range planning policy of the Sewer and Water Commission, a policy that soon began to pay dividends in improved water conditions.

In this chapter stress has been placed on the value of long-range planning in the proper development of a water system, or, in fact any public utility.

In a city-wide survey made in 1933-34 the then existing water mains and all other installations were accurately mapped and this work has since been continued without cessation so that complete information on the system is immediately available.

The necessity for this work was pointed out in the Board of Water Supply report for 1931-32 in these words:
"At the time the Board of Water Supply took charge of the water works plans and records of existing mains and appurtenances, real estate, easements, water rights, etc., were meager; dependence being made for this location, size, condition and existence on the memory of a few employees. A city-wide survey and investigation of all mains, valves and other appurtenances and structures, as well as real estate, easements, water rights, etc., have been started and all information collected is being plotted on a map of the City on a scale of one inch to 200 feet."

Conservation activities of the Board, principally the sealing of leaking wells and complete metering of the city, had resulted by 1933 in marked reduction in draft on artesian reserves and a resultant sharp rise in artesian heads.

A report of the period noted that "the distribution system is receiving a much needed overhauling," and that the recently rebuilt steam pumping units at Kaliihi, Beretania and Kaimuki stations were making "most satisfactory" operating records.

In the years just before and during the first three years of the Second World War, Honolulu experienced a great growth in population, largely due to the influx of defense workers and war workers and a prodigious expansion in the armed services personnel stationed on Oahu.

This situation is graphically reflected by the fact that from 1939 to January, 1945 there was a 100 per cent increase in Honolulu's water requirements.

Foreseeing the future heavy demands for service, the Board of Water Supply, as part of its long-range planning, was adequately prepared to meet the situation.

On plans prepared many months in advance, construction of the Waialae underground pumping station was started on December 20, 1935 and three days later work began on the Kaliihi Valley station. These new sources of water were completed on January 15, and January 30, respectively, of 1937.

Introduction of underground pumping stations to Honolulu was beyond question the second most important development in the creation of the present water system, the first having been the discovery and development of artesian water in 1879-80 (see Chapter 2).

Mr. Ohrt, in a report dated January 15, 1941, wrote: "The performance of the underground pumping stations at the Kaliihi and Waialae shafts has been highly satisfactory, and the results obtained support the belief that in time to come this method of drawing water from the artesian areas will replace the deep well stations."

This prediction seems almost certain to come true.

The underground pumping station was not a new idea of the water board. Similar installations have been made elsewhere in the world and stations very much like Honolulu's were constructed many years earlier by sugar plantations on the islands of Maui, Hawaii and Kauai. Indeed, the inclined shaft underground station has become known as the "Maui type" well.

The impact of the war, bringing with it an amazing and constantly growing demand for water, soon forced the Board to expand its underground pumping facilities and on April 28, 1942, again under already prepared long-range plans, work was started on a station in North Halawa Valley, northwest of Red Hill.

This was the first and so far the only time the Board of Water Supply has gone outside the metropolitan limits of Honolulu to obtain water for the city.

Construction of the North Halawa station and installation of a 42-inch main leading from it to North King Street and Gulick Avenue for connection with the city-wide distribution system was completed December 1, 1944.

An extension of the "Big Inch" main to Young and McCully Streets, nine miles from North Halawa, was completed July 14, 1947, marking the completion of the largest and most important single project yet undertaken by the water system of Honolulu.

It is now possible, in an emergency or case of need, to supply water to the Koko Head area from the North Halawa station, a distance of 15 miles.
Total cost of the North Halawa station and nine miles of 42-inch main was $4,100,000, the station representing an investment of $600,000 while $3½ million was expended on the big pipeline.

It might be well at this point to interpolate a brief description of an underground pumping station, using the North Halawa unit as an example.

The portal, or entrance, to this station is 165 feet above sea level and therefore above the coastal caprock which makes possible our artesian reservoirs (see Chapter 2). From the portal a 30-degree inclined shaft was driven into the wall of the valley and down 284 feet to 23 feet above sea level, where the electric pumps are installed. A sump, located under the pump room floor and extending down 18 feet below sea level, collects water from a horizontal tunnel 919 feet long which was driven into water-bearing lava strata at about sea level.

Water from the underground stations, coming from the top of the main ground water body instead of from near the bottom, as it does in the deep artesian wells, makes it less subject to the effects of salt water intrusion.

The water is from the same original source, the rainfall on the mountain watershed, but being tapped from an elevation above the caprock extension it does not rise to the surface from pressure, but must be pumped.

In its report dated January 28, 1943, the Board of Water Supply gave itself a well-deserved pat on the back for a big job well done in these words: "In reviewing the events of the past biennium in retrospect, it is a source of pride to the Board to report the smooth and efficient transition of the Honolulu water system from normal peace-time operating conditions to those greatly augmented by the demands of Hawaii at war."

Statistics may be helpful in emphasizing the development of Honolulu's water system during the past century and more. As recorded in the first chapter of this history, the cost of the original installation in 1848 was $2,647.

When the Territory turned the system over to the City and County in 1913 its sale valuation was placed at $1,142,031, and at that time the system comprised 12 reservoirs, two redwood tanks, 105.3 miles of mains, four pumping stations, 430 fire hydrants and 5,422 connected services.

The water system was evaluated at $7¾ million when the Board of Water Supply took over its control and management in 1930.

As of the end of 1954, the system stood on the books at an investment valuation of more than $33,600,000 and it now includes 30 distribution reservoirs, four open reservoirs, four tanks, two aerators, three artesian well pumping stations, three underground pumping stations, 20 booster pumping stations, 3,614 fire hydrants, 38,000 metered services and 464 miles of mains.

It is estimated that under present conditions it would cost more than $60½ million to replace the entire system.

Throughout the years Honolulu's consumption of water and the artesian head (the height above sea level to which water rises in the wells) have fluctuated widely under the influence of wastage, conservation, population growth, and weather conditions.

Here are some figures on the daily draft, from all Honolulu sources, the figures following the dates indicating millions of gallons: 1900, 28; 1910, 34; 1920, 40; 1926, 52; 1927, 44; 1932, 33; 1940, 37; 1944 (wartime peak), 65; 1949, 44.5. Daily all-over draft in 1953 was 49.6 million gallons.

The sharp reduction from the 1926 daily consumption of 52 million gallons to the 33 million of 1932 was due almost entirely to the work and conservation policy of the Sewer and Water Commission and the Board of Water Supply.

The artesian head in the Beretania area, when the first well was drilled in 1880, was 42 feet. Figures for later years follow: 1890, 41; 1900, 34; 1910, 31; 1920, 27; 1923, 30.8; 1926, 25.5; 1932, 30.8; 1945, 23; 1948, 26.5; 1950, 28. As of December 1, 1954 the head was 26 feet.
The sharp decline in 1926 was largely due to a prolonged drought, the dry spell starting in 1923. A similar decline in artesian head in 1945 was due to the heavy consumption of the war years, rising to a daily usage of 65 million gallons in 1944, and the North Halawa station was not yet in service with its potential production of 25 million gallons a day.

Average daily pumpage by the Board of Water Supply stations was 19.6 million gallons in 1931. In 1953 the figure was 36.19. Production had almost doubled in 22 years.

The first change in the executive engineering of the water system in almost 27 years came on May 1, 1952, when Frederick Ohrt, retiring to other activities, was succeeded by Edward J. Morgan. Mr. Ohrt joined the Sewer and Water Commission in 1925 as chief engineer. His successor as manager and chief engineer of the Board of Water Supply, Mr. Morgan, came into the system on August 1, 1931.

Members of the Board of Water Supply at the end of 1954 were: Ralph E. Clark, Chairman; Simes T. Hoyt, LeRoy C. Bush, Taijiro Miyahara, James B. Wilson, Ben E. Nutter and William C. Vannatta.

Covers the period 1925 to 1955 and concludes his An early history of Honolulu's water system and The discovery and development of artesian water.
