

## APPENDIX D

## HISTORY OF THE WATER WORKS

UP TO 1913, ABSTRACTED FROM THE REPORT OF THE SUPER-  
INTENDENT OF PUBLIC WORKS TO THE GOVERNOR  
OF THE TERRITORY OF HAWAII FOR THE  
YEAR ENDING JUNE 30, 1913

FROM 1914 TO DATE, ABSTRACTED FROM VARIOUS ANNUAL  
REPORTS OF THE HONOLULU WATER WORKS AND  
HONOLULU SEWER AND WATER COMMISSION

133 YEARS AGO.—When the first foreigners came to Honolulu, they found only a few fishermen's huts scattered along the shoreline of what was then nothing but a hot, barren plain. Such was Honolulu of those days! In developing a settlement adjacent to the harbor, water was needed for domestic purposes. To meet this need, shallow wells were dug. These wells were sunk to sea level where, in the porous coral formation, an abundant supply of ground water was encountered. The first well was thus sunk in the year 1822.

100 YEARS AGO.—The greatest demand for water, however, came from ships, principally whaling vessels. Often the harbor would be filled with these vessels, awaiting their turn to take on water and provisions. Watering of these vessels was carried out by means of small boats which plied up the Nuuanu Stream to where the water was fresh and pure. Tanking up, they brought back their indispensable cargo to the waiting ships. This method was both slow and tedious.

90 YEARS AGO.—In 1838, the first attempt was made to provide a water system to meet this increasing demand. It was proposed to pipe water to the harbor from some distant source. With this in view, 14 reels of 1½ inch lead pipe, weighing over four tons, were shipped from Boston to Honolulu. That this venture did not meet with the success anticipated is evidenced by the fact that in 1845 ten of the fourteen reels still remained on hand, unused.

77 YEARS AGO.—Meanwhile, plans were being made to bring water in from Nuuanu Valley to the harbor through iron pipes. It was proposed to collect water in a small masonry reservoir, in the vicinity of what is now Bates Street, and from there to conduct it down Nuuanu Street through a 4-inch iron main. This work was completed in 1851. In addition to supplying the harbor needs, numerous residents connected to the main for greater purity and convenience of domestic supply.

74 YEARS AGO.—By 1854, this system had become inadequate. Mr. William Webster, an engineer, submitted to His Excellency, John Young, plans and estimate for a more extensive system. He proposed constructing a new and larger reservoir, 80' x 100' x 10' deep, lined with brick. Water was to be piped to this reservoir from three different springs, including the Kapena Spring. He estimated, that for a population of 6,000 people, the combined flow of these springs would yield 72 gallons per capita per day during wet season and 48 gallons per capita per day during the dry season—"an abundant supply for domestic purposes; watering the streets; washing down the houses, etc." From the reservoir, he proposed leading the water through a 12-inch main to Queen Street. The old 4-inch main was to be torn up and used for distributing mains. These plans were not put into operation until 1860-61.

For the following 10 or 15 years, this system functioned admirably. Extensions were made to the distributing system, but nothing was done to augment the supply; it was sufficient.

50 YEARS AGO.—Meanwhile Honolulu was extending into the plains towards Punahou; Palama was being settled. By 1878, it became evident the city had outgrown the old system as built by Mr. Webster.

Many schemes were advanced to meet the situation. All were unsatisfactory. An appropriation of \$40,000.00 was asked for with the object of getting all the water immediately available. The government considered the advisability of granting a franchise to private enterprise. It was also suggested placing the whole matter in the hands of a water board.

In the midst of this dilemma, a new and heretofore unknown supply was brought to light—both Mr. Campbell and Mr. Marques obtained good, flowing, artesian wells! This artesian water would not rise more than 42 feet above mean sea level, however, all property above that must be served by pumping or by a separate gravity system.

48 YEARS AGO.—The citizens of Honolulu were quick to grasp the potential value of this new supply. The first city well was bored, shortly after 1880, at Pawaa on the Waikiki road, and pipe was laid from it to supply the residents of Waikiki. Other wells, too, were drilled to supply the vast tracts of arid wastes on leeward Oahu—and the great sugar industry began.

For the city water works, however, the development of gravity supply still continued the major consideration. Further reservoirs were built in Makiki and Nuuanu and distributing pipe laid.

47 YEARS AGO.—About 1881, a severe small-pox epidemic stimulated action towards securing a purer water supply and also a sewerage system. The absolute purity of the artesian water was undisputed, and plans for pumping same to higher levels received consideration.

Meanwhile, a filtering plant was constructed on the John A. Wood property in Upper Nuuanu. This was the first effort to purify the mountain waters.

At this time, inadequacy of supply again began to be felt. Major A. S. Bender submitted plans for the construction of a large earth or masonry dam (approximately on the site of the present No. 4 reservoir). But his plans were not then carried out.

42 YEARS AGO.—In 1886, a devastating fire visited Chinatown. An efficient fire department and an adequate water supply saved Honolulu's business section. There was not, however, adequate protection during periods of drought. The danger was realized. Once more, Major Bender was called upon. Again he submitted plans and again they were not acted upon.

For the next few years, with the exception, perhaps, of two small cisterns or reservoirs built in Nuuanu Valley, primarily to supply power to a small city electric lighting plant, nothing was done to augment the city's water supply.

39 YEARS AGO.—The inevitable happened. During the winter 1888-1889, Honolulu was visited by a severe drought. Practically no rain fell. A water famine threatened. Citizens were notified to use water sparingly. Irrigation was regulated. Household plumbing was inspected and 500 leaky taps repaired. Stream beds were cleaned out and springs opened up to better advantage. The drought became alarming. A fire engine was attached to the artesian well at Thomas Square and the water pumped to Makiki reservoir. This was an important experiment pointing the way, as we now know, to the ultimate development of Honolulu's water system. The experiment was entirely satisfactory.

An appropriation of \$3,000 was made for pumping purposes. But rain fell; the appropriation was not used and Honolulu sank back into its normal consumption of water.

38 YEARS AGO.—Stimulated by the drought, however, the construction of three of our present reservoirs, known today as Nos. 1, 2 and 3, were undertaken and carried to completion in Nuuanu Valley. They had a combined storage capacity of 39 million gallons. At this time also, 1888-1890, the distributing system came in for some attention. Many of the

existing pipes were badly encrusted. A complete system of new mains was laid out and installed.

At this time, also, something happened of great ultimate significance to the water users of Honolulu City. *His Majesty's well at Waikiki became defective!* The head of water lowered to such a point that it failed to deliver water in sufficient quantities to the residents of Waikiki whom it served. It was estimated that it would cost more to recase the old well than to drill a new one. So a new well was bored and the old well capped and abandoned. Meanwhile, through the rusted holes in the casing of the old well, far below the surface of the ground and out of sight, the pure artesian water ran to sea through subterranean channels and porous strata in unknown quantities.

37 YEARS AGO.—In 1891, Honolulu was again visited by a *severe drought*. Speaking of this drought, the then superintendent of Water Works says: "Had it not been for the artesian supply, meagre though it was, Honolulu would have had one of the greatest scourges that can befall a country or community—a water famine!" A fire engine was again attached to the Thomas Square well and pumping continued for 47 days.

35 YEARS AGO.—In 1893, there was *another drought* and again a fire engine was called upon to pump water from the Thomas Square well.

34 YEARS AGO.—In 1894, *another drought* followed. But in the interim a steam pump had been installed at the Makiki well. This equipment proved so efficient during the drought that pumping was accepted as the best means of combating a possible water famine in the future.

33-28 YEARS AGO.—All efforts were bent to this end. In 1895 the Beretania Pumping Plant was installed with a capacity of 3 million gallons daily. By 1900 the Kalihi Pumping Plant, delivering 5 million gallons daily, was in operation. And soon afterwards, the Kaimuki Pumping Station, capacity 3 million gallons daily, came into service. In 1897 Rudolph Hering recommended a Nuuanu Filtration Plant.

To check the abnormal and excessive per capita consumption of water, a Bill was introduced into the Legislature of 1909 providing for the installation of meters and it became law.

22 YEARS AGO.—In 1910, the Beretania High Lift Pump was installed, thus augmenting the City's available pumping facilities a further 3 million gallons daily. In this year, also, the Upper Nuuanu reservoir No. 4 was completed. At this time, too, systematic stream-gaging was inaugurated within the Territory.

Honolulu's consumption of water had now reached the tremendous figure of 350 to 400 gallons per capita per day. Its drain upon the artesian resources was becoming serious. Since the first well was drilled, the artesian head had dropped from elevation 42.0 feet to an elevation of about 30.0 above mean sea level. Honolulu was drawing upon its artesian resources faster than the supply was being replenished. A bill was presented to the Legislature giving the government greater control over the artesian wells, but failed to become law!

15 YEARS AGO.—In 1913 another drought was experienced. All pumps were worked to capacity and irrigation was restricted to a few hours a day. Yet, in this year, Act 112, S. L. 1909, providing for the installation of meters, was repealed!

Thus far, the Honolulu Water Works had been the property of, and administered by, the Territory. In 1914, by Act 138, Session Laws of Hawaii, 1913, the Honolulu Water Works was transferred from the Territory to the City and County of Honolulu. The transfer price was \$1,142,031.00. Payment was to extend over a period of 30 years commencing 1916. The annual sinking fund payment was fixed at \$20,362.41, and the annual interest payment at \$45,681.24.

The City of Honolulu was growing very rapidly and inadequacy of water supply continued to be the major concern of the Water Department. In spite of fluctuations dependent upon dry or wet years, it became increasingly evident that the artesian head was steadily lowering.

The question of waste was discussed. The per capita consumption, 1915, according to H. E. Murray, was 324 gallons daily. Metering had begun, fifteen percent of the system was already included. This covered the large users. In an endeavor to check waste the desirability of extending the metering to include the smaller users was advised.

14 YEARS AGO.—At this time, also, the quality of the Nuuanu Valley surface water was the source of much complaint. As a measure to combat this, two chlorine plants were installed at reservoir No. 1 in the year 1914. These were only partially successful. After every storm the water was badly discolored, with the result that complaints continued to be received from the sections served from this source.

12 YEARS AGO.—To augment the supply of pure water, tunnelling began to be urged. The campaign against waste continued. By the year 1916 the City was twenty-three percent metered and one hundred percent metering was suggested.

11 YEARS AGO.—Since its completion in the year 1910, the storage capacity of reservoir No. 4 in Nuuanu Valley had never been more than partially used. With a view to utilizing this, the Maole conduit was constructed in 1917 at a cost of \$23,579.00. It consisted of 5,585 lineal feet of open ditch and 534 lineal feet of tunnel under the Maole Ridge to Hillebrand Glen. Its carrying capacity was rated at 40,000,000 gallons daily. However, on the basis of the stream gaging station records at the makai station, covering the period from 1918 to 1923 (1,704 days), the discharge for more than 49.8% of the time did not exceed 50,000 gallons per day (see Honolulu Sewer and Water Commission Supplement, page 40) and during dry weather the ditch was dry.

Meanwhile, complaints continued to be received from the high-level sections supplied by the Nuuanu surface water. To correct this evil, a filtration plant, with a capacity of 6,000,000 gallons daily, was recommended by F. G. Kirchhoff in 1918. It was not, however, constructed.

8 YEARS AGO.—Metering was progressing very slowly; by the end of 1919 the City was only twenty-five percent metered. Tunnelling for the Water Works was begun by W. A. Wall in 1920. It rapidly gained impetus and, for the next four years, continued with unabated effort.

7 YEARS AGO.—By the end of 1921, the average delivery of so-called tunnels in Nuuanu Valley for the year was stated to be 5,000,000 gallons daily according to W. A. Wall. Venturi measurements by the Honolulu Sewer and Water Commission in 1928 showed but a mean of 1.6 million gallons daily with a maximum daily flow of 2.66 million gallons and a minimum of 0.41 million gallons daily. The Nuuanu Tunnel development is, in the opinion of the engineering staff, nothing more than surface diversion.

Tunnelling was also done in Palolo Valley and an initial flow of 2,000,000 gallons daily secured according to W. A. Wall. It was recommended by W. A. Wall, at the time, that this tunnel be extended a further 1,000 feet into the mountain. He believed that a delivery of 4 to 5 million gallons daily could then be expected. The original flow, however, was not maintained and continuation of the tunnel, as recommended, was not proceeded with. The average benefit to the City as measured by the Honolulu Sewer and Water Commission meter for 830 days was 150,000 gallons per day. (See Honolulu Sewer and Water Commission Supplement.)

In Makiki Valley three prospective tunnels were opened up by W. A. Wall; two in black sand, one in solid rock formation, with no beneficial results.

About this time, considerable additions were made to the pumping capacities of the various pumping stations. A 5-million-gallon centrifugal motor-driven pump was installed at the Kaimuki Pumping Station. The Beretania Pumping Station's capacity was increased by the addition of a 3-million-gallon pump of similar design; while the old 1-million-gallon gear pump at the Wilder Avenue Station was replaced by a 2-million-gallon centrifugal pump. Makiki Station was also increased by the addition of a 720,000-gallon booster pump. Together, these pumps added a total of 10 million gallons to the daily capacity of the pumping system.

It was in January, 1921, that a cloudburst occurred over the Koolau Range, of unusual dimensions. Reservoir No. 4 fortunately was low at the time. It filled up 47 feet in a few hours and overflowed its 300-foot spillway 3 feet deep. This held up dangerous storm waters which might have been disastrous to the residents along the lower reaches of the Nuuanu Stream. In Palolo, a large volume of water swept everything before it, carrying away two houses near Waialae Road. Old superstitious Hawaiians said the gods were angry at the tunnelling operations going on and believed the deluge came out of them.

6 YEARS AGO.—Tunnelling was prosecuted energetically again throughout 1922 in Kalihi and Makiki Valleys. Additional tunnels in Nuuanu, Palolo and Pauoa Valleys were strongly recommended by W. A. Wall. A 6,000,000-gallon reservoir on Punchbowl saddleback and a 1,500,000-gallon reservoir on the slopes of Round Top were also recommended by W. A. Wall.

5 YEARS AGO.—The completion of a 2,500,000-gallon concrete reservoir, now known as No. 5 reservoir, for storing the spring and tunnel waters in Nuuanu Valley, in April, 1923, gave the residents of that section clear water for the first time since 1858. The surface water hitherto used, and which had occasioned so much complaint in past years, was held only for emergency use. This marks the abandonment of the entire reservoir system and use of surface water in Nuuanu Valley.

The year 1923 saw a continuation of tunnelling operations in Manoa Valley. In the 1923 Report of the Water Works, Mr. W. A. Wall gives the total initial flow for three tunnels in Manoa Valley as 900,000 gallons per day. The measurements made by the Honolulu Sewer and Water Commission show a total average yield of 430,000 gallons per day with a maximum of 770,000 and a minimum of 210,000 gallons per day.

Further tunnel development in the four main valleys back of Honolulu was strongly urged by the Water Works. It was also recommended that small dams be built across blind gulches to impound stream or run-off water, and then, that tunnels be drifted under these natural filtration sites.

The 6,000,000-gallon reservoir on Punchbowl saddleback again came in for recommendation in 1923. An increase in the water rate, to make the water works self-supporting, was also recommended by the Water Department.

At this time, also, the development of Kaau Crater as a natural reservoir was strongly urged. It was recommended damming the gap, where the waters overflow from the crater, in order to increase its storage capacity and then to extend the existing tunnel in Palolo Valley 1,000 feet under the crater. It was estimated by the Water Department that four-fifths of the water in Kaau Crater seeps or percolates through the bottom of the crater. The tunnel, it was believed, would intercept a large portion of the seepage.

4 YEARS AGO.—Tunnelling operations continued to be recommended throughout the year 1924 but, owing to lack of funds, were held up in all cases.

The inadequacy of the storage capacity of the distributing reservoirs was pointed out and the construction of the 6,000,000-gallon reservoir on Punchbowl saddleback was again recommended in 1924.

During these years, Honolulu had been slowly reaching a crisis in regard to its water supply. The artesian supply was being overdrawn as evidenced by its steadily falling head, and no mountain water had been developed on a sufficiently comprehensive scale to meet the needs of a rapidly growing city. The distributing system and pumping facilities also had become inadequate. It was clearly a case of the City having completely outgrown its old system.

In the year 1925 the Legislature, by Act 150, created a special commission of five members to be appointed by the Governor and to be known as the Honolulu Sewer and Water Commission. This act was instituted to meet the public health emergency at Honolulu by authorizing the construction

of needed sewer and water improvements by special commission with funds provided by a bond issue.

The work performed under this Commission is a matter of current history. Bonds to the value of \$6,000,000 have been issued, about sixty percent of which has been expended upon improvements to the Honolulu Water Works system and forty percent to the sewer system.